

Service of nursing in intracranial pressure monitoring in patients neurocríticos

Assistência de enfermagem na monitorização da pressão intracraniana em pacientes neurocríticos

Servicio de enfermería en el monitoreo de la presión intracranial en pacientes neurocríticos

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ABSTRACT

Objective: To identify through literature the nursing interventions in the intracranial pressure monitoring in patients neurocríticos. **Method:** Integrative review of literature with search of articles in SciELO, LILACS, and PUBMED. The selected articles were published between the years 2007 and 2017. **Results:** We found 94 articles and excluded 78 as inclusion criteria. So 16 articles were used in this review. These suggest that the neurological monitoring can be performed in a invasive and non invasive. Among the invasive methods is the monitoring of intracranial pressure, and the nurse, who was directly responsible for this care. Thus, care and the elevation of the head, care with tracheal aspiration, care with hypoxemia, coordination and management in nursing care among others must be part of nursing care. **Conclusion:** Nursing care is essential for the patient neurocrítico. This care contribute to both positive developments as negative in these patients.

Descriptors: Intracranial pressure, Intracranial hypertension, Nursing care, Intensive care unit.

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RESUMO

Objetivo: Identificar por meio da literatura as intervenções de enfermagem na monitorização da pressão intracraniana em pacientes neurocríticos.

Método: Revisão integrativa da literatura com busca dos artigos nas bases de dados SciELO, LILACS e PUBMED. Os artigos selecionados foram publicados entre os anos de 2007 e 2017. **Resultados:** Foram encontrados 94 artigos e excluídos 78 conforme critérios de inclusão. Assim, 16 artigos foram usados nesta revisão. Estes apontaram que a monitorização neurológica pode ser realizada de maneira invasiva e não invasiva. Entre os métodos invasivos, está a monitorização da pressão intracraniana, sendo o enfermeiro, responsável direto neste cuidado. Assim, cuidados como a elevação da cabeceira, cuidados com aspiração traqueal, cuidados com hipoxemia, coordenação e gerenciamento nos cuidados de enfermagem, entre outros, devem fazer parte da assistência de enfermagem. **Conclusão:** Os cuidados de enfermagem são indispensáveis para o paciente neurocrítico. Estes cuidados contribuem tanto para evolução positiva quanto negativa desses pacientes.

Descritores: Pressão intracraniana, Hipertensão intracraniana, Assistência de enfermagem, Unidade de terapia intensiva.

RESUMEN

Objetivo: Identificar a través de la literatura las intervenciones de enfermería en el monitoreo de la presión intracraneal en pacientes neurocríticos. **Método:** Revisión de la literatura integradora con búsqueda de artículos, SciELO, LILACS y PUBMED. Los artículos seleccionados fueron publicados entre los años 2007 y 2017. **Resultados:** Se encontraron 94 artículos y excluidos 78 como criterios de inclusión. Hasta 16 artículos fueron utilizados en esta revisión. Estos datos sugieren que la monitorización neurológica puede realizarse en una invasiva y no invasiva. Entre los métodos invasivos es el monitoreo de la presión intracraneal y la enfermera, que era directamente responsable de este cuidado. Por lo tanto, el cuidado y la elevación de la cabeza, cuidado con aspiración traqueal, cuidado con hipoxemia, coordinación y gestión en enfermería entre otros debe ser parte de la atención de enfermería. **Conclusión:** Cuidados de enfermería es esencial para el paciente neurocrítico. Este cuidado contribuir tanto positivos como negativos en estos pacientes.

Descriptores: Presión intracraneal, Hipertensión intracraneal, Cuidado de enfermería, Unidad de cuidados intensivos.

