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Improving Traumatic Brain Injury Outcomes: Early Identification and Management of Paroxysmal Sympathetic Hyperactivity

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Randi Rockwell

Executive Summary

Improving Traumatic Brain Injury Outcomes: Early Identification and Management of

Paroxysmal Sympathetic Hyperactivity

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Southern Illinois University Edwardsville

Introduction

There is a high incidence of excessive sympathetic outflow activity in many traumatic brain injury (TBI) patients (Meyfroidt, G., Baguley, I. & Menon, D., 2017). Symptoms consist of hyperthermia, sweating, arterial hypertension, tachycardia, tachypnea, and extremity motor dystonic posturing, often in response to stimuli (Meyfroidt, Baguley & Menon, 2017; Samuel, Allison, Lee & Choi, 2016; Zheng, Lei, Yang, Huang & Zhang, 2020). The lack of clear definition or terminology of the symptomatology of this syndrome has caused underdiagnosis despite its high incidence in severe traumatic brain injury, morbidity and mortality and the increased healthcare and societal costs associated with traumatic brain injured patients (Meyfroidt, Baguley & Menon, 2017). The absence of a unified diagnostic criterion has severely hindered the ability to advance medical treatments. Finally, in 2014, a consensus expert group came together, 60 years after the first described written case, to establish a rigorous conceptual definition and diagnostic criteria (Meyfroidt, Baguley & Menon, 2017; Samuel, Allison, Lee & Choi, 2016; Zheng et al., 2020). The term Paroxysmal Sympathetic Hyperactivity (PSH) was introduced by a consensus group in 2014 and has become the unified term or acknowledged definition of these abnormal symptoms in TBI patients. The identified criteria and assessment tool, known as the Paroxysmal Sympathetic Hyperactivity Assessment Measure (PSH-AM) was developed and can be useful in assisting healthcare professionals in the diagnosis and medical management of TBI patients (Zheng et al., 2020). The PSH-AM is broken into two components the Diagnostic Likelihood Tool (DLT) and Clinical Feature Scale (CFS).

Currently, within a large teaching community level one trauma center, in the south side of Chicago, there is a perceived lack of implementation of evidence into practice in the surgical trauma intensive care unit. Most nurses working in the surgical trauma intensive care unit

(STICU) admit that TBI patients are difficult to take care of given the complex pathophysiological nature of their injury or injuries. The trauma multidisciplinary team's data has also seen an increase in TBI readmission to the intensive care unit related to PSH symptoms and medication administration. It was identified that an educational quality improvement project was needed to improve care provided to our TBI patients, specifically, patients showing signs and symptoms of PSH, in the STICU. By providing education to healthcare professionals about the current literature, pathophysiology, pharmacological management, and newly acknowledged PSH-AM tool, healthcare professionals can deliver evidence-based care. The belief is that PSH will be recognized and treated earlier to prevent worsening brain injury and unfavorable outcomes in this patient population.

Literature Review

Literature was reviewed and obtained after using the search engines of CINAHL, MEDLINE, and PubMed. The search strategy and keywords that were used consisted of full-text, English, an adult population (>18 years of age), paroxysmal sympathetic hyperactivity (PSH), autonomic dysregulation, sympathetic storm, dysautonomia, traumatic brain injury (TBI), and acquired or acute brain injury ABI). Four main research articles were evaluated and synthesized for evidence about PSH in TBI patients. Mathew et al., (2019), have acknowledged in the literature that most studies have a wide range of incidental findings of PSH in TBI patients ranging from 8% to 33%. All articles identified the most common symptoms of PSH as tachycardia, tachypnea, hypertension, hyperthermia, diaphoresis, and extremity motor posturing. The studies recognized that symptoms could occur within the first five days of admission and may last more than two months. Symptom management is vital throughout all transitional phases in the acute care setting of these patients.

All studies evaluated for evidence identified the significance of clinical symptomatology of PSH and that the PSH-AM tool had clinical usage in assisting healthcare providers in identifying symptoms of PSH for adequate diagnosis and prompt treatment management. Most literature notes that greater than 80% of the paroxysmal episodes in TBI or acquired brain injury patients are related to allodynic responses to noxious and non-noxious stimuli like suctioning, pressure sensations, and noise to name a few (Thomas & Greenwald, 2019). Identifying patient triggers or stimuli is beneficial in the overall care management of PSH patients. The studies also addressed the impact PSH had on length of hospital stay and worsening outcomes. Samuel et al., (2018) in their study, assumed clinical assessment as the gold standard, while utilizing the PSH-AM tool yielded a sensitivity of 94% (identifying who has PSH) and specificity of 35% (ruling out who does not have PSH). The other studies discussed how the PSH-AM tool correlated with adequate diagnosis when used appropriately. The literature reviewed on PSH in TBI patients will provide imperative information regarding best practice management of the syndrome and allow for the development of a unit-specific educational seminar for quality improvement on TBI care and outcomes.

Project Methods

The project's purpose is to improve the bedside care of TBI injury patients in the STICU by preventing secondary brain injury through early identification and management of PSH. The STICU setting was selected for this quality initiative because of the amount of TBIs this unit acquires, the high acuity this patient population poses, and the increased awareness of the identified educational needs of the healthcare professionals working in this unit. The internal review board for the institution was consulted, but no further approval was needed from the review board since this was deemed a quality improvement project. Key stakeholders were

identified early and included the trauma director, attending physician leadership, nursing management, nursing educator, and the STICU's pharmacist. The gatekeeper and overseer of the project was the trauma director and another surgical trauma attending colleague who assisted with creating urgency of PSH knowledge amongst residents and other physician colleagues. The nursing unit management and the unit nurse educator helped with sending out emails regarding the educational project presentation, empowering nurses, and obtained presentation equipment technologies. Lastly, the STICU's pharmacist assisted with the pharmacological knowledge of the medications associated with the syndrome. Project objectives and outcomes were discussed in detail with all key members prior to the project's roll-out to healthcare providers working in the STICU setting.

