Nurses' Knowledge and Practices Regarding Care of Children Undergoing Vascular Access and its Related Complications

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Abstract

Background: Intravascular catheters are safe devices routinely used in critically ill children for administration of inotropes, high dose drugs, blood products. Vascular access devices can cause complications which lead to long hospital stay, morbidity and high mortality. The catheter- related complications can largely be preventable through efficient nurses' level of knowledge and practice. **This study aimed to:** Assess nurses' knowledge and practice regarding care of children undergoing vascular access and its related complications. **Design:** Descriptive study design was utilized to carry out the study. **Settings:** Pediatric Intensive Care Units (PICU) at Benha University Hospital and Specialized Pediatric Hospital at Benha city. **Sampling:** Convenient sample of 77 nurses who are working at the previously mentioned settings and a purposive sample of (77) pediatric patients. **Tools of data collection:** Three tools were used: **Tool (I):** A structured interviewing questionnaire format to assess personal characteristic of nurses' and their knowledge regarding VAD **Tool (II):** Observational checklists to assess nurses' practice before, during and after venous access procedures and care of its complications **Tool (III):** The child medical assessment sheet. **The results of this study revealed that:** The majority of the studied nurses had satisfactory knowledge and competent practices towards care for children undergoing vascular access devices respectively. **It was concluded that:** There were a positive statistical correlation between total level of nurses' knowledge and practice towards caring for children undergoing VAD So **it recommended that:** Pediatric nurses should update their knowledge and practice through continuing training, educational programs and workshops concern the care of children with vascular access devices and its related complications.

Keywords: Knowledge, Practice, Nurses, Children, Vascular access, Care, Complications.

Introduction:

Vascular access devices (VADs) are a common and essential component of pediatric health care. A range of peripheral and central venous devices that provide a route to administer critical and supportive therapies such as antibiotics, nutrition, and chemotherapy exists. Poor choice of VAD can lead to the insertion of an inappropriate device, which reduces treatment efficiency and places the patient at increased risk of harm. Clinicians

need to make device and insertion decisions that ensure optimum therapy provision while preventing or reducing VAD-related complications (such as infection, thrombosis, and vessel damage), child distress, and treatment delays ***(Paterson et al., 2020).***

The technique for central venous catheter (CVC) placement has changed with the use of ultrasound guidance to minimize complications, number of attempts and decreased procedure duration. The role of the pediatric surgeon and the anesthesiologist on line placement has been extended to interventional radiologists and specially trained nurses. Nonetheless, there is still value in the use of anatomical landmarks for line placement ***(Lamperti et al., 2020).***

Management of VADs involves maintaining function, securement and dressing coverage, identification of complications and the administration of medications requiring clinician education on aseptic technique and appropriate device usage. Activities performed within this quadrant include: daily assessment for identification of complications and dressing adherence, aseptic technique with VAD access and determination of device necessity. The goals of this phase are to maintain functionality of the device, avoid complications and, if they occur, quickly identify actions needed, based on recommendations, to avoid more serious complications or reoccurrence ***(Moureau & Carr, 2018).***

The choice of vascular access devices (VAD) depends upon the clinical condition, the likely duration and frequency of treatment, and the properties of the infusate. Therefore, knowledge of indications, contraindications, advantages, and disadvantages of different types of vascular access is required to provide the best care for the sick child. The indication and duration of vascular access should be carefully considered before cannulation to minimize the number of attempts and the psychological trauma to the child and the family ***(Nakamura et al., 2020).***

The nurse plays an important role in monitoring the child and the catheter site. The child's vital signs should be monitored and recorded, the sterile field must be maintained during any handling of the line and the line should be securely fastened to the child. The dressing on the central venous site should be changed in accordance with hospital policy and procedures. It should always be changed using aseptic techniques and the catheter site must be closely observed. The nurse usually removes the catheter after the medical practitioner has given an instruction for removing ***(Mohamed et al., 2019).***

Significance of the study

Venous catheters have a vital importance to children's survival through optimizing their management in PICU. Critically ill children who admitted to PICU rely highly on venous access for administering fluids, parenteral nutrition, medications and blood products (***Ainsworth & McGuire, 2015) &(Ismail, 2015).***

Worldwide, millions of vascular access devices (VADs) are used in healthcare facilities to provide supportive and interventional therapies during acute and chronic illness of children. Within pediatrics, the therapies that VADs facilitate are diverse. Children with VADs are already vulnerable to

complications because of their underlying health condition.