INTRODUCTION

Intracranial Pressure (ICP) is the hydrostatic pressure of the cerebrospinal fluid that surrounds the neural tissue and the cerebral vasculature in the cranial cavity.¹ This is often obtained by placing an external ventricular drain in one of the lateral ventricles of the brain area.^{1,2}

This is characterized as a key vital sign in neuroscience and is the result of the balance of three components: cerebrospinal fluid, blood, and cerebral parenchyma. Its normal pressure ranges from 5 to 15 mmHg¹ or up to 20 cmH₂O.³ Among the alterations in the ICP is Intracranial Hypertension (IH), which is characterized by an increase in ICP above 20 mmHg. It is classified into four forms, according to its etiology and pathogenic mechanisms: parenchymal IH with intrinsic cerebral cause; vascular IH, which has its etiology in disorders of cerebral blood circulation; IH caused by brain-spinal fluid dynamics and idiopathic IH.⁴

Among the causes of IH, it is mainly the traumatic brain injury, which accounts for almost 1.4 million injuries and

52,000 deaths per year in the United States.⁵ Nearly all acute and catastrophic brain diseases increase ICP, notably: Traumatic Brain Injury (TBI), strokes, brain tumors, intracranial surgeries, infections, hepatic encephalopathy, hydrocephalus, hypoxia, and diabetic ketoacidosis.⁶

Once elevated, ICP can reduce cerebral blood flow, resulting in ischemia and cell death. 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 irregularity of breathing (Cheyne-Stokes).⁷ The concentration of carbon dioxide in the blood and brain tissue is also relevant in regulating local blood flow.

An increase in the arterial pressure of arterial carbon dioxide (PaCO₂) causes cerebral vasodilation, leading to increased blood flow in the brain and then elevating ICP. A reduction in PaCO₂ has a vasoconstrictor effect, limiting blood flow to the brain. Reduced venous flow may also increase cerebral blood volume and thereby elevate ICP.⁷

The major goal of monitoring is to avoid secondary brain cell lesions, which can cause functional, psychological, behavioral and cognitive sequelae, and are important for the rehabilitation and difficulty of a psychosocial and familial reintroduction of these patients. Its indications include patients who have suffered head trauma, stroke, cardiac arrest, surgery, hemorrhage and who have brain tumors. Through the clinical aspects presented by patients undergoing ICP monitoring, these become highly complex.⁸

ICP measurements are essential in the evaluation and treatment of neurological disorders such as subarachnoid injection and intracerebral hemorrhage, ischemic stroke, hydrocephalus, meningitis encephalitis and TBI, with several invasive and non-invasive methods currently available to monitor this variable. These methods not only enable better monitoring of ICP, but also in conducting procedures, nonetheless, with some limitations related to invasive methods such as short-term monitoring, a risk of infection and restriction of patient mobility.⁹

Concerning the nursing team, it plays a fundamental role in assisting neurocritical patients in the intensive care unit, either positively or negatively. For this, it is necessary to know the care offered in order to ensure quality nursing care and with the lowest possible risk to patients.

In this sense, the elaboration of this research started from the following guiding question: What are the nursing interventions while monitoring the intracranial pressure in neurocritical patients?

It is observed that patients showing high intracranial pressure can develop several complications that require specific interventions.¹⁰ Therefore, nurses who manage patient care should diligently monitor these patients in order to reduce ICP when elevated and prevent injuries secondary brain disorders such as Ventilator-Associated Pneumonia (VAP) and/or skin rupture.¹⁰

Given the aforementioned context, the present study aimed to scrutinize, through the literature, the nursing care in the monitoring of intracranial pressure in neurocritical patients in the intensive care unit.

METHODS

It is an integrative review of the literature that consists of a research method composed of the following steps:¹¹ identification of the theme and selection of research questions, establishment of inclusion and exclusion criteria, selection of studies, definition of information to be extracted from selected studies, evaluation of evidence and analysis (categorization), discussion and presentation of the synthesis of knowledge evidenced in the studies analyzed.

The scientific search was based on the following guiding question: What are the nursing interventions while monitoring the intracranial pressure in neurocritical patients?

The bibliographic review was carried out in the following databases: *Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS)* [Latin-American and Caribbean Literature in Health Sciences], National Library of Medicine from the USA (PubMed), SciELO (Scientific Electronic Library Online), and *Banco de Dados de Enfermagem (BDENF)* [Nursing Database]. The research strategy at the *LILACS*, *BDENF* and SciELO databases were used as descriptors: “Intracranial pressure”, “Intracranial hypertension”, “intensive care unit” and “nursing”. The following descriptors were used in the PubMed: “Intracranial Pressure” (MESH) “Intracranial Hypertension” (MESH) “Intensive Care Units” (MESH) and “Nursing”. In order to refine the literature search, there was a combination of the descriptors added to the Boolean AND and OR.

