Using the Human Response to Illness Model to assess altered level of consciousness in patients with subdural hematomas

By Janice Nesbitt and Jo-Ann V. Sawatzky

Abstract
Head injuries are the leading cause of trauma mortality and account for nearly half of all deaths related to trauma injuries. Patients who present with subdural hematomas are at risk for initial damage to the brain, as well as for subsequent brain damage related to re-bleed, ischemia or cerebral edema. These injuries can be acute or chronic in nature, and may be manifested in the patient as an altered level of consciousness. Skilled nursing assessment of altered level of consciousness leads to early nursing and medical intervention, which, in turn, can improve patient outcomes.

In this paper, a critical review of the literature will focus on altered level of consciousness in patients presenting with a subdural hematoma. The Human Response to Illness Model will be utilized as a framework for this review. Accordingly, the physiological, pathophysiological, behavioural, and experiential perspectives of altered level of consciousness will be examined. Thus, a comprehensive understanding of this human response and rationale for evidence-based interventions will be established.

Background
Traumatic brain injuries (TBI) are the leading cause of trauma mortality, accounting for half of all trauma deaths (Tallon, Ackroyd-Stolarz, Karim, & Clarke, 2008). These injuries are most common in young men and the elderly, and are often related to motor vehicle accidents, physical violence, or falls (Abelson-Mitchell, 2007). In 2004, a total of 16,811 head injuries were reported in Canada, of which 68% of these victims were males (Canadian Institute for Health Information [CIHI], 2006). One classification of TBI is subdural hematomas (SDH), which are usually the result of blunt trauma, but can also occur spontaneously in some individuals. SDH accounts for approximately 30% of all head injuries (Tallon et al., 2008). Depending on the size and location of the lesion, patients can present with focal deficits, which can cause cerebral ischemia and advance to become a threat to the patient’s life (Josephson, 2004).

Despite advances in the care of patients with TBI, patients presenting with a diagnosis of acute SDH experience a mortality rate of 60% to 90%, as a result of the primary injury and/or secondary cerebral damage (Hlatky, Valadka, Goodman, & Robertson, 2004). While individual patient presentations and responses can vary, altered level of consciousness (LOC) is a key response to monitor for signs of change in the patient’s clinical status. Although the incidence of head injury has decreased by more than 35% over the past decade, there continues to be a need for specialized care for those suffering a TBI (CIHI, 2006). Neuroscience nurses are in key positions to detect early changes, which can lead to early interventions, prevent secondary injury, and improve patient outcomes (Ammons, 1990).

Nursing care plans must be based on evidence-based interventions that optimize the functioning of the individual patient and promote well-being. Holistic nursing care requires the nurse to have a solid knowledge base of the human responses to actual or potential health problems (Mitchell, Gallucci, & Fought, 1991). It is important for the nurse to be aware of the normal physiological functioning and potential pathophysiology of altered LOC in patients with head injuries to be able to establish appropriate interventions. On a review of current literature, there is a gap in research of assessment of patients with subdural hematomas and altered LOC using any.
type of specific nursing framework. The Human Response to Illness (HRTI) Model is an effective tool to accomplish this goal (Mitchell et al., 1991; Figure 1). This model provides a framework that enables the nurse to examine the physiological, pathophysiological, behavioural, and experiential perspectives of a specific illness response. The purpose of this paper is to discuss each of these perspectives in relation to the response of altered LOC in patients with SDH. Based on this comprehensive assessment, appropriate evidence-based nursing interventions will be noted as well.

Human Response to Illness Model

Physiological perspective

The first component of the HRTI Model is the normal physiological response (Mitchell et al., 1991). Thus, within the context of altered LOC, normal physiological functioning is examined in terms of consciousness. Consciousness and normal cerebral functioning are the result of physical interactions of brain tissue, nerve function, cerebral spinal fluid (CSF) and circulation. Cerebral perfusion, oxygenation and metabolic demands all impact the effectiveness of this complex component of normal human functioning. The action of each of these factors fluctuates with changes in an individual's health status and activity, and adjusts on a continual basis to maintain adaptive homeostasis (Reilly & Bullock, 2005). While the central nervous system (CNS) consists of the cerebral cortex, cerebellum, and spinal cord, the following review of physiology focuses on the function of the brain in relation to altered LOC in SDH.