Aim of the study:

To assess nurses' knowledge and practice regarding care of children undergoing vascular access and its related complications**.**

Subject and Methods

Research design:

A descriptive research design was used to conduct the study.

Setting:

The study was conducted at Pediatric Intensive Care Units (PICU) at Benha University Hospital and Specialized Pediatric Hospital at Benha city.

Sample:

A convenient sample of (77) nurses who work in previously mentioned settings regardless of their characteristics (44 nurses work at Benha University Hospital and 33 from Benha Specialized Pediatric Hospital). A purposive sample of (77) pediatric patient

Tools for data collection:

Tool (I): A structured interviewing questionnaire format: A structured interviewing questionnaire designed by the researcher after reviewing recent literatures. It was written in an Arabic language, it composed of two main parts:

Part 1:

Personal characteristic of the studied nurses consisted of (6) questions (related to age, gender, qualification, place of work, years of experience and attendance of training courses related to care of children undergoing vascular access and its related complications).

Part 2:

Nurses' knowledge regarding vascular access, it consisted of (22) multiple choice and (10) true and false questions regarding definition, purpose, types, sites of insertions, equipment, duration of peripheral and central vascular access, complications, and its prevention and nursing care of children undergoing vascular access.

Scoring system of nurses' Knowledge:

The total number of questions that assessed knowledge was 32. Regarding knowledge score, the complete correct answer scored (2), incomplete correct answer scored (1) and wrong / don't know scored (0), while true and false divided as, correct answer scored (1) and incorrect answer scored (0). The total knowledge scores were 32 scores, the scores were summed up and converted into percent score (100%).

Nurses` total score of knowledge was considered to be satisfactory (if nurses' total score of knowledge equal or more than 80%) or unsatisfactory (if nurses' total score of knowledge less than 80%).

Tool (II):

Observational checklists which adopted from ***O'Grady & Alexander, (2011), Dougherty & Lister, (2015) and Gorski et al., (2016)*** to assess nurses' practice before, during and after venous access procedures and care of its complications. It composed of two parts as the following

I - Vascular Access Devices insertion practices and care which include the following procedures namely;

a- Peripheral venous access (Peripheral cannula), consisted of (26) steps; before insertion (10) steps, during insertion (13) steps and after insertion (3) steps.

b- Central venous access consisted of (21) steps; before insertion (11) steps, during insertion (5) steps and after insertion (5) steps.

c- Central line care, it contain (30) steps; dressing (18) steps, catheter hubs and needless connector (3) steps, tubing and administration sets (6) steps and flushing (3) steps.

d- peripheral cannula care (site care and flushing), consisted of (12) steps.

II- Care of complications related to vascular access devices practices:

1- Procedure care of complications related - insertion include (29) steps; care of infection (9) steps, care of catheter malposition (9) steps and care of nerve injury (11) steps.

2- Procedure care of complications during use include (68) steps; care of air embolism (12) steps, care of catheter embolism (10) steps, care of occlusion (9) steps, care of infiltration/extravasation (10) steps, care of phlebitis (13) steps care of infection (9) steps and care of venous thrombosis (5) steps.

3- Procedure care of complications during removal include (20) steps; care of air embolism (12) steps and care of catheter malposition (8) steps.

Scoring system for nurses' practice :

Data collected using the observational checklists were based on: done correctly and not done correctly.

Regarding practice score.

- Done correctly was scored (1)
- Not done correctly was scored (0)

The total score of nurses practice was classified as the following: competent (if nurses scored 100%) and be scored incompetent (if nurses scored less than 100%).

