



LUNDS UNIVERSITET

Medicinska fakulteten

The Board of Nursing Education

Incidence of reoperation for ventriculo-peritoneal shunt in adult patients in relation to challenges of the perioperative nurse

A retrospective register study on complications

Author's name: Irina Halling

Supervisor: Bengt Sivberg

Masters' Thesis

Spring 2017

The Nursing, Radiography, and Reproductive, Perinatal and Sexual
Health Programmes Board
Faculty of Medicine
Lund University, Box 157, 221 00 LUND

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Abstract

Background: Ventriculo-peritoneal (VP) shunt is a catheter which circulate flow of cerebrospinal fluid (CSF) from the lateral ventricle to the abdomen and it is the most commonly used shunt in modern neurosurgery. Complications of VP shunts are very common and often require emergency services. For the perioperative nurse this means that the VP shunt reoperation is one of the most often performed emergency operations in neurosurgery with many unknowns.

Aim: To study the incidence of VP shunt reoperation in adult patients in relation to the challenges of the perioperative nurse in selection and preparation for acute reoperation.

Method: Descriptive statistic analyse from a quality register of cases from shunt register and operation notes in the Hospital of Sweden.

Result: The risk that patients with a first VP shunt operation get complications and must be reoperated during first sex month is high, the majority of patients who needed acute reoperation of VP shunt was patients with congenital anomaly and NPH. The main complication was infection, and the risk to get infection was highest during the first month efter shunt implantation. The process of the operation and final diagnosis is often different that what was preoperatively planned.

Conclusion: The handling of instruments and how the borderline room can be used to provide needed instruments in a quick and precise way without introducing risks of bacterial infection should be discussed in department of neurosurgery. Study should be supplied additional quantitative research in VP shunt complication in a bigger study group to make more clear connection between ethiology of hydrocephalus and VP shunt complications.

Key words

perioperative nursing, ventriculo-peritoneal shunt, reoperation

Contents

- Introduction..... 5
 - Statement of the Problem..... 6
 - Background..... 6
 - Research Design..... 9
 - Aim of Study..... 10
 - Research Questions..... 10
- Method..... 10
 - Conceptual Framework..... 10
 - Research Respondents..... 11
 - Sampling..... 11
 - Analysis of the Research Data..... 12
 - Ethical Statement..... 12
- Results..... 13
 - Patient demographics and characteristisk..... 13
 - Reason for VP shunt reoperation..... 14
 - Outcomes after VP shunt reoperations..... 16
- Discussion..... 22
 - Method..... 22
 - Results..... 23
 - Conclusion..... 28
- References..... 29
- Appendix/Annex 1 (2)..... 34
- Appendix/annex 2 (2)..... 35

Abbreviation

VP shunt – ventriculo-peritoneal shunt

CSF – cerebrospinal fluid

ICP - intracranial pressure

NPH - normal pressure hydrocephalus

IIH - idiopathic intracranial hypertension

Introduction

Statement of the Problem

The perioperative nurse is responsible for the preparation of necessary instruments for each operation and supply them in a manner to maximize safety for patient and efficiency for work environment (Steelman, 2011). This art requires an in-depth knowledge of the anatomy, the pathology of the condition and each step of the operation. The other important part of a successful operation is communication which refers to a certain ability to collaborate with the surgeon and present every instrument in an appropriate manner (Drønen & Helgesen, 2012). Ventriculo-peritoneal (VP) shunt is a catheter which circulate flow of cerebrospinal fluid (CSF) from lateral ventricle to abdomen and it is the most commonly used shunt in modern neurosurgery (Greenberg, 2010; Park, Kim, Park & Park, 2015). Placement of a ventriculo-peritoneal shunt is the most widely accepted neurosurgical operation for treatment of hydrocephalus (Chung, Yu, Kim & Kim, 2009).

Complications of VP shunts are very common and often require emergency services (Wang, Jackson, Jallo & Ahn, 2015). Preoperative evaluation of shunt problems often doesn't show exactly what happened with VP shunt. Sometimes, surgeon can find out the problem with VP shunt and take decision about VP shunt extraction or exchanging some of part of it during operation (Greenberg, 2010).

For the perioperative nurse this means that VP shunt reoperation is one of the most often performed emergency operations with many unknowns. The surgeon often cannot inform the nurse exactly about the procedure, duration of operation, which extra instruments are needed or the risks of the operation. For the patient and their family reoperation is very significant in respect of long-term care of VP shunt and future expectation of shunt function (Hallbjørg, 2002; Lindwall, 2008).

The importance of this study for perioperative neurosurgical nursing is to get knowledge of the reasons for acute VP shunt revision and use it for improvement of the perioperative preparation to this type of operation. It can also be used to make the selection and preparation of instruments more precise and decrease the time of operation and possible risk of complications, which is the competence of perioperative nurse in Sweden (SEORNA, 2011).

Background

Definition of hydrocephalus.

Hydrocephalus, as a result of increased pressure in the ventricular system of the brain, is a condition where the cerebrospinal fluid (CSF) accumulate in part of the system (Mellergård, 1998). Increase of the intracranial pressure (ICP) results in cerebral compression, the development of pathological neurological symptoms and ultimately the death of the patient (Hbeib et al, 2012).

