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Nursing Care Regarding Post Intraosseous Access Insertion in Critical Care Units

Hanem Ismaiel Zedan, Eman Talaat Mohammed, Amany Mohammed Safwat
Medical-Surgical Nursing-Critical Care Nursing department-Faculty of Nursing -Ain Shams University

Abstract

Background: Critical care nurses have an important role in care of vascular access difficulties' patients. Intraosseous is parenteral vascular access through the bone marrow. **Aim of the study**: to assess nursing care regarding post intraosseous access insertion in critical care units. **Design**: A descriptive exploratory design was utilized in this study. **Research questions**: What are the nursing care regarding intraosseous (IO) access insertion in critical care units? **Setting**: The study was carried out at different Critical Care units at Tanta University Hospitals, in Egypt. **Sample**: A sample of purposive of 40 nurses from different critical care units. The minimum 6 months of experience were included in the present study. **Tools of data collection**: Two tools were used to collect data; the first tool has two parts; part one is characteristics data that included gender, age, years of experience, educational level and area of work. Part two was intraosseous access knowledge questionnaire to assess knowledge regarding indication, contraindication, and nursing measures towards intraosseous access. The second tool was intraosseous observational checklist that was designed to assess nurses' practices while preparing patient and equipment, handling the physician during insertion, administering fluids and medication and removing of intraosseous access. **Results**: The current study findings revealed that 65% of studied nurses had unsatisfactory level of knowledge regarding intraosseous access care. While, 35% of studied nurses had satisfactory level of knowledge. Regarding nurses' level of practice, it was found that, 55% of nurses had unsatisfactory practical level. While, 45% of studied nurses had satisfactory practical level regarding intraosseous access care. Regarding intraosseous insertion. A significant correlation were existed between age and practice also between their level of knowledge and practice regarding caring of theintraosseous access. **Conclusion**: it can be concluded that critical care nurses have unsatisfactory level of knowledge and practice regarding nursing care post intraosseous access insertion in critical care units. **Recommendations:** Carrying out educational programs about nursing management of patients with vascular access difficulties especially intraosseous access. Replication of the study on a large probability of sample from different ICUs concentrated on emergency departments for benefits of emergency situations is required.

Key words: Critical Care Nurses ' knowledge, Nurses practice, intraosseous access, intraosseous infusion.

Introduction

The establishing of vascular access is one of the most common procedures carried out in the emergency department (ED) and a high priority for the care of a critically ill and unstable patient. The condition of the patient often plays a role in the likelihood of attaining vascular access. Conditions associated with difficult

vascular access include obesity, chronic illness, hypovolemia, intravenous (IV) drug abuse, and vasculopathy**(American Heart association (AHA), 2015)**.

Intraosseous (IO) infusion is a means of achieving rapid temporary vascular access until a patient can be stabilized and traditional IV access obtained. It is indicated when fluid or drugs must be introduced into the circulation rapidly and venous access is not readily available. The primary indication is cardiac arrest patients **(Taylor, 2016& Phillips et al., 2010).**

The intraosseous access is a temporary vascular access to provide fluids and medications to resuscitate critically ill neonates may be indicated following unsuccessful attempts to establish intravenous vascular access or when caregivers are more skilled at securing intraosseous access {**The Egyptian Pediatric Association (EPA), 2014}.**

Intraosseous accessis contraindicated in a fractured bone or in a limb with vascular injury, compartment syndrome, cellulitis or burns at the site and underlying bone disease, such as osteoporosis, previous orthopedic procedures, such as prosthetic limb or joint, soft tissue infection, and if there is excessive tissue and/or absence of adequate anatomical landmarks for insertion **(Faminu, 2014).**

Regarding the role of nurse, the Emergency Nurses Association (ENA) and the American Association of Critical Care Nurses (AACN) clarified the role of the qualified registered nurse including insertion, maintaining, and removing IO access devices. Intraosseous access should be considered if IV access cannot be obtained and substantial concern exists for increased morbidity or even mortality in the patient from notobtaining treatment **(Infusion Nurses Society, 2009)**.

