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Case study

Estudio de caso a persona con riesgo de perfusión cerebral ineficaz secundario a hemorragia intraparenquimatosa, basado en la filosofía de Virginia Henderson

Case study of a person at risk of ineffective cerebral perfusion secondary to intraparenchymal hemorrhage, based on the philosophy of Virginia Henderson

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Resumen

Introducción: La hemorragia intraparenquimatosa es una patología que representa entre el 10 % y 15 % de los accidentes cerebrovasculares; causa una alta mortalidad o deja graves efectos neurológicos.

Objetivo: Desarrollar un estudio de caso a una persona con riesgo de perfusión cerebral ineficaz secundario a hemorragia intraparenquimatosa, basado en la filosofía de Virginia Henderson.

Metodología: Estudio observacional y cualitativo. Los datos se obtuvieron mediante un instrumento de valoración basado en las 14 necesidades básicas de Virginia Henderson. Se utilizó el método sistemático Proceso de Atención de Enfermería (PAE). Se realizó una revisión de la literatura a través de las bases de datos Pubmed, ScienceDirect, Scielo, Redalyc y Google académico. Se consideraron los lineamientos de la Ley General de Salud en Materia de Investigación NOM-012-SSA3-2012 y el uso de consentimiento informado.

Presentación del estudio de caso: Mujer de 41 años con diagnóstico de hemorragia intraparenquimatosa, postoperada, con craniectomía descompresiva e histerectomía. En la unidad de terapia intensiva adultos (UTIA) se encontró con elevación de presión intracraneal y datos de bajo gasto cardiaco, mediante medidas de neuroprotección como la hipotermia terapéutica.

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Aplicación del proceso de enfermería: Se aplicaron las 5 etapas del PAE y se realizaron planes de enfermería para resolver necesidades alteradas.
Plan de alta: Se desarrolló un plan para darle continuidad a los cuidados proporcionados a la persona con secuelas neurológicas.
Conclusiones: A pesar de las bajas probabilidades de sobrevivencia, la atención brindada en la UTIA logró conservar la vida humana, aunque con secuelas neurológicas irreparables.

Palabras clave: Accidente cerebrovascular hemorrágico, hemorragia intracraneal, hipertensión intracraneal, hipotermia inducida, proceso de enfermería, cuidados de enfermería.

Abstract

Introduction: Intraparenchymal hemorrhage is a pathology that accounts for 10-15% of strokes; it causes high mortality or leaves severe neurological effects.
Objective: To develop a case study of a person at risk of ineffective cerebral perfusion secondary to intraparenchymal hemorrhage, based on the philosophy of Virginia Henderson.
Methodology: Observational and qualitative study. Data were obtained using an assessment instrument based on Virginia Henderson's 14 basic needs. The systematic Nursing Care Process (NCP) method was used. A literature review was conducted through the Pubmed, ScienceDirect, Scielo, Redalyc, and Google Scholar databases. The guidelines of the General Health Law on Research NOM-012-SSA3-2012 and the use of informed consent were considered.
Case study presentation: 41-year-old woman diagnosed with intraparenchymal hemorrhage, postoperative decompressive craniectomy, and hysterectomy. In the adult intensive care unit (AICU) she was found with intracranial pressure elevation and low cardiac output data, using neuroprotective measures such as therapeutic hypothermia.
Application of the nursing process: The 5 stages of the NCP were applied and nursing plans were made to resolve altered needs.
Discharge plan: A plan was developed to provide continuity of care for the person with neurological sequelae.
Conclusions: Despite the low probability of survival, the care provided at the AICU managed to preserve human life, albeit with irreparable neurological sequelae.

Keywords: hemorrhagic stroke, intracranial hemorrhage, intracranial hypertension, induced hypothermia, nursing process, nursing care.

Introduction

Cerebral Vascular Disease (CVD), also known as stroke, is caused by the occlusion or rupture of one of the small blood vessels of the brain, causing an inadequate cerebral blood supply. It is attributed to be one of the major causes of high rates of disability and mortality in those who suffer from this pathology.

According to AHA (*American Heart Association*) statistics, in 2020, worldwide, CVD caused 7.08 million deaths; of these 3.25 million were of ischemic origin, 3.25 million were due to intracerebral hemorrhage (ICH), and 0.35 million due to subarachnoid hemorrhage[1]. ICH accounts for 10-15% of all CVDs[2].

In Mexico, according to INEGI (*National Institute of Statistics and Geography*), CVD ranked sixth nationally in deaths with 18,632 deaths in 2021[3]. On the other hand, in 2022 the Mexican Ministry of Health reported that there are 118 cases of CVD per 100,000 inhabitants, inferring that 170,000 new patients are presented each year, of which 20% may die during the first 30 days, while 7 out of 10 will be left with sequelae that generate some disability[4].

In 2021, the Manuel Velasco Suárez National Institute of Neurology and Neurosurgery (INNNMVS) attended 580 people with CVD, of which 80% were due to cerebral infarction, 13% due to ICH, and the remaining percentage due to other unspecified causes[4].