Tool (III): The Child medical assessment sheet

It was designed by the researcher and included (10) questions related to characteristics of the studied children who undergoing vascular access (related to age (months and years), gender, rank, medical diagnosis, purposes and types of VA, duration of insertion, previous insertion and previous complications during previous hospitalization).

Tools validity and reliability:

The study tools were revised by a panel of three experts (professor and two assistant professors) in the field of Pediatric Nursing from Benha University. The experts reviewed the tools for its clarity, relevance, comprehensiveness, simplicity and applicability. Tools validity tested the face and content validity of the designed tools. Testing reliability of study tools was done using Cronbach's alpha coefficient test to measure the internal consistency of the tools. This turned to be (α =0.79) for knowledge and (α =0.86) for practice.

Administrative design:

An official letter was obtained from the Dean of Faculty of Nursing, Benha University, hospital administrators and head of units of the previously mentioned study settings. A clear explanation was given about the aim and expected outcomes of the study to obtain their approval and cooperation which is needed for conducting this study.

Ethical considerations

The researcher informed all nurses about the aim, nature and expected outcomes of study before their inclusion. Nurses' oral consent was obtained from them before participation in the study. Anonymity and confidentiality of the study subjects were secured. Nurses were informed that the gathered data would be used for the research purpose only. Nurses were allowed to withdrawal from the study at any time.

Pilot study:

A pilot study was carried out during August, 2020 involving 10% of sample size (8) nurses and (8) children undergoing vascular access devices to test content validity, clarity, applicability and feasibility of the study tools and to estimate the time needed to fill each tool. Nurses participate in the pilot study were included in the sample, where no radical modifications were carried out in the study tools as revealed from results of pilot study. So that, nurses who were included in pilot study were not excluded from the total study sample.

Field Work:

The process of data collection was carried out from the beginning of September to the end of November 2020. The researcher was available at each study setting by rotation for three days weekly during morning and afternoon shifts to collect data by using the previously mentioned tools, these days were (Sunday, Tuesday and Thursday). The purpose of the study was explained by the researcher to each study subjects.

On interviewing the nurses the researcher started by introducing herself to the nurses, give them a brief idea about the study and its expected outcomes. A structured interviewing questionnaire was distributed in order to collect the required data and each nurse was individually interviewed for 20- 30 minutes, the researcher was available for more explanation whenever needed.

The researcher checked the observational checklists while observing the nurses' actual practice on children (pre, during, after insertion and care of complications related to vascular access devices) that performed by the nurses was ranged from 2 - 4 hours.

Statistical Design:

Data entry and statistical analysis were done using SPSS 21.0 statistical software package.

Results:

Table (1); Showed that, personal characteristics of the studied nurses, it was evident that nearly half (49.4%) of nurses aged between 20<25 years ($\overline{X}$±SD 24.35±3.90 years), more than half (57.1%), (51.9%) of them were females had bachelor degree of nursing science respectively. More than two thirds (67.5%) of them had<5 years of experience in pediatric units and ($\overline{X}$±SD 4.81±3.02 years) and more than three quarters

(75.3%) of them didn't attend training courses related to vascular access.

Table (2); Showed that, the personal characteristics of the studied children. It was found that more than two fifths (41.2%) of the studied children aged 1-<3 months ($\overline{X}$±SD 4.79±3.08months), while one fifth (20.8%) of them aged 4-<8 years ($\overline{X}$±SD 6.60±3.35years), nearly half (48.1%) were ranked first. As regards children's diagnosis, it clear that less than half (45.5%) of them had respiratory disorders.

Table (3); Illustrated that, total level of nurses' knowledge regarding VAD, it was evident that majority (80.5%) of nurses had satisfactory knowledge regarding VAD for children, on the other hand the less than one quarter (19.5%) of them had unsatisfactory knowledge regarding VAD for children.

Table (4); Revealed that, relation between total level of nurses' knowledge and their personal characteristics, it was evident that there was statistically significant difference between total nurses' knowledge level and place of work. Also, there was no statistical significant difference as regards their age, gender, qualification, years of experience and training courses related to VAD.

