

## THE IMPACT OF PROTOCOL OF CARE FOR MOTHERS OF CHILDREN WITH VENTRICULOPERITONEAL SHUNT ON OCCURRENCE OF POSTOPERATIVE COMPLICATIONS

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### ABSTRACT

Ventriculoperitoneal shunt (VP) is a surgical treatment for children with hydrocephalus (HC). The aim of the current study was to evaluate the impact of protocol of care for mothers of children with VP shunt on occurrence of postoperative complications. A quasi-experimental research design was utilized to fit the aim of the study. The study was conducted in pediatric neurosurgery unit at Cairo University Specialized Pediatric Hospital. A convenient sample of 60 mothers of children who had HC and undergoing VP shunt insertion were included in the study. Data were collected using the following tools: structured interview sheet, recording postoperative complications sheet and pre/posttest and observation checklists. The study results revealed that, the majority of mothers in the study group had higher mean scores and satisfactory level of knowledge and practice after implementation of protocol of care than those in the control group. There were statistically significant differences between mothers in both groups as regards to the total mean score of knowledge and practice after implementation of protocol of care. Children of the mothers in the study group had less postoperative complications than those in the control group. The study results concluded that, the designed protocol of care was effective in improving mothers' knowledge and practice regarding the care of children with VP shunt, as well as reducing the occurrence of the postoperative complications among children in the study group.

**KEYWORDS:** Mothers of Children with Hydrocephalus, Protocol of Care, Ventriculoperitoneal Shunt

### INTRODUCTION

Pediatric hydrocephalus is a surgical disease. If left untreated, most cases are lethal. With the present day standard of care of most children with hydrocephalus will survive and the outcome of hydrocephalus dependent on early detection and early intervention [1]. Hydrocephalus is a condition resulting from an imbalance between the production and absorption of cerebral spinal fluid (CSF) and result in increased intracranial pressure (ICP) [2]. It is estimated that hydrocephalus affects approximately 1 in every 500 children worldwide [3]. Seventy five percent of fetal deaths and 40% of deaths within the first year of life are secondary to central nervous system (CNS) malformations [4]. Congenital hydrocephalus is present at birth, and can be caused by spina bifida; arachnoid cysts, aqueductal stenosis and acquired hydrocephalus may be caused by subarachnoid hemorrhage, intraventricular hemorrhage, trauma, infection, tumor [5].

Ventriculoperitoneal shunting is the standard therapy for management of hydrocephalus and 47% from the obstruction and infection are the most common causes of shunt malfunction [6]. Shunt malfunction is still an existing problem for neurosurgeons which is associated with high incidence of complications [7]. A child with a shunt obstruction is often admitted to the emergency department with worsening neurologic status [8]. Shunt malfunction generally similar symptoms each time such as a full and tense fontanel, bulging of the scalp veins and swelling or redness along the shunt tract, vomiting, irritability, sleepiness and decreased interest in feeding. If the suture lines are closed, there are other symptoms to be alert such as headaches, vomiting, irritability, tiredness and coma [9]. It was estimated that 50% of shunts in the pediatric population fail within two years of placement and repeated neurosurgical operations are often required [10]. Prognosis of hydrocephalus is difficult to predict, although there is some correlation between the specific causes and the outcome, early diagnosis and treatment will improve the chance of a good recovery [11]. The nurse plays an active role to provide care and guidance for family; therefore, it is necessary to have knowledge about the disease and its treatment, through seeking the best quality of life for child [12]. However, there were scare studies had been conducted to evaluate the impact of protocol of care for mothers of children with VP shunt on occurrence of postoperative complications. Therefore, this research was designed to provide knowledge and practices for mothers of children with VP shunt to improve the standard of care.

## METHODS

### Operational Definition

**Postoperative Complications for VP Shunt:** Postoperative complications for VP shunt are defined as the occurrence of certain threats which may arise after insertion of VP shunt such as obstruction, infection, over drainage and disturbed conscious level. Postoperative complications judged by means of measurement of the child's physiological function changes such as elevated body temperature and elevated blood pressure, infected wound, increase head circumference, increase abdominal girth, malposition of head after the operation and disturbance of consciousness level.

### Aim of the Study

The aim of the current study was to evaluate the impact of protocol of care for mothers of children with ventriculoperitoneal shunt on occurrence of postoperative complications.

