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Review

Initial Nursing Management of Patient With Severe Traumatic Brain Injury

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Abstract

Background: Pre-hospital care of patient with severe traumatic brain injury requires great care to minimize secondary brain injury and potential morbidity related to spinal immobilization.

Aim: The need to review data on literature for traumatic brain injuries in adults is urgent due to the human costs associated with these injuries. Literature data on initial nursing management for severe traumatic brain injuries has been introduced to standardize aspects of its care. However, information available regarding the initial nursing management of acute neurotrauma in adults is scarce. This article provides recent evidence regarding initial nursing management for severe traumatic brain injuries in pre-hospital settings and introduces areas in need of future research.

Method: A computerized keyword search in Medline and the Cumulative Index to Nursing and Allied Health Literature was performed using the names of specific initial nursing interventions such as airway clearance, breathing and tissue perfusion, and key words such as acute neurotrauma, pre-hospital setting, and severe traumatic brain injury. The search was primarily restricted to works in English published between 2000 and 2012 in which all or parts of the sample included adults with severe traumatic brain injuries. Few articles were found on primary survey for these patients.

Conclusion: With a thorough understanding of initial management of the patients with severe traumatic brain injuries, nurses can maximize patient's survival rates and neurological outcomes.

Keywords: Acute, initial, nursing management, neurotrauma, pre-hospital setting, severe traumatic brain injury

Ciddi Travmatik Beyin Yaralanmalı Hastaların Birincil Hemşirelik Yönetimi

Özet

Giriş: Ciddi travmatik beyin yaralanması olan hastaların hastane öncesi bakımı, sekonder beyin yaralanmasının ve spinal immobilizasyon kaynaklı olası sorunların azaltılması açısından gereklidir.

Amaç: Erişkin travmatik beyin yaralanmalı hastalarla ile ilgili literatürü gözden geçirmek, bu yaralanmalarla ilişkili maliyetler nedeniyle önemlidir. Ciddi travmatik beyin yaralanmalı hastaların ilk hemşirelik yönetimi ile ilgili literatür, bakımın standardize edilmiş yönünü ortaya koymaktadır. Ancak, erişkin akut nörotravmalı hastaların ilk hemşirelik yönetimi ile ilgili ulaşılabilen bilgi sınırlıdır. Bu makale, ciddi travmatik beyin yaralanmalarının hastane öncesi alandaki ilk hemşirelik yönetimine ve gereksinim duyulan gelecekteki araştırmalara ilişkin son kanıtları sağlamayı amaçlar.

Yöntem: Tarama, Medline, Cumulative Index to Nursing ve Allied Health Literature veri tabanlarında, hava yolu açıklığı, solunum ve doku perfüzyonu gibi ilk hemşirelik girişimlerine özgü terimler ve nörotravma, hastane öncesi alan, ciddi travmatik beyin yaralanması gibi anahtar kelimeler kullanılarak, bilgisayar ortamında yapıldı. Tarama, 2000-2012 yılları arasında öncelikle ciddi travmatik beyin yaralanmalı erişkin hastaların tamamı ya da bir kısmı ile yapılmış ve basım dili İngilizce olan çalışmalarla sınırlıydı. Ciddi travmatik hastaların birincil tanılamasına ilişkin birkaç makaleye ulaşıldı.
Sonuç: Ciddi travmatik beyin yaralanmalı hastaların ilk hemşirelik yönetiminin tam olarak anlaşılması yoluyla, hemşireler, hastaların sağ kalım oranlarını ve nörolojik sonuçlarını en üst düzeye çıkarabilir.

Anahtar Kelimeler: Akut, ilk, hemşirelik yönetimi, nörotravma, hastane öncesi alan, ciddi travmatik beyin yaralanması

INTRODUCTION

Trauma is the most common cause of brain injuries (TBIs). In persons aged 65 and older, traumatic brain injury (TBI) is responsible for more than 80,000 emergency department (ED) visits each year; with three-quarters of these visits resulting in hospitalization. 150,000 people are dying yearly, more than 5 million deaths worldwide are seen[1,7] while 2% of the United States (US) population is currently living with disabilities[22].

Of patients admitted to the ED, most are male and half show evidence of alcohol or other substance abuse. The second largest risk factor is driving without seat belts. Peak occurrence happens during evenings, nights, and weekends. Other causes are assaults, falls, and sports-related injuries. Falls are the leading cause of TBI in older adults (51%) with motor vehicle traffic accidents second (9%)[2,3,6-10,16,17,21,22,30,34]. In a recent cohort study, 53% of patients admitted to hospital with severe TBI died within 6 months, and only 29% had favourable outcomes after 6 months[32].