Table (5); Revealed that, relation between total level of nurses' practice and their personal characteristics, it was evident that there was a statistical significant difference between total nurses' practice level and their place of work. On the other hand, there was no statistical significant difference as regards their age, gender, qualification, years of experience and training courses related to VAD.

Table (6); Revealed that, there was a positive statistical correlation between total level of nurses' knowledge and practice towards care for children undergoing VAD as (r=0.574) and (P-value=0.041).

Figure (1); Illustrated that, total level of nurses' practice, it was evident that the majority (88.3%) of nurses had competent practices towards caring for children undergoing VAD, while 11.7% of them had incompetent practices.

Table (1): Distribution of the studied nurses regarding their personal characteristics (n=77).

Characteristics of the studied nurses	No	%
Age/ years		
16- < 20	5	6.5
20- < 25	38	49.4
25- < 30	23	29.8
30- < 35	11	14.3
X±SD 24.35±3.90		
Gender		
Female	44	57.1
Male	33	42.9
Qualification level		
Secondary nursing education	5	6.5
Nursing Technical Institute Diplome	24	31.2
Bachelor degree of nursing science	40	51.9
Post graduate studies	8	10.4
Years of experience in pediatric units		
1- < 5	52	67.5
5- < 10	16	20.8
10- < 15	9	11.7
X±SD 4.81±3.02		
Attending training courses related to vascular access		
Yes	19	24.7
No	58	75.3

Table (2): Distribution of the studied children regarding their personal characteristics (n=77).

Characteristics of the studied children	No	%
Age /months		
1-<3	14	41.2
3-< 6	7	20.6
6-<9	9	26.5
9-≤12	4	11.7
X±SD 4.79±3.08		
Age /year		
1-<4	11	14.3
4-<8	16	20.8
8-<12	14	18.3
12-≤16	2	2.6
X±SD 6.60±3.35		
Child ranking		
First	37	48.1
Second	18	23.3
Third or more	22	28.6
Diagnosis		
Respiratory disorders	35	45.5
Gastro- intestinal disorders	9	11.6
Neurological disorders	16	20.8
Others (congenital heart disease – poisoning)	17	22.1

Table (3): Distribution of total level of studied nurses' knowledge regarding vascular access devices (VAD)(n=77).

Total level of nurses' knowledge	No	%
Satisfactory	**62**	**80.5**
Unsatisfactory	**15**	**19.5**
Total	**77**	**100.0**

Table (4): Relation between total scores of nurses' knowledge level regarding vascular access devices VAD and their personal characteristics(n=77).

Personal characteristics	Total Knowledge				X2	p-value
	Unsatisfactory (n=15)		Satisfactory (n=52)			
	No	%	No	%		
Age / years						
16- < 20	**0**	**0.0**	**5**	**9.6**	**2.667**	**0.446**
20- < 25	**8**	**53.3**	**30**	**57.7**		
25- < 30	**6**	**40.0**	**17**	**32.7**		
30- < 35	**1**	**6.7**	**10**	**19.2**		
Gender						
Female	**10**	**66.7**	**34**	**65.4**	**0.69**	**0.406**
Male	**5**	**33.3**	**28**	**53.8**		
Qualification						
Secondary nursing education	**2**	**13.3**	**3**	**4.8**	**1.719**	**0.633**
Nursing Technical Institute Diplome	**5**	**33.3**	**19**	**30.6**		
Bachelor degree of nursing science	**7**	**46.7**	**33**	**53.3**		
Post graduate studies	**1**	**6.7**	**7**	**11.3**		
Place of work						
Benha university hospital	**11**	**73.3**	**22**	**42.3**	**7.065**	**.008***
Specialized pediatric hospital	**4**	**26.7**	**40**	**76.9**		
Years of experience						
1- < 5	**11**	**73.3**	**41**	**78.8**	**.500**	**0.779**
5- < 10	**3**	**20.0**	**13**	**25.0**		
10- < 15	**1**	**8**	**0**	**0.0**		
Attending training courses related to vascular access						
No	**11**	**47**	**0**	**0.0**	**0.04**	**0.842**
Yes	**4**	**15**	**0**	**0.0**		

**Statistically significant at p<0.05* ** * highly statistically significant at p<0.001*

Table (5): Relation between total scores of nurses' practices level regarding VAD and their personal characteristics.