Evaluation

The evaluation process consisted of 10 completed seminars with pre- and post-tests of the educational content provided. A two-sample t-test power analysis was completed for the sample size of N=50. There were six questions on the pre- and post-tests, and both had the same questions but in a different order. Data collected from these tests were quantitative in nature and showed an increase in mean percentage test scores. A Likert scale evaluation tool was utilized for seminar presentation evaluation and overall attendee satisfaction. One of the 10 seminars was tailored for the eight attending surgical trauma intensivists on the unit. The rest of the seminars were geared toward nursing staff, residents, and nurse practitioners working on the unit. 36 nurses, three NPs, and four attending physicians completed the seminar, the pre-post-tests, and evaluation process. This quality improvement project did have a few limitations. The goal of 50 participants was not achieved. This was due to several factors, including high acuity of the patients in the intensive care setting, work and staffing schedules, timing of seminar sessions,

and the presenter being ill with COVID-19 for 10 days (about 1 and a half weeks). During the implementation of education, there were some technological issues with signing online to obtain the PowerPoint presentation and the connection capabilities of the computer and monitoring screens. At times, the PowerPoint was viewed via laptop computer with a few nurses huddled around. Lastly, the evaluation process and chart review were completed by the project content expert.

One of the goals for the project was to achieve a post-evaluation test score increase of greater than 20%. A two-sample T-test was used for the mean average score of the pre-test versus the mean average in post-test score. The pre-test score average was 3.9 out of 6 questions with an overall score of 65% and the post-test average was 5.5 out of 6 questions with an overall score of 92% of all participants. The outcome goal for knowledge attainment was achieved post-test with an overall score of greater than 85%. After the educational seminars and post-tests were completed, eight patients' charts were reviewed for PSH symptoms acquired after sustaining a TBI utilizing the two constructs of the Paroxysmal Sympathetic Hyperactivity Assessment Measure (PSH-AM). Five patients were identified early, and treatment started at the time of symptom onset, while three patients were noted to have missed symptoms with treatment started one to three days post spike in temperature and documented symptoms. Propranolol was still noted as the attending physician's first preference in patient management; however, oxycodone was more widely applied early and utilized with post-weaning of Fentanyl drips for PSH patients experiencing prominent symptoms identified by the PSH-AM and clinical presentation as per literature recommendations.

Before this project's implementation, the pre-test scores showed that the staff in the STICU had inadequate knowledge of PSH. Post-presentation, there were improved post-test

scores. After a small chart review, there was an increase in providers' ability to identify and diagnose symptoms of PSH in TBI patients and adherence to professional management guidelines on best practices. Most patient symptomatology only lasted, on average, two to three weeks, and by the time of discharge, some of the PSH medications were able to be weaned off. This notes that the chart sample evaluated may have identified only mild to moderate TBI injury patients since the literature suggests symptoms can occur up to one-year post-TBI in severe cases. Key takeaways were noted with the post-presentation Likert evaluation form. The major acknowledged significances included the following: the information presented was important for bedside practice, the presentation was concise, objectives were identified and addressed, the review and understanding of the pathophysiology of the syndrome and the rationale for early identification and management was presented clearly, the overall outcomes were summarized, and the continuous need for increased monitoring and bedside care for TBI patients who may develop PSH was identified by all healthcare providers. This continuous quality improvement project will continue onward in the STICU with the medical management and care of TBI patients, specifically patients at considerable risk of acquiring PSH.

Impact on Practice

There was an immediate impact with the healthcare team's early recognition of the signs and symptoms of PSH in our TBI patient population. The t-test scores identified greater than 20% increase in average scores. The earlier identification of symptoms allowed for appropriate medication management of this syndrome and prevented worsening outcomes. Nursing care was further adjusted to prevent provocation of PSH symptoms and to meet patient and family care needs. The predicted long-term impact will include utilizing the information provided in this educational quality improvement project to identify PSH symptomatology, earlier

pharmacological management, meeting quality outcomes for this population within the acute care setting and limiting and preventing secondary brain injury in the healthcare system's TBI population. Ongoing educational implementation will be impactful in the long term. The STICU nursing website will provide a resource for nursing staff. The website will include the project's educational PowerPoint and three main articles reviewed on PSH. Continued excitement and reinforcement measures at the bedside from the surgical trauma healthcare team regarding TBI management will be key in meeting quality outcomes for this highly unique patient population.

Conclusions

In conclusion, the data gathered from this quality improvement project indicates that knowledge attainment can be achieved by presenting new evidence on TBI care management and engaging educational seminars in the ICU setting. The most current evidence was disseminated and transitioned into practice, immediately. Further educational seminars should be provided to nurses and new healthcare professionals caring for traumatic brain injury patients by the surgical trauma team. The Likert evaluation tool allowed for suggestions and improvements in the visual presentation and the delivery method of key information in the presenter's PowerPoint. Key stakeholders and leadership partners need to continue to maintain urgency in early identification and management of PSH in TBI patients to prevent worsening outcomes in this population. Further research and evidence are needed with the utilization of the PSH-AM tool in acute care practice. A TBI management protocol would be beneficial in acute care settings including the management of PSH and prevention of secondary brain injury in the TBI patient population.

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