

Management of intracranial hypertension in patients neurocriticos: integrative review

Abstract

Objective: Discuss through the literature on the management of intracranial hypertension in patients neurocriticos, as well as their possible adverse effects.

Method: An integrative review of the literature, with the guiding question drawn from the search strategy peak. The selected databases were: LILACS, SciELO and BDNF, MedLine, PubMed and SCOPUS with articles published between 2008 and 2017. Initially, 148 articles were identified, of which 20 were selected for this study.

Results: There are several adverse effects that may develop in the presence of intracranial hypertension or during monitoring, highlighting the hiatal hernia and cerebral edema, intracerebral hemorrhage and the development of infections resulting from catheterization, which monitors the intracranial pressure, among others. However, patients should also be monitored for effects, such as ventilator-associated pneumonia (VAP) and rupture of the skin. This makes many times the balance between maintaining brain function and prevent adverse side effects.

Conclusion: There are several adverse events that may arise in patients with intracranial hypertension or even in patients requiring invasive monitoring of intracranial pressure. And nursing is a profession that can provide non-invasive care that helps to reduce intracranial hypertension, contributing to the reduction of secondary cerebral lesions.

Keywords: intracranial pressure, intracranial hypertension, nursing care, transmissible

Volume 5 Issue 3 - 2018

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Received: March 04, 2018 | **Published:** May 01, 2018

Introduction

Its concept is intracranial pressure (ICP) as the hydrostatic pressure of the cerebrospinal fluid (CSF) that surrounds the brain neural tissue and vasculature into the cavity crania.¹ This is often achieved through the placement of an external ventricular drain (EVD or ventriculostomy), in a region of the lateral ventricles cerebral^{1,2} results from the balance of three components: cerebrospinal fluid, blood, and brain parenchyma, which makes a key vital sign in neuroscience. Its normal pressure ranges from 5 to 15 mmHg, or even 20 cmH₂O.³

Among the changes in ICP is intracranial pressure (ICP), which is characterized by increased ICP above 20 mmHg. This is classified according to its etiology and pathogenic mechanisms: parenchymal HIC, HIC vascular, HIC caused by the cerebrospinal fluid dynamics of disturbances and HIC idiopática.⁴ These appear as principal etiologies the craneoencefálico injury (TBI), brain vascular accident (stroke), brain tumors, intracranial surgery, infections, hepatic encephalopathy, hydrocephalus, hypoxia, and ketoacidosis diabética,⁵ especially traumatic brain injury, which accounts for almost 1.4 million injuries and 52,000 deaths annually in the United Unidos.⁶ Once enlarged, the PIC may reduce cerebral blood flow and result in cell death and ischemia. In the early stages of cerebral ischemia, vasomotor centers are stimulated and systemic pressure rises to maintain cerebral blood flow. It is usually accompanied by slow and strong arterial pulsation and breathing irregularity, such as Cheyne-Stokes.⁷ The carbon dioxide concentration in the blood and brain tissue is also important in the regulation of local blood flow. An increase in partial pressure of

arterial carbon dioxide tension (PaCO₂) causes cerebral vasodilation, leading to increased blood flow increasing brain ICP. A decrease in PaCO₂ has vasoconstrictor effects, limiting blood flow to the brain. The reduced venous flow can also increase cerebral blood volume and thereby increase the PIC.⁷

This makes the ICP monitoring of invaseive form is required. This obetive monitoring avoids secondary lesions of brain cells, which can cause functional sequelae, psychological, behavioral and cognitive with and important for the rehabilitation and difficult psychosocial and family reintroduction of these patients. Its indications include patients who have suffered TBI, stroke, heart failure, surgery, bleeding and have encephalic tumors. Through the clinical patients presented by ICP monitoring, these become a high complexidade.⁸