Intraparenchymal hemorrhage is subclassified within hemorrhagic type CVDs and consists of extravasation of blood into the brain parenchyma due to an abrupt rupture of a small blood vessel in the brain from a non-traumatic source[5].

The pathophysiological mechanism begins at the moment of vascular rupture (between 1 and 10 seconds), which causes vascular changes and gives rise to hematoma formation (in < 1 hour), hematoma growth and finally causes the appearance of edema (between 1 and 5 days); This is due to the lysis of red blood cells which also release pro-oxidized Hb (hemoglobin) and degradation products (heme + iron) which are cytotoxic, resulting in brain damage (secondary injury).

Perilesional edema is vasogenic and cytotoxic, producing a mass effect, which contributes to an increase in intracranial pressure (ICP), leading to loss of cerebral autoregulation. This, in turn, leads to a reduction in cerebral blood flow and, consequently, to a decrease in cerebral perfusion pressure (CPP), since this depends on both MAP (mean arterial pressure) and ICP, thus running the risk of inducing an ischemic lesion.

Therefore, it is important to know how to immediately recognize signs and symptoms that could cause secondary injuries. In addition, specialist nurses implement timely interventions for the management of the critically ill person, which anticipate possible irreversible complications or even encephalic death. This requires extensive knowledge of neurology and neurological assessment and interventions. The nursing professional is the one who is at the bedside and interprets clinical data to anticipate and support the therapeutic decision.

Given the problem of hemorrhagic CVD, it was decided to develop a clinical case study to improve the care provided by the nursing staff to people suffering from this condition in an intensive care unit, to contribute to a

better life prognosis and reduce the neurological sequelae.

Target

The main objective was to develop a case study of a person at risk of ineffective cerebral perfusion secondary to intraparenchymal hemorrhage, based on the philosophy of Virginia Henderson and using the systematized method of the Nursing Care Process (NCP) for its development.

Methodology

One person was considered for the development of a case study related to the previously mentioned topic. A 41-year-old woman who was in the adult intensive care unit (AICU) of the INNNMVS with a medical diagnosis of intraparenchymal hemorrhage, decompressive craniectomy, and hysterectomy; she was on her third day in this unit with a low prognosis of survival and, in addition, she had induced hypothermia as a neuroprotective measure. To take the case and obtain information through an assessment, an informed consent form was used, which was authorized and signed by the family member in charge.

Bioethical aspects such as the principles of beneficence, non-maleficence, the right to health information, confidentiality, and privacy were considered in the elaboration of this assessment6. Likewise, the Helsinki Declaration was taken up again following the ethical principles for medical research on human beings. At the national level, it adhered to the provisions of the Regulations of the General Law on Health Research and, finally, it was coupled to the provisions of the Mexican Official Standard NOM-012-SSA3-2012, which establishes the criteria for the execution of health research projects involving human subjects.

A search of the current literature on induced hypothermia as a neuroprotective measure was carried out to confirm its benefits. The databases consulted were PubMed, ScienceDirect, Elsevier, Scielo, Redalyc, and Google Scholar. The Boolean operators AND and OR were used, and the keywords hemorrhagic stroke, intracranial hemorrhage, intracranial hypertension, induced hypothermia, nursing process, and nursing care. Similarly, NOT was used with the following words, by way of exclusion: ischemic stroke, subarachnoid hemorrhage, and traumatic intracerebral hemorrhage.

Subsequently, an exhaustive review of articles from the last 5 years was carried out. However, 5 were discarded because they did not meet the following inclusion criteria: non-traumatic intracerebral hemorrhage, therapeutic hypothermia, and adults. Finally, only 6 articles were selected, which are briefly described below:

1. A systematic review study published in 2023 with the title "*The utility of therapeutic hypothermia on cerebral autoregulation*", whose objective was a search for more recent information on the use of therapeutic hypothermia (TH) in acute brain injury and its impact. It was highlighted that it reduces edema, protects the blood-brain barrier, and improves behavioral outcomes. Its induction at an early stage could be counterproductive by increasing bleeding, as neuroprotective effects

would be reached to be observed after 12 hours post intracerebral hemorrhage (ICH). Finally, we found that TH can reduce late cerebral ischemia, but does not affect mortality[7].