The reasons for hydrocephalus could be one of three causes. An imbalance between production of CSF, its reabsorption or an obstruction of normal circulation of CSF (Kourtopoulos, 1994). Problems with CSF production are rare. Reabsorption of CSF in adults is usually disturbed by mechanical problems like bleeding, tumour or infection (Greenberg, 2010). Depending on the location of obstruction, hydrocephalus can be divided into communicating or non-communicating. Communicating hydrocephalus refers to an obstruction outside the ventricular system. Noncommunicating hydrocephalus refers to a disturbance of CSF flow within the ventricular system (Zemack, 2003).

Other forms are Normal Pressure Hydrocephalus (NPH) which occur in patients with progressive dementia. Intracranial pressure is usually normal or can in some patients be relatively high (Paulson et al., 2010). Patients with NPH presents with a clinical symptoms of hydrocephalus, dementia and urinary incontinence and are usually in the sixth to eight decades of life (Sutton et al., 2012).

Idiopathic intracranial hypertension, also known as a pseudotumor cerebri, is a nonhydrocephalic clinical syndrome which presents with increased ICP, but small size of ventricles. The pathophysiology of this syndrome is still unclear. Patients are generally overweight women who develop increasing ICP without identification of reason of this (Hbeib et al, 2005).

Surgical treatment of hydrocephalus

The treatment options for hydrocephalus mainly remains as a surgical (Greenberg, 2010).

Means of treating hydrocephalus can be divided into the following groups:

- 1) Pharmacotherapy for reduction of CSF formation
- 2) Surgical reopening an obstructed ventricular system (fenestration, ventriculostomi or ventriculo-subarachnoid shunt)
- 3) Increasing the capacity of reabsorption (shunting CSF) (Zemack, 2003).

The goal for surgical treatment of hydrocephalus is to make optimum CSF and to keep normal intracranial pressure (Blommengren et al., 2007). Generally surgeon's intervention of it created by various types of cerebrospinal shunts as a ventriculo-peritoneal shunt, ventriculoatrial shunt and lumbal peritoneal shunt (Mishra et al, 2016). Shunt surgery should be done as soon as hydrocephalus is diagnosed. Advantages of ventriculo-peritoneal shunt are that this programmable device can rapidly normalize intracranial pressure, the risk of intraoperative complications is less than other types of shunting or ventriculostomi and it does not demand hightcost equipment (Nigim et al., 2015).

Ventriculo-peritoneal shunt

The VP shunt operation was first described in 1908 by Kausch for the drainage of CSF and since 1961 it has been performed in Sweden (Farahmand et al., 2009)

The VP shunt consists of a ventricular catheter, a one-way valve and a distal catheter which are implanted to provide drainage of excessive CSF from the brain. The ventricle catheter is implanted into the lateral ventricular through a borehole and connected to a reservoir with a valve that located on the mastoid bone. A small incision for implanting the reservoir is made behind the ear (Hickey, 2009). The distal part passes subcutaneously through a tunnelling device to the abdomen into the peritoneal cavity (Hbdeib & Cohen, 2012).

Complication of VP shunt

Complications due to a VP shunt are still a major problem in the management of common neurosurgical diseases (Park, Kim, Park & Park, 2015). According to Khan, Rehman, Shamim and Bari (2016) and Reddy (2012) they have been reported to occur in 40% of operations and the majority of reoperations are due to distal shunt failure.

Reported VP shunt complications in literature are infection of the shunt, malfunction due to blockage, disconnection, migration and equipment failure, which are related to extraperitoneal retraction of the catheter, development of an incisional hernia, subcutaneous collection of CSF, and peritoneal pseudocyst formation due to low-grade infection followed by wrapping by the omentum (Khan, Rehman, Shamim & Bari, 2016; Reddy, 2012; Reddy, Bollam & Caldito, 2012).

Previous studies showed the complications of VP shunt in young infants, children and adult patients according to specific diseases as a, for example, hemorrhage-related hydrocephalus (Reddy, 2012), hydrocephalus after cranial surgery (Khan et al., 2016), idiopathic normal-pressure hydrocephalus (Miyajima et al, 2016). Researches introduced statistisc analyses of different diagnoses for VP shunt revision as a shunt infection (Ritz et al, 2007), intraabdominal complications (Chung et al., 2009), distal catheter migration (Abode-Iyamah et al, 2015). But these studies did not provide information which could be used by the perioperative nurse to prepare the operation team for reoperation of this type of complication. The current study should make it clear what part of the VP shunt is the most sensible in different ethiologi of hydrocephalus in relation to diagnoses of VP shunt complication and give scientifically based understanding for perioperative nurse about appropriate perioperativ preparation and patient's security in operation with unknown reason and high risk of infection.

Perioperative nurse and acute VP shunt revision.

Knowledge of anatomy, surgical procedures, instruments and equipment is essential to optimize the perioperative process. According to the Swedish description of professional competence for the perioperative nurse (SEORNA, 2011), the goal of preparation before and

during operation is to make the operative procedure as safe as possible. For the operation team this means to provide as short as possible preoperative- and operative time while maintaining a minimum of possible complications.

In the neurosurgical department of the Hospital in Sweden a list of standard instruments is offered as a help for the perioperative nurse in selecting instruments for VP shunt implantation and revision. However, the patient with an implanted VP shunt, often has anatomical variation which makes revision of VP shunt more difficult or the reason for operation is not clear (Kortopoulos, 1994). This often leads to the need of extra instruments, e.g. clamps, forceps, retractors, tunnelling instruments, which is special for each case. The key problem with selecting instruments for acute reoperation is that perioperative nurse is stressed and the reason for this is minimum time for preparation and not clear information about complication (Blommengren & Ohlgren, 2007). The other problems in selecting instrument is the prevention of surgical site infections - only instruments and equipment which are really needed for operation must be taking to operation room to avoid contamination of them by microorganisms (Nicolette, 2014). The selected extra instruments from instrument's store leads to extra waiting time and door opening, which increase instability in ventilation system and risk of infection (Tang, Nicolle, Pantelic ,2013).