Personal characteristics	Total practice				X2	p-value
	Incompetent (n=9)		Competent (n=68)			
	No	%	No	%		
Age / years						
16- < 20	0	0.0	5	7.4	2.366	0.5
20- < 25	3	33.3	35	51.5		
25- < 30	4	44.5	19	27.9		
30- < 35	2	22.2	9	13.2		
Gender						
Female	4	44.4	29	42.6	0.01	0.918
Male	5	55.6	39	57.4		
Qualification						
Secondary nursing education	0	0.0	5	7.4	2.161	0.54
Nursing Technical Institute Diplome	3	33.3	21	30.9		
Bachelor degree of nursing science	4	44.5	36	52.9		
Post graduate studies	2	22.2	6	8.8		
Place of work						
Benha university hospital	9	100.0	24	35.3	13.588	.000**
Specialized pediatric hospital	0	0.0	44	64.7		
Years of experience						
1- < 5	6	66.7	46	67.6	1.427	0.49
5- < 10	1	11.1	15	22.1		
10- < 15	2	22.2	7	10.3		
Attending training courses						
No	7	77.8	51	75.0	0.033	0.856
Yes	2	22.2	17	25.0		

Table (6): Correlation between total level of nurses' knowledge and practices towards care for children undergoing vascular access devices VAD.

Items	Total Nurses' Knowledge	
	r	p-value
Total Nurses' Practices	**0.574**	**0.041**

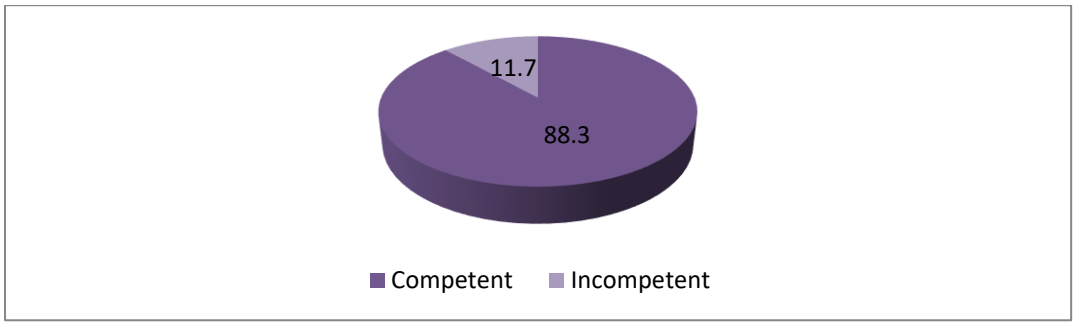

Figure (1): Distribution of total scores of studied nurses' practices toward care for children undergoing vascular access devices (VAD)(n= 77).

Discussion:

Insertion of VA is amongst the most frequently performed invasive procedures. In severely ill and long-stay children, inserted VADs enable relatively safe and painless application of parenteral nutrition, long-term antibiotics, chemotherapy, intravenous fluids and blood components and is also used for repetitive blood sampling. Furthermore, CVCs are used for invasive hemodynamic monitoring, hemodialysis and plasmapheresis and in case of shortage of a peripheral access ***(Mohammed et al., 2018).***

The current study was a descriptive study that aimed to assess nurses' knowledge and practice regarding care of children undergoing vascular access and its related complications.

As regard to personal characteristic of the studied nurses, The present study revealed that, nearly half of the studied nurses aged between 20<25 years ($\overline{X}$±SD 24.35±3.90 years). This result was supported with the study done by ***Ahmed & Kafl, (2019)*** entitled " Knowledge and practice of the critical care nurses on vascular access devices related infection " who reported that, 62.1% of the studied nurses were in the age group from 20 to less than 30 years.

