



## IMPROVING THE QUALITY OF NURSING CARE PROVIDED FOR CHILDREN UNDERGOING VENTRICULOPERITONEAL SHUNT

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**Abstract:** **Background:** Nursing care provided for infant and children with VP shunt was challenging for effective shunt functioning and complication reduction. Pediatric nurses play a necessary role in providing preoperative care and preparation, immediate post operative care, care of child with complication and provide discharge teaching to provide care for their children at home. **Aim of the study:** this study aimed to improve the quality of nursing care provided for children undergoing VP shunt. **Methods:** A quasi-experimental research was employed on a convenience sample of 41 nurses who were working at female neurosurgery department and neurosurgery intensive care unit affiliated to Mansoura university Hospital (MUH), Mansoura, Egypt. Two tools were used for data collection as follows: nursing care for infant and children with VP Shunt questionnaire and post-operative nursing care for infant and children with VP Shunt observation form. **Results:** The results of the study showed that, the majority of nurses were replied that shunt obstruction, malfunctions and infections were the most common complications of VP shunt. The minority of nurses was assessing the fontanel for bulging; eyes for nystagmus, proper shunt functioning and none of the nurses assess the abdomen for illus post operative. The percentage improved after program implementation with statistical significant difference. **Conclusion:** The study concluded that, the mean score of nurses' knowledge, reported practice, practice and discharge plane teaching was improved after program implementation with statistical significant difference. This difference reflects the importance of continuing education for nurses and health care team.

**Keyword:** Child, Hydrocephalus, Inservice Training, Nursing Care, Ventriculoperitoneal Shunt

### Introduction

Hydrocephalus (HC) is a lifelong condition and one of the most frequently seen problems in pediatric neurosurgical practice. Additionally, it is the most common congenital abnormality of the central nervous system. It is characterized by imbalance between the absorption and production of cerebrospinal fluid (CSF), as a result of the excessive accumulation of CSF in the brain's ventricles (**National Institute of Neurological Disorders and Stroke, 2018, Oreskovic', and Klarica, 2011**). There are different types of HC that can affect the child's outcome: communicative or non-communicative, congenital, or acquired. This disorder can present at any age as a result of a wide variety of different diseases (**Krishnamurthy and Li, 2014; Martin, 2017**).

The National Institute of Neurological Disorders and Stroke has estimated that one to two in every 1000 children are born with HC per year. Worldwide annually around 160 000 ventriculoperitoneal shunt (VP) are inserted. The estimated incidence of HC is 0.2– 0.8/1000 live births in the USA (**Jea et al., 2017; Isaacs, et al., 2018**). Seventy percent of children with HC are treated by the insertion of a VP shunt, which diverts excessive CSF from the ventricles to another body part, commonly the peritoneum (**Smith et al., 2013**). According to the **American Academy of Neurological, (2016)**, it was estimated that, 50% of VP shunts in the children fail within 2 years of placement, and they need revision to manage shunt obstruction or malfunction. Early diagnosis, effective treatment and appropriate interventional services for children with HC can prevent damage to the brain and achieve adequate

Academic Journal of Nursing and Health Education

An official Publication of Center for International Research Development

Double Blind Peer and Editorial Review International Referred Journal; Globally index

Available @cirdjournals.com/AJNHE: E-mail: ajnhe@cirdjournals.com



neurodevelopmental outcome. So, the future for those children promised. Early signs of HC are irritability or restlessness, lethargy, poor feeding, vomiting, and enlarged head. While, late signs consist of enlarged bulging fontanel, “sunset eyes,” distended scalp veins, high-pitched cry, hypertonicity, and seizures. All these symptoms appear as a result of increased CSF volume, increased ICP and ventricular walls dilatation. Current practice is surgical intervention to redirect the CSF flow to another body cavity, such as the peritoneal cavity (VP), right atrium (VA), gallbladder, or pleural cavity, hence reducing accumulation of CSF in the ventricles (**Krishnamurthy and Li, 2014 ; Nelson, 2018**).