### Research Hypotheses

- Mothers who will receive the protocol of care will have higher mean scores regarding care of children with VP shunt than those who not.
- Children of the mothers who will receive the protocol of care will have less postoperative complications than those who not.

### Research Design, Participants & Setting

A quasi-experimental research design was utilized to fit the aim of the study. The study was conducted in pediatric neurosurgery unit at Cairo University Specialized pediatric Hospital. A convenient sample of 60 mothers of children who had congenital or acquired HC and undergoing of VP shunt were participated in the study. The first 30 child with their mothers was considered as a control group who received the hospital routine care. The second 30 child and their

mothers were participated as a study group who exposed to the protocol of care.

### **Ethical Considerations**

An official permission was obtained from the research ethical committee to carry out the study. A written informed consent was obtained from the children's mothers by the research investigator after complete description of the purpose and nature of the study in order to obtain their acceptance as well as to gain their cooperation. Children and their mothers were informed that participation in the study is voluntary; mothers have the right to withdraw from the study at any time without giving any reason and without any effect on the care of their children. Confidentiality was assured to children and their mothers. For ethical consideration, data were collected firstly from the control group then the study group.

### **Data Collection Tools**

Data were collected using the following tools: structured interview sheet used to collect personal data about the child; his/her family, postoperative recording complications sheet to assess the children during the postoperative period and pre/posttest to assess mothers' knowledge related to care of children with VP shunt and observation checklists to evaluate the mothers' practice regarding care of children with VP shunt. Observation checklists were adapted from [13]. Checklists were modified and simplified by the research investigator to fit the capabilities of mothers. Observation checklists were involved: measurement of head circumference and abdominal girth; wound care, measurement of axillary temperature and cold compresses.

### **Scoring System**

For mothers' knowledge; each correct response will take "2" scores, the incomplete one "1" score and the wrong response or the not known will take no score. The total score was 70 score and score will be converted to 100%, and then categorized as following: the total score less than 50% (less than 35 score) was considered as unsatisfactory while a score of 50% and more (35 score and more) was considered as satisfactory level. As regards mothers' care giving activities, each item will be scored as the following: performed complete/correct will takes "2" scores, performed incomplete/incorrectly takes "1" score and did not perform /missed will takes "0"score. The total score was 68 score and the total score will be converted to 100%, and then categorized as following: the total score less than 50% (less than 34 score) was considered as unsatisfactory while a score of 50% and more (34 score and more) was considered as satisfactory level.

### **Data Collection Procedure**

The study was carried out on three phases: preparatory, implementation and evaluation phases.

#### **Preparatory Phase**

Involve preparation of the study tool and testing its validity. Before conducting the study an official permission was obtained from the director of CUSPH and permission from the heads of pediatric surgery departments. The research investigator introduces him to the children's mothers who fulfill the inclusion criteria. Written consent was attained after explanation of the aim of the study. The research investigator filled the structured interview on individual bases from the both groups. Before the teaching sessions, the mothers in both groups will be exposed to pre/test.

### **Implementation Phase**

Mothers were exposed to the protocol of care which guided by two parts: first part: preoperative teaching include two educational sessions, first session: the research investigator gave preoperative teaching for mothers having children with VP shunt about postoperative care it include knowledge such as (definition of disease, causes, types of shunt, function of shunt...etc.) and the second session: was concentrated on mothers care giving practices through demonstration on doll such as ( measurement of temperature, cold compresses, positioning, measurement of head circumference and abdominal girth...etc.). The educational session was provided for a group of five mothers per session and every session is given in an hour. Aided by the using of instructional illustrated Arabic booklet. After completion of mothers' teaching sessions, were exposed to post/test to evaluate the impact of protocol of care on mothers' knowledge and care giving practices.

The second part of the protocol of care was carried out immediately postoperative and during the first week after VP shunt it took two hours daily for implementation after placement of VP shunt through redemonstration of care for children by the mothers guided by research investigator. It was concentrated upon implementation of certain activities such as measuring temperature and growth measurements (head circumference and abdominal girth). Protocol of care also will contain wound care, and head control and position. And worked with mothers in fourth floor in waiting operating room and continuous worked in neurosurgery clinic for follow up children complication and mother's knowledge and practices.

