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# Paroxysmal Sympathetic Hyperactivity in Children: An Exploratory Evaluation of Nursing Interventions

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ABSTRACT

*Background:* Paroxysmal sympathetic hyperactivity (PSH) produces symptoms of autonomic instability and muscle over-activity; however, the majority of nursing interventions used in clinical practice are anecdotal and not evidenced based.
*Objective:* The primary objective was to report nursing documentation of PSH events, and to describe the clinical nursing interventions and care provided to children who have suffered a severe brain injury and are exhibiting PSH. The secondary objective was to demonstrate how the Symptom Management Theory (SMT) can serve as a framework for research related to brain injury and PSH.
*Methodology:* The study consisted of a retrospective chart review of nursing progress notes using direct content analysis. The nested sample of ten randomly selected charts was chosen from a larger quantitative study of 83 children who had suffered severe brain injuries with and without PSH. Textual analysis of verbatim nursing progress notes was used to describe nursing interventions that were used and documented for this patient population.
*Results:* The priority nursing interventions to manage these symptoms included medication administration, facilitation of family presence, and strategies to target auditory, tactile, and visual stimuli. The sample received different individual interventions for PSH. Additionally, individual subjects demonstrated different patterns of interventions.
*Implications:* While tactile interventions were documented most frequently, there was not a uniform approach to interventions. The SMT can be useful to provide a framework that organizes and tests clinical care and management of PSH strategies.



## Introduction

Paroxysmal sympathetic hyperactivity (PSH) is a symptom cluster that has been defined in the literature as recurrent fever without a source of infection, hypertension, tachycardia, tachypnea, agitation, diaphoresis, and dystonia. This cluster of symptoms can present following severe brain injury in children and adults (Kirk et al., 2012; Krach, Kriel, Morris, Warhol, & Luxenberg, 1997; Baguley et al., 2014). PSH produces symptoms of autonomic instability and muscle over-activity; however, the majority of nursing interventions used in clinical practice are anecdotal and not based on research.

Nursing studies regarding symptom management following brain injury remain descriptive in nature, and PSH-specific nursing studies are lacking. Routine nursing interventions performed for individuals following brain injury have been documented; however, the relationship of the intervention with associated outcomes has not been explored (McNett & Gianakis, 2010). Standardized patient care guidelines are limited, contributing to a delay in nursing prioritization of interventions and treatment (Thompson, Kirkness, & Mitchell, 2007a, 2007b). To date, there has been a lack of nursing studies conducted with the goal of focusing on recognition or targeted interventions to manage PSH. Thus, there is no solid foundation of evidence-based interventions for management of PSH and no literature suggesting how nurses should intervene in managing these symptoms.

Nursing care priorities following brain injury have been described as monitoring blood pressure, oxygen saturation, and temperature (McNett & Gianakis, 2010). Once hyperthermia is present, nursing interventions including acetaminophen and cold saline administration, application of ice packs and cooling blankets, and administration of

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tepid bathes have been used to alleviate fever (Brown, Udomphorn, Suz, & Vavilala, 2008; Fink, Kochanek, Clark, & Bell, 2012; Thompson et al., 2007a, 2007b). However, nursing studies to evaluate effective interventions in PSH are desperately needed given that PSH presents as a cluster of symptoms. Furthermore, a uniform approach to management is urgently warranted to promote healing and recovery which may include manipulation of the physical environment (auditory, tactile and visual stimuli).

## Objectives

Based on the lack of evidence in the literature to guide practice, the question remains, what are nursing strategies that are being employed in clinical practice when symptoms of PSH are present? The primary objectives of this exploratory study, grounded by the Symptom Management Theory as a framework, were to report nursing documentation of PSH events, and describe the clinical nursing interventions and care provided to a child who has suffered a severe brain injury and is exhibiting PSH. The secondary objective was to demonstrate how the Symptom Management Theory can serve as a framework for research related to brain injury and PSH.

## Symptom Management Theory

Symptom Management Theory (SMT) can serve as a framework for research related to brain injury and PSH. The model was introduced in 1994 and developed by faculty at the University of California-San Francisco School of Nursing. A major strength of the SMT is that it is a multidimensional, dynamic process for management of symptoms, which has provided a framework for symptom research and clinical practice. Symptoms affect health and can disrupt the recovery process after illness or injury. Nursing care and interventions need to be developed to manage these symptoms that take the whole child into consideration. This theory guides clinical interventions for single symptoms as well as symptom clusters.

The three main concepts of the SMT, include symptom experience, management strategies, and outcomes. In addition, the nursing domains of person, environment, and health/illness are also incorporated to provide a holistic approach to symptom management. Additionally, the relationships and connections between the concepts provide a structure that can be used to test hypotheses (Dodd et al., 2001; Humphreys et al., 2008).