2. A systematic review article published in 2019 called "*Therapeutic Hypothermia and Neuroprotection in Acute Neurological Disease*", whose purpose was to present the current status of TH in various acute neurological diseases. It showed that there is some protection only when TH is delayed 12 hours, as it may affect the procoagulant and thrombolytic systems, predisposing to bleeding in the acute period[8].
3. In 2019, a descriptive type of research under the name "*Neuroprotection in neurointensive medicine*", the purpose of which was to describe the relevant measures of neuroprotection in neurointensive care medicine and the benefits of TH, stated that it had not yet been possible to establish the effectiveness of introducing TH in different forms of brain damage, especially in ICH, despite the results of experimental animal studies being very promising[9].
4. On the other hand, Beker *et al.*[10], in their 2021 publication entitled "*Therapeutic hypothermia for intracerebral hemorrhage: Systematic review and meta-analysis of the experimental and clinical literature*", intending to search for available preclinical and clinical studies regarding the use of TH to treat ICH, identified 21 preclinical studies, of which 13 found an effect in favor of TH on cerebral edema; and 5 experimental studies in humans, in which only one determined that there was a significant reduction in cerebral edema after intracerebral hemorrhage.
5. The experimental preclinical study published in 2018 by Feifei *et al.*[11], entitled "*Therapeutic time window and regulation of autophagy by mild hypothermia after intracerebral hemorrhage in rats*", whose goal was to find the appropriate time window of mild TH and regulation of autophagy in rats with autologous ICH, concluded that TH of 33°C-35 °C of 48 hours induced in a group of rats was neuroprotective when introduced later than 6 or 12 hours, compared to the normothermic group.
6. Finally, the experimental research by Peng *et al.*[12] published in 2020 under the title "*Effect of mild hypothermia on behaviors of rats with intracerebral hemorrhage and the possible mechanism*", aimed to find the effect of mild hypothermia on the inflammatory response and angiogenesis in brain tissues of rats with ICH, determined that mild TH can reduce the inflammatory response of brain tissue, protect damaged nerve function, and probably antagonize brain inflammation and promote angiogenesis.

This study was based on the philosophy of Virginia Henderson because it is a humanistic proposal and focused on the 14 basic needs of the human being which constitute the model of nursing care[13]. In addition, this proposal allowed the development and application of an assessment instrument to collect not only clinical data but also holistic data, achieving the detection of physical, psychological, social, and spiritual problems; finally, it contributed to organizing the information collected practically.

A generalized assessment was carried

out to obtain objective and subjective information. Likewise, secondary sources were used, such as the clinical record and the interview with the family member. Subsequently, the data obtained were organized according to the structure of the instrument for the detection of health problems and the development of diagnoses using the PES format (Problem + Etiology + Signs and Symptoms). Then, specialized nursing interventions were planned and implemented to reduce the problems detected. Finally, the effectiveness of each intervention implemented was evaluated.

Case study design

This case study was prepared using the systematized method of the NCP, which consists of five stages: assessment, diagnosis, planning, implementation, and evaluation.

A nursing clinical assessment instrument focused on the critically ill patient was applied. According to Virginia Henderson, it is structured according to the 14 basic human needs and allows data collection in an organized and hierarchical manner. Secondary sources were used to complement the information on the patient's state of health, such as the clinical record (imaging studies, laboratories, electrocardiogram), the clinical history, and the interview with the family member.

Presentation of the case

Person. A 41-year-old woman, originally from Mexico City; she is single and professes the Christian religion. She has a bachelor's degree and works occasionally.

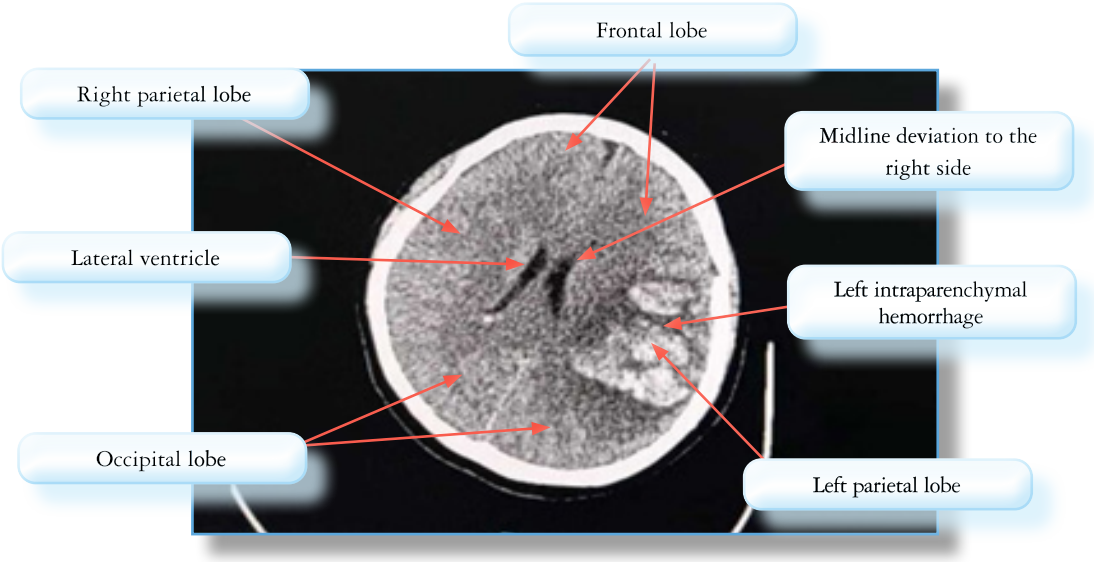
Environment. She lives alone in an apartment in an urban area of Mexico City. Her nuclear family (mother, father, and siblings) live in the same building. She has all the intra and extra-domiciliary services.

Health. Hereditary family history: 71-year-old mother with type II diabetes and hypertension; her father suffers from asthma; her younger brother suffers from bronchial spasm and she had a sister who died at the age of 6 years of leukemia. Non-pathological personal history: gyneco-obstetrics with 0 gestations, 0 miscarriages and hyperpolymenorrhea. No chronic degenerative history, allergies, trauma, or blood transfusions. There is no complete vaccination record. Personal pathological history: on two occasions, she suffered COVID-19 without complications; and abnormal uterine bleeding due to uterine myomatosis of large elements.