Ventriculoperitoneal (VP) shunt is a common applicable treatment performed in children with HC. The VP shunt has three chief components: first; internal catheter inserted inside the ventricles to drains the CSF, second; a valve mechanism that is usually located behind the ear to control the flow of CSF, and an outflow catheter that runs under the skin and directs CSF from the valve to the peritoneal cavity (**Parsons, Seay & Jacobson, 2016**). Insertion of VP shunt was associated with complications, the most common post operative complications are: shunt infection, shunt placement failure, shunt obstruction – malfunction, abdominal complications (peritonitis) valve complications, slit-ventricle syndrome and seizures (**Athanasakis & Despina Ermidou, 2011**).

Proper monitoring and timely action for the VP shunt site by an interdisciplinary team is essential for positive outcomes for children. Continues training for nurses and parents to monitor and follow-up care, improves long-term consequences in children undergoing VP shunt. So the nurses have a crucial role to guide the families to how acquire new skills needed to care for their children. Careful monitoring and early recognition of symptoms by a nurse or parent are essential for positive outcomes to allow children with VP shunt have a productive life. Besides, prevention of complications and timely management can save costs associated with frequent hospitalization and shunt revisions and eliminate distress in parents (**Petrelli, 2011& Browd, et al., 2016**).

Improvement of the current state of diagnosis and treatment of HC involves a better understanding of the proper nursing management provided to children with VP shunt (**Krishnamurthy and Li, 2014**). Nursing care of children

with VP shunt includes: Close observation for any changes from normal behaviors and physical status, positioning on the unaffected side or on the back with head elevated at 15 ° to 30 ° to reduce rapid drainage of CSF, check the proper functioning of the VP shunt via applying pressure to specific reservoir site on the valve, check skin for redness around the shunt site on bony prominences, and check body temperature, hydration status and fluid consumption. In addition, using aseptic techniques when handling shunts to change dressings is necessary (**Smith et al., 2016; Martin, 2017; Joseph, et al., 2017; Vacca, 2018**). A proper nursing assessment leads to early identification of potential complications, which common occur in child at VP shunt and treated early, can result in positive neurodevelopmental outcomes in children (**Athanasakis & Despina Ermidou , 2011**). Carefully observe for any signs of bulging fontanels and measuring head circumference, observe shunt site for infection and monitoring vital and neurological signs before and after surgery. Then nurses must observe, report, and document all signs of increased ICP and if the child has returned for shunt revision, complete history taking from parents before surgery as a baseline of the child’s behavior (**Browd, et al., 2016; Joseph, et al., 2017**).

Improving nurses’ knowledge about caring for children with a VP shunt will enable them to provide better care for children and equip parents for continuing care at home. So the nurses must be equipped with knowledge and skills to care for children with VP shunt. Monitoring for early signs of increased ICP can facilitate timely diagnosis and prompt surgical intervention and equipping families will be helpful in early identification and timely management of shunt failure. So, the recent studies recommended further research on children with VP shunt placement is essential to develop appropriate guidelines for nurses and explore experiences of families to identify caregiver burden and improve parental preparation (**Joseph, et al., 2017; Elaziz, et al., 2017**). In addition, **Petrelli, (2011)**, recommended provide further direction to health care providers have important role to improve assessment, management, treatment, education and support to the children and the adolescents with shunted hydrocephalus. Therefore, this study aims to evaluate the effect of implementing inservice training program for nurses on improving nursing care provided for children with VP shunt.



### **Significance of the problem:**

The care of children with VP shunt is a challenging specialty in pediatric nursing. To promote nursing care for children with VP shunt, there is a demand for knowledge and practice from nursing staff and others who are involved in children care. However, the nurses working in neurological departments and ICUs require frequent training program to increase their awareness of shunt's complications and its management. Many of researches are implemented on improving home care for mothers having children with VP shunt. On contrary, limited researches are conducted on nurses and care provided for children with VP shunt in the hospital. Therefore, empowering nurses with knowledge and skills is very important to enable them to provide the best standard of care for children VP shunt.

### **Aim of the study:**

The aim of this study was to improve the quality of nursing care provided for children undergoing VP shunt. This aim can be achieved through

1. Assessment of the nurses' knowledge, practice and reported practice about VP shunt and post operative care for children with VP shunt.
2. Designing and implementing inservice training program based on updated evidence-based practice related to care of children with VP shunt.
3. Evaluating nurses' knowledge and practice about care of children with VP shunt and find out the relation between nurses knowledge and practice before and after intervention.