Research Design

The analysis of cases of reoperations of VP shunt in a Hospital in Sweden between year 2015-2016 shows the occurrence of complications according to disease, age, gender and surgeons decisions during intervention – to exchange all VP shunt, some part of it or perform only VP shunt revision. This assessment will be used for description of role of perioperative nurse in improvement of selection and preparation the instruments for acute VP shunt reoperation according to Swedish standard of the nursing competence. Which is a guaranty of security for the patients during and after operation (Sherwood & Barnsteiner, 2013).

Aim of Study

The aim was to study the incidence of VP shunt reoperation in adult patients in relation to the challenges of the perioperative nurse in selection and preparation for acute reoperation.

Research Questions

1. Which patients (≥ 18 years) with VP shunt were reoperated according to ethiology of hydrocephalus as a reason for first operation, age and gender?
2. What was the reason of reoperation and how did it affects the work of the perioperative nurse?
3. Which part of VP shunt was replaced and how did it affects the considerations of the perioperative nurse?

Method

This study was a part of qualitative improvement work in neurosurgical department at the Hospital in Sweden and included quantitative retrospective data from a quality register of cases for VP shunt reoperation using shunt register and operation notes. Descriptive statistic analyse was chosen as a study method to answer the aim of the study. Advantages of this is the studiegroups was easily selected and study contributed objectivity and accuracy of results (Waltz, 2010).

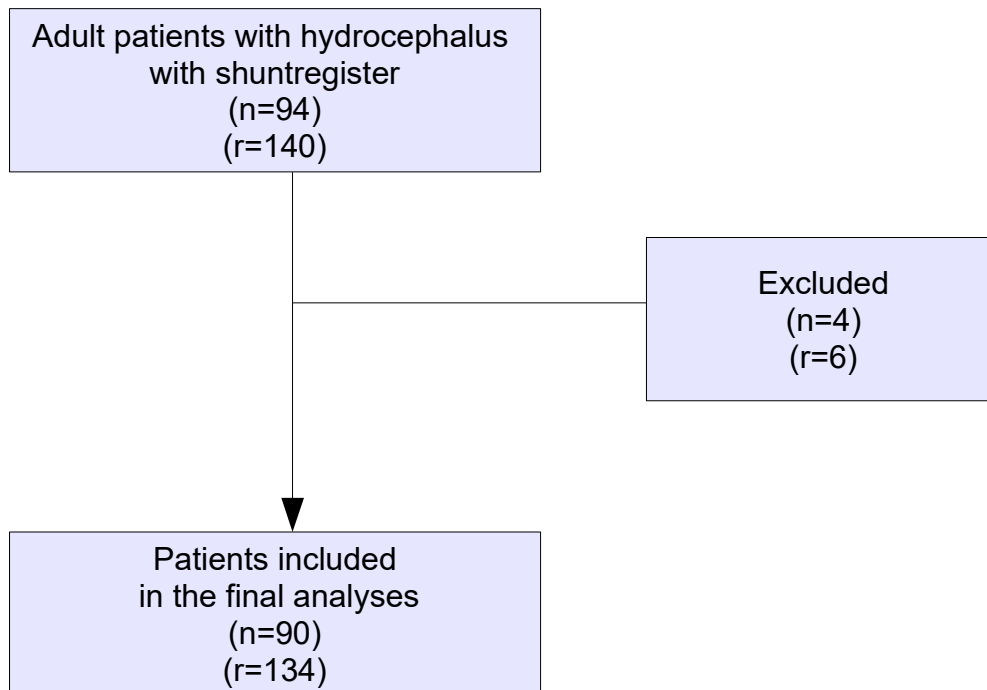
Conceptual Framework

The population is all adult patients (≥ 18 years old) who underwent shunt reoperation from January 2015 to December 2016 at Hospital in Sweden. It was 94 patients who got VP shunt implanted in different period of life and were reoperated during the period from January 2015 to December 2016 (Figure 1).

Excluding criteria was other type of shunt surgery as a ventriculo-atrial shunt, ventriculo-lumbal shunt and combination VP-shunt with other type of shunt.

Figure 1.

Selection of patient for study on VP shunt reoperation from January 2015 to December 2016. n - number of patient, r - number of reoperation.



Research Respondents

Variables which was investigated are presented in Appendix 1.

Collection of data from the shuntregister at the Hospital in Sweden which has information about all patients which get VP shunt at the Hospital, recording the period from operation to reoperation, neurological disease, age and gender.

Review the medical records in order to find information about which part of VP shunt was exchanged during reoperation.

Variables that was investigated are:

n – number of patient

r - number of reoperation

age – age of patient

dis – disease

vps_inst – VP shunt installation

typ_op - typ of operation

reas_reop – reason for reoperation

inv_part - involved part

op_out – operations outcome

Variables was compared in different combinations:

age - disease

gender - diseases

disease - VP shunt installation

disease - typ of operation

involved part - typ of operation

involved part - operations outcome

Sampling

The author collected the data from Shunt register in the Hospital in Sweden. The data contained information on neurological disease, age, gender, interval from operation to reoperation, reason for reoperation and what part of VP shunt was exchanged.

The incidence of shunt revision was analysed according to time interval between original shunt surgery and revision and which part of the shunt that was exchanged.

