Over the Drape: Olive Berger and 'blue baby' anesthesia, 1944-1954.

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Abstract

The purpose of this dissertation research was to identify, describe, and analyze the impact of technological developments on nurse anesthesia in the 1940s. Anesthesia practice was evaluated utilizing a case study approach of Olive Berger, RN, a nurse anesthetist at Johns Hopkins hospital for 30 years. Berger provided anesthesia for and documented care given to many of Alfred Blalock MD's pioneering "blue baby" surgeries.

Olive Berger spent her entire career navigating a highly politically charged and contested space of practice. Her collaboration with Dr. Alfred Blalock facilitated and enabled surgical advancement. Nurse anesthetist historian Virginia Thacker makes the case that as medicine grew more complex during the 1930s to 1950s, collaboration with physicians (she called it interdependence) was an essential part of progress. Large institutions, like Johns Hopkins, were highly organized and surgeon-nurse anesthetist collaboration evolved. Olive Berger was Alfred Blalock's archetype of a nurse anesthetist.

Olive Berger witnessed and participated in the transition in medicine and anesthesia from an art to a science, incorporating advances in technology with the techniques and skills of nursing. Like other nurse anesthetists in the 1940s, Olive Berger contributed to the shape and form of the profession by her willingness to go beyond the defined boundaries of nurse anesthesia practice of the era.

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Dedication

This work is dedicated to my mother and father, Carol Lee and Edward Carmel. My only wish would be that they would have lived to see my journey and destination.

I miss you every day.

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I cannot possibly repay the support, advice and patience of my family, friends and the faculty at the University of Virginia. Dr. Arlene Keeling opened my mind and heart to the power of history in my first PhD course and I was inspired. Dr. W. Bernard Carlson has been not only a tremendous history of technology resource but also a true mentor. Dr. Mary Gibson and Dr. Barb Maling were always attentive, supportive and had much needed practical advice.

Beth your support has been unwavering. This dissertation has definitely been both a personal and professional journey. I have never been more proud of our teamwork.

It has been said that the consequence of not knowing the past is to not understand the present. I believe that if nurse anesthetists have an appreciation for those who have preceded us and why and how we do the things that we do, we then have a better foundation to improve the future. Knowledge of nurse anesthesia history helps us to appreciate our inheritance, to recognize the present and potential scope of our practice, and grounds us in our professional identity. My hope is that that future generations of nurse anesthetists will be taught and embrace this history. And when all is said and done the span of my career will be a stepping-stone.

Isn't it strange, that princes and kings,
and clowns that caper in sawdust rings,
and common-folk like you and me,
are builders for eternity?

To each is given a bag of tools,
a shapeless mass and a Book of Rules;
and each must make 'ere time has flown,
a stumbling block or a stepping stone.

R.L. Sharpe, "A bag of tools," circa 1809

Chapter 1

Introduction

Expensive technology of the 21st century fills the landscape of most modern hospitals throughout the United States. Today's operating rooms incorporate into their environment state-of-the-art architecture, smooth antimicrobial surfaces, integrated computers, scanners and plasma screens, and computer-supported, multi-colored digital displays accompanied by the beeps and alarms in the background. Technology has become so pervasive within the practice of medicine that it often seems to be a force beyond the clinician's control.[1] Talk of technology, its role, influence, and effects on every aspect of life is prevalent. Nurse anesthetists in the 21st century use technology to an unprecedented extent even if they disagree over whether technology's impact has been positive or negative.[2]

Social scientists have attempted to demonstrate the "social construction" of technology, the idea that social relationships impact technological change. Writings of "technological imperative," the concept that any technology that can be used should be used, and "technological determinism," the Marxist belief that technology itself can determine social change, have been explored in the literature in past decades. As such, technology has been recognized as an independent driving agent and described as "both an objective, material force and as a socially constructed and chameleon-like entity."[3] Additionally, technology often exists within a technological system that unites politics, organizations, and humans. Technology in healthcare has been linked to the history of nursing practice and introduces patterns of activity that by their very nature influence patient care, values, roles, relationships and responsibilities.[4] Technology has also been implicated in both healthcare organization and rising healthcare costs.[5]

The definition of technology is complex; its meaning is subject to historical, gender, and socio-cultural bias.[6] Historically, technology can refer to both old and new equipment and pharmaceuticals, as well as the skills and the associated knowledge necessary to use them. The U. S. Office of Technology Assessment defines medical technologies as "drugs, devices, and medical and surgical procedures used in medical care, and the organizational and supportive systems within which such care is provided."[7] If we use this definition, then "technology" encompasses most of our current nursing and medical practices. In the health care setting, the word "technology" creates an aura of professionalism. It is a common descriptor for specialist knowledge and skills and has been influential in the specialization within medicine and nursing.[8] As defined, technology has power, serves as a source of cultural symbols, and has social effects.[9]

On a daily basis, nurse anesthetists discover ways to make their practice efficient and safer. Their outcomes have historically been linked to technology.[10] Scientific technologies have contributed to numerous healthcare developments in the areas of sanitation, surgical techniques, and antibiotics. But rarely have nurses had the power to control the research and development of technology. Rather nurses historically have titrated technology into clinical practice relying less on scientific knowledge and more on personal and intuitive understanding and techniques developed and refined through practice.[11] Therefore for nurse anesthetists, technology often creates, develops, and modifies existing practices.

Nurse anesthetists play a primary role in the use and integration of healthcare technology. In fact according to nursing philosopher Alan Barnard, "Nurses are positioned at an axis point between technology, individuals, clinical environments and communities and have the responsibility to take a primary role in interpreting the relationship(s) between technology, healthcare praxis and human experience."[12] Barnard and Sandelowski argue:

> …recent scholarship suggests a more complicated relationship, as what any technology is at any moment in time is increasingly understood to depend on the eye of the beholder, the hand of the user, and the technological systems that influence integration and use.[13]

Exploring how nurse anesthetists have used, and introduced technology into clinical practice in the past; how nurse anesthetists acquired and disseminated skill and knowledge related to use of technology; and how technology has affected their practice may shed light on the professional autonomy, recognition and gender equality that nurse anesthetists currently experience.

Documenting what nurses have done in the past is critical to the process of removing barriers and proposing approaches for solutions.[14] Historians of nursing agree "… nurses are indeed powerful and resourceful, and the illumination of power stems less from the source of their training than their ability to work within locations to shape their own practices…nurses' ability to capture opportunities to creatively apply their skills, knowledge, and a keen sense of the possibilities."[15] Examining how nurse anesthetists in the past integrated technology into their practice, transferred their specialized skills and knowledge and influenced social and political arenas may provide us with insight into the skills and leadership needed by today's advanced practice nurses to meet the current challenges of healthcare economics, technological implementation, and patient safety.

Purpose

The purpose of this dissertation research was to identify, describe, and analyze the impact of technological developments on nurse anesthesia in the 1940s. Anesthesia practice was

evaluated utilizing a case study approach of Olive Berger, RN, a nurse anesthetist at Johns Hopkins hospital. Berger documented and published her techniques and outcomes.

To date, little has been documented about the influence of technology on the art and practice of nurse anesthesia, the technologic advances developed by nurse anesthetists or the acceptance of technological advancements by this nursing specialty. Historian Stanley Joel Reiser in his extensive "technological medicine" writings never explores the nurse-technology relationship.[16] Nurse researcher Margarete Sandelowski in her book *Devices & Desires* attempts to "fit technology to care" and explore the nurse-technology relationship but never specifically addresses nurse anesthesia practice.[17] In many articles researcher Alan Barnard tries to understand the influence and meaning of technology for nursing but never considers advanced practice nurses.[18] Historian Julie Fairman highlighted the importance of understanding that technological knowledge and influence are multi-directional and that more critiquing of technological progress is needed.[19] Fairman and Sandelowski suggest that the decisions nurses made while using technology deeply influenced patient care. "By giving voice to those who have been silent and forgotten in the past" Fairman suggests that we have the opportunity to "more fully comprehend change and understand the dynamics of the contemporary nurse-technology relationship."[20]

Research questions included: (1) how did Olive Berger represent nurse anesthesia practice in the 1940s? (2) what were the specific dimensions of nurse anesthesia knowledge, skill and role that developed with increased use of machines and technology in the operating room in the 1940s? (3) how does Olive Berger's practice embody the rise of technology in anesthesia and nursing? (4) how does Olive Berger navigate the contested space of practice of nurse anesthesia?

And finally, (5) what lessons can be learned from Olive Berger's work that may inform nurse anesthesia practice today?

Significance

Today Certified Registered Nurse Anesthetists (CRNAs) are advanced practice registered nurses (APRNs) who provide the majority of anesthesia care to rural and medically underserved America, as well as, to the U.S. Armed Forces. CRNAs provide more than 32 million anesthetics in the U.S. annually for all types of surgery.[21] Working independently or in collaboration with surgeons, physician anesthesiologists, and other healthcare professionals, CRNAs practice in every setting in which anesthesia is delivered. Throughout their history nurse anesthesia have prevailed over challenges by organized medicine and others who have sought to limit their scope of practice and limit access to their services. Similar challenges lie ahead for today's advanced nurse practitioners (APRNs).

Nurse anesthesia care is not only very safe, it is the most cost-effective method of anesthesia services delivery.[22] This is a critical consideration as Congress and policymakers seek to bring healthcare costs under control. The 2010 Patient Protection and Affordable Care Act (HR 3590 - ACA) represents the most sweeping healthcare overhaul since the creation of the Medicare and Medicaid programs in 1965.[23] For nurse anesthetists, the adoption of healthcare reform will bring into the insurance and reimbursement system millions of patients whose CRNA services are currently unpaid and unreimbursed. The ACA also advances patient access to nurse anesthesia care through a provider nondiscrimination provision.

In 2010 the Institute of Medicine (IOM) released its landmark report *The Future of Nursing: Leading Change*.[24] In light of the tremendous need for nurses in health care today and

in the future, due to the growing numbers of people with chronic diseases, an aging population, and the need for care coordination, the report provided a blueprint for how to transform the nursing profession. Recommendations put forth by the report committee included removing barriers to practice and care, and expanding opportunities for nurses to practice to the full extent of their education and training.

In 1986, CRNAs made history when congressional law made them the first nursing specialty to be accorded Medicare reimbursement rights. However, many advanced-practice registered nurses (APRNs) currently are not able to practice to the full extent of their education and training, due to scope-of-practice barriers. As such, the IOM report made recommendations to Congress, state legislatures, the Centers for Medicare & Medicaid Services (CMS), and others to remove barriers that prevent nurses from fully utilizing their skills to meet health care needs. The anesthesia care rule that enables states to opt out of the supervision requirement was published by CMS in the *Federal Register* [66 *FR* 56762-56769] on November 13, 2001. The rule allows a governor to notify CMS in writing of the state's desire to opt out (be exempt from) the supervision requirement for Certified Registered Nurse Anesthetists (CRNAs) after the governor meets the following prerequisites: consults with the state's boards of medicine and nursing, determines that opting out of the requirement is consistent with state law, and decides that it is in the best interests of the state's citizens. To date, only 18 states have declared exemption from the physician supervision requirement.

Another theme underscored in the IOM report is that nurses should achieve higher levels of education and training, and this depends on an improved nursing education system. Because individual and population health needs are changing, and our health care system is ever evolving, nurses need additional knowledge and training to provide care in a transformed system. CRNAs

have embraced advanced quality education since the American Association of Nurse Anesthetists (AANA) was founded in 1931. This is a position that continues today: "To best position CRNAs to meet the ongoing challenge and remain recognized leaders in anesthesia care, the AANA believes it is essential to support doctoral education that encompasses technological and pharmaceutical advances, informatics, evidence-based practice, systems approaches to quality improvement, healthcare business models, teamwork, public relations, and other subjects that will shape the future for anesthesia providers and their patients."[25] CRNA educators have embraced simulation technology and utilize it in many programs. They also have supported a date of 2025 for a requirement for a doctorate to enter into nurse anesthesia practice.

Finally, there is an essential need for more nurses to provide leadership. At the bedside, nurse anesthesia leaders provide critical skills and capabilities for coordinating care and managing the disparate services involved in serving individual patients. Succeeding as a CRNA requires strong clinical skills, critical care expertise, and a creative thinking. Typically, registered nurses implement orders written by physicians. In contrast, nurse anesthetists issue orders and decide when specific interventions are necessary. During surgery, they must maintain constant vigilance, even when a procedure appears to be going routinely. These technical and critical thinking skills in nursing practice are essential to achieve the ACA reform objectives, to lead the way for change, and to advance health care in the United States.

The need to find meaning in technology is evident for the future of nurse anesthesia. Nurse anesthetists have always used tools and techniques in valued ways. Vigilance and patient safety have been conceptually linked with technology for nurse anesthesia. Many of the current monitoring standards currently in practice have been eagerly adopted by practitioners but are not evidence or outcome based.[26] Surveillance and integration of technological data has become an

essential skill. In the future, nurse anesthesia practice and direction will be critically connected to advances in technology.

Research Design and Methodology

Introduction to Methods

The incorporation of technology into the operating room was implemented within the context of a larger movement of technological medicine. Therefore, the use of traditional historical methods with a social history framework was the methodology most appropriate to address the research questions for this dissertation. Given that the research on the use of medical technology, as well as its relationship with nursing and nurse anesthesia is scarce, this project examined historical data from the practice of Olive Berger, a nurse anesthetist for Alfred Blalock's "blue baby" surgeries at Johns Hopkins Hospital in the 1940s, as a case study.

Historical research is a particularly powerful tool for addressing why certain social arrangements and influences took place, and why policy developed in one way or another.[27] It is appropriate to investigate entire social systems to discern what is common, what is unique, and what the long-term societal changes are, and how divergent social factors are connected. Historian Cynthia Connolly defines social history as the "experience, behavior, and agency of those at society's margins, rather than its elite."[28] While many would argue that nurse anesthetists are the elite among nurses, others would argue that nurse anesthetists have been at the margins of the operating room hierarchy. In her 1953 *History of Anesthesia with Emphasis on the Nurse Specialist* historian Virginia Thatcher identified the reasons why surgeons turned to nurses to administer anesthesia. According to Thatcher, surgeons "wanted a person who would

(1) be satisfied with the subordinate role that the work required, (2) make anesthesia their one absorbing interest, (3) not look on the situation of anesthetist as one that put them in a position to watch and learn from the surgeon's technique, (4) accept relatively low pay, and (5) have the natural aptitude and intelligence to develop a high level of skill in providing the smooth anesthesia and relaxation that the surgeon demanded."[29]

In addition to focusing on grass-roots people, the social history framework focuses "on a particular period in attempts to understand prevailing values and beliefs that may have helped shape subsequent developments."[30] Historian Patricia D'Antonio emphasizes that a social framework "assists the historian in determining which questions will be asked, what data will be used for analysis, the processes by which such analysis will be constructed, and how these analyses will be contextualized in space and time."[31] In fact, D'Antonio writes that history may serve as "a new paradigm for nursing knowledge."[32] Relying on traditional historical methods I systematically gathered primary and secondary source materials, collected data, organized and appraised it critically, then identified the themes and presented a synthesis of the results.[33]

Focus of Inquiry

The focus of this research was to provide a more accurate view of the impact of technology on the nurse anesthesia practice of Olive Berger, RN, a nurse anesthetist and educator at Johns Hopkins hospital in the 1940s. Olive Berger provided anesthesia for patients and documented that care during many of Alfred Blalock's pioneering "blue baby" surgeries. At this time pediatric surgery was in its infancy and pediatric cardiac surgery was experimental. The

Blalock-Taussig shunt for the congenital cardiac condition, Tetralogy of Fallot, was considered experimental.

This research discusses the influence of technology on patient care, professional values, roles, relationships, and responsibilities. Factors that influenced the use of technology included philosophical and religious reasons, economic and political systems, and social and cultural values. Thus this analysis was also framed by the political, social, economic and technologic context of state-of-the-art healthcare of the 1940s.

Primary and Secondary Data Resources

Archival sources included:

A. The Alan Mason Chesney Medical Archives of the Johns Hopkins Institutions, Baltimore, Maryland Personal Papers Collection: Olive Louise Berger Collection
    - Collection Date: 1927 - 1985
    - Extent: 1 linear foot; focuses on her career as a nurse anesthetist at Johns Hopkins. It consists of detailed records of the administration of anesthesia to Alfred Blalock's patients, including three notebooks labeled: "Tetralogies," "Valvulotomies," and "P.O. Pneumonia." The notebooks describe early cases of cardiac surgery, including the first cases of surgical treatment of cyanotic congenital heart disease, and the first lung and mitral valve operation performed at the Johns Hopkins Hospital. Also included are articles by Berger, a letter of recommendation written on Berger's behalf by Thomas Cullen, and material concerning the Olive L. Berger Memorial Fund.

B. Personal Papers Collection: Alfred Blalock Collection

- Collection Date: 1940 -1959
- Extent: 60 linear feet; mainly consists of correspondence and medical documentation
- Unpublished inventory available at the archives

C. Personal Papers Collection: Helen Brooke Taussig Collection

- Collection Date: 1928 -1986
- Extent: 132 linear feet; spans her entire career at Johns Hopkins and documents her varied professional and personal activities. Professional materials include correspondence, grant records, manuscripts, notes, patient records, and research materials relating to tetralogy of Fallot patients and their long-term follow-up. Personal materials include awards, biographical material, correspondence, manuscripts, photographs, and scrapbooks. The collection documents Taussig's activities as a national leader in promoting health care issues and her support of a wide range of social causes, including her successful campaign in the early 1960s to ban the use of thalidomide by pregnant women.
- Unpublished inventory available at the archives

D. Material Cultures Collection

- This collection consists of over 2,000 items of equipment and devices, furnishings, instrumentation, uniforms, and other materials used in research, teaching, and clinical practices at the Johns Hopkins Medical Institutions from the late 19th through the 20th century.

E. Photographic Collection

- The Medical Archives hold over 400,000 photographic items, spanning collections formed by institutional departments during their course of work and collected by individuals associated with the Johns Hopkins Medical Institutions from the 1880s to the present day.
- The collections range in content from documentation of the early medical campus, to clinical photography, and images of education and student life at Hopkins. As a whole, the Medical Archives photograph collections document the evolution of health care practice and education over the course of the 20th Century.
- Major Collections include:
    - Portraits Photograph Collection
    - Buildings Photograph Collection
    - People at Work Photograph Collection
    - Group Photograph Collections
    - Institutional and Departmental Collections
    - Personal Paper Collections

F. Institutional Records
    - Documents include original architectural plans, records of governance and administration that provide information about the organization and operations of the hospital

American Association of Nurse Anesthetist (AANA) Archive, Park Ridge, Illinois

A. Organizational Papers documenting Olive Berger's professional activities
    - AANA President

- Publications in the *Journal of the American Nurses Association*

B. Various folders dated 1940-1949; includes pictures, newspaper articles, member communications

C. *Journal of American Nurses Association*, 1940-1949

D. 1940s textbooks of anesthesia and curricula of nurse anesthesia programs

Secondary sources

The history of American Nursing and the history of the American hospital system have been well documented in texts such as Susan Reverby's *Ordered to Care: The Dilemma of American Nursing, 1850-1945,* Charles Rosenburg's *The Care of Strangers: The Rise of the American Hospital System,* and Rosemary Stevens's *In Sickness and in Wealth: American Hospitals in the Twentieth Century*. These books were all written in the 1980s and remain definitive historical resources of medical and nursing history.

The most well known writings of technology and its impact on medicine have been the writings of Stanley Joel Reiser.[34] Reiser views diagnostic instruments, like the stethoscope, as responsible for encouraging specialization in medicine and dramatically impacting the physician-patient relationship. Reiser never considers nursing's role or clearly explains how and why patients accepted technologies. Joel Howell, in *Technology and the Hospital,* studied implementation of technologies like X-rays, EKGs and laboratory testing into medical practice and noted that an institutional or social context promoted their acceptance.[35] Howell never considers nursing actions or responsibilities for implementation and patient acceptance of these technologies. Jeffery Baker in *The Machine in the Nursery: Incubator Technology and the Origins of Newborn Intensive Care* utilized a case study format of the infant incubator as an example of ethically laden "runaway technology" and "technological transfer" between French

and American cultures.[36] Baker describes the incubator as "the mechanical nurse," but discusses very little of the nursing care administered to these premature infants or the nurse's responsibilities for the incubator itself.

The nurse-gender-technology relationship has been explored in *Devices and Desires* written by Margarete Sandelowski. Sandelowski examines the political, social, economic, and cultural ramifications of this relationship by exploring both the "low tech" and "high-tech" eras of nursing. Historian Julie Fairman also has written frequently about technology in the development of critical care nursing and fetal monitoring.[37]

Historian Virginia Thatcher in 1953 authored *The History of Nurse Anesthesia with Emphasis on the Nurse Anesthetist*, which documents the history of early nurse anesthesia practice. In 1989 Marianne Bankert wrote *Watchful Care: A history of America's Nurse Anesthetists*, which documents basic and organizational history of the American Association of Nurse Anesthetists.

Data Exploration – Criticism of Sources

Corroboration of facts in historical nursing research is important. Primary sources were evaluated for authenticity and reliability using the processes of internal and external criticism.[38]

Methodological Controls and Ethical Conduct of Research

The study followed the guidelines of the University of Virginia's Social and Behavioral Science (SBS) institutional review board. SBS approved the study with exempted status (Project# 2014-0134-00). Citi training was completed. Authorization was granted by the Alan

Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions for access to the collections. The Health Insurance Portability and Accountability Act (HIPPA) guidelines were followed.

Inclusion of Women and Minorities

All nurse anesthetists prior to 1944 were white. All nurse anesthetists prior to 1947 were female. Therefore, this research focuses on the careers of white women and included the anesthesia administered to "blue babies" and pediatric patients in the 1940s. To my knowledge children from several countries received a Blalock shunt at Johns Hopkins during the 1940s.

Strengths and Weaknesses of the Study

Experience and knowledge as a nurse anesthetist guided my exploration. The care given at Johns Hopkins for "blue babies" by nurse anesthetists was representative of the state-of-the-art pediatric cardiac care in the 1940s, but it certainly was not all inclusive of pediatric surgery or anesthesia. Discussing the findings with professors and members of the dissertation committee controlled biases.

Chapter Overview

Chapter one provides a brief introduction of the issue of technology and nurse anesthesia practice and its significance. The study's purpose, significance, research questions and method,

primary archival resources, data management, and analysis, as well as method controls and ethical conduct of research were described.

Chapter two sets the stage for the Johns Hopkins Hospital and the "blue baby" surgery in November 1944. It includes the social, political, and economic condition of Johns Hopkins Hospital located in Baltimore, Maryland. In addition, a brief background of nurse anesthesia is presented. The state of the art of nurse anesthesia, pediatric anesthesia, and cardiac care and surgery are described. Finally, the physicians and nurse anesthetists who will be named throughout this study are introduced.

Chapter three discusses the life and career of Olive Berger, nurse anesthetist, who administered anesthesia for over 500 blue-baby surgeries.

Chapter four discusses the national and local politics that created a "contested space of practice" for Olive Berger.

Chapter five includes photo analysis of the famed blue baby surgery photo. In addition, 1940s technology and the relationship with nurse anesthetists, as well as, how this technology altered relationships with peers, physicians, and patients are explored.

Chapter six includes the conclusions that were drawn from the historical analysis of the research data. Implications for current nurse anesthetist practice and education are presented.

Certainly, this historical perspective fills a gap in both the medical and nursing literature about this important aspect of technology and nurse anesthesia.

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[2] Rozzano Locsin. *Advancing Technology, Caring, and Nursing,* (Westport, Conn: Auburn, 2001) 68-75.

[3] Alan Barnard and Margarete Sandelowski, "Technology and humane nursing care: (ir)reconcilable or invented difference?," *Journal of Advanced Nursing* 34 (2001): 367-375. Wiebe Bijker and Trevor Pinch first addressed the idea of the social construction of technology in *The Social Construction of Technological Systems* (Cambridge: MIT Press, 1987) 17-50.

[4] Julie Fairman and Patricia D'Antonio, "Virtual power: gendering the nurse-technology relationship," *Nursing Inquiry* 6 (1999): 178-186.

[5] Daniel Callahan, "Health care costs and medical technology," in *From Birth to Death and Bench to Clinic: The Hastings Center Bioethics briefing Book for Journalists, Policymakers, and Campaigns*, ed. Mary Crowley (Garrison, NY: The Hastings Center, 2008), 79-82.

[6] Ruth Swartz Cowan explored the idea of gender and choice in technological development. *A Social History of American Technology*, (New York: Oxford, 1997).

[7] *Medical Technology and the Costs of the Medicare Program* (Washington, D.C.: U.S. Congress Office of Technological Assessment, OTA-H-227, 1984), p. x.

[8] Rosemary Stevens, *In Sickness and in Wealth: American Hospitals in the Twentieth Century*, (Baltimore: Johns Hopkins, 1989) 200-226.

[9] Thomas P. Hughes, *Human-Built World: How to think about technology and culture*, (Chicago, IL.: Chicago Press, 2004) 1-16.

[10] In fact with the exception of pulse oximetry there are no large randomized trials that support the current intraoperative monitoring standards. Monitoring standards can be found at

file

http://www.asahq.org/~/media/For%20Members/documents/Standards%20Guidelines%20Stmts/Basic%20Anesthetic%20Monitoring%202011.ashx. Accessed February 15, 2012

[11] Several authors offer historical evidence of nursing and intuitive practice. Susan Reverby, *Ordered to Care: the Dilemma of American Nursing, 1850-1945*, (Cambridge: Cambridge Press 1987) Monica Baly, *Nursing and Social Change*, (London: Routledge 1995).

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[14] Arlene Keeling, *Nursing and the Privilege of Prescription: 1893-2000* (Columbus: Ohio State University, 2007): 28-48.

[15] Patricia D'Antonio, Cynthia Connolly, Barbara Mann Wall, Jean Whelan, and Julie Fairman, "Histories of nursing: The power and the possibilities," *Nursing Outlook* 58 (2010): 207-213.

[16] Stanley Joel Reiser, *Technological Medicine: The Changing World of Doctors and Patients* (New York: Cambridge University Press, 2009).

[17] Margarete Sandelowski, *Devices and Desires: Gender, Technology and American Nursing* (Chapel Hill: University of North Carolina Press, 2000)

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Advanced Nursing 31 (2000): 1136-1144; with Margarete Sandelowski " Technology and humane nursing care: (ir) reconcilable or invented difference?," *Journal of Advanced Nursing* (2001) 34: 367-375;"Philosophy of Technology and Nursing," *Nursing Philosophy* 3 (2002): 15-26;

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[20] Ibid.

[21] American Association of Nurse Anesthetists AANA website http://www.aana.com. Accessed September 25 2011

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[23] Patient Protection and Affordable Healthcare Act (HR 390) available at http://www.gpo.gov/fdsys/pkg/BILLS-111hr3590enr/pdf/BILLS-111hr3590enr.pdf. Accessed September 25 2011

[24] Institute of Medicine of the National Academies, *The Future of Nursing: Leading Change, Advancing Health* October 2010 available at http://www.iom.edu/Reports/2010/The-future-of-nursing-leading-change-advancing-health.aspx Accessed September 25 2011

[25] AANA Position on Doctoral Preparation of Nurse Anesthetists. Adopted June 2, 2007

[26] Both the ASA and AANA have Standards of Intraoperative monitoring yet the only monitor with outcome evidence supporting it's use is oxygen saturation monitoring. Current

standards can be found at http://www.asahq.org/~/media/For%20Members/documents/Standards%20Guidelines%20Stmts/Basic%20Anesthetic%20Monitoring%202011.ashx. Accessed Sept 25 2011

[27] Trudy Yuginovich, "More than time and place: Using historical comparative research as a tool for nursing'" *International Journal of Nursing Practice* 6 (2000): 70-75.

[28] Cynthia Connolly, "Beyond social history: new approaches to understanding the state of and the state in nursing history," *Nursing History Review* 12 (2004): 5-24.

[29] Virginia Thatcher, *History of Anesthesia with Emphasis on the Nurse Specialist* (out of print, *1953)* available for download at http://www.aana.com/resources2/archives-library/Pages/History-of-Anesthesia-With-Emphasis-on-the-Nurse-Specialist.aspx Accessed February 15 2006

[30] Helen Speziale and Dona Carpenter, *Qualitative Research in Nursing: Advancing the Humanistic Imperative 4th edition* (Philadelphia: Lippincott, 2007), 327-348.

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[34] Stanley Joel Reiser's books include: *Medicine and the Reign of Technology* (New York: Cambridge University Press, 1978), *The Machine at the Bedside: Strategies for Using Technology in Patient Care* (New York: Cambridge University Press, 1984), and *Technological Medicine: The Changing World of Doctors and Patients* (New York: Cambridge University Press, 2009).

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[37] Julie Fairman articles include: "Alternative visions: The Nurse-Technology Relationship in the context of the History of Technology," *Nursing History Review* 6 (1998):129-146; with Patricia D'Antonio, "Virtual power: gendering the nurse-technology relationship," *Nursing Inquiry* 6 (1999): 178-186.

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Chapter 2

Foundations and Founders of Nurse Anesthesia

The Role of Nurses as Anesthesia Providers

With the inception of ether and chloroform anesthesia in the nineteenth century the issue of safety was a constant one. Having no particularly qualified specialists to administer the drugs, surgeons assigned the job to whoever were available—primarily medical students.[1] In the late 1800s the greatest incidence of morbidity and mortality was related to the anesthetic. American surgeons attributed these adverse effects to the "occasional anesthetist"—those medical students who only administered anesthesia occasionally. To alleviate the problem the male surgeons turned to their trusted surgical nurses and asked them to dedicate themselves solely to the administration of anesthesia. In *History of Nurse Anesthesia with Emphasis on the Nurse Specialist* Virginia Thatcher describes the attributes of the nurses that the doctors requested. These nurses should (1) be satisfied with the subordinate role that the work required, (2) make anesthesia their one absorbing interest, (3) not look on the situation of anesthetist as one that put them in a position to watch and learn from the surgeon's technique, (4) accept relatively low pay, and (5) have the natural aptitude and intelligence to develop a high level of skill in providing the smooth anesthesia and relaxation that the surgeon demanded."[2]

Nurse anesthetists succeeded due to their training as watchful guardians. Initially trained as nurses, nurse anesthetists had learned that " The most important practical lesson that can be given to nurses is to teach them what to observe—how to observe--what symptoms indicate improvement—what the reverse-which are of importance."[3] During surgery, the nurse anesthetist

employed her eyes, ears and touch. In the late 19th century when the use of ether and chloroform predominated, the anesthetist's skill in recognizing and responding to clinical signs was of paramount importance. She watched respiratory depth and frequency, muscle movements, skin color, and stages of excitation or sedation. Continuously palpating the pulse, the anesthetist noted only gross characteristics (wean/bounding, regular/irregular).