Current situation. On April 12, 2023, she was admitted to the Women's Hospital due to lipotimia secondary to transvaginal bleeding of one month's evolution, where a Hb level of 3.3 g/dL was determined; she was transfused with 3 erythrocyte concentrates and 1 package of fresh frozen plasma (FFP). Subsequently, the Hb increased to 5 g/dL. The hospital physicians performed a hysterectomy. The following day, she presented with a deviation of the labial commissure on the left side with right hemiparesis and dysarthria. She was evaluated by INNNMVS physicians and was admitted to the institution with the following vital signs: blood pressure of 140/80 mmHg, heart rate of 98 beats per minute, temperature of 37.9°C and capillary glycemia of 133 mg/dL. The NIHSS scale assigned 16 points. Finally, a cerebral CT

angiography showed an intraparenchymal hemorrhage in the frontal lobe and left parietal lobe with midline deviation (photo 1).

Photograph 1. Cerebral CT angiography



Source: Taken from the electronic clinical record. Photograph published under informed consent.

Photograph 1 shows a left frontoparietal intraparenchymal hematoma with extensive vasogenic edema in the frontal lobe, with a midline shift of 6 mm to the right.

After the finding, they admitted her to the AICU to manage her situation. Subsequently, the family authorized her to undergo an extensive left decompressive craniectomy on April 16, 2023. The medical diagnosis established in the critical area is intraparenchymal hemorrhage, decompressive craniectomy, and hysterectomy.

Nursing. It supports the person to regain or maintain their independence by developing their strength, knowledge, and will. In this specific case, the person-nurse relationship is one of substitution due to the lack of independence to meet basic needs.

The data from the initial clinical assessment conducted on April 21, 2024, structured according to the 14 basic needs model, are presented below:

Need 1: *to breathe normally*. On examination, the following vital signs were found: heart rate 41 bpm, respiratory rate 18 rpm, esophageal temperature 35.2°C, oxygen saturation 100%, invasive blood pressure (BP) 124/48 mmHg, manual BP 70/50 mmHg and MAP (mean) 56 mmHg. By transcranial Doppler: left CPP 71 mmHg and left ICP 18.9 mmHg. In neuromonitoring, measurement of the optic nerve sheath (ONS): right ICP 19 mmHg and left ICP 20 mmHg.

She is under sedation on the RASS scale of -5 points (very deep sedation) and BIS of 41 (general anesthesia). The skin is pale. She

has ventilatory support in stage 3 through an 8.0 mm I.D. caliber orotracheal cannula fixed in the dental arch at 20 cm, the pneumotach balloon has a pressure of 20 mmHg, has a closed suction system and is monitored with a capnograph: $ETCO_2$ of 32 mmHg; bronchial secretions are moderate, yellowish and thick. Mechanical ventilation in Pressure A/C mode, FiO_2 at 45 %, PEEP 5 cmH_2O, inspiratory time 1.2 s, flow trigger 2 L/min, inspiratory pressure 14 cmH2O. Inspiratory volume 525 ml, peak pressure 19 cmH_2O, and I:E ratio 1:1.8.

Arterial blood gases: pH 7.45, pCO_2 38.3 mmHg, HCO_3 -26.5 mEq/L, PaO_2 66.3 mmHg, EB 2.7 mEq/L, SaO_2 92.5 % and lactate 1.5 mmol/L. A Kirby index of 147 mmHg is obtained (moderate acute respiratory failure). Respiratory workshop: arterial O_2 content 10.325 ml/dL, capillary O_2 content 11.202 ml/dL, venous O_2 content 8.961 ml/dL, arteriovenous O_2 difference 1.364 ml/dL and O_2 extraction rate 13.21 %.

Weak bilateral carotid pulses; with right jugular 7 French (Fr) caliber central venous catheter (CVC) installed on April 13, 2023, and covered with clear dressing with chlorhexidine cushion. Left jugular 7-gauge Fr bulb catheter installed on April 18, 2023, with SJO_2 82 %, O_2 arterio-jugular difference 2.1 ml, lactate index 0, cerebral O_2 extraction 17.7 % (cerebral hyperemia).

Aortic, pulmonary, tricuspid, and mitral cardiac focus audible, but diminished and slow-paced. S1 and S2 perceived. Auscultation shows roncus-like pulmonary sounds in apices and low intensity in the basal area. Hemodynamic assessment by USG: Cardiac output (CO) 3.3 l/min. Serum electrolytes: Na 160.7 mEq/L, K 3.9 mEq/L, Cl 134.9 mEq/L, Ca 7.7 mg/dL, P 2.5 mg/dL and Mg 2.5 mEq/L. Blood biometry results: leukocytes 5.8 10/S/3/µI, neutrophils 5.4 10/S/3/µI, lymphocytes 0.3 10/S/3/µL, hemoglobin 8.36 g/dL and HTC 26.9%.