Analysis of the Research Data

Statistical analysis was performed by using SPSS Statistic (Version 24). Frequencies was presented using descriptive statistics numbers (numbers and percentage).

Ethical Statement

In this study the personal data from hospital medical records of patients with VP shunt is used. The confidentiality of patients are maintained in that the researcher has been given permission to perform quality improvement studies by the department manager and that access to medical records are restricted to only this one researcher (SFS 2008:355). The quantitative research data is depersonalized to protect the individual patient's identity (WMA, 2013). The patients have given written permission for medical treatment at the Hospital in Sweden, where they are informed about the operation and possible complications during operation. The patients are also informed that their medical records data can be used for improvement work (Appendix 2).

This study was approved in the Research-Ethical Commity in Lund University.

Results

Patient demographics and characteristics

Patients from the Hospital in Sweden, who received VP shunt reoperations from January 2015 to December 2016, were retrospectively reviewed for the cases of hydrocephalus, complications, and the causes of revision. Other shunt surgeries, such as a ventriculo-pleural, lumboperitoneal and ventriculoatrial shunts, were not included in analysis.

The total number of VP shunt reoperation performed during the 2-years period from January 2015 to December 2016 was 134. There were 90 patients who in total had 134 cases of reoperations. Of this 44 were males and 46 females. The mean age of the males was 49 the mean age of the females was 50. Age distribution is shown in Table.1.

Table 1.

Age distribution of cases of revision VP shunt for 2 years, in numbers and percentage.

Age	Females		Males		Total	
	n	%	n	%	n	%
18-29	8	17.4	13	29.6	21	23.3
30-39	10	21.7	5	11.4	15	16.7
40-49	6	13	8	18.2	14	16.7
50-59	3	6.5	4	9.1	7	7.8
60-69	6	13.0	7	15.1	13	14.4
70-79	12	26.1	5	11.4	17	18.9
80 +	1	2.2	2	4.6	3	3.3
Total	46	100	44	100	90	100

The study group was stratified into subgroups by etiology of hydrocephalus which was also the reason for VP shunt installation. The most common causes of hydrocephalus were congenital anomaly in both female group and male groups (37.8%). The other large group of patients who needed reoperation of VP shunt was patients with normal pressure hydrocephalus (16.7%). Results are presented in Table 2.

Table 2.

Ethiologies of hydrocephalus and reason for VP shunt implantation according to gender, in numbers and percentage.

Ethiology	Females		Males		Total	
	n	%	n	%	n	%
Tumor/cyst	9	19.57	6	11.64	15	16.67
trauma	2	4.35	4	9.09	6	6.67
Subarachnoid hemmorrhage	3	6.52	4	9.09	7	7.87
NPH	9	19.57	7	15.92	16	17.78
Congenital anomaly	16	34.78	18	40.91	34	37.78
IIH	5	10.87	2	4.55	7	7.87
others	2	4.35	3	6.82	5	5.47

Note:

NPH - Normal pressure hydrocephalus

Congenital anomaly - posthemorrhagic hydrocephalus in infants: aqueductal stenosis, arachnoid cyst, Dandy-Walker malformations, Charri malformations

IIH - idiopathic intracranial hypertension or pseudotumor cerebri

Others- meningitis, occipital abscess, venous sinus thrombosis, second hydrocephalus due to other clinical condition

Reason for VP shunt reoperation

The rate of reoperation cases for the period of January 2015 to December 2016 is shown in Table 3. The result indicates that the largest group of population (68.9%) was reoperated once during the study period. About one third of the patients group (31.1%) was reoperated with VP shunt twice or more than twice for the period of this study, which explains the difference between the amount of patients and incidence of reoperations. This group of patients was given 72 reoperations, or 53,7% from all VP shunt reoperations.

Table 3.

Number of patients and number of shunt revisions for 2 years, in numbers and percentage.

Frequency of reoperations	Number of patients		Number of reoperations	
	n	%	n	%
1	62	68,89	62	46,27
2	14	15,56	28	20,9
3	11	12,22	33	24,63
4	2	2,22	8	5,87
5	1	1,11	5	3,73
Total	90	100	134	100

Table 4 shows the patients incidence of VP shunt reoperation or how many reoperations one patient had have during life since VP shunt installation. About one half of study group (46.6%) was reoperated on VP shunt more than three times since the VP shunt installation, and for these patients it was not possible to investigate exactly the amount of revision of VP shunt. The most common ethiology of hydrocephalus of patients in this group was tumor and congenital anomaly.

Table 4.

Patient's prevalence of previous reoperation of VP shunt according to ethiologies of hydrocephalus since first shunt implantation to reoperation, in numbers and percentage.

diagnosis	first reoperation		second reoperation		more than 2 reoperations	
	n	%	n	%	n	%
Tumor/cyst	8	16.67	0	0	7	20.0
trauma	3	8.32	0	0	3	5.57
Subarachnoid hemmorrhage	4	8.32	1	14.29	2	5.71
NPH	9	18.83	1	14.29	6	17.14
Congenital anomaly	17	35.42	3	42.86	14	42.85
IIH	5	10.41	1	14.29	1	2.85
others	2	4.16	1	14.29	2	5.71
Total	48	100	7	100	35	100

Note:

NPH - Normal pressure hydrocephalus

Congenital anomaly - posthemorrhagic hydrocephalus in infants: aqueductal stenosis, arachnoid cyst, Dandy-Walker malformations, Charri malformations

IIH - idiopathic intracranial hypertension or pseudotumor cerebri

Others- meningitis, occipital abscess, venous sinus thrombosis, second hydrocephalus due to other clinical condition

The most common reasons for revisions were "unknown" (21,64%) and infection (17,16%). "Unknown" means that surgeon did not have enough time for clinical or/and other investigation for diagnosis - what part of shunt was involved. Often it was situation when patients have been transported to operation room by emergency reason. Other complications called "unknown" were when clinical investigation as a magnetic resonance tomography, computerized tomography scan, radiography did not show possible problems with VP shunt. Table 5 shows that 37 cases (20,61%) of VP shunt reoperations happend during the first six-month period after shunt installation. Other sensitive periods for reoperation were after 10 years after shunt installation. Malposition of shunt's part was more common in patients during the first month, fracture of shunt part was more common in patients who have had shunt implantation more than 10 years ago.