In the *History of Anesthesia with Emphasis on the Nurse Specialist* Virginia Thatcher identifies the importance for nurse administered anesthesia at the turn of the 19th century as " to make anesthesia their one absorbing thought . . . not look on the situation of anesthetist as one that put them in position to watch and learn from the surgeon's technic [vs. medical students] . . . and they have the natural aptitude and intelligence to develop a high level of skill in providing a smooth anesthesia and relaxation that the surgeon demanded."[4]

In her 1906 paper, "A Review of Over Fourteen Thousand Surgical Anesthesias,"[5] Alice Magaw, who worked with the Mayo physicians at Mayo clinic in Rochester Minnesota, emphasized that it was the *experience* of the anesthetists in reading and reacting quickly to the condition of the patient that was of the greatest importance—not tools or technology. According to Magaw it was "far better for the anesthetists to become skillful in watching for symptoms and preventing them, than to become so proficient in the use of such articles as an oxygen tank, loaded hypodermic syringe or tongue-forceps."[6] At the same time Magaw acknowledged that experienced anesthetists were scarce: "there is no class of work that has so little encouragement, and few are willing to follow this line of work (that in difficult and nerve strain is next to that of a surgeon) long enough to become familiar with the first requirements of a good anesthetizer."[7]

Surgeon Advocacy for Nurse Anesthesia

Since the surgeons were the first members of the surgical team to identify the contributing factor of an unfavorable outcome of their surgeries (i.e. the "occasional anesthetist") as well as the first to find a solution—train a nurse—they naturally became advocates and champions of nurses as anesthetists.

After the American Civil War, during which The Sisters of Charity and Mercy gave anesthesia, nurses made great progress as anesthesia providers at hospitals throughout the United States. At St. Mary's Hospital in Rochester Minnesota, William Worrall Mayo MD hired Edith Graham, RN, a graduate of Women's Hospital Training School in Chicago and the only professionally trained nurse in Rochester, to be his "anesthetist, office nurse, general bookkeeper, and secretary."[8] Shortly after hiring Edith Graham, Mayo taught her how to administer anesthesia using the open drop method a German physician had taught him a few years earlier.[9] Both of Dr. Mayo's sons, William J. Mayo and Charles H. Mayo, shared their father's belief that nurses were capable of becoming fine anesthetists, and in 1893 they began working with Alice Magaw who earned their respect. Later, Dr. Charles Mayo gave her the title "the Mother of Anesthesia" for her outstanding performance and contributions to anesthesia.[10] Mayo Clinic in Rochester subsequently became a place where surgeons from all over the country sent their nurses to observe and learn anesthesia administration from Magaw.[11]

Nurse anesthetists such as Alice Magaw perfected the technique of using a combination of chloroform and ether by the open-drop method. "Open drop" anesthesia was actually quite a simple method: a wire frame covered with gauze was placed over the patient's mouth and nose and the anesthetizer would slowly placed drops of the anesthetic agent on the gauze until the

patient lost consciousness.[12] The keys to the nurses' success with this method included: attention to detail, knowledge of the signs and symptoms of anesthetic depth, vigilant observation, and expert airway management skills. Magaw's technique combined empathy and a "feminine touch" to anesthesia delivery. Physicians visiting the Mayo Clinic reflected on their respect for Magaw and her colleague Florence Henderson noting: "… it is quite a common occurrence for an anesthetist who does not understand the use of suggestion to use from ten to twenty times the amount of the ether in anesthetizing a patient that is used by Alice Magaw and Ms. Henderson, who make use of suggestion in every possible way in a given operation." They went on to note that there was: "there is no period of excitement, no struggling of the patient that demands restraint, comparatively little stidorous [stridorous] breathing, no feeling of the pulse, and no hypodermics administered." Above all they carefully documented the success they achieved: an "unbroken record of approximately seventeen thousand cases of anesthesia without a single death from the anesthetic."[13]

In December 1906 Magaw published "A Review of Over 14,000 Surgical Anesthetics" in *Surgery, Gynecology, and Obstetrics*. In that article, she reported using chloroform and ether anesthesia with the open-drop technique without a single fatality attributable to anesthesia.[14] Magaw's papers influenced clinicians throughout the world and played a role in the California supreme Court case thirty years later, *Chalers-Francis v Nelson*, which determined the legality of anesthesia as a practice of nursing.

Another surgeon advocate for nurse anesthetists was Dr. George Washington Crile at Lakeside Hospital in Cleveland, Ohio. In 1908, Crile asked Agatha Hodgins to work with him, and within a year they perfected the administration of nitrous oxide-oxygen anesthesia. Surgeons

who came to observe both surgery and anesthesia at Lakeside were so impressed by this method of anesthesia that they asked if Hodgins could train nurses from their own clinics.

Crile and Hodgins advocated for preoperative injections of scopolamine or atropine and morphine prior to nitrous oxide and oxygen administration. The combination produced a "dissociated" mental state that Crile termed anoci-association, a state in which patients did not perceive pain. This was a forerunner of balanced anesthesia.[15] The administration of nitrous oxide, with limited concentrations of oxygen and no oxygen monitor, required special skills.

Alice Hunt, author of the first nurse anesthesia text, described the Lakeside approach. "The technique calls for careful attention to detail in several ways, as follows: (1) an endeavor to gain the patient's confidence and cooperation and to allay apprehension; (2) adequate narcotic premedication for relief of pain; (3) rinsing out of all diluting air from the lungs and tissues of the body; (4) avoidance of painful manipulation during the induction period; and (5) gentle surgical handling of the body tissues throughout the operation—a strong plea for this anesthesia, for it is a well recognized fact that all important contributing cause of surgical sock is trauma to the tissues."[16]

Crile also knew that the nitrous oxide technique demanded observant care. Remarking on Hodgins and her skill in his autobiography, he wrote:

> Oxygen is a pilot light to keep the flame of life burning safely. If the light burns too high, the patient immediately comes out from the anesthesia, if too low the patient is too deeply submerged; if it is turned out, the patient dies. Yet with a steady flow of gas under constant pressure, the patient is carried easily through the narrow zone of anesthesia.

> Miss Hodgins made an outstanding anesthetist. She had to a marked degree both--the intelligence and the gift.[17]

Nurse anesthesia education of the early 1920s functioned on an apprenticeship model as nurses paired with surgeons who were willing to coach them. The most successful anesthesia programs were built around individual personalities and female nurse anesthetists who achieved distinction. Edith Graham, Alice Magaw and Florence Henderson were the first of note. Later came Margaret Galt Boise (1883–1972) who had been trained at the Mayo clinic by Florence Henderson. Boise went first to New York then to Baltimore, arriving about the same time that Samuel J. Crowe, an otolaryngologist joined the staff at Johns Hopkins in 1913.[18] Crowe employed Boise as his private anesthetist but agreed to have her share her time with urologist, Hugh Young.[19] After only a few months at Hopkins, Boise was recognized by famed surgeon William Stewart Halstead who noted her skill in ether administration. Shortly after her talents were noted, Boise was promoted to head anesthetist for the surgical department. Although she was in a supervisory position, she was the primary anesthetist for Halsted's patients until his death in 1922.[20] She also began training graduate nurses in the skill of administering anesthesia.

Samuel Crow documents this time in his book *Halstead of Johns Hopkins:*

> Ether, was administered by surgical interns, caused so much coughing, gagging and vomiting . . . After 2 years of struggling with [surgical interns], Ms. Margaret Boise, a graduate nurse who have been giving anesthetics in a New York hospital for several years, came to Baltimore . . . Hearing that Miss Boise was in Baltimore, I went to Hugh Young . . . And proposed that we employ her to give our anesthetics . . . Dr. Halstead had a prejudice against nurse anesthetists, but he reluctantly consented to allow us to employ

> Ms. Boise . . . She proved to be an expert anesthetist . . . Dr. Halsted came to see me operate during the first week or 10 days. After one of these visits, he called me into his office and said; "Crow, I have a very sick patient with exophthalmic goiter. Could I borrow Ms. Boise to give the anesthetic?" this request was repeated frequently over the next 2 years. Then Dr. Halstead offered Ms. Boise the position of Anesthetist in Chief for general surgery . . . In addition he permitted Ms. Boise to train graduate nurses. Thus was the start of the school, which under the direction of her pupil, Ms. Olive Berger, continues to supply nurse anesthetists to hospitals throughout the country.[21]

Through the support of surgeons, women, as nurse anesthetists, were claiming their position in the operating room.

Olive Berger, Nurse Anesthetist and "Blue Baby" Anesthesia

Olive Berger entered the health care arena as a nurse anesthetist at a critical time in the history of medicine (1922-1969). She was Dr. Alfred Blalock's preferred anesthetist during many of his "blue baby" surgeries. In order to understand Berger's contribution and the role she played, it is important to understand that this was a time of rapid change in medicine, in hospitals, in surgery and in anesthesia. Medicine was increasingly scientific and specialized. Hospitals were increasingly technological. Surgery was advancing and favorable outcomes were increasing. Anesthesia was not only necessary, it also was becoming increasingly scientific and technical. Moreover, increasing numbers of physicians were entering the specialty of anesthesia. The dualism of nurse anesthetists and physician anesthetists providing similar services created both local and national tension and a contested space of practice.

There is no evidence to suggest that Olive Berger administered or was involved with the anesthetic for the "first" blue baby surgery but there is no doubt that she was indeed the anesthetist for many of the blue baby operations. In the famous "blue baby" photo, which is widely published, chief of surgery Alfred Blalock, MD is seen performing the procedure assisted by then chief resident William Longmire, MD while intern Denton Cooley, MD and famous laboratory technician Vivien Thomas look on (Appendix A).[22] Reportedly pediatric cardiologist, Helen Taussig, MD was also in attendance.[23] But like many historical surgical photos some members of the surgical team go unidentified. Such is the case for the anesthetist in white at the head of the table. She is Olive Berger, nurse anesthetist at Johns Hopkins for more than 30 years who administered anesthesia for most of the cases performed by Blalock.[24]

How Berger became involved in this historic event is a fascinating story. In 1944, then chief of anesthesia Austin Lamont MD refused to give anesthesia for what would be the "first" blue baby operation when Blalock proposed the cardiac procedure.[25] William Longmire, MD, recalled at the 110th Society of Clinical Surgery meeting: "a week before the operation Dr. Lamont, chief of anesthesia refused to give the child an anesthetic for some minor procedure. He called the night before the proposed chest operation to tell me that he did not think the 15 month old child would stand anesthesia and he did not want to put her to sleep. Dr. Blalock's mind was made up, however. The seriousness of the operation had been discussed with the family; he had told them that the procedure was entirely untried and the chances of death on the table were quite real." He further described the November 29, 1944 operation: "we had only limited anesthesia equipment for a child of this size and if I am not mistaken, certain modifications and improvements in equipment had to be made… An unsuccessful intubation was made with a urethral catheter because no suitable endotracheal tubes for infants were available at Hopkins."[26]

The child, Eileen Saxon, had been born prematurely on August 3, 1943 at Hopkins.[27] Doctors detected a heart murmur, but they did nothing about it. Ten months later, the doctors realized the child's blood wasn't getting enough oxygen. Since Eileen had a blue complexion, and had episodes of losing consciousness, she was placed in an oxygen tent. On June 25, 1944, she was admitted to the Harriet Lane Home at Hopkins where Helen Taussig, MD headed the pediatric division. It was obvious that the child's condition was fatal—she suffered from increasing cyanosis and weight loss (at 15 months she weighed less than 10 pounds). X-rays confirmed that she was suffering from pulmonary stenosis. Taussig immediately contacted Blalock who agreed to operate on the child. Eileen's parents, middle-class Baltimoreans, eagerly gave their consent.

Considering the experimental nature of the surgery and the poor physical condition of the child, it is not surprising that Lamont had reservations. Pediatric equipment was lacking at Hopkins and few anesthetists had any experience with anesthesia for this or any type of pediatric cardiac procedure.

Eileen's cardiac procedure took place on November 29, 1944. The operating room was located on the north side of the building's top floor in order to provide optimal natural lighting through two large windows positioned behind the surgeon's back. Heated by large cast iron radiators in winter and cooled by oscillating fans in summer, the operating room was a comfortable temperature year round for patients, staff and surgeons . Scalpels, clamps, and needles were all standard issue, the kind of equipment a surgeon would find useful in performing a routine appendectomy.[28]

Anesthesia resident, Merel Harmel, MD, administered oxygen and ether for the four-and-a-half hour operation. Longmire remembers, "She took the anesthesia okay . . . Post operatively the child developed bilateral pneumothorax and her condition was critical for several days. After this, she improved markedly."[29]

Lamont and Harmel published the results of the first 100 cases in the September 1946 issue of *Anesthesiology*, "Anesthesia in the Surgical Treatment of Congenital Pulmonic Stenosis," one of the first papers on cardiac anesthesia. This type of anesthesia required a new understanding of cardiac pathophysiology and the interaction with anesthesia. Twenty-three of the first 100 patients died. The doctors provided a detailed account of the operative anesthetic management, but did not acknowledge any other anesthesia provider in the twenty one-page article. Although they did not make mention of a nurse anesthetist present in the operating room, Olive Berger may have been present and may have been observing cases.

Indeed, Olive Berger kept a detailed notebook labeled "Tetralogies" of the first 100 cases, as well as the 475 succeeding cases. In the log she detailed the name of the patient, the age of the patient, date, ward the patient was located on, operation performed, anesthetic used, duration of time anesthetic was used, operating staff (doctor, nurses, anesthesiologist, etc.), patient number, diagnosis of the patient, and patient specific morbidity and mortality notations (Appendix B).[30] So clearly, as evident in the "famed" photo and her detailed notebook, Olive Berger was involved - at least as an observer - in the first 100 cases. This seems in contrast to anesthesiologist Merel Harmel's recollections: "Austin and I anesthetized the first 50 patients after which Olive Berger participated in the anesthetic management under Austin's or my supervision."[31] His assessment is not surprising as nurse anesthetist's contributions were commonly dismissed by physician anesthetists but recognized by surgeons and hospital

administrators. Lamont left Hopkins in 1946 after two years of employment. Harmel followed only months later. Olive Berger and her staff of nurse anesthetists remained to provide anesthesia.

"Blue Babies"

"Blue babies" was the term given to infants and children suffering from Tetralogy of Fallot, the most common cyanotic type of congenital heart disease.[32] The components of Tetralogy of Fallot were: (1) pulmonary stenosis or atresia, (2) interventricular septal defect, (3) dextroposition or overriding of the aorta, and (4) right ventricular hypertrophy (Appendix C). Children with Tetralogy of Fallot displayed signs and symptoms that were direct consequences of the disturbances in the normal circulatory dynamics. Cyanosis, the outstanding sign, resulted from the constant admixture of unoxygenated blood from the right ventricle with systemic blood. This mixture occurred because stenosis of the pulmonary artery produced an increase in right ventricular pressure, causing reduced pulmonary blood flow and shunting of venous blood through the interventricular septal defect and into the overriding aorta. In this syndrome, cyanosis would be present at birth, or could develop over several years. Initially cyanosis was apparent only when the child exerted him/herself but later in life the cyanosis usually became constant. The usual characteristics of "Blue babies" included small size, undernourished, club fingers and toes. Children with Tetralogy of Fallot often had other cardiac symptoms including bradycardia and hypotension with a very narrow pulse pressure. Polycythemia was usual. Oxygen saturation of the arterial blood widely varied from 12 to 90 percent.[33] Prolonged crying of the child, routine feeding or any physical activity could result in an increasing cyanosis or "tet

spell." Any prolonged, or severe tet spell might result in the child experiencing syncope, seizures, or cardiac arrest. Many "blue babies" were only able to walk very short distances, then they would rest in the telltale "squatting" position.[34]

The Blalock-Taussig Procedure

The Blalock-Taussig procedure was a groundbreaking procedure that saved the lives of countless children; it is widely considered as one of the first procedures in the dawn of modern cardiac surgery. The surgery has been well documented in TV movies such as *Partners of the Heart* and *Something the Lord Made*.[35] Most new operations take some time before they become standard procedure and enter into common use. The Blalock-Taussig shunt, as it came to be known, earned widespread attention almost immediately. Parents with their frail "blue babies" flooded to Johns Hopkins from the United States, Canada and across the Atlantic.[36]

Opinions vary as to the origins of the Blalock-Taussig operation. Reportedly in 1943, Helen Taussig, pediatric cardiologist, overheard Alfred Blalock and Edward A. Park, chairman and head of the Harriet Lane Home for Invalid Children, discussing the difficulty associated with cross clamping the descending aorta to repair a coarctation.[37] Taussig, convinced that the major physiological problem in Tetralogy of Fallot was lack of blood flow to the lungs, questioned the two men, "If you can put the carotid artery into the descending aorta, could you put the subclavian artery into the pulmonary artery?" Thinking Taussig's idea was a good one, Blalock took the concept to his lab where he experimented in dogs with a design to increase circulation to the lungs. His experiment consisted of anastomosis in the proximal end of one of the systemic vessels to the side of one of the pulmonary vessels. The heart, it was thought at the time, was too

central, too vital, and too complex to permit surgery or other invasive techniques. It would take a team of inordinately skilled physicians, surgeons and diagnosticians to conceive, plan and execute this cardiac surgery when there were no books, no models and little practical experience to use as a guide.

Blalock and Taussig in the May 19, 1945 JAMA article described the operation in detail:

> After light general anesthesia was produced, the patient was placed on his back with slight elevation of the side of the chest; the right or left side, depending on the position of the great vessels and the artery to be used in the anastomosis; the incision was made in the 3rd interspace and extended from the lateral border of the sternum to the axillary line; the pleural cavity was entered and the 3rd and 4th costal cartilages were divided; a rib spreader was introduced and a good exposure of the upper half of the pleural cavity was obtained; the right or left pulmonary artery was then exposed and the vessel was dissected from the adjacent tissues; the subclavian or innominate artery was dissected free and the vessel chosen was occluded temporarily at the point which it arose from the aorta with a bulldog arterial clamp; a second bulldog arterial clamp was placed on the left or right pulmonary artery just proximal to the point where the vessel supplied the upper lobe of the lung; a transverse opening was made in the side of the pulmonary artery and the anastomosis between the end of the subclavian artery and the side of the pulmonary artery was carried out with fine silk on a curved needle in a running stitch pattern; the bulldog clamps were then removed and the lung re- expanded and the incision in the chest wall was closed.[38]

The Johns Hopkins Hospital

Such groundbreaking medicine was not new for Johns Hopkins; in fact, since it opened in 1889 Hopkins was one of the first models of a teaching hospital, designed to unite functions of patient care with education and research. Mr. Johns Hopkins endowed the medical facility with a specific set of guiding principles. He wrote that the hospital must provide for "the indigent sick of this city and its environs, without regard to sex, age, or color, who may require surgical or medical treatment."[39] He also specified that schools of nursing and medicine be established in conjunction with the hospital.

Four years later, in 1893, The Johns Hopkins School of Medicine opened. Four founding physicians, the "Big Four" as they are known at Hopkins, had larger-than-life personalities and made a durable impression upon both Hopkins and Medicine: pathologist William Henry Welch; surgeon William Stewart Halsted; internist William Osler; and gynecologist Howard Kelly.[40] Spending time in the laboratory, lecture hall, and at the patient's bedside, students and interns brought the scientific approach to medicine and received hands-on training in the diagnosis and treatment of patients. The "Hopkins experiment" changed the pattern of medical education in the United States and had a tremendous impact on patient care. Within two decades, the hospital and the School of Medicine were models of patient care and education for the nation.[41]

Alfred Blalock

Alfred Blalock graduated from the University of Georgia in 1918, and that year entered the study of medicine at Johns Hopkins University School of Medicine where he earned his MD degree in 1922. He moved to Nashville to become a resident in surgery at the new Vanderbilt

University Hospital. While at Vanderbilt, Blalock did pioneering work on the nature and treatment of hemorrhagic and traumatic shock.[42] He demonstrated that surgical shock resulted primarily from the loss of blood, and he encouraged the use of plasma or whole blood transfusions as treatment following the onset of shock. In an experiment in 1938, Blalock joined the left subclavian artery to the left pulmonary artery in an effort to produce pulmonary hypertension. The experiment failed and was put aside for the time being; however, he later revisited this concept for the "blue baby" surgical procedure.

After being at Vanderbilt hospital from 1938 to 1941 Blalock accepted a position as professor and director of the Department of Surgery at Johns Hopkins--a position he would hold until his retirement in 1964.[43] At Hopkins, Blalock surrounded himself with a group of admiring and aspiring young physicians, many of whom went on to further the specialty of cardiac surgery in the 1950s, 1960s and 1970s. According to Mark Ravitch, an authority on Blalock:

> In the operating room Blalock was demanding and uncompromising. His characteristic manner of complaint can only be described as a whine, which a generation of house officers, as he was well aware, would imitate to amusement of their fellows. 'Won't somebody help me'; 'Must I operate all alone?' this despite the presence of his own superb scrub nurse, often assisted by another; his resident; the "cardiac intern" as well; Miss Berger providing anesthesia for most all of his cases; James his alert and attentive orderly who could aim the two electric fans and adjust the overhead light with a nonchalant flick of the wrist and the suggestion of a soft shoe routine; "lab man" to administer fluids or blood; apart from the instantaneous readiness of everyone else to help.[44]

When Alfred Blalock successfully performed his famed "blue baby surgery" at Hopkins, he became the third surgeon to contribute to the evolution of cardiac surgery. Robert Gross, pediatric surgeon at Children's Hospital in Boston had already closed a patent ductus arteriosus six years prior.[45] And a month before Blalock performed the first Blalock-Taussig shunt, Gross in Boston and Crafoord in Sweden excised a coarctation of the aorta.[46] While these operations did correct singular congenital heart defects, the Blalock-Taussig shunt offered a new approach to complex abnormalities of the heart. Closing a patent ductus arteriosus seemed like the obvious and logical thing to do. Indeed, creating a ductus was a new and ingenious concept to indirectly relieve the problem of Tetralogy of Fallot. Additionally, most patients with isolated patent ductus arteriosus and those with coarctation had relatively asymptomatic childhoods and most reached adulthood, while only one fourth of the patients with Tetralogy of Fallot reached adolescence.[47]

The abundance of patients who underwent the Blalock procedure provided a wealth of information about cardiac circulation and physiology. The fact that children with congenital heart disease could now be helped by surgery made cardiac catheterization an essential tool in clinical diagnosis. From the mid-1940s on, new information surfaced to substantiate what had been described only theoretically. By the time Blalock retired in 1964, more than two thousand children had received the shunt at Hopkins; worldwide, more than fifteen thousand would owe their existence to the life-saving procedure.[48] Many would subsequently undergo open heart surgery as new more sophisticated procedures developed in the 1950s and 1960s which allowed surgeons to more fully correct congenital heart problems; others lived full lives with their shunts and required no additional surgery.

The Growth of Pediatric Anesthesia

From the very beginning of anesthesia delivery in the mid to late 19th century, children were clearly at higher risk for anesthetic complications and death.[49] Indeed, anesthesia for children had long been considered a risky endeavor and its use was advocated for very few patients; only those with the gravest conditions were worth the risks involved with surgery under anesthesia. The reasons for this were multiple. The understanding and knowledge of children's physiology was minimal compared to that of the adult.[50] Anesthesia equipment was poor; there was little ability for intravenous access and little understanding of resuscitation techniques. In this pre-ICU era, children were routinely returned to regular hospital wards immediately after the operation.[51] Additionally, surgical techniques were primitive and dangerous because few surgeons devoted their clinical practice to children. Complications included bleeding and infection.[52]

Medical research in pediatric anesthesia was extremely limited in the 1940s. In fact, prior to 1960 anesthesiologists published only two notable research studies in pediatric anesthesia, one authored by James Eckenhoff, MD investigated pediatric postoperative personality changes and John Bunker, MD explored infant responses to anesthesia.[53] Any success that occurred in pediatric anesthesia before the 1940s was the direct result of the dedicated work of clinicians who designed special anesthetic equipment, dedicated their anesthetic practice to the care of infants and children, and trained others in their techniques. Many of these clinicians were nurse anesthetists. Reflecting on the history, Robert M. Smith, author of *Anesthesia for Infants and Children,* praised two outstanding nurse anesthetists in particular who had made significant contributions to the field. He noted Olive Berger and Betty Lank, "upon whom both Blalock and Gross depended during their initial surgical successes."[54]

Advanced Equipment for Anesthetists

During the early 20th century with the intensification of complex surgical procedures, anesthetists needed to monitor patients more accurately. A recommendation for the use of the precordial stethoscope became standard in monitoring the pediatric patient (Appendix D).[55] S. Griffith Davis, anesthesiologist at John Hopkins University, used the first precordial stethoscope.[56] He adapted a technique developed by Harvey Cushing's laboratory in which dogs with surgically induced valvular lesions had stethoscopes attached to their chest wall so that medical students might listen to bruits characteristic of a specific malformation. However, practitioners disregarded Davis's "phonendoscope" technique and thus the technique never gained widespread use. Dr. Robert Smith, a pioneer of pediatric anesthesiology in Boston in the 1940s, described the construction, placement, and use of the precordial stethoscope.[57] He also advocated for its use "in all anesthetic procedures, no matter how brief."[58]

Precordial stethoscopes provide an uncomplicated, nonelectric method to qualitatively assess both heart and lung function. Reflecting on the early days of pediatric anesthesia Robert Smith wrote: "complications occurred frequently, most of them due to blood loss, anesthetic depression, or airway obstruction. The term 'cardiac arrest' was heard all too frequently, and connotated an unexplainable act of God."[59]

Betty Lank, chief nurse anesthetist at Boston Children's Hospital and a colleague with Robert Smith, wrote an article in The *American Journal of Nurs*ing in 1959 detailing anesthesia for newborns. She reflected on the importance of the precordial stethoscope: "the most reliable information as to adequate ventilation is obtained by continuous use of a stethoscope strapped to the chest."[60] She went on to describe: "The best way we have of judging blood loss in small

infants is the stethoscope strapped to the patient's chest, since it gives us both the respiratory exchange and heart sounds and we are able to detect immediately changes in intensity of the heart beat. If the stethoscope strapped to the chest is in the surgeon's way, and the heart sounds are so lessened that the radial pulse is not audible, then the axillary or carotid pulse may be used."[61] Later Robert M. Smith described the changes over time, noting: "Judgment in the use of monitors suggest two stages of maturity; the older anesthetists perhaps not using them enough and relying instead on clinical observation and the educated hand, while the younger anesthetist use them too much, unnecessarily exposing the infant to excessive manipulation, electrical hazards, possible vascular damage, and post operative immobilization."[62]

It appears that anesthetists preserved their exclusive use of the precordial stethoscope and maintained a high level of skill for their individual practices. Precordials were considered fundamental technology although not without limitation.[63] Few pediatric monitors approached the ideal of practicality, safety, accuracy, and reliability. As Robert Smith, MD later lamented, "Our monitors failed to tell us what we really need to know, for example, the presence of pain, the measurement of cardiac output, or the metabolic changes occurring within the cell."[64]

Also during the late 1940s and 1950s, the first pediatric anesthesia textbooks became available. In 1948, Canadian physicians Digby Leigh and Catherine Belton published the first text, *Pediatric Anesthesia*.[65] Leigh and Belton state that "the margin of safety in infants and children is considerably less than adults . . . the fundamentals of good anesthesia [must] be observed. Therefore, greater attention to detail is essential."[66] In 1959 Smith published the first pediatric anesthesia textbook in the United States, *Anesthesia for Infants and Children,* which was an essential resource for anesthetists of the time period.[67]

Changes in Anesthesia

Several new anesthetic agents and new methods for their administration occurred from 1930 to 1950. As the use of inhalational anesthesia became more common, clinical observations correlated with needed stages of anesthesia.[68] Clinical experimentation with mixtures of inhalational and intravenous anesthetics worked with varying levels of success.

From a clinical standpoint, tradition and assumption defined anesthetic methods more than science and careful measurement. Consider Robert Smith's description:

> General anesthesia was open drop ether, or occasionally cyclopropane. Spontaneous ventilation was mandatory, since the pattern of respiration was considered the most important sign of anesthetic depth. Experience in the anesthetic management of small children was limited, and individual judgment weighed heavily. Local rules mandating the use of, or contraindication to, an agent or method might sometimes be proclaimed following only very limited trial. However, large numbers of operations safely performed under a wide variety of anesthetic approaches made it obvious that there was seldom just one correct road.[69]

Leigh and Belton commented on the open drop technic:

> Open drop ether is the method of choice for the untrained anesthetist. More experienced specialists often employ the less toxic agents and more complicated techniques, since in their hands there will be the same degree of safety but with added comfort for the patient and greater facility for the surgeon.[70]

Nurse anesthetist Betty Lank first demonstrated cyclopropane for infant anesthesia at the Children's Medical Center in Boston in 1936. Cyclopropane was a potent and non-irritating agent that when used with small children and infants, induced anesthesia rapidly and allowed for a rapid recovery to consciousness. Cyclopropane was expensive for the time and required a closed-circuit system in adults, which prompted the development of the T-piece system for controlled ventilation of the pediatric patient.[71] More importantly Cyclopropane was explosive; therefore, its use restricted the use of cautery instruments and many monitoring devices during surgery.

Sodium pentothal given by intravenous injection caused a rapid induction of anesthesia. For this intravenous method of anesthesia, the anesthetist placed a needle in the patient's vein and administered the solution intermittently during the procedure. The problem was that the plane of anesthesia was often difficult to control.[72]

After halothane debuted in the 1950s, there was rapid change in pediatric anesthesia. Halothane was a nonflammable agent that quickly replaced cyclopropane.[73] Halothane was non-irritating to the airways and could be used as an effective inhalational agent in pediatric patients. However, Halothane caused significant cardiac arrhythmias as well as ventricular depression that often made its use contraindicated in cardiac patients.