Significant of the studding:

Intraosseous access can be achieved quickly and effectively in a variety of clinical settings. Found that a 5-min success rate of 100% for intraosseous insertion versus just 67% success for peripheral intravenous catheter placement. Intraosseous access was achieved on the first attempt 90% of the time versus just a 60% first-attempt success rate for central line placement. **(Dolister, Miller, Borron, et al., 2013).**

The evaluation of the efficacy of the intraosseous route compared to Intra Venous (IV) access routes, researchers demonstrated that fluid infused into the IO space gains access to the central circulation within several seconds even during cardio pulmonary resuscitation (CPR) **(Holleran, 2009).**

Aim of the Study

This study was aimed to:

Assess nursing care regarding post intraosseous (IO) access insertion in critical care units through**:**

1- Assess nurses' level of knowledge regarding post intraosseous (IO) access insertion in critical care units.

2- Assess nurses' level of practice regarding post intraosseous (IO) access insertion in critical care units.

Research question:

What are the nursing care regarding post intraosseous (IO) access insertion in critical care units?

Subjects and methods:

The study was portrayed under the four main designs as follows:

1- Technical design
2- Operational design
3- Administrative design
4- Statistical design

I- Technical design:

It included the research design, setting, subjects, and tools for data collection.

1. Design:

Descriptive exploratory design was used to conduct this study.

2. Settings:

This study was conducted in ICU (14 nurses), laboratory(5 nurses) and ER unit(14 nurses) at Tanta University Emergency Hospital and also in Tanta Oncology Center(7).

3. Subjects:

A purposive sample of (40) nurses was chosen. The sample was drawn from two settings, (Tanta University Emergency Hospital and Tanta Oncology Center). The nurses were working in the above settings in ICU, blood laboratory and ER. In this study, the subjects were selected according to the following criteria: nurses who from all level and who were eligible to participate in the study.

4. Tools for data collection

Two tools were used in the study:

A) Self-interview structured questionnaire:

It was adapted and modified by the researcher and written in a simple English language and translated to Arabic language to assess the level of nursing knowledge regarding intraosseous (IO) access insertion in critical care units. It included the following parts:

Part I: demographic characteristics of nurses. It included questions about: age, level of qualification, years of experiences and training courses.

Part II: Nurses' self-reported knowledge related to intraosseous access (IO) care. This questionnaire was composed of 44 multiple choice questions which had been developed and modified by the researcher based on related literature **(Shirly, 2014; Vidcare, 2013; Mosby's, 2012)**. The nurses were asked to choose correct answer from 4 choices for each question. Points included general knowledge regarding (IO) as (definition, historical background, anatomy and physiology, indications, contraindication, complications), family health education and nursing managements (pre-during-post insertion observation and removing), the tools were revised by experts from professional nursing college to test its validity.

❖ **Scoring system:**

Responses of the studied nurses were scored as each answer was given "1" score for correct answer and "0" for incorrect or unknown answer. The total score was (44) and it was then converted into percentage as follows; scores less than 80% was considered unsatisfactory and the scores equal or more than 80% considered satisfactory based on the simplified Therapeutic Intervention Scoring System (TISS-28) in intensive care units (**Kisorio, Schmollgruber, Becker**,**2009).**

B) Nurses' observational checklist:

It was used to evaluate the nurse's practices related to intraosseous procedure (IO) care. It wasmodified by National Registry of Emergency Medical Technicians. The designed tool was adapted and modified by the researcher. It consists of 46 steps including patient preparation and instruments EZ-IO set pre procedure, nursing care during and post insertion, prevention strategies of complications and removing procedures.

❖ **Scoring system**

A total score for checklist was 46 grades. It was distributed as following; one degree for each item done correctly while zero score was given to not done/done incorrectly and the total level of nurses 'psychomotor skills were categorized as unsatisfactory (<85%), and satisfactory (≥85%)based onthe simplified Therapeutic Intervention Scoring System(TISS-28) in intensive care units(**Kisorio et al., 2009) .**

II- Operational design

It included preparatory phase, validity & reliability, pilot study and field work.

1. Preparatory phase

In this phase, the prepared tools were based on the review of literature as **(Shirly, 2014;Vidcare, 2013; Mosby's,2012)..** In order to assess nursing performance regarding intraosseous (IO) insertion. The study tools were developed and tested its content validity and reliability.

Content validity and reliability:

The developed structured interview questionnaire and observational checklist tools were reviewed by nine panel of experts in critical care medicine (one professor and one lecturer) and medical surgical nursing (3 professors, 2 assist professor and 2 lecturers) to test its validity. Their opinions were elicited regarding the tools format layout, consistency and scoring system. The contents of the tools were tested regarding the knowledge accuracy, relevance and competence. The questionnaire and checklists reliability were confirmed by *Cronbach's alpha* coefficient (alpha = 0.88 for nurses' knowledge questionnaire & alpha = 0.85 for observation checklist.