Table 5.

Relation between complication and interval from VP shunt implantation to reoperation in numbers and percentage.

period	< 1 month		1-6 month		6-12 month		1-5 years		5-10 years		> 10 years		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
shuntinfection	6	26.1	1	14.4	0	0	6	26.1	0	0	10	43.5	23	17.2
malposition	4	26.7	5	33.3	1	6,6	3	20	0	0	2	13.3	15	11.2
obstruction	3	18.8	0	0	1	9.0	1	9.1	4	36.6	3	27.3	11	8,2
fracture	1	5.6	0	0	0	0	0	0	0	0	17	94.4	18	13.4
valve installation mistake	1	5.3	2	10.5	2	10.5	3	15.8	1	5.3	10	52.6	19	14.2
unknown	5	17.2	3	10.3	1	3.8	7	24.7	5	17.2	8	27.6	29	21.5
other	1	5.3	6	31.6	0	0	3	15.8	1	5.3	8	42.1	19	14.2
total	20	14.9	17	12.7	5	3.7	23	17.2	11	8.3	58	43.3	134	100

Outcomes after VP shunt reoperations

The majority part of the study group was operated acute (without 24 hours) or subacute (without 48 hours), there were 82 reoperations or 61,2%. Prevalence of acute revision of VP shunt were patients with tumor/cyst and congenital anomaly.

Table 6.

Comparison of etiology of hydrocephalus and priority of VP reoperation in number and percentage.

	acute and subacute		elective	
	n	%	n	%
Tumor/cyst	21	26.61	7	13.46
trauma	7	8.54	4	7.69
Subarachnoid hemmorrhage	5	6.09	4	7.69
NPH	12	14.63	9	17.31
Congenital anomaly	27	32.93	22	42.31
IIH	6	7.32	1	1.93
Others	4	4.88	5	9.61
Total	82	100	52	100

Note:

NPH - Normal pressure hydrocephalus

Congenital anomaly - posthemorrhagic hydrocephalus in infants: aqueductal stenosis, arachnoid cyst, Dandy-Walker malformations, Charri malformations

IIH - idiopathic intracranial hypertension or pseudotumor cerebri

Others- meningitis, occipital abscess, venous sinus thrombosis, second hydrocephalus due to other clinical condition

Table 7 shows outcomes of reoperation or which part of VP shunt was exchanged according to frequency of VP shunt reoperation. Operation "VP shunt extraction" had been done after symptom of VP shunt infection or if VP shunt must be removed after approved clinical test which showed that shunt did not help patients with treatment of hydrocephalus. From the data in Table it 7 can be seen that probability to get exchange or get revision of abdominal part of shunt in a patient who had the first reoperation is more high than in a patients who had more than two reoperation in anamnese.

Interesting was that reason for reoperation for twelve of cases (8.96%) were defined as a "unknown" and revision for this cases did not show exact problem with VP shunt. It means, that during reoperation all parts of VP shunt were unconnected, checked up and connected again after visible good flow of liquor in the shunt system.

Table 7.

Frequency of outcomes of VP shunt revision and patients incidence of previous reoperation of VP shunt since first shunt implantation to reoperation, in number and percentage.

	first reoperation		second reoperation		more than second reoperations		total	
	n	%	n	%	n	%	n	%
shunt extraction	9	18.75	7	28.00	12	19.67	28	20.90
ventricel catheter	5	10.42	4	16.00	10	16.39	19	14.18
valve	5	10.42	6	24.00	17	27.87	28	20.90
abdominal part	14	29.17	5	20.00	10	16.39	29	21.64
valve+abdominal part	3	6.25	0	0.00	3	4.92	6	4.48
revision	6	12.50	1	4.00	5	8.20	12	8.96
other	6	12.50	2	8.00	4	6.56	12	8.96
total	48	100.00	25	100	61	100	134	100

Note:

Revision - disconnection of each parts of VP shunt, registration of good liquor's flow and connection system of VP shunt

Other - VP shunt ligature, exchange of connector

Table 8 compares the different outcomes of VP shunt reoperations and their corresponding to preoperative diagnosis of VP shunt problems. In the present study the definition "Preoperative diagnosis" is used to define information which the perioperative nurse received from surgeon about expected intervention - time of operation, which extra instruments are needed and risks of the operation.

"Perioperative diagnosis is correct" means that during operation, surgeon used only instruments which was prepared by perioperative nurse according to list of standard instruments. The rate of such operations for two years was 47.8%.

"Perioperative diagnosis is not correct" means that during intraoperative investigation about VP shunt complication, surgeon informed perioperative nurse about problems in other part of the VP shunt. It refers to taking extra instrument from instrument store, door openings, waiting time and increasing risk of infection.

Table 8.