After World War II, the rise in pediatric surgery brought with it the mandate for improvements in the anesthetic management of infants and children. Research focused on sedatives to control fear and psychological trauma, new forms of administration and new agents that would control pain and movement without serious side effects. This led to the need for

advanced airway management, ventilatory control and the adaptation of adult devices for infants and children.

Another technique in anesthesiology that developed during this period was endotracheal intubation. Although it was used for adult patients in the 1920s, endotracheal intubation was not used in pediatric patients until years later and not without a good deal of controversy within the surgical ranks. The use of a laryngoscope was the common routine in pediatric anesthesia; however, in 1945, it was suggested that special endotracheal tubes with a wider proximal portion to reduce resistance and a short narrow distal intratracheal segment be used in infants. These wider tubes were used for more than 20 years until it was shown that the endotracheal tubes could cause damage to the glottis.[74] Leigh and Belton open their 1949 intubation chapter by stating: "In the last few years our use of endotracheal anesthesia has increased so that now it is utilized in over fifty percent of our anesthetics. As is evident from this, we feel that its advantages far outweigh its disadvantages."[75]

Olive Berger, Building a Foundation

Like her predecessors, Olive Berger kept meticulous records of her techniques, surgeries and outcomes. Communication of technique outcomes and case reviews were published in medical and nursing journals and presented at annual professional meetings.

Berger's articles detailed the anesthetic approach such that another anesthetist could replicate a safe and effective technique. For nurse anesthetists like Olive Berger, the practice of recording patient data, anesthetic technique, complications and outcomes, which established standards, is historically based.

Although the early foundations of the nurse anesthesia profession have been well documented, the contributions of nurse anesthetists to the specialty practice of pediatric cardiac anesthesia have not been recognized. Nurse anesthetists like Olive Berger began to make the surgery for children with heart defects a possibility. Olive Berger shaped her profession and her career by successfully administering anesthesia for blue babies at Hopkins. Blalock and Berger worked together for more than 20 years and demonstrated the heritage of nurse anesthetist and surgeon working cooperatively for the benefit of patients.

[1] Interestingly, famed neurosurgeon Harvey Cushing as a medical student delivered ether anesthesia where a patient aspirated and died. In a letter to F. A. Washburn he writes, "To my perfect amazement, I was told it was nothing at all, that I had nothing to do with the man's death, that he had a strangulated hernia and had been vomiting all night anyway, and that sort of thing happened frequently . . ." He was so haunted by the experience that he almost left medicine entirely. This experience almost surely explains his primary involvement with implementation of blood pressure monitoring in the operating room as well as anesthetic documentation. Michael Bliss, *Harvey Cushing: A life in Surgery* (New York: Oxford University Press, 2005).

[2] Virginia Thatcher, *History of Anesthesia with Emphasis on the Nurse Specialist* (Philadelphia: J. B. Lippincott, 1953). This text is out of print but available for download at http://www.aana.com/resources2/archives-library/Pages/History-of-Anesthesia-With-Emphasis-on-the-Nurse-Specialist.aspx.

[3] Florence Nightingale, *Notes on Nursing & Notes on Nursing for Labouring Classes: Commemorative Edition* (New York: Springer Publishing, 2010).

[4] Virginia Thatcher, *History of Anesthesi, with Emphasis on the Nurse Specialist,* (Philadelphia: J. B. Lippincott, 1953).

[5] Alice Magaw, "A Review of Over Fourteen Thousand Surgical Anesthesia," *Surgery, Gynecology and Obstetrics* 3 (December 1906): 795-799.

[6] Ibid.

[7] Ibid.

[8] Jean Pougiales, "The First Anesthetizers at the Mayo Clinic," *Journal of the American Association of Nurse Anesthetists* 38, 3 (June 1970): 235-241 (quote 236).

[9] Ibid.

[10] Virginia Thatcher, *History of Anesthesia with Emphasis on the Nurse Specialist* (Philadelphia: J. B. Lippincott, 1953).

[11] Clark Nelson, *Mayo Roots: Profiling the origins of the Mayo Clinic* (Rochester, MN: Mayo Foundation, 1990): 274.

[12] Arlene Keeling, Chapter 2, "Prescribing Medicine without a License?": Nurse Anesthetists, 1900-1938," in *Nursing and the Privilege of Prescription*, (Columbus, Ohio: Ohio State University Press, 2007).

[13] Nancy A. Harris, "Alice Magaw: the Mother of Anesthesia" (PhD diss., University of Iowa, 2006). Henry Munro was the physician who observed Magaw and Henderson.

[14] Alice Magaw, "A Review of Over Fourteen Thousand Surgical Anesthesia," *Surgery, Gynecology and Obstetrics* 3(December 1906): 795-799.

[15] Bruce Evan Koch, "The Evolution of Nurse Anesthesia in the United States," in *The Wonderous Story of Anesthesia*, ed. Edmond I. Eger et al. (New York: Springer, 2014).

[16] Alice Hunt, *Anesthesia: Principles and Practice, a Presentation for the Nursing Profession*. (New York: G. B. Putnam's Sons, 1949) 72.

[17] George Crile, *George Crile: an Autobiography*. (Philadelphia: J. B. Lippincott, 1947): 199.

[18] O. Berger in an interview given in 1975 reminisced of Margaret Boise's love of music and that her father (Otis Bardwell Boise) who taught at the Peabody Conservatory in Baltimore as a teacher of harmony and composition.

[19] Boise and Young collaborated on a specialized gas-ether machine known as the Boise-Young apparatus at Hopkins.

[20] Virginia Thatcher, *History of Anesthesia with Emphasis on the Nurse Specialist* (Philadelphia: J.B. Lippincott, 1953): 86.

[21] Samuel Crowe, *Halsted of Johns Hopkins: The Man and His Men* (Springfield, Ill.: Charles C. Thomas Company, 1957).

[22] "Alan Mason Chesney Medical Archives," http://www.medicalarchives.jhmi.edu/oprhres.jpg. Accessed December 1, 2013.

Dr. Blalock and his surgical team, performing an early procedure.

[23] Helen Taussig born in 1898 was the youngest daughter of well-known economist who taught at Harvard and was advisor to Woodrow Wilson. Her mother died when Helen was 11 years old. She was a frail child suffering from tuberculosis that often forced her to skip many days at school. To make matters worse, she had dyslexia. However, despite struggling with her dyslexia, she completed Radcliffe College, the women's college connected to Harvard, in 1917. She then took a course in anatomy at Boston University and greatly impressed Prof. Alexander Begg, Dean and Professor of anatomy, who advised her to apply to Johns Hopkins University, one of very few medical schools in America that accepted women at that time. After graduating in 1927, she was confronted with the loss of her hearing. Determined to practice anyway, and choosing cardiology as her specialty, she learned to read lips, and "listen with her fingers" to her patient's hearts. She was steered towards pediatrics a specialty considered an appropriate career track for women at the time. Edward A. Park, chairman and head of the Harriet Lane home for invalid children, and a major influence in American pediatrics, took Taussig under his wing and encouraged her to establish a cardiac clinic that would focus on rheumatic and congenital heart disease. The clinic at Harriet Lane became her base for the next 50 years.

[24] n.a., "Happy Birthday, Cardiac Surgery," *Dome* 55, no. 10, December 2005, Johns Hopkins University and Hopkins Health System.

[25] William Longmire, *Alfred Blalock: Personal reflections* (Pasadena CA: Castle Press August 1964). Presented at the 110th Society of Clinical Surgery April 4, 1964 in Baltimore, Maryland.

[26] Ibid.

[27] Gershon Fishbein, "The Surgery That Gave Hope for 'Blue Babies,'" The Washington Post December 6 (1994): Health Z9.

[28] Mike Field, "Hopkins pioneered "blue baby" surgery 50 years ago 'I remember . . . Thinking it was Impossible,'" *The Gazette: The Newspaper of the Johns Hopkins University,* May 30,1995.

[29] William Longmire, *Alfred Blalock: Personal reflections* (Pasadena CA: Castle Press August 1964): 7.

[30] Olive Berger Collection, Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions.

[31] William P. Longmire, *Alfred Blalock: His Life and Times* (Published by the author, 1991).

[32] Joyce Baldwin, *To Heal the Heart of a Child – Helen Taussig, MD*. (New York: Walker and Company, 1992).

[33] Olive Berger, "Anesthesia for the Surgical Treatment of Cyanotic Congenital Heart Disease," *Journal of the American Association of Nurse Anesthetists,* (May 1948): 79-90.

[34] Now a practicing psychologist in Minneapolis, Sandro Stoltz underwent the procedure at Hopkins in 1945 at the age of 11. (The term "blue baby" is something of a misnomer for

depending on the severity of the problem many infants affected with Tetralogy of Fallot lived well into adolescence however their life expectancy was severely limited by the condition.) Stoltz remembers her condition vividly; “I was a blue baby until I was 11, complete with purple toes, nose, fingertips and lips.” She wrote in a recent testimonial “I was often short of breath, had limited energy, and occasionally fainted . . . I desperately tried to be normal and longed to keep up with the other kids.” After the operation she said, her life changed forever “While I remember little of the first year postop, thereafter I deemed the operation a complete success. I learned to ride a bike, and attended public school for the first time. In high school, I was excused from physical education, but could jitterbug the night away! I joined a sorority, felt popular and considered myself normal at last.” Mike Field, “Hopkins pioneered “blue baby” surgery 50 years ago ‘I remember . . . Thinking it was Impossible,’” *The Gazette: The Newspaper of the Johns Hopkins University,* May 30, 1995.

[35] *Something the Lord Made*. A 2004 film produced by HBO (Home Box Office, Inc.). According to the HBO web site, the film depicts "the story of two men—an ambitious white surgeon and a gifted black carpenter turned lab technician—who defied the racial strictures of the Jim Crow South and together pioneered the field of heart surgery."

Partners of the Heart—A 1998 documentary film by Duke Media and Spark Media Production for American Experience, on PBS (Public Broadcasting System). The PBS website describes the documentary as follows, "In 1944, two men at Johns Hopkins University Hospital pioneered a groundbreaking procedure that would save thousands of so-called blue babies' lives. One of them, Alfred Blalock, was a prominent white surgeon. The other, Vivien Thomas, was an

African American with a high school education. Partners of the Heart tells the inspiring, little-known story of their collaboration."

[36] Countries children traveled from to Hopkins was retrieved from Olive Berger's log.

[37] The Harriet Lane Home for Invalid Children, the nation's first pediatric hospital affiliated with an academic research institution, opened at Hopkins in 1912. Baltimore banker Henry Johnston and his wife Harriet Lane bequeathed funds in memory of their sons, who died in childhood from rheumatic fever. By 1930 Hopkins clinicians had discovered that sulfa drugs could prevent its fatal cardiac devastation.

[38] Alfred Blalock and Helen B. Taussig, "The Surgical Treatment of Malformations of the Heart: In which there is a pulmonary stenosis or pulmonary atresia" *Journal of the American Medical Association* (May 19, 1945): 128, 189-202.

[39] "Alan Mason Chesney Medical Archives," http://www.medicalarchives.jhmi.edu/hospital.html and "History of Johns Hopkins hospital," http://www.hopkinsmedicine.org/about/history/.

[40] John Cameron, "William Stewart Halsted: Our Surgical Heritage" *Annals of Surgery* 225; 5 (1997): 445-458.

[41] Abraham Flexner, "Medical Education in the United States and Canada: A Report to the Carnegie Foundation for the Advancement of Teaching," Bulletin 4 (1910): 234.

[42] Alfred Blalock, "Mechanism and treatment of experimental shock: shock following hemorrhage." *Archives of Surgery* 15 (1927), 762. Blalock's early work on shock is credited with saving the lives of many casualties during World War II.

[43] Mark Ravitch, *The Papers of Alfred Blalock*. (Baltimore: The Johns Hopkins University Press, 1966).

[44] Ibid.

[45] Robert Gross and James Hubbard, "Surgical Ligation of a Patent Ductus Arteriousus: Report of First Successful Case," *JAMA* 128 (1939): 525-530.

[46] Robert Gross and Charles Husnagel, " Coarctation of the Aorta: Experimental Studies Regarding Its Surgical Correction," *New England Journal of Medic*ine 233 (1945): 287-293.

[47] Dan McNamara, "The Blalock-Taussig Operation and Subsequent Progress in Surgical Treatment of Cardiovascular Diseases," *JAMA* 251 (1984): 2139-2138.

[48] Mike Field, "Hopkins Pioneered "Blue Baby" Surgery 50 Years Ago 'I remember . . . Thinking it was Impossible'," *The Gazette: The Newspaper of the Johns Hopkins University,* May 30,1995.

[49] In fact, the first recorded anesthetic death was that of a child recorded in 1847 in the *London Gazette*—an 11-year-old boy who was undergoing an amputation of his leg died shortly after the surgery. That same year the *Edinburgh Medical and Surgical Journal* reported a 15-year-old girl suffered a cardiac arrest while under a chloroform anesthetic for a toenail removal. Even W. T. G. Morton noted that children were more likely to have nausea and vomiting after surgery. Andrew Costarino and John Downes, "Pediatric Anesthesia Historical Perspective" *Anesthesiology Clinics of North America* 23(2005): 573-595.

[50] Charles Robson, "Anesthesia in Children" *American Journal of Surgery* 34(1936): 468-475.

[51] Christine Mai and Myron Yaster, "Pediatric Anesthesia: A Historical Perspective" *American Society of Anesthesiologists Newsletter* 75;10 (October 2011), 10-13. The first critical

care unit in North America that accepted children and adults was opened in 1959 at Baltimore City Hospital. In 1967 the Children's Hospital of Philadelphia established the first pediatric intensive care unit (PICU) in the United States. Johns Hopkins established its PICU in 1976.

[52] Robert Smith, "The Pediatric Anesthetist, 1950-1975" *Anesthesiology* 43(1975): 144-155.

[53] James Eckenhoff, "Relationship of Anesthesia to Post-operative Personality Changes in Children," *American Journal of Diseases in Children* 86(1953): 587-591. John P. Bunker, William Brewster, Robert Smith and Henry Beecher, "Metabolic Effects of Anesthesia in Man III. Acid-Base Balance in Infants and Children during Anesthesia," *Journal of Applied Physiology*, 5 (November 1952): 233-241.

[54] Robert Smith, "The Pediatric Anesthetist, 1950-1975," *Anesthesiology* 43;2 (August 1975): 144-155.

[55] Cushing described "continuous auscultation of cardiac and respiratory rhythm during the entire course of the anesthesia" while using a precordial stethoscope. But Cushing's suggestions for intraoperative monitoring were not initially readily accepted. Harvey Cushing, "Technical Methods of Performing Certain Cranial Operations," *Surgery, Gynecology and Obstetrics* 6 (1908): 227-234.

In fact the *British Medical Journal* claimed, "By such methods we pauperize our senses and weaken clinical acuity." Ralph Hermon Major, "The History of Taking the Blood Pressure," *Annual of Medical History* 2 (1930): 47-55.

[56] Raymond Fink, Lucien Morris, and Charles Stephan, *The History of Anesthesia: Third International Symposium Proceedings, Atlanta, Georgia, March 27-31, 1992*. (Park Ridge, IL: Wood Library-Museum of Anesthesiology, 1992).

[57] Robert Smith, *Anesthesia for Infants and Children* (St. Louis: C. V. Mosby, 1959).

[58] Ibid. Continuous auscultation of the chest allows the anesthetist to monitor the cardiac and respiratory system. The quality of heart sounds provides data on strength of cardiac contraction; during hypovolemia, cardiac sounds may become muffled, and with hyperkalemia or congestive heart failure, extra cardiac sounds may be heard. Obviously, heart sounds are not heard during asystole or ventricular fibrillation. The onset of extra systole's, tachycardia, or bradycardia is immediately apparent even in the inexperienced listener. Attention to breath sounds during continuous chest auscultation also provides data on the quantity and quality of ventilation. Changes in breath sounds may reveal the development of bronchospasm, upper airway obstruction, or airway circuit disconnection. However, because respiratory rate is relatively slow, a decrease in rate and even total absence are difficult to detect, even for the experienced listener. The rationale for using the precordial is to enable the anesthetist to continuously monitor respirations and heart sounds with maximal signal to noise ratio. A muffling of heart and breath sounds accompanied by swallowing noises can be the first indication that the anesthetic may be insufficient.

[59] Robert Smith, "The Pediatric Anesthetist, 1950-1975," *Anesthesiology* 43:2 (August 1975): 144-155.

[60] Betty Lank, "Anesthesia for the Newborn," *The American Journal of Nursi*ng, 59:9 (1959): 1255-1258.

[61] Ibid.

[62] Robert Smith, "The Pediatric Anesthetist, 1950-1975," *Anesthesiology* 43:2 (August 1975): 144-155.

[63] The earliest monitoring standards of both the American Association of Nurse Anesthetists (AANA 1990) and the American Society of Anesthesiologists (ASA 1986) mandated continuous monitoring of ventilation and circulation during the administration of a general anesthetic.

[64] Robert Smith, "The Pediatric Anesthetist, 1950-1975," *Anesthesiology* 43:2 (August 1975): 144-155.

[65] Digby Leigh, and Kathleen Belton, *Pediatric Anesthesia* (New York: MacMillan Company, 1949).

[66] Ibid.

[67] Smith's *Anesthesia for Infants and Children* is currently in its eighth edition and remains a fundamental resource for nurse and physician anesthetists.

[68] Arthur Guedel outlined the observations made during stages of anesthesia serving as a guide to the depth of narcosis. Observations included that of: respiration and use of intercostal and diaphragm muscles, respiratory response to skin incision, pharyngeal and laryngeal reflexes, ocular movements, pupil size, eye reflexes, secretion of tears and muscular tone. These stages applied to use of ether, cyclopropane, chloroform, ethyl chloride, and vinethene anesthesia.

[69] Robert Smith, "The Pediatric Anesthetist, 1950-1975," *Anesthesiology* 43:2 (August 1975): 144-155.

[70] Digby Leigh, and Kathleen Belton, *Pediatric Anesthesia* (New York: MacMillan Company, 1949).

[71] David Steward, "History of Pediatric Anesthesia," in George A. Gregory's *Pediatric Anesthesia, Second Edition*. (New York: Churchill Livingstone Inc., 1983): 1-14.

[72] Alice Hunt, *Anesthesia: Principles and Practice, a Presentation for the Nursing Profession* (New York: GB Putnam's Sons, 1949) 20.

[73] David Steward, "History of Pediatric Anesthesia," in George A. Gregory's *Pediatric Anesthesia, Second Edition*. (New York: Churchill Livingstone Inc., 1983): 1-14.

[74] Ibid.

[75] Digby Leigh, and Kathleen Belton, *Pediatric Anesthesia* (New York: MacMillan Company, 1949).

Chapter 3

Olive Berger: Combining the Art and Science of Anesthesia

> Certain attributes are common to all nurses who have succeeded in anesthesia. Surgery and the tense, restless atmosphere of the operating room must appeal to her. She must inspire confidence. She must grasp the patient's state of mind, as well as his physical state. She must endure long hours of physical as well as nervous strain without relaxing in the intensity of her application to her task. She must possess some of the adventurer's spirit of finding unusual and interesting phenomenon in commonplace situations. Without exception anesthesia has proved enduringly interesting to this type of person.[1]

In the year 1928 nurse anesthetist Margaret Boise wrote these words describing the attributes of a good nurse anesthetist. Boise also noted characteristics that contributed to success in anesthesia included: "self-control and balance, good coordination of head in hands, interest in surgical procedures and interest in human nature."[2] Nurse anesthetist Olive Berger, who studied with Boise at Johns Hopkins, had these qualities. In fact, Berger was exceptional. Boise's article also indirectly describes her teaching goals when she noted:

> The first lesson the pupil in anesthesia has to learn might be termed ear-training. The anesthetist who hears every breath her patient takes, and interprets the sounds correctly, will avoid serious difficulties . . . Next in order of importance is to learn the meaning of

> the picture presented to our eyes. The color of the skin, the blood and the tissues, gives us indictable information and the eye-signs [Guedel's classification] tell us a story, which we must learn to interpret correctly . . . The sense of touch must be trained to measure the volume, force and rate of the pulse and to note the subtlest changes."[3]

Olive Berger trained at the School of Nursing at Roosevelt Hospital, New York in 1920.[4] After graduation Olive Berger stayed in the city and became head nurse in charge of the delivery room at Sloan Maternity Hospital for six months. Her interest in anesthesia peaked when she moved into the gynecological operating room at Sloan as the head nurse.

Berger was accepted as one of two students at the Johns Hopkins Hospital School of Anesthesiology in 1921. The period of instruction at Hopkins was six months, plus an apprenticeship. As cited by Thatcher, requirements for a program of nurse anesthesia in the 1920s included: "Obtaining the consent of the hospital and the surgeons and a willingness on the part of the instructor to impart the knowledge of the technics to the student apprentice." Thatcher went on to discuss how students would learn, noting "the student, with few exceptions, was expected to acquire a smattering of the science of anesthesia from a few lectures or through osmosis. The courses presented all shades of adequacy, depending on the native intelligence and the teaching ability, experience and the education of the instructor.[5]

This would be the case for Berger. Boise's approach to instruction was structured and required a certain "type" of student who would demonstrate a good work ethic, learn quickly,

demonstrate the necessary skills and be a team player. Boise wrote in the *American Journal of Nursing* her philosophy of anesthesia that would be imparted to Berger.

> A course in anesthesia must enable the student to obtain satisfactory results with simple methods, before she is instructed in the use of complicated machines. She requires all the knowledge she has acquired in using the simple machines to enable her to use the modern apparatus with safety. A nurse who has learned the mechanism and manipulation of only one complicated machine would be as presuming in calling herself an anesthetist as would the builder and calling himself an architect.[6]

No doubt, Berger's training was typical of the era. Nurse anesthesia students received twenty dollars a month while in training and were provided room and board. During her training period, Olive Berger administered anesthesia for about four hundred surgical cases, attended some clinics, and listened to physicians' lectures. Delivering anesthesia, rather than attending classes, was the priority. Time allotment to classroom instruction, the amount of clinical training and supervision all depended on the number of cases that had to be covered. Upon completion of her training, Berger received a certificate and was required to work as a nurse anesthetist at Hopkins for two years.

Berger at Hopkins

Berger resided at Hampton House (named for Isabel Hampton Robb, the first superintendent of nurses at Hopkins), which provided single rooms for 235 nursing students and suites for members of nursing school faculty. It was during this early part of her career that

Berger immersed herself in the Hopkins culture and community. Initially Berger "didn't like Baltimore at all . . . the tempo was too slow . . . it took them too long to makeup their minds to do anything. I didn't like it very much. I didn't think I would ever get use to it. But I got down to their speed . . . I don't like New York at all anymore."[7]

Olive Berger was the nurse anesthetist for operating room B (primarily gynecology) from 1922 through 1929. During this time, Berger mastered her anesthesia techniques as was evident in a 1928 recommendation letter from Thomas S. Cullen, MD, a gynecologist with whom she worked closely.

> Her handling of the anesthetics has given me and my colleagues the greatest satisfaction. Personally I have known of no instance where there was the slightest reason for any criticism, and that is saying a great deal. Furthermore, she has always been cheerful and been tactful to the usual degree. It is with greatest regret that we lose her, and we hope that at no distant time she may return to us. It gives me unusual pleasure to vouch for her, both as a skilled anesthetist and as a delightful person with whom to work.[8]

Camaraderie was the hallmark of the operating room at Hopkins. This bonding atmosphere was demonstrated in the photo of the staff from operating room B enjoying lunch together. The entire surgical team is present (Appendix E).

Berger left Hopkins and accepted a position in charge of the delivery room and the operating room at Children's Hospital in Chattanooga, Tennessee from 1929 to 1931. She returned to Hopkins in 1931 as the chief nurse anesthetist and director of the Anesthesia School for Nurses at the Johns Hopkins Hospital, a position she held until her retirement in 1969.

Clinical Pioneer and Researcher

During her time at Hopkins in the 1940s, Olive Berger was both a clinical pioneer and a researcher.[9] She maintained a detailed notebook labeled “Tetralogy's” of the first 100 cases as well as the 475 succeeding cases which identified the name of the patient, their hospital number, the age of the patient, date, the ward the patient was located on, the operation performed, the anesthetic used, the duration of time the anesthetic was used, the operating staff (surgeons, nurse anesthetist, physician anesthetists), and notations of specific patient characteristics or complications.[10]

The notebook is a simple composition book with almost every page filled with Berger’s descriptive data. Now worn and yellowed, the notebook’s inside cover contains the analysis of the first 500 cases, noting that physician anesthetists provided 27.6 percent and 72.4 percent were provided by nurse anesthetists.[11] The columns are carefully measured and labeled with no data points missing. Most of the handwriting is identical for the first 997 cases. Often her writing instruments appear to change as many unique notations are documented in colored pencil and/or often followed by an exclamation point.

Berger is listed as the anesthetist for case number 22, 33 and 41 of the first fifty cases. Only six of the first twenty-five cases had endotracheal tubes. Many children died intra-operatively or within thirty hours from what was noted to be “pulmonary edema.” It is evident in the data that after Berger had administered anesthesia for approximately a dozen blue-baby surgeries that she is listed as the anesthetist almost exclusively. Most of the early cases utilized cyclopropane, ether and oxygen, and occasionally nitrous oxide. Changes in anesthetic technique

are evident in the log as Berger documents varying concentrations and combinations of anesthetic gases. The introduction of Curare and Pentothal were also noted in 1948.

During the early months in 1945, eight to twelve blue baby surgeries were performed per month. By 1946 this number increased by 50 percent. By 1947 more than twenty cases (to a peak of thirty-three in May) per month were completed. On most days Blalock performed two surgeries. Berger notes that patients came to Hopkins from around the world (Italy, Canada, Denmark, Brazil, France, Chile, Australia, Mexico, Bombay, and South Africa).

Most impressive is Berger's obvious attention to detail with her evaluation of the anesthetic and key perioperative incidents. Notes of "ear burned by oxymeter," "poor anesthesia," "respiratory stridor," "cardiac arrest," "heart rate slowed with retraction" are evident.[12] Her follow-up postoperative complications are noted, as well as any post mortem results.

Olive Berger published her findings and observations of the next 275 cases "Anesthesia for the Surgical Treatment of Cyanotic Congenital Heart Disease" in May 1948 in the *Journal of the American Association of Nurse Anesthetists*. She continued to publish Hopkins' experience in "Further Observations on Anesthesia for the Surgical Treatment of Cyanotic Congenital Heart Disease" in February 1949 again in the *Journal of the American Association of Nurse Anesthetists*. These articles detail premedication, anesthetic administration technique, complications and their management, as well as post-operative course. In addition, Berger documented any deaths. The fastidious nature of these lengthy articles was not only to communicate a replicable technique or an evolving standard of care but also to encourage peer evaluation.

Relying on her training, Berger advocated for preoperative visits and teaching. From her understanding of the pathophysiology of the disease process she wrote:

> Considerable tact, patience, and understanding are called for in caring for these patients . . . A primary visit by the anesthetist is desirable. Thus the patient recognizes a friend when he comes to the operating room . . . Fighting, crying, or any slight exertion may produce dyspnea, increase cyanosis, a typical attack.[13]

However, as was typical of the state of the art of medicine and nursing in this era, the child's needs to be supported by their parents on the day of surgery was not permitted. Accordingly, Berger stated that "many of these patients present a severe psychological problem as they have been spoiled and pampered all their lives . . . the child is not allowed to see his parents on the day of operation." This policy minimizes emotional disturbances and contributes to smoother safer anesthesia."[14] Recommendations, however, were given for pre-operative medication. Premedication was important to assure a smooth induction. Drugs like morphine approximately 1 mg per 5 kg of body weight and atropine 1/20 the dose of morphine "should be administered 90 minutes before the start of anesthesia."[15]

Berger described the administration of her anesthetic technique in detail: "a Waters model Foregger gas machine" was utilized. Inhalational induction occurred by a "semi-closed method." Berger observed that these cyanotic children had a "high tolerance for cyclopropane" [probably due to poor pulmonary circulation] and that a "high percentage mixtures were needed for 5 or 10 minutes [even up to 30 minutes] until relaxation of the jaw was sufficient to allow intubation . . . We since have been able to procure plastic tubes in sizes 00 to 9."[16] Berger also

included a picture of the position of the patient. Typically the to and fro Waters carbon dioxide absorber with an intratracheal technique was used to administer a cyclopropane and oxygen mixture for maintenance of anesthesia. Berger described that "lower mid-plane anesthesia" has proven adequate for the Blalock shunt procedure. Nurse anesthetists needed to "assist respirations by gentle rhythmic compression of the breathing bag" which provided the minimal movement of the mediastinum. A water manometer was incorporated into the anesthesia circuit to affect positive and expiratory pressure. The nurse anesthetist needed to use her skills of observation. It was critical for her to diligently observe both the child and the surgical field. Berger summarized this by saying, "we rely on the sense of touch and visual observation."[17] The lung was allowed to collapse when the plural was entered. The lung was ventilated for one to three minutes prior to pulmonary artery occlusion to limit anoxia. Upon completion of the anastomosis the lung was re-expanded and maintained until completion of the operation. Berger warned, "Hyperpyrexia from heat retention has been a complicating factor . . . In a non-air-conditioned operating room during hot weather."[18]

The management of the anesthetic agents was regulated to ensure active reflexes by the end of the case. Berger was an expert clinician and reported, "Many patients are sufficiently conscious to answer questions or respond to simple directions before leaving the operating room." An artful skill that was necessary since children were taken directly to the floor to recuperate. The lack of a recovery room proved problematic. "They didn't know what to do with them. They would let them go too long and then send for us. Patients would be as blue as indigo and not breathing . . . why I don't know."[19]

Berger warned her readers each patient presents a different problem . . . "The anesthesia must be individualized . . . There can be no hard and fast rules to govern the management of

anesthesia for this type of surgery."[20] Physiologic knowledge and experiential knowledge guided Berger's every clinical judgment and action to individualize her technique. Her ability to create what was to be an adequate anesthetic for the surgeon but hopefully unremarkable for the patient was noteworthy.