A state of consciousness is dependent on an intact system of complex neuronal connections within the cerebral cortex and brainstem. If all of the components of the brain are in a state of equilibrium, the cerebral cortex and the Reticular Activating System (RAS) are able to maintain a state of consciousness (McLeod, 2004). The RAS initiates a message in the pons, which then passes through the midbrain and thalamus, and moves through the complex neuron pathways within the cerebral cortex to enable an appropriate response. This results in the state of consciousness, which includes being awake and aware. Due to the complex nature of this process, these pathways are easily disrupted. Any change in volume (e.g., a subdural hematoma), or imbalance in metabolic activity can lead to an altered LOC (Reilly & Bullock, 2005).

Adequate perfusion of cerebral tissues is central to maintaining a normal LOC (Reilly & Bullock, 2005). The brain receives approximately 750 millilitres of blood per minute, which is the equivalent of 15% to 20% of the body’s total cardiac output. The actual amount of circulating blood varies, depending on the metabolic needs of the body and brain (Hickey, 2003). The cerebral arteries ultimately form a complicated capillary bed that supplies nutrients to the gray matter of the cortex. The veins drain blood back to the systemic circulation (Reilly & Bullock). Cerebral perfusion pressure (CPP), which is responsible for the amount of oxygen and nutrients received from the brain tissues, is controlled by autoregulation of brain processes. Autoregulation controls the vasodilatation or vasoconstriction of blood vessels and, thus, is crucial to maintaining an adaptive perfusion pressure (Josephson, 2004).

There are several key differences between the vasculature of the brain and the rest of the body. The muscle layers of the cerebral vessels are thinner in nature and, therefore, are more vulnerable to injury (Hickey, 2003). In addition, the cerebral veins have no valves and possess a unique pathway of perfusion. Unlike systemic veins, which follow the pathways of arteries, cerebral veins function more independently. The veins branch off the arteries and follow the path of the dural sinuses, which are fed by emissary and bridging veins. Emissary veins connect the extracranial veins to the dural sinuses, while bridging veins merge cerebral veins with the dural sinuses. Bridging veins are the most common sites of subdural hemorrhage, causing the formation of a subdural hematoma (Hickey; Reilly & Bullock, 2005).

Cerebral spinal fluid (CSF) is also an important component of the CNS. It is a protein- and glucose-rich, clear yellow fluid that circulates around the brain and spinal cord in the subarachnoid space. CSF is produced in the choroid plexus at a rate of approximately 25 millilitres per hour, for a total of about 500 millilitres in a 24-hour period. CSF is then absorbed by the arachnoid villi in the subarachnoid space. Normally, circulating CSF amounts to approximately 125–150 millilitres, most of which are in the cerebral ventricles, and easily visualized on diagnostic images (Hickey, 2003). The “modified Munro-Kellie hypothesis” (McLeod, 2004, p. 355) explains that homeostasis is maintained through autoregulation of CSF, with the brain being able to increase or decrease the amount of CSF to maintain intracranial pressure between 5mmHg and 15mmHg. This mechanism provides one explanation for gradual and vague changes in LOC.
Finally, the cerebral cortex is covered with three connective tissue layers (i.e., pia mater, the arachnoid, and the dura mater), referred to as the meninges (Hickey, 2003). The dura provides protection for the outer layer of the cortex and the brain stem and nerves as they exit the foramen magnum at the base of the skull. The subdural space, which is the site of subdural hematomas, lies between the dura mater and arachnoid layer, and is supported with a venous vasculature (Reilly & Bullock, 2005). Disruption to the CNS system as a consequence of an SDH can result in the pathophysiological response of altered LOC.