She has a left pedial arterial line installed with a #20 Gauge catheter, in which a 0.9% NaCl solution of 250 ml plus 100 IU of heparin is passed for 24 hours.

Need 2: ***adequate eating and drinking.*** Somatotype endomorph, height 1.55 m, weight 75 kg, and BMI 31.25 kg/m2 (grade I obesity). Capillary glycemia is 145 mg/dL. Grade II facial edema is observed. Oral mucosa are hydrated. She has a polymeric diet by enteral feeding by Levin-type nasogastric tube, 14 Fr caliber in left nostril, continuous infusion with 979 kcal and 46 grams of protein, total volume of 928 ml at a rate of 62 ml/h.

Blood chemistry: serum albumin 2.6 g/dL (hypoalbuminemia), TGO 93 U/L, TGP 64 U/L, GGT 445 mg/dL. She presents edema in upper and lower limbs with positive Godet's sign grade II.

The trilumen right jugular CVC is functional: the distal lumen has an infusion of 0.9% NaCl solution plus 3 g of $MgSO_4$ at 4.1 ml/h for 24 hours; medial lumen with fentanyl infusion of 1 mg in 100 ml of 0.9% NaCl at a dose of 1.6 mcg/kg/h; in the same lumen, an infusion of midazolam 100 mg in 100 ml of 0.9% NaCl at a dose of 0.33 mg/kg/h and in the proximal lumen, an infusion of norepinephrine with 8 mg in 100 ml of 0.9% NaCl at a dose of 0.017 mcg/kg/min; in the same lumen, dopamine 400 mg in 100 ml of 0.45% NaCl at a dose of 8.8 mcg/kg/h is administered. The following drugs are administered: Ceftriaxone 1 g intravenous (IV) c/12 h, paracetamol 1 g IV c/8 h for necessary reason, enoxaparin 60 mg subcutaneous c/24 h, vancomycin 1 g IV with start on April 21, 2023, and metoclopramide 10 mg by nasogastric tube.

In the trilumen left jugular bulb catheter: in the distal lumen pass NaCl solution 0.9 % 100 mL plus 1000 IU of heparin at 2 ml/h for patency.

Venous congestion assessment (VExUS system): IVC distensibility 16%, pulsatility index 40%, and renal resistance index 0.66.

The abdomen is globose due to adipose panniculus, soft and depressible. On abdominal auscultation, 2 peristaltic sounds per minute of very low intensity and little perception are perceived. On percussion, the upper quadrants have a dull sound, and a tympanic noise in the lower quadrants. Finally, the water balance of partial admissions is 1132 ml.

In the arterial line, she is infused with NaCl solution 0.9 % 250 ml plus 250 IU heparin for 24 hours. Hemodynamic monitoring: SPV 2 mmHg and PPV 4 %.

Need 3: ***normal elimination by all routes.*** Urinary catheter 16 Fr to shunt. Uretic elimination: 5820 ml in 10 hours and urine output of 7.76 ml/kg/h (polyuria); characteristics were amber yellow, density 1.005; creatinine 0.41 mg/dL, urea 53 mg/dL, BUN 25 mg/dL, uric acid 1.1 mg/dL, GFR = 127 ml/min/1.73m2. Partial output: -6395 ml. Partial water balance: -5263 ml. No bowel movements since admission to the unit.

Need 4: ***to move and maintain proper posture.*** Neurological assessment: anisochoric arreactive pupils with a right diameter of 2 mm and a left diameter of 4 mm. Examination of cranial nerves: I (olfactory), II (optic), VI (external ocular motor), VII (facial), VIII (cochlear vestibule), XI (accessory) and XII (hypoglossal) not assessable; oculocephalic reflex present for assessment of nerve III (common ocular motor) and IV (trochlear); bulbar reflexes absent (gag, cough, and swallowing); corneal reflex absent; spinociliary reflex absent; nerve V (trigeminal) with painful stimulation in supraciliary and maxillary region, without response. Examination of motor function: no response. Sensory function examination: absent. Hypotonic and spastic muscles. Scales: Ashworth 4 points, Daniels 0/5 points in the 4 upper and lower extremities, Katz index 6 points, and Braden 8 points.

Need 5: ***to sleep and rest.*** Index BIS 41 (general anesthesia). An alternating pressure air mattress with a bubble system is installed in her hospital bed.

Need 6: ***to choose appropriate clothing, dressing, and undressing.*** She has both a disposable and cloth diaper covering the genital region. She is wearing a hypothermic water circulation suit that covers from shoulders to feet.

Need 7: ***to maintain body temperature.*** She is under induced hypothermia employing a hypothermic suit programmed to 34°C, core temperature measurement is performed with an esophageal probe, reporting 35.2°C (mild hypothermia).

Need 8: ***to maintain body hygiene and skin integrity.*** Normal cephalic skull, scalp with alopecia secondary to trichotomy, left frontotemporoparietal surgical wound clean and faced with stitches; at the same site soft skin without tension is palpated, and no cranial bone is perceived. Dehydrated lips and the presence of whitish plaque in the oral mucosa are observed; in the sublingual region, there is a 1 mm laceration[2].