### **Evaluation Phase**

To evaluate the mother's care giving activities regarding the care of children with VP shunt were took place using modified and simplified observation check lists. It was assessed three times; the first time immediate postoperative of VP shunt insertion, the second time after two weeks, and then the third one after one month of VP shunt placement. Each child was assessed the occurrence of postoperative complications by the researcher through using recording postoperative complications sheet was filled immediate postoperative, after two weeks and after one month postoperative and takes 1 hour to assess the child in the three times. Data were collected over a period of 12 months, started from September, 2015 to August, 2016.

### **Tools Validity and Reliability**

Data collection tools were developed after extensive reviewing of literature. The tools were reviewed by 5 experts in pediatric surgery nursing, and pediatric neurosurgery to test the content of the tools. Internal consistency and reliability were determined using Cronbach's alpha for protocol of care was 0.75.

### **Statistical Design**

The collected data were, coded, categorized, tabulated, and analyzed using (SPSS 21.0). Descriptive data were expressed as mean and standard deviation. Qualitative data were expressed as frequency and percentage. Chi-square was used to detect the relation between mothers' knowledge based on their selected personal variables. Comparison of means was performed using paired-sample t-test. Correlation among variables was done using Pearson correlation coefficient. The significance level of all statistical analysis was at  $< 0.05$  (P-value).

## RESULTS AND DATA ANALYSIS

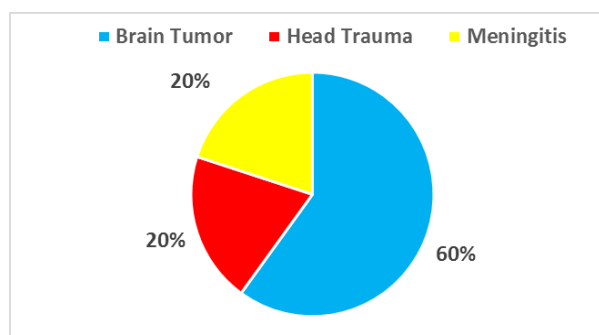
### Part I: Children' Characteristics, Mothers' Personal Data as Well as Children' Diagnosis in Study and Control Group

**Table 1: Percentage Distribution of Children' Characteristics in Study and Control Group**

Child's Characteristics	Study Group (n=30)		Control Group (n=30)		X <sup>2</sup>	P
	N	%	N	%		
<b>Child's Age/Years</b>						
Less than 1 year	15	50	14	46.7	1.07	.898
From 1- less than 3years	8	26.7	11	36.7		
From 3 to 5 years	7	23.3	5	16.7		
Mean $\pm$ SD	1.70 $\pm$ .749		1.73 $\pm$ .827			
<b>Gestational Age</b>						
Full term	19	63.3	27	90	2.19	.335
Preterm	9	30	3	10		
Post term	2	6.7	0	0		
<b>Gender</b>						
Male	17	57	17	57	.415	.519
Female	13	43	13	43		
<b>Types of hydrocephalus</b>						
Congenital	15	50	17	56.7	3.92	.417
Acquired	15	50	13	43.3		

**Table 2: Percentage Distribution of Mothers' Personal Data in Study and Control Group**

Mothers Characteristics	Study Group (n=30)		Control Group (n=30)		X <sup>2</sup>	P
	N	%	N	%		
<b>Mothers 'Age/Years:-</b>						
>20	3	10	4	13.3	26.82	.140
20>25	9	30	8	26.7		
25>30	7	23.3	8	26.7		
30>35	9	30	6	20		
35>40	2	6.7	2	6.7		
40 and more	0	0	2	6.7		
Mean $\pm$ SD	2.9 $\pm$ 1.14		3.0 $\pm$ 1.38			
<b>Level of Education</b>						
Not read and write	8	26.7	5	16.7	13.38	0.86
Just read/write	1	3.3	8	26.7		
Primary school education	1	3.3	0	0		
Secondary school education	17	56.7	16	53.3		
University education	3	10	1	3.3		



**Figure 1: Study Group (n=15)**

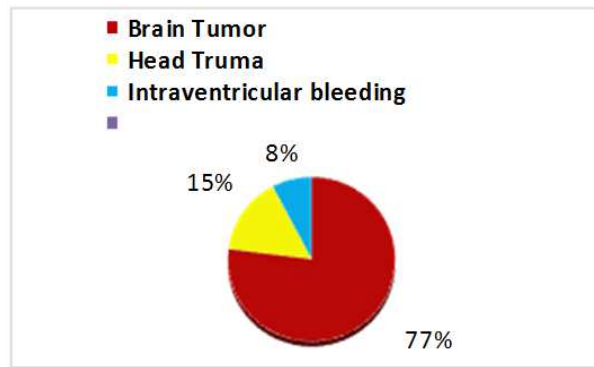


Figure 2: Control Group (n=13)

