



Patient's neurological status assessment from a nursing point of view - a literary review

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Neurological and neurosurgical patients show their symptoms in a variety of ways. Describing the conditions there are a few assessment methods nurses use. The most common of those is the Glasgow Coma Scale, also known as GCS. Another method used for intubated patients is the Full Outline of Unresponsiveness, also known as FOUR.

Purpose of this thesis is to provide information for nurses and nursing students interested in the neurological status assessment and the current research behind it. The aim is to describe the current literature about assessing the neurological status of a patient from the nursing point of view. And the research question is how the neurological status assessment is described from the nursing point of view in literature.

Method used descriptive narrative literature review. Data was obtained from reliable databases such as EBSCOhost (CINAHL), PubMed, ProQuest, ScienceDirect (Elsevier) and Medic. Total of selected articles was thirteen. Selection was guided by the inclusion and exclusion criteria.

Key findings are that there is only a few research done to support the nursing point of view in the neurological assessment. Commonly used assessment methods could use the help of other assessment methods, both neurological and other. Assessing a patient comprehensively needs the support of other assessment methods.

The author found that there is a gap in research about neurological status assessment from the nursing point of view. Continuous training and practicing nursing skills is highly appreciated across the spectrum. The author recommends continuous education for nursing profession and the use of new assessment methods when they are introduced.

Keywords: neurological, neurosurgical, neurological status, nursing intervention

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1 Introduction

According to WHO (2024) over one third of all people are affected by a neurological condition in their lifetime. Currently over 3 billion people living with a neurological condition (WHO 2024). As reported by the research in 2018 by Dewan, Rattani, Fieggen, Arraez, Servadei, Boop, Johnson, Warf, and Park there are 22,6 million neurological patients in a year, of those 13,8 million need surgeries.

Most common neurological conditions leading to health loss in 2021 were stroke, neonatal encephalopathy, migraine, dementia, diabetic neuropathy, meningitis, epilepsy, neurological complications from preterm birth, autism spectrum disorder, and nervous system cancers (WHO 2024). This thesis has a focus on adult patients with stroke, hydrocephalus, heamorrhages, tumours and traumas as they are the situations where neurological status is most often assessed (Mäntynen, Koivu, Hutri & Rydenfelt 2023).

Assessing one adult patient's neurological status can be done within five minutes (Betts, Young, Wise, Johnson, Poe, Kruse, Korol, Johson, Womble, DeSaix. 2013; Ernstmeyer & Christman 2021). Neurological assessment is done once every four hours or more frequently, which means at least six times a day per patient (White 2022). Depending on the situation the assessment rotation can be more frequent (John Hopkins Medicine 2024a).

Assessing patient's complete neurological status is usually up to the neurologist. In practical work however, the nurse assesses it more often (Betts et al 2013). In the work description of the neurological nurse is the neurological status assessment (StudySmarter 2024). One of the assessment methods is widely used by nurses as part of the ABCDE approach (Resuscitation Council 2021).

A neurological condition affects many people. The neurological status is assessed multiples times in multiple locations by both nurses and doctors. Early detection of changes in the neurological status can be crucial in the wellbeing of the patient. The literature information on what the assessment is based on is searched in this thesis.

2 Background

The basic neurological conditions, including neurological and neurosurgical patient conditions. A picture to help visualize the concepts. The thesis continues to explain the two neurological status assessment methods and their utilization. Figures are present to help envisage the status assessments.

2.1 Neurological conditions

The brain is surrounded by a bed of cerebrospinal fluid inside its protective casing, also known as the skull (Nienstedt, Hänninen, Arstila & Björkqvist 2019, 535). Explained by Nienstedt et al (2019) the cerebrospinal fluid follows its own path of forming and flowing out. Any changes to its normal path can cause severe problems to the patients.

There are many reasons a patient's neurological condition might be interesting to monitor. These reasons include injuries to the brain tissue, breaking of the skull, bleeding inside the skull, strokes, brain tumours, epileptic seizures, and disturbances in the cerebrospinal fluid. Neurological status can be disturbed by other reasons than neurological conditions. These include hypoxia, pneumonia, hypotonia, shock, sepsis, poisoning, and hypo- and hyperthermia. (Mäntynen et al 2023.)

Assessing the neurological status often is very important as early detection has better results (Shahrokhi & Asuncion 2024). Neurosurgical patients should be monitored even more closely because the operation might cause swelling or bleeding in the brain. Both conditions can be lethal if not found in time (Wan & Luoma 2020). Research done by Kishore and Cusimano (2021), states that a neurological status should be assessed in the first two days after a brain event for the best results. Argued by Wells-Pittman and Gullicksrud (2020), there is not standard on how often a neurological status should be assessed in an acute stroke situation.

Symptoms and treatments can be very similar with different neurological and neurosurgical patients. One specific symptom type does not exist (Kallio 2018). Different neurological conditions' symptoms can be compared on the Johns Hopkins University webpage (2024b), it can be observed that many symptoms of different neurological conditions can be very similar, if not the same. To note from Kallio's research (2018) that epilepsy is a symptom, not a cause. However often an anti-epileptic medication is administered to prevent the post operation seizures (Wan 2020, 350).

It is crucial to monitor the patient's neurological status post-operatively as the possibility of intracranial haemorrhage is highest within four hours post-surgery (Wan 2020, 349). And

within the first six hours a cerebral oedema can occur. It is a life-threatening condition that can follow a tumour resection (Wan 2020, 349).

Post-operation sepsis is not common in elected surgeries (Gabriel, Grigorian, Nahmias, Pejcinovska, Smith, Sun, Won, Bernal, Barrios, & Schubl 2019, 367). But according to Gabriel et al (2019, 367) in emergency surgeries the possibility of the post-operation sepsis is higher. One of the symptoms for a septic shock is an acute alteration of mental status, which will affect the neurological status assessment (Sonneville, Verdonk, Rauturier, Klein, Wolff, Annane, Chretien & Sharshar 2013).

2.1.1 Neurological patient

Neurological patients include stroke, hydrocephalus, and thrombectomy. Not all neurological patients need a surgical intervention to help their situation. Often less invasive interventions can be enough. (Li, Wu, Zhou, Xu, Zheng, Hua, & Xu 2023.)

A stroke is caused by a blocked artery, that causes lack of oxygen in an area of the brain (Terveyskylä 2019). Different areas cause different symptoms in the patient, for example from the Stroke Association (2024b) a stroke can affect the patient's sensitivity to touch or to temperature. A stroke can lead to hydrocephalus, which then would need a ventriculostomy which can only be inserted at the intensive care unit (Aivoliitto 2020).