### **Hypothesis**

1. Nursing care provided for infant and children with VP shunt will improve after implementation of inservice training program.
2. Nurses' knowledge, reported & observed practice will improved after implementation of inservice training program.

### **Methods:**

#### **Study Design & Setting**

A quasi-experimental research design using one group (pre and post-test measures) was utilized to fit the aim of the study.

#### **Setting:**

This study was conducted in the female neurosurgery department and neurosurgery Intensive Care Unit affiliated to

Mansoura University Hospital (MUH), Mansoura city, Dakahlia governorate, Egypt. The MUH is the main and only large university hospital at Mansoura with patient bed capacity was 1512 and includes 44 departments, operations suite and central sterilization and providing care for all population in Dakahlia governorate. Previously the VP shunt was done at pediatric surgery department in Mansoura University Children's Hospital (MUCH); but nowadays and according to hospital new policy, the care of infant and children with hydrocephalus before operation and the operation itself and post operative was done at MUH. The female neurosurgery department includes 18 beds and provides care for children and adult with different neurosurgical problem. Similarly for neurosurgical ICU which included 9 beds combining both adult and pediatric patient. Children suffering from complications post operative or having signs and symptoms indicating ICP can be admitted and care either in MUCH or MUH.

#### **Sample:**

The study included a convenience sample of 41 nurses who were working in the previously mentioned study setting and ready to share in the study were recruited.

**Tools:** Two tools were used for data collection

#### **Tool 1: "Nursing Care for Infant and Children with VP Shunt Questionnaire"**

The questionnaire was intended to examine the nurses' knowledge and reported practice about VP shunt, preparation for surgery, post operative care, care of complications and discharge plan. The questionnaire was developed by the researchers after thorough review of the related literature and studies (Joseph, et al., 2017; Sarmey, et al., 2015 & Athanasakis & Despina Ermidou, 2011). The questionnaire was translated into Arabic version by the researchers. The questionnaire consisted of three sections: The first section included questions on general characteristics of the nursing participants' such as age, qualification, department and years of experience. The second section involved questions about VP shunt such as definition, components, complications and nurses knowledge about discharge plan and guidance for mothers having children with VP shunt. The third section focused on nurses reported practice about post operative care and care of complications for children with VP shunt and included questions about proper positioning immediately after surgery and 24 hours post operative, measurement of



head and chest circumference, care of pediatric patient with increased ICP and shunt infection.

#### **Tool 2: "Post Operative Nursing Care for Infant and Children with VP Shunt Observation Form"**

This tool was developed based upon relevant guidelines and literature (Joseph, et al., 2017 and Athanasakis & Despina Ermidou, 2011); it was included 13 items related to post operative nursing care for infant and children with VP shunt for example position, assessment of pediatric patient condition (vital signs, incision site, signs of complication) and evaluation shunt functioning. Investigators resort to items by checking "done" or "not done".

#### **Evidence-Based VP Shunt care inservice training program**

The researchers developed VP shunt care program based upon recent, current, national, and international literatures and updated articles and evidence based nursing practice (Joseph, et al., 2017; Sarmey, et al., 2015 and Athanasakis & Despina Ermidou, 2011). The researchers focused on assessment of the nurses knowledge, reported and observed practice about care of children with VP shunt at baseline (pretest) using the previously mentioned tools.

The VP shunt care inservice training program was introduced for nurses on five sessions including three theoretical sessions and two practical; each session was continued for 30 minutes and the program was conducted inside the department. The researchers distributed the nurses to small group five (5) nurses in each group. The theoretical session including overview about hydrocephalus such as definition, causes, manifestation, detection and diagnosis and treatment. The protocol was also include knowledge about nursing care of infant and children with VP shunt including (type of VP shunt, preparation of pediatric patient to surgery, immediate post operative nursing care such as positioning, measuring head and abdominal circumference, assessment of vital signs, assessment of dangerous signs and signs of complications, evaluation of proper shunt functioning, signs of increased ICP and shunt obstruction and differences in each age group and nursing care for complication. The inservice training program was also include practical information related to measuring head circumference and abdominal girth and its importance, assessment of shunt functioning, assessment of fontanel for detection of increased ICP

In addition, the researchers also developed discharge teaching plan and designed booklet for mothers to be

available in the department to ensure continuity of care at home including information about hydrocephalus and shunt care at home for mothers focusing on activity, diet, wound care, constipation, bathing and prevention of injury.