Figure 1, 2: Percentage Distribution of Causes of Acquired HC among Children in Study and Control Group

Table 3: Signs and Symptoms of Congenital HC among Children in Study and Control Group

Signs and symptoms	Study Group (n=15)				Control Group (n=17)			
	Yes		No		Yes		No	
	N	%	N	%	N	%	N	%
Increase head circumference	14	93.3	1	6.7	17	100	0	0
Bulging anterior fontanel	10	66.7	5	33.3	17	100	0	0
Projectile vomiting	13	86.7	2	13.3	12	70.6	5	29.4
Delayed of closure anterior fontanel	9	60	6	40	13	76.5	4	23.5
Poor feeding	9	60	6	40	13	76.5	4	23.5
Convulsion	6	40	9	60	12	70.6	5	29.4
Dilated scalp vein	9	60	6	40	9	53	8	47
Soft skull bone	10	66.7	5	33.3	14	82.4	3	17.6
Posing forehead	14	93.3	1	6.7	13	76.5	4	23.5
Sunset eyes	10	66.7	5	33.3	11	64.7	6	35.3
Delayed primitive reflexes	9	60	6	40	13	76.5	4	23.5
Delayed fine and gross motor milestones	11	73.3	4	26.7	15	88.2	2	11.8
Disturbance conscious level	6	40	9	60	8	47	9	53

Table 4: Signs and Symptoms of Acquired HC among Children in Study and Control Group

Signs and symptoms	Study Group (n=15)				Control Group (n=13)			
	Yes		No		Yes		No	
	N	%	N	%	N	%	N	%
Headache	10	66.7	5	33.3	12	92.3	1	7.7
Projectile vomiting	15	100	0	0	12	92.3	1	7.7
Deterioration neurological development	9	60	6	40	8	61.5	5	38.5
Delayed fine and gross motor milestones	14	93.3	1	6.7	11	84.6	2	15.4
Loss of appetite	11	73.3	4	26.7	11	84.6	2	15.4
Decreased daily living activities	11	73.3	4	26.7	11	84.6	2	15.4
Amnesia	2	13.3	13	86.7	2	15.4	11	84.6
Change in child behavior	1	6.7	14	93.3	7	53.9	6	46.1
Disequilibrium	8	53.3	7	46.7	11	84.6	2	15.4
Swelling around eyes	2	13.3	13	86.7	7	53.9	6	46.1
Disturbance conscious level	9	60	6	40	6	46.1	7	53.9

**Part II: Mothers' Knowledge about Care of Children with VP Shunt**

**Table 5: Comparison between Total Mean Score of Mother's Knowledge in Study and Control Group in the Pre and Posttest**

Item	Study Group (n=30)		t	P	Control Group (n=30)		T	P
	Pre-Test	Post-Test			Pre-Test	Post-Test		
Mean± SD	9.73±2.63	34.60±.563	53.28	.000	10.86±2.82	10.93±2.85	1.43	.161

\*\*\* Significant at p < 0.01 \* Significant at p < 0.5

**Part III: Postoperative Observation Checklists for Mothers of Children with VP Shunt in the Study and Control Group**

**Table 6: Comparison between Total Mean Scores of Observation Checklists between Three Readings in Study and Control Group**

Checklists	Study Group (n=30)		Control Group (n=30)		t	P
	Mean± SD	Mean± SD	Mean± SD	Mean± SD		
Immediate post-operative	62.40 ± 4.44	17.13 ± 4.19	62.40 ± 4.44	17.13 ± 4.19	76.87	.000*
After two weeks	59.30 ± 4.82	17.16 ± 4.15	59.30 ± 4.82	17.16 ± 4.15	67.35	.000*
After one month	59.76 ± 5.14	17.16 ± 4.15	59.76 ± 5.14	17.16 ± 4.15	63.63	.000*