The ICP measurements are essential in the evaluation and treatment of neurological disorders such as spinal injection and intracerebral hemorrhage, ischemic stroke, hydrocephalus, meningitis, encephalitis, and TCE. These methods can be invasive and non-invasive. These methods not only allow a better monitoring of ICP but also the outlet ducts. However, the invasive monitoring has some limitations such as monitoring the short-term risk of infection and the very restricted mobility of the patients.⁹ With regard to nursing, this plays a key role in assisting neurological patients in the intensive care unit. For this, it is necessary knowledge of the care given to these patients, as well as the possible adverse effects present in patients with ICH, in order to ensure a quick nursing care, quality, and minimum risk. It is observed that, in everyday life, patients with increased ICP can develop several complications that require interventions específicas.¹⁰ Among the

professionals offering these interventions are nurses, particularly nurses to be the direct responsible for assistance to critical patients. These manage care in order to reduce the peak when high and prevent secondary brain damage. Therefore, these patients should be monitored diligently to prevent secondary complications to elevated ICP. In this context, this study aimed to discuss through the literature on the management of intracranial hypertension in neurological patients and their possible adverse effects.

Methods

This is an integrative review with the adoption of PICO search strategy, which is an acronym for population or patient, intervention, control or comparison and "Outcomes" (outcome). As emphasized population is the patients who developed ICH. As intervention (I) addressed to intracranial pressure monitoring in neurological patients. The control or comparison (C) was not addressed or not apply to this study. The desired/Expected Outcomes is the knowledge of management of ICH and its possible adverse effects. These four elements are essential to the bibliographic formulation of the research question and the search for evidence, allowing the definition of necessary information to resolve the clinical question of research.¹¹ The integrative review was carried out through the following steps: Setting theme, establishing a hypothesis or research question, sampling or literature search, categorization of the study, evaluation of studies included in the review, interpretation of results, knowledge synthesis or presentation revision.¹² The main question was drawn from the PICO search strategy that focused on: What are the possible adverse effects resulting from intracranial hypertension in neurological patients? Later there were the lifting items that occurred between March and April 2017, using the following descriptors in Health Sciences (DeCS): intracranial pressure, intracranial hypertension, nursing interventions, encephalopathies; and the descriptors of Medical Subject Headings (Mesh): intracranial pressure, intracranial hypertension, nursing interventions, encephalopathies. The descriptors are combined using the Boolean operator "AND" to refine the search (Figure 1). The literature review was directed by the guiding question described above.

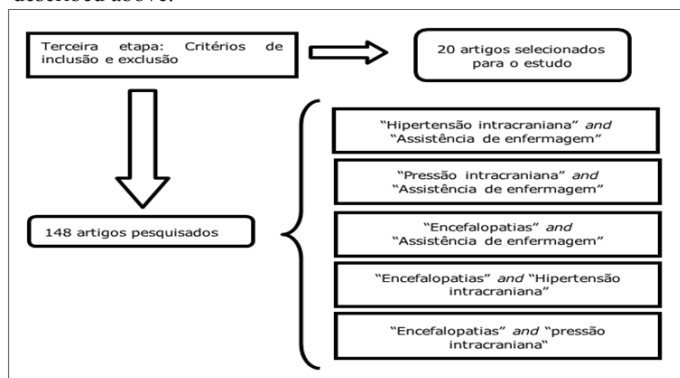


Figure 1 Flowchart of selection of items for inclusion in the survey.

Source: Authors, 208

Thus, there was a survey of scientific publications available in the databases LILACS, SciELO, BDENF, MedLine, PubMed/MEDLINE and SCOPUS. the filters were used: articles available in full publications between 2008 and 2017 in Portuguese, English and / or Spanish. Inclusion criteria were: studies that addressed the theme ICH

or raised ICP, published in Portuguese, English or Spanish, from 2008 to 2017, which were available online in its entirety for free. Articles with dual publication were considered only once. The exclusion criteria were adopted: items that do not deal with neurological patients and articles published prior to 2008, comments or previous notes or that did not cover the proposed problem. Table 1 shows the result of the search.

Table 1 Search and selection of the articles included in this review, in 2018

Electronic search in the databases LILACS, SciELO, BDENF, PubMed / Medline and Scopus.	
Identification of articles 148	Search the full articles (83 exclusions are not available for free online)
65 productions	Reading the title and abstract (23 exclusions thematic focus)
42 productions	Reading in full (14 exclusions did not answer the research question).
28 productions	Analysis of the database (8 exclusions Estrem available in two or more database).
20 productions	CORPUS RESEARCH

Source: Authors, 2018.