The researchers uses different methods of teaching strategies and using different media such as , group discussion, brain storming, demonstration and re-demonstration using PowerPoint, video, posters and educational booklet was distributed and available in the department for nurses and mothers. At the end of the program and after three (3) months of program implementation and observation of nurses practice; the researchers assess the nurses knowledge, reported and observed practice about care of children with VP shunt (post test).

#### **Validity and reliability**

The reliability and validity of the developed tools was done. These tools were revised by a panel of 10 experts in pediatric and critical care nursing and in neurosurgery medicine at Mansoura University. An insignificant modification was done on the tools. Tools reliability were done using Alpha Cronbach's coefficient test, the alpha reliability of the tool 1 was ( $\alpha = 0.81$ ), while, reliability of tool 2 was ( $\alpha = 0.89$ ).

#### **Pilot study**

We conducted pilot study from involving five nurses to test the questionnaire for clarity of statements and the applicability of the questionnaire and there is no modification required and the nurses replied that the tool is clear.

#### **Data collection**

Data were collected between April 2018 and September 2018. Before starting the data collection process, necessary data about policy and protocol of care for pediatric patient with VP shunt and numbers of beds in previously mentioned study setting and nurse - patient ratio was collected. Two methods of data collection was used; "nurses self administered questionnaire about care for children with VP shunt" and direct observation of nurses practice and post-operative care for children with VP shunt. The survey was distributed to all nurses working in female neurosurgical department and ICU; of the 47 distributed surveys, we collected 41, so, the response rate was 87.2%. Observation of nurse's practice was done during the morning and afternoon shift with total number of observation was 60.

#### **Ethical Considerations**

Ethical authorization was gained from "Research Ethics Committee at the Faculty of Nursing - Mansoura University".



Conformity to carry out the study was obtained from the chief of the hospital after explaining and clarifying the study aim and process. An informed consent was obtained from the nurses after complete description of the purpose and process of the study by the researchers to obtain their acceptance for participation. Nurses were informed that their participation in the study is voluntary, they have the right to withdraw from the study at any time without giving any reason and without any effect on her work. They were assured that the personal information kept confidential and also the information weren't being linked directly with the results.

#### Statistical Analysis:

The collected data for this study was analyzed through the application of statistical procedures and by using (SPSS) version (23) which may assist to determine the study results. A descriptive statistical data analysis approach was used to describe the study variables: frequencies, mean, standard deviation and percentages. Wilcoxon and McNemar tests were used to detect differences between nurses' knowledge about VP shunt before and after the program. Comparison of means was performed using paired-sample t-test. Correlation among variables was done using Pearson correlation coefficient. Level of significance at  $p < 0.05$ ,  $0.001$  were used as the cut of value for statistical significance.

#### Results:

Characteristics of the studied nurses in percentage distribution were illustrated in **table (1)**. It was revealed that the mean age of studied nurses was  $27.80 \pm 6.48$ . Regarding nurses' educational level, the current results revealed that more than half of nurses (51.2%) had diploma in nursing which was 3 years studying nursing after finishing the preparatory school. While, less than one third (31.7%) of them had Bachelor degree of nursing. More than half of nurses (53.7%) having less than 5 years of experience compared to less than one third (31.7%) of them having less than 5 to less than 10 years of experience.

Nurses' knowledge about definition and component of VP shunt was represented in **Figure (1)**. It was clear that only 12.2% of the nurses were replied complete correct definition of VP shunt pre program compared to 65.9% after the program. In addition, three quarters of the studied nurses (75.6%) did not know the components of VP shunt pre program. While, after the program 64.3% of nurses replied the correct answer. The difference was statistically significant ( $p < .001$ ).