The study was performed in March 2017. The inclusion criteria were as follows: studies that deal with monitoring the ICP in critically ill patients, and possible nursing care for the neurocritical patient with monitored ICP, articles published in the last 10 years. The selected bibliographies were published in the English and Portuguese languages, from 2007 to 2017, available online free of charge. Articles with double publication were considered only once. Documents such as annals, brief citations, website or articles that did not answer the guiding question were disregarded. **Table 1** shows the search results.

Table 1 - Review-study structuring. *LILACS*, SciELO, *BDENF* and PubMed, 2017.

Electronic search in databases <i>LILACS</i> , PubMed, SciELO and <i>BDENF</i>	
	Articles excluded by being published for over than 10 years 24
ARTICLES FOUND	Articles excluded for not being related to the theme 16
	Articles excluded by repetition 7
94	Articles excluded after systematic reading (title and abstract) 24
	Articles fully analyzed 23
	RESEARCH CORPUS 16

Source: Authors, 2017

Considering the articles selected for analysis, 16 answered the research question and formed the study corpus. After an exhaustive reading, the primary studies were submitted to the same extraction and data collection, through the conclusion of a table-type flowchart. The articles were identified by the letter “A”, followed by a numbering (A1, A2, A3, successively) (**Table 2**). With regards to ethical issues, the precepts of authorship were respected.

RESULTS

Herein, 16 publications distributed in different years of publication were used as a scientific basis. Considering the language in which the studies were written, English predominated over most of the selected studies (81.25%). The population studied in the articles included patients who were undergoing ICP monitoring in the intensive care unit. The research scenario was hospitals with ICP monitoring support, which perform surgeries for cardiovascular diseases. In the methodological design, there was a predominance of quantitative studies. **Table 2** shows the identification, author, title, publication year and the periodical of the studies.

The process of searching for the articles used in the present review was briefly described in a table (**Chart 1**) for a better understanding of the methodology and selection of articles. The descriptors were combined to enable a refined search of the literature.

Chart 1 - Selection of the articles referring to intracranial pressure.

	DATABASE	DESCRIPTORS MATCHING APPROACH	SEARCHING PROGRESSION	N	n	
TOTAL OF ARTICLES 94	SciELO	Intracranial pressure OR Intracranial hypertension AND nursing	1 st search	4	2	
		Intracranial pressure OR Intracranial hypertension AND intensive care unit.	2 nd search	8		
	LILACS	Intracranial pressure OR Intracranial hypertension AND nursing	1 st search	8	4	
		Intracranial pressure OR Intracranial hypertension AND intensive care unit.	2 nd search	22		
	PubMed	"Intracranial Pressure" AND "Intracranial Hypertension" AND "Nursing"	1 st search	7	10	
		"Intracranial Pressure" AND "Intracranial Hypertension" AND "Intensive Care Units"	2 nd search	42		
	BDENF	Intracranial pressure OR Intracranial hypertension AND nursing	1 st search	3	0	
		Intracranial pressure OR Intracranial hypertension AND intensive care unit.	2 nd search	0		
	RESEARCH CORPUS				16	

Source: Authors, 2017

N: Number of bibliographies found during the articles searching process.

n: Number of articles included in this review.

Characterization of the publications

The chosen articles were structured in a table (Table 1), and identified by the vowel A followed by an Arabic number (A1, A2, A3...) successively.

Table 2 - Summary of the publications selected by this review.