After the selection was constructed containing a table summarizing the studies relevant to the identification and study of the year, method, evidence level, complications of studies described in PIC as well as the possible interventions of nursing.

Results

Found 148 studies, only 20 of which met the inclusion criteria established. After a complete reading of the articles was performed BOOK REPORT publications selected to organize the central ideas. Then, it designed a table (Table 2) with the characteristics of the studies presenting authors and year, title, journal and its corresponding qualis. The selected productions are produced studies and published in national and international periodicals with Qualis between "A1 and B2" facing the health sector, in particular, area of nursing and medical. The research found unfold in performed in hospitals studies, especially in the intensive care unit and review studies (systematic resisões and meta-analyses) (Table 2).

In summary the possible effects adversos stand out as ischemia cerebral,^{6,13} hypoxia/hypoxemia cerebral,¹⁴⁻²² febre,^{6,15} cerebral,^{13-15,23-25} herniation, interference bloodstream/delay intracraniano,¹⁴ blood flow, decreased perfusão,¹⁴ pressure obstruction venoso,¹⁴ reflux renal,¹⁵ failure, hiperglicemia,²⁶⁻³¹ hipoglicemia,²⁶ death/encefálica,^{15,19,22} death, infection due to insertion of the catheter for monitoring PIC,^{17,20,29} line offset média,¹⁷ Hematoma,^{17,19,29} intracerebral hemorrhage,^{17,18,20-23,30,31} secundária brain injury,¹⁸ edema cerebral,^{19,25,27,29} hipercapnia,²³ desregulação blood pressure (hypo- or hypertension),^{23,31} convulsões,^{23,29,31} hipotermia,²⁷ hidrocefalia,^{29,31} vasoespasmio,²⁹ metabólicos disorders,²⁹ thrombotic events venosos.³¹ It was observed that the peak is a complex variable used to obtain information about PPC, cerebral auto regulation and compensatory mechanisms. And that the ECA was the main responsible for the development of ICH followed by cerebral edema. The main causes identified by the study were divided into primary and secondary causes. The main causes for its primary increase in ICP are: Brain Tumor;

Trauma (epidural and subdural hematoma, brain contusion); non-traumatic intracerebral hemorrhage; BIRD; hydrocephalus; HIC benign or idiopathic; other (pseudotumor cerebri, pneumoencephalo, cysts and abscesses, brain).^{6,13–31}

The main secondary causes (extracranial) are airway obstruction; Hypoxia or hypercapnia or hypercarbia (hypoventilation); Hypertension (pain / cough) and hypotension (hypovolemia / sedation); Posture of the patient (head rotation); hyperpyrexia; seizures; And metabolic drugs (e.g., tetracycline, rofecoxib, divalproex sodium, lead poisoning); Others (eg, cerebral edema high altitude, liver

failure). The causes of HIC postoperative can present as a mass lesion (hematoma); Edema; Increased cerebral blood volume (vasodilation); LCR disorders.^{5,13–31}

The most commonly used technique in clinical practice to monitor the peak involves an intraventricular or intraparenchymal catheter system, which is still considered the gold standard for monitoring ICP. These advances in PIC monitoring technique provides a variety of methods to assess ICP. These techniques are able to record the PIC in real time at the bedside and allow therapeutic intervention by detecting changes in the pathophysiology intracranial.²⁰