Presence of left lateral abdominal surgical wound between mesogastrium and hypogastrium region, 14 cm long, covered with gauze. There is a second surgical wound of 1 cm^2 with a small amount of serous discharge, similarly covered with gauze.

Need 9: ***avoidance of environmental*** **hazards** and avoidance of injury to others. On

admission to the AICU, the following scales were assessed: APACHE 26 points (55% mortality prognosis), CPOT 1 point (mild pain), BPS 3 points (objective pain), FOUR 0 points (arreactive coma), Downton 2 points (medium risk of falling) and SOFA 11 points (50% probability of mortality). Bronchial secretion culture: the presence of staphylococcus aureus, and CRP (C-reactive protein) in the blood is 7.8 mg/L.

Need 10: ***to communicate with others expressing emotions and needs.*** She is visited every day for 30 minutes by her brother.

Need 11: ***to practice their beliefs.*** A practicing Christian. She used to go to church every Sunday.

Need 12: ***to work in something rewarding for the person.*** She has a Bachelor's degree in Pharmaceutical Biological Chemistry and was a teaching assistant at the Faculty of Chemistry at the UNAM.

Need 13: ***to develop play and recreational activities.*** She was dedicated to taking care of her mother, who is an elderly person and suffers from chronic illness.

Need 14: to learn to satisfy curiosity. No data for assessment.

Aplication of the nursing process

The following are some of the nursing intervention plans carried out on the individual. They are represented in a table for a better organization of the interventions.

Intervention Plan 1

Need 1: to breathe normally

Nursing diagnosis: Risk of ineffective cerebral perfusion r/t cerebral blood flow supply above consumption (cerebral hyperemia).

Objective: To reduce the factors that contribute to the risk of ineffective cerebral perfusion to avoid cerebral ischemic injury.

Source of difficulty Strength	**Level of dependence** 6	**Nursing role** Substitute
Interventions	**Actions**	
1. Neurological nursing assessment	- Assess the level of consciousness, pupils (size, shape, and response), vital signs; examination of cranial nerves, motor, and sensory function[13]. - Assess FOUR scale[13].	
2. Neurological monitoring	- Calculate the CFP with the following formula: PPC = PAM - PIC[14]. - Obtain ICP by measuring VNO[14]. - Set target CPP between 60-70 mm Hg[15,16].	
3. Hemodynamic management	- Optimize MAT: 90 to 110 mmHg using a vasoconstrictor drug, norepinephrine with doses of 0.05-0.1 µg/kg/min[17]. - Calibrate arterial line to obtain correct BP reading[18]. - Note the presence of Cushing's triad.	
4. Management of O_2	- Maintain core temperature reduction: 32 to 35°C through induced hypothermia and, thus, decrease brain O_2 consumption[19]. - Take jugular bulb blood gas after adjustments made[20]. - Establish pCO_2 targets adjusted to Mexico City level: 28 to 32 mmHg[19]. - In hypercapnia adjust ventilatory parameters: I:E ratio, increase RR, and minute volume[21,22].	
5. Neurocritical care	- Implement THE MANTLE mnemonic: Temperature 36°C - < 37°C (central); Hb 8-12 g/dL; electrolytes and acid-base status: Na+ 135-145 mEq/L, pH 7.35-7.45, p50 26-28 mmHg; $SvJO_2$ metabolism > 55 %, $PtiO_2$ 18 mmHg, PPC 60-70 mmHg; SBP > 110 mmHg, glycemia 110-180 mmHg, target PaO_2 80-110 mmHg; lung protective ventilation Vt 6-10 ml/kg, respiratory rate for pCO_2 35-45 mmHg, driving pressure < 13 cm H_2O, plateau pressure < 24, mechanical power < 17 J/min; ICP < 22 mmHg, DNVO < 5.5 mm, PI < 1.2, serial CT[23].	

Evaluation: At 7 AM on April 22, 2023, a left CPP of 66 mmHg and a right CPP of 79 mmHg were reported through the neurological monitoring sheet using transcranial Doppler; the results of which show that cerebral perfusion improved compared to the data recorded in the previous shift.

Intervention plan 2

Need 1: to breathe normally

Nursing diagnosis: Diminished intracranial adaptive capacity r/t loss of cerebral compliance secondary to extravasation of blood content to the left cerebral parenchyma m/b anisochoric pupils: right pupil 2 mm and left pupil 4 mm, TAM 57 mmHg, ICP by VNO right 19 mmHg and left 20 mmHg and left IP 1.4.

Objective: Restore cerebral compliance by lowering ICP to avoid further secondary lesions.