Pathophysiological perspective
The pathophysiological perspective is the second component of the HRTI Model. This response occurs when the normally functioning system is disrupted (Mitchell et al., 1991). Altered LOC is a pathophysiological response of a variety of CNS disorders, including SDH. With the cerebral cortex being a closed system comprising tissue (80%), blood (10%), and cerebral spinal fluid (CSF, 10%), it is a fragile balance of function. An increase in any of these three major brain components can lead to physiological changes, including alteration in LOC (McLeod, 2004). As well, increased pressure within the cortex will result in herniation through the foramen magnum, direct pressure on the RAS, and a consequent altered LOC (Wijdicks, 2006).

Subdural hematomas are usually the consequence of blunt trauma to the head, resulting in disruption of the venous system, with venous blood draining into the subdural space (Hickey, 2003). The increase in blood within the subdural space displaces brain tissue and causes increased pressure within the cerebral cortex. As subdural hematomas result from a venous source, they can be slower in nature, and so the brain is able to compensate during the initial stages. With the subdural space covering the entire surface of the brain, the affected area can become quite large before any deficits are detected, and when the brain begins to decompensate, neurological deficits can be significant. Once the hematoma reaches a certain volume, the brain can no longer accommodate, and changes in intracranial pressure occur. The brain can begin to swell and exert pressure on the brain stem and RAS (Reilly & Bullock, 2005). This will result in impaired LOC and overall neurological function, which can potentially cause permanent brain damage. Without early intervention, the bleeding will persist and the pressure on the brain will continue to increase. The subsequent increasing intracranial pressure and edema exerts pressure on the healthy brain tissue, causing cerebral ischemia. Poorer long-term clinical outcomes will result if early symptoms of altered LOC are not noted and managed (McLeod, 2004).

With or without medical intervention, the risk of secondary injury is significant. Cerebral edema, hydrocephalus and re-bleed are all potential secondary complications that can arise from a subdural hematoma and lead to altered LOC (Reilly & Bullock, 2005). The presence of blood in the meninges can irritate the brain, leading to cerebral edema. Depending on the size and location of the bleeding and clot formation, obstructive hydrocephalus can result, with an excessive accumulation of CSF in the ventricles. Finally, with any type of cerebral hemorrhage, the patient is always at risk for bleeding again during the recovery process (Hickey, 2003; Reilly & Bullock). Thus, any one of these three complications can lead to cerebral ischemia and increased Intracranial Pressure (ICP). If severe, these complications can ultimately lead to uncal herniation and fatal outcomes (Wijdicks, 2002).

Behavioural perspective
The behavioural perspective includes measurements of the response that are observable and objective in nature (Mitchell et al., 1991). The Glasgow Coma Scale (GCS) is a universally recognized, gold standard, objective measure for LOC assessment. This evidence-based standardized tool is widely used to measure patient’s responsiveness and to monitor trends in responsiveness. The GCS measures the two components of consciousness: awareness and ability to respond. This is accomplished by evaluating eye opening and verbal and motor responses. Experienced neuroscience nurses can use this tool to note changes in LOC, which, in turn, can also reflect changes in ICP and the patient’s overall neurological status (Edwards, 2001). Even subtle changes in a patient’s condition can be noted, indicating either improvement or deterioration in their condition. While one measurement alone is usually not meaningful, the trended LOC results are helpful in monitoring the patient’s ongoing status (McLeod, 2004). Although the GCS has limitations, including the failure to test brainstem reflexes and false scoring for patients who cannot speak (as a result of intubation or tracheotomy) or open their eyes, it is a widely used, reliable and valid assessment of LOC.