No.	TITLE	YEAR	JOURNAL
A1. ¹²	Monitoring of intracranial pressure in patients with traumatic brain injury.	2014	<i>Front Neurol</i>
A2. ¹³	Avanços na monitorização neurológica intensiva: implicações para a enfermagem.	2016	<i>Rev Bras Enferm.</i>
A3. ¹⁴	Advances in neuro-monitoring.	2013	<i>Anesthesia, Essays and Researches.</i>
A4. ¹⁵	Neurologic and epidemiologic characterization of frontal head trauma during a period of five years in Villa Clara.	2017	<i>Medicentro Electrónica.</i>
A5. ¹⁶	Traumatismo craneoencefálico no município de fortaleza.	2017	<i>Enferm. Foco.</i>
A6. ¹⁷	Clinical review: Neuromonitoring-an update.	2013	<i>Critical Care.</i>
A7. ¹⁰	Nursing care and intracranial pressure monitoring.	2009.	<i>American Journal of critical care.</i>
A8. ¹⁸	Advances in Intracranial Pressure Monitoring and Its Significance in Managing Traumatic Brain Injury.	2015	<i>Int. J. Mol. Sci.</i>
A9. ¹	Model-Based Noninvasive Estimation of Intracranial Pressure from Cerebral Blood Flow Velocity and Arterial Pressure.	2012	<i>Sci Transl Med.</i>
A10. ²⁰	Guidelines for the management of severe traumatic brain injury. VI. Indications for intracranial pressure monitoring.	2007	<i>J Neurotrauma</i>
A11. ²¹	Raised intracranial pressure: nursing observations and interventions.	2009	<i>Nurs Stand.</i>
A12. ²²	Pattern of nursing intervention performed on trauma victims according to the nursing activities score.	2015	<i>Rev Esc Enferm USP.</i>
A13. ²³	Factors Affecting Intracranial Pressure and Nursing Interventions.	2014	<i>J J Nurs Care.</i>
A14. ²⁴	Impact of Intracranial Pressure Monitoring on Prognosis of Patients With Severe Traumatic Brain Injury.	2016	<i>Medicine (Baltimore).</i>
A15. ²⁶	Intracranial Pressure Waveform Analysis During Rest and Suctioning. Biol Res Nurs.	2009	<i>Biol Res Nurs.</i>
A16. ³⁰	Effects of nursing interventions on intracranial pressure.	2013	<i>Am J Crit Care.</i>

Source: Authors, 2017

Note: The titles were kept as in their original language.

In short, caring for neurocritical patients involves both non-invasive and invasive neurological monitoring (monitoring of the ICP). Some care may include nutritional support, ventilatory support, body hygiene care, bedside maintenance, monitoring of CO₂ levels and maintaining adequate parameters, care with tracheal aspiration, maintaining systemic blood pressure within the appropriate variability, record ICP pressure numbers and analyze possible interferences in the result, monitor the quality and characteristics of ICP waves, monitor cerebral perfusion pressure, monitor brain temperature and jugular bulb oximetry, among others.

The latter is indicated mainly in the presence of clinical alterations such as severe TBI, mainly with GCS <8; IH; anesthetic procedures for neurosurgeries and cardiovascular surgeries.¹²⁻¹⁵

Figure 1 - Representation of a neurocritical patient.¹⁰



There are several techniques for ICP monitoring, the most used being as follows: the use of liquid filled polyethylene or silicone catheters; with fiber optic sensor; with electronic sensors; screws or capsules that are connected to pressure transducers and monitor systems. Its insertion can be performed at the bedside, in intensive care units, or, more commonly, in a surgical center.⁸

Regarding the non-invasive monitoring, neurological monitoring can be considered by scales such as the Glasgow Coma Scale (GCS) where the GCS result can be classified according to severity:^{13,15,16}

- GCS of 13-15 = mild trauma;
- GCS of 9-12 = moderate trauma;
- GCS <8 = severe trauma.

Another form of evaluation and monitoring of the neurological state is the transcranial Doppler where it is used in the ICU for the detection and follow-up of vasospasm, evaluation of intracranial hypertension and even a possible confirmation of encephalic death. The evoked potentials - somatosensory can also be evaluated. This strategy also becomes important as it exposes an electrical manifestation of the brain response to an external stimulus.^{13,14}

Neurological monitoring can also be followed by observing the level of consciousness, agitation, anomalous decorticate motor postures (upper limb flexion and lower limb extension) and decerebrate (extension of upper and lower limbs) indicate a progressive lesion of the trunk. As these last 2 signs appear late.¹³

Considering the ventilatory support, the indications for the patient with neurological impairment do not differ from those accepted for any patient in the ICU. Only more attention is focused on the prevention of hypoxemia, even if only for the shortest periods, since in these patients they can have devastating effects.¹³

Most of the monitoring modalities described above are not effective when considered in isolation. Invasive techniques provide continuous information about a specific area of the brain with an associated risk of complications, while noninvasive techniques provide non-continuous information from multiple locations. Therefore, the challenge is to integrate all these modalities (multimodal monitoring) to combine their strengths and allow greater confidence in decision making for patient management.¹⁴

Invasive neurological monitoring mainly comprises the ICP.^{13,17} Nursing care related to patients with this method are described and summarized in **Chart 2**.