Hydrocephalus is an abnormal build-up of cerebrovascular fluid in the ventricles (NIH 2024). Causes for it can be present at birth, develop after birth or post a neurological event, for example a serious head injury or brain tumour (NHS 2023). Hydrocephalus worsens if not treated in time. Complications will lead to death in worst cases (Mayo Clinic 2023). Common symptoms include headache, blurred vision and nausea and vomiting (NIH 2024). A lesser known condition to hydrocephalus is normal pressure hydrocephalus, NPH, which usually affects people over the age 60. These include post stroke hydrocephalus (NHS 2023).

According to the Stroke Association (2024c) thrombectomy is the removal of a blood clot, thrombus, in a blood vessel, it is treatment for an ischaemic stroke. Done in the operation room with a catheter that enter the patient to pull out or suck out the clot (Stroke Association 2024c). The blood clot can form anywhere in the body where there is bloodflow. In the worst cases if left untreated it can be fatal (Cleveland Clinic 2022). The operation uses x-ray vision access to the blood vessels, which is called digital subtraction angiography. Digital subtraction angiography is performed by the radiologist (Kaufman & Lee 2013, 51).

2.1.2 Neurosurgical patient

Neurosurgical patients include hemorrhages in the skull, tumours, and fractures of the skull. Hemorrhages and fractures can be caused by head traumas. Neurosurgical patients often have undergone a surgical procedure.

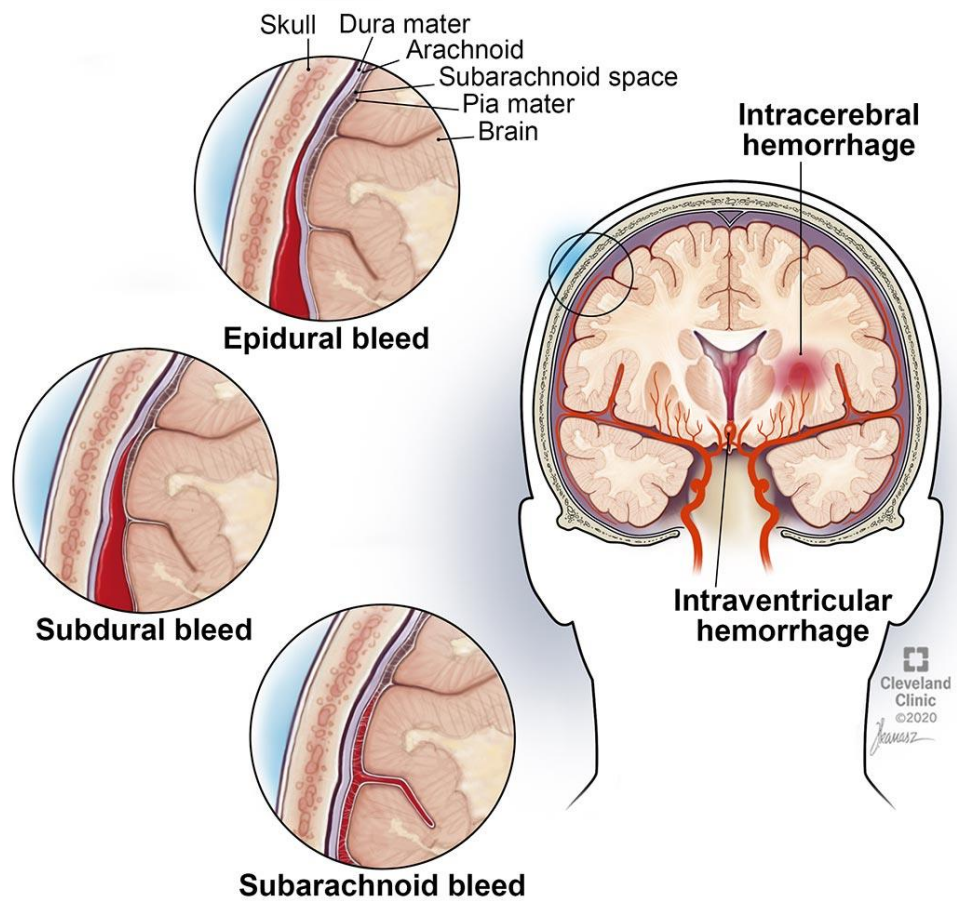
There are a few hemorrhages that can occur in the brain. Epidural hematoma, subdural hematoma, subarachnoid hemorrhage, intracerebral haemorrhage, and intraventricular haemorrhage (Nienstedt et al 2019, 534). The location of these bleeds affects the patient differently and can be a direct indicator where the bleed is (Nienstedt et al 2019, 566).

Epidural hematoma (EDH), subdural hematoma (SDH) and subarachnoid hemorrhage (SAH) are all bleeds in between the skull and brain matter. The name suggests the exact location and what treatment to give to the patient. EDH is a bleed between the dura mater and the skull. This situation needs immediate action, and it is certain that if it is left untreated, the patient's survival is almost non-existent (Cleveland Clinic 2021). SDH is a bleed in the area between the dura and the arachnoid. This bleed pushes the brain but does not get in between the matter. This can be as an acute or chronic bleed (Cleveland Clinic 2024). SAH is a bleed in the subarachnoid space which is the area between the arachnoid and the pia mater. Usually cause by an erupted aneurysm which can be spontaneous or erupt due to a trauma (Terveyskylä 2021). The exact locations of these can be perceived in the picture 1.

Intracerebral haemorrhage (ICH) Intraventricular haemorrhage (IVH) are bleeds inside the brain matter. Information from Aivoliitto (2020) explains that ICH is a bleed of a inside the brain matter as the IVH is a bleed in the ventricles of the brain. The bleeding in IVH occurs in one of the smaller veins in the brain matter (Aivoliitto 2020). With these bleeds you can see the effect on the colour of the cerebrospinal fluid (Mäntynen et al 2023). In picture 1 it can be observed the difference between these two.

Two main types of brain tumours are gliomas and meningiomas. Both are then classified in grades. Gliomas to four grades and meningiomas to three grades. The symptoms and treatment are the same in a nursing perspective. The location is what effects the patient physically and mentally (American Cancer Society 2020). A tumor can locate in an area that causes symptoms to the patient. The symptoms can vary from slight headache to seizures to problems in walking or talking (American Cancer Society 2020). Brain tumour patients face after the surgery strong headaches so severe that it can affect vision, swallowing, speech, coordination, balance (Kallio 2018). Giving certain medicines, such as opioids to the pain, should be taken into consideration when assessing the neurological status as these may affect the patient's neurological status assessment (Lääketietokeskus 2024).