Perioperative diagnosis of shunt problem and outcomes, in number and percentage.

Preoperative diagnosis of shunt problem	total		Preoperative diagnosis is correct		Preoperative diagnosis is not correct	
	n	%	n	%	n	%
all system	27	20.2	15	55.6	11	44.4
			<i>13 - extraction 2 - shuntligature</i>		<i>6 - extraction+ICP 1 - ventricular catheter+valve 1 - abdominal part 1 - abdominal part+ICP 1 - abdominal part+valve 1 - other type of shunt</i>	
ventricular catheter + connection	14	10.5	8	57.2	6	42.8
			<i>6 2 +borehole</i>		<i>2 - extraction 1 - ventricular catheter+ valve 2 - valve 1 - valve+abdominal part</i>	
valve	23	17.2	16	69.6	7	30.4
					<i>1 - extraction 3 - valve+ventricular catheter 2 - ventricular catheter 1 - abdominal part</i>	
abdominal part	21	15.7	17	81.0	4	19.0
			<i>10 - catheter in abdomen 7 - exchange of abdominal part</i>		<i>1 - extraction 1 - valve 1 - straitconnection 1 - shuntligature</i>	
ventricular catheter+valve	5	3.7	1	20.0	4	80.0
					<i>2 - ventricular catheter 1 - valve 1 - abdominal part</i>	
valve+abdominal part	5	3.7	5	100	0	
			<i>1 - valve 4 - abdominal part</i>			
unknown	34	25.4	0		34	100
					<i>3 - extraction 3- ventricular catheter 1 - connection 1 -ventr. c.+ valve 1 - ventr.c+abd.p. 9 - valve 1 - valve+abd.part 3 - abdominal part 12 - revisio</i>	
shuntligature	5	3.7	4		1	20.0
					<i>1 - abdominal part extraction</i>	
total	134	100	64	47.8	70	52.2

The main result of the current study shows that the difference between perioperative diagnoses applied by surgeon to perioperative nurse and the outcomes of operations is large. One half of reoperations (47,7%) accomplished as it was planned, the other half demanded extra instruments or equipment.

Discussion

Method

The aim of this study was to describe the incidence of VP shunt reoperation in adult patients in relation to the challenges of the perioperative nurse in selection of instruments and preparation for acute reoperation. This study was a part of qualitative improvement work in neurosurgical department of a hospital in Sweden.

A retrospective study of cases for VP shunt reoperation was performed by using the shunt register and operation notes from the hospital in Sweden.

This shuntregister has information about all patients who underwent shunt neurosurgical operations at the hospital in Sweden since september 2014. The study population was all adult patients (≥ 18 years old) who underwent VP shunt reoperation from January 2015 to December 2016. It was 94 patients which received some type of shunt implanted in different period of life and were reoperated during the study period. Exclusion criteria was other type of VP shunt operation, such as a ventriculo-pleural and ventriculoarterial shunts or combination of VP shunt and ventriculo-pleural shunt. In total 4 patients were excluded which had in total 6 reoperations.

The rate of reoperations in this study was similar as in other studies (Khan, 2014 and Farahmand et al. 2009).

Data which was obtained from the Shuntregister was analysed with respect of time from operation to reoperation, neurological disease, age and gender. For protection the individual patient's identity the shuntregister was presented to author as a printed depersonalized list with a register-number.

To find information about which part of the VP shunt was exchanged during reoperation the patients medical records were reviewed. Access to data was restricted to only one researcher. During collection of data the author often could not perform the analysis of the patients comorbidity. Some patients was transported to the operation department as emergency cases, which means that it was not enough time to collect or register data, and those records are missing.

For ethical reason statistical analysis presented in different groups of knowledge concerning neurological disease, age, gender, interval from operation to reoperation, reason for

reoperation, what part of VP shunt was exchanged and demanding of extra instruments during operation.

The incidence of shunt revision was analysed according to time interval between original shunt surgery and revision and which part of shunt was exchanged. Some patients did not have notes about period of VP shunt installation or they had notes such as- "has VP shunt since child age". This fact can be explained that this patient was reoperated many times since the original shunt implantation and can not remember the exact date and inform surgeon about all operations. Some of patient was operated in other hospital and medical records are missing. This group of patient was discussed with manager of neurosurgeon department, and counted as a VP shunt installed more than 10 years.

Statistical analysis was performed by using SPSS Statistic (Version 24). Frequencies was presented using descriptive statistics numbers (numbers and percentage).

Results

In this study the data was analysed in relation to the preparation of perioperative nurse for acute Ventriculo-peritoneal (VP) shunt reoperation and specifically in the selection and preparation instruments.

The first research question aimed to investigate what kind of adult patients who needed VP shunt revision. The study group was adult patients (≥ 18 years) with hydrocephalus, who got VP shunt in different period of life and who was reoperated with complication of VP shunt in a hospital of Sweden from January 2015 to December 2016. Statistiscal analysis of this group of patients showed that an equal numbers of male and female needed reoperation. This result corresponded to previous publications in this area. Sundström et al. (2016) described 2360 patients registered in the Swedish Hydrocephalus Quality Register during 2004-2011, and the distibution of gender correspond to the presented study: male 52%, female - 48%.

Analysis of age distibution suggest a higher incidence in younger patients, under 50 years old. These results are probably due to the main ethiology of hydrocephalus which in this study was shown to be congenital anomaly. The reason of hydrocephalus was a birth-defect or stucture deformation that obstruct CSF flow. Such syndromes are aqueduct stenosis, spina bifida, Dandy-Walker malformation, Chiari malformation (Hbdeib, 2011).