Chart 2 - Nursing care for patients with monitored ICP.^{10,13,17}

NURSING CARE	JUSTIFICATION
Keeping the patient in a high position at 30° with the head in a neutral position, aligned to the thorax.	To avoid venous stasis and facilitate venous drainage of the brain.
Preventing hyperthermia and hypothermia, promoting hyperventilation and restricting liquids, if indicated.	Take additional measures to prevent intracranial hypertension.
Adjusting the alarm limits on the monitor and keeping them on.	Early identification of changes in values.
Keeping the connections between the catheter, the transducer and the monitor firmly attached.	To obtain reliable data.
Not allowing air to enter and remain in the transducer system.	To obtain reliable data
Attaching the transcranial transducer to the patient.	To avoid traction or extension and consequent malposition of the catheter.
Inspecting the transducer entrance site daily. Observing hyperemia, edema and presence of secretion.	To detect early signs of infection.
Replacing the dressing of the transducer every 24 hours with antiseptic solution.	To reduce the risk of infection.
Recording special procedures performed on the ICP chart, such as tracheal aspiration, body hygiene, etc.	To detect possible interferences and relate them to procedures.
Monitoring the Average Blood Pressure (ABP) and calculate the Cerebral Perfusion Pressure (CPP).	To control the effective blood perfusion of the CNS.

The following are other nursing interventions that can be offered to patients with the ICP monitored:¹⁰

- Determining the ICP reference values for each patient as determined by the patient's severity, underlying pathology, and treatment plan.
- Monitoring pulmonary hygiene and the effects of interventions, such as aspiration and patient placement, on intracranial pressure.
- Determining a daily interdisciplinary care plan including individualized daily goals.
- Taking care of skin and hygiene handling, as indicated by the patient's condition.
- Planing the nursing care at intervals to allow patients with high ICP to stabilize.

DISCUSSION

In summary, the articles indicate that ICP is a complex variable used to obtain information about Cerebral Perfusion Pressure (CPP), compensatory mechanisms of the brain and self-regulation.

The technique most commonly used in clinical practice to monitor ICP involves the intraventricular or intraparenchymal catheter system, which is still considered the gold standard for ICP monitoring. These advances in PCI monitoring technique provide a variety of methods for assessing ICP. These techniques are able to record the ICP in real time, at the bedside, and allow therapeutic interventions through the detection of changes in intracranial pathophysiology.¹⁸

With some sacrifice in measuring accuracy, ICP can also be monitored in subarachnoid or subdural spaces, without the need for an invasion of brain tissue, although it still involves skull penetration. All of these methods, therefore, require neurosurgical expertise and are at risk of infection and tissue damage. Assessment of spinal fluid pressure by lumbar puncture may also provide a local estimate of ICP. Nonetheless, this strategy is not recommended when there is a suspicion of an increase in ICP due to the risk of a cerebral

hernia.¹ In other words, a single local evaluation using this strategy is not indicated since it should not be based on an individual pathology indicator, since it does not provide dynamic ICP parameters.

Some systemic changes resulting from ICP are the following: headache, vomiting and papilloedema. A headache tends to be holocranial (involves the entire skull) and is due to compression of meningeal nerve branches. The vomiting, by jet, is related to the compression of bulb centers. Papillary edema consists of blotting of the margins of the optic disc with an ophthalmoscopic examination. It occurs due to the increased intracranial pressure is transmitted around the optic nerves by the surrounding meninges cuff, hindering venous return. This leads initially to congestion of the retinal vessels and then to papilla edema. Moreover, compression of the axons of the optic nerve is also admitted, hindering anterograde axonal flow.¹⁹

In addition to the classical triad, mental confusion or coma, seizures, and localized deficit signs may be associated with the area affected by the lesion, such as hemiplegia, aphasia and hemianopsia.¹⁹ This makes the nursing, especially the nurse, be alert to these clinical signs in order to promote early identification of IH and consequently to guide rapid and effective decision-making.