Table 2 Characteristics of the articles included in this review, in 2018

Author (s), year	Title	Journal	Qualis
Cecil Chen, Callaway, Rowland, Adler, Chen, 2011. ⁶	Traumatic brain injury: advanced multimodal neuromonitoring from theory to clinical practice.	Crit Care Nurse	A1
Hickey, Olson, Turner, 2009. ¹³	Intracranial Pressure Waveform Analysis During Rest and Suctioning	Biological Research for Nursing	A1
Han, Yang, Zhang, Zhao, Li, 2016. ¹⁴	Impact of Intracranial Pressure Monitoring on Prognosis of Patients With Severe Traumatic Brain Injury: A Systematic Review and Meta PRISMA-Analysis.	Medicine (Baltimore)	A2
Xian, Liao, Su Lai, Li, Zang, 2011. ¹⁵	Intracranial pressure and cerebral perfusion pressure in the preventive monitoring of nursing care Severe Traumatic Brain Injury	Scientific Research and Essays	B1
Nogueira Padilha, Silva, Spear, Oliveira, Sousa, 2015. ¹⁶	The pattern of nursing interventions Performed on trauma victims According to the Nursing Activities Score	Magazine USP School of Nursing	A2
Ferreira, Bassi, Lucena, cart, Miranda, Tierno et al. ¹⁷	Measurement of intracranial pressure and Short-Term Outcomes of Patients with Traumatic Brain Injury: The propensity-matched analysis	Rev Bras Ter Intensiva	B2
Olson, McNett, Lewis, Riemen, Bautista 2013. ¹⁸	Effects of nursing interventions on intracranial pressure.	American Journal of Critical Care	A1
Shen Wang, Su, Qiu, Xu, Zhou et al. ¹⁹	Effects of Intracranial Pressure Monitoring on Mortality in Patients with Severe Traumatic Brain Injury: A Meta-Analysis	PLOS ONE	A1
Kawoos, McCarron, Auker, Chavko. ²⁰	Advances in Intracranial Pressure Monitoring and Its Significance in Managing Traumatic Brain Injury.	International Journal of Molecular Sciences	A1
Suadoni. ²¹	Raised intracranial pressure: nursing observations and interventions	Nursing Standard	B2
Yugras, Yukse. ²²	Factors Affecting Intracranial Pressure and Nursing Interventions.	Jacobs and Journal of Nursing Care	*
Nyholm, Steffansson, Fröjd, Enblad, 2014. ²³	Secondary insults related to nursing interventions in neurointensive care: a descriptive pilot study	Journal of Neuroscience Nursing	A1
Cornejo, Romero Ugalde Bustos, Diaz Galvez et al. ²⁴	High-volume hemofiltration and prone ventilation in subarachnoid hemorrhage complicated by severe acute respiratory distress syndrome and refractory septic shock	Rev Bras Ter Intensiva.	B2
Kamel, Hemphill. ²⁵	Characteristics and sequelae of intracranial hypertension after intracerebral hemorrhage.	Neurocritical Care	B1
Tsaousi, Bilotto. ²⁶	From the Neurocritical Care Unit Requires Dedicated Staff Nurse?	Journal of Nursing & Care	*
Ropper, 2012. ²⁷	Hyperosmolar Therapy for Raised Intracranial Pressure	N Engl J Med	A1
Xie, Wu Yan, Liu, Wang. ²⁸	Mortality and outcome comparison between combined intracranial brain tissue oxygen pressure / cerebral perfusion pressure and intracranial pressure guided therapy / cerebral perfusion pressure guided therapy in traumatic brain injury: A meta analysis	World Neurosurgery	B1
Haddad, Arabi, 2012, 2012. ²⁹	Critical care management of severe traumatic brain injury in adults	Scand J Trauma Resusc Emerg Med.	B1
Boulouis, Morotti, Goldstein, Charidimou. ³⁰	Intensive blood pressure lowering in Patients with acute intracerebral hemorrhage: hemorrhage expansion and clinical outcomes. Systematic review and meta-analysis of randomized trials.	J Neurol Neurosurg Psychiatry	A1
Balami Buchan. ³¹	Complications of intracerebral hemorrhage	The Lancet Neurology	A1

*Periodic Qualis not found

Source: Authors, 2018.

Discussion

The management of intracranial hypertension: types/ classification

The management of HIC: It involves the prevention factors that precipitate or aggravate its increase. Once high, it is essential to rule out new lesions mass that must surgically be conducted. Their treatment, when elevated, is to include sedation, CSF drainage and osmotherapy with mannitol and hypertonic saline. In regard to the initial management refractory IH, coma induction by barbiturates, decompressive craniectomy or hypothermia should be considered. Steroids are not indicated and can be harmful to the treatment of HIC resulting from traumatic brain injury.⁵