Head traumas happen suddenly and unexpectedly to patients which is why the alertness of the patient can change fast (Terveyskylä 2023). The nurse needs to be careful if there are broken bones or parts of the skull taken away for the swelling because certain broken bones will affect the nursing, for example if the ethmoid bone is fractured (Spurrier & Johnston 2008). The ethmoid bone is the barrier between nose and the brain (Nienstedt et al. 2019, 139). According to Spurrier and Johnson (2008) inserting a nasogastric tube can be lethal for the patient as the tube can travel to the brain. The nurse needs to be mindful of the high-density oxygen nasal cannula, ex. Optiflow, can also be dangerous for a similar reason that the oxygen can go in the skull through the fracture and create pressure (Chang, Kim & Chung 2020).



Picture 1 Haemorrhages inside the skull (Cleveland Clinic 2021)

2.2 Nursing intervention

Coined term “nursing” became more common due to Nightingale’s work in 1800s (British Red Cross 2023). And her work has influenced nursing ever since (Potter, Perry, Stockert & Hall 2018, 3). Nightingale is often referred as the mother of nursing (British Red Cross 2023). Her work decreased the mortality of her patients therefore her work was extremely valuable (Potter et al 2018, 3)

Written by Potter et al (2018, 6), a nurse is someone who sees the patient the most. Agreed by Monteiro, the nurse is someone who sees the patient the most often, so they assess the patient in a variety of ways during the day. Nurses impact the patient’s health and recovery immensely as they are the ones seeing the smallest changes in the wellbeing of the patient (Monteiro 2023). The bedside and all necessary items are checked by a nurse prior to needing the items, nurses anticipate and foresees the possibles outcomes of each patient (Creed & Hargreaves 2016, 12).

Patients’ emotional changes can be drastic during and after a visit to the hospital (Stroke Association 2024a). Importance of nurse staying calm is highly valued in the recovery stage. (Potter et al 2018, 26). But keeping it the facts as honest and realistic helps with the recovery (Creed & Hargreaves, 2016, 16). Communication is both verbal and nonverbal, therefore even before speaking information is already being transferred to the recipient (Potter et al, 178). In the Oxford Handbook for Critical Care Nursing (Creed & Hargreaves 2016, 16), the communication with the relatives is highlighted. As they might know the wishes of the patient, if the patient is unable to communicate it themselves (Creed & Hargreaves, 2016, 16). Critical care faces death often because all critically ill patients might not survive (Creed & Hargreaves, 2016, 498).

One of the factors affecting patient safety is the lower nursing staff as there is not enough nurses, it can take longer to notice the changes in patients (Potter et al 2018, 5). Ten percent of patients face unsafe conditions, by WHO (2023). Patient safety is important to all healthcare professionals, and yet half of the ten percent would have been preventable (WHO 2023). On the international level operates ILO, International Labour Organization, which creates the boundaries of a safe working environment to combat unsafe working conditions (TEM 2024).

2.3 Methods of neurological status assessment

Neurologists have an extensive list of checking the neurological status of patients. Nurses do not have the training to go as much into detail, nor is it necessary to check as often as nurses do as thoroughly as neurologists do (Ernstmeyer & Christman 2021). More common practices for nurses to check the neurological status are such as the Glasgow Coma Scale (GCS), as Full Outline of Unresponsiveness (FOUR) is less common in basic wards (Bayraktar, Sahinoglu, Cicekci, Kara, Karabagli, Duman & Celik 2019).

2.3.1 Glasgow Coma Scale (GCS)

Glasgow Coma Scale, or as often referred as 'GCS', was introduced to use in the 1974 by Graham Teasdale and Bryan Jennett (Glasgow Coma Scale 2024a). It has three parts which collect "points" to a sum, scaling from 3 points to 15 points (Glasgow Coma Scale 2024a). GCS is used in a variety of patients in early assessment, for example GCS is in the ABCDE approach, which is commonly used in nursing practices, in part D, Disability (Resuscitation Council 2021). To count the GCS, see figure 1.

Glasgow Coma Scale- Pupils Score, GCS-P, is an added assessing factor to the basic GCS described to use in 2018. It recognizes the pupil's reactivity or lack of to the sum of the GCS. It subtracts pupil reactivity score, 'PRS', from the GCS points to create GCS-P. It is calculated using this form: $GCS-P = GCS - PRS$. Then the scale goes from 1 point to 15 points. (Glasgow Coma Scale 2024b.) To count the pupil reactivity score (PRS) see figure 2.

Here is the GCS tablet is figure 1. There are three actions, and the points are gathered from the reaction given. Minimum of 3 points and maximum of 15 points. 3 points can mean a brain-dead person, as 15 points means a normal status, alert person. The actions are opening eyes, verbal response, and motor response. Possible reactions for opening eyes are spontaneous opening (4 points), to sounds (3 points), for example speech, to pressure (2 points) and no response (1 point). Possible reactions for verbal response are the speech is orientated and coherent (5 points), confused (4 points), for example not recognizing the location, saying random single words (3 points), just sounds (2 points) and no response (1 point). Intubated patient receives 0 points contrary which makes the sum of GCS invalid to observe. Last assessment is the motor reactions, firstly to obey commands (6 points), for example lift your hand. After the first then the patient is given a localized pain, a pinch or pressure, firstly the patient localizing the pain (5 points), secondly normal flexion (4 points), so the hand rises towards the pain indicator but does not localize it, thirdly abnormal flexion (3 points), which is a flexion that is not towards the pain, fourthly there is the extension (2 points), where the patient extents the hand where the pain indicator is given. And lastly no

response to any pain indicator (1 point). (Glasgow Coma Scale 2024a; Duodecim Käypähoito 2024.)

At figure 2 there is the added pupil reactivity score and how it is counted. If both pupils react normally the patient receives no points for their PRS, if one pupil is unreactive, they receive one point and if both pupils are unreactive, they receive two points. The PRS is subtracted from the GCS to create GCS-P. (Glasgow Coma Scale 2024b.)