AIM

Numerous recommendations have been made on the initial management of severe TBI (Glasgow Coma Scale [GCS] score≤8 / GCS<9) patients[9,18,21,29]. However, there is scarce information available regarding the nursing management of patients with severe TBIs in developing countries. There is an urgent need to review literature data in adults in which human costs are associated with these types of injuries. Not all recommendations concern activities independently performed by nurses, yet nurses are responsible for implementing and monitoring the outcomes of these activities. Although published guidelines on the management of patient with severe TBI exist, new data and recommendations regarding the role of nursing in the initial management phase is limited. This article outlines pre-hospital nursing approaches for patients with severe TBI for nurses who provide care and initial management.

METHOD

Searching the PubMed database, a computerized search of Medline and the Cumulative Index to Nursing and Allied Health Literature (CINAHL) (1989 to present) identified literature for this article. English-language articles of relevance were selected and reviewed. Additional resources were obtained through bibliographies of reviewed articles. The following search terms were used: initial nursing interventions, neurotrauma, pre-hospital management, severe TBI, airway management, cervical immobilization, breathing, tissue perfusion, disability, and exposure. A summary of recommendations for patients with severe TBI used in the pre-hospital setting for initial nursing management of patients are reviewed in this article.

PRIMARY SURVEY AND NURSING INTERVENTIONS

Initial assessment, triage, and resuscitation of severe TBI patients are directed towards preventing and limiting secondary brain injury (SBI) while facilitating rapid transport to facility capable of providing definitive neurocritical care[4]. During resuscitation of severe TBI patients (GCS≤ 8 /GCS<9), management is directed at correcting and maintaining mean arterial pressure (MAP), blood glucose (BG), PaO_2 and $PaCO_2$ within their normal ranges[6,7,9,11,17-19,21,29].

Briefly, the goals of pre-hospital assessment are:

- To– establish whether trauma to the head has occurred.

- To estimate the severity– of any injury to the brain

- To identify and prevent hypoxia and/or– hypotension

- Identify risk factors for acute complications of TBI which may– require intervention

- Identify other injuries that may require urgent– treatment[4].

Assessment: Primary survey considerations are important for patients with severe TBI. Patients with severe TBI-GCS scores of 3 to 8 are considered comatose and will not follow commands and may further exhibit decerebrate or decorticate posturing[6]. Such comatose situations may last for 1 hour or longer with initial assessment and data being obtained from witnesses at the scene of the accidents[6,10,17,21].

Airway (A) and Breathing (B)

Nursing Diagnosis: Airway clearance, Ineffective (NANDA) related to decreased LOC, loss of protection of airway and inability to maintain positioning[17].

Outcomes: Patient will be free of respiratory distress or aspiration pneumonia[17].

NOC Outcomes: Aspiration Prevention; Respiratory Status: Airway Patency and Ventilation[17].

The patient will have effective airway clearance. The upper airway should be free of secretions. Respirations should be of a regular rate (16-22 breaths/min), rhythm, and depth. Breath sounds should be clear in both lungs and the chest should have symmetrical movement. The trachea should be in a midline position with no dyspnea or accessory muscle function being noted. Aspiration should be prevented, PaO_2 should be maintained at greater than 90 mmHg, and $PaCO_2$ between 30-35 mmHg initially. Chest films should be clear[17].

Interventions: Airway and cervical spine are immobilised in a neutral position. Nursing actions aimed at maintaining adequate airway clearance include clearing the mouth and oral pharynx of foreign bodies and suctioning the oropharynx and trachea every 1 to 2 hours and as needed[17]. An airway should be established, by the most appropriate means available, in patients who have severe TBI, the inability to maintain an adequate airway, or hypoxemia not corrected by supplemental oxygen (O_2). Current recommendations state that 100% supplemental O_2 via non-rebreather mask, bag-valve-mask/advanced airway should be provided immediately to any TBI patient[5,9]. Avoidance of suctioning the nasopharynx is recommended until after a basilar fracture or meningeal tear is rule out. A semiprone lateral position with the head of bed (HOB) elevated 30 degrees reduces the risk of secretions from entering the lungs. This position is contraindicated with increased ICP or a cervical fracture[17,26].

There is a high association of cervical fracture with HI. Lateral cervical spine x-ray films are obtained before the patient's

head is moved, or the immobilization devices are removed. The patient with HI is protected from possible complications of SCI by immobilizing the head and neck immediately, using a cervical collar or sandbags. As with all trauma, C-spine precautions must be immediately implemented and continued throughout resuscitation. Humidified O_2, endotracheal (ET) intubation, mechanical ventilation/tracheostomy may be required to maintain the patient's PaO_2 and $PaCO_2$ within set parameters[17].