Berger presented potential complications in her articles. She reported bradycardia as the most common complication reported. It occurred at almost any time during the anesthesia for a variety of reasons. Berger warned, "close visual observation of the heart itself is the best means of detecting signs of impending cardiac arrest . . . the blood pressure could not be obtained by auscultation," even preoperatively.[21] Cerebral thrombosis was an ever-present complication that had to be assessed; it was "essential that careful infrequent observations of the pupils be made throughout the operation."[22] Berger reported that several patients had convulsions. She thought they were due to "heat retention and carbon dioxide excess."[23] Surprisingly, she never reported any cases of pulmonary edema. The most frequent development in the postoperative period that she cited was croup. She states that "in approximately 25% of all patients . . . a steam kettle or croup tent" was used for supportive treatment. Twenty-two of the 475 patients in the cases reported by Berger died during the procedure; five of these occurred suddenly at closure. "We have been at a loss to explain why these deaths could have occurred," Berger admits. An additional eleven patients died within twenty-four hours of the operation. Berger recognized the limitations of current anesthetic agents and techniques, and stated "in all probability the anesthesia has been a contributing factor in some cases."[24]

Olive Berger and Alfred Blalock

Olive Berger's relationship with Blalock can only be referred to as one of mutual respect. Berger recalled "lots of places had nurse anesthetists but also had a physician anesthetist in charge… but we didn't. Dr. Blalock did not want it… And Dr. Blalock had great faith in us."[25] Berger was under the impression that "Blalock did not want to be told what he could do or not do." Nurse anesthetists typically answered "yes sir, no sir, I will try sir . . . he apparently enjoyed that (laughing)."[26]

One of the many visiting professors that came to Hopkins to observe the blue baby operation gave Berger a first edition of Florence Nightingale's book, *Notes on Nursing; What it is and What it is not,* published in 1859. The first page of the book contains the following inscription:

> To Ms. Berger by OOF December 1947
>
> To one of the unsung heroes, Ms. Olive Burger, today I watched for 2 1/2 hours Dr. Alfred Blalock operate on a heart case why I'm not sure you could have gotten along without Al [sic] I feel certain he couldn't have gotten along without you.
>
> And this lady who also has had a great deal of publicity for carrying a lantern around during war never was surrounded by tanks for 2 1/2 hours.
>
> And Al had much help and relief; you did yours alone. All the world should sing your praises, and I do.[27]

Olive Berger, the Educator

In 1935 the AANA education committee issued a report that resulted in the creation and adoption of a standardized curriculum for the preparation of nurse anesthetists. These recommendations set the course for the educational level of nurse anesthetists to continue to increase over the years. The goal of the AANA committee was to transform the education of nurse anesthetists from mere apprenticeships (created to serve the hospitals) to a degree earned from accredited universities.

The report contained recommendations regarding the subjects to be taught, the number of hours for classroom and clinical instruction, and the minimum number of cases that each student needed to administer. The AANA report served the same purpose that the 1910 Flexner report did for physicians, using educational standards to position nurse anesthetists and the practice of nurse anesthesia in a politically advantageous place.[28] Olive Berger served on the AANA educational committee from 1934 through 1937. In a letter to Helen Lamb chair of this committee, dated July 11, 1935, Olive Berger stated the importance of educational standards: "it cannot be over emphasized, particularly in the face of the present day widespread disapproval of employment of the nurse anesthetists. If we are to continue to hold our positions as we have done in the past on merit alone, merit being the only justification I believe for the use of nurses to administer anesthetics, the responsibility of the schools of anesthesia and hospitals maintaining such schools is indeed very great."[29]

The 1934 committee consisted of Helen Lamb as chair, Olive Berger, May Cameron, Laura Davis Dunstone, Mary Muller, and Agatha Hodgins as a consultant. The recommendations reflected the practices used by what were considered to be excellent training centers. This report

was critical in shaping the recommended curriculum of anesthesia schools and created the "standard" for nurse anesthesia education. The report addressed:

> Type of Institution—established only in the hospitals that could have an active surgical division that embraces all types of surgical cases . . . should strive to secure the benefits, which universities have extended to other professions.
>
> Anesthesia Department Personnel—chief anesthetist . . . to direct the actual training . . . have at least 5 years of continuous experience as an active anesthetist, and should have and inclination for study—constantly supplementing her knowledge by this means and by continuous observation.
>
> Equipment— . . . involves a broad instruction and experience with widely varied anesthetizing apparatus . . . to provide adequate training and commonly met with manipulation and maintenance problems.
>
> Permanent records—a complete system of permanent, uniform records of the students progress during her course should be maintained, this record compromising grades obtained in the various subjects, hours of actual classroom theoretical instruction, hours of class. Practical instruction, hours of practical anesthesia and number of anesthetics administered . . . Together with information concerning her health, character and personality.
>
> Technical library—technical reference library, containing at least standard late edition textbooks . . . Recommended list.

Duration of course . . . Recommended that 6 months be the minimum acceptable, with a one-year course advocated . . . Recorded hours of classroom instruction, 95; recorded hours of operating room instruction, 18; number of cases administered, 325 (of which 25 should be of obstetrical; 25 may be dental; 25 maybe spinal, locals, etc.).

Requirements for Admission - only graduates of accredited schools of nursing . . . 24 years of age minimum and a maximum of 35 years . . . personal interview is desired . . . references from 2 physicians . . . physical examination and chest x-ray.

Limited size of student body limited to number . . . So that each student can have available the full and required number and kind of cases . . . No student should be graduated who has not had a total of at least 275 cases.

Uniform teaching—a curriculum must be rigidly adhered to . . . And no tendency permitted to supersede specific classroom work by contracted compromise lectures in the operating room or during case administrations . . . a pattern of teaching is given as the example for ether.

Examinations—in addition to daily or weekly quiz conferences, definite written examinations on each subject taught . . . A final exam, at the end of the course, is also desirable.

Discussion groups—discussion periods are valuable . . . Such discussion conferences encourage development of powers of observation, self-expression, originality of thought and initiative.

> Time off duty—there is grave question if any anesthetist can remain mentally or physically capable of work, if her hours of duty average more than 8 daily.
>
> Field trips—highly desirable . . . to other hospitals
>
> Recommended curriculum and Operating Room Instruction—specific curriculum must be outlined, recommended that the minimum be; length of course 6 months (with one year advocated), recorded hours of classroom instruction 95, recorded hours of operating room instruction 18, number of cases administered 325 (25 obstetrical, 25 dental, 25 spinal or locals).[30]

The AANA membership approved these initial recommendations, but a year later in 1935 the AANA educational committee made this additional recommendation:

> National Association list of certified schools of anesthesia—each listing would have size of hospital, number of anesthetics, number of students, number of nurse anesthesia staff, length of course, profession degree of head of the anesthesia department, anesthetic agents use regularly, makes of anesthetizing machine, methods of anesthesia practice regularly.
>
> Eventual national examinations—the committee suggested that the real measure of the schools were the desirability as a training institution, must be in the last analysis be determined by the degree of knowledge and skill which is actually showed by those persons whom the graduates; and that therefore the real rating of each school of anesthesia will eventually be measured by the percentage of its graduates which passed

> examinations given by some such body as a national Board of examiners or certification . . . Committee has worked out a master list of examination questions . . . Committee calls attention to definite trend toward recently created American Board of Surgery and Council on Dental Education exams.[31]

The vision and work of these educators was decisive in moving nurse anesthesia as a profession forward.[32] By securing educational standards, nurse anesthesia confronted the legal challenges concerning the right to practice and secured an alliance with the American Hospital Association.

Johns Hopkins School of Anesthesia

The Johns Hopkins School of Nurse Anesthesia's training program varied in length from six months to twelve months during Olive Berger's tenure as director. The program accepted two students at a time two to three times per year.[33] From 1917 when nursing education in anesthesia started at Hopkins until 1939, sixty-five nurses were trained. Johns Hopkins Hospital as an institution prided itself in the training of personnel. "It is generally recognized that one of the most important functions which a hospital can fulfill is that of training the younger members of its staff, both physicians and nurses, *beyond* the level represented by their degrees or diplomas . . . Johns Hopkins Hospital from the very start has been such to facilitate this process."[34]

Requirements for entrance into the school at Hopkins included four years of high school, graduation from an accredited training school, a state of Maryland registration, and one year of experience in any nursing field. Olive Berger advocated for four hours of theoretical instruction per week that included: ethics of anesthesia, history of anesthesia, anatomy and physiology, physiology of anesthesia, pharmacology of anesthetic and hypnotic drugs, signs and symptoms

of anesthesia, choice of anesthesia, methods of administration, and general care and upkeep of anesthetic equipment and supplies. Her goal was to provide five hundred practical hours and a total of six hundred hours of anesthetics in a year of training at Hopkins. These standards exceeded any national ones. She believed that students should work under the watch of a supervisor for the first six months. After that the students could be on call at night for emergencies. Berger reasoned, "A one year course allows the student ample time to proceed slowly and to be thoroughly grounded in her work. I believe the 1st week or 2 should be devoted entirely to the observation of what is in all probability a new surgical and operative technique. Without knowledge of the surgical principles, intelligent anesthesia is impossible."[35]

JHH nurse anesthetist students were rated in a two page "Efficiency Report" that addressed:

> (1) Manner of approached to patients—scaled from indifferent to warm and friendly (2) Preparedness—seldom has everything needed to rarely forgets anything (3) Foresight in anticipate special and emergency needs (4) Composure during an anesthesia (5) Judgment and composure during an emergency (6) Manual dexterity—slow, awkward, wasteful to uses hands skillfully (7) Ability to apply theoretical knowledge—clear understanding to unable to apply to clinical practice (8) Planning ability—good to poor (9) Appearance—neat and good posture to untidy and poor posture (10) Voice—which included a five-part scale from enunciation good consciously pleasing and well modulated (11) Manners and Professional conduct—antagonistic to pleasing, stimulating and courteous (12) Interest in learning—no effort to little effort (13) Judgment—little thinking and reasoning, reasoning illogical or distinguishes essentials and draws intelligent conclusions.[36]

JHH nurse anesthetist students were also evaluated in a "Student Rating" that addressed technical ability, seriousness of purpose, industry, initiative, influence, concern for others, responsibility, and emotional stability.[37] These characteristics, personal traits, and abilities were considered essential to functioning as an anesthetist. Olive Berger's approach to quantify and closely evaluate students assured the quality and the reputation of Hopkins' graduates. Berger carefully structured her evaluation of students and believed that "a student who does not show herself fitted physically, mentally or morally should be dropped from the course no later than the end of the third month."[38] Olive Berger held high standards for the education of nurse anesthetists. She wanted to assure that her graduates would represent her well and have the knowledge to deliver scientific and artful care.

A file of a Johns Hopkins Hospital School of Anesthesia Graduate in 1948 indicated that the student had administered over 500 hours and over 450 cases in a variety of surgical services (gynecology, obstetrical, general, genitourinary, orthopedic). This record demonstrated that the student had employed both the closed and semi-closed technique, had performed venipuncture and spinal anesthetics, and had used both the blind intubation and direct visual techniques in performing endotracheal intubations. . The training received by Hopkins nurse anesthetist students was rigorous.

Graduates of Hopkins were expected to be professional. During her tenure as school director at Hopkins, Berger encouraged the staff and the students to be interested in as well as active in the state and national organizations of nurse anesthesia. Subsequently, two Johns Hopkins graduates went on to serve as presidents of the AANA.[39]

Olive Berger felt strongly that nurses trained in the military during WWII should not be grandfathered into the profession but was realistic in the value of what they had learned during their service. A redacted letter from Berger dated October 29, 1945 was addressed to a Lieutenant:

> At a recent meeting of instructors of anesthesia in Chicago it was decided the majority of nurses who had been trained in anesthesia in the Army had not received sufficient theoretical training to make them eligible to take examinations for membership in the national association . . . Most of you have had considerable experience in the administration of aesthetics and therefore your greatest need is a theoretical course combined with practical experience . . . For this reason we have found it necessary to change our planned course of purely clinical experience to one combined with theory. [40]

Respected by Hopkins nurses, Berger became an honorary member of the Johns Hopkins Nurses Alumni Association in 1944. "In recognition of her meritorious service to our school and hospital, your executive board wishes to have her personally identified with this Association . . . She has contributed articles to the Johns Hopkins Nurses Alumni Magazine; has lectured to the students; has taken an active part in all activities of our school; and has given faithful personal service over altogether 20 years."[41]

Olive Berger, Leader

Olive Berger was a member of the American Nurses Association (ANA), and an active member of the Maryland Association of Nurse Anesthetists (MANA) and the American Association of Nurse Anesthetists (AANA). Berger served the AANA as second vice president

from 1935 through 1937; trustee from 1952 through 1954; second vice president from 1954 through 1956; first vice president from 1956 through 1958; and president of the AANA from 1958 through 1960. Her Presidents report from 1958-1959 illustrates the status of the organization at that time.

> The membership is now very close to 10,000 . . . In spite of the ever-increasing membership the need for more anesthetists seems to increase. With an average of only 50 members seeking changes in position, at headquarters the number of positions known to be available exceeds 600. An increasing number of hospitals are requiring AA and a membership for employment as nurse and thus at this . . . The well-planned and well attended meeting by interested and enthusiastic members at all state and regional meetings leave no doubt that AANA is a strong, healthy and growing organization. [42]

She further documented her views and the organizational vision as "continued cooperation could result in better anesthesia service if we accept our responsibility as professional people and continue to strive for more knowledge through better education. A concerted effort by all persons in the hospital field should be directed to recruiting more persons into the field of anesthesia and to expand our training programs."[43] Perhaps Berger's parting words from the podium best reflected her vision for the nurse anesthesia profession: "if you believe that many members working together can accomplish more than individuals alone, we will find the enthusiasm necessary for group action."[44]

Olive Berger Portrait (See Appendix F)

Prior to her retirement in 1969 Johns Hopkins commissioned a portrait of Olive Berger. Since the necessary funds for the portrait needed to be raised, the administration sent out letters requesting donor's support. In a letter dated June 13, 1967 anesthesiologist Donald Benson MD wrote to Austin Lamont MD saying: "thank you very much for your contribution and your kind note regarding Ms. Berger. I appreciate very much your offer to help out if it were necessary, but I am very happy to tell you and I am sure you'd be glad to hear that the response has been just a little bit short of overwhelming. We have paid for the portrait almost 3 times already so that there is no worry on that score whatsoever."[45] Isabella Hunner Parsons painted an oil-on-canvas, half-length color portrait of Olive Berger that certainly represents Berger's lifetime contributions to the Hopkins community. It is a faithful portrayal of "Lady Olive"—the title that Berger was respectfully and affectionately called by those at Hopkins. ." The portrait currently resides in the Johns Hopkins School of Medicine art collection.

Olive Burger died of natural causes on July 13, 1981. Due to failing health, she was unable to attend the ceremony at which she was to receive the sixth Annual Agatha Hodgins Award for outstanding accomplishment in 1981. (The Hodgins Award was established to recognize individuals whose dedication to excellence has furthered the art and science of nursing anesthesia.) At the time Berger was named the recipient of the award, she received a letter of congratulations from the President who at the time was Jimmy Carter. This presidential letter became her most prized possession. The letter read: "I am especially pleased to join you in congratulating and in expressing the thanks of the American people to Ms. Olive Burger, CRNA, of Baltimore. Ms. Berger's pioneering work in anesthesia is highly worthy of your praise. I salute Ms. Berger and other nurse anesthetists who did so much to improve the healthcare system in the

nation."[46] From the time of her death until the Johns Hopkins School of Nurse Anesthesia closed in 1985, the Olive Berger Memorial Fund provided financial support to improve and enrich the education of student nurse anesthetists at Johns Hopkins Hospital. She had created a legacy. Nurse anesthesia as a profession was assured. The integration of art and science with technology would expose future generations of nurse anesthetists to techniques, surgeries, and responsibilities that Olive could only have imagined.

[1] Margaret G. Boise, "The Nurse Anesthetist," *The Johns Hopkins Nurse Alumni Magazine* 23 (May 1924): 62-65.

[2] Margaret G. Boise, "Essential Qualifications of the Anesthetist," *The American Journal of Nursing* 28 (February 1928): 125-127.

[3] Ibid.

[4] The hospital was located between 58th and 59th Streets and 9th and 10th Avenues in New York City. Qualifications for admission at the time of Berger's application were: age 23 to 35, single, sound health, the equivalent of a grammar school education, adaptability to new conditions, a readiness to make personal sacrifices, and an equable temperament.

[5] Virginia Thatcher, *History of Anesthesia, with Emphasis on the Nurse Specialist,* (Philadelphia: J. B. Lippincott, 1953): 103-105.

[6] Margaret G. Boise, "The Practice of Anesthesia," *The American Journal of Nursing* 28(1928): 227-230.

[7] Olive Berger, interview by Michael Sarr and Donald St. Germain, Item 200437, 1975-09-07(date created), Victor Almon McKusick Collection, History of the Johns Hopkins Medical Institutions Oral Histories, Alan Mason Chesney Medical Archives (hereafter AMCMA).

[8] Thomas S. Cullen reference letter, May 25, 1928, Olive Berger Collection (hereafter OBC), AMCMA.

[9] In 1942 Olive Berger contributed a study that evaluated 51,392 anesthetics at Hopkins (July 1, 1931 to July 1,1941) which analyzed deaths during general and spinal anesthesia. The study concluded that 20 deaths were related to anesthesia – 9 unavoidable and 11 avoidable. John Lynford, Olive Berger and Harris Shumacker, "An Analysis of Deaths in the Operating Room of

the Johns Hopkins Hospital with Special Reference to those occurring Under General anesthesia and Spinal Anesthesia," *Bulletin of The Johns Hopkins Hospital* 70(1942): 488-503.

[10] Notebook labeled "Tetralogies," OBC, AMCMA. Berger also maintained a notebook titled "Valvulotomies" and "P.O. Pneumonia."

[11] Ibid.

[12] Ibid.

[13] Olive Berger, "Anesthesia for the Surgical Treatment of Cyanotic Congenital Heart Disease," *Journal of the American Association of Nurse Anesthetists* (May 1948): 79-90.

[14] Ibid.

[15] Ibid.

[16] Ibid.

[17] Ibid.

[18] Ibid.

[19] Olive Berger, interview by Michael Sarr and Donald St. Germain, Item 200437, 1975-09-07(date created), Victor Almon McKusick Collection, History of the Johns Hopkins Medical Institutions Oral Histories, AMCMA.

[20] Ibid.

[21] Ibid.

[22] Ibid.

[23] Ibid.

[24] Ibid.

[25] Ibid.

[26] Ibid.

[27] Florence Nightingale's, *Notes on Nursing; What it is and What it is not,* published in 1959 can be found in the Olive Berger Collection AMCMA

[28] AANA sponsored refresher courses for their members between 1947 in 1951 to help them meet these educational requirements.

[29] Olive Berger to Helen Lamb, 11 July 1935, Olive Berger President Folder, AANA Archives, Park Ridge, IL.

[30] Education Committee Report Bulletin of the National Association of Nurse Anesthetists 3, no 1, January 1936, AANA Archives, Park Ridge, IL.

[31] Education Committee Report Bulletin of the National Association of Nurse Anesthetists 4, no 4, November 1936, AANA Archives, Park Ridge, IL.

[32] These recommendations would take time, money and support for implementation. In 1939 AANA called for accreditation of nurse anesthesia programs by inspection and a national certification exam. In 1945 the first certification exam was administered. Accreditation of nurse anesthesia programs would be implemented in 1952.

[33] The last students of the Johns Hopkins School of Nurse Anesthesia graduated in 1985.

[34] The Johns Hopkins Hospital 50th Anniversary (1889-1939): A Brief Account of Its Founding and of Its Achievements during the First 50 Years of Existence, Dinner Program May 4, 1939, Baltimore, MD. Olive Berger attended, sitting at table 75. AMCMA

[35] Suggested Course in Anesthesia for Graduate Nurses, Johns Hopkins Hospital, Baltimore, MD. Attached to a letter to Helen Lamb, 11 July 1935, AANA Archives, Park Ridge, IL.

[36] Efficiency report of 1948 graduate (redacted), Student files AMCMA.

[37] Student rating of a 1948 graduate (redacted), Student files AMCMA.

[38] Suggested Course in Anesthesia for Graduate Nurses, Johns Hopkins Hospital, Baltimore, MD. Attached to a letter to Helen Lamb, 11 July 1935, AANA Archives, Park Ridge, IL.

[39] Carol Abby and Delores Biggins were Olive Berger's students.

[40] Olive Berger to a Lieutenant, 29 October 1945, Student files AMCMA (redacted).

[41] "Olive Berger: Presented for Honorary Membership by Miriam Ames," *Johns Hopkins Nurses Alumni Magazine*, 43(April) 1944: 66-67.

[42] Olive Berger, 1958-1959 President's Report, AANA Archives, Park Ridge, IL.

[43] Ibid.

[44] Ibid.

[45] Donald Benson to Austin Lamont, 13 June 1967, Anesthesiology Dept. Folder, AMCMA.

[46] "Olive L. Berger Named Recipient of the 6th Annual Agatha Hodgins Award for Outstanding Accomplishment," AANA News Bulletin, October/November 1980: 5.

Chapter 4

A Contested Space of Practice: "The Other Side of the Drape"

While Olive Berger and other nurse anesthetists were combining the art and science of anesthesia in their practice, the number of physician anesthesiologists was increasing as was the number of legal challenges they made to the nurse anesthetist role. At the same time that Olive Berger was providing care for televised and photographed blue baby operations, physician anesthetists waged a public war in print. In "Nurses or Physicians – Who Should Give Anesthetics?" published in *Hospitals* in 1947, the question of provider type was examined. "Three groups of professional personnel provide surgical anesthesia. These groups are the specially trained physician anesthesiologists, the other physicians and the nurse anesthetists . . . No one can with assurance tell to what extent patients now are able to differentiate between these three groups."[1] Emotionalism, devoid of objectivity, quickly became the norm for making an argument for either anesthetist professions: physician anesthetists v. nurse anesthetists. Battle lines were drawn. The "other side of the drape," the sheet that hung between the surgical field and the patient's head where anesthetists administered the anesthetics, was now a contested space of practice. But this battle was nothing new; the battle over the rights to practice in the field of anesthesia had been on going for some time.

Beginning in the early 1900s, several physicians who were trying to initiate a medical specialty for the administration of anesthesia challenged the legality of nurse anesthesia practice. According to historian Virginia Thatcher, "The rapid growth of postgraduate schools of anesthesia in which nurses were trained, as well as, the increasing enthusiasm for the trained

nurse anesthetist during and after World War I, did not escape the attention of physician specialists in anesthesia, and during the 1920s resentment against the nurse anesthetists culminated in attempts to legislate her out of existence."[2] The physicians' legal challenges became most prominent in the Ohio, Kentucky, and California courts. None ruled in favor of the physicians. In fact all the cases resulted in first a court decision and later a legislative ruling that affirmed the right of nurses, practicing under physicians direction, to perform anesthesia.

The decisions of these cases rested on the nurses' past performance. In fact, nurse anesthetists' extraordinary record of service in World War I proved to be a pivotal point of evidence. In 1915, on returning to the United States after providing care to wounded soldiers during World War I, Agatha Hodgins, RN and George Crile, MD of Lakeside Hospital (now Case Western Reserve) faced the first major challenge concerning nurses' rights to administer anesthesia. The Ohio State Medical Board sent a letter to Crile on August 9, 1916 to inform him of the board's decision: that no one other than a registered physician was permitted to administer anesthesia. The letter also mentioned that the state attorney general concurred with that conclusion. The board also issued a "cease and desist" order to Crile, stating that if he continued to use nurses in the administration of anesthesia, Lakeside Hospital School of Nursing would lose its accreditation.

It took two years for Crile to persuade the medical board to lift the order. Crile and Hodgins began educating nurses in anesthesia once again in 1917. As soon as Crile and some of his supporters suspected that the same challenge could be directed at others; they went to the Ohio legislature to acquire an exemption within the medical practice act for nurses appropriately educated in anesthesia to administer anesthesia under the supervision of a physician. This

exemption was achieved in 1919 and became the first mention of nurse anesthetists in any state statute.[3]

Another serious challenge to the profession arose in 1917, when the Kentucky Medical Society stated that only a physician should administer anesthesia. With the concurrence of the state attorney general, the society issued an ethical policy that sanctioned by expulsion any member of the medical society who used a nurse anesthetist or practiced in hospitals that employed nurse anesthetists. Lewis Frank, MD, a Louisville surgeon, and his nurse anesthetist, Margaret Hatfield, along with the Kentucky State Department of Health, filed suit against the society. Frank and Hatfield won at the appellate level, with the Justice ruling that Hatfield was not practicing medicine under the circumstances in which she was administering anesthesia.[4] Even after winning these legal challenges to their practice, nurse anesthetists were acutely aware of potential future threats to their profession.

The demand for nurse anesthetists increased rapidly after World War I. As a result, new nurse anesthesia educational programs expanded from schools of nursing into university hospitals and major community hospitals across the country. Johns Hopkins, University of Michigan, Charity Hospital, Barnes Hospital, Presbyterian Hospital in Chicago; and of course, Lakeside Hospital and the Mayo Clinic were some of the first hospitals to provide this training.

By the late 1920s, nurse anesthetists realized that they needed to organize. Pioneer nurse anesthetists believed that such an organization would ensure quality anesthesia care to patients, and ensure better anesthesia education while strengthening the nurse anesthetist's ability to defend her professional scope of practice. Indeed, surgeons and friendly hospital administrators urged and supported nurse anesthetists to "safeguard their work."[5] At the 1930 convention of the

American Nurses Association (ANA) renowned nurse anesthetist Agatha Hodgins presented a paper calling for the organization of nurse anesthetists into a "coherent and acting body."[6] Hodgins' thesis was that only by acting together could nurse anesthetists improve the education necessary for the profession, the entry into the practice, and the quality of anesthesia patient care. Hodgins attempted to negotiate with the ANA for a separate section within the association. But the ANA refused. This refusal of the ANA for a separate section for nurse anesthetists within its organization was so significant that it led directly to the formation of the National Association of Nurse Anesthetists. The decision set the stage for a schism within nursing, causing nurse anesthetists to leave mainstream nursing.[7]

The following year (1931) the formation of the National Association of Nurse Anesthetists (NANA), became a reality.[8] A group of forty nurses and hospital administrators, representing 12 states, met in an anesthesia department classroom at Lakeside Hospital in Cleveland. Olive Berger RN was among those present. There they signed the charter, elected officers, and began to formulate an agenda, and write their bylaws.[9]

The young NANA had on its original agenda three main goals: (1) to establish educational standards for nurse anesthesia education programs, (2) to create an accreditation mechanism for the programs, and (3) to provide the registration, licensure or certification of nurse anesthetists. NANA recognized that their goals were ambitious and would take time. Indeed, it was not until 1934 that nurse anesthetists agreed on the curriculum for nurse anesthesia educational programs. An alliance between the NANA and the American Hospital Association (AHA) occurred early on and proved to be very helpful. The AHA assisted the newly formed nurse anesthetist group to get started. They also provided assistance and support in how and

where NANA held its meetings. In addition, AHA recognized that it was to their advantage to support either an accreditation or certification program for nurse anesthetists.[10]

While the NANA was getting established, the last significant court cases on the subject of whether or not nurse anesthetists were "practicing medicine" occurred. In 1933 nurse anesthetist Dagmar Nelson RN was charged with practicing medicine without a license by several California physician anesthetists. Appeals on the case went all the way to the California Supreme Court, as Nelson received favorable rulings at each level. Supreme Court Judge Allen B. Campbell concluded:

> The administration of general anesthetics by the defendant Dagmar A. Nelson, pursuant to the directions and supervision of duly licensed physicians and surgeons, as shown by the evidence in this case, does not constitute the practice of medicine or surgery, within the meaning of the laws of the state of California . . . and constitutes the practice of nursing within the meaning of the laws of the State of California. [11]

Nurse anesthetists across the country notified the NANA of proposed legislation affecting practice in their respective states and contacted governmental officials at every level to protect and maintain the nurse anesthetist's right to administer anesthesia. Carl Scheffel, in *Jurisprudence for Nurses* published in 1938, reviewed many legal challenges and state bills/laws of the past "year or so," and outlined the current law in connection with the administration of general anesthesia. He made the following summation:

> In view of the admittedly unsettled legal status of the nurse anesthetist in many states, and in order to avoid expensive and long drawn out litigation concerning this matter, it is

> urgently suggested that there be enacted in every state, laws which specifically give qualified nurse anesthetists the legal right to administer general anesthesia under such conditions and circumstances as they desire.[12]

Clearly, the states had to take action to protect nurse anesthesia practice.