Action	Reaction	Points
Eye opening	Spontaneous	4
	To sound	3
	To pressure	2
	None	1
Verbal response	Orientated	5
	Confused	4
	Words	3
	Sounds	2
	None	1
Motor response	Obey commands	6
	Localizing	5
	Normal flexion	4
	Abnormal flexion	3
	Extension	2
	None	1
Total		3-15

Figure 1 Glasgow Coma Scale (Glasgow Coma Scale 2024; Duodecim Käypähoito 2024)

Pupils Unreactive to Light	Pupil Reactivity Score
Both Pupils (neither pupil react to light)	2
One Pupil (one of the pupils react normal to light)	1
Neither Pupil (Normal reaction to light)	0

Figure 2 Glasgow Coma Scale Pupil Reactivity Score (Glasgow Coma Scale 2024b.)

2.3.2 Full Outline of Unresponsiveness (FOUR)

Full Outline of Unresponsiveness, FOUR, is a scale developed in 2005 for the use in trauma intensive care units (Bayraktar et al 2019). As it says in its name, it has four sections in its measurement. They are eye response, motor response, brainstem reflexes and respiration pattern. The score ranges from 0 to 16 (Sivula, Luoto, Heinilä, Huhtala, Karlsson, Yli-Hankala & Långsjö 2017).

Here is the FOUR tablet is figure 3. The eyes are assessed as if the eyes are open, or are opened by demand, they follow the person who is speaking, the score is four. If the eyes are open but they do not follow the person speaking or leading visual clues, the score is three. If the eyes stay closed until a loud noise is made, the score is two. If the eyes open to pain, the score is one. And if the eyes do not open to anything, the score gets a zero. (Wijdicks 2024)

The motor response means limb movement. If the patient is able to show a sign with their hands by command, the score is four. If the patient after being given localized pain, moves their limb towards the pain stimulation, the score is three. If the patient flexes towards the pain stimulation but does not go all the way towards it, the score is two. If the patient moves away from the pain, the score is one. But if there is no motor response to localized pain stimulation, the score is zero. (Wijdicks 2024)

The brainstem reflexes are assessed through the eyes. If both pupils react to light stimulation normally and are similar sized, the score is four. If one of the pupils is wider than the other, the score is three. If one of the pupils either does not react to the light or does not follow with the eye, the score is two. If both pupils do not react to the light and do not follow, the score is one. And if both pupils do not react to any stimulation, the score is zero. (Wijdicks 2024)

The respiration pattern is assessed that if the patient is not intubated and is breathing normally, the score is four. If the non-intubated patient has Cheyne-Stokes breathing, the score is three. If the non-intubated patient is breathing irregularly, the score is two. If the patient is intubated but is breathing on their own, the score is one. If the patient is intubated but is not breathing on their own, the score is zero. (Wijdicks 2024)

Action	Reaction	Points
Eyes	Open, follows, or blinks by demand	4
	Open, does not follow	3
	Closed, opened by a loud noise	2
	Closed, opened by pain	1
	Closed	0
Motor response	Thumbs up, makes a fist or a peace sign by demand	4
	Localizes the pain	3
	Flexion to pain	2
	Extension to pain	1
	No response or status epilepticus	0
Brainstem reflexes	Pupil and corneal reflexes present	4
	One pupil wide and fixed	3
	Pupil or corneal reflexes absent	2
	Pupil and corneal reflexes absent	1
	Absent pupil, corneal and cough reflexes	0
Respiration pattern	Non-intubated, normal	4
	Non-intubated, Cheyne-Stokes	3
	Non-intubated, irregular	2
	Intubated, own breaths	1
	Intubated, no own breaths	0
Total		0-16

Figure 3 Full Outline of Unresponsiveness (Sivula et al 2017; Wijdicks 2024)

The scale FOUR is very similar to GCS. And by the research published in Turkish neurosurgery paper about Comparison of Glasgow Coma Scale and Full Outline of Unresponsiveness (Four) Score: A Prospective Study in 2019, it states that GCS is as good as FOUR and as it is more used in nursing already, it is easier to use and to measure (Bayraktar et al 2019).

Supporting this research is a Finnish research from Tampere TAYS in 2017 by Sivula et al. That research concluded that GCS and FOUR are equally equipped to predict mortality within one month stay in an intensive care unit setting for patients. In this research FOUR is more equipped to fairly notice if a patient is in locked-in. This research also argues the faults in GCS for intubated patients as GCS scores of the verbal response cannot be adequately assessed with intubated patients. (Sivula et al 2017.)

3 Methodology

The methodology starts with the purpose, aim and research questions, continues to the type of the research. Then the data information, including inclusion and exclusion criteria, the data collection and analysis.

3.1 Purpose, aim, and research question

3.1.1 Purpose

Provide information for nurses and nursing students interested in the neurological status assessment and the current research behind it.

3.1.2 Aim

Describe the current literature about assessing the neurological status of a patient from the nursing point of view.

3.1.3 Research Question

How neurological status assessment in the nursing point of view is described in literature?

3.2 Literature Review

There are three types of literature reviews, descriptive, systematic, and meta-analysis (Salminen 2011, 6). Descriptive literature review are the most used research methods in healthcare field (Kangasniemi, Utriainen, Ahonen, Pietilä, Jääskeläinen, Liikanen 2013, 292). Descriptive literature review is divided into two subthemes, narrative and integrative (Salminen 2011, 6). As described by Salminen (2011, 6-8) the narrative is broader, commentative and general view to the topic, as the integrated gets closer to the topic, even some parts similar to the systematic review.

Systematic review is often used as a preface for research (Salminen 2011, 9). It looks deep into the data and analyses the credibility of them (Salminen 2011, 9). Meta-analysis is divided into two categories, qualitative and quantitative (Salminen 2011, 38). The qualitative is then divided into two subcategories, meta-synthesis and meta-conclusion (Salminen 2011, 38; Suhonen, Axelin & Stolt 2015, 7-8). In both systematic review as well as meta-analysis the focus is heavy on the researcher to create new information (Suhonen et al 2015, 7-13; Baumeister & Leary 1997, 312; Salminen 2011, 16-30).

The type of literature review for this thesis is a descriptive narrative literature review. In the descriptive narrative review type, the connection between data is linked due to topics chosen (Baumeister & Leary 1997, 312). The data analysis is based on the data selection, and they are formed in unison (Kangasniemi et al 2013, 295). Using the descriptive literature review requires a deep understanding of the method to create more reliable information (Kangasniemi et al 2013, 298). According to Kangasniemi et al (2013, 299) the descriptive literature review may answer the research question, in some instances.