While there are several other published scales that measure LOC, most of these scales have not been validated for head-injured patients. For example, the Full Outline Unresponsiveness (FOUR) scale assesses eye, motor, brainstem and respiratory perspectives. Although the FOUR has been found to be a reliable scale for clinical use (Wijdicks, 2006) and allows for assessment of altered LOC at all levels of awareness, including voluntary eye movements and brainstem reflexes (Giacino & Smart, 2007), it is a relatively new tool that has not yet been widely tested. The Reaction Level Scale is another alternative to the GCS. This tool consists of a scale from one to eight (1 = alert; 8 = unconscious). While this is a simple tool to use in clinical practice, its descriptors are vague in the middle range and open to subjective interpretation. The Alert, Verbal, Pain stimuli, or Unresponsive (AVPU) Scale is more commonly used in emergency room triage settings. (Limmer & Monosky, 2002; McLeod, 2004). While this tool does allow for a quick assessment and frame of reference, the descriptors are vague and open to interpretation. Therefore, AVPU is not a useful tool to monitor trends in altered LOC and subtle changes in clinical status over time.

Other indicators of altered LOC, although not objectively measurable, are important components of the neurological assessment. For example, the SDH patient population commonly experience personality and cognitive changes. Because these individuals can be alert, but not mentally
aware, they cannot be considered fully conscious according to the definition of consciousness. A loss of inhibition, disorientation, hallucinations, or receptive dysphasia may cause the patient to exhibit inappropriate behaviours or responses (Testani-Dufour, Chappell-Aiken, & Guelder, 1992). These behaviours impact the stress experienced by the family, as well as the interventions chosen by nursing staff.

In the state of altered LOC, restlessness may be an indication that the patient is improving clinically, deteriorating, or a sign of a patient’s frustration or discomfort. A confused patient, who is incapable of understanding the environment that they are in, may become agitated and inappropriate in their responses (Petchprapai & Winkelman, 2007; Hickey, 2003). This can lead to combative behaviours, which may increase ICP. These patients are frequently physically restrained to prevent them from harming themselves, but this can exacerbate their agitation, causing them to be verbally abusive of those around them. As a result of their cognitive deficits, this stage of the brain injury process can be frightening and frustrating to patients and families. Therefore, it is important to ensure they understand the cause of the behaviours and the plan for management. Nursing interventions play a key role in this process.

There are other objective components of the neurological exam, which are not direct measures of LOC, but do provide insight into the assessment of these patients. For example, ICP monitoring is an objective measurement tool that may be used in patients with a severe head injury related to an SDH. ICP monitoring enables the healthcare team to objectively assess changes in ICP (Reilly & Bullock, 2005). Increased ICP leads to decreased cerebral perfusion pressure, ischemia, and altered LOC if not treated immediately. Changes in pupils, vital signs, or pulse pressure are also indicators of deterioration in neurological status and can coincide with changes in LOC. Thus, it is critically important for nurses to be aware of the key components of an objective assessment of altered LOC in the patient with an SDH. This knowledge will, ultimately, lead to early interventions and optimal patient outcomes.

**Experiential perspective**

The final component of the HRTI Model is the patient’s subjective experiential perspective, or verbal expression of symptoms experienced (Mitchell et al., 1991). This is one of the most important aspects of the model, as the patient’s perspective is often the best indicator of what is actually happening. For example, while a patient with a severe head injury may be in a deep coma and not respond to any stimuli, other patients, with mild head injuries, may be awake, but not cognitively intact (Hickey, 2003). This may result in disorientation to their surroundings, lack of ability to think abstractly, or inability to rationalize their responses (Petchprapai & Winkelman, 2007). Fluctuations in responses can create an environment of uncertainty and anxiety for the patient, and an assessment challenge for the health care team.

There is limited information in the literature on the perspective of a patient with an acute TBI or SDH, as their communications and behaviours are not always congruent with what is truly happening and their explanations are not always rationale or reliable. Hence, research has focused on the outcomes and effects on the patients and families, rather than examining the experience of the patient with acute altered LOC (Kneafsey & Gawthorpe, 2004; Testani-Dufour, 1992; Verhaeghe, Defloor, & Grypodonck, 2005). Acute and chronic behaviours of altered LOC impact the patient and family, leading to feelings of fear, anxiety, and powerlessness (Petchprapai & Winkelman, 2007).