Local Battles Reflect National Contention

In the early 1930s the specialty of anesthesiology was in its infancy. Little had been done to firmly establish the foundations for the field. Inter-professional conflicts increased with the rise of anesthesia as a medical specialty. Standards for the education of anesthesiology were weak for both nurse and physician anesthetists. Training programs, research, professional organizations, and a certification process had only recently been implemented for both. By the mid 1930s—partly as a consequence of the application of innovative techniques (intra-tracheal intubation, carbon dioxide absorption filters, Foregger circle system), anesthetic agents, and the progress in the science of anesthesia (eg: the Guedel levels of anesthesia)—the "lines were drawn between the proponents of nurse anesthesia on one hand and of physician anesthesia on the other."[13]

During these contentious national debates about the scope of practice, nurse anesthetist Olive Berger returned to Johns Hopkins Hospital in 1931 to assume the chief nurse anesthetist position and direct the anesthesia school for nurses. Despite the ongoing controversy in their field, Berger and her staff of six to eight nurse anesthetists continued to provide the anesthesia service for the Johns Hopkins surgeons. This arrangement, however, was about to be challenged by the arrival of the first medically trained anesthesiologist, Austin Lamont MD, in 1943. Prior

to Lamont accepting the position, he visited Hopkins for three days and communicated to Alfred Blalock MD his observations in a letter dated May 28, 1942:

> I repeat that I do not necessarily condemn these differences for I have had little experience in giving anesthesia as it is done at the Hopkins. Nor am I in any way criticizing Miss Berger and her staff. I believe and I doubt if later experience in other hospitals will modify my belief that Miss Berger and her staff are doing a far better job then you have any right to expect when you consider the difficulties under which they work. Every day they have to take patients right up to death's door and bring them back safely. Very frequently it is the anesthetists and not the surgeon on whom the patient's life depends during operation. And yet these girls are given less training in anatomy, in physiology, in pharmacology, etc., than medical students. The nurse anesthetist seldom or never consulted in regards preoperative medication, and so it frequently happens that she is expected to get ether vapor into a patient whose respiration is so depressed by morphine that even the best anesthetist in the world would have difficulty. The Hopkins anesthetists have no opportunity, save what they can contrive in the hospital, to learn new techniques; they can't go away and see how things are done in other places, they have little or no opportunity to study their patients before and after anesthesia. The wonder of it is that in spite of all this, they have been able to render such efficient service.[14]

Clearly Hopkins nurse anesthetists had clinical experience and skill with the anesthetic agents of the 1920s and 30s, but anesthesia was changing quickly and even they recognized they needed additional education. Olive Berger herself alluded to her staff's lack of knowledge: "they

didn't give us a course . . . it was 'training on the job' . . . But I knew it was wrong—the nurses didn't really have adequate training."[15] Berger went on to explain, "there was a time that I was the only one in Baltimore who knew how to intubate."[16]

Having trained at the first academic program for physician anesthesia at the University of Wisconsin under Ralph Waters, Lamont came to Hopkins with a distinct plan to development a Division of Anesthesiology at Hopkins that eventually would include *only* physician anesthetists. The outbreak of World War II and the subsequent demand for anesthetists at the front, however, left the entire United States with far fewer trained anesthetists than ever before. Hopkins nurse anesthetist Beverly Colt recorded this national and local shortage in an article "Anesthesia Needs Help" in the *Johns Hopkins Nurses Alumnae Magazine* in October 1943. In it she describes "the long hard hours of going from one case to another without a moments relaxation; the demanding call hours; and the long study hours to keep abreast of the rapid changes in methods of administration and types of anesthetic." She ended with the question: "How long can this continue?"[17]

The Army Medical Corps reflected this shortage, and the civilian sector could not provide sufficient numbers of trained anesthetists to support wartime medical care. Although increased demand was a cause for this shortage, a major contributing factor was that the majority of anesthesia providers were nurse anesthetists. Nurse anesthetists were female, and in military terms, women had limited value.[18]

Nonetheless, throughout the country nurse anesthetists provided most of the anesthesia. Roger DeBusk MD, a prominent hospital administrator at Stanford, California, was able to

quantify the situation in 1944 at the annual convention of the American Association of Nurse Anesthetists:

> The most recent figures from the American Medical Association reveal that there are 929 registered licensed physicians who have reported themselves as giving special attention to anesthesia and of these only 347 list their practice as being limited to the specialty of anesthesia . . . only 231 are diplomats of the American Board of Anesthesiology . . . latest survey there are 4,051 nurses in anesthesia of which 3,609 devote their full time to this activity . . . total number of anesthetists of all groups we find that there are 5,780.[19]

At the time of Debusk's address, there were "approximately 7,000 hospitals in the country where it is assumed anesthesia will be used." Additionally, Debusk qualified the duality of physician and nurse anesthetists as "unparalleled in the history of medicine." But most importantly he presented the reality of the mid 1940s: "these men are the ones who are going to do the major portion of clinical, pharmacological, physiological, and biochemical research and the fact that they do give anesthesia in many instances is not of too great importance." Debusk concluded that nurse anesthetists should not be threatened "it will be a long time before the saturation point for medical anesthetists will be reached . . . [due to] economics."[20]

Berger was in her early 40s when the United States entered World War II and was considered essential staff at Hopkins. Her contribution would be to provide expert anesthetics, train anesthetists, and maintain the anesthesia department.

At Hopkins, the situation was much the same as throughout the nation—there were too few physician anesthetists. Thus Berger and her nurse anesthetists continued with their work. In 1944 after a year as a surgical intern, Merel Harmel, MD, joined Lamont as a resident in anesthesiology. But Lamont, tired and frustrated by the anesthetist shortage and resistance at Hopkins to create an all physician anesthesia department, apologized to Blalock for being irritable and not "say[ing] what I wanted to say in the way I had intended," when reprimanded by Blalock for his attitude about nurse anesthetists. Lamont described the Hopkins ongoing anesthesia shortage in a letter dated July 16, 1945 and his attempts to recruit nurse anesthetists despite his professional opposition.[21]

> Early last winter Miss Berger finally convinced me that I should be really worried about the outlook. For over two years our anesthetists have been working under considerable pressure. It had become increasingly difficult to keep on our staff younger nurse anesthetists. The four or five older ones were not capable of working the hours required of them. There was an increase in bickering and grousing in general. The quality of the work was deteriorating. We redoubled our efforts to attract nurse anesthetists to our staff. We increased our starting salaries to almost double what they had been four or five years ago. I instituted staff meetings with the nurses and held seminars for them in preparation for their nurse association examinations, something which I have sworn I would never do.[22]

Despite this apparent change of heart – or at least his acquiescence to reality, Lamont submitted his plan to Blalock and the Hopkins Board for a Department of Anesthesia at Hopkins.

Lamont's philosophy was certainly that of his mentor, Ralph Waters, who in April 1946 in the *Journal of the American Medical Association* outlined where anesthesiology "fit" in the hospital and in medical schools. Waters addressed both the art and the science of anesthesia, stating: "all drugs and the methods by which they are administered are subject to abuse. Through fundamental knowledge and diagnostic skill the abuses are avoided or neutralized, quite as much as by artificial technical manipulations . . . It's not the tools but the way the tools are used." But Waters countered his own argument and continued, "perhaps it is not strange that in many communities it has become accustomed in our country to hold nurses responsible as technicians in anesthesia . . . If we employed nurses or other nonmedical persons as technicians only, as assistants in the care and preparation of equipment, in supervising depressed patients, and in various other ways where diagnostic and therapeutic decisions are not involved, their service can be valuable. If we attempt to teach nurses the science and art of anesthesia, that is also wrong because it exploits the medical students who wish to learn anesthesiology while in school and may wish to practice in it after graduation . . . The ultimate result might become a technical nonscientific service in anesthesia with no one in the medical profession competent to criticize it."[23]

Lamont's proposal for a medical anesthesiology department at Johns Hopkins included details regarding departmental organization, budget, policy, and procedures. The proposal also directly addressed the contested space of practice:

> An important question is: why have only doctors when nurses can apparently give satisfactory anesthesia and the majority of credit cases? In brief it can be said that: (a) the fact that nurses can give good anesthesia in many cases is no real reason why they could be encouraged to do so in a university hospital anymore than we should encourage the

> retention of midwives. Indeed, it could be well argued that the retention of midwives is the more reasonable, for the ordeal of childbirth is a very natural biological process while the ordeal of anesthesia and operation is highly unnatural (b) the advocacy of nurse anesthesia implies a belief that the anesthetist's relation with the patient should begin and end in the operating room, an anesthetic nurses in general act accordingly. But if anesthesia is to be of the best quality it is just as important for the anesthetists as it is for the surgeon to see the patient before operation and to follow the patient after operation. In addition, no one, so far as we know, has suggested that the anesthetic nurse is competent to perform the many other services to patients which physician anesthetists now perform (c) even if one could persuade anesthetic nurses to make pre-and post operative visits, their training in the basic sciences and in clinical diagnosis is insufficient to permit proper evaluation of the patient's reactions. This lack of training can prove dangerous when anesthetic emergencies arise, for although the majority of cases proceed smoothly, one can never tell when an apparently ordinary anesthesia may suddenly, in a matter of seconds, turn into a desperate struggle to revive a patient in extremis (d) equally important is the fact that few good young doctors will be attached to an anesthesia department in which the doctors do the same sort of work as nurses.[24]

Lamont continued his argument, noting: "It is difficult to escape the conclusion that the science of anesthesia will not develop here as it should if we deliberately planned to retain nurses to administer anesthesia. It is unfortunate, to say the least, that a branch of the medical art such as anesthesia should have been handed over to nurses as completely as it has in this country. But

there would seem to be little profit in perpetuating an error which has in this community been maintained to a much greater extent than in other comparable medical center in the nation."[25]

It is interesting to note the similarity of language and intent included in Lamont's plan to the language used in a 1945 publication by the American Association of Anesthesiologist (ASA).[26] The ASA publication defined the art and science of anesthesia from a physician point of view, noting "the art of anesthesia has gradually developed from simply the clever and skillful administration of drugs into a combination of art and science; art in the necessary personal contact with fellow medical practitioners, in sympathetic understanding of their problems, in the approach to patients and in the technic of the administration of drugs; science in the prevention of harm to the physiological welfare of patients." It went on to describe what was common across the United States and certainly was at Hopkins: "The impression is all too common that a single individual, however able, should be expected to carry the responsibility. The training and employment of technicians by a competent director of anesthesia may serve as a temporary substitute for an adequate number of physicians, but it must be looked upon as a temporary expedient only to serve until such time as physicians are prepared to undertake these duties . . . And undesirable department of anesthesia in a modern hospital is one whose personnel is entirely technician in character, working without contact with the physician who trained them, unsupervised and paid for the work by the hospital management."[27]

No doubt Lamont agreed with the arguments. But at the same time he depended on Olive Berger and her opinions. Writing in a letter to Blalock, he described his stance: "In July, 1945 the chief anesthetic nurse, a woman of long experience and of great devotion to the hospital, at my request drew up recommendations regarding size of staff required for efficient service assuming (a) no increase in number of operating rooms (b) no increasing calls for anesthetics

outside the operating room (c) no increase in physician anesthetists over the two then employed. She recommended a minimum of 14 anesthetic nurses plus two assistants not trained in anesthesia."[28] Lamont concluded: "It is not proposed, however, to discharge any of the nurses who have given long service to the hospital simply in order to make room for resident staff.[29]

Perhaps the most significant role for nurse anesthetists was their increasing importance in the hospital's economy. By the 1940s, surgery was a catalyst for hospital recognition and income. Nurse anesthetists provided needed services at relatively inexpensive wages. Due to anesthesia staffing shortages hospitals, like Hopkins, were eager to implement nurse anesthesia training programs. Nurse anesthesia students provided an inexpensive and stable workforce. This stability was largely based on long-time service of particular individuals - like Olive Berger. Hospital administrators viewed additional expenses for specialty departments as nonessential and addition physician charges to patients as unwarranted.

Frank Bradley MD, who may have softened his stance in his address to the 1946 Annual Convention of the American Association of Nurse Anesthetists, accurately described the situation: "the challenge to the nurse anesthetist is the overall challenge in the normal life history of a profession: birth, growth, production, reproduction, maturity and death (at least for individuals and technics)."[30] Bradley continued " . . . as long as the nurse anesthetist is trained well and produces anesthesia in quantity and quality at a cost that is not prohibitive to the public, it is my sincere conviction that the medical profession and hospitals will use the nurse anesthetist."[31] Bradley was correct about "normal life history"; the nurse anesthetists at Johns Hopkins heeded this advice. Indeed, in the United States, medicine, hospitals, and anesthesia had changed during the years and the physician challenge threatened the entire nurse anesthesia profession.

Meanwhile, physician-anesthetists like Lamont were distressed and determined to establish anesthesia as a medical specialty. They were denied to contribute to the medical community, considered an added expense by hospital administrators, viewed as competition and superfluous by surgeons, and classified in direct functional and economic competition with nurse anesthetists. Lamont resubmitted an "updated" proposal for a Division of Anesthesia in late March 1947. "Such a concept of anesthesia may not be readily understood in an institution where there has been none but nurse technicians in anesthesia for the past 25 or 30 years, and little or no effort to illuminate the mystery of anesthesia. In the nations of the British Commonwealth nurses are not permitted to administer anesthetics and yet there is no greater shortage of anesthetists in these countries than of other specialists. In this country those University hospitals which have none but doctors giving anesthesia have no difficulty in normal times in filling the anesthesia house staff. So far as I have been able to ascertain that cannot be said of most of the hospitals which have both doctors and nurses giving anesthesia."[32]

In a letter dated April 4, 1947, Blalock acknowledges not only receipt of the proposal but states that he has studied them very carefully and that he had "discussed them with several individuals who are interested in the problem. I regret to state that I do not favor some of the ideas which you propose and hence could not subscribe to an agreement on the basis of this document." Blalock was pragmatic: In 1945 approximately 9,500 patients had operations at Hopkins, by 1947 that number had increased to 14,000.

Both Blalock and the hospital board at Hopkins continued to support nurse administered anesthesia. Austin Lamont resigned in June 1946. His resignation letter dated March 19, 1946 reflects his disagreement with Blalock and the hospital board: "But this difference of opinion is so fundamental to me and I have made so little headway in winning support for my views that

there is no reason for further discussion or for bringing up any of the other points which have not been satisfactorily answered. I am convinced that the interests of the Johns Hopkins and of the various individuals involved will best be served by your accepting my resignation . . .”[33] Clearly the two administrators were in a heated competition, but Blalock was winning. Merel Harmel, siding with Lamont, left Johns Hopkins in August 1946.

Understanding Blalock

To understand Blalock's difficulty with physician anesthetists it must be noted that his introduction to and training in surgery came at a time when there were few physician anesthetists. He also had experienced little difficulty working with nurse anesthetists. Nurse anesthetists were his preference and he was not about to change. Moreover, the 1930s Chalmer v Nelson case had legally established the doctrine of surgeons as “captain of the ship.”[34] The “captain of the ship” doctrine simply assumed that the surgeon controlled (and was liable for) everything that went on in the operating room (including anesthetists). The case did not show any evidence to contradict the surgeon's ability to control what happened in the operating room.[35] Blalock fully believed that anesthesia was a subdivision of surgery. In fact until the mid-1950s at Hopkins “the surgeons run the recovery room, have chief say about fluid replacement, post their own choice of anesthesia, failed to request anesthesia consult on special problems, etc. Lamont later reflected:

> Blalock no longer saw any need to change what had become his established routine. He preferred that anesthesia for his patients be delivered by technically proficient nurse anesthetists under direct supervision of surgeons who themselves have been given only a general overview of anesthetic principles during their training.[36]

> The fact that Miss Berger has been especially requested as anesthetist in many patients, in whom Blalock is especially interested, has been carefully noted by many.[37]

Transition of anesthesiology to a medical specialty created stress as the former surgeon-hired anesthetists became anesthesiology colleagues who were not necessarily the surgeon's choice.

The Subterfuge of Nurse Anesthetists

Although the fighting of World War II had ended, a new fight was just beginning for nurse anesthetists. They had served as primary anesthesia providers both at home and abroad during the war. Nurse anesthetists returned from overseas to an empowering "we can do it" woman's culture. Physician anesthetists returned from active duty to a slightly enlightened surgical culture but were recognized functionally as providing the same service as the nurse anesthetist. All this occurred at a time when medical personnel were motivated to establish a hierarchy of medicine in order to gain distinction (specialization).[38] Consequently, to secure a place, both economically and physically, physician-anesthetists needed to continue with their pre-war assault on nurse-administered anesthesia on both the public and legislative fronts. Their strategy was clear: portray nurse anesthetists as unqualified, poorly trained, and most importantly unsafe. [39]

Articles critical of nurse anesthetists appeared in lay publications such as *This Week*, *Cosmopolitan*, *Good Housekeeping*, *Look*, and *Readers' Scope*.[40] In these articles, physicians were adamant and vocal in their opposition to nurse anesthetists. The articles became commonplace and attempted to destroy public confidence by contending that only a physician was capable of administering an anesthetic.

In 1947 *This Week* published "Unknown Men in White" which began, "Suppose you're on your way to the operating room. Within a few minutes your life will be in the hands of two people. One is your surgeon. The chances are he knows his business. The other is your anesthetist. Unlucky for you, most anesthetists today are not qualified for their job . . . " The article went on to explain, "The anesthetist is, if average, a young woman with three years nurse's training, a couple months in surgical nursing, and a course of about nine months in anesthesia. But the gap between what they [uncertified/unlicensed anesthetists] know and what they ought to know represents the difference between comfort and misery, and sometimes life and death for their patients."[41]

In August of 1947 *Cosmopolitan* took a slightly more subtle approach to the doctor versus nurse controversy. The title of the article, "When They Put You Out," explained the stages of anesthesia and the public perceptions/fears of ill-administered anesthesia including awareness during surgery. The anesthetist that prevents such adverse events was always referred to as "the doctor" or "he."[42]

In July 1946, *Good Housekeeping* presented a wonderful photo of an attentive physician-anesthetist administering anesthesia to a child. After describing the complicated and exacting science of anesthesia the article went on to reveal its true purpose: "a competent anesthetist must have long training and profound medical judgment. The nurses who give most anesthetics today have neither."[43]

Look's article, "Safer Surgery for 1947," contained ten photographs of the physician-anesthetist and depicted both general and regional anesthetic techniques. The article concluded: "The close teamwork between physician-anesthetist and surgeon shown above is one of the

reasons surgery is safer today . . . The physician anesthetist not only knows how to handle anesthesia, but he also understands the surgical risks involved. And he knows how to take prompt action that will prevent trouble during any type of operation."[44]

Reader's Scope advice from the article, "Will You Live Through Your Operation?" was yet another example of physician-only anesthesia. After citing statistics of unnecessary operating room deaths, the article stated:

> What made the difference? . . . only physician anesthetists are permitted to administer anesthesia . . . A physician anesthesiologist is a graduate Doctor of Medicine, who is also an expertly trained anesthesiologist. He knows the make-up of all anesthetic agents and he knows what they do to you. He knows the symptoms of the complications they bring on. He is trained to avoid complications. But if they do occur, he knows what to do before they become serious. He knows everything about resuscitation, oxygen therapy, and treatment of shock.[45]

The Counter Attack

The anti-nurse, pro-physician anesthesia campaign prompted a variety of reactions among AANA members. President Lucy Richards acknowledged that some wanted to "retaliate with an intensive publicity campaign" while others urged "inaction."[46] Those in favor of nurse anesthesia faced and responded to the physician-anesthetist propaganda, not by countering with a pro-nurse anesthesia articles in the same or similar publications, but by creating an explicit multi-faceted approach. Their first strategy was to continue recruitment. Their second strategy was to strengthen relationships with surgeons and hospital administrators. Their third was to

highlight the stories of individual nurse anesthetists in the local newspapers. One of the nurse anesthetists recognized by the media was Olive Berger.

Berger continued to recruit, train, and provide anesthetics at Johns Hopkins while serving as a loyal Hopkins employee and anchoring the anesthesia services department. She indeed was featured in popular magazines of the time. Olive Berger is identified and named in the *Baltimore Sun* as the individual providing anesthesia; however, she was not named but she was featured in a *Life* article in March 1949.[47]

In addition to these above strategies, nurse anesthetist leadership called for all nurses to have renewed patient vigilance both inside and outside the operating room. They knew that the reputation of nurse anesthetists had been built on grassroots patient safety. By keeping that foundation in focus they were certain their profession could endure the physicians' confrontation. The nurse anesthetists challenged the assault by being pro-active in finalizing and implementing program accreditation and provider certification. By assuring competency and knowledge standards for all nurse anesthetists, the AANA pleased not only hospital administrators but also the entire medical community. Gertrude Fife, a leader in the AANA, addressed the need for action in a 1947 editorial in *The Journal of the American Association of Nurse Anesthetists:* "We do not wish to behave like an ostrich, nor do we wish to engage in a fruitless rebuttal . . . the positive answer to the challenge is to continue to improve standards of the nurse anesthetist and to give the medical profession the same loyal service that has been given in the past, in order that the nurse anesthetist may receive the recognition that she deserves."[48] Like many of her peers, Olive Berger was a proponent of the progressive work done within the AANA to raise standards of education and certification, and to closely partner with loyal surgeons and hospital administrators.[49]

The National Scene

In the 1940s legislative bills and bureaucratic barriers to nurse anesthesia practice were present in almost every state in an attempt to restrict, dissolve, or prohibit nurse anesthetists from their practice.[50] Many nurse anesthetists contacted the AANA to keep the national organization informed of local news and activities. They sent telegrams and letters from across the United States reporting: "Rumors of legislative bill concerning anesthesia. Not presented yet. Am watching closely."[51] The AANA replied to every inquiry they received with a written response giving suggestions for action. Frequent communications relayed the most current information.

> Thank you so much for your letter of June 2nd. I am glad that Assemblyman Olliffe has accepted your invitation to explain the Desmond-Olliffe Bill to your group . . . Will you please be kind enough to send me a report of this part of your program so that it can be submitted to the Board of Trustees of the AANA?[52]

AANA members also attended conferences with keen ears and notified AANA leadership of potential legislative threats. One member reported: "Judging from a speech made by a prominent surgeon . . . he said, 'We must organize and pass a law which will prevent anyone except an MD to give anesthetics.' . . . I am making every effort to organize the Missouri Association [of Nurse Anesthetists] into a close knit and active organization and have some plans to combat the propaganda . . ."[53]

Despite the physicians' campaign through the media, the anti-nurse anesthetist articles were unable to discredit the capabilities of nurse anesthetists - particularly in the eyes of surgeons, hospital administrators, and even the public. Since the mid 19th century, nurse

anesthetists had given excellent care and documented their successes.[54] On December 1, 1947 Henry K. Beecher, MD of the Massachusetts General Hospital sent a letter to Blalock at Hopkins pointing out the seriousness of this deluge of articles aimed at eliminating the nurse anesthetist. According to Beecher: "possibly this series is a move on the part of the Anesthesia society in its efforts to eliminate the nurse anesthetist. These articles certainly work in that direction with the lay public. It is my profound conviction that unless you men at the top take some vigorous action against the campaign to eliminate the nurse anesthetist you will be shirking your duties to the entire country."[55] Shortly after sending that letter, Beecher also published an editorial in *Surgery, Gynecology and Obstetrics* in which he firmly spoke out about the problem.

The effect Beecher was hoping for from Blalock happened. Blalock apparently decided to use his influence as secretary with the Southern Surgical Association. On December 11, 1947 the Council of the Southern Surgical Association unanimously passed the following resolution:

> Although the Southern Surgical Association has been and always will be extremely interested in the advancement of all medical sciences, and particularly in anesthesia because of complete dependence on safe anesthesia for the safe performance of a surgical procedure . . . the Southern Surgical Association heartily disapproves of the publicity given by certain newspapers and popular lay magazines to the statements sponsored by a group of anesthesiologists who are seeking to discredit the well trained nurse anesthetist and to compel surgeons to operate only if anesthetics are administered by physician anesthetists.
>
> This attempt to persuade the public that there is grave danger in a surgical operation if the anesthetist is not a certified medical specialist is already

> decreasing the number of efficient well trained nurse anesthetists and forcing surgeons to perform recently developed complicated operations with anesthetics administered by young hospital interns or general practitioners, neither of whom have special training or experience in the administration of an anesthetic.[56]

Blalock submitted this resolution in a letter to the editor section of the *Journal of the American Medical Association*. The resolution appeared in the January 24, 1948 issue. In addition, the American Medical Association also denounced the publication of articles against nurse anesthetists: "The attention of the Board was called to articles being published in the lay press regarding nurse anesthetists, and it was voted to condemn publicity that is not based on scientific understanding and that does not accurately reflect the prevailing situation."[57]

In response to his letter to the editor, Blalock received a letter from the director of St. Luke's Hospital in New York expressing his support for Blalock's stance: ". . . the excellent work of nurses in this field deserves praise rather than disparagement."[58] Blalock received letters of thanks from nurse anesthetists to whom he responded: " I feel very strongly that the nurse anesthetist should be encouraged rather than discouraged. You all have done a superb job and I think that surgeons would be greatly handicapped without you."[59] Shortly after this, the then AANA president Lucy Richards wrote to the membership, "our tormentors have been chastised by their peers and we have maintained our professional integrity."[60]

Blalock's support of nurse anesthetists was not without opposition. Blalock promptly received a letter from W. Allen Conroy, MD of St. Luke's Hospital in Chicago, Illinois. The letter read as follows:

> Your letter to the editor of *JAMA* of 24 January 1948 has come to my notice. The resolution you quote contains one glaring error statement 'sponsored by a group of anesthesiologists.' I can assure you that no group of anesthesiologists sponsored or even attempted to sponsor the articles concerned. The very fact that individual writers spontaneously hit upon the same theme, is all the more gratifying to men in our specialty who have been laboring individually to improve and neglected phase of therapeutics. Where surgical colleagues have developed the same foreword looking attitude, there has been no difficulty in applying new knowledge, because they have encouraged qualified man to take on this work . . .We recognize that anesthesia nurses will play a large role for years to come but we cannot in good conscious do less work towards the same ideal that surgeons and obstetricians had when they first began to oppose for surgeons and midwives. Medicine cannot be advanced by nurses.[61]

However, in other cases both surgeons and hospitals expressed their support for nurse anesthetists. At a meeting on February 22, 1948, the Board of Regents of the American Colleges of Surgeons adopted a resolution commending the services of nurses who had had special training in the administration of anesthesia and recommending the continuance of training courses in this field for nurses. The resolution read as follows:

> The American College of Surgeons regards with deep concern the actions of some physician anesthesiologists in giving the impression to the laity in the public press that it is unsafe for experienced nurse anesthetists to conduct surgical anesthesia. While it supports the increasing tendency of having physician anesthesiologists in charge of

> surgical anesthesia, it deplores at this time any propaganda for the elimination of the trained nurse anesthetist. On the contrary, the American College of Surgeons is of the opinion that, in view of the splendid record of achievement of the nurse anesthetists, institutions engaged in the training of nurses for this purpose should be encouraged to continue their programs.[62]

Obviously the controversy of nurse versus physician anesthetists was not resolved. In fact just a year later in 1949, Blalock expressed his discouragement in resolving the matter as he faced difficulties in recruiting a successor to Austin Lamont. In a letter to Harry Beecher, MD on April 18, 1949 Blalock wrote:

> I have been rather discouraged thus far because the prevailing opinion seems to be that it is out of the question to have a combination of physician anesthetists and nurse anesthetists. It is perfectly apparent to me that there may be enough good men going into anesthesia some years from now to have the entire work taken over by the physician but I feel confident that this will require a long time. In the meantime I see no point in trying to get rid of all the nurse anesthetists.[63]

Blalock went on to express his view of anesthesia and concerns about pre- and post-operative care:

> I have also been worried by the general feeling that pre and post operative care should be largely turned over to the anesthesiologist. My feelings about this is that this would be

> dependent upon the investigative interests of the people concerned. If a member of the department of anesthesiology were particularly interested in fluid balance and were making contributions to the subject I would feel that such responsibilities could be delegated to the department. On the other hand if members of the surgical staff are making contributions, while then I think that you should assume most of the responsibility. I do want you to know that I'm extremely interested in having a good department of anesthesiology here. It will be a subdivision or subpart of the department of surgery.[64]

The Outcome for Nurse Anesthesia

The anti-nurse anesthetist campaign, however, did discourage capable nurses from entering the field. The hospitals were grossly understaffed; demand was far greater than supply, and opportunities existed across the United States for both nurse anesthetists and physician-anesthetists. Many hospitals and medical centers had a medical anesthesiologist heading the anesthesia department, nurses administering the majority of routine general anesthesia, and training programs for both nurse anesthetists and physician-anesthetists. Such hospitals included: Mayo Clinic, University Hospitals of Cleveland, Barnes Hospital, Charity Hospital, Wesley Memorial Hospital, Johns Hopkins Hospital, Massachusetts General Hospital, and New York Hospital.[65]

After Austin Lamont's resignation in 1946, Olive Berger supervised the anesthesia service and the nurse anesthesia program at Hopkins until Donald Proctor, MD became the

director of anesthesiology in 1951. This time period from 1946 to 1951 proved to be very trying years. Proctor reflected:

> When Lamont resigned the burden fell on Miss Olive Berger who was soon under great duress because of the shortage of properly trained nurse anesthetists . . . There were many other deaths during this period because the coverage could not be maintained with adequately trained nurse anesthetists. Miss Berger was literally overwhelmed. The Baltimore City Health department actually told the director of the hospital that there were too many anesthetic deaths and that something would have to be done about it. Since Lamont's departure anesthesia and oxygen therapy had undergone steady deterioration in spite of the Herculean efforts of Miss Olive Berger, the chief nurse anesthetist. She was badly understaffed especially considering the fact that anesthesia was being given in thirteen separate areas of the hospital and occasionally in four other areas. Much of the anesthesia equipment was old-fashioned and inefficient . . . How Dr. Blalock could have been willing to permit the continuance of such inadequacies or be ignorant of them was beyond my understanding. The Johns Hopkins hospital was indeed living in the dark ages of the 1920s with respect to anesthesia.[66]

In March 1951 Blalock asked Proctor to form the division of anesthesiology at Hopkins. Proctor accepted the position knowing that "on the one hand a difficult and prolonged transition period would be required here at Hopkins, and, on the other hand, that in the country as a whole (among physician anesthetists) there was a very real antagonism towards Hopkins because of its failure to recognize the possibilities of the physician in anesthesia."[67]

Proctor, being an otolaryngologist, was asked to undergo an anesthesia fellowship prior to heading a division of anesthesiology. Even after additional training, he encountered many of the same barriers to establishing a Division of Anesthesia that his predecessors had. Specifically he ran into conflicts with Alfred Blalock. Proctor described a typical "Blalock dictum":

> I received a message that the next day an entirely new technique was to be tried for management of one of the more dangerous types of heart operations and that Dr. Blalock wanted, "for sentimental reasons," to have Miss Berger give the anesthesia. I told him that I felt the safety of the patient demanded the services of our best physician anesthesiologist. He insisted on the nurse and had his way.[68]

Donald Proctor submitted his resignation from the position of anesthesiologist in charge at Hopkins on May 2, 1955; he attached an updated outline of Austin Lamont's original 1945 proposal. The other physician members of the anesthesia staff departed soon after Proctor's resignation in late 1955; subsequently the nurse anesthetists at Johns Hopkins resumed their primary responsibilities for providing anesthesia until 1956.