The available evidence did not support any benefit from pre-hospital intubation and mechanical ventilation after TBI[9,33]. However, current guidelines suggest that only a subset of the TBI population may benefit from prehospital ET intubation. If ET intubation is necessary, a jaw thrust maneuver must be used rather than neck flexion to open the airway without possible SCI. A baseline assessment of the patient's motor and sensory function should be obtained at the scene of the accident[17].

The indications for intubation and ventilation generally include:

- to– ensure adequate oxygenation (SpO_2 > 95%),

- to ensure adequate– ventilation (airway unsecured or hypercarbia),

- to ensure safely perform– cranial or other CT scans,

- hypoxia that isn't corrected by supplemental– O_2,

- hypoventilation,–

- inability to maintain an adequate– airway,

- severe TBI–

- loss of protective laryngeal reflexes and– ventilatory insufficiency as manifested by hypoxemia (arterial oxygen tension [PaO_2] < 60 mm Hg),

- hypercarbia (arterial CO_2– tension [$PaCO_2$ > 45 mm Hg),

- spontaneous hyperventilation– (causing $PaCO_2$ < 26 mm Hg), and

- respiratory– arrhythmia[6,9,18,21,26,29],

Hypoxemia (SPO_2 < 90%) should be avoided, and corrected immediately upon identification[4,5,18,29].

Guidelines recommend the use of both lung auscultation and end-tidal carbon dioxide ($EtCO_2$) monitoring to confirm tube placement. Pulse oximetry, direct visualization and condensation in the ET tube are important indicators of proper tube placement[5,9].

Severe O_2 desaturation (< 60%) during transport to the hospital is associated with a 3.5-fold increase in mortality. Patients with TBI should be normoventilated ($PaCO_2$ ≈ 40 mm Hg) unless they clearly demonstrate signs of raised ICP[26,28] and duration of in-hospital oxygen desaturation (< 90%) is an independent predictor of mortality[14,26].

Spontaneously breathing TBI patients with a pulse oximetry reading (SpO_2) of > 90% on supplemental O_2 who are ground transported within an urban environment (transport time < 10 minutes) and intubated by rapid sequence intubation (RSI) in the field have experienced equivocal or even worse patient outcomes. Therefore, RSI is currently not recommended in the population meeting these criteria[9]. In severe TBI, the pre-medication of patients with such agents as lidocaine, fentanyl or esmolol hasn't demonstrably reduced morbidity/mortality. Avoidance from agents known to increase ICP, such as ketamine, are strongly urged, although this is currently being challenged as well[26].

Continuous pulse oximetry and EtCO2 (capnometry) monitoring should occur with all severe TBI patients. Capnometry is imperative in severe TBI patients to ensure eucapnea, which is defined as maintaining CO_2 levels in a normal state (35–40 mmHg). Interventions include achieving oxygenation and lowering the ICP with hyperventilation by mechanical ventilation

or by manually hyperventilating the patient with a bag- valve mask device if the patient has evidence of cerebral herniation[17]. In patients who are normoventilated, well oxygenated, normotensive, and still have signs of cerebral herniation-hyperventilation should be used as a temporizing measure, and discontinued when clinical signs of herniation resolve. Patients should be maintained with normal breathing rates (ETCO2 ≈ 35-40 mmHg), and hyperventilation ($ETCO_2$ < 35 mmHg) should be avoided unless patients show signs of cerebral herniation[5,9]. Around 5% of patients will have a co-existing SCI and it is common practice to do imaging for the entire cervical and upper thoracic spine at the same time as the initial head computed tomography (CT)[19,29].

Circulation (C)

Nursing Diagnosis: Tissue perfusion: Cerebral, Ineffective (NANDA) related to edema from TBI/ Risk for ineffective cerebral tissue perfusion secondary to hypotension, hypertension, intracranial hemorrhage, hematoma, or other injuries[17].

Outcomes: Patient will maintain cerebral perfusion. The patient will have adequate CPP. The patient will have a stable or improving LOC with a stable GCS score and an ICP < 15 mm Hg. Temperature will be maintained at less than 38.5º C. The patient's BP will be maintained within established parameters. Urine output will be a minimum of 0.5ml/kg/hour and not greater than 200 ml/hour. Laboratory values will remain within normal limits[17].

NOC Outcomes: Circulation Status; Cognition; Neurologic Status: Consciousness; Tissue perfusion: Cerebral[17].

The goal of resuscitation in TBI is to preserve cerebral perfusion and minimize neuronal injury. Hypotension and hypoxemia are associated with poor outcomes in patients with severe TBI, thus systemic resuscitation is the highest priority in pre-hospital management[5,26,28].

Hypotension, defined as a systolic blood pressure (SBP) less than 90 mmHg, doubles mortality in severe TBI[4,9]. Hypotensive patients should be treated with isotonic fluids. An IV line is placed and fluids are given to stabilize the BP to SBPs over 90 mm Hg. HI alone does not cause major loss of blood[17].

