

Integrating Pupillometry into a Cardiovascular Intensive Care Unit: An Evidence- Based Quality Improvement Project

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SCHOOL *of* NURSING

DNP Project Team

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Background and Significance

- Neurologic assessment, including pupillary assessment, is a standard of care in critically ill patients.
- Accurate neurologic assessment is essential (Olson et al., 2016; Phillips et al., 2019).
- Abnormalities of pupillary response are associated with neurological deterioration and correlate with poor neurological outcomes (Chen et al., 2011; Emilifeonwu et al., 2018).

Background and Significance

- Manual pupillary assessment has been the standard of care.
 - Low inter- and intra- observer reliability among clinicians
(Olson et al., 2016).
- Pupillometers standardize this crucial assessment.
- A pupillometer is an automated, objective, non-invasive, handheld device.
- Pupillometry is not widely adopted.

Literature Review

Major Conclusions:

- Literature supports the accuracy of pupillometry and its use in patient's post cardiac arrest.
- The most common neurologic consequence following cardiac arrest is hypoxic-ischemic brain injury.
- Hypoxic-ischemic brain injury is like neurologic complications following.

Literature Review

Major Conclusions (con't.):

- Pupillometry has been well documented as beneficial in neurological literature (Chen et al., 2011; El Ahmadieh et. al., 2021; Godau et al., 2021; Osman et al., 2019).
- Pupillometry is superior to manual pupillary assessment and should be the standard of care.

Project Purpose

Since cardiovascular surgery patients are at increased risk for neurologic complications, **integrating pupillometry will assist neurologic assessment and detection of neurologic complications.** Doing this has been shown to improve the accuracy of neurologic assessments and will potentially improve patient outcomes.

Project Design: Methods

Setting and Sample:

- Cardiovascular Intensive Care Unit (CVICU): 24-bed surgical ICU.
- This patient population is at an increased risk for neurologic complications.
- The patients at highest risk for neurologic complications are patients requiring mechanical circulatory support devices (MCS).

Project Design: Methods

Inclusion Criteria

- Adult patients admitted to the CVICU during the project window with MCSD.

Exclusion Criteria

- All other CVICU patients.

Project Design: Measures

- Age (range).
- Gender.
- Admission diagnosis.
- Co-morbidities.
- Mechanical device type.
- Length of device use.
- Length of stay.
- Neurologic complication occurred (Yes or No).
- Mortality.

Project Design: Measures

- Anticoagulation use (Yes or No).
- Anticoagulation type.
- Pupillometry data points documented.
- Nursing compliance to order (% pupillometry is documented).
- % Order for pupillometry is placed.
- Intervention/provider notification was documented because of abnormal pupillometry.

Project Design: Procedures

- Institutional Review Board (IRB) determination (July).
- Background education for project (August):
 - Educational computer-based module on pupillometry.
 - Charge nurse education.
 - Discussion of project at staff meetings/unit huddles.
- Order for pupillometry placed in all mechanical circulatory support device order sets (September 1).
- Informational decision support tool posted (September 1).

Protection of Human Subjects Consideration

- IRB Application.
 - Determination of Human Subjects Research.
- Pupillometry was the standard of care, so consent was waived.
- Ethical considerations:
 - Confidentiality.
 - Justice.
 - Beneficence.
 - Non-maleficence.

Data Analysis

Variable	N	%
Age (years)		
18-39	3	18.75
40-59	4	25.0
60-79	8	50.0
80+	1	6.25
Gender		
Male	13	81.25
Female	3	18.75

Data Analysis

Variable	N	%
Device Type		
VV-ECMO	6	37.5
VA-ECMO	3	18.75
CENTRIMAG™	1	6.25
IABP	4	25.0
LVAD	1	6.25
IMPELLA™	1	6.25

Data Analysis

Variable	IQR	Median
Length of Stay (days)	12-48.5	25.5
Length of Device Use (days)	2-20	3.5

Data Analysis

Variable	N	%
Neurologic Complication		
Yes	2	12.5
No	14	87.5
Mortality		
Yes	4	25.0
No	12	75.0
Anticoagulation		
Yes	12	75.0
No	4	25.0

Data Analysis

Variable	N	%
Total Expected Documented Assessments for All MCSD Patients	747	
Total Expected Documented Assessments with Orders Place	735	100.0
Total Completed Assessments Documented	551	75.0
Total Assessments Not Documented		
No Documentation	145	19.7
Patient Refusal Documented	35	4.8
Pupillometer Unavailable Documented	4	0.5

Data Analysis

Variable	N	%
Abnormal Results Documented	33	100.0
Provider Notification/Intervention Documented		
Yes	5	15.0
No	28	85.0

Sustainability and Discussion

- An in-depth understanding of barriers is needed for sustainability.
- Further investigation into workflow and ease of documentation is needed.
 - Use of the Epic[®] Brain.
- There was a 75% improvement in pupillometry use as a result of this project.

Sustainability and Discussion

- Requirement of and improvement in documentation of provider notification and intervention is necessary.
 - Documentation of provider notification/intervention was not required.
 - Many variables could account for lack of documentation.
 - Variables impacting lack of intervention.

Strengths of the Project

- Uses a validated and reliable instrument among all ethnicities (pupillometer).
- Implementation of current evidence.
- Minimal adjustment to current clinical flow.
- No financial requirements.
- Promotes enhanced clinical assessment and potentially early recognition of neurologic complications.

Nursing Practice Implications

- **Improve neurologic assessment** (Chen et al., 2011; El Ahmadieh et. al., 2021; Godau et al., 2021; Osman et al., 2019).
- **Potential for earlier detection and intervention** (Chen et al., 2011; El Ahmadieh et. al., 2021; Godau et al., 2021; Osman et al., 2019).
- **Potential for improved patient outcomes** (Chen et al., 2011; El Ahmadieh et. al., 2021; Godau et al., 2021; Osman et al., 2019).
- **Potential reduction in healthcare costs for the patient and institution** (Chen et al., 2011; El Ahmadieh et. al., 2021; Godau et al., 2021; Osman et al., 2019).
- **Application in other populations.**

Disseminate Results

- A manuscript ready for publication:
 - Final report of the DNP project in Libra.
 - Manuscript submission to Journal of Critical Care Nurse.
- Poster ready for presentation.
- Considerations for future scholarship:
 - Improve documentation workflow.
 - Research.
 - Broaden scope.

Conclusion

- Neurologic assessment, including pupillary assessment, is a standard of care in critically ill patients.
- Pupillometry is reliable and reproducible (Nyholm et al., 2022).
- Pupillometry improves neurologic assessment (Chen et al., 2011; El Ahmadieh et al., 2021; Godau et al., 2021; Osman et al., 2019).

Conclusion

- Early, accurate detection of neurologic deterioration has the potential to improve outcomes and save on healthcare costs (Chen et al., 2011; El Ahmadieh et al., 2021; Godau et al., 2021; Osman et al., 2019).
- It is feasible to perform routine pupillary examinations on MCSD patients.
- In-depth understanding is needed to sustain.

Questions?

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