Blalock again searched for a physician anesthetist who was not "bitterly opposed to nurse anesthetists."[69] He found exactly what he was looking for in Donald Benson, MD who wrote: "Miss Berger and I shall certainly get along well I am sure. Her staff seems quite competent and capable. I am looking forward eagerly to working with her."[70] Benson became the first head of anesthesia at Johns Hopkins to have completed a residency in the specialty of anesthesia from the University of Chicago Clinics.

Conclusion

The national and local politics of physician versus nurse anesthesia in the 1940s was so highly charged that nurse anesthetists like Olive Berger have been left out of the historical record. The contested space of practice for nurse anesthesia can be seen as part of a political, social, and economic process, influenced by the changes in technology and the science of the developing field of anesthesiology, and encompassing more than the individual nurse anesthetist or a particular surgeon or a particular institution. Olive Berger retired in 1967 after more than thirty years at Hopkins, having spent her entire career in a continuously contested space on "the other side of the drape." Her clinical competence, her loyalty to Blalock and Hopkins, and her leadership among nurse anesthetists has never been disputed.

[1] "Nurses or Physicians – Who Should Give Anesthetics?" *Hospitals*, April 1947. It was common practice that medical students, interns, and residents administered surgical anesthesia.

[2] Virginia Thatcher, *History of Anesthesia with Emphasis on the Nurse Specialist* (Philadelphia: J. B. Lippincott, 1953): 108.

[3] John Garde, "The Nurse Anesthesia Profession: A Present, Past, and Future Perspective," *Nursing Clinics of North America* 31 (1996): 567-580.

[4] Arlene Keeling, *Nursing and the Privilege of Prescription*, (Columbus, Ohio: Ohio State University Press, 2007): 28-48.

[5] Thatcher, *History of Anesthesia,* 109.

[6] Ibid.

[7] Ira Gunn, "Issues and Perspectives Affecting CRNA Practice," *CRNA: The Clinical Forum for Nurse Anesthetists* 10(1999): 41-47.

[8] In October of 1939 the National Association of Nurse Anesthetists (NANA) changed its name to the American association of Nurse Anesthetists (AANA).

[9] The factors that led to the organization of the NANA would become the vision, mission, core values, and motto of today's American Association of Nurse Anesthetists. The NANA sought to be the recognized leader in anesthesia patient care by advancing educational standards and clinical competence.

[10] In 1937 ANNA occupied space in the AHA's offices in Chicago.

[11] Agnes McGarrell, official reporter, Superior Court California. July 1934. Transcript on Appeal, vol. I. In the Supreme Court of the State of California. *William V. Chalmers-Francis, William Dewey Wight, George P. Waller Jr., and Anesthesia Section of the Los Angeles County*

Medical Association (Plaintiffs) v. Dagmar A. Nelson and St. Vincent's Hospital (defendants), Los Angeles Supreme Court of Appeals No. 364130 (1934), 95-345. Xeroxed copy RG 08113, American Association of Nurse Anesthetist's Executive Office, Historical Files. Park Ridge, Illinois.

[12] Carl Scheffel, *Jurisprudence for Nurse: Legal Knowledge Bearing upon Acts and Relationships Involved in the Practice of Nursing*, 1938.

[13] Thatcher, *History of Anesthesia,* 129.

[14] Austin Lamont to Alfred Blalock, 28 May 1942. Blalock Collection, The Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions, Baltimore, MD (hereafter AMCMA).

[15] Interview with Olive Berger interviewed by Michael Sarr and Donald St. Germain. Victor Almon McKusick Collection, AMCMA, Oral Histories, Item 200437,1975-09-07(date created).

[16] Ibid.

[17] Hopkins nurse anesthetist Beverly Colt, looking to recruit nurse anesthetists, describes the perfect candidate; "to the nurse who likes responsibility and can carry it gracefully, anesthesia opens her arms eagerly. She must be poised and self-confident without being stiff and conceited. She must know how to laugh with the baby or silently gain the confidence of the middle-age businessman who won't let one know he is secretly frightened by 'going to sleep.' Her bump of conscientiousness must be large and prominent, as must that of judgment and intellect. In other words, she must be a good nurse who likes people, and she would be happy to

be known as the 'shadowy pleasant nurse with a nice voice who put me to sleep." Beverly Colt. "Anesthesia Needs Help," *Johns Hopkins Nurses Alumnae Magazine*, October 1943: 160.

[18] According to Virginia Thacker during WW II, the U.S. military would not give nurse anesthetists the respect within the specialty. Experienced nurse anesthetists who volunteered were required to accept general nurse status and thus could be assigned to any nursing role. It was "as though the armed forces were to group all physicians into a single category, with no recognition of their various specialties." Nurse anesthetists were in a difficult position. Many wanted to serve and practice their specialty. Despite these barriers nurse anesthetists volunteered in great numbers.

[19] Robert DeBusk, "The Nurse Anesthetist in the Post War Period," *The Journal of the American Association of Nurse Anesthetists* (February 1945): 7-10.

[20] Ibid.

[21] Austin Lamont submitted an eighteen page document titled "Discussion and Outline for Anaesthesia in the Johns Hopkins University and Hospital" to Blalock in August of 1946 and again on March 27th 1947. Blalock Papers, Communications folder, AMCMA.

[22] Ibid.

[23] Ralph Waters, "Anesthesiology in the Hospital and in the Medical School," *JAMA* 130, no 14 (April 6, 1946): 909-912.

[24] Austin Lamont, "Discussion and Outline for Anaesthesia in the Johns Hopkins University and Hospital" attached to letter to Alfred Blalock dated March 27th 1947. Blalock Papers, Communications folder, AMCMA.

[25] Ibid.

[26] American Society of Anesthesiologists, *The Specialty in the Practice of Medicine* (Booklet 1945): 4-8.

[27] Ibid.

[28] Austin Lamont, "Discussion and Outline for Anaesthesia in the Johns Hopkins University and Hospital" attached to letter to Alfred Blalock dated March 27th 1947. Blalock Papers, Communications folder, AMCMA.

[29] Ibid.

[30] Frank Bradley MD, "The Challenge to the Nurse Anesthetist," *The Journal of the American Association of Nurse Anesthetists* (February 1947).

[31] Ibid.

[32] Austin Lamont, "Discussion and Outline for Anaesthesia in the Johns Hopkins University and Hospital" attached to letter to Alfred Blalock on March 27th 1947. Blalock Papers, Communications folder, AMCMA.

[33] Austin Lamont resignation letter to Isaiah Bowman, 19 March 1946, 1-2. Attached was a copy of the Report of the Committee on Anesthesia recommendations, which was presented to the Advisory Board.

[34] Keeling, *Nursing and the Privilege,* 28-48.

[35] Gene Blumenreich, "Let the Record Show: A Special Collection of Legal Briefs" Columns from *AANAJ,* February 1993, "Captain of the Ship," p. 154.

[36] Stanley Muravchick and Henry Rosenberg, "Austin Lamont and the Evolution of Modern Academic American Anesthesiology," *Anesthesiology* 84(1996): 136-441.

[37] Donald Proctor to Phil (a professional peer), 12 July 1954. Dept of Anesthesia Papers, AMCMA.

[38] George Rosen, *The Specialization of Medicine* (New York: Arno Press, 1937).

[39] Bankert described as "a vigorous public relations campaign that was pro-anesthesiologist and anti-nurse anesthetist."

[40] "A Degree Doesn't Make an Anesthetist," *Modern Hospital* 68:49, February 1947, as well as *Hospital Managemen*t in April of 1948 refuted the articles that appeared in: *New Yorker* magazine of October 25, November 1, November 8, 1947 in a profile of Dr. Emery Andrew Rosenstein, a physician anesthesiologist, written by Mark Murphy. *Cosmopolitan* magazine of August 1947 in "When They Put You Out" by William A. Lydgate. *Science Illustrated* of March 1948 in "Anesthesia versus Pain" by Morton M Hunt. *This Week* magazine of November 22, 1947 in "Unknown Men in White" by James R. Miller. *Readers Scope* of February 1947 in an article by Lawrence Drake, said to have been hired as press agent by certain physician anesthesiologists. *Look* magazine, which developed considerable space in the 1947 issue to pictures and an article signed by Lawrence Drake.

[41] James R. Miller, "Unknown Men in White," *This Week* (November 1947).

[42] William A. Lydgate, "When They Put You OUT," *Cosmopolitan* (August 1947).

[43] Maxine Davis, "Anesthesia," *Good Housekeeping* (July 1946).

[44] Lawrence Drake, "Safer Surgery for 1947," *Look* (January 1947).

[45] Lawrence Drake, "Will You Live Through Your Operation?," *Reader's Scope* (February 1947).

[46] Lucy Richards, "Letter to George Lull MD, Secretary of the American Medical Association," *AANA News Bulletin* 2 (1) (January 22, 1948): 4. AANA Archive Folder: Lucy Richards president AANA 1948-1950.

[47] n.a. "Blue Baby Research," *Life* (March 14, 1949): 105-109 and n.a "Color Television Transmits 4 Surgical Operations," *The Evening Sun,* Baltimore, MD 12/6/1949.

[48] Gertrude Fife, "Is the Situation Serious?," *AANAJ* XV, no 2, (May 1947).

[49] Thatcher, *History of Anesthesia*.

[50] Two bills were of particular importance. On January 31, 1947, Senator Kraft introduced Bill 1059 into the California Senate. This bill, which would have prohibited the penetration of human tissues by anyone but a licensed physician, was amended prior to its introduction due in part to influences from nurse anesthetists. The other bill, to amend the Education Law of New York State (No. 3030, 1948) would have required the licensing of all persons administering anesthesia, and would have eliminated the nurse anesthetist from practice in that state by process of attrition. On March 15, 1949 the committee defeated the bill.

[51] Carin Pedersen Western Union telegram to AANA, January 1939 AANA, Presidential correspondence.

[52] AANA president Hazel Blanchard to Pauline Zawistowski, June 1946.

[53] Cecilia Frein to AANA president, July 1936, AANA archive, Presidential Correspondence, 1.

[54] Alice Magaw, "A Review of Over Fourteen Thousand Surgical Anesthesias," *Surgery, Gynecology and Obstetrics* (October 1906): 795-799.

[55] Henry K. Beecher to Alfred Blalock, 1 December 1947, AMCMA, Blalock Papers Folder Correspondence, 1.

[56] "The News," *Journal of the American Association of Nurse Anesthetists* (February 1948).

[57] "Proceedings," *JAMA* (1948).

[58] C. W. Munger to Alfred Blalock, 30 January 1948, AMCMA, Blalock Papers Folder Correspondence, 1.

[59] Alfred Blalock to Hattie Vickers, nurse anesthetist, 19 February 1938. AMCMA, Blalock Papers Folder Correspondence, 1.

[60] "Lucy Richards AANA: Past, Present and Future," *AANAJ* 16(3) (1948): 174.

[61] W. Allen Conroy to Blalock, 26 January 1948, AMCMA, Blalock Papers Folder Correspondence, 1.

[62] "The News," *AANAJ* (February 1948).

[63] Alfred Blalock letter to Harry K. Beecher dated 18 April 1949, Blalock Papers Folder Correspondence, 1. Beecher was Anesthetist-in-Chief at Massachusetts General Hospital and Instructor in Anesthesia at Harvard Medical School.

[64] Ibid.

[65] Thatcher, *History of Anesthesia*.

[66] Donald Proctor Final Report from the Division of Anesthesiology JHH and University School of Medicine, 1 May 1955, AMCMA, Blalock Papers Folder Correspondence, 1-9.

[67] Ibid.

[68] Ibid.

[69] Alfred Blalock to J. Carrott Allen, 17 June 1955, AMCMA, Blalock Papers Folder Correspondence, 1.

[70] Donald W. Benson to Alfred Blalock, 24 December 1955, AMCMA, Blalock Papers Folder Correspondence, 1.

Chapter 5

Nurse Anesthesia and Technology

Scholar and historian Marguerite Sandelowski has suggested that American nursing is divided into two periods due to emerging technology: before and after World War II.[1] Sandelowski presents the case that throughout American nursing history technology transformed nursing work, altered social relationships and the division of labor, and transferred many forms of technology from the area of medicine to the domain of nursing. She described nursing work in the post-World War II era as "device mediated procedures" which required the use of appliances, utensils, and other objects.[2] Sandelowski links hospitals' emerging image as sites for "sympathetic and scientific care embodied in the new trained nurse" with the use of new devices including the stethoscope, laryngoscope, and electrocardiography. Thus, at mid-20th century there is a paradigm shift occurred in nursing. The profession that once offered only support and care could now supplement those caring measures with scientific knowledge, skills, and technologies. This shift was most evident in the practice of nurse anesthesia.

Historian Judith McGaw's definition of technology-- a "system of tools, skills, and knowledge needed to make or do things"—allows us to understand technology as a socially constructed system that is part of a political, social, and economic process, influenced by gender and encompassing more than any individual anesthetist or any particular machine.[3]

A careful evaluation of the famed blue baby photo, Olive Berger's log, and her publications offer us insight into this critical period of time in the nurse anesthetist-technology relationship.

Famed Blue Baby Photo (Appendix A)

The saying "a camera never lies" is most appropriate to describe the photo that has represented the significance of the blue-baby operation in multiple publications.[4] Most observers fail to realize that this well-known image is a captured still photograph taken by Sy Friedman of a televised blue baby surgery. In fact, this surgical procedure performed at the Johns Hopkins Hospital in February 1947 is also an historic event as it is the first closed circuit televised surgery.[5] If the viewer inspects the photograph closely, they will see the television camera, microphones, and lights. This historic surgical event was transmitted from Baltimore to Washington for the American Medical Association clinical sessions. Prior to this time education through observation occurred in surgical theaters that could accommodate only a small number of observers, many of who had a poor view of the operative field. During this televised presentation, however, a thousand physicians at a time entered the National Guard Armory to view fifteen color televisions to watch and listen to the surgeries.[6] In fact Hopkins transmitted four separate surgical procedures and medical clinics that day.

Blalock required his most reliable anesthetist for this televised, high profile blue baby surgery. Olive Berger can be identified administering anesthesia not only in the famed blue baby surgery photo but was pictured in an article in the *Baltimore Evening*

Sun administering anesthesia for an abdominal operation.[7] Berger is also pictured in a *Life* article titled, "Blue Baby Research" which appeared in the March 14, 1949 issue.[8]

Before the introduction of videotape, filming a surgical procedure was cumbersome, time-consuming, and even hazardous.[9] Providing an ideal vantage point for the photographer and camera required significant alterations to the operating room. The use of a non-flammable anesthetic agent, such as sodium pentothal or nitrous oxide, was strongly recommended because the intense lighting required for filming could cause an explosion created by static electricity. Thus it was necessary for the anesthetist to be familiar with and skillful in multiple anesthetic techniques.

Although photographic images serve as a powerful record of people, events, and places, only words can elicit ideas and evoke emotions and the captions used to describe the well-known blue baby photo did just that. They include: "Dr. Blalock and colleagues performing the blue-baby operation" and "during the early blue-baby surgeries, Alfred Blalock insisted that Vivien Thomas be in the operating room to advise him."[10] The glory went to the doctors. Olive Berger, nurse anesthetist, goes unidentified or un-named as is true of nurses in many historical photographs.

Sy Friedman's motivation for capturing a moment during the telecast can only be presumed to capture its evident historic nature. By 1947 several hundred children had undergone the blue baby operation and Blalock and Taussig were known worldwide.

The blue baby photo clearly is taken from a high vantage point. The perspective relates to purpose but also to the different relationships between the objects in the photo and the viewer's vantage points. The perspective from a high place is meant to disengage

the viewers physically from the objects viewed (in this case a child who's chest is opened for surgery) to create a panorama. Friedman cropped the photo so that Blalock is at the center of the photograph. All nurses, the anesthetist, and the residents are focused on his actions. Vivian Thomas stands behind Blalock and away from the field in the horizontal view. In the vertical photo Thomas is operating the EKG machine on the periphery of the room.

Olive Berger's image is slightly blurred indicating she is moving. She stands alone at the head of the table on the "other side of the drape." The height of the drape is very low allowing a sight line from the child to the surgeon's actions with little barrier to communication. Berger's right hand is on the anesthesia bag supporting the Waters' carbon dioxide canister while her left hand is touching the child. Her precordial stethoscope hangs from the bed rail. Berger stands for the surgery (there is no stool in the photo) while her anesthesia machine appears to be within her reach to her right.

One must remember that any photograph only contains a partial story. Sy Friedman was privileged to select his frame and compose his photo, which represented his purpose, art, and experience. Capturing what he saw as a representation of this historic surgery could not possibly include all the operating room elements, interpersonal dynamics, and conversations that took place.

Olive Berger's Technology

Since the inception of nurse anesthesia in the latter half of the 19th century, patient monitoring in the operating room was one of the core responsibilities of nurse

anesthetists. Both Olive Berger's log and detailed articles offer us insight into the evolution of techniques and the experiences of nurse anesthetists interacting with technology. The following technologies can be identified in the famed photos, notes directly taken from Berger's log, or her published articles.

The Precordial Stethoscope and Perioperative Monitoring

The discoveries that facilitated patient monitoring in the perioperative period occurred long before the introduction of clinical anesthesia. The stethoscope is arguably the most significant technological advancement in diagnosis. Invented by French physician Rene Laennec in 1819, the stethoscope profoundly changed the practice of medicine.[11] The introduction of the stethoscope changed the medical approach to illness from an anatomical to a scientific one. The caregiver-patient relationship changed as well.[12]

One of the most significant modifications of the stethoscope was introduced by Dr. Robert C. M. Bowles of Brookline, Massachusetts, who patented five modifications between 1901 and 1904 (US Patents #677172, #693487, #700728, #734159, #773274).[13] HIs major improvement was to locate the diaphragm on the surface of the chest piece so that it would be in direct contact with the skin. The chest piece was designed with concentric grooves to enhance transmission of higher frequency sounds and could be connected to a typical binaural earpiece. [14]

The improved Bowles–type stethoscope provided better sound and a non-compressible stem (the part that connects to the tubing). Stems made of compressible material, like flexible rubber, could easily be bent, and thus interrupted any sound to the earpieces. In his patent, Bowles noted that the non-compressible stem allowed physicians to listen for heart and lung sounds without requiring patients to remove their clothing. (This was a useful feature during the modest Victorian era). It was also useful when the anesthetist needed to monitor an anesthetized patient without disrupting the surgical team. Before 1904 the "Bowles" stethoscope was manufactured in two sizes; a 2-inch diameter and a 1-3/8 inch diameter. Understandably the larger diaphragm transmitted better sound but was inconvenient to use in areas above the clavicle, apices, and on children. Alternatively it could be used to determine blood pressures by detecting Korotkoff's sounds just distal to the Riva-Rocci cuff placed on a patient's upper arm. Bowles' design dominated the stethoscope market in the 20th century. The Bowles-type stethoscopes were once the primary monitoring devices employed by those administering anesthetics (See Appendix D).

By the early 1900s neurosurgeon Harvey Cushing suggested that blood pressure be measured and recorded during surgery. Cushing described "continuous auscultation of cardiac and respiratory rhythm during the entire course of the anesthesia"[15] while using a precordial stethoscope. But Cushing's suggestions for intraoperative monitoring were not initially nor readily accepted. In fact, the *British Medical Journal* stated, "by such methods we pauperize our senses and weaken clinical acuity."[16] But other anesthetists respected Cushing's theory. In fact, S. Griffith Davis MD, a physician at John Hopkins who administered anesthesia, used the first precordial stethoscope.[17] He adapted a

technique developed by Harvey Cushing. Davis's "phonendoscope" technique was forgotten but was reintroduced by Dr. Robert Smith MD, a pioneer of pediatric anesthesiology in Boston. In the 1940s Smith described the construction, placement, and use of the precordial stethoscope.[18] He advocated, "a precordial stethoscope should be used in all anesthetic procedures, no matter how brief."[19] Precordial stethoscope's provide an uncomplicated, nonelectric method to qualitatively assess both heart and lung function. Later William Dorvette, a physician anesthetist wrote, "The stethoscope is a vitally important part of the anesthesiologists armamentarium, in fact, the most important single device used for monitoring purposes."[20]

Olive Berger became a strong advocate of the precordial stethoscope. The precordial stethoscope was commonly placed either on the opposite chest - away from the surgical incision, suprasternal notch or on the patient's lateral neck. She utilized continuous auscultation of the chest allowing her to monitor the cardiac and respiratory systems. The quality of heart sounds provided her with data regarding the strength of cardiac contractions. This was vital as during hypovolemia, cardiac sounds may become muffled. In cases of hyperkalemia or congestive heart failure, the anesthetist can hear extra cardiac sounds with the stethoscope. Obviously, the listener cannot hear heart sounds during asystole or ventricular fibrillation, but with the stethoscope the onset of extra heartbeats, tachycardia, or bradycardia is immediately apparent.

By paying close attention to breath sounds during continuous chest auscultation Berger calculated the quantity and quality of ventilation. Any changes that she noted in breath sounds revealed that bronchospasm had developed, the upper airway was obstructed, or the airway circuit had disconnected. However, because respiratory rate was

relatively slow, a decrease in rate and even total absence were difficult to detect. The rationale for using the precordial stethoscope was to enable the anesthetist to continuously monitor respirations and heart sounds with the ratio of signal to noise maximized. A muffled sound of the heart and or breath accompanied by swallowing noises was the first indication to the anesthetist that the amount of anesthetic was insufficient.

In an *American Journal of Nursing* article in 1959 about anesthesia for newborns, Betty Lank, chief nurse anesthetist at Boston Children's Hospital, justified use of the precordial stethoscope saying, "the most reliable information as to adequate ventilation is obtained by continuous use of a stethoscope strapped to the chest."[21] She went on to describe: "The best way we have of judging blood loss in small infants is the stethoscope strapped to the patient's chest, since it gives us both the respiratory exchange and heart sounds and we are able to detect immediately changes in intensity of the heart beat. If the stethoscope strapped to the chest is in the surgeon's way, and the heart sounds are so lessened that the radial pulse is not audible, then the axillary or carotid pulse may be used."[22]

Thus, the use of the precordial stethoscope was fundamental to anesthesia practice. Anesthetists preserved their exclusive use of the tool and maintained a high level of skill for their individual practices.[23] Physician anesthetist Clayton Petty valued the precordial/esophageal stethoscope especially when he needed to make a critical judgment.[24] He saw the precordial stethoscope as an "extension of the anesthetists' own senses." Petty also observed that the precordial/esophageal stethoscope was important not only because it contributed to better patient outcomes but also because it increased the

ability of inexperienced professionals to detect heart sounds, the quality of heart tones, and dysrhythmias. .

Supporting precordial use and stating that it was essential, physician C. D. Vandam wrote, "Use of the precordial (or esophageal stethoscope) is simply an economical extension of the senses . . ."[25] The use of the precordial (or esophageal stethoscope) provides a direct and continuous physical link between the anesthesia provider and the patient. Heart tones and breath sounds are monitored continuously, as well as, sentinel events like air embolism, pulmonary edema or pneumothorax can be readily detected. More recently anesthesiologists Cullen and Larson explained, "it is critical to the success of monitoring, however, to adopt and apply the concept that the monitor is the anesthetist."[26] Thus, the anesthesia provider became the monitor, responsible for interpreting the input supplied by the precordial stethoscope. The skills associated with the use of the precordial stethoscope influenced the role of the nurse anesthetist. The knowledge and data that the precordial stethoscope produced in the operating room was an applied knowledge. Although nurse anesthetists who used the device had some training in physiology, the major function (clinical utility) of the stethoscope was to obtain information that directly affected the administration of the anesthetic. Most analyses of anesthetic mishaps in the 1940s (morbidity and mortality) strongly implied that the anesthetist was not vigilant enough during the surgical procedure.

Since the precordial stethoscope was the latest technology of her time, Olive Berger undoubtedly trained her students in the use of this valuable instrument. In fact, special "teaching stethoscopes" were developed to allow experienced nurse anesthetists

like Olive Berger to identify significant changes in respiratory and heart sounds and to share those observations with their trainees. But while Berger carefully imparted to her students the tacit dimensions, she would include subtle nuances of her expertise as well. Nurse anesthesia training was (and still is) an apprenticeship in nature.

Precordial stethoscopes have always provided data to the anesthetist that is difficult to interpret, therefore anesthetists have had to develop an acute sense of hearing (one of the senses least developed in diagnosis), and learn to fractionate their hearing so that some sounds are excluded in order to note slight changes in others.[27] In reality practical clinical knowledge has two dimensions—a visible, codified component that is the equivalent of "the tip of an iceberg." A larger but crucial underlying tacit component, consisting of values, procedures, and practices of the trade are impossible to document.[28] Berger demonstrated expertise in both.

"The Waters model Foregger gas machine" [29]

In the first half of the 20th century, U. S. manufacturer Richard von Foregger transformed anesthetic equipment. Foregger collaborated with Ralph Waters and other anesthetists to create the to-and-fro canister for carbon dioxide absorption.[30] Introducing the equipment in 1924, Waters focused on the benefits of a carbon dioxide absorber: a reduction in the amount of anesthetic gas required to anesthetize patients, a reduction in the amount of gas that leaked into the air of the operating room, better humidity of the delivered gases, and a reduced loss of the patient's body heat.[31]

In her first article Olive Berger mentions, “the Waters model Foregger gas machine has been used in every case”.[32] Berger was an advocate of the anesthesia machine because it supported the administration of medical gases, (such as oxygen and nitrous oxide), and helped with mixing an accurate concentration of anesthetic vapor (such as cyclopropane) to the patient at a safe rate.[33]

In the same article in which Berger discussed the Foregger equipment, Berger also describes the “semi-closed method” for induction of anesthesia. The semi-closed method is simply the utilization of a circuit that allows for a portion of the exhaled air to be exhausted from the circuit and a portion to be rebreathed by the patient after the anesthetic apparatus has removed the carbon dioxide. But with the use of the semi-closed method of administering anesthesia, which was employed with nitrous oxide and with cyclopropane, the patient's exhalations escape into the room throughout the operation. The result was that explosive anesthetic gases like cyclopropane also escaped into the operating room.

Cyclopropane – “C3H6 Ether 3/4”[34]

In the 1940s cyclopropane was the inhalational induction agent of choice, especially for children. Cyclopropane was a volatile gas, considerably heavier than air, and has a slightly pungent not unpleasant odor. It was a remarkably potent anesthetic with slightly toxic properties. Introduced into clinical use by Ralph Waters in 1934 cyclopropane offered the advantage of decreased pulmonary irritation for inhalational anesthesia and less agitation during induction.[35]

Anesthetists experienced with cyclopropane knew it was a potent respiratory depressant necessitating frequent alteration in concentration and often complicated techniques. Olive Berger states that inhalational induction in blue babies took “five to ten minutes” before intubation could be achieved.[36] Her article describes intriguing details of a complex technique.

Cyclopropane causes a variety of cardiac arrhythmias. At the conclusion of anesthesia, patients could suffer a sudden decrease in blood pressure, potentially leading to cardiac dysrhythmia, a reaction known as "cyclopropane shock." Berger discussed one of her experiences with this gas:

> Cyclopropane undoubtedly predisposes to cardiac arrhythmia; this is usually transient and can be controlled by modifying the anesthetic and oxygen tensions or altering the anesthesia level. Results for more than 800 anesthesias for cardiac surgery have made us feel justified in continuing the use of cyclopropane even though other anesthetic gases and combinations of agents do afford satisfactory anesthesia. The selection of agents must depend on the desires and requirements of the surgeon as well as the needs of the individual patient.[37]

The hazard of flammability and explosion existed with cyclopropane. Thus the surgical anesthetists took necessary precautions to prevent static and other apparent electrical potentials. Surgeons could not use cautery instruments and medical personnel advocated for electrical grounding and humidification of operating rooms. Across the United States, anesthetists reported intraoperative explosions to seek regulations and

change. Anesthetists, like Olive Berger, attempted to decrease explosive risk by draping wet towels or blankets over themselves and the patient's airway. Squibb advertisements, a major pharmaceutical company and supplier of cyclopropane, advocated that only an expert should administer cyclopropane. The ads stated: "An exacting technique in the administration of cyclopropane is very important because of the great potency in low concentration, the absence of respiratory stimulation and the fact that dangerous concentrations may be given without cyanosis. It should be administered only by those specially trained in its use."[38] Berger's technique of cyclopropane use evolved as her experience with the anesthetic agent increased. Her later use of cyclopropane–air-oxygen minimized the hazard of explosion.

Pentothal---"2.5% Pent Ind. O2 Ether"[39]

In the 1940s anesthetists longed for the perfect anesthetic drug—one that would induce the patient rapidly, insure a maximum of safety, surgical relaxation, quiet breathing, normal color, no salivary secretion, and rapid elimination. It also had to not alter the function of the internal organs and allow the patient to recover without experiencing nausea and vomiting. Several intravenous anesthetics matched these requirements, one of which was Pentothal. Anesthetists started using Pentothal, a barbiturate, in 1929 to induce anesthesia.

Olive Berger used Pentothal in the Johns Hopkins operating room commonly in combination with other anesthetic agents. In an article she wrote for the Johns Hopkins Nurses Alumnae Magazine in 1943 she noted: "Pentothal sodium was introduced in the

Johns Hopkins Hospital in October 1939. From that time up to April 1943 it has been a administered 7,231 times."[40]

Pentothal enhanced weaker anesthetic agents, like nitrous oxide and reduced the amount of more toxic agents. Pentothal had no explosion hazard. It quieted breathing for more optimal surgical conditions and prevented 'postoperative psychosis' as well as nausea and vomiting- all of which would be desirable for a child suffering from Tetralogy of Fallot.

Pentothal was directly injected into the bloodstream and reached the brain in less than ten seconds. There was no respiratory irritation, no excess salivation, no patient agitation, and induction was smooth and rapid. To produce the desired effect throughout the operation the anesthetist had to administer additional amounts of the drug. Pentothal was cumulative in its action, thus the longer the anesthetic was given, a smaller amount of Pentothal was required for re-dosing.