The second most common group with hydrocephalus was patients with Normal Pressure Hydrocephalus (NPH). NPH take place in progressive dementia, intracranial pressure is usually normal or can in some patients be relatively high (Paulson et al., 2010). Bozhkov et al. (2017) showed that the implantation of VP in these patients give a positive result in symptom treatment of hydrocephalus. Khan, (2016) in his study about factors affecting VP shunt survival in adult patient described patients with NPH and common reason for complications and reoperation. In the current study of patients with NPH, complication of VP shunt were common. These patients could have symptoms of dementia and confusion (Hickey, 2009), which could be a the risk of trauma in the operative situation. That is why the perioperative nurse should be attentive when taking patient to the operation bed and to have a good communication with other members of operation team during meeting patient in operation team and positioning (Hansen&Brekken, 2012).

Tumor/cyst is an obstructive cause of hydrocephalus. Braintumor or cyst can obstruct CSF pathway and thus cause hydrocephalus. Usually these patients presents themselves with chronic hydrocephalus in a similar way as patients with braintrauma (Hbdeib & Cohen, 2005). Khan, (2014) described that about 28% of adult patients with different kinds of braintumors was implanted with VP shunt. The rate of VP shunt complications and reoperations was shown to be 14.9%. Khan, (2016) described that the growth of the braintumor could be a reason of VP shunt dysfunction.

Patients with subarachnoidal hemorrhage develop hydrocephalus due to obstruction caused by blood clotting and resulting block CSF circulation in the ventricular system or disturbances of CSF absorbtion in the subarachnoid granulations (Reddy, 2012). In this study the number of patient with subarachnoidal hemmorage who got VP shunt implanted was the same as in current study. About one half of the VP shunt patients got complications and was reoperated within 10 years (ibid.).

Idiopathic intracranial hypertension, also known as a pseudotumor cerebri, is a nonhydrocephalic clinical syndrom which presents itself by increased ICP, but the ventricles remain of normal size. The pathophysiology of this syndrome is still unclear. Patients are generally overweighted women who develops increasing ICP without a known reason (Hbeib et al, 2005). In the current study, this group of patients were all in their 40ites and needed VP

shunt reoperation in only 2-3 years due to complications. This fact that the patients has led a healthy life to adulthood and suddenly need neurosurgical reoperations can easliy lead to a big stress for the patient and a feeling of distrust to VP shunt and to the neurosurgical profession. The group of other patients contained patients who had other ethiology of hydrocephalus, e.g meningitis, sinusthrombosis, bleeding after intracranial operation, cases where hydrocephalus was a comorbidity in relation to other clinincal conditions such as leucemia.

This information is important to connect with the next research question which include analysis of number of reoperation which the patients have during their life.

Statistical analysis from the current study showed that one third of the patients were reoperated with VP shunt twice or more during the 2 year period of this study. About one half of the study group (46.6%) was reoperated with VP shunt more than three times after the VP shunt installation, and for these patients it was not possible to investigate exact times they were reopetrated with VP shunt. This information is very important for perioperative nurse in relation to personcentered care, so that the nurse can take into account the patient's own experience of health, illness, needs and preferences (Arakelian et al., 2016). Reoperation especially if it happens in the brain and many times means for patient a great stress, increase in the risk of infection and risk of future development of hydrocephalus which could be life threathening (Pelegrin, et al., 2017).

Analyses of reoperation cases in this study showed that the leading preoperative reasons for revisions were not exactly defined, e.g "unknown" or infection. "Unknown" means that surgeons did not have enough time for clinical or/and other investigation for diagnosis - what part of shunt was involved. Often it was a situation when patients had been transported to the operation room for emergency reason. Other conditions where the diagnos was not clear were after investigation with a magnetic resonance tomography or computerized tomography scan where the investigation did not show any identifiable problems with VP shunt.

Analyses of the the length of the timeperiod from VP shunt implantation to reoperation can show how long the mean time period of good function is of the VP shunt and maybe can be used in designing a program for prevention or early detection of VP shunt problems. Thirty seven cases (27,6%) of VP shunt reoperations in this study ocured during the first six-months after first shunt installation. The main reason for reoperation was malposition,

infection and obstruction in the abdominal part of the VP shunt. This finding has to my knowledge not been reported before and should be discussed with neurosurgeons.

Another sensitive period for reoperation occurred after 10 years after the first shunt installation. The most patients in this group had VP shunt due to congenital anomaly and about half of these patients were reoperated acute and subacute. This finding, the rate of acute and subacute reoperation are high, was surprising due to the fact that these patients have regular check-ups in the neurosurgery department.

The main reasons for reoperation were fracture in abdominal part and valve installation mistakes. This study shows that this group of patients had series of reoperations of VP shunt before.

The third question of this study was which was about which part of the VP shunt that was replaced and how this potentially affect the considerations of the perioperative nurse.

Using the preoperative information from surgeon and data about the patient medical history, the perioperative nurse has gathered knowledge and select the optimum instruments for the planned operation.

In the neurosurgical department of a hospital in Sweden a list of standard instruments is offered as a help for the perioperative nurse in selecting instruments for VP shunt implantation and revision. However, as shown by the results from the current study, the preoperative diagnosis and diagnosis after operation matched to each other in 50% of reoperations. In the part of reoperations where preoperative diagnosis was incorrect it demanded a rapid reaction from the perioperative nurse to changes in the operation wound and the capacity to explain to the assistant nurse what should be fetched from instrument storage. The perioperative nurse must be sure that the position of the patient, skin disinfection and drapering is ok and that the surgeon has an easy access for each part of VP shunt - head, neck, thorax and abdomen.