There were statistical significant differences regarding nurses' reported practice about post-operative care for children with VP shunt as it was clarified in **table (2)**. It was clear that the majority of the nurses (65.9%) were replied that they put the children on supine position with elevated head  $15^\circ$  to  $30^\circ$  the percentage improved to 78% after the program. Also, less than half (41.5%) of nurses reported that they measure the head circumference once daily post operative for detection of VP shunt complication compared to 53.7% after the program. Concerning nurses reported practice about measurement of the abdominal circumference, it was observed that less than one third of nurses (28.6%) were measuring the abdominal circumference pre program and this percentage improved to 53.7% post program. The mean score of nurses knowledge, reported practice, and discharge plane teaching was improved after program implementation with statistical significant difference between pre and post test ( $p < .001$ ).

Nurses knowledge and reported practice about nursing care of children with VP shunt complication were illustrated in **table (3)**; the majority of nurses were replied that shunt obstruction, malfunctions and infections were the most common complications of VP shunt (82.9%, 87.8% & 63.4% respectively). Furthermore, the minority of nurses was reported that they elevate the head of the bed to  $30^\circ$  and keeping the head in a neutral position and avoid over hydration for children with increases ICP (4.9 & 7.3 % pre program respectively); the percentage was improved after program conduction with statistical difference. In addition, less than one third (29.3%) of nurses wear gloves during every nursing intervention provided for children with VP shunt to prevent VP shunt infection. While, after the program, the percentage improved to 56.1%. The difference was statistical significant.

**Table (4)** Nurses' observational checklist about post operative nursing care provided for children with VP shunt; it was observed that the minority of nurses was assessing the fontanel for bulging; eyes for nystagmus, proper shunt functioning and none of the nurses assess the abdomen for illus (12.2%, 9.8%, 7.3% & 0% pre program respectively). This percentage was improved after program implementation and the difference was statistical significant.



Table (1); Characteristics of the Studied Nurses in Percentage Distribution

Characteristics	NO (n=41 )	%
Age in years: Mean± SD		27.80±6.48
<b>Qualification</b>		
Diploma	21	51.2
Technical institute of nursing	7	17.1
Bachelor degree of nursing	13	31.7
<b>Years of experience</b>		
< 5	22	53.7
5 < 10	13	31.7
10 < 15	1	2.4
15 & more	5	12.2