There are four stages of the descriptive review: 1) formulation the research question 2) finding the most suitable data 3) building a description 4) observation of the finished product (Kangasniemi et al 2013, 291-292). The amount of data is determined by the vastness of the research question (Kangasniemi et al 2013, 295). The goal for the thesis, guided by Baumeister and Leary (1997, 312) is to review the literature of the neurological status and provide the overview to nurses and to nursing students.

3.3 Inclusion and exclusion criteria

For the inclusion criteria the author selected evidence-based studies and dissertations between 2014-2024 that are in English language. The studies had to be available for free use and full text. Considering the subject and degree of the thesis, articles had to include the nursing point of view as well as the neurological status assessment. Thesis level studies, review articles, publications in other languages, studies where full text was not available, and studies related to pediatric nursing, medicine and radiology were excluded.

Table 1 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Evidence-based studies, dissertation	Not evidence-based, bachelor theses, review articles
Full text, free use	Full-text not available
Publications between 2014-2024	Publications before 2014
English language	Other languages
Nursing perspective	Other perspectives, ie medicine, radiology
Adult patients	Pediatric patients

3.4 Data collection

The author used terms “nursing assessment” or “nursing intervention” with the terms “neurological status assessment”, “Glasgow Coma Scale”, or “Full Outline of Unresponsiveness”. Databases used were EBSCOhost (CINAHL), PubMed, ProQuest, ScienceDirect (Elsevier), and Medic, all provided by Laurea University of Applied Sciences. The purpose was to find articles in English language, between the years 2014 to 2024. Limitations for the search were also that the articles were available in full text and from the nursing point of view. After the initial search the result were 186 articles. Assessing the title, abstract, full text and content, the number of researched articles came to 13.

Table 2 Data collection

Database	Inclusion criteria search terms	Limitation	Results	Accepted based on title, abstract, full text, criteria
EBSCOhost (CINAHL)	“nursing assessment” OR “nursing intervention” AND “neurological status assessment” OR “full outline of responsiveness” OR “Glasgow coma scale	2014-2024 Full-text English Nursing perspective	10	3
PubMed	“nursing assessment” OR “nursing intervention” AND “neurological status assessment” OR “Glasgow coma scale” OR “full outline of unresponsiveness”	2014-2024 Full-text English Nursing perspective	112	3
ProQuest	“nursing assessment” AND “neurological status” OR “Glasgow coma scale” OR “full outline of unresponsiveness”	2014-2024 Full text and peer reviewed English Nursing perspective	6	3
ScienceDirect (Elsevier)	“nursing assessment” OR “nursing intervention AND “neurological status assessment” OR “Glasgow coma scale” OR “full outline of unresponsiveness”	2014-2024 Open access English Nursing perspective	57	4
Medic	nurs* OR “nursing intervention” AND “neurological status” OR “Glasgow coma scale” OR “full outline of unresponsiveness”	2014-2024 English Nursing perspective	1	0
Total articles selected			186	13

3.5 Data Analysis

The researched articles were analyzed and categorized by common themes. The research question of “How neurological status assessment in the nursing point of view is described in literature?” guided the author with the review.

Thematic analysis identifies, analyses and reports themes within the data searched (Braun & Clarke 2006, 79). It is important that the prerequisites for the data search are clearly defined (Lusa, Proust-Lima, Schmidt, Lee, le Cessie, Baillie, Lawrence & Huebner 2024). It is by the author’s judgement whether an article is suitable for the analysis (Braun & Clarke 2006, 82).

The themes are the root of the articles (Saaranen-Kauppinen & Puusniekka 2009, 105). Themes capture the important data in the selected articles that respond to the research question (Braun & Clarke 2006, 82). Every theme does not need to be present in every article. Main themes are broader, as the subthemes can go more in-depth (Saaranen-Kauppinen & Puusniekka 2009, 107). Stated by Braun & Clarke (2006, 83) there is no right or wrong way of determining themes.

This thesis found two main themes to present in the results: Continuous education and Neurological assessment techniques. Both of which were formed with subthemes according to table 4, the summary of themes. During the analysis process, the articles were reviewed and re-read multiple times.

Table 3 Data analysis

n.	Author(s), year, country	Title	Purpose, aim and method	Participants	Main theme
1.	Abreu Vieira, L., Cavalcante Guedes, MV. & Alves Barros, A. 2016, Brazil	Application of Glasgow, Braden and Ranking Scales in Patients Affected by Cerebrovascular Accident	<p>Purpose: To assess the level of consciousness, risk of pressure ulcers and functional dependency of patients affected by Cerebrovascular Accident using the scales of Glasgow, Braden and Rankin modified</p> <p>Aim: To assess the need for other assessment methods for patients with Cerebrovascular Accidents</p> <p>Method: A cross-sectional analytical study with a quantitative approach</p>	40 participants, patients	2
2.	Alrashedi, H.N., Bushra, A., Maha, A., Fawziha, A., Noor, A., Effa, A. & Fatimah, A., 2022, Saudi-Arabia	Self-Rated Emergency Core Nursing Competencies Among Emergency Nurses in Qassim	<p>Purpose: Emergency situations require advanced and specialized knowledge and skills to handle urgent situations.</p> <p>Aim: Enhance the amount of literature on emergency nurses' competencies.</p> <p>Methods: A cross-sectional study</p>	213 participants, nursing staff	1, 2
3.	Baker, W. L., Sharma, M., Cohen, A., Ouwens, M., Christoph, M. J., Koch, B., Moore, T. E., Frady, G., & Coleman, C. I., 2024, USA, UK & Canada	Using 30-day modified rankin scale score to predict 90-day score in patients with intracranial hemorrhage: Derivation and validation of prediction model.	<p>Purpose: Whether 30-day modified Rankin Scale (mRS) scores can predict 90-day scores is unclear.</p> <p>Aim: To note that a short-term assessment can predict recovery</p> <p>Method: Derived and validated a model to predict ordinal 90-day mRS score using 30-day mRS values and routinely available baseline variables.</p>	247 participants,	2
4.	Divya, K.Y. & Ponchitra, R., 2018, India	Registered nurses' knowledge on comprehensive neuro assessment: A pre-experimental design.	<p>Purpose: To assess the effect of a structured training program on comprehensive neuro system assessment among registered nurses</p> <p>Aim: To assess the registered nurses' knowledge about neuro assessment</p> <p>Method: Descriptive and inferential statistics, a quantitative approach</p>	83 participants, registered nurses	1
5.	Feldman, A., Hart, K. W., Lindsell, C. J., & McMullan, J. T., 2015, USA	Randomized controlled trial of a scoring aid to improve Glasgow Coma Scale scoring by emergency	<p>Purpose: To improve the emergency medical services (EMS) personnel the Glasgow Coma Scale (GCS) assessment of the injured and critically ill patients</p> <p>Aim: To assess the accuracy of EMS providers' GCS scoring, as well as the</p>	180 participants	1, 2