Concerning gender of the studied nurses, the present study illustrated that, more than half of the them were females. This result was similar with the studies done by ***Barbosa et al., (2017)& Kahraman et al., (2020)*** entitled "Knowledge of the nursing team on care with central venous catheters" and "The effect of a nurse education program on infiltration and extravasation in pediatric patients at a university hospital" respectively reported that, 82% and 57.3% of the studied nurses were females. From the researcher point of view, this might due to the study of nursing was special for females only till a few years ago, thus the career of nursing was mostly feminine.

Concerning the educational level, the present study revealed that, more than half of studied nurses had bachelor of nursing science. The result was disagreed with the study done by ***Ahmed & Kafl, (2019)*** who reported that, less than half (43.24%) of the studied nurses had technical health institute diploma. The finding also disagree with the study done by ***Deshmukh & Shinde, (2014)*** entitled "Impact of structured education on knowledge and practice regarding venous access device care among nurses" who reported that, 56.67 % were having diploma in general nursing. From the researcher point of view, this might due to the majority of them graduated from faculties of nursing.

Regarding the years of experience, the current study demonstrated that, more than two thirds of the studied nurses had 1<5 years of experience in pediatric units ($\overline{X}$±SD 4.81±3.02 years). This finding was agree with the study done by *Atia, (2017)* entitled "Effect of instructional module about central venous catheter on nurses' performance and patients outcomes in selected hospital" and found that, 45% of the studied nurses had 2-5 years experience in ICU. This finding was disagree with the study done by *Khadrawi, (2019)* entitled "Assessment of nurses' knowledge and practice related to caring of central venous line at Al damam Hospital" who found that, 54.5% of them had 5-10 years of experience in pediatric units.

Concerning the attendance of training courses related to vascular access, the current study illustrated that, more than three quarters

of the studied nurses didn't attend training courses. This finding was supported with the study done by ***Mohamed et al., (2019)*** entitled "Auditing and re-auditing nursing care for children undergoing central venous line insertion in Pediatric Intensive Care Unit" who reported that, all nurses didn't receive any previous training courses. This finding disagree with the study done by ***Khalil et al., (2017)*** entitled "Oncology critical care nurse's knowledge about insertion, care and complications of venous port catheters in Egypt" who found that, 62.0% had attend previous training courses related to vascular access. From the researcher point of view, this emphasis on the importance of training to pediatric nurses.

As regard to personal characteristic of the studied children, it was evident that, more than two fifth of the studied children aged 1-<3 months ($\overline{X}$±SD 4.71±3.083 months). This result was in a disagreement with the study done by ***Yamaguchi et al., (2017)*** entitled "Peripherally inserted central catheters are associated with lower risk of bloodstream infection compared with central venous catheters in pediatric intensive care patients: a propensity-adjusted analysis" and reported that, ages of the studied children were 40.9% between 1-12 months. From the researcher point of view, infant at this age at high risk for complications related to VAD.

As regards to child gender, the current study indicated that, more than half of the studied children were male. The finding of the present study was supported with the study done by ***Paquet et al., (2017)*** entitled "Impact of arm selection on the incidence of PICC complications" who reported that, 51% and 54% in Right-side & Left-side insertion of studied children were males. Further more, ***Atay et al., (2018)*** found in a study entitled "Incidence of infiltration/ extravasation in pediatrics using peripheral venous catheter and affecting factors" and found that, 60.6% of the studied children were males. From the researcher point of view, male gender could be associated with increased risk of complications related to VAD.

Regarding medical diagnosis of the studied children, the current study revealed that, less than half of the studied children had respiratory disorders. This result was supported with the study done by ***Suliman et al., (2020)*** entitled "The incidence of peripheral intravenous catheter phlebitis and risk factors among pediatric patients" and reported that, 55.7% of the studied children had respiratory disorders. This result was disagrees with the study done by ***Mohammed et al., (2018)*** entitled " Central venous catheter related complications in Pediatric Intensive Care Unit (PICU)" and reported that, 64% of the studied children admitted to PICU by neurological diseases. From the researcher point of view, VAD related complications increased with respiratory disorders.