\*Significant at p < 0.01

**Part IV: Post-Operative Complications among Children with VP Shunt in the Study and Control Group:**

**Table 7: Comparison between Children as Regards Signs and Symptoms of Infected VP Shunt in Study and Control Group**

Signs & Symptoms	Study Group (n=30)						Control Group (n=30)						X <sup>2</sup>	P
	Immediate		2 weeks		1 month		Immediate		2 weeks		1 month			
	N	%	N	%	N	%	N	%	N	%	N	%		
<b>Fever</b>														
Present	1	3.3	6	20	9	30	3	10	14	46.7	26	86.7	7.54	.27
Not present	29	96.7	24	80	21	70	27	90	16	53.3	4	13.3		
<b>Tachycardia</b>														
Present	1	3.3	0	0	2	6.7	1	3.3	9	30	18	60	.022	.98
Not present	29	96.7	30	100	28	93.3	29	96.7	21	70	12	40		
<b>Tachypnea</b>														
Present	0	0	1	3.3	2	6.7	0	0	8	26.7	16	53.3	3.76	.15
Not present	30	100	29	96.7	28	93.3	30	100	22	73.3	14	46.7		
<b>Shivering</b>														
Present	1	3.3	2	6.7	0	0	2	6.7	6	20	9	30	5.17	.52
Not present	29	96.7	30	93.3	30	100	28	93.3	24	80	21	70		
<b>Dry skin</b>														
Present	0	0	1	3.3	0	0	2	6.7	11	36.7	14	46.7	1.88	.39
Not present	30	100	29	96.7	30	100	28	93.3	19	63.3	16	53.3		

**Table 8: Comparison between Children as Regards Signs and Symptoms of Obstructed VP Shunt in Study and Control Group**

Signs & Symptoms	Study Group (n=30)						Control Group (n=30)						X <sup>2</sup>	P
	Immediate		2 Weeks		1 Month		Immediate		2 Weeks		1 Month			
	N	%	N	%	N	%	N	%	N	%	N	%		
<b>Increased Head Circumference</b>														
Present	8	26.7	2	6.7	1	3.3	7	23.3	6	20	3	10	9.78	.134
Not present	22	73.3	28	93.3	29	96.7	23	76.7	24	80	27	90		
<b>Increased Abdominal Circumference</b>														
Present	0	0	1	3.3	0	0	4	13.3	5	16.7	3	10	6.72	.081
Not present	30	100	29	96.7	30	100	26	86.7	25	83.3	27	90		
<b>Projectile Vomiting</b>														
Present	2	6.7	2	6.7	0	0	15	50	18	60	15	50	2.95	.398
Not present	28	93.3	28	93.3	30	100	15	50	12	40	15	50		
<b>Poor Feeding</b>														
Present	3	10	3	10	5	16.7	9	30	9	30	8	26.7	8.88	.180
Not present	27	90	27	90	25	83.3	21	70	21	70	22	73.3		
<b>Anorexia</b>														
Present	8	26.7	2	6.7	1	3.3	13	43.3	14	46.7	15	50	2.82	.419
Not present	22	73.3	28	93.3	29	96.7	17	56.7	16	53.3	15	50		
<b>Decreased Child's Movement</b>														
Present	2	6.7	7	23.3	4	13.3	24	80	25	83.3	25	83.3	2.91	.405
Not present	28	93.3	23	76.7	26	86.7	6	20	5	16.7	5	16.7		
<b>Bulging Fontanel</b>														
Present	0	0	0	0	1	3.3	9	30	10	33.3	10	33.3	14.48	.001
Not present	30	100	30	100	2	6.7	21	70	20	66.7	20	66.7		

**Part V: Correlational analysis****Table 9: Correlation between Selected Mother's Personal Data and Total Mean Score of Knowledge, Practice and Postoperative Complications in the Study Group (N=30)**

Item	Total Mean Score Of Posttest		Postoperative Complications	
	R	P	R	P
Mother's age	.167	.378	.245	.192
Mother's level of education	-.152	.003**	.179	.344
Mother's occupation	.041	.831	.248	.187
Mother's place of residence	.008	.966	.446	.004**

**DISCUSSIONS**

The current study results showed that, the half of children's in both study group and control group had less than 1 year. This explanation congruent with the findings presented in [14] which revealed that, the common child age of shunted HC at 3- 6 months until 1 year. Moreover, more than half of children in the study group and vast majority in control group born as full term neonates. In the same context of [15], it was found that, 50.5% of full term neonate had (hyperbilirubinemia, hydrocephalus, intraventricular hemorrhage (IVH)).