Regarding the monitoring of ICP in critically ill patients, the most recent lines of research from the Brain Trauma Foundation recommend (level II evidence) that ICP should be monitored in all patients recoverable with severe TBI (Score of the Glasgow Coma Scale from 3 to 8 after resuscitation) and abnormal computed tomography.²⁰

Nurses who provide critical care to critical patients should pay attention to the potential problems encountered in people with brain injury, as the brain may be deteriorating. Therefore the nurse must have a holistic view of the patient. In addition to monitoring the hemodynamic functions of the patient with intracranial pressure, treating the underlying causes, managing factors that control ICP, monitoring and managing intracranial pressure, and avoiding secondary injuries.²¹

Initially, the nurse should behave in relation to a patient with monitored ICP aiming to perform a clinical evaluation to prove the existence of changes, thus avoiding inappropriate interventions in relation to the patient's condition, minimizing the risk of failure assistance.²²

Another important fact regarding the ICP is the degree of elevation of the patient's head in the bed. Of the twenty-six articles analyzed, three evidenced the importance of elevating the patient's head with IH to 30°. And this strategy significantly reduces ICP when compared to the supine position of IH patients.²³

Hemodynamic monitoring is an important role of the nurse. Blood pressure monitoring should be taken into account because the patient's pulse is unstable in the early stages of ICP. At later stages, there is bradycardia that must be observed.²⁴ The author further states that baroreceptors increase vagal stimulation of the heart to lower heart rate in an effort to reduce blood pressure.

High body temperature indicates hypothalamic damage caused by high ICP. The higher the intracranial pressure, the higher the body temperature, and it is of the utmost importance that nurses know how to differentiate a high temperature caused by ICP or an infection.²⁵

Among the articles selected, four evidenced aspects such as analgesia and hyperventilation. The first one prevents increased intracranial pressure caused by pain and agitation, while the second feature, even when not routinely used, is used in patients with cerebral herniation caused by ICP.²⁶

Concomitant to inadequate surveillance of the nurse can bring severe consequences resulting from an altered ICP. Among some complications is the occurrence of cerebral ischemia due to the decrease in cerebral blood perfusion caused by poor cerebral oxygenation through the mechanical ventilator, as well as an increase in carbon dioxide in the body, increasing the intracranial pressure.

Therefore, oxygen monitoring of brain tissue in neurocritical patients provides unique information about brain oxygenation. And the monitoring and maintenance of adequate oxygenation to this patient may minimize complications such as cerebral ischemia and respiratory acidosis.²⁷

In a model of multiple organ dysfunctions with clinical situations associated with increased thoracoabdominal pressure, the increase in intracranial pressure triggered by elevated abdominal pressure appears to be due to worsening respiratory system complacency. Elevation of venous pressure in LPA situations may also correlate with the elevation of ICP, probably by reducing the pressure gradient for cerebral venous drainage.²⁸ Characteristics such as subarachnoid hemorrhages and cerebral herniation should also be monitored since they are part of the group of complications due to ICP.²⁹

Diffuse or localized increase in brain volume tends to displace some part of the encephalon in relation to the intracranial compartments of the dural folds. This compression causes part of the brain to overflow some parts of the brain thus compressing vital structures.³⁰

With regards to nursing interventions, these may positively or negatively affect ICP. And nurses have an opportunity to

manage patient care in order to control ICP or help decrease it when elevated, in order to prevent some secondary brain injury.¹⁰

Some nursing interventions to the patient requiring ICP monitoring are diverse. Some of these are as follows: Level the sternum transducer to a consistent anatomical reference point, correctly interpret intracranial pressure waves and record ICP pressure readings, monitor the quality and characteristic of the ICP waveform, check the presence of stiffness and maintain and/or strengthen the dressing insertion site when necessary, monitor CO₂ level, and maintain adequate parameters, change the aspiration procedure and administer lidocaine prior to the probe introduction, and monitor systemic blood pressure.²⁵

Nevertheless, patients should also be monitored diligently for side effects, such as Ventilator-Associated Pneumonia (VAP) and skin rupture. It becomes a delicate balance to maintain brain function, helping to prevent other secondary injuries.¹⁰

Conversely, the work of nurses, as part of a health team, plays a key role in improving patient outcomes. For this, the nursing team, especially the nurse, need to know, elaborate and implement a nursing management for the neurocritical patients, especially those with constant monitoring of the ICP, so that the patient is better attended, and consequently demonstrate and understand their potential value within the health team.