Anesthetists mastered the technique for administering intravenous anesthesia. Children's veins are small and vena puncture was often difficult -commonly in children the saphenous vein at the ankle was used. Pediatric anesthesiologists Leigh and Belton noted: "Proficiency at venipuncture [in children] requires some practice".[41]

Careful attention and calculation was required in preparation of Pentothal solution before infusing it. Commonly anesthetists administered Pentothal with a specially designed apparatus that held glass syringes, a three-way valve, and some rubber tubing. After the patient was induced, anesthetists watched for any slight movement of the patient's extremities, phonation, and increased depth in the rate of respiration. Any of

these signs would require them to administer additional Pentothal.[42] The technique was potentially very dangerous since respirations were at times imperceptible. To help them monitor the patient's respiration, many nurse anesthetists devised a "butterfly" made out of cotton or paper and attached it to the patient's upper lip so that the anesthetist could detect the movement of air coming through the patient's nostrils. If the patient were intubated, the anesthetist would watch the rise and fall of the bag to follow the rate and depth of the patient's respiration. Additionally, the condition of the patient required them to carefully and constantly observe the patient's blood pressure, the rate and volume of their pulse, and the color of their mucous membranes and nail beds. They monitored the patient's pupils as well for adequate depth of anesthesia, making certain that the eyeball was fixed with a moderately dilated pupil. Anesthesiologist Dr. Julius Holly in 1943 noted:

> The contraindications for the use of Pentothal sodium is first, age. Patients below 12 years of age do not tolerate intravenous barbiturates. They require very large doses and they have a poor anesthesia range [margin of safety]. That is, they are either too light or too deep and have a tendency to develop respiratory depression. Children below the age of 12 as a rule do not have very good veins to inject.[43]

Only trained anesthetists who were comfortable with difficult airway management and had adequate equipment available for both the airway and administration of the drug used Pentothal. For Berger the amount and experimental nature of the work necessary to deliver an uneventful anesthetic using Pentothal in children was significant.

"Mushroom"[44]

In several cases in her log, Olive Berger notes the use of a "mushroom." This was made in reference to finding a solution to a problem. When an anesthetist attempted to perform intermittent positive pressure ventilation with a semi-closed circuit and squeezed the bag the gas tended to escape from the circuit rather than inflating the lungs. Valves added to the circuit, like the Mushroom-flap valve, assisted anesthetists with achieving positive pressure ventilation. On inspiration, or when the breathing bag is squeezed, the mushroom-style diaphragm inflates—the pressure increases blocking the exhalation channel. When the pressure inside the mushroom-flap drops at the end of inspiration - it opens the channel and allows the exhaled gases to pass out of the circuit and closes the inspiratory limb. However, the valve would tend to stick if it became wet or dirty.

Curare – "Curare 8 us" [45]

For centuries the Indians of South America used curare, a substance prepared from vines found in the rainforest, to poison the tips of their arrows for hunting and warfare. When a poisoned arrow penetrated even a non-vital part of the body, the drug caused paralysis. Intrigued by the therapeutic possibilities of this substance, American botanist, Richard Gill, made several expeditions to the Amazon to procure the plant and return it to the United States.

In 1939, the pharmaceutical company Squibb introduced Curare under the brand name Intocostrin (d-tubocurarine chloride) used to help treat convulsions and spastic conditions. The relaxant effects, however, suggested to some doctors, the possibilities for using the drug as a general surgical anesthesia. Dr. Harold Griffith reported the first series of cases in which he used Intocostrin in 1942.[46] The value of curare was the fact that by its carefully controlled use of muscle relaxation, adequate for the surgeons' needs, the patient could be kept in a light plane of anesthesia. The danger however was that characteristic signs of anesthesia were obliterated.

Only highly skilled anesthetists used curare during the early years since the drug presented some challenges.[47] Responses to neuromuscular blockers are not the same for all muscle groups, all disease processes or all age groups. Hypotension and additive action with inhalational anesthetics were common and intermittent dosing was required. Endotracheal intubation was recommended to secure an adequate airway.

Prior to the mid-1940s endotracheal intubation in general was used so infrequently that it was unrecorded in statistics.[48] As the use of endotracheal intubation grew and became standard practice - paralytics were used. "Aided respiration" developed or as Berger described "we have not used the 'respirator type' of mechanism to control respirations, since we believe that the simple assistance of respirations by gentle manual compression of the breathing bag provides more flexibility in the management of the anesthesia."[49] In the 1940s use of ventilators did not exist in the operating room and postoperative recovery rooms were extremely rare.[50]

Curare remained in clinical use for fifty years. The introduction of muscle relaxants into anesthetic practice was a major innovation, as "muscle relaxant banished forever the need for deep anesthesia" which was the risk factor of anesthetic mortality and morbidity.[51]

Millikan Oximeter – "oxymeter reading burned ear"[52]

During the blue baby procedures Olive Berger used a Millikan oximeter. The oximeter consisted essentially of a small ear unit and a galvanometer. The earpiece contained an electric bulb, light filters, and a photoelectric cell. It fits over the pinna of the ear with the bulb in front, and the filters and cell behind. The heat generated by the bulb dilates the arterioles of the ear and increases the blood flow sufficiently to make the ear blood equal in oxygen content to the arterial blood.[53] Models available in the in the late 1940s covered only half the potential range of saturation. There was a time lag of five seconds in the galvanometer. The instrument was accurate within three to seven percent. The instrument after being attached to the ear had to "warm up" for fifteen minutes.

The science of measuring and monitoring blood saturation of oxygen is called oximetry.[54] Development of oximetry in the United States was stimulated by needs of World War II fighter aircraft pilots. Most of the aircrafts lacked pressurized cabins so the pilots would become unconscious when dogfights took place at high altitudes. Between 1940 and 1942, Glenn Millikan developed a lightweight ear oxygen meter that he named the "oximeter" as a warning alarm for pilots. The Milliken oximeter afforded a simple

and accurate way to determine the changes in arterial oxygen saturation without an arterial puncture or the difficulty of gas analysis. "Useful in determining the amount of oxygen in the blood. It provides a means by which the depletion of oxygen as in the case of aviators flying at high altitudes or patients under anesthesia can be continuously observed . . . So that appropriate measures may be taken before the danger point is reached. The objects of the invention are to provide a simple and practical device for purposes such as those stated; to make it applicable to persons having different physical characteristics, to permit frequent checking of the accuracy of the instrument; to protect the person being tested from pain or discomfort; to give greater ease and accuracy of operation."

Nothing is more important than oxygen supply to human tissues. A 1940s argument can be made therefore that during the care of an anesthetized patient nothing is more important than skin color. Cyanosis had been used for centuries as a clinical indicator; experienced anesthetists could easily detect cyanosis in a normal child. But blue babies were perpetually cyanotic, so it was logical that those caring for these sick children would be eager to employ any technology that would assist in their assessment and care.

Clearly the Milliken oxymeter generated enough heat to burn a child's ear as recorded in Berger's log. Although Johns Hopkins hospital had Millikan oximeters, significant barriers to clinical functionality existed.[55] But Berger's willingness to explore the efficacy and efficiency of its use in the operating room demonstrates her desire for more objective physiologic data that would provide information for her assessments and clinical decision-making.

Sandborn Viso Cardiette EKG Machine - "Abn. EKG" "4 episodes cardiac arrest, op abandoned"[56]

Olive Berger's log and articles reference cardiac arrests and dysrhythmias. By the turn of the 20th century, physiological events had been converted to electrical signals, making it evident that patient monitoring in the operating room was just around the corner. However, cardiac monitoring did not occur immediately.

A major reason for the slow development of cardiac monitors in the operating room was the lack of display devices. For example, direct inking and hot stylus pens did not appear until the late 1930s. Multi-beam cathode-ray tubes did not appear in the marketplace until about 1945, their availability then hastened by the development of military radar during World War II. So electrocardiograms at best would only be intermittent and delayed which limited their usefulness.

In her 1948 article, Berger stated, "we have been fortunate in having direct tracing electrocardiographic records made on more than 300 patients during operation. A study of these graphs indicates that there may be a definite pattern warning of impending danger."[57] Berger went on to state, "Close visual observation of the heart itself is the best means of detecting signs of impending cardiac arrest. A sudden fall in blood pressure, however is almost always a dependable warning sign . . . If the heart action ceases more than twice during the operation, it is probable that the patient will not regain consciousness."[58] It was to Olive Berger's credit that cardiac emergencies during the blue baby surgery were handled successfully. Considering treatment was based entirely on

clinical appearance of the patient, observation of the heart, precordial heart sounds, pulse rate and possibly blood pressure.

James R Jude recalls one striking example of observation trumping technology during his observation of a surgery:

> I can hear Dr. Blalock in his more or less whining voice say to the anesthetist, Olive Berger 'but the heart isn't contracting' when he asked her what the electrocardiogram looked like - she was using one of the very early paper written EKG machines - she told him that the EKG looked okay. Obviously, the very cyanotic heart was with electrical but no mechanical activity.[59]

Understandably, anesthetists in the United States debated the pros and cons of cardiac monitoring. [60] But Blalock and Berger knew that the process of change was not linear. While scientific advances were made, old methods were often still useful. Clearly Berger and Blalock utilized cardiac monitoring but only as a complement to their keen observations. Despite limitations of the electrocardiogram in the 1940s, Blalock and Berger held to a conviction that intraoperative cardiac monitoring would contribute significantly to the outcomes of blue babies. Reluctance to embrace 'state of the art' technology did not appear to be part of the culture at Hopkins.

Two years after her first published article, in 1949, Berger published her further observation article in which she states, "electrographic tracings are extremely helpful in warning of impending danger thus permitting the early use of corrective measures and avoiding a serious or fatal crisis . . . Is important to know whether the cause is simple

cardiac arrest or ventricular fibrillation. Direct observation and electrocardiogram give definite information, on the basis of which specific therapy can be carried out."[61] While realizing fully the importance of information provided by electrocardiography and the emerging development of oximetry, Berger notes "there are some instances when such devices are unavailable or out of order. It is under such circumstances that direct observation is even more important than usual."[62] New technology required Berger to re-examine what is and what is not considered "care of the patient."

Nurse Anesthesia and Technology

In 1943 Edison French MD stated, "Anesthesia is becoming a special field of endeavor both as an art and as a science this has resulted because of the addition of new anesthetics in such numbers as to bewilder the surgeon."[63] Perioperative monitoring technology began clinical utilization in the operating rooms of the 1940s. There is no evidence that Olive Berger was involved in the process of technology development. But Berger was not removed from the decision-making process that was involved with and evolved from its utilization. Berger's contributions to anesthesia have been downplayed. As more men entered the nurse anesthesia profession in the late 1940s, anesthesia as an "art" was minimized and a more scientific and technologic approach developed.[64]

Nurse anesthetists embraced technologies as objective data that added to their observational and experiential data. Experienced nurse anesthetists like Olive Berger were not dominated by technology. Berger responded comprehensively to patient needs and was not distracted by gaining mastery over a device. Technology to Berger was

neither good nor bad, but rather a tool that could be used to improve patient outcomes and safety.

Julie Fairman, in evaluating the nurse-technology relationship in the context of the history of technology, identified two themes that are evident within Olive Berger's practice.[65] (1) "Use within" technology systems—the political hierarchy at Hopkins and especially Blalock's operating room was clear. Blalock dictated the relationship and responsibilities. The experimental nature of the blue-baby operation necessitated anesthetists being involved in the planning and that all team members actively participated during the procedure. Communication between surgeon and anesthetist was essential. It appears that as specific devices were proven efficacious they were brought into the operating room as patient safety allowed. It is unclear as to the source of Berger's education concerning these evolving applications of technology. (2) "Ownership of " technology systems – For Berger 'technology' was not a particular device but rather a process – tools, skills and knowledge to assure positive patient outcomes. Nurse anesthetists of the 1940s claimed identification with and use of the precordial stethoscope. Mastery of the sound interpretation along with observation dictated clinical judgments and actions. Nurse anesthetists were 'listening' to their patients and connected to them. The advancement in pharmacologic, physiologic devices, anesthesia implements, and techniques required specially trained or experienced anesthetists, like Olive Berger to utilize and evaluate them.

[1] Margaret Sandelowski, "Making the Best of Things": Technology in American Nursing, 1870-1940," *Nursing History Review* 5 1997): 3-22 (quote on p. 4).

[2] Ibid. (quote on p. 6).

[3] Judith McGaw, *Why Feminine Technologies Matter in Gender and Technology: A Reader by Nina Lerman, Ruth Oldenziel and Arwen Mohun* (Baltimore: Johns Hopkins University Press, 2003): 14-36.

[4] Two images of the blue baby surgery were taken by Friedman; a horizontal and a vertical. The classic photo can be viewed in many books including the cover of *American Cardiology: The History of a Specialty and Its College* by W. Bruce Fye.

[5] John S. O'Shea, "Motion Pictures and the College: A History of 'Learning by Seeing,'" *Bulletin of the American College of Surgeons* 88 (2003): 17-23.

[6] n.a "Color Television Transmits 4 Surgical Operations," *The Evening Sun,* Baltimore, MD 12/6/1949.

[7] Ibid.

[8] n.a. "Blue Baby Research," *Life* (March 14, 1949): 105-109.

[9] Once the procedure was filmed, it could take as long as 14 to 16 weeks to finish the original and deliver copies. Each foot of film involves the making of 40 frames of individual pictures and the typical 15-minute presentation called for the use of 400 or more feet. This allowed surgical education to be democratized beyond small elite groups and made accessible to all practicing surgeons whether they were in urban academic settings or rural private practices.

[10] Lisa Yount, Alfred Blalock, Helen Taussig & Vivien Thomas, *Mending Children's Hearts*, (New York: Chelsea House, 2012): 57.

[11] Stanley Joel Reiser,. *Medicine and the Reign of Technology*. (New York: Cambridge University Press, 1978). Before the 19th century, university-educated physicians determined treatment largely through patient narratives with possible inspection or light palpation. A "hands-on" practical knowledge approach was not utilized. The ear to the chest prior to the stethoscope was considered unethical in female patients and distasteful in others.

[12] Ibid.

[13] M. Donald Blaufox,. *An Ear to the Chest: Evolution of the Stethoscope* (Carnforth: Parthenon 2001). They were based largely on his patent of 1894 (US Patent # 526802). The original version had a flat diaphragm chest piece that could be used with or without a short rod that screwed into the diaphragm in order to localize heart sounds. The diaphragm had to be thin and could be made of metal, hard rubber, celluloid, silk, or mica.

[14] Early versions of his stethoscope had only the diaphragm chest piece, but later models had both a bell and diaphragm interchangeable in the same chest piece, which was usually referred to as a combination stethoscope. The sole manufacturer of the Bowles stethoscopes in America during the first half of the 20th century was George P. Pilling Son Co. of Philadelphia.

[15] Harvey Cushing. "Technical Methods of Performing Certain Cranial Operations," *Surgery, Gynecology and Obstetrics* 6 (1908): 227-234.

[16] Ralph Hermon Major,. "The History of Taking the Blood Pressure," *Annual of Medical History* 2 (1930): 47-55.

[17] B. R. Fink, L. E. Morris, , and C. R. Stephan (eds), *The History of Anesthesia* (Park Ridge, IL: Wood Library-Museum of Anesthesiology, 1992).

[18] Robert Moors Smith , and Robert E. Gross, *Anesthesia for Infants and Children*, 1959.

[19] Ibid.

[20] William. H. L. Dornette, "The Stethoscope: the Anesthesiologist's Best Friend." *Anesthesia and Analgesia*, 42(1963): 711-719.

[21] Betty Lank, "Anesthesia for the Newborn," *The American Journal of Nursing*, 59(1959): 1255-1258.

[22] Ibid.

[23] The earliest monitoring standards of the American Association of Nurse Anesthetists (AANA 1990) and the American Society of Anesthesiologists (ASA 1986) mandated continuous monitoring of ventilation and circulation during administration of a general anesthetic. By the mid-1980s, improved technology such as pulse oximeters, capnography monitors, and electrocardiography began to replace precordial and esophageal stethoscopes. These newer devices were considered to be more accurate and easier to use than the stethoscopes.

[24] Clayton Petty, "We Do Need Precordial and Esophageal Stethoscopes," *Journal of Clinical Monitoring*, 3(3) (1987):192-193.

[25] C. D. Vandam, "The Senses as Monitors: The decline and fall," in C. D. Blitt and R. L. Hines, *Monitoring in Anesthesia and Critical Care Medicine*, 3rd ed. (New York: Churchill Livingstone, 1995).

[26] S. C. Cullen, and C. P. Larson, *Essentials of Anesthetic Practice* (Chicago: Year Book Medical Publishers, Inc., 1974)

[27] Audrey B. Davis, *Medicine and Its Technology: an Introduction to the History of Medical Instrumentation*, (Westport, CT: Greenwood Press 1981).

[28] Tacit knowing, developed by Michael Polanyi, refers to knowledge that functions at the periphery of attention and makes possible the conventionally recognized explicit domains of human knowledge.

[29] Olive Berger, "Anesthesia for the Surgical Treatment of Cyanotic Congenital Heart Disease," *Journal of the American Association of Nurse Anesthetists* 16 (1948): 79-90.

[30] Richard Foregger, "Richard von Foregger, PhD,1872-1960," *Anesthesiology* 84(1996): 190-200.

[31] Wood Library-Museum of Anesthesiology, online woodlibrarymuseum.org/museum/item/108/waters-co2-absorber (accessed September 2014).

[32] Olive Berger, "Anesthesia for the Surgical Treatment of Cyanotic Congenital Heart Disease," *Journal of the American Association of Nurse Anesthetists* 16 (1948): 79-90.

[33] The most common type of machine was the continuous-flow anesthesia machine. In 1917 British anesthetist H. E. G. Boyle invented the original concept for this

device. Prior to this time, anesthetists carried their equipment with them wherever they administered anesthesia. But as gas cylinders became heavier and the airway equipment became more varied, transporting equipment was no longer practical.

[34] Olive Berger, Notebook labeled "Tetralogies," OBC, AMCMA.

[35] J. A. Styles, W. B. Neff, E. A. Roverstine and R. M. Waters, "Cyclopropane as an Anesthetic Agent: a Preliminary Clinical Report, *Anesthesia and Analgesia* 13 (1934): 56.

[36] Olive Berger, "Anesthesia for the Surgical Treatment of Cyanotic Congenital Heart Disease," *Journal of the American Association of Nurse Anesthetists* 16 (1948): 79-90.

[37] Olive Berger, "Further Observations on Anesthesia for the Surgical Treatment of Cyanotic Congenital Heart Disease," *Journal of the American Association of Nurse Anesthetists* (February 1949): 19-24, 74.

[38] E. R. Squibb advertisement, *The American Journal of Surgery* (1942).

[39] Olive Berger, Notebook labeled "Tetralogies," OBC, AMCMA.

[40] Olive Berger, "Intravenous anesthesia," *Johns Hopkins Nurses Alumnae Magazine* (July 1943): 109-112.

[41] Digby Leigh and Kathleen Belton, *Pediatric Anesthesia* (New York: MacMillan Company, 1949).

[42] Edison French, "Pentothal Sodium Oxygen Anesthesia in Major Surgery," *American Journal of Surgery* (July 1943): 16-37.

[43] Julius Holly, "Pentothal Sodium in Major Procedures," *American Journal of Surgery* (October 1943): 13-18.

[44] Olive Berger, Notebook labeled "Tetralogies," OBC, AMCMA.

[45] Ibid.

[46] Harold R. Griffith and G. Enid Johnson, "The Use of Curare in General Anesthesia," *Anesthesiology* 3 (1942): 418-420.

[47] Alice Hunt, *Anesthesia: Principles and Practice* (New York: G. P. Putnam and Sons, 1949): 124-128.

[48] Richard Keenan and Margaret Sullivan, "Evolution of the Modern Anesthetic Technique," *Bulletin of the New York Academic Medicine* 53 (1977): 650-665.

[49] Olive Berger, "Further Observations on Anesthesia for the Surgical Treatment of Cyanotic Congenital Heart Disease," *Journal of the American Association of Nurse Anesthetists* (February 1949): 19-24, 74.

[50] Olive Berger published an article concerning the use of respirators in the post-operative period in 1959. Olive Berger, "The Use of Respirators in the Immediate Postoperative Period," *Journal of the American Association of Nurse Anesthetists* (August 1959): 182-189.

[51] Albert Betcher, "The Civilizing of Curare: A History of Its Development and Introduction Into Anesthesia," *Anesthesia and Analgesia* 56(1977) 305-319.

[52] Olive Berger, Notebook labeled "Tetralogies," OBC, AMCMA.

[53] The light generated by the bulb penetrates the ear and strikes the photoelectric cell. The filters and cell have such characteristics that vibration variations in the amount of oxyhemoglobin within the blood vessels of the ear are recorded continuously on the galvanometer.

[54] Hemoglobin was identified as an oxygen carrier in the 1860s by Stokes and Hop Skyler.

[55] Raymond Penneys, "Studies with the Millikan Oximeter at the Bedside of Patients with Cardiac and Pulmonary Disease," *Bulletin of the Johns Hopkins Hospital* 90 (1952):192-200. Raymond Pennys was a post-doctoral fellow in the Department of Preventative Medicine at the Johns Hopkins University School of Medicine.

[56] Olive Berger, Notebook labeled "Tetralogies," OBC, AMCMA.

[57] Olive Berger, "The Cardiac Mechanism during Anesthesia and Operation in Patients with Congenital Heart Disease and Cyanosis," *Bulletin of the Johns Hopkins Hospital* 83(1948): 237-274. The results were published by R. F. Ziegler.

[58] Ibid.

[59] William Longmire, *Alfred Blalock: Personal reflections* (Pasadena CA: Castle Press August 1964). Presented at the 110th Society of Clinical Surgery April 4, 1964 in Baltimore, Maryland.

[60] It was only after continuous monitoring became available that electrocardiograms to detect abnormalities of heart rate and rhythm became practical in the late 1950s. See T. H. Cannard, R. D. Dripps, J. Helwig Jr, and H. F. Zinsser, "The Electrocardiogram during Anesthesia and Surgery," *Anesthesiology* 21(1960):194-202.

[61] Olive Berger, "Further Observations on Anesthesia for the Surgical Treatment of Cyanotic Congenital Heart Disease" *Journal of the American Association of Nurse Anesthetists* February 1949: 19-24,74.

[62] Ibid.

[63] Edison French, "Pentothal Sodium Oxygen Anesthesia in Major Surgery" *American Journal of Surgery* July 1943: 16-37.

[64] Men entered the AANA in 1947. Today men comprise nearly fifty percent of nurse anesthetists.

[65] Julie Fairman, "Alternative Visions The Nurse Technology Relationship in Context of the History of Technology" *Nursing History Review* 6(1998): 129-146.

Chapter 6

Conclusion

The Art and Science of Anesthesia

Olive Berger was a witness to and a participant in the transition in medicine and anesthesia from an art to a science. As historian Joel Howell wrote: "the meaning of the word "science" in the first half of the 20th century, appeared to be more than merely a body of knowledge, it was a "method and a spirit". The new elements of the hospital which helped define its new role in healthcare ultimately became part of a broader change in the relationship between healthcare providers and patients." [1] By the mid-20th century research, technology, and surgical advancements were the driving forces of university hospitals, like Hopkins. Within these hospitals, surgeons performed increasing numbers of procedures and became increasingly powerful. According to Rosemary Stevens in her book *In Sickness and In Wealth*, "The size and complexity of the large hospitals of the 1930s stamped them as technological bureaucracies in which experts prescribed ideal treatments."[2] By the 1940s Hopkins delivered the gold standard—technologically driven, groundbreaking care. As Stevens points out: "Although specialized training might be required to perform laboratory tests, X-rays and anesthesia, it was not clear that the specialists had to be physicians."[3] Therefore nurse anesthetists across the country found themselves adapting core anesthesia skills and knowledge to new patient populations and surgical procedures, incorporating these new scientific skills into the art of nurse anesthesia practice.

Vice versa, Olive Berger, like other nurse anesthetists in the 1940s, contributed to the shape and form of the profession through her willingness to incorporate the art of nurse anesthesia into the science. This was made evident at times when she decided to rely on her own clinical assessment skills and judgment when necessary. Her approach was holistic and her expertise was transferred to her peers through her attitude and her actions. Olive Berger was a clinical expert, exhibiting both mental and manual dexterity. Her ability to observe, recognize, and respond to changes in the condition of blue babies under anesthesia was extraordinary; her vision of what the perfect anesthetic needed for these children was her motivation. Clearly, it was the art of anesthesia practice that was just as valuable as the science.

Olive Berger's clinical expertise in anesthesia involved a variety of factors including a tacit dimension that has historically been neglected. Tacit forms of knowledge were critical for nurse anesthetists during this time period. Information that was obtained by general observation of the surgical field, "feel of the bag," touch of the skin, the nature of the patient's heart and breath sounds were essential to make clinical judgments.[4]

Anesthesia expertise includes both context-specific and a general context-independent knowledge.[5] A key characteristic of Berger's expertise was to simultaneously balance many sources and types of knowledge. Olive was able to recall her previous clinical experiences as well as information from her formal education and apply them to the blue baby operation. As her experience with the blue baby surgery increased, her anesthetic technique evolved to include new pharmacologic agents and monitoring devices. The information she obtained from hundreds of operations,

observations, and communications "over the drape," she interpreted and applied to her anesthesia delivery.

With an increasing emphasis on science came a greater emphasis on objective data that could be obtained through new instruments. Although past procedures had resulted in adequate outcomes, medical professionals desired more exact objective information concerning blue babies and brought the most up-to-date devices into the operating room. Olive Berger was a pioneer anesthetist as she utilized both electrocardiography and pulse oxymetry, technologies that offered additional data but also proved to be a distraction and introduced the possibility of explosion. These devices were of limited usefulness to Berger as she realized that watching cardiac action, by monitoring precordial stethoscope heart sounds, and by frequently determining the patient's blood pressure, made the most important signs of cardiac competence.[6] Although electrocardiography and pulse oxymetry did not offer Berger additional information that might alter her clinical decisions, she willing incorporated them into her technique, realizing that these sources of information had great potential to improve patient outcomes in the future. Berger evolved her technique to utilize advancements in inhalational anesthetics and muscle paralysis. Although some of these advancements were a challenge to anesthetists, they helped surgeons to obtain optimum operating conditions for more intricate and invasive surgical procedures.

Berger published her anesthetic technique and outcomes in two detailed articles that clearly conveyed that Berger operated from a deep understanding of her specialty by her meticulous descriptions and problem solving differentials. At the AANA meeting on September 23, 1948, Berger's forty-five minute presentation and question and answer

session followed Alfred Blalock's presentation, " Cardiac Surgery with Particular Reference to the Treatment of Pulmonic Stenosis." Her talk demonstrated her willingness to share her skill and knowledge. Berger's method of tracking anesthetic techniques, her willingness to introduce new techniques and technologies, and her careful evaluations of patient complications and outcomes helped shape a safe approach to both pediatric and cardiac surgical intervention.[7]

Nurse Anesthesia Building Blocks: Vigilance and Patient Safety

Not only medical professionals but also nursing professionals have historically challenged nurse anesthetists for "practicing medicine." But nurse anesthesia joins together vigilance with surveillance and patient safety. Vigilance, in fact, was at the core of Olive Berger's nurse anesthesia practice and for her it was *nursing*.

Vigilance for nurse anesthesia is a professional value and a practice reality.[8] It requires a complex set of interactions between and among providers, the operating room environment, and the patient. Certainly during Olive Berger's career vigilance necessitated conscious, engaging, and intuitive actions of surveillance/assessment, critical/emergency decision-making of the anesthetist during the course of administering an anesthetic while surgery was in process and into the post-operative period.

Olive Berger practiced when vigilance was central to nurse anesthesia practice and critical to insure patient safety. . In the 1940s nurse anesthetists adopted a seal for the American Association of Nurse Anesthetists (AANA) that is designed as the "Watchful

Care of the Sleeper by the Light of the Lamp of Learning." Marianne Bankert explained the design:

> A figure of Hypnos, the God of Sleep, who daily retired to his ledge in the Cave of Night to seek his rest. To foster sleep and pleasant dreams, he took with him a bunch of poppies that he continued to hold in his hand, even in a slumber so profound that his arm slid off the edge. Morpheus, the versatile God of Dreams, was delegated to watch over Hypnos as he slept, to fend off harm and to ensure pleasant dreams. In the seal he is shown holding aloft the Lamp of Learning, by the light of which he keeps his vigil.[9]

The term "vigilance" comes from a French term "vigile." The Oxford English Dictionary defines vigilance as: (1a) the quality of character of being vigilant; watchfulness against danger or any action on the part of others; alertness or closeness of observation (1b) a guard or watch (2) the state of being awake.[10] Vigilance, therefore, has an implied spiritual/mystical connotation, as in keeping a vigil through the night before a religious observance, keeping vigil at a dying family members bedside, or the "art" of a smooth anesthetic.[11] Olive Berger's concept of "vigilance" was not just a physiological or psychological behavior, but also rather a spiritual awareness, the very essence of, or perhaps even a singular fundamental definition for nurse anesthesia.[12]

Administering anesthesia has been described by many as the "hours of boredom punctuated by moments of terror."[13] Maintaining vigilance in providing anesthesia is stressful and requires mental work, but it is also essential.[14] Interest in vigilance dates to Olive Berger's blue baby years and evolution of the work of scientist Norman

Mackworth.[15] Mackworth's experiments during WWII sought to determine why radar and sonar operators missed weak signals on their displays, particularly toward the end of their watch. More importantly for anesthesia, Mackworth also noted that vigilance was an "intersection between motivation and environment."[16] To date most vigilance research done by researchers and experimental psychologists has focused on the operating room environment, not on the *motivation* of the one providing the anesthesia. For nurse anesthetists in the 1940s, like Olive Berger, the operating suite was not laden with machines and technology; rather it was staffed with nurse anesthetists and their "watchful vigilance" to protect the patients. For nurses to maintain intense observation of anesthetized patients and to take appropriate actions when needed required more than just their common sense. Olive Berger applied her pharmacologic and physiologic knowledge, her knowledge-based nursing, her anesthesia skills, and her intuition in her vigilance.[17] Later nurse anesthetists, Hirter and Van Nest defined vigilance for nurse anesthesia as a "state of watchful attention, of maximal physiological and psychological readiness to act and of having the ability to detect and react to danger."[18] As such, vigilance is the prerequisite of informed nursing action and is the mental work of nurse anesthesia.[19]

Olive Berger was "on duty" and "owned the label" and responsibility of being a nurse anesthetist. Berger maximized her function through vigilance. She went beyond her "duty" to ensure not only a positive outcome but also one that would be satisfying to both patient and surgeon. By "watching out" for the physiological and psychological needs of the patient and for every threat that the disease, system, and surgeon could present, she demonstrated vigilance (even when there were no emergent decisions to be made!). More

importantly it was her specialized knowledge and vigilance (motivation and awareness) that successfully achieved her patient goals. Blalock respected and depended upon Olive Berger.