Source of difficulty Strength	**Level of dependence** 6	**Nursing role** Substitute
Interventions	**Actions**	
1. Neurological monitoring	- Interpretation of transcranial Doppler variables: A. ICP monitoring by ONS (optic nerve sheath diameter) formula = (5.69 x ONS) - 8.23[24]. B. Transcranial Doppler. ICP measurement with Bellner's formula: ICP = 10.93 x IP - 1.28[25].	
2. Management of cerebral edema	- Administration of an osmotic diuretic: mannitol at a dose of 0.5-1.4 g/kg over a maximum of 20 min[26]. - Use of hypertonic solutions: 3% NaCl at 0.1-0.2 ml/kg/h (maximum 1 liter per day)[26].	
3. Basic general measures to reduce ICP	- Keep the head of the bed at 30° in an aligned and neutral position of the body, avoiding neck flexion[27]. - Optimize blood pressure with a target > 90 mmHg: titrate norepinephrine until target is reached[17]. - Promote hyperventilation: decrease PCO_2 and maintain it between 26 and 30 mmHg, by increasing RR on the mechanical ventilator[28]. - Minimize stimuli that could induce cough reflex or Valsalva, such as aspiration of secretions by TOT[28,29]. - Optimize good sedation with BIS of 40 to 60 or target RASS using midazolam at maintenance doses of 0.03-0.2 mg/kg/h[16]. - Administer a barbiturate drug (pentobarbital or thiopental) if ICP does not improve with the interventions described above[27]. - Optimize good analgesia with fentanyl: maintenance dose at 0.07 - 5 µg/kg/h up to 10 µg/kg/h[15].	

Evaluation: The ICP reported at 7 am by measuring the left ONS was 19.6 mmHg and right ONS was 20 mmHg, neither of which parameters did not improve despite the interventions performed.

Intervention plan 3

Need 1: to breathe normally

Nursing diagnosis: Decreased cardiac output r/t vasoplegia as a mechanism of shock m/b heart rate of 41 bpm, cardiac output of 3.3 liters per minute, blood pressure of 70/50 mmHg, MAP of 57 mmHg, generalized pallor, weak peripheral pulses and capillary refill of 3 seconds.

Objective: To favor the increase of cardiac output to improve hemodynamic status and, at the same time, meet the required demands of vital organs.

Source of difficulty Strength	**Level of dependence** 6	**Nursing role** Substitute
Interventions	**Actions**	
1. Pharmacological control	- Administer positive inotropic drug to increase cardiac contractility: initiate dopamine doses at 5-10 µg/kg/min for a beta 1, inotropic and chronotropic effect[30]. - Titrate vasoconstrictor drug: perform noradrenaline increase of 0.1 to 0.3 µg/kg/min approximately every 5 minutes until the desired goal is reached[31].	
2. Vital signs monitoring	- Evaluate the HR recorded on the VS monitor and at the same time perform manual pulse-taking on the radial arterial for one minute[32]. - Interpretation of the arterial line waves recorded on the monitor and proceed to perform calibration of the monitor to avoid reading errors[33]. - Corroborate the BP by manual measurement with the sphygmomanometer[34]. - Observe the pulse oximeter plethysmography waveform and interpret the vascular status of the arteries (whether there is vasoconstriction or vasodilatation)[35].	
3. Cardiac Output (CO) Monitoring	- Ask the physician responsible for the ICU to measure the CO noninvasively (USG) and to provide the values obtained: R^2 = TSVI/2, Area = pi (π) x r^2, VS = area x ITV, and CO = VS x FC. - Measure, calculate, and record the following parameters: CO and CI (cardiac index)[36].	

Evaluation: An improvement in hemodynamic status was observed, increasing the heart rate to 45 bpm one hour after the interventions and to 55 bpm in two hours; however, two hours later there was again a drop in heart rate, obtaining less than 50 bpm until 7 am.
Similarly, blood pressure had constant imbalances: at 2 hours with a BP of 150/80 mmHg, at 4 hours 80/60 mmHg, and at the end of the shift 180/90 mmHg.

Intervention plan 4

Need 1: to breathe normally

Nursing diagnosis: Ineffective tissue perfusion r/t imbalance between blood flow supply and demand to vital organs (brain, kidney, and heart) m/b generalized pallor of the skin; slow, weak, and barely perceptible pulses and capillary filling of more than 3 seconds.

Objective: To improve perfusion at the tissue level to avoid cellular hypoxia and, consequently, multiple organ failure.

Source of difficulty Strength	Level of dependence 6	Nursing role Substitute
Intervenciones	**Acción**	
1. Hemodynamic management	- Continuous hemodynamic and vital signs monitoring: heart rate, pulse, and blood pressure[37]. - Increase MAP from 65 to 75 mmHg by using a vasoconstrictor drug: norepinephrine at doses of 0.01-3.3 µg/kg/min and titrate the dose from 0.1 to 0.3 µg/kg/min every 5 min to dose response[31].	
2. Intravenous therapy	- Fluid response assessment[38]. a. Evaluate the PPV at the monitor. b. To evaluate the distensibility of the IVC by Doppler USG. - Administer intravenous crystalloid solution if responder with volume at 25-30 ml/kg/day.	
3. Respiratory monitoring	- Take an arterial blood gas measurement: evaluate anaerobic metabolism through serum lactate[39]. - Venous blood gas sampling through the right jugular CVC to obtain venous saturation ($SvCO_2$)[39]. - Evaluate the CO Delta2[39].	

Evaluation: The interventions performed increased MAT to 103 mmHg post 1 hour, with an average of 100 mmHg over the 10 hours.
Capillary filling did not improve during the entire care, this was more than 3 seconds.