2. Pilot study

The pilot study was carried out on 10% (4 nurses) of the total study sample. This was done to test the study process's clarity, applicability of the tools used, in addition to the subjects and settings. A little modification of the tools was made based on the results of the pilot study. So the pilot study sample was excluded from the final sample.

3. Field Work:

Study period: This study was conducted during the period starting from June 2016 to December 2016.

An official letter from the Faculty of Nursing –Ain Shams University was delivered to the administrators of Tanta University Hospital. The researcher introduced herself to every participant, to explain the purpose of the study and obtain their approval for participation, and assured them that confidentiality would be maintained throughout the study then a verbal consent was obtained from each participant.

The time taken for every questionnaire to be completed was about 20-30 minutes for each nurse. The researcher met about 3-4 nurses every time in critical care units from 8.00 am to 2.00

pm.

Then, each nurse was observed during intraosseous cannulation (preparing equipment IOZ set, during insertion, post care). The sheets were collected from nurses and corrected manually.

Lately, the designed questionnaire was distributed to them, with instructions about its filling. This was repeated in each place of the study setting as following; 2 days in ICU , 2days in ER and one day in laboratory . The researcher was present all the time to clarify any ambiguity.

III- Administrative design:

An official permission to conduct the proposed study was obtained from the ethical committee. An official permission for data collection and implementation of the study in intensive care unit, ER of Tanta University Hospital was obtained from the directors and the heads of the Critical Care Department, the director of Tanta institute of oncology.

Ethical research considerations:

An official permission to conduct the proposed study was obtained from the ethical committee. An official permission for data collection and implementation of the study in intensive care unit, ER of Tanta University Hospital was obtained from the directors and the heads of the Critical Care Department, the director of Tanta institute of oncology and from all health personal who will be included in the conduction of the study. The researcher emphasized that the participation is voluntary and had the right to withdraw from the study at any time without any rationale. As well anonymity and confidentiality were assured through coding the data. As well, these data will have used for the purpose of this research only and if it will be reused another agreement will be used. The reactions of the administrative personnel were very supportive for the program and they offered all available facilities that might help in the success of the program.

Obstacles of the study:

The only obstacle of this study was insufficient equipment, especially the disposable items.

IV- Statistical design and data analysis:

Data were presented using statistical analysis by using number and percentage, means, standard deviation, frequency, chi-square test, correlation coefficient, and t-test. Probability level of 0.05 was adopted as the level of significance and chi-square test by Statistical Package of the Social Science (SPSS) Software V.20. **(IBM Knowledge Center,2011)**

Result

(I) Distributive demographic data:

Table (1): Distribution of the nurses according to demographic characteristics (n=40).

Frequency / Demographic data	No.	%
Gender		
Male	8	20.0
Female	32	80.0
Age group		
<30	32	80.0
≥ 30	8	20.0
Mean ± SD	29.25 ± 5.06	
qualifications		
Assistant	4	10.0
Technical institute	14	35.0
Bachelor	19	47.5
Postgraduate studies	3	7.5
Experiences in years		
< 10	33	82.5
≥ 10	7	17.5
Mean ± SD	6.90 ± 5.04	
Department		
ICU	14	35.0
Emergency	14	35.0
Laboratory	5	12.5
Oncology	7	17.5
Training Course		
No	30	75.0
Yes	10	25.0
Protocol of IO		
No	40	100.0
Yes	0	0.0

Table (1): shows percentage distribution of nurses regarding demographic characteristics. It was found that, 47.5% of participants were carrying bachelor's degree and 35% of studied nurses had technical institute. Regarding years of experience in nursing field, 82.5% of the studied nurses were <10 years of experience, with mean of 6.90 ± 5.04. While, 75% of the studied nurses hadn't any previous training courses.

(II) Assessment of nurses' knowledge

Table (2): Nurses' general knowledge in relation to intraosseous access care (n=40).