As regards the classification of HIC This can be classified into four forms, according to their etiology, pathogenesis and increased ICP standards: HIC parenchymal; HIC vascular; HIC caused by the dynamics of CSF disorders; HIC idiopathic.^{4,32} The first (HIC parenchymal) is related to the result of an intrinsic etiology of primary brain and changes in intracranial volume (edema expansive, compressive, hypoxic or traumatic).⁴ The second (HIC vascular) is due to the development of cerebral edema. With this increased ICP is determined by disorders of cerebral blood volume (excluding the etiology of parenchymal ICH). Cerebral edema is by "brain congestion" after the increase of cerebral blood volume caused by a large stream of blood, or a reduction or stop in cerebral blood output. There is also a reduction in CSF absorption involved in the reduction of cerebral blood flow.³³

The HIC vascular occurs in various situations such as:³³

Cerebral vascular -Doenças: cerebral venous thrombosis and thrombosis upper sagittal sinus thrombosis mastoiditis with the transverse sinus or sigmoid (the "optical hydrocephalus" described by Simonds); Extra-cerebral -Doenças: as acute hypertension hypertensive encephalopathy, encephalopathy in cases of malignant hypertension of whatever cause, glomerulonephritis, eclampsia, etc., or reduced cerebral venous flow in congestive heart failure, superior vena cava syndrome or mass lesions intrathoracic. The third (HIC caused by disturbances of the dynamics of cerebrospinal fluid) It is related to the dynamics of cerebrospinal fluid, which includes all aspects of the CSF circulation (from production to absorption). The dynamics of disorders LCRT They may be related to circulation disorders, which often result in the obstruction of their traffic routes, causing their accumulation in the ventricles due to blockage of its flow. Tumors, bleeding, and infections aqueductal stenosis may cause obstruction at both points along roads. Their clinical characteristics are similar to a hydrocephalus obstructiva.³³

And last is the HIC idiopathic where its pathogenesis is not yet established and understood in its entirety.^{34,35} This is characterized as the persistent increase in PIC in the absence of intracranial lesions: intracranial tumor, hydrocephalus, intracranial infection, dural sinus thrombosis or hypertensive encephalopathy. It occurs in endocrine, metabolic and hematological disorders, hormonal treatments, etc. HIC The rate is the lowest in relation to associated diseases. The diagnosis of this type of HIC is done only after measuring PIC and the full exploitation of neuroimaging.³³⁻³⁵ Bearing on the admission of a patient with neurological disorders, monitoring of PIC is indicated at times:⁶

- i. In cases of patients presenting Glasgow Coma Scale of 3 to 8 (after resuscitation), abnormal presentation of head CT, hematoma and/or brain edema, cranial contusion, herniation, compressed basal cisterns.
- ii. In the case of patients who have Glasgow Coma Scale of 3 to 8 (after resuscitation) with a normal presentation of the CT scan head with 2 or more of the following risk factors: age > 40 years, changes in motor position, systolic blood pressure < 90 mm Hg.

Nursing and changes in intracranial pressure

The CSF changes that lead to HIC, generally, are those that cause obstruction of cerebrospinal fluid flow at any point in its path and causing difficulty in resorption LCR.³³ The total volume of the intracranial blood is approximately 4 to 4.5 ml / 100 g of brain tissue, which normally is distributed by 60% in the venous side and 40% on the arterial side. Clinically, the venous system can be regarded as incompressible and the vessels of the venous system are unchanged from their diameters, so the entire stroke response is the blood side, which is less than 2% of the intracranial volume or about 25 ml in the adult brain.³³ Cerebral blood flow (CBF) is directly proportional to cerebral perfusion pressure (CPP) and inversely proportional to the cerebral vascular resistance (SVR). PCP is proportional to the mean arterial pressure (MAP) under venous pressure. As in man, the pressure in the venous sinuses is difficult to measure and it runs parallel to the PIC, it is considered the PPC proportional to the difference between MAP and ICP. Therefore, the FSC can be expressed by the following equation:^[5,33]