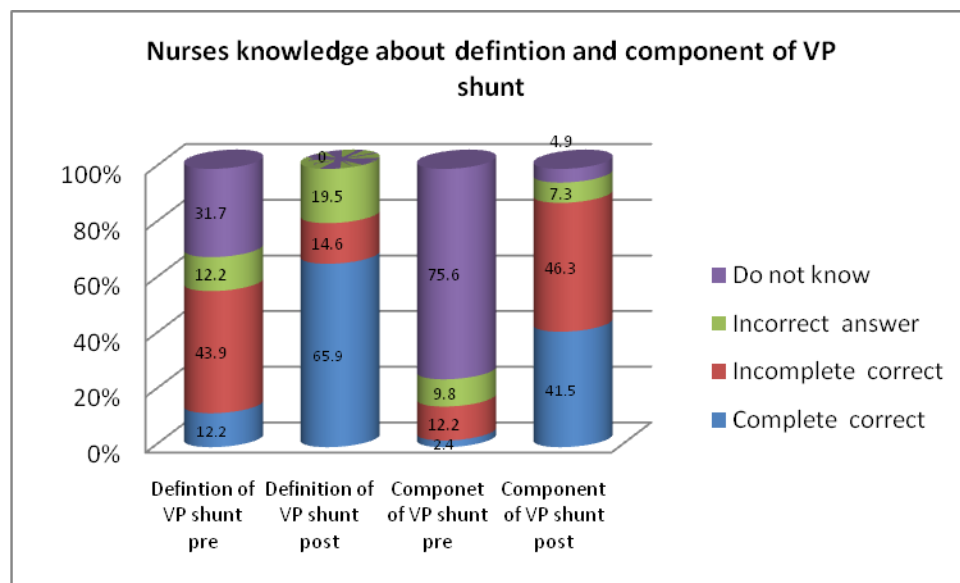


Figure (1); Nurses Knowledge about Definition and Component of VP Shunt



**Table (2); Nurses Reported Practice about Post Operative Care for Infant and Children with VP Shunt**

Characteristics	Pre		Post		Test of significance # P
	No (41)	%	No (41)	%	
<b>Correct position for the child with VP after operation</b>					
Put the child on supine position with elevated head 15 ° to 30 °	27	65.9	32	78.0	.022*
Put the child on lateral position or in the back without head elevation	6	14.6	9	22.0	
Do not know	8	19.5	0	0	
<b>Effective functioning of VP shunt can be detected through</b>					
Pumping the valve behind the ear via apply pressure to specific reservoir site on the valve	5	12.2	28	68.3	<.001**
Relive of signs & symptoms of vomiting	14	33.3	13	31.7	
Do not know	22	52.4	0	0	
<b>Measurement of the head circumference after performing VP shunt</b>					
No	20	48.8	12	29.3	.08
Head circumference measurement isn't important	4	9.7	7	17.1	
The Head circumference must be measured at least once daily for detection of VP shunt complication	17	41.5	22	53.7	
<b>Measurement of the abdominal circumference after performing VP shunt</b>					
No	26	61.9	10	24.4	<.001**
Abdominal circumference measurement doesn't have role for child with VP shun	3	2.4	9	22	
Abdominal circumference measurement is important to discover the complication of VP shunt.	12	28.6	22	53.7	
<b>Dangerous signs &amp; symptoms that the nurse must observed for child with VP shunt</b>					
Increase intracranial pressure	28	68.3	35	85.4	.065
Peritonitis or illus	2	4.9	13	31.7	.002*
Seizures	35	85.4	35	85.4	-
Vomiting	28	68.3	35	85.4	-
Do not know	5	14.3	0	0	-
<b>Total score</b>	<b>Mean ±SD</b>		<b>Mean ±SD</b>		
<b>Mean score of nurse total reported practice</b>	15.36±3.41		25.65±6.70		<.001**
<b>Mean score of nurse total knowledge about VP shunt</b>	9.39± 1.41		17.36 ±2.25		<.001**
<b>Mean score of nurse total knowledge about Discharge plan teaching</b>	3.85±1.406		7.58 ±1.64		<.001**



# Wilcoxon test was used

\* $p < .05$

\*\* $p < .001$

Table (3); Nurses Knowledge and Reported Practice about Nursing Care for Children with VP Shunt Complication

Characteristics	Pre		Post		Test of significance	
	No (41)	%	No (41)	%	#	p
<b>Complication of VP shunt #</b>						
Shunt obstruction	34	82.9	40	97.6		.07
Shunt malfunction	36	87.8	40	97.6		.219
Bleeding	6	14.6	27	64.3		<.001
Infection	26	63.4	36	85.7		.031
Do not know	7	17.1	0	0		-
<b>Signs &amp; symptoms of increased ICP #</b>						
Bulging anterior fontanel	3	7.3	23	56.1		<.001**
Distended scalp veins	15	36.6	32	78		.15
Projectile vomiting	41	100	41	100		1
Rapid increase in head circumference	4	9.8	26	63.4		<.001**
Loss of consciousness	16	39	37	90		<.001**
Seizures	29	70.7	40	97.6		.004*
Poor feeding	33	80.5	40	97.6		.016
High-pitched cry & Irritability	39	95	41	100		.5
<b>Nursing care for infant &amp; children with increased ICP #</b>						
Elevating the head to 30 °and keeping the neck in neutral position	2	4.9	18	43.9		<.001**
Avoid over hydration	3	7.3	13	31.7		.02*
Maintain a normal body temperature and maintain a normal oxygen and carbon dioxide level	12	29.3	38	92.7		<.001**
Assist the physician in aspiration of CSF	41	100	41	100		1
Reducing stimuli, avoiding cluster care	0	0	23	56.1		<.001**
Manual hyperinflation and limiting routine endotracheal suction	0	0	29	70.7		<.001**
<b>Nursing care for infant &amp; children to prevent VP shunt infection #</b>						
Hand-washing before and after any manipulations of the catheter, as well as between patients	20	48.8	32	78		0.5
Wear gloves during every nursing intervention	12	29.3	23	56.1		<.001**
Vital signs measurement, especially temperature every three	39	95	41	100		0.5



hours					
Assess the shunt site for presence of any secretion or edema	21	51.2	35	85.4	.023*
Obtain cerebrospinal fluid specimen and culture for detection of infection	41	100	41	100	1
Give antibiotic as prescribed	41	100	41	100	1