One episode of post-TBI hypotension doubles mortality risk, whereas two or more episodes increase the relative risk of mortality to 8.1[15,26] and the total duration of hypotensive episodes is a significant predictor of morbidity and mortality[14,26]. In general, a MAP greater than 65 is necessary to avoid ischemia[9].

Hypertonic resuscitation is a treatment option for TBI patients with a GCS < 8[5,9]. Cerebral perfusion pressure (CPP) is MAP minus ICP (CPP=MAP-ICP). As ICP increases due to a TBI, MAP becomes critical to maintain CPP and brain blood flow. Hypertonic saline (HS), (2-3%) is a current treatment option for fluid resuscitation in severe adult TBI. It's currently felt that HS and normal saline are equivocal. Using standard normal saline is probably the best management step at this point. Crystalloid, isotonic, dextrose-free solutions (0.9% normal saline, Lactated Ringer (LR)[9] or packed red blood cells[9,26] when appropriate should be administered with a two-liter initial bolus[9]. Although appropriate in certain clinical scenarios, LR solution should generally be avoided in patients with TBI as it has been shown to increase ICP[23,26] and decrease intracranial compliance[24,26]. HS may be more appropriate in patients with TBI as it has been shown to improve intracranial compliance and lower ICP[26,27].

Glucose-based solutions should be avoided in adult patients with TBI. Elevated BG in the first 24 hours after TBI, following surgical intervention or during hospital course is associated with worse neurologic

outcomes[12,20,26,31,35]. Dextrose, in the form of IV dextrose (D50W in adults), should be administered only if clinically indicated (BG < 70 mg/dL). Steroids, such as methylprednisolone, should not be administered for treatment of severe TBIs. Hyperosmolar therapy in the form of mannitol and HS has no current evidence-based support for their use in the prehospital setting for brain-targeted therapy[9].

Interventions: Maintaining all physiologic parameters within normal limits, positioning the patient for optimal venous return, and monitoring extracerebral systems for complications, communicating a patient's neurologic status accurately and documentation are essential to early identification of change and early intervention. ICP monitoring may be required[17].

According to prehospital severe TBI guidelines[4,5], patients with suspected severe TBI should be monitored for hypoxemia (< 90% arterial hemoglobin SpO2) or hypotension (< 90 mmHg SBP). SpO2 should be measured continuously with a pulse oximeter, and oxygenation. SBP and diastolic blood pressure should be measured as often as possible using the most accurate method available and should be monitored continuously if possible[4,5].

Disability (D)

GCS score must be obtained through interaction with the patient[4,5,13,25]. As the GCS doesn't affect the completion of the ABCs, the GCS may be performed in conjunction with the ABCs, either prior to sedation and paralysis or after the medications are metabolized[5,9,13,25].

In describing a patient's state, it is better to use the descriptors rather than "GCS score= 9"[21]. Pupillary asymmetry is rarely seen in TBI patients unless the ICP is greater than 20 mmHg (the upper limit of normal). Left and right pupillary findings should be identified (unilateral or bilateral dilated pupil[s]; fixed and dilated pupil[s]). Asymmetry, or anisocoria, is defined as > 1 mm difference in pupil diameter. A fixed pupil is defined as < 1mm response to bright light and may indicate cerebral herniation[5,6,9,17]. A rapid neurological examination may be based on the AVPU scale and pupil reaction[6,17].

Exposure (E)

The patient should be fully exposed to evaluate for extracranial injuries, but must also be aware of heat loss[6,9,17,21].

Severe TBI destination decision protocols should be in place well before any incidents happen. Patients require transport directly to a facility with immediate CT scan availability, prompt neurosurgical care, the ability to monitor ICP, and the ability to treat intracranial hypertension[4,5,9].

- Assess and manage according to clear principles and standard practice such– as the Advanced Trauma Life Support System.

- Full cervical spine immobilisation if GCS– < 15, neck pain or tenderness, focal neurological deficit, paraesthesia in the extremities, or any other clinical suspicion of cervical spine injury.

- Transport patient directly to a facility where TBI is managed in its– entirety, if possible.

- Otherwise, transport the patient to a facility identified as having the– appropriate resources to resuscitate, investigate and initially manage any patient with multiple injuries.

- For people with a severe TBI (GCS ≤8), make a standby call to the– destination to ensure appropriately experienced professionals are available to treat patient and to prepare for imaging.

- Pain should be managed effectively because it can lead to a rise in– intracranial pressure. Reassurance and splintage of limb fractures are helpful; catheterisation of a full bladder will reduce irritability[4].

CONCLUSION

Severe traumatic brain injured patients have poor prognosis starting immediately with the incident. With a thorough understanding of acute care of such patients, nurses can maximize patients' survival and neurological outcomes.

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