Nurse anesthetists, like Olive Berger, see themselves as having a sacred trust to ensure the best outcomes, becoming patient surrogates, and taking over the patient's body functions. The difference between their practice and that of physician anesthetists was and is in the "how" of anesthesia care not the "what."[20]

Patient Safety

The culture of an operating room is the product of individual and group norms, beliefs, attitudes, and values. Administering anesthesia during pediatric cardiac surgery in the 1940s was a high stress and high-risk procedure. The blue baby operations that Olive Berger participated in had significant morbidity and mortality rates. Over the years Berger tracked in her log any complications and deaths. Patient safety during these groundbreaking surgeries was inherently dependent on successful interdisciplinary teamwork. Anesthetic actions affected the surgery, and surgical actions affected the anesthetic.

Anesthetic hazards included the anesthesia provider, the surgeon and the environment within the operating theater. Administering the anesthetic to a blue baby required the anesthetist to have a specific set of skills and a wide knowledge base. Being aware of all the contributing factors to a success or failure, Olive Berger kept meticulous logs that recorded the name of the individual provider, their technique, and the outcomes.

In the early days, many anesthetists had a poor understanding of anesthetic applications for pediatric patients and cardiac procedures. Thus their approach to anesthetic delivery and the operative procedure itself was one of "trial and error." As Berger's experience with the blue baby operation progressed, she published two articles that would establish the standard of practice for pediatric cardiac anesthesia.[21]

Scientific knowledge became necessary as technological patient monitoring and anesthesia drugs and equipment advanced. Certainly Olive Berger's practice at Hopkins in the 1940s reflected these medical influences, technological changes, and surgical advancements.

Blalock's optimal performance in the operating room undoubtedly relied on his open dialogue with his associates and his team's understanding of his expectations. The famed photo captures the team members who contributed to Blalock's success: Vivian Thomas, Blalock's lab technician; Olive Berger, nurse anesthetist; and residents, the scrub nurse, and the circulating nurse. Whether the surgery was successful or not was dependent on Taussig's accurate diagnosis, Blalock's skillful surgical technique, and Berger's individualized anesthesia. Although Blalock was "captain of the ship," his patient outcomes were clearly paramount in his mind and not restricted by the race, gender, or class or his surgical team. Blalock's clinical leadership was based on trust, demanded perfection, and required interdisciplinary communication.

Navigating the Contested Space of Practice

Olive Berger spent her entire career navigating a highly politically charged and contested space of practice. Her collaboration with Alfred Blalock allowed Berger to navigate the contested space of practice as well as to facilitate and enable advances in surgery. Nurse anesthetist historian, Virginia Thacker makes the case that, as medicine grew more complex during the 1930s to 1950s, collaboration (she called it interdependence) was an essential part of progress. "Medical nor surgical practice could prosper without the host of attendants and tons of apparatus that the hospital provided . . ."[22] Large institutions, like Hopkins, were highly organized and provider groups evolved.[23] Medicine became "a graphic illustration of science as a cooperative pursuit in which an accepted interdependence of many classes of workers was a vital necessity."[24]

Olive Berger was Alfred Blalock's archetype of a nurse anesthetist. The Jungian definition of archetype is an original pattern or model from which all things of the same kind are copied or on which they are based; a model or first form; prototype.[25] Alfred Blalock and Olive Berger had shared values and complementary strengths. Blalock was an innovative surgeon who needed a knowledgeable anesthetist who he found in Berger. Blalock realized that both he and everyone in the operating room would have to share a common goal to make the blue baby procedure successful. The team communicated during the procedure, reviewed outcomes that were important, and strategized to improve outcomes. Blalock appreciated Berger's anesthetic skills that provided a basis for a professional relationship of trust and collaboration. With each successive and successful surgical procedure, Blalock's and Berger's trust continued to grow.

Douglas Bacon, an anesthesiologist and trustee of the Wood Museum, wrote a short article published in the ASA newsletter in 1989 entitled "Pediatric Cardiac Anesthesia; The Unsung Heroes," addressing the anesthesia and anesthesiologists involved in early cardiac surgery. Bacon's article, although accurate insofar as it went, has major omissions--he fails to mention the role that nurse anesthetists, such as Olive Berger (and other nurse anesthetists), played in this area of pediatric and cardiac anesthesia. . In her 1948 article in the *AANA Journal* titled, "Anesthesia for the Surgical Treatment of Cyanotic Congenital Heart Disease," Berger wrote about how nurses were involved, noting that "there have been 480 anesthesias administered to 475 patients in this series, in 41 cases, the anesthetics were administered by physician anesthetists. The remainders were administered by six nurse anesthetists. The youngest patient was aged four months and the oldest 45 years. Fifty-four patients were over 20 years of age, and four were over 30." Berger concluded her article by recognizing others who contributed to these achievements. "The advice of Dr. Austin Lamont and Dr. Meryl H. Harmel was invaluable during the early cases of this series. Dr. Alfred Blalock's patience and unfailing confidence in us is sincerely appreciated."[26]

The area "Over the Drape" remains a contested space of practice, constantly monitored by professional anesthetists for barriers to full practice. Strong patient and surgeon advocacy remain important.

Personal and Professional Identity

The same times and circumstances that enabled Alfred Blalock to perform his famed blue baby surgery in Baltimore at Hopkins also provided nurse anesthetist Olive

Berger with unique opportunities to advance the practice of anesthesia. But was this timing simply serendipity or something else? How could the personalities, politics, socially imposed classes and roles create such an innovative environment?

Olive Berger clearly knew who she was both personally and professionally. Personal identity often stems from family and community heritage, along with personal contributions. Olive Berger lived and dedicated her life to the "Hopkins" community. During her more than 30 years of anesthetic service she lived at Hampton House with nursing students and faculty.

Likewise, a valid, professional identity stems from both its historical roots and the role that one has played in service to humanity and contributions to the changing times. Olive Berger and other nurse anesthetists played a significant role in the development of pediatric and cardiac anesthesia. She also realized that teamwork and communication were essential. Olive had the right temperament, talents and intellectual capabilities to excel as a nurse anesthetist.[27]

Olive Berger had strong and deep roots both as a nurse and as an anesthetist. Her roots entwine with those of Magaw, Hodgins, and Henderson through Margaret Boise. Her legacy lives on and CRNAs today should be proud to know the roots of their profession are from the strong character of pediatric and cardiac nurse anesthetist, Olive Berger.

Implications for Practice Today

The philosophical debate of art vs. science and craft vs. practice remain. Historically the art of nursing has been linked to caring. Regardless of how aesthetically Olive Berger administered an anesthetic, no one would say she was engaged in the "art of nursing" if that care caused unneeded pain, surgical awareness, or enhanced the possibility of death. The best anesthetics are the ones that are remarkably unremarkable. Gramling, in her summary of the discourse on the art of nursing, suggests that we should not be asking, "*What* is the art of nursing?" but rather "*When* is the art of nursing?"[28] Perhaps that is the question we should be asking today. The *when* for Olive Berger occurred not only in her application of anesthetic techniques but also in her effort to replace trial and error with a practice that was evidence-based. She assessed and evaluated any complications and outcomes in order to assure safe practice. She integrated machines and new pharmaceuticals, as they were developed to keep her practice current. And she communicated her techniques and findings to her professional peers for their review and utilization.[29] Berger shared skills, values, roles and attitudes associated with nurse anesthesia 'culture' and socialized her students. Nurse anesthesia of the 1940s was an "artful practice" based on an emerging science. Science has enhanced nurse anesthesia but human interaction and a relational experience remain central and timeless to the profession.

Ultimately the art and science of nurse anesthesia is directly related to autonomy, influence, and power. Nurse anesthetists like Olive Berger worked diligently after WWII to establish and maintain autonomy for the nurse anesthetist profession in the contested space of practice environment. Berger was loyal to Hopkins, Blalock, and her blue

babies. She embodied nurse anesthesia as a profession. Berger was a clinical pioneer, advanced practice clinician, teacher, researcher, and leader.

Scope of practice is historically defined. Anesthesia today takes place in an environment where technology is prominent. The nurse anesthetist's role today, as it was for Olive Berger, is to titrate technology to ensure the safe passage of the patient through the operative experience. Olive Berger demonstrated that administering anesthesia requires delicacy and discrimination on the part of the provider. Berger had specialized knowledge and skills and a willingness to continue to learn and evolve her practice. Olive knew that minute-to-minute changes in physiology required the nurse anesthetist to adapt to or control patient responses not only to the anesthetic but also to the surgery. She surveyed the patient, surgical field, operating room and equipment – she was vigilant. The excellent care that Olive Berger provided to her patients paved the way for further advancements in the science of anesthesia and surgery. Stanley Joel Reiser argued that after each move to a new technique or technology, skills using old techniques declined with a sacrifice of the unique insights that they once provided.[30] Ventilators have replaced tacit knowledge concerning "feel of the bag"; multiple physiologic monitors have replaced observations once critical to evaluate anesthetic depth and patient status; and differentiating intricacies of "breath and heart sounds" are all but lost.

But one could also argue that as nurse anesthetists integrate technology into their practice that an up-skilling or re-skilling enhanced their skills. Rarely do nurse anesthetists act on single data points but assimilate monitoring data into the anesthetic plan and their actions. Additionally, nurse anesthetists are often the first to trouble shoot or repair equipment.

As evidenced by the famed photo, the full picture of advances in surgery has to include tools, skills, and knowledge. Olive Berger utilized tools—the technologic proxies of the EKG monitor and Milliken oxymeter for objective information to guide her anesthetic of these "physiologically bizarre group of patients."[31] She applied her skills through vigilance by continuous assessment/observation of the patient's color, lung movement, heart sounds, and contractility. From "the other side of the drape" she continuously observed, listened and touched. She also used her knowledge that had to be idiosyncratic with her function. Berger integrated the technological proxies into a holistic vigilance in the care of the patient. Although it is common to refer to nurse anesthesia as both an art and a science the true meaning for Olive Berger remains elusive. Historically nurse anesthetists have appreciated and struggled with their care being called art.

Today's nurse anesthetists' need to exercise their autonomy, influence, and power to create a practice environment that is collaborative, where nurse anesthetist contributions are valued, where practice is evidence-based, where patient safety is assured, and caring is perceived.[32] The balance of the art and science of anesthesia remains at the core of nurse anesthesia practice today.[33]

[1] Joel Howell, *Technology in the Hospital: Transforming Patient Care in the Early Twentieth Century*, (Baltimore: Johns Hopkins, 1995).

[2] Rosemary Stevens, *In Sickness and in Wealth: American Hospitals in the Twentieth Century* (Baltimore: Johns Hopkins Press, 1989).

[3] Ibid.

[4] Tim Thorton, "Clinical Judgment, Expertise and Skilled Coping," *Journal of Evaluation and Clinical Practice* 16 (2010): 284-291. Thorton identifies four features of anesthetic expertise as: (1) a variety of epistemic factors, (2) a variety of kinds of skill, (3) a sensitivity to specific contexts or situation, and (4) a sensitivity to specific patients.

[5] A. Smith, D. Goodwin, M. Mort, and C. Pope, "Expertise in Practice: an Ethnographic Study Exploring Acquisition and Use of Knowledge in Anesthesia," *British Journal of Anesthesia* 91 (2003): 319-328.

[6] Robert M. Smith and H. Paul Wiley, "Evaluation of Electrocardiography During Congenital Heart Surgery," *Anesthesiology* 18 3 (May-June 1957): 398-412.

[7] In 1952 Berger presented and published anesthesia techniques other heart defects. Olive Berger, "Anesthesia for the Surgical Treatment of Valvular Pulmonary Stenosis and Mitral Stenosis," *Journal of the American Association of Nurse Anesthetists* (February 1952): 10-17.

[8] There are several synonyms that occur in the literature when researching vigilance: watchful care, watchfulness, situational awareness, attention, sustained attention, and mindful awareness.

[9] Marianne Bankert, *Watchful Care: A History of America's Nurse Anesthetists* (New York: Continuum, 1989).

[10] Oxford University Press, http://www.oed.com.proxy.its.virginia.edu/ (accessed September 15, 2013).

[11] Bankert noted this phenomenon in her book about the history of nurse anesthesia practice entitled "Watchful Care."

[12] G. Meyer and M. A. Lavin, "Vigilance: The Essence of Nursing," *The Online Journal of Issues in Nursing* 10 (1) (June 2005).

[13] n.a.

[14] J. S. Warm, G. Matthews and R. Parasuraman, "Cerebral Hemodynamics and Vigilance Performance," *Military Psychology* 21 (2009): S75-100.

[15] Mackworth developed a two-hour "Clock Test"; a psychomotor response was required to a simulated radar display in which a critical signal was displayed. Mackworth confirmed his suspicion that vigilance declines quickly. These findings have given rise to a considerable body of empirical work by human factors researchers and experimental psychologists. To this group of researchers (psychologists and cognitive neuroscientists) vigilance describes the ability to perform a task for a period of time; they often refer to a decrement in vigilance.

[16] Norman H. Mackworth, "Vigilance,'" *The Advancement of Science*, 53 (1957): 389-393.

[17] Julie Fairman, "Watchful Vigilance: Nursing Care, Technology, and the Development of Intensive Care Units," *Nursing Research*, 41 (1992): 56-60.

[18] Jeanette Hirter and Ronald Van Nest, "Vigilance: A Concept and a Reality," *CRNA: The Clinical Forum for Nurse Anesthetists*, 2 (May 6, 1995): 96-98.

[19] Geralyn Meyer and Mary Ann Lavin, "Vigilance: The Essence of Nursing." *OJIN: The Online Journal of Issues in Nursing*, 10 no 1 (June 23, 2005). http://www.nursingworld.org/MainMenuCategories/ANAMarketplace/ANAPeriodicals/OJIN/TableofContents/Volume102005/No3Sept05/ArticlePreviousTopic/VigilanceTheEssence of Nursing.html (accessed September 30, 2010).

[20] Rita Schreiber and Marjorie MacDonald, "Keeping Vigil over the Patient: a Grounded Theory of Nurse Anesthesia," *Journal of Advanced Nursing*, 66 (3) (2010): 552-561.

[21] Olive Berger, "Anesthesia for the Surgical Treatment of Cyanotic Congenital Heart Disease," *Journal of the American Association of Nurse Anesthetists* (May 1948): 79-90 and Olive Berger, "Further Observations on Anesthesia for the Surgical Treatment of Cyanotic Congenital Heart Disease," *Journal of the American Association of Nurse Anesthetists* (February 1949): 19-24.

[22] Virginia Thatcher, *History of Anesthesia with Emphasis on the Nurse Specialist* (Philadelphia: J. B. Lippincott, 1953): 157.

[23] Bruce Evan Koch, "Surgeon-Nurse Anesthetist Collaboration Advanced Surgery Between 1889 and 1950," *Anesthesia and Analgesia* 120 (2015): 653-662.

[24] Thatcher, *History of Anesthesia*, 157-161.

[25] Online dictionary at, http://www.merriam-webster.com/dictionary/archetype (accessed January 15, 2015).

[26] Olive Berger, "Anesthesia for the Surgical Treatment of Cyanotic Congenital Heart Disease," *Journal of the American Association of Nurse Anesthetists* (May 1948): 79-90.

[27] She was also called "Lady Olive" by Hopkins staff for her collaborative not confrontational manner.

[28] Barbara Carper, "Fundamental Patterns of Knowing in Nursing," *Advances in Nursing Science* 1 (1978): 13-23.

[29] Jasmine Tayray, "Art, Science or Both?" *Nursing Clinics of North America,* 44 (2009): 415-421.

[30] Stanley Joel Reiser, *Medicine and the Reign of Technology* (Cambridge: Cambridge University Press, 1978).

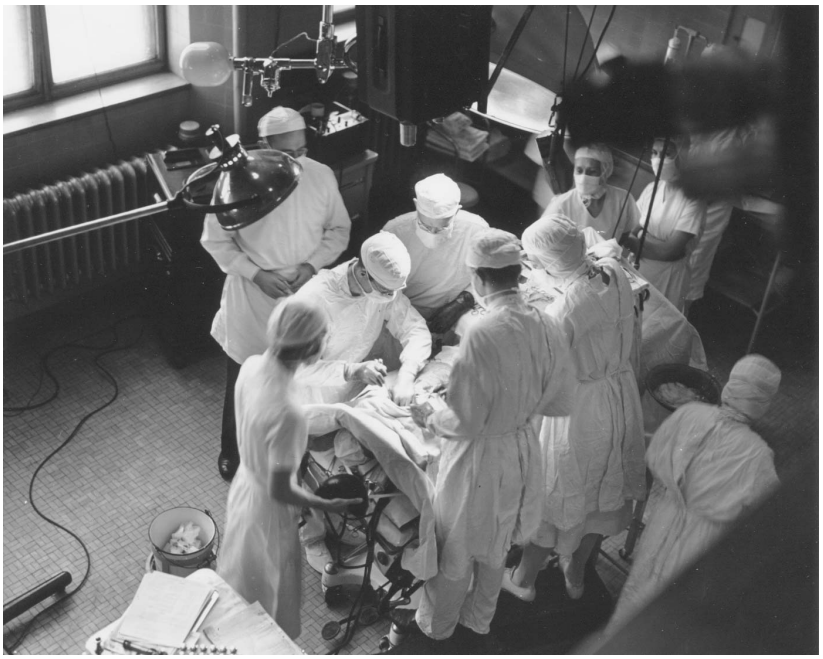
[31] Olive Berger, "Anesthesia for the Surgical Treatment of Cyanotic Congenital Heart Disease," *Journal of the American Association of Nurse Anesthetists* (May 1948): 79-90.

[32] Today evidence-based practice replaces the use of trial and error, optimizes evaluation, development, and professional advancement.

[33] Jasmine Tayray, "Art, Science or Both?" *Nursing Clinics of North America,* 44 (2009): 415-421.

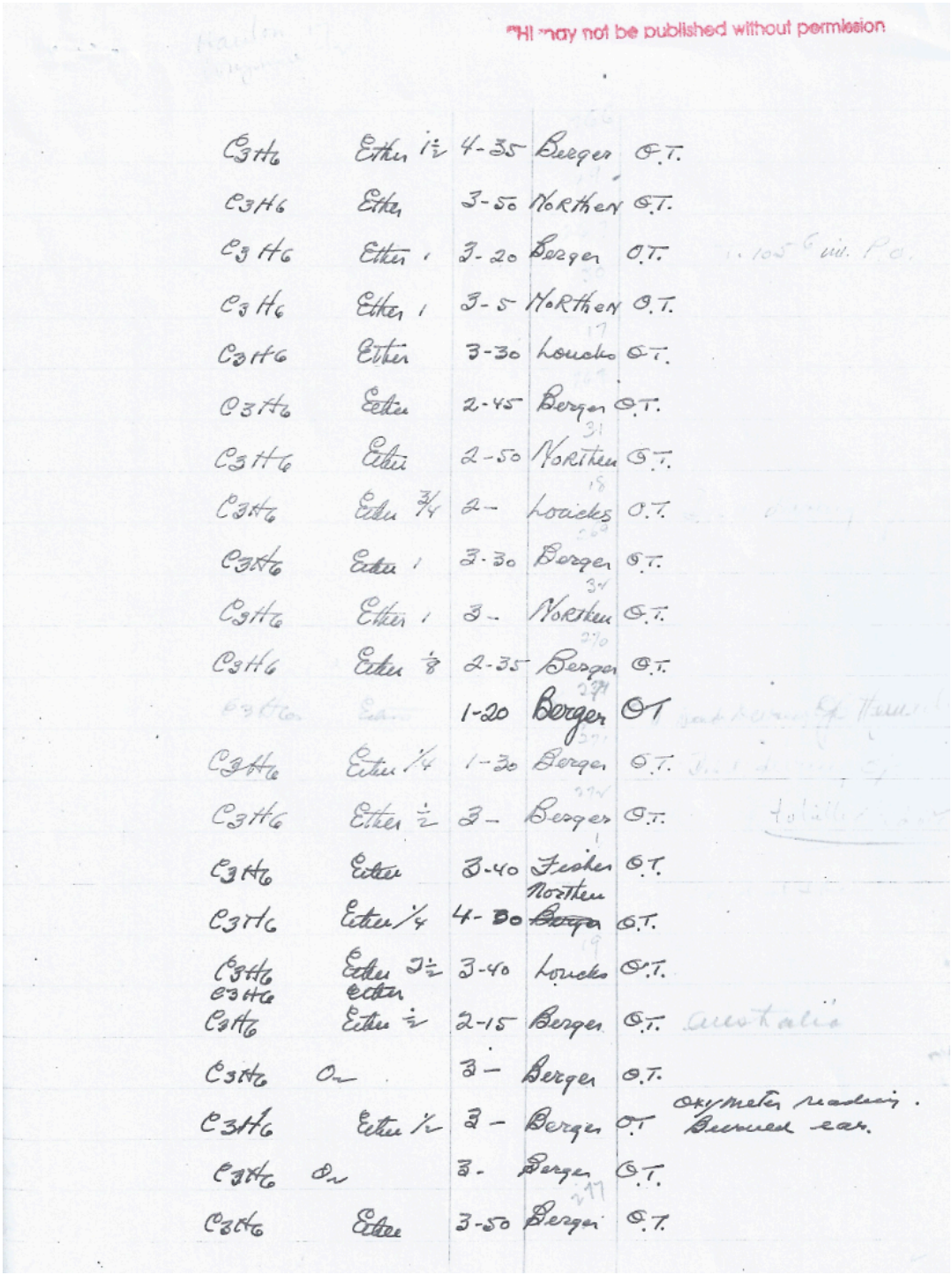
Appendix A – Photos of blue baby procedure, February 28, 1947

Alan Mason Chesney Medical Archives of The Johns Hopkins Medical Institutions



Appendix B – Olive Berger's log sample

Alan Mason Chesney Medical Archives of The Johns Hopkins Medical Institutions



C_3H_6	Ether ½	4-35	Berger	O.T.
C_3H_6	Ether	3-50	Norther	O.T.
C_3H_6	Ether 1	3-20	Berger	O.T.
C_3H_6	Ether 1	3-5	Norther	O.T.
C_3H_6	Ether	3-30	Loucks	O.T.
C_3H_6	Ether	2-45	Berger	O.T.
C_3H_6	Ether	2-50	Norther	O.T.
C_3H_6	Ether ¾	2-	Loucks	O.T.
C_3H_6	Ether 1	3-30	Berger	O.T.
C_3H_6	Ether 1	3-	Norther	O.T.
C_3H_6	Ether ⅛	2-35	Berger	O.T.
		1-20	Berger	OT
C_3H_6	Ether ¼	1-30	Berger	O.T.
C_3H_6	Ether ½	2-	Berger	O.T.
C_3H_6	Ether	3-40	Fisher Norther	O.T.
C_3H_6	Ether ¼	4-30	~~Berger~~	O.T.
C_3H_6 C_3H_6	Ether ½ ether	3-40	Loucks	O.T.
C_3H_6	Ether ½	2-15	Berger	O.T.
C_3H_6	O₂	3-	Berger	O.T.
C_3H_6	Ether ½	3-	Berger	O.T. Oxymeter reading. Burned ear.
C_3H_6	O₂	3-	Berger	O.T.
C_3H_6	Ether	3-50	Berger	O.T.

Appendix C– Alfred Blalock, MD and Helen B Taussig, MD. "The Surgical Treatment of Malformations of the Heart in which there is Pulmonary Stenosis or Pulmonary Atresia" *JAMA* 128; 3 (May 19th 1945) 189-202.

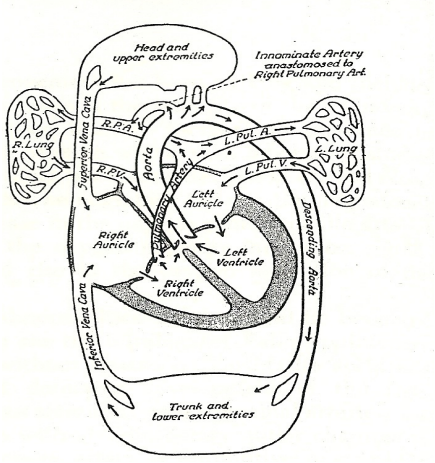


Fig. 12.—Diagram of the course of the circulation in the tetralogy of Fallot after the anastomosis of the innominate artery to the pulmonary artery. Under these circumstances the blood from the right auricle flows into the right ventricle and, as before, part of the blood from the right ventricle is pumped directly into the aorta. Now, in addition to the blood which is pumped through the pulmonary orifice into the pulmonary artery, some of the blood from the aorta is diverted through the anastomosis to the lungs. Thus the volume of blood which reaches the lungs is increased and the volume of oxygenated blood which is returned to the left auricle and the left ventricle is proportionately increased. All of the blood from the left ventricle and also some blood from the right ventricle is pumped into the aorta. Some of the blood from the aorta is directed to the lungs, and the remainder goes to the systemic circulation and is returned by the superior vena cava and the inferior vena cava to the right auricle. Thus the left ventricle receives more blood than before operation and the right side of the heart receives less. The operation has bypassed the obstruction in the circulation of the blood to the lungs.

Appendix D – Robert M. Smith's *Anesthesia for Infants and Children, 1st edition 1959*.

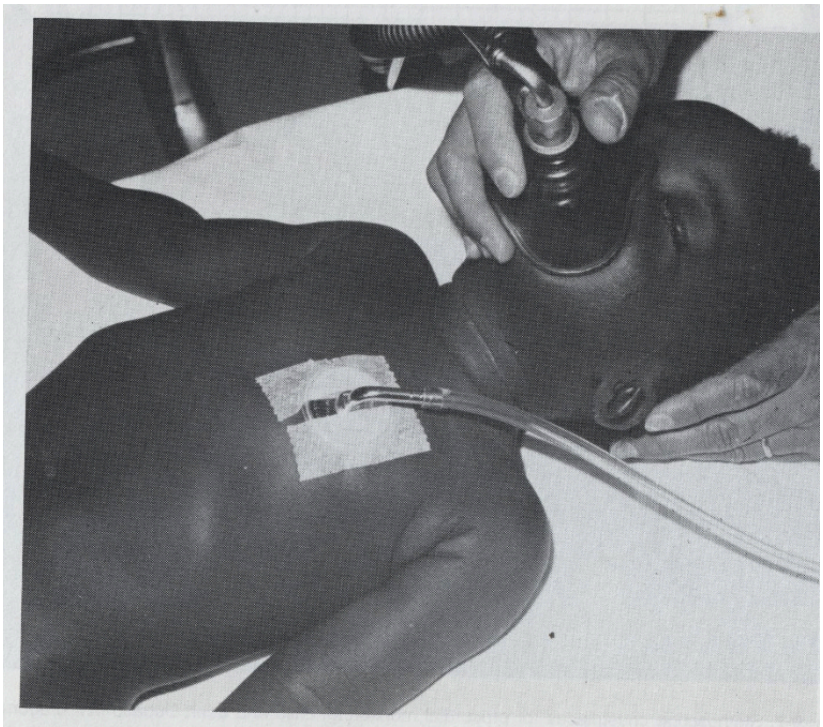


Fig. 9-8. Precordial stethoscope in place over the outer border of the heart at the nipple line.

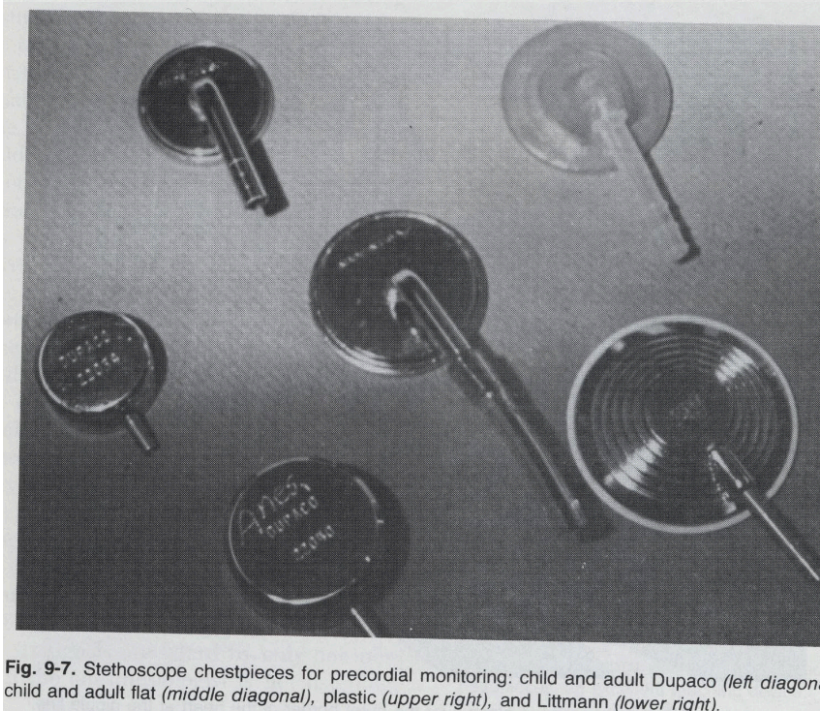


Fig. 9-7. Stethoscope chestpieces for precordial monitoring: child and adult Dupaco *(left diagon*
child and adult flat *(middle diagonal)*, plastic *(upper right)*, and Littmann *(lower right)*.

Appendix E – Johns Hopkins Hospital Gyn OR B staff

Alan Mason Chesney Medical Archives of The Johns Hopkins Medical Institutions

Appendix F– Olive Berger Portrait

Alan Mason Chesney Medical Archives of The Johns Hopkins Medical Institutions