# Mc Nemar test was used

\**p* < .05

\*\**p* < .001

**Table (4); Nurses' Observational Checklist about Post Operative Nursing Care Provided For Children with VP Shunt**

Steps	Pre		Post		Test of significance # p- value				
	Done		Not done						
	No	%	No	%					
1. Measure vital signs frequently especially breathing	41	100	0	0	41	100	0	0	-
2. Assess the anterior fontanel for any bulging	5	12.2	36	87.8	28	68.3	13	31.7	<.001**
3. Assess the level of consciousness	11	25.6	26	63.4	28	68.3	13	31.7	<.001**
4. Assess the infant eyes for presence of nystagmus	4	9.8	37	90.2	25	61	16	39	<.001**
5. Asses the infant and children for any signs & symptoms of ICP	7	17.1	34	82.9	23	56.1	18	43.9	<.001**
6. Observe the infant and children for signs and symptoms of seizures	25	61	16	39	37	90.2	4	9.8	<.001**
7. Asses the incision site for any signs of bleeding or infection	12	29.3	29	70.7	33	80.5	8	19.5	<.001**
8. Assessment of vomiting and hydration status	34	82.9	7	17.1	41	100	0	0	<.001**
9. Assess the abdomen for any signs of ileus	0	0	41	100	18	43.9	23	56.1	<.001**
10. Check the effective functioning of VP shunt	3	7.3	38	92.7	24	58.5	17	41.5	<.001**
11. Measure head circumference	9	22	32	78	27	65.9	14	34.1	<.001**
12. Put the infant on the unaffected side or on the back with head elevated at 15 °to 30 °	11	26.8	30	73.2	36	87.8	5	12.2	<.001**
13. Give the infant and children analgesics as prescribed to control the pain	41	100	0	0	41	100	0	0	1
<b>Mean score of nurse total practice</b>	<b>Mean ±SD</b>				<b>Mean ±SD</b>				
	4.95±1.37				9.80±1.60				<.001**

# Mc Nemar test was used \**p* < .05

\*\**p* < .001

**Discussion**

**Academic Journal of Nursing and Health Education**

**An official Publication of Center for International Research Development**

Double Blind Peer and Editorial Review International Referred Journal; Globally index

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The present study confirmed that, the nurses have low level of knowledge and practice about care of children with VP shunt; significant difference and improvement of nurses' knowledge and practice was obvious after implementation of inservice training program. Therefore, education and training of nurses is essential to increase their awareness, knowledge and skills about the importance of management of VP shunt. The nurses had good knowledge in the area of shunt complication and danger signs that the nurse must observe, majority of nurses assess for signs of convulsion and all of them measuring vital signs frequently and administering analgesics for controlling pain. Poor level of knowledge and practice was evident in area of checking proper shunt functioning, proper nursing intervention for VP shunt complication, post operative nursing care and observation especially assessment of fontanel, eye, abdomen for illus and assessment of signs and symptoms indicating increase in ICP.

The current study findings revealed that, the majority of nurses knew that the common complications of VP shunt are shunt obstruction, infection and malfunction. While, the minority of them knew that the bleeding was one of shunt complications; the percentage improved after implementation of program. Similarly, **Mavridis, et al., (2017)** mentioned that, VP shunt is associated with many complications such as shunt malfunction and revision, shunt contamination and infection, and seizures. But the bleeding into the brain parenchyma or ventricles is a rare reported complication. So delayed postoperative intracerebral hemorrhage (ICH) after VP shunt surgery at the site of the catheter is a quite rare and potentially severe event. So, the neurosurgery nurse should be aware of this potentially fatal complication of VP shunt. This result could be explained in the fact that, the major causes for hospital admission for children with VP shunt or shunt revision are obstruction, infection and shunt malfunction. For that reasons, the majority of nurses were replied that answer. In contrary, no cases or even very rare cases are reported or observed that they have post operative bleeding. Therefore, the nurses excluding or did not mention that the bleeding may be one complication for VP shunt.