General knowledge items of IO	Correct		Incorrect\ don't know	
	No.	%	No.	%
Definition	39	97.5	1	2.5
Historical background	12	30.0	28	70.0
Considered route	34	85.0	6	12.0
Criteria of bone marrow	33	82.5	7	17.5
Preferences of long bone	35	87.5	5	12.5
Previous common use of IO	28	70.0	12	30.0
Medications delivered through IO	31	77.5	9	22.5
Common sites of insertion	23	57.5	17	42.5
Preferred site of insertion in adult	26	65.0	14	35.0
Indications of IO	31	77.5	9	22.5
Contraindications of IO	34	85.0	6	15.0
Complications of IO	14	35.0	26	65.0
Total Correct (Mean ± SD**)**	28±8.35			

Table (2): reveals that, 97.5% defined the concept of intraosseous correctly. In addition, Nurses had correct answers regarding considered route, criteria of bone marrow and preferences of long bone, indications, medication delivered through IO and contraindications of IO ,85%, 82.5%, 87.5%, 77.5% & 85% respectively. While, 65% of studied nurses had unsatisfactory level of knowledge regarding complications of IO.

Table (3): Total nurses' knowledge scores in relation to intraosseous access care (n=40).

Knowledge	No.	%
Satisfied	14	35.0
Unsatisfied	26	65.0
Total	40	100.0
Total knowledge mean score	73.05 ± 11.97	

Table (3): indicates that 65% of nurses had unsatisfactory level of knowledge regarding intraosseous insertion care with total knowledge mean score of (73.05 ± 11.97). While 35% of studied nurses had satisfactory level of knowledge regarding intraosseous insertion care.

(III) Assessment of Nurses' Practice:

Table (4): Nurses' practice post insertion care in relation to intraosseous access (n= 40)

Action of post insertion care	Done correctly		Incorrect\ not done	
	No.	%	No.	%
Attach the IV tubing set.	40	100.0	0	0.0
Infuse fluid at the desired rate.	38	95.0	2	5.0
Reassess the patient.	30	75.0	10	25.0
Observe any complications as: redness *swelling *hotness * extravasation	28	70.0	12	30.0
Make frequent fluid pressure to improve the flow.	30	80.0	8	20.0
Make frequent flushing to avoid occlusion.	39	97.5	1	2.5
Change dressing around the needle / shift.	18	45.0	22	55.0
Assess intake and output.	36	90.0	4	10.0
Asses any signs of dehydration or renal failure.	24	60.0	16	40.0
Document the time of insertion.	39	97.5	1	2.5
Document the site of insertion.	38	95.0	2	5.0
Document the rate of fluid infused.	40	100.0	0	0.0
Document the type of fluid infused.	40	100.0	0	0.0
Document the volume of fluid infused.	40	100.0	0	0.0
Total correct practice mean score	**34±7.2**			

Table (4): clarifies that 100% of studied nurses had attached the IV tubing set. In addition to, 97.5% of nurses were doing frequent flushing and documented the time, site, rate and type of infusion. While, 55% of nurses didn't change the dressing around the needle/shift.

Discussion

Rapid vascular access is critical in many emergency care situations. In certain presentations such as profound blood loss, dehydration, and burn injury, peripheral veins may be difficult to identify. Multiple studies document that peripheral access cannot be obtained in up to 10% of critically ill patients as **Fowler et al., (2008)** mentioned in their study titled "Consecutive field trials using two different intraosseous devices."

So, the researcher conducted the present study to assess nursing care regarding post intraosseous access insertion in critical care units.

The following discussion will focus upon findings related to the stated question of the study. A discussion of the findings is presented in the following sequence:

- Section I: Demographic characteristics of the studied sample.
- Section II: Nurses' knowledge regarding intraosseous insertion care.
- Section III: Nurses' practice as regards intraosseous insertion care.
- Section IV: Correlation between demographic characteristics with nurses' knowledge and practices scores regarding intraosseous insertion.

Section I: Demographic characteristics of **the studied sample:**

The current study results revealed that the majority of the study sample of nurses, their age was less than 30 years with mean age 29.25 ± 5.06. This finding agreed with **Eskander, Youssef, and Morsy (2013)** who studied "Intensive Care Nurses' Knowledge & Practices regarding Infection Control Standard Precautions at a Selected Egyptian Cancer Hospital". Their results revealed that most nurses' age ranged between 20 - 29 years (27.82± 4.65).In contrast, **Khalil (2013)** reported that the mean age of studied nurses was (32.95±6.99) years.