Moreover, the results showed that, more than half of children were males in the both groups, in this respect [16] emphasized that more common gender complained from HC with VP shunt were male child (63.8%). In addition most of congenital anomalies are male linked for unexplained causes. The results of the current study proved that, more than half of children in both study group and control group had congenital HC. This finding was supported by [17] who reported



that, the most prevalent of congenital anomalies observed in CNS and most common anomalies 34.7% spina bifida and 44% HC.

The current study result revealed that, more than one quarter of mothers in both groups their age ranged from 20 to less than 25 years. This explanation in the same line with the study of [18], who found that 20% of mothers of infants with HC their age were below 25 years. Moreover, in our study, half of mothers in both study and control groups had secondary school education. This results contradicting with the study of [19] which revealed that, 75.4% of child mother's with HC were illiterate. In addition, in our study, the highest percentage of children in both groups had acquired HC is resulting from a brain tumor. These results were supported by [20], who stated that, CNS tumors demonstrating evidence of extraneural spread (hydrocephalus) associated with VP shunt in children in a wide variety of tumors and recommended for larger studies are required to evaluate VP shunt as potential risk factors lead to shunt complications.

The findings of the current study revealed that, the highest percentage of children in both groups had increased head circumference related to congenital HC. These results were in agreement with findings presented in [3], which revealed that, 92% of infants had signs of increased HC at admission due to increasing of CSF. Also, the maximum percentages of children in both groups had bulging anterior fontanel. This explanation congruent with result of [21], who reported that, HC signs in infants are bulging anterior fontanel, occurs when fluid builds up in the brain or causing increased pressure inside the skull.

Moreover, the current study showed that, more than two thirds of children in the study group compared to 82.2% among children in the control group had delayed of milestones related to congenital HC signs, and all of children in study group had projectile vomiting compared to vast majority among children in the control group. This explanation was in the same line with the findings presented in the study of [22] which summarized that most of children suffer from congenital HC had delayed growth and development milestones. So, the parent must follow child's growth rate through growth curve. Therefore, the findings of [23] reported that children with medulloblastomas most commonly present with signs of elevated ICP due to obstructive HC, especially headaches and forceful vomiting.

Furthermore, the results of the current study showed that, less than three quarters of children in the study group and majority of children in the control group had loss of appetite and decreased daily living activities regarded to signs of acquired HC, in this respect [24] emphasized that a significant number of children had some forms of developmental milestones delay. These results were supported by the study findings held by [25] which concluded that, CNS tumors are the most common solid tumors diagnosed in children, 90% of children had the frequent symptoms of brain tumors such as headaches, loss of appetite, generalized weakness and vomiting. Moreover, in our study, more than two thirds in the study group and majority of children in the control group complained from frequent headache. Which is in agreement with previous results [26] concluded that, 85% of children with brain tumor complain from headache is considered to be one of the most important symptoms for discovering the disease.

The current study results revealed that, there was highly statistical significant difference between mothers' pre and posttest in the study group. This explanation congruent with the findings presented in the study of [27], which concluded that development of standardized protocols of care after insertion of CSF shunts, is essential to reduce CSF shunt infection rate and other complications.

It was found that, the majority of mothers of children with HC in the study group had satisfactory level of knowledge after implementation of protocol of care. While, the majority of mothers of children in the control group still had unsatisfactory level of knowledge. Which in agreement with the study by [28] reported that the health team member provide an education program for parents to help them to decreases stress level and increase level of knowledge about the disease. In addition, the study of [29] concluded that, responsibility of the nurses for family is educative, counseling and supportive roles to increase level of care for their children. It was found a statistically significant difference between mothers' in the observational practice in the both groups was detected at ( $p < 0.01$ ). This could be related to that mothers in the control group received the routine hospital care which unfortunately weren't informed about protocol of care.

A statistically significant difference was detected in observation checklists (mother's practices) between immediate post-operative and after one month of protocol of care conduction. From the researcher's point of view; level of mother's practices was decreased gradual from immediate postoperative protocol conduction to one month from shunt placement. These results indicating that the mothers need for continuous education about the care of shunt for their children. On the other hand, it was evident that highest percentage of mothers of in study group had satisfactory level of practices. While the vast majority of mothers of children in the control group still had unsatisfactory level of practice. These results indicated the effectiveness of the protocol of care on improving mothers' practices in the study group.