This study showed that, less than one third of nurses knew that, measurement of the abdominal girth is important to discover the complication of VP shunt; while, after the program, the percentage was improved to more than half. Also, the minority of them knew that, the peritonitis and illus are sings should be

considered for assessing the child with VP shunt. This results was supported with **Guthe, et al., (2018)** they stated that, the migration of peritoneal end of VP shunt into the rectum, vagina, scrotum, abdominal wall, and mediastinum are rare complications. And the risk of abdominal complication associated with VP shunt is 25%. So, the awareness of this rare complication is very important to achieve early recognition, management and timely intervention to save the child's life.

Checking of the proper shunt functioning was mandatory post operative for early detection of shunt obstruction or shunt malfunction. Our study represented that, the minority of nurses' were replied the correct answer regarding checking proper shunt functioning post operatively; this result was consistent with the result in the same study as the majority of nurses did not check the shunt valve for proper functioning and did not know the technique or the component of VP shunt. This result could be interpreted in the fact that, checking proper shunt functioning was done by physician in the hospital.

Our study also represented that, all nurses were replying that, the nursing intervention for children with ICP is to assist the physician in aspiration of CSF. The nurses answers could be interpreted in the fact that in the hospital, when children having signs and symptoms indicating ICP the physician perform aspiration of CSF from fontanel. In addition, the nurses also had beliefs that the only effective intervention for increase in ICP is CSF withdrawal.

Current study showed that, the majority of nurses were replied that the seizures were the most important dangerous signs that the nurse must observe followed by increase in ICP and vomiting. This result may be interpreted in the fact that the majority of cases admitted in the hospital with shunt infection, obstruction or malfunction were clinically suffering from seizure. For that reasons, the nurses were alert to manifestation of seizure. This results was supported by **Athanasakis & Despina Ermidou, (2011)** who stated that, shunt placement failure may be asymptomatic, with a simple change in the patient's behavior or rapid appearance of sleepiness, lethargy, irritability, vomiting, headache, swelling of the head, loss of balance and downward deviation of the eye, prominent scalp veins, loss of previous abilities, seizures, headache and loss of balance.

The period of discharge from the hospital is one of the most vulnerable and complex time for children and their parents.



Parents often experienced anxiety, uncertainty, or a lack of understanding regarding discharge instructions. Discharge teaching is the main responsibility of the nurses, informing mothers about home care and danger signs that need immediate care are necessary. Providing mothers with knowledge about home care and follow up help in improvement of patient outcome, early detection of complication and prevention of deterioration of child condition. Our study showed that, the mean score of nurses' knowledge about discharge plan and teaching was (3.85±1.406) before the program and improved after implementing of inservice training program (7.58±1.642). This reflects the importance of continuing education and training for nurses.

Finally, the inservice training program was effective in improving nurses' knowledge and practice to improve the care provided for children with VP shunt as it was evident in table (5). A multidisciplinary team consisting of pediatric neurosurgeon, rehabilitation therapist, pediatric nurses and social workers should be involved in the management plan to provide holistic care for children with VP shunt and their families.

#### Conclusions & Recommendations

The current study concluded that, the inservice training program was effective in improving nurses' knowledge and practice regarding the proper care for children with VP shunt. The researchers recommended applying further research concerning evidence-based nursing care for children with VP shunt. In addition, development of the multidisciplinary team to provide proper care for children with VP shunt in the hospitals and at home was mandatory. Longitudinal study is necessary to evaluate the children with VP shunt in relation to schooling and barriers for schooling, the future of children with VP.

#### Limitation of the study

The main limitation of our study was that, the available articles are only literature reviews with limited studies on evaluating nurses' practice regarding care provided for children with VP shunt in the hospital pre or post operative. Therefore, the comparison of result was narrowed and difficult. In addition, the study was conducted on one hospital at Mansoura city with small sample size, so, the results may not be generalized.

#### Acknowledgment

The authors wish to thank the participants for the time and effort that they invested in this study.

#### Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research and publication of this article

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