		medical services providers	improvement in GCS score assessment with the use of a scoring aid Methods: Randomized, controlled study		
6.	Garner, A. A., Mann, K. P., Fearnside, M., Poynter, E., & Gebski, V., 2015, Australia	The Head Injury Retrieval Trial (HIRT): a single-centre randomised controlled trial of physician prehospital management of severe blunt head injury compared with management by paramedics only	Purpose: To conduct a randomized trial to evaluate additional physician intervention compared with paramedic only care Aim: To assess the advanced prehospital interventions for severe brain injury Method: Prospective, randomised controlled trial	375 participants, patients	1, 2
7.	Gélinas, C., Boitor, M., Puntillo, K.A., Arbour, C., Topolovec-Vranic, J., Cusimano, M.D., Choinière, M., & Streiner, D.L, 2019, Canada & USA	Behaviors Indicative of Pain in Brain-Injured Adult Patients With Different Levels of Consciousness in the Intensive Care Unit Journal of Pain and Symptom Management.	Purpose: To describe and compare behaviors in brain-injured patients with different levels of consciousness during nociceptive and no nociceptive care procedures in the ICU and to examine interrater agreement of individual behaviors as well as discriminative and criterion validation of putative pain behaviors Aim: To describe if pain assessment influences the neurological assessment Method: A prospective cohort observational design	147 participants, patients	1, 2
8.	Gencturk, N, Ay, F, Demirci, Ş, Acamur, Z, Izdeş, S & Bulut, A 2017, Turkey	An Examination of the Nursing Records of Cerebrovascular Disease Patients in Intensive Care	Purpose: Determine the nursing care needs of acute cerebrovascular disease patients in the intensive care unit and the nursing interventions provided for them. Aim: To assess the needs and nursing interventions required for cerebrovascular disease patients Method: retrospective cohort	43 participants, patients	1
9.	Hyvärinen, S., Jarva, E., Mikkonen, K., Karsikas, E., Koivunen, K., Kääriäinen, M., Meriläinen, M., Jounila-Ilola, P., Tuomikoski, A., Oikarinen, A., 2024, Finland	Healthcare professionals' experience regarding competencies in specialized and primary stroke units: A qualitative study.	Purpose: Healthcare professionals who provide stroke care need multifaceted, multi-professional skills. Aim: Ongoing training is important for competent stroke care. Method: A descriptive qualitative study.	25 participants, healthcare professionals	1

10.	Liu, W., Zhu, J., Liu, J., & Guo, Q., 2015, China	Psychological state and needs of family member caregivers for victims of traumatic brain injury: A cross-sectional descriptive study	<p>Purpose: To evaluate the impact of varying severity of traumatic brain injury on the psychological state and demands of family caregivers</p> <p>Aim: To determine the most significant and least significant daily needs among family caregivers</p> <p>Method: a cross-sectional descriptive study</p>	300 participants, caregivers	2
11.	Ndung'u, A., Ndirangu, E., Sarki, A., & Isiaho, L. 2022, Kenya	A Cross-sectional Study of Self-Perceived Educational Needs of Emergency Nurses in Two Tertiary Hospitals in Nairobi, Kenya.	<p>Purpose: To highlight educational needs specific to nurses working in 2 emergency departments in Nairobi, Kenya</p> <p>Aim: To assess the current knowledge of nurses in two hospitals in Nairobi, Kenya</p> <p>Methods: A descriptive cross-sectional study</p>	84 participants, nursing staff	1
12.	Qasim, A.K., 2022, Iraq	Knowledge of Nurses Regarding Glasgow Coma Scale Techniques Implementation in Al Nasiriyah General Hospital.	<p>Purpose: To find out the relationship between nurses' knowledge and their demographical characteristics include educational level and years of experiences at Al Nasiriyah General Hospital</p> <p>Aim: To assess the nurse's knowledge regarding Glasgow Coma Scale techniques implementation</p> <p>Method: A cross-section, correlational study</p>	93 participants, nurses	1, 2
13.	Vaz da Costa, CP, Araújo Luz, MHB, Freire Bezerra, AK & Santiago da Rocha, S 2016, Brazil	Application of the Nursing Theory of Callista Roy to the Patient with Cerebral Vascular Accident	<p>Purpose: To report the experience of application of the nursing process implemented in the light of the Theory of Adaptation of Callista Roy to a patient with stroke</p> <p>Aim: To prove that the theory of Callista Roy is valuable in patients with cerebral vascular accidents</p> <p>Method: a descriptive study of type experience report</p>	15 nursing diagnoses	2

Table 4 Summary of themes and subthemes

Main theme	Subtheme	Content including paper number where data were retrieved
1. Continuous education	Educational needs	Recognizing that there is a need for further education (2, 5, 8, 9, 11, 13)
		Importance of the further education (4, 6, 7, 8, 11, 12, 13)
	Evaluation	Self-evaluation (2, 4, 9, 11, 12)
		Peer-reviewed / patient review (5, 6, 7, 8)
2. Neurological assessment techniques	Glasgow Coma Scale	GCS was used as a method (1, 2, 3, 6, 7, 10, 12)
		GCS was evaluated (5)
	Other methods	Modified Rankin Score (mRS) (1, 3)
		Critical-Care Pain Observation Tool (CPOT) (7)
		Symptoms Checklist-90 (SCL- 90 score) (10)
		Callista Roy theory (13)

4 Results

As doing the research for the articles, the research question “How neurological status assessment in the nursing point of view is described in literature?” brought up the main themes and the subthemes. The main themes were 1. Continuous education and 2. Neurological assessment techniques.

4.1 Continuous education

The title of the first theme is inspired by the Act of Health Care Professionals, Section 18: Obligation to take part in further training (Act of Health Care Professionals 559/1994). The

theme is divided into two subthemes which have been summarized by reviewing the articles. The subthemes are “Educational needs” and “Evaluation”.