As regard to total level of studied nurses' knowledge regarding vascular access devices, it was evident that majority of nurses had satisfactory knowledge regarding VAD for children. This finding supported with the study done by ***Mersal et al., (2019)*** entitled "Effect of Educational Guidelines on Nurses' performance regarding prevention of port-A-catheter complications among Patients undergoing chemotherapy" who found that, 80.0% of nurses had satisfactory knowledge regarding VAD for children. Furthermore, this finding also in an accordance with the study done by ***Abu Sharour, (2018)*** entitled "Oncology nurses' knowledge about central line catheter: Caring, complications, and applications among cancer patients—A cross-

sectional study" who found that, 85% of nurses had satisfactory knowledge regarding VAD for children. This finding disagree with the study done by ***Raynak et al., (2020)*** entitled "Nurses' knowledge on routine care and maintenance of vascular access devices: A scoping review" who found that, 65.47% of nurses had satisfactory knowledge regarding VAD for children. From researcher point of view this may be more than half of them had bachelor degree of nursing.

Regarding total level of nurses' practice, it was evident that the majority of the studied nurses had competent practices towards caring for children undergoing VAD. This finding was agree with the study done by ***Qamar et al., (2017)*** entitled "Assess nurses knowledge and practices towards care and maintenance of peripheral intravenous cannulation in services hospital Lahore, Pakistan" who found that, nurses had good practice towards caring for children undergoing VAD. Furthermore, This finding was agree with the study done by ***Deshmukh & Shinde, (2014)*** who found that, nurses had good score in the practice towards caring for children undergoing VAD.

Concerning Relation between total scores of nurses' knowledge level regarding vascular access devices VAD and their personal characteristics, the present study showed that, there was no statistical significant difference as regards their age, gender, qualification, years of experience and training courses related to VAD. This finding was in an agreement with the study done by ***Raynak et al.,(2020)*** who reported that, there was inconsistent relationship between years of experience and nurses' knowledge level regarding vascular access devices.

As regard to the relation between total scores of nurses' practice and their personal characteristics, it was evident that there was a statistical significant difference between total nurses' practice score and their place of work in pediatric VAD. On the other hand, there was no statistical significant difference as regards their age, gender, qualification, years of experience and training courses related to VAD. This finding was in an agreement with the study done by ***Khadrawi, (2019),*** who showed that no significant statistical differences in nurses' practices and years of experience. This finding was in an disagreement with the study done by ***Ahmed & Kafl, (2019),*** who reported that, there was a significant relationship between mean levels of nurses' practice regarding vascular access devices and years of experience.

Regarding correlation between total level of nurses' knowledge and practices, the present study revealed that, there was a positive statistical correlation between total level of nurses' knowledge and practice towards care for children undergoing VAD. This finding was in accordance with the study done by ***Mersal et al., (2019)*** who reported that, there was significant positive correlation between the nurses' knowledge level and their demographic characteristics. From the researcher's point of view, satisfactory level of knowledge is associated with competent level of nurses' practice.

Conclusion:

The current study concluded that, majority of the studied nurses had satisfactory knowledge and competent practices regarding care of children undergoing VAD. The most common complications during insertion were infection, catheter malposition and nerve

injury, while complications during use were air embolism, catheter embolism, infiltration/ extravasation, phlebitis, venous thrombosis and occlusion. Complications during removal of VAD were air embolism and catheter embolism (due to damage). It was clear that, there were a significant positive statistical correlation between total level of nurses' knowledge and practice towards caring for children undergoing VAD.

Recommendation:

1. Monitoring and supervising the nurses for early detection of complications related to vascular access and providing appropriate care accordingly.
2. Staff nurses should update their knowledge and practice through continuing training, educational programs and workshops concern the care of children with vascular access devices and its related complications in pediatric health care setting.
3. Further researches the study should be replicated on a larger sample in different settings are needed for generalization the obtained results.

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