$$FSC = CPP = MAP - PV (PIC)$$

$$RVC = RVC$$

Monitoring in the epidural space, it is less invasive, but the transmission of PIC is more difficult and requires the use of more sophisticated pressure transducers, which are applied directly to the dura mater. The same goes for ICP monitoring performed by fontanelle bregmática.³³ The monitoring system most widely used currently has a transducer at the end of a semi-rigid catheter that can be placed in the ventricle, the parenchyma and subarachnoid space through an optical fiber are connected to the device which records the pressure values. This method evaluates the brain pic its normal value set between 0 to 15 mmHg. Thus one must be attentive to values greater than 15-20 mmHg, as from these values is that start in general therapeutic measures for ICH. And values between 20 to 40 mmHg are considered moderately high, above 40 mmHg seriously high. ICP often is higher in TBI patients, and when it stays above 60 mmHg, it is often fatal.^{33,36} If the PIC and PPC present elevations above the recommended limits may develop complications such as Herniação brainstem, diabetes insipidus, and syndrome of inappropriate secretion antidiuretic hormone (SIADH). Thus, care should be instituted as monitoring PIC and cerebral oxygenation, interpretation of the waves PIC, Infection prevention, water balance, correct positioning, night 30 to 45, head maintained a neutral position, avoiding hip flexion, as this position increases abdominal pressure; maintaining clear respiratory tract, oxygen supply, maintain normal body temperature, sedation and treatment of administration, provide an increase in blood pressure, intravenously transfuse sufficient volume of liquid, mannitol as prescribed administered intravenously drain LCROffer oroenteral via a nasogastric tube, or nimodipine.⁷ If these measures do not diminish the PIC or whether they increase the PPC, a computed tomography (CT) of emergency should be realized.^{29,33}

Other precautions such as monitoring body temperature should also be instituted. This should be restricted below 38.5 or between 35 to 38. When high, the passage of alcohol into the skin of the patient, use of ice bags, ice sheets, wet blankets and administration of medications are strategies for reducing it. Care hemodynamic função must also be set as monitor and ensure systolic blood pressure between 90 160 mmHg, central venous pressure (CVP) from 5 to 12 mmHg, heart rate between 50 and 120 bpm, respiratory frequency between 8 and 24 bpm, ≥ 75 mmHg PaO_2 , paying attention to values lower than 60 mmHg and $\text{SPO}_2 > 95\%$.¹⁵ At first, the conduct that nurses when facing the patient with neurocritical should direct to ICP monitoring. This should make a clinical assessment to prove the existence of false changes thus avoiding inadequate interventions in relation to the condition of the patient, minimizing the risk of failure in the same tour.^[16] This professional, to provide intensive care to these patients should be aware of potential problems found across the brain injury. Therefore nurses must take a holistic view of the patient, paying attention to the monitoring of hemodynamic function of the patient with PIC. For the treatment of the underlying causes, the management of the factors that contribute to the control of ICP, as well as monitor and manage the PIC and prevent secondary injuries.²¹

Another simple care refers to the elevation of the head, keeping it between 30-45 degrees, except when there are contraindications. The elevation of the head 30 to reduce the peak significantly compared to the supine position. This position moves the liquid into the subarachnoid space and also increases brain drain, and favors the venous drainage of the brain.²² When related to patient monitoring, hemodynamic monitoring is an important role of the nurse. The blood pressure monitoring should be taken into account because the patient's wrist is unstable in the early stages of elevated ICP. Already in later stages there is a bradycardia which should be observed.¹⁴ The author also states that the baroreceptors increase vagal stimulation of the heart to slow the heart rate in an effort to reduce blood pressure. Among the articles selected four highlight aspects such as analgesia and hyperventilation. The first prevents increased PIC caused by pain and agitation, as the second characteristic, although not routinely used, and used in patients with cerebral herniation caused by ICP.¹³ Therefore the maintenance of adequate oxygenation of the patient with PIC minimizes complications such as cerebral ischemia and respiratory acidosis.³⁷ The success of therapy for patients with increased ICP is the maintenance of respiratory and hemodynamic support, which are ideal to ensure adequate brain perfusion and oxygenation. A rapid clinical evaluation facilitates the recognition of elevated ICP and prompt institution of therapy against increased PIC.³⁷

Patients with suspected ICH should be monitored for their PIC; the cerebral oxygen extraction, with jugular oximetry or PO_2 brain tissue in some cases when indicated. The neurological function of injured patients must also be monitored closely, paying attention to the systemic parameters, including ventilation, oxygenation, electrocardiogram, heart rate, blood pressure, temperature, blood glucose and the fluid intake and outlet. Patients should be routinely monitored by pulse oximetry and capnography to avoid unrecognized hypoxemia or hypoventilation and hyperventilation. A central venous catheter is often necessary to help evaluate volume status and a Foley catheter is used for the production of urine.⁶