CONCLUSIONS

Management of patients with elevated ICP includes nursing care that converges to normalize ICP, improve cerebral blood flow, and perfusion pressure to prevent imbalances that exacerbate ICP complications. It is common for patients with high ICP to develop various complications that require nursing support.

Key actions included monitoring of cerebral oxygenation, a correct interpretation of intracranial pressure waves, body and head positioning of the patient, bedside elevation, endotracheal aspiration care, neurological assessment using standardized scales (Glasgow Coma Scale), constant and correct measurement of vital signs.

Some complications that may develop in the presence of changes in ICP, such as cerebral ischemia, herniation, hypoxia, respiratory acidosis, encephalic death, among others, were evident. What makes nursing a key part of the management of the neurocritical patient. And ICP monitoring is a direct parameter for immediate detection of changes in ICP and their respective complications. Hence, this study will contribute to the knowledge of some nursing interventions in ICP monitoring, in order to improve the quality of nursing care in relation to the neurocritical patient.

Furthermore, as the nurses are responsible for managing the nursing team, they must be in constant training and improvement on the care of neurocritical patients, in order to provide better, safe and qualified care to patients and a quality nursing management.

REFERENCES

1. Kashif FM, Verghese GC, Novak V, Czosnyka M, Heldt T. Model-Based Noninvasive Estimation of Intracranial Pressure from Cerebral Blood Flow Velocity and Arterial Pressure. *Sci Transl Med*. 2012; 4(129):129ra44.
2. Rogers M, Stutzman SE, Atem FD, Sengupta S, Welch B, Olson DM. Intracranial Pressure Values Are Highly Variable After Cerebral Spinal Fluid Drainage. *Journal of Neuroscience Nursing*. 2017; 49(2):5-9.
3. Cheregatti AL, Amorim CP. *Enfermagem em unidade de terapia intensiva 2th ed*. St.Louis: Martinari; 2011.
4. Iencean SM, Ciurea AV. Intracranial hypertension: classification and patterns of evolution. *Journal of Medicine and Life*. 2008; 1(2):101-7.
5. Cecil S, Chen PM, Callaway SE, Rowland SM, Adler DE, Chen JW. Traumatic brain injury: advanced multimodal neuromonitoring from theory to clinical practice. *Crit Care Nurse*. 2011; 31(2):25-36.
6. Rangel-Castillo L, Gopinath S, Robertson CS. Management of Intracranial Hypertension. *Neurol Clin*. 2008; 26(2):521-41.
7. Smeltzer SC, Bare BG. *Brunner & Suddarth: tratado de enfermagem médicocirúrgica*. 15. ed. Rio de Janeiro: Guanabara Koogan; 2015.
8. COREN/SP, Conselho Regional de Enfermagem de São Paulo. Dispõe sobre o procedimento de aspiração de cateter de pressão de pressão intracraniana por profissional enfermeiro. Parecer Coren-SP nº 056, 2011. [Acesso em 2017 mar 25]. Available at: http://portal.coren-sp.gov.br/sites/default/files/parecer_coren_sp_2011_56.pdf
9. Hirzallah MI, Choi HÁ. The Monitoring of Brain Edema and Intracranial Hypertension. *J Neurocrit Care*. 2016; 9(2):92-104.
10. Bell BL, Cox B. Nursing care and intracranial pressure monitoring. *American Journal of critical care*. 2009; 18(4):338.
11. Souza MT, Silva MD, Carvalho R. Revisão integrativa: o que é e como fazer. *Einstein*. [Internet] 2010 [acesso em 2017 jan 01]; 8(1):102-106. Available at: http://www.astresmetodologias.com/material/O_que_e_RIL.pdf.