Intervention plan 5

Need 7: Maintain body temperature in normal ranges.

Nursing diagnosis: Induced hypothermia r/t protection of the cerebral parenchyma m/b esophageal temperature of 35.1°C and skin cold to the touch.

Objective: To maintain induced hypothermia at < 35°C or according to protocol to restore normal ICP. Likewise, avoid secondary damage caused by excessive temperature decrease.

Source of difficulty Strength	Level of dependence 6	Nursing role Substitute
Interventions	**Actions**	
1. Management of induced hypothermia	- Corroborate the correct installation of the esophageal probe for core temperature measurement40. - Properly install the hypothermic suit and keep the temperature controlled between 32°C and 35°C[41]. - Monitor the recommended induction phase time (maximum 6 to 12 hours), maintenance (24 to 72 hours), and passive reheating (< 0.25° c/hour)[42].	
2. Temperature management	- Take axillary and esophageal temperature every hour and compare variabilities[43]. - Avoid elevated temperature or fever[44].	
3. Monitoring of side effects	- Assess the following laboratory findings: prolonged clotting times, decreased pCO_2, increased pO_2 and pH, high venous saturation, and decreased serum electrolytes (potassium, magnesium, calcium, and phosphorus)[45].	

Evaluation: During the shift, the core temperature fluctuated, reaching a maximum of 35.3°C and a minimum of 34°C. The temperature did not influence the decrease in ICP, since at the end of the shift the ICP per right ONS was 20 mmHg and the left ONS was 19.6 mmHg.

Discharge plan

To follow up on the care provided, a discharge plan focused on hospital discharge based again on the 14 basic human needs was proposed.

Discharge plan	
Date of elaboration: 26/May/2023. **Diagnosis:** Intraparenchymal hemorrhage plus decompressive craniectomy.	**Addressed to:** To the family and primary caregiver (legal representative).
Need 1: to breathe normally Airway care: - Remember that, upon aspiration of secretions, it is necessary to stop the diet being administered to avoid bronchoaspiration. - Perform aspiration of secretions once a day or in case of excessive secretions. - The technique should be performed as cleanly as possible.	
Need 3: normal elimination by all routes Bladder catheter care: - Wash hands before and after handling the probe. - Perform daily genital hygiene and drying with soap and water. - Change the bag every 5 days according to the recommendation of the permanent nursing committee. - Do not disconnect the bag, neither for emptying nor for hygiene. - Drain the bladder catheter every time it is ¾ of its capacity. - Keep the probe below waist level. - Keep the collection bag above the ground to avoid contamination of the circuit. - Report changes in urine or low amount of urine.	
Need 4: to move and maintain proper posture - Perform passive exercises in the upper and lower limbs to promote joint mobility.	
Need 9: avoidance of environmental hazards and avoidance of injury to others Warning signs: - Decreased awake state. - Difficulty breathing in ambient air. - Temperature increase. - Enlargement of the decompressive craniectomy site (left cranial parietal or left frontotemporoparietal region).	
Name and category of the person performing: **Bachelor of Science in Nursing R.B.T.P.**	

Discussion

The results obtained in this observational and qualitative study are similar to those described by García *et al*.[14], who describe the case of a 40-year-old man with hemorrhagic CVD and determine that the patient becomes a chronic patient, as occurred in this study. Likewise, there is a narrative of a clinical case of a 38-year-old man with left intraparenchymal hemorrhage, in which it was decided to manage him in the AICU and he only remained for 7 days without major complications, in total he spent 21 days in the hospital[15]; this experience differs from our study subject, since she was hemodynamically unstable and had a low probability of survival.

Regarding the use of hypothermia, a retrospective study determined its use in those

with cerebral edema and concluded that it did not have a positive impact on neurological outcomes because people required more time on mechanical ventilation, which can cause pneumonia[16]; this could be consistent with the present study since the patient had a positive bronchial culture for gram-positive microorganisms, which was the cause of the respiratory problems presented.

Nursing interventions in a person in a neurocritical state secondary to intraparenchymal hemorrhage are still not well defined, due to the lack of current research available to support the effectiveness of specific interventions in this type of situation. The clear example described in this work is the neuroprotective measure of therapeutic/induced hypothermia, as there is no consensus on its application and effectiveness in reducing secondary injuries. For this reason, given that the nursing profession has not generated research on its role in this topic, recommendations proposed from the medical perspective, with the participation of nurses, were followed to develop the intervention plan for this case study.

Conclusion

The main objective of this case study was achieved by using the NCP systematic method, following each of its stages. Likewise, the use of the 14 basic needs proposed by Virginia Henderson made it possible to describe the situation of a woman who was in an acute critical condition secondary to intraparenchymal hemorrhage.

The implementation of specialized interventions helped to improve survival. However, it is emphasized that nursing professionals specializing in critically ill adults generate quantitative and qualitative research regarding specific nursing interventions in persons with decreased cerebral perfusion or risk of decreased cerebral perfusion.

It is intended that this study will be considered in the future as a starting point for further improvement of the NCP, as well as for optimizing the quality of care provided by nurses in critical care units.

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