Five out of the 13 selected articles were aimed for healthcare providers, and they gave a self-evaluation on their own knowledge on different topics, one of the topics being neurological status assessment. A paper or online questionnaire was used in three of the five articles, two used a semi-structured interview to collect data. The results were self-evaluating of learning and educational needs. Self-assessment studies revealed people saying they have good knowledge, but not great knowledge on neurological assessment. (Alrashedi, Bushra, Maha, Fawziha, Noor, Effa & Fatimah 2022, 1-3; Divya & Ponchitra 2018, 29; Hyvärinen, Jarva, Mikkonen, Karsikas, Koivunen, Kääriäinen, Meriläinen, Jounila-Ilola, Tuomikoski & Oikarinen 2024, 27; Ndung’u, Ndirangu, Sarki & Isiaho 2022, 468; Qasim 2022, 6013.)

In Qasim (2022, 6017) research it was stated that little over two thirds of nurses have a moderate knowledge on the GCS. The main components of the assessment are known to many according to Qasim (2022, 6018), but for example the assessment of the eyes and pupil can often be missed. The nursing professional are responsible for monitoring and identification of alteration in consciousness levels. Therefore, it is vital that they know how to assess in a unified way a patient. Alrashedi et al (2022, 10), Divya & Ponchitra (2018, 29), Ndung’u et al (2022, 475) and Qasim (2022, 6019) all suggest that an education program or training lessons to improve on the neurological assessment, especially GCS, are needed for nurses. Hyvärinen et al (2024, 33) concur that continuous training is essential to good patient care. (Alrashedi et al 2022, 10; Divya & Ponchitra 2018, 29; Hyvärinen et al 2024, 33; Ndung’u et al 2022, 475; Qasim 2022, 6019.)

Four out of the 13 selected articles assessed the patient outcome with the nurse evaluation by peer-reviewing and patient reviewing. Two were randomized studies that spread across the board, focusing on selected patient type. One study was based on patient experience. And the last was a retrospective study that based on the nursing documentations made. Peer reviewed concluded that nurses’ assessments can be different from the doctors’. (Feldman, Hart, Lindsell & McMullan 2015, 325; Garner, Mann, Fearnside, Poynter & Gebiski 2015, 869; Gélinas, Boitor, Puntillo, Arbour, Topolovec-Vranic, Cusimano, Choinière & Streiner 2019, 764; Genturck, Ay, Demirci, Acamur, Izdes & Bulut 2017, 419.)

In studies by Feldman et al (2015, 326) and by Garner et al (2015, 874) the evaluation was aimed towards paramedics. Both studies concluded that the assessment done by paramedic is not always accurate. The physicians’ assessment often was more accurate. Garner et al (2015, 870) utilised the Glasgow Outcome Scale that measures in the acute phase the estimation of the survival of the patient. The Garner et al (2015, 872) study however was discontinued due to a change in emergency service operations.

In the research by Gélinas et al (2019, 762), the patient was assessed in cooperation with the patient. The research was focused on the pain assessment and how it differs from intubated to extubated patients. Most of the patients in the study were in the intensive care unit. The study concluded that people experience and show their pain in different way. The assessment method is based on if the patient is tense or is showing a grimace. Some patients may show their pain in other ways so the knowing the patient fully is important. (Gélinas et al 2019, 762.)

Article by Genturck et al (2017, 419) noticed that nurses tend to report on things only when they differ from the usual. The article highlights the importance of accurately document the patient's condition for the benefit of the treatment. It was noted that in the intensive care unit the workload is massive, and the documentation of the nursing interventions had come last during the time of the research. (Genturck et al 2017, 419.)

Researches by Feldman et al (2015, 326), Garner et al (2015, 874), Gélinas et al (2019, 762) and Genturck et al (2017, 419), conclude that there is a great margin of error in the assessment of patients. Factors affecting it vary from the lack of efficient education and human factors. Lack of clear and unbiased assessment methods that does not take long to document can factor in. (Feldman et al 2015, 326 ; Garner et al 2015, 874 ; Gélinas et al 2019, 762 ; Genturck et al 2017, 419.)

In self-evaluation type of articles, the responders and the article writers realize the need for further education on self-assessment alone. In peer or patient reviewed situations the facts speak for themselves in the articles. (Alrashedi et al 2022, 10; Divya & Ponchitra 2018, 29; Feldman et al 2015, 328; Garner et al 2015, 874; Gélinas et al 2019, 772; Genturck et al 2017, 419; Hyvärinen et al 2024, 32; Ndung'u et al 2022, 475; Qasim 2022, 6013.)

4.2 Neurological assessment techniques

Second of the themes is divided into two subthemes which have been summarized by reviewing the articles. The subthemes are "Glasgow Coma Scale" and "Other methods".

Glasgow Coma Scale was used in seven out of the 13 articles selected. Seven of them used GCS as a patient assessment method, two of them assessed the method, and two evaluated nurses' knowledge on it. (Abreu Vieira, Cavalcante Guedes & Alves Barros 2016, 4226; Alrashedi et al 2022, 1; Baker, Sharma, Cohen, Ouwens, Christoph, Koch, Moore, Frady & Coleman 2024; Feldman et al 2015, 329; Garner et al 2015, 869; Liu, Zhu, Liu & Guo 2015, 231; Qasim 2022, 6012.)

Five of the articles used GCS as a background information for their own results. Two of those assessed the nurses' own knowledge on the method. Two of the articles noticed in their research the problems with the assessment method. (Abreu Vieira et al 2016, 4231; Alrashedi et al 2022, 8; Baker et al 2024; Feldman et al 2015, 329; Garner et al 2015, 874; Liu et al 2015, 235; Qasim 2022, 6017.)

In Abreu Vieira et al (2016, 4231) study it was noted that GCS is lacking in detecting sensory losses. The study utilised Braden score to help note when patient has developed pressure ulcers. Pressure ulcers are not followed as closely to conscious patient as it is assumed they know to change positions more, but Abreu Vieira et al (2016, 4231) study noted that there is a correlation with higher Braden scores. GCS can miss paresis of the patients that can often form on neurological patients. (Abreu Vieira et al 2016, 4231.)

According to Feldman et al (2015, 329) GCS is not valid in all neurological conditions. There can be errors in assessment. Not all patients can be applied the GCS to fully comprehend their status (Feldman et al 2015, 329). According to Feldman et al (2015, 328) the GCS is widely used but often also falsely scored. Notion of better methods is mentioned but as GCS is such a staple of use, it can be hard to learn new methods. Stated by Garner et al (2015, 874) that GCS would benefit from a secondary assessment together. Glasgow Outcome Score and Abbreviated Injury Scale were mentioned in the study (Garner et al 2015, 875).