To decrease the number of door openings to the operation room the borderline room can be used, which makes picking the instruments during the operation more rapid and more precise. It can also decrease the time of operation and risk of complications.

To reduce the stress of the perioperative nurse a minimum time before the operation for preparation of instruments must be set, at the beginning of an acute-shift so that the perioperative nurse is sure that all instrument are available in instrument store or borderline room.

This study shows that perioperative nurse, after the surgeon's preoperative diagnosis, must be prepared to change the operation process at a short notice. To prevent of risks of infection it is good practice to keep extra instruments in the borderline room, to guarantee easy access to them and to avoid contamination of instruments by microorganisms in the operation room.

Conclusion

This study on the incidence of VP shunt reoperations was made to get a deeper understanding of the reasons for acute VP shunt reoperation and use this knowledge in the improvement of perioperative nursing preparation in this type of common neurosurgical operation.

Reoperation of ventriculoperitoneal shunt is a significant medical problem, in term of both urgency of reoperation and personcentred care. The risk that patients with a first VP shunt operation get complications and must be reoperated during first sex month is high.

This study showed that the majority of patients who needed acute reoperation of VP shunt was patients with congenital anomaly and NPH. The main complication was infection, and the risk to get infection was wery highest during the first month efter shunt implantation. This fact underline the importance of prevention of infection for all memebers of operation team and also to keep strict antiseptic rules by the perioperative nurse.

The most sensitive part of shunt during the first sex month efter VP shunt imlantation was the abdominal part whereas after 10 years of VP shunt implantation it was the valve.

The result of this study shows that the process of the operation and final diagnosis is ften different that what was preoperatively planned. This has consequenses for handling of instruments and how the borderline room can be used to provide needed instruments in a quick and precise way without introducing risks of bacterial infection.

This study showed that information about previous VP shunt implantation, model of device in a adult patints with congenital anomaly are often missing. This makes the planning of operation more complicated and introduces unnecessary risks. The Shunt register with information transferred to the patients medical records and a VP shunt passport for each patient could be as important for the VP shunt patient as knowing prevous vaccinationns for any patient.

Study should be supplied additional quantitative research in VP shunt complication in a bigger study group to make more clear connection between ethiology of hydrocephalus and VP shunt complications.

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Appendix/Annex 1 (2)

Variables for study Ventriculo-peritoneal shunt reoperations.

n – number of patient

r - number of reoperations case

gender – m-male

f-female

age – 1 - 18-29

2 - 30-39

3 – 40-49

4 – 50-59

5 – 60-69

6 – 70-79

7 – 80 +

dis – disease

1 – tumour/cyst

2 - posttraumatic

3 – subarachnoidal hemmorage

4 - NPH

5 - IIIH

6 - congenial anomali

7- other

vps_inst – shunt installation

1 – less than 30 days ago

2 – 30 days – 1 year

3 – 1-5 years ago

4 – more than 5 years ago

reas_reop – reason for reoperation

1 – shuntinfection less than 30 days

2 – shuntinfection more than 30 days

3 – shunt dysfunction

4 – other

typ_op - typ of operation

1 - acute

2 – sub-acute

3 – elective

op_out – operations outcome

1 – shunt extraction

2 – exchange of ventricle catheter

3 – exchange of valve

4 – exchange of abdominal catheter

5 – exchange of ligature

6 – other

Appendix/Annex 2 (2)

Region Skåne

Datum 2016-10-10 Dnr

Uppdrag om projektbaserad kvalitetssäkring på enhetsnivå.

Detta dokument reglerar endast vilka behörigheter nedanstående medarbetare har i journalsystemet och andra vårdssystem i det aktuella uppdraget och ersätter inte övriga anställningshandlingar.

Härmed intygas att Irina Halling (IH) innehar uppdraget som kvalitetssäkrare på Neurokirurgiska klinikkens operationsavdelning för vård, enligt beskrivning nedan. Detta uppdrag är personligt och kan inte överlåtas. Uppdraget är tidsbegränsat och gäller från 2016-10-10 till 2017-06-30.

Uppdraget innebär att inhämta uppgifter gällande kvalitetsstudie av ventrikulo-peritoneal shunt, hur ofta och varför behövs reoperation, uppgifter från shuntregister och patientjournal används för patienter opererade 2014-01-01 till 2016-12-31.

För att IH ska kunna fullfölja ditt uppdrag behöver IH åtkomst till patienters uppgifter i journalsystemen och i andra vårdssystem på patienter, trots att inte vårdrelation till patienterna föreligger.

IH ska vara väl förtrogen med vilka regler och rutiner som gäller angående kvalitetssäkring i förhållande till Patientdatalagen (2008:355) och Socialstyrelsens föreskrifter om informationshantering och journalföring i hälso- och sjukvården (SOSFS 2008:14).

För det fall IH slutar på vårdenheten, slutar inneha uppdraget eller avsäger sig uppdraget, upphör behörigheten ovan.

Datum:
17/01/10

Ort: Lund

Mottagande av uppdrag

Utfärdande av uppdrag

Irina Halling

Ola Nilsson

Kvalitetssäkrare
Irina Halling
Operationssjuksköterska
Neurokirurgiska operations
Avdelningen, SUS

Verksamhetschef, docent
Ola Nilsson
VO Neurokirurgi
Skånes Universitetssjukvård, Division 3