In a phenomenological study, Chamberlain (2006) describes the patient’s experience of surviving a TBI, but not altered LOC itself. The results are relevant, however, because the individuals’ experiences during the recovery process and associated episodes of altered consciousness were described. In this study, five themes were identified: regret and grief within self, insensitivity of health professionals, invisibility of self, stranded self, and recovery in self. Working through these experiences required patients to re-invent and learn to live with new versions of themselves. Patients used these self-reflections to appreciate their survival and accomplishments in recovery (Chamberlain, 2006).

Knowledge of the actual lived experience of being unconscious, or less responsive provides important insights for the care of patients with altered LOC. In a mixed-methods study, Lawrence (1995) described unconscious experiences of 100 patients. Although the study included patients with a broad range of diagnoses, the results are relevant to the TBI patient population. According to Lawrence (1995), altered consciousness experiences can be categorized into five distinct states: unconsciousness, inner consciousness, perceived unconsciousness, distorted consciousness, and paranormal experiences. Patients in some states of altered LOC were reportedly still very aware of their environment. Some could recall voices and conversation that occurred around them, while others stated that they were aware of requests being made of them, but were physically unable to respond. Individuals also reported being aware of the emotions of family and staff around them, including feelings of despair and hope. Based on the evidence from this study, Lawrence (1995) concluded that patients’ unconscious experiences can cause long-term effects, and that caregivers need to be aware of the impact of their words and actions on these patients.

**Personal and environmental factors**

Within the HRTI Model, person and environmental factors interact with the four perspectives to establish individual risk for a specified response to illness (Mitchell et al., 1991). These factors can have a significant impact on the human response (i.e., altered LOC), as well as the patient’s outcomes.

**Person factors**

Non-modifiable person factors include factors within the individual that may influence the response of altered LOC in the patient with a subdural hematoma related to a TBI. For example, age is an important influencing factor, with the...
elderly being particularly vulnerable to more severe alterations in LOC related to co-morbidities and concomitant medications, which may adversely affect the response (Neatherlin, 2000). This, in turn, may lead to delays in regaining consciousness and recovery. As well, the brain tends to atrophy with age, which may delay the onset of symptoms of altered LOC in the patient with a subdural hematoma that can delay treatment and have a negative impact on patient outcomes (Neatherlin, 2000).

Medications that an individual is taking prior to their TBI can also have a significant impact on the response and the illness. Anti-coagulant therapy increases the risk for a larger initial SDH, as well as for re-bleeding (Reilly & Bullock, 2005). Consequently, the severity of the underlying pathology and the consequent response of altered LOC may be more serious. Patients requiring sedatives (Josephson, 2004), or who present under the influence of mind-altering drugs or alcohol (Reilly & Bullock) may have altered LOC for reasons other than the underlying pathology. These additional individual co-morbidities may lead to delays in recovery of consciousness and recovery.

Modifiable person factors are preventable or amenable to change in the post-injury period. For example, post-injury infection, fever, hypoxia, hypotension, extreme serum glucose levels, hyponatremia, seizures, and hypoxemia are all potential responses to TBIs, and can all impact on the altered LOC (McLeod, 2004). Many of these illness consequences can be prevented and/or managed by optimal patient care. Similarly, select nursing interventions can be effective in maximizing cerebral perfusion (McLeod, 2004). Various combinations of medications given to the SDH patient may alter LOC or mask the signs of altered LOC. For example, high doses of phenytoin or lorazepam can result in lethargy, making it difficult to decipher if altered LOC is related to medication side effects or deterioration in the underlying pathology (Josephson, 2004).

Environmental factors

The external patient care environment can have a significant impact on altered LOC. The availability of specialized equipment and expert neurosurgical medical and nursing staff is central to managing altered LOC in the SDH patient effectively. While equipment to monitor CBF and ICP is helpful to detect early changes in altered LOC and can lead to early intervention and improved outcomes, there is no evidence that the equipment itself improves patient outcomes (Stiefel, Spiotta, Gracias, Garuffe, Guilamondegui, Maloney-Wilensky et al., 2005; Steiner & Andrews, 2006). Further research is needed as to the impact that the availability of cerebral hemodynamic monitoring can have in these situations.