Baker et al (2024) and Liu et al (2015, 235) used GCS as a background information for the patients that their study focused on. Baker et al (2024) focused on the modified Rankin Scale and its usage. With Liu et al (2015, 235) they evaluated a Symptom Checklist- 90.

Other methods of assessing the neurological status were discussed in four articles out of 13 total. Three of them also had GCS as an assessment method. One focused merely on nursing theory and documentation. (Baker et al 2024; Gélinas et al 2019, 761; Liu et al 2015, 231; Vaz da Costa, Araujo Luz, Frere Bezerra & Santiago da Rocha 2016, 352.)

Modified Rankin Scale was used in two out of the 13 articles selected. Modified Rankin Scale, mRS, measures the disability or dependence of the patient after a neurological condition. Baker et al (2024) compared in their research that can the mRS be assessed in a later part in the patient treatment. In the research the method was applied to patients with ICH. Abreu Vieira et al (2016, 4227) compared GCS, Braden scale and mRS. In the research the patients were mostly orientated.

Symptom Checklist-90, SCL-90 score, is a questionnaire to evaluate the psychological side of the patient. It can be useful with neurological patients or with their relatives as a neurological condition can be very debilitating. The score came up from an article from China by Liu et al (2015, 231). SCL-90 score is made up of psychological measurements. The article

states that higher the traumatic injury on the patient, higher the psychological pressure. (Liu et al 2015, 231.)

One article from Canada by Gélinas et al (2019, 772) used CPOT, which is a pain assessment method, an abbreviation for Critical-Care Pain Observation Tool. The study featured Intensive Care Unit patients, both with traumatic brain injury and those with non-traumatic brain injury. The traumatic brain injured patients reacted more through different kind of pain stimulations than regular neurological status assessment. Which is an indication that there may be more brain activity than regular assessment methods are able to show. Noting if the patient suffers from a paresis, the pain indication can be hard to read on the patient. (Gélinas et al 2019, 772)

Callista Roy theory was a method in the article from Brazil by Vaz da Costa, Araujo Luz, Frere Bezerra & Santiago da Rocha (2016, 353). Theory of Callista Roy organizes the nursing intervention to a clearer way. The research found that organizing the nursing interventions gave importance to the trigger responses of neurological patients. (Vaz da Costa 2016, 353.)

5 Discussion of the results

Need and want for further nursing education and continuous training is highlighted in nine of the 13 articles selected. For example, the sensory loses can be left unnoticed by the nurse if they are not educated in the topic enough. A comprehensive assessment of the patient is needed throughout. At the current state this review did not find current research articles about assessing or improving the current assessment methods. The types and reasons behind the nurses' assessment of neurological status are insufficient.

Comparing the evaluation types in these articles, self-evaluation, and peer reviewed. In self-evaluation the personnel can more easily evaluate themselves higher than in peer reviewed situation. The integrity of the research can shake if the only basis of knowledge of the actual skillset is based solely on the person. In the examples of Feldman et al (2015, 326) and Garner et al (2015, 874) in which a professional was reviewing the GCS assessment the result of the research can be more reliable.

Using more than just neurological status assessments in neurological patients can be useful as a method of assessing the patient's neurological status. People react in different ways to different stimuli. Also evident in proper nursing documentation in theory of Callista Roy (Vaz da Costa et al 2016, 357). In Gélinas et al (2019, 772) study that used CPOT, a pain assessment method in neurological patients, stated that some patients respond to different pain stimuli. Noted in Abreu Vieira et al (2016, 4231) which stated that GCS on its own does

not assess sensory losses. That means the hemiparesis can be left unnoticed if the nurse assessing is not educated enough on the topic of neurological patients.

Surprising the author was that none of the articles selected highlighted the Full Outline of Unresponsiveness, FOUR, more. FOUR was mentioned in the conclusion of one of the articles. The research noted that FOUR may be a better assessment method in certain cases. (Feldman et al 2015, 329). Author finds this as an opportunity for further research on the assessment method.

6 Limitations and Ethical Consideration, Affiliations

A good ethical consideration was used throughout this thesis. The thesis was written in Finland and it followed the Responsible Conduct of Research, RCR, guidelines drafted by TENK. TENK is abbreviation from the Finnish name for the Finnish National Board on Research Integrity. TENK's work include research misconduct prevention in all scientific disciplines, creation of the national guidelines, coordination of the ethical reviewing of the human sciences, and influence nationally and internationally. RCR ensures the integrity, meticulousness, and accuracy in conducting research in Finland. RCR follows the European code of conduct for research integrity guidelines by ALLEA. ALLEA is abbreviated from All European Academies, it is the European code of conduct for research integrity. (TENK 2023a; TENK 2023b; TENK 2024; Fingerroos & Kokko 2022, 65.)

The author did not have prior experience on the usage of search engines and doing a large data selection, however, the author used the help of the information technician in the literature search which improves the credibility of thesis. Affecting credibility is also the licentiate limitations. In few instances due to the paywalls, the author could not access the original source and had to rely on a secondary source.

Limitations were faced in the search section as of the topic there were not many articles about improving the status assessment, but more about the patient's survival and the quality of life. Limited scale of used articles lowered the credibility. The articles selected varied from continent to continent and were not focused on one location which however improved the credibility.

7 Conclusion

Nurses need to upkeep their knowledge and continuous training is needed is a factor that came up in nine of the articles. As nurses in Finland, we are bound by law to take part in further training (Act of Health Care Professionals 559/1994). Further training is also needed in other countries.

More research of the neurological status from the nursing point of view is needed. Using different assessment in the research is also needed. The neurological nurses often use a model assigned by the ward's neurologist and it is not challenged, as the doctor's assessment is more accurate. The method of assessment can differ vastly from nurse to nurse. A unified way of assessing neurological status might help the patient safety. The lack of nursing point of view research in neurological status assessment was prominent.

According to StudySmarter, becoming a neurological nurse takes three steps; becoming a registered nurse, learning the experience in neurological nursing, which usually requires two years, and the third step is pursuing the certification. The neurological nurse is in charge of assessing and monitoring the patient and their neurological status. They are in charge of administering treatments and medications. They provide patient and their closed ones' education on the patient's condition. Neurological nurses also help with physical therapy and the patient's rehabilitation. (StudySmarter 2024.)

The author recommends that nurses upkeep their education and actively maintain themselves in the newest evidence-based information.

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Picture 1. Hemorrhages inside the skull

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