The evidence supporting the application of the SMT in the pediatric population is developing. The SMT has been applied to pediatric cancer and asthma studies and has successfully guided study design (Humphreys et al., 2008; Linder, 2010; Newcomb, 2010). Researchers agree that additional applications are needed to advance utility of the model in pediatric symptom management research. Using the SMT as a conceptual framework may help understand PSH both from a symptom cluster perspective and as a concept to promote family-centered nursing care.

### *PSH Symptom Experience*

PSH is an elusive phenomenon first reported in the literature by Strich in 1956. Strich (1956) describes episodes of agitation, diaphoresis, hyperthermia, tachycardia, tachypnea, and posturing after severe brain injury that initially labeled as brainstem attacks. Since that time, multiple nomenclatures have been coined to describe these events. Examples of other nomenclatures include dysautonomia, paroxysmal autonomic instability, storming, central autonomic dysfunction, and diencephalic seizures. PSH symptoms first appear within days after injury and may persist for weeks to months following the injury if an individual does not regain consciousness (Blackman, Patrick, Buck, & Rust, 2004). Unfortunately, there are currently no uniform criteria regarding vital sign parameters and how many symptoms need to be present during an episode; however, a spectrum of severity could be the answer to this debate. Symptoms could be present in clusters or in combination based on the severity or pattern of the brain injury.

The symptom experience of PSH within the context of the SMT includes perception, evaluation, and response to the symptoms. Individuals that exhibit PSH have impaired arousal and perception, a strength of the model is that it allows for the interpretation by the parent and/or caregiver of a nonverbal individual's symptoms (Dodd et al., 2001). Evaluation of the symptoms is complex and requires thoughtful consideration of how these symptoms may be affecting the individual in a negative manner, particularly, in an individual who has impaired arousal and awareness. The nurse and/or caregiver can provide valuable insight regarding the perception, evaluation, and response to the symptoms that encompass a PSH episode. Another strength is that the model takes into consideration environmental and developmental influences that may impact management strategies such as physical, social and cultural circumstances. Additionally, the model supports the identification of potential trigger and for the implementation of preventive strategies to prevent PSH episodes.

Symptom management strategies within the SMT seek to decrease negative outcomes associated with the symptom experience. Nursing strategies pertaining to PSH should seek to reduce the frequency of episodes, minimize the severity of symptoms, or relieve distress associated with the symptoms. The domains of the person, environment, and health status should be taken into consideration when developing targeted interventions while maintain a holistic approach to care. Unfortunately, management and treatment options for episodes of PSH are lacking and nursing care for these patients is practical in nature because of limited evidence. There are a few medical case studies that have reported different medications used to treat and control targeted symptoms of PSH (Kirk et al., 2012; Srinivasan, Lim, & Thirugnanam, 2007; Tanti, Gasperini, & Rossini, 2005; Wang & Manley, 2008); however, more nursing studies are needed to address the gap in the literature.

### *Outcomes*

In adults with brain injury, PSH is associated with poorer clinical outcomes, including longer hospitalizations and poorer cognitive and motor function (Baguley et al., 1999; Hendricks, Heeren, & Vos, 2010; Tanti et al., 2005). There are only two published studies exploring PSH and the effects on recovery trajectory in children. Kirk et al. (2012) and Krach et al. (1997) have reported a poorer recovery trajectory for children as defined by prolonged rehabilitation hospitalizations and poorer cognitive and motor function.

Outcomes within the SMT need to be assessed following the implementation of a symptom management strategy. For example, previous applications of the model in intervention studies have demonstrated improved outcomes related to (1) better physical and mental functioning, (2) improved quality of life, (3) shorter hospital stay, (4) quicker return to work, (5) greater productivity, and (6) less cost to the individual, family, health care system, or employer (Humphreys et al., 2008). The success of a nursing intervention for a child with severe brain injury with PSH could be determined if the frequency, severity, and distress are decreased. However, the ultimate goal is to improve functional (cognitive and motor) outcomes following severe brain injury in children and evidence-based nursing interventions are needed.

Successful intervention strategies may target different aspects of the individual's symptoms (Dodd et al., 2001). Given that PSH, present as a cluster of symptoms a single intervention may not be sufficient a multicomponent interventions strategy may be needed to address PSH with better success.

While additional research needs to be conducted to evaluate the relationships, Fig. 1 provides a visual representation of how the SMT can be applied to PSH. The proposed hypothesis is that the physical environment, which includes auditory, tactile, and visual stimuli, could affect the symptom experience of PSH, influencing the clinical outcomes and

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