Ideally, neurosurgical nurses should possess the knowledge and skills to assess the patient and minimize the SDH patient’s risk for altered LOC. Their knowledge of the factors that influence patient outcomes ensures evidence-based care. For example, reducing external stimuli and elevating the head of the bed have been found to minimize intracranial pressure (Schwarz, Georgiadis, Aschhoff, & Schwab, 2002), which, in turn, has a favourable effect on altered LOC.

Nursing implications

The four perspectives of the HRTI Model establish a comprehensive framework to address implications for clinical practice, education, and research. The review of the literature, based on these perspectives facilitates a holistic assessment of the individual patient and provides insight for the development of evidence-based nursing interventions and best practice guidelines for optimal patient care.

Implications for clinical practice

Physiologically, airway, breathing, and circulation are the primary areas of concern in the patient with altered LOC (Ammons, 1990; Wijdicks, 2006). When a patient presents with, or deteriorates to a GCS of ≤ 8, the airway may be compromised and intubation may be necessary (McLeod, 2004; Wijdicks, 2006). Adequate ventilation serves to minimize ischemia to the brain and other vital tissues. Therefore, the maintenance of the airway protection, as well as its effectiveness must be a nursing priority. In addition, monitoring of vital signs and pulse oximetry are important components of the assessment of circulation and oxygenation. For example, in an unconscious patient, a widened pulse pressure, with bradycardia, may be an imminent sign of further increase ICP and impending neurological deterioration (Ammons; Hickey 2003; McLeod, 2004). Adequate oxygenation promotes proper autoregulation of oxygen and carbon dioxide in the brain tissues, and the consequent vasoconstriction that reduces ICP (Hickey). Conversely, hypoxia with hypercapnia results in vasodilation, increasing cerebral blood flow and increased ICP (Edwards, 2001; Kerr & Brucia, 1993). Thus, altered LOC can be minimized with adequate oxygenation.

Ongoing, comprehensive neurological assessments are critically important in order to monitor for changes in the patient’s clinical status and note changes in LOC in a timely manner. Nurses are in a key position to perform these assessments and communicate their findings to the medical staff. In addition to the GCS, these assessments should include: checking pupillary response, vital signs, and ICP and CPP if available (McLeod, 2004). Skilled nursing assessments can detect subtle changes in hemodynamics, or motor or verbal responses, that may lead to further investigation and early intervention. Early medical intervention can minimize cerebral tissue damage, and minimize long-term deficits that are often associated with sustained alterations in LOC.

Patients who present with altered LOC can become desensitized to the busy external stimuli of hospital sounds over time (Gerber, 2005). As a result, they may be less responsive to the routine requests associated with neurological assessments. In order to re-train their orientation to relevant stimuli, it is suggested that these patients should be kept in a calm and quiet environment, and have a scheduled, structured coma stimulation program. This can be initiated as early as 72 hours post-injury, and involves the stimulation of auditory, visual, olfactory, gustatory, tactile, and kinesthetic senses (Gerber, 2005). The goal of this intervention is to “wake up” and re-train a damaged RAS by stimulating cortical
activity, to ultimately improve alertness and awareness. Although there is minimal research literature available surrounding this novel intervention, it is a logical and harmless intervention that may improve patient outcomes.

Simple, but critical nursing interventions, such as elevating the head of the bed and maintaining the head and neck in a neutral position can promote venous drainage and, ultimately, reduce the risk for increased ICP and alterations in LOC (Christie, 2008; Schwarz et al., 2002). Monitoring fluid and electrolyte balances is also important because any imbalance can affect the neurological response (Fryman & Murray, 2007). Timely medication administration is critical in supporting effective cerebral functioning. As well, monitoring medications for their effects and possible side effects is essential. For example, although the administration of anticonvulsants can minimize the incidence of seizures, these medications also present the risk for hyponatremia. While glucocorticosteroids can reduce cerebral edema, and ultimately lower ICP, they can also cause hyperglycemia, immune compromise, irritability, insomnia, and muscle atrophy (Josephson, 2004). The side effects of both of these classes of medications can have an acute onset, and can begin after only a brief period of administration (Hickey, 2003). Skilled neuroscience nurses must be aware of these potential complications of the medications, and include a review of current medications in their patient assessments.