12. Hawthorne C, Piper I. Monitoring of intracranial pressure in patients with traumatic brain injury. *Front Neurol*. 2014; 5:1-16.
13. Alcântara TFDL, Marques IR. Avanços na monitorização neurológica intensiva: implicações para a enfermagem. *Rev Bras Enferm*, Brasília 2009; 62(6):894-900.
14. Mahajan C, Rath GP, Bithal PK. Advances in neuro-monitoring. *Anesthesia, Essays and Researches*. 2013;7(3):312-8.
15. Mendaro ARAD, Luna OC, Pérez LCA, Rodríguez MA. Neurologic and epidemiologic characterization of frontal head trauma during a period of five years in Villa Clara. *Medicentro Electrónica*. 2017; 21(1):30-8.
16. Silva JA, Souza AR, Feitoza AR, Cavalcante TMC. Traumatismo cranioencefálico no município de fortaleza. *Enferm. Foco* 2017; 8(1):22-26.
17. Stocchetti N, Roux PL, Vespa P, Oddo M, Citerio G, Andrews PJ, *et al*. Clinical review: Neuromonitoring-an update. *Critical Care* 2013, 17:201.
18. Kawoos U, McCarron RM, Auker CR, Chavko M. Advances in Intracranial Pressure Monitoring and Its Significance in Managing Traumatic Brain Injury. *Int. J. Mol. Sci*. 2015; 16(12):28979-97.
19. Góes M, Laurenti M. Hipertensão intracraniana e tumores cerebrais. 2017. [Acesso em 2017 mai 15]. Available at: <http://disciplinas.famerp.br/Neurologia/Documents/4%C2%BA%20S%C3%89RIE%202017/ROTEIROS%20DE%20AULAS%20E%20SLIDES/HIPERTENS%C3%83O%20INTRACRANIANA%20E%20TUMORES%20CEREBRAIS/roteiro%20dr%20M%C3%A1rio%20Goes%20-%20Hipertens%C3%A3o%20intracraniana.pdf>
20. Bratton SL, Chestnut RM, Ghajar J, McConnell Hammond FF, Harris OA, *et al*. Guidelines for the management of severe traumatic brain injury. VI. Indications for intracranial pressure monitoring. *J Neurotrauma*. 2007; 24(Suppl 1):S37-S4.
21. Suadoni MT. Raised intracranial pressure: nursing observations and interventions. *Nurs Stand*. 2009; 23(43):35-40.
22. Nogueira LS, Padilha KG, Silva DV, Lança EFC, Oliveira EM, Sousa RMC. Pattern of nursing intervention performed on trauma victims according to the nursing activities score. *Rev Esc Enferm USP*. 2015; 49(Esp):28-34.
23. Ugras GA, Yuksel S. Factors Affecting Intracranial Pressure and Nursing Interventions. *J J Nurs Care*. 2014; 1(1):003.
24. Han J, Yang S, Zhang C, Zhao M, Li A. Impact of Intracranial Pressure Monitoring on Prognosis of Patients With Severe Traumatic Brain Injury. *Medicine (Baltimore)*. 2016; 95(7):e2827.
25. Bulechek GM. *Nursing Intervention Classification (NIC)*. 6th ed. St.Louis: Mosby Elsevier; 2016.
26. Hickey JV, Olson DM, Turner DA. Intracranial Pressure Waveform Analysis During Rest and Suctioning. *Biol Res Nurs*. 2009; 11(2):174-86.
27. Eriksson EA, Barletta JE, Figueroa BE, Bonnell BW, Vanderkolk WE, McAllen KJ, *et al*. Cerebral perfusion pressure and intracranial pressure are not surrogates for brain tissue oxygenation in traumatic brain injury. *Clin Neurophysiol*. 2012; 123(6):1255-60.
28. Zampieri FG, Almeida JR, Schettino GPP, Park M, Machado FS, Azevedo LCP. Modulação da pressão intracraniana em um modelo experimental de hipertensão abdominal e lesão pulmonar aguda. *Rev Bras Ter Intensiva*. 2011; 23(2):164-9.
29. Lantigua H, Gutierrez SO, Schmidt JM, Lee K, Badjatia N, Agarwal S, *et al*. Subarachnoid hemorrhage: who dies, and why? *Critical Care*. 2015; 19:309.
30. Olson DM, McNett MM, Lewis LS, Riemen KE, Bautista C. Effects of nursing interventions on intracranial pressure. *Am J Crit Care*. 2013; 22(5):431-8.

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