As regards to postoperative complication among children with HC, the results of the current result indicated that more than two thirds of children in the study group were didn't have fever after one month from VP shunt insertion on relation to the control group, 86.7% of children had that problem. This explanation was in same line with the findings presented in the study of [30] which summarized that the control group had significantly more cases of postoperative shunt infection than the treatment group at ( $p=0.0042$ ). The significantly more cases of shunt infection occurred within one month after surgery at ( $p=0.021$ ).

Moreover, the results showed that, the highest percentage of children in both groups were not having tachycardia and tachypnea. These result concurrent with [31] which stated that 20% of shunt infections present more than 6 months after insertion and can effect on all body function and sequence signs related to infection such as tachycardia, tachypnea, signs of increased ICP finally the children admitted to the intensive care unit (ICU) for treatment. Moreover, almost of children in the study group their head circumference not increased postoperatively compared to the vast majority of children had increased head circumference in the control group. These results were presented in a study by [32] who reported that, shunt complications were seen in 53% of children, available of which 70% had increased HC related to shunt block.

On the other hand, the current study results revealed that, all of children in the study groups not complained from projectile vomiting, otherwise, 50% of children in the control group had projectile vomiting and anorexia. Which in concurrent with the study presented of [33] reported that, the shunt failure rate was almost 31% of the first year and classic symptoms of shunt placement failure include increased head size, irritability, projectile vomiting, and headache, downward deviation of the eye, seizures, and anorexia. On the same line, highest percent of children in both study and control groups their abdominal circumference didn't increased after VP shunt insertion. These results supported by [34] who found that approximately two thirds of all shunt infections with abdominal pain due to accumulation of fluid in the peritoneal cavity.

Furthermore, the results of the current study revealed that, majority of children in the study group not complained from redness in wound site compared to most of children in the control group had the problem. In this respect [35] emphasized that symptoms of shunt malfunction which including 33% of cases had wound redness, 22% had abdominal pain and 19% complain with shunt infections. These results were presented of [36] who reported that, there were twelve of children with VP shunt showed postoperative fever and postoperative infected wound with wound swelling. Moreover, in our study, the vast majority of children in the study group didn't have wound swelling compared to 96.7% of children in the control group had the same problem. On the other hand, 96.7% of children in the study group didn't complain from separation of wound suture and discharge from wound compared to less than one quarter of children in control group have the problem. This is in agreement with result present of [37] concluded that, the organism is spread to the surgical wound by contamination and 30% of cases with shunt infection had separation and discharge from wound.

This explanation in the same line with the study of [10], who indicated that there was a strong correlation between mothers' knowledge and practice and their level of education as when increasing levels of education we get increase the standard with confidence in caring with children and improve quality of life. Moreover, in our study, there was statistically significant positive correlation between the total mean scores in the study group of mothers' knowledge and practice and their level of education. Furthermore, the current study revealed that there were statistically significant correlation between the mothers' place of residence and occurrence of postoperative complications among children in the study group. This result correspond of the study presented by [38], which concluded that, there was statistically significant correlation between the mothers' place of residence and occurrence of postoperative complications and this problem is related to more challenges, including malnutrition, infectious diseases, limited resources and resident place of parent to access to hospital for seeking care.

## CONCLUSIONS

The study results of the current study concluded that, the designed protocol of care was effective in improving mothers' knowledge and practice regarding the care of children with VP shunt. Mothers of children who received, the protocol of care had a satisfactory level of knowledge and practices rather than those in the control group. Children of mothers who received, the protocol of care had postoperative complications, less than children in the control group neither immediate, after two weeks nor after one month after VP shunt insertion. The study results also concluded that, there was statistically significant positive correlation between the total mean score of mothers' knowledge and practice in the study group and their level of education.

## RECOMMENDATIONS

Integration of the designed protocol of care for children with hydrocephalus and undergoing VP shunt insertion in pediatric neurosurgery units is mandatory. Raising the awareness of pediatric surgical nurses through in-service training about the benefits of preoperative teaching to the mothers of children with undergoing VP shunt insertion on reducing the postoperative complications among those children. A multidisciplinary team consisting of pediatric neurosurgeon, rehabilitation therapist, pediatric nurses and social workers should be involved in the protocol of care to provide holistic care for children with VP shunt and their families. Longitudinal study is necessary to monitor the late postoperative complications and long term outcomes among children with VP shunt.

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