Monitoring for signs of a fever in the patient with altered LOC is also important. The cause of the fever may be neurogenic, or related to an infection. A neurogenic fever results when increased ICP causes damage to the hypothalamus, and temperature control is lost (Reilly & Bullock, 2005; Thompson, Pinto-Martin, & Bullock, 2003). A fever will raise the metabolic and oxygen demands of the brain, and may exacerbate symptoms of altered LOC. This added cerebral stress also contributes to ischemia and cell death. Following up on results that may identify an underlying cause for the infection and maintenance of normothermia with antipyretics and/or a circulating fan are appropriate nursing interventions (Thompson et al., 2003).

Although not a direct factor in the altered LOC response, families should be considered in the development of patient-centred care strategies and clinical nursing interventions. While any change in LOC can cause anxiety and fear, explanations and re-orientation regarding symptoms, investigations, assessments and environment are essential to minimize patient and family stress (Testani-Dufour et al., 1992). Unfortunately, in neuroscience, there are rarely definite answers and only time will tell how the patient will progress or respond to treatment. The frustration experienced by the patient and family can be far-reaching, and can present additional challenges to the nursing staff. A team approach with a network of support systems for the patient and family is essential for the delivery of consistent and positive nursing care (Yetman, 2008).

Implications for nursing education
While communication between patients, families, and nursing staff is essential to minimize knowledge deficits and anxiety, it can also have a favourable effect on ICP. Based on Lawrence’s (1995) findings, some unconscious patients may be aware of sounds and conversations around them. By explaining interventions prior to implementation, the element of surprise and related stress may be lessened, and may help to minimize an increase in ICP. In patients who are awake, but not fully aware, explanations of treatments are critical to reducing anxiety and avoiding confusion. Confused patients may misinterpret the intentions of staff and become more agitated, which, in turn, can cause an increase in ICP, and potentially alter their LOC.

As research in neuroscience nursing care is constantly evolving, it is crucial for nurses working in this specialty area to maintain their clinical competency through formal and informal education. As new measurement tools are introduced and tested, a practical alternative to the GCS may eventually be validated and accepted. Without self-motivated education, the transfer of this knowledge would not occur. Attendance at in-services and conferences and/or reading current research journals regarding altered LOC will contribute to the nurse’s knowledge base, and facilitate the development of evidence-based interventions. Finally, advanced practice nurses are in key positions to question current practice and co-ordinate nursing research projects that will, in turn, result in improved patient outcomes.

Implications for nursing research
Through observation of clinical practice and patient outcomes, neuroscience nurses can identify gaps in evidence-based practice and collaborate with the multidisciplinary team to identify research questions related to altered LOC in patients with SDHs. Although there is considerable research-based evidence related to the care of the SDH patient with altered LOC, this review also revealed a number of gaps in the research literature. For example, the effects of a structured coma stimulation program on patients with the altered LOC and a SDH are not fully understood. As well, further research is needed regarding the lived experiences of these patients. And finally, research is just beginning to emerge on the impact of caring for these patients and their families on nurses. Thus, further research is needed in this area.

Conclusion
Patients who present with an SDH frequently exhibit signs of altered LOC. Nursing care of these individuals and their families is complex and focuses on optimal assessment strategies and evidence-based care. Application of the HRTI Model enables neuroscience nurses to complete a comprehensive assessment of the altered LOC response, based on the physiological, pathophysiological, behavioural, and experiential perspectives, as well as the person and environmental factors. Nurses can then develop individualized, research-based nursing interventions for this specific response to illness. Valuable insights related to patient evaluation strategies have also been gleaned during this process. Thus, this model facilitates achieving the goal of optimal patient care and outcomes for this patient population.
Footnotes

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