In a meta-analysis published in 2017, focusing on patients with intracerebral hemorrhage, he pointed out that the presence of HIC in the acute phase of injury in the absence of contraindications, the acute

blood pressure reduction may be a good option for your savings. But it does not seem to provide an incremental clinical benefit in terms of reduced mortality and better functional outcomes. However, for patients with acute intracerebral hemorrhage with hematoma and large increase in ICP, which have a higher risk of cerebral hypoperfusion, safety and benefit of reducing the PA not present claros.³⁰ Another meta-analysis showed that the guided therapy (ICP/PPS), combined with oxygen in the brain tissue to obtain best possible favorable results in patients with traumatic brain injury compared to targeted therapy ICP/PPS pattern. The combination therapy had little effect on ICP and CPP, on mortality rate and time internação.²⁸

With regard to body temperature in patients with changes in ICP, its elevation in the hypothalamus may indicate damage caused by elevated ICP. The higher the PIC, Increased body temperature, therefore, is of paramount importance that the nurse knows differentiating a high temperature caused by an infection or PIC.^{38,39} One study found that increasing the intra-abdominal pressure can lead to worsening of lung compliance. This factor can directly reflect the increased PIC. Elevation of venous pressure in cases of acute lung injury also may correlate with increasing PIC, probably by reducing the pressure gradient for cerebral venous drainage.⁴⁰ Subarachnoid hemorrhages and cerebral herniation, have also been reported in the studies analyzed. Olson and his colleagues¹⁸ indicate that diffuse or localized increase in the brain volume tends to displace some part of the brain in relation to the compartments of intracranial dural folds. This compression causes part of the brain exceed the falx and the tent cerebellum compressing vital structures. Starts from the assumption, some nursing interventions front ICP monitoring of these patients can be carried out: Level the sternum transducer to a consistent anatomical reference point, record the PIC pressure readings, monitor the quality and characteristic wave PIC, check the presence of stiff neck, exchange and/or reinforce the dressing where appropriate insertion site, monitor CO_2 levels, care tracheal aspiration procedure and monitor systemic blood pressure.³⁹ Knowledge of the temporal patterns in neuromonitorização data can help in how long decision process to record the values of the PIC in order to capture and potentially treat the most critical episodes and also allow early identification of patients with serious injury that may be risk of death or persistent neurological disability or neuroprotectas requires early surgery or therapy.⁴¹ However, patients should also be monitored diligently to side effects such as pneumonia associated with ventilator (PAV) and skin breakdown. What makes a delicate balance to maintain brain function, and help prevent other secondary lesions.¹⁰

In addition, the nursing work as part of an integrated health team has an essential role in improving patient outcomes. This team needs to meet and implement the good nursing management for patients with ICH and understand their potential underlying value. In referring to nurses, they must receive training and continuing education on how to care for these patients, so that they become competent to do so. Moreover, it is important to examine the knowledge, practice, and attitude of these nurses before and after this training or after an educational intervention to ensure good performance, and quality of competence.

Conclusion

The management of high pic includes nursing care that converge in order to normalize the peak improve cerebral blood flow and perfusion pressure, to prevent complications that exacerbate imbalances ICP. Often patients with elevated ICP develop various complications requiring nursing support, whose actions can positively and negatively

affect the picture. Among the main actions observed the monitoring of cerebral oxygenation, correct interpretation of the waves of PIC, Body positioning and the patient's head, lift the headboard, environmental control, proper endotracheal suctioning, control of water balance, oral hygiene and body of the patient, correct administration of prescribed medications, neurological evaluation through standardized scales (Glasgow), steady and accurate assessment of vital signs. Adversous effects were evident as cerebral herniation, fever, hypoxia, brain death, hypotension, papilledema, severe headache, cerebral hemorrhage, cerebral hematoma among others. Furthermore, the study contributes to the improvement in the quality of the nursing care to patients with HIC. Moreover, it shows how it should be the planning of care provided by the nurse that the patient has the best possible prognosis.

Acknowledgments

None.

Conflict of interest

The authors declare that there is no conflict of interest.

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