Regarding the gender of the nurses in the present study, it was found that more than three quarters of the study sample were female nurses. It was in the line with **Mohamed (2011)** who reported that the entire sample wasfemale nurses. In contrast, **Fashafsheh, Morsy, Ismaeel&Alkaiasi, (2013)** reported that slightly more than half of the studied samplewas male nurses. The researcher suggests that, this result may be due to the high proportion of female nurses is most probably attributes to the fact that the study of Bachelor of Science in Nursing (BSN) in the Egyptian Universities was exclusive for females only till few years ago, so the profession of nursing in Egypt was mostly feminine.

Regarding the presence of intraosseous protocol or ACLS algorithm poster, the current study found that there was no protocol related to intraosseous or ACLS algorism or even vascular access available in critical care units. This is contradicted with nursing care standers regarding intraosseous access published by **infusion nurse society, (2009),** in which stated thatthe use of IO access and infusion should be established in organizational policies, procedures, and/or practice guidelines.

Section II: Nurses' knowledge regarding intraosseous insertion:

The finding of the present study regarding the nurses' knowledge revealed that nearly two-thirds of the study sample of nurses had unsatisfactory level of knowledge related to intraosseous cannulation; while less slightly more than one-third of them had satisfactory level of knowledge. This may be due to two possible reasons. First, lack of training as only one-quarter of studied nurses had attended training courses and there was no available written protocol regarding ACLS guidelines including the IO recommendation.The second reason, deficiency of learning resources for nurses to up-date their knowledge and work load would be other reason for the very low level of nurses' knowledge.

This finding was supported by **Voigt et al; 2012**, who studied "Intraosseous vascular access for in-hospital emergency use: a systematic clinical review of the literature and analysis. The authors stated that lack of nurses' knowledge is still seen regarding IO as a result of lack of awareness, lack of guidelines, lack of proper training, and lack of proper equipment.

In the present study, the study found that more than three fourths of nurses identified the definition of intraosseous correctly, indications and contraindications. These findings were in similarity with **INS, (2009)** guidelines regarding intraosseous access, as it considers an alternative vascular access route when recommended that nurse should be alert with indication and contraindication of intraosseous use.

Also **Mohammed, (2015)** reported that more than half of the studied nurses didn't know the definition of isotonic, hypertonic, and hypotonic fluids. While more than half of nurses didn't identify the complications of intraosseous access. This may lead to a negative impact on the patient's care. This finding was in similarity with **Torres (2013)** who studied "Nurses' practice in relation to intraosseous access EZ-IO in a prehospital emergency service" who stated that the weakness of nurses' level of knowledge, it was regarding complications.

Section III: Nurses' practice as regards intraosseous insertion.

According to data that answered the research question, finding of the present study revealed that more than half of the studied sample of nurses had unsatisfactory practice scores related to nursing care regarding post intraosseous access insertion .while less than half had satisfactory practice scores. This finding was in matched with **Taha, (2014)** who reported that the nurses had got low practice scores pertinent to administration of total parental nutrition. Also, it wasin agreement with **Shahin (2012)**who carried out a study entitled "Nurses' knowledge and practices regarding enteral nutrition at the Critical Care Department of Al- Manial University Hospital in Egypt: Impact of a Designed Instructional Program" which conducted on 85 nurses representing approximately all practitioner nurses at the critical care department at Al-Manial University Hospital. The results revealed that the mean score of preprogram practice was 103.6 out of 138 degrees that reflected many incompetent and unsafe practices of nurses.In contrast, **Torres, (2013)** stated that the majority of nurses had a highly satisfactory level of practice regarding intraosseous insertion and removing care.

Regarding removing phase,nurses had unsatisfactory practical level in relation to inform the patient or family to tell the physician for any signs of infection at the site of insertion after removing IO. It is an important issue when patient becomes in high risk of getting nosocomial infection when receiving IV therapy, so prevention of IO or peripheral intravenous cannula infection and its control is only sustainable if there is a commitment from all levels of the healthcare institutions. It is an important principle that nurse should inform and educate the patient or his family the signs of infection post removing any vascular access.

Regarding the documentation of time, site of insertion, medication, infusion rate flow and removing time related to intraosseous cannulation post care, it was found that, the nurses had highly satisfactory level of practice. In agreement with this result, **Torres et al**., **(2013)** who stated that nurses had satisfactory level of practice regarding documentation of location and time of insertion through making the patients wear an IO identification wristband indicating the location and time of insertion.

Section IV: Correlation between demographic characteristics with nurses' knowledge and practices scores regarding intraosseous insertion:

In relation to knowledge, practice and level of education it was found that there were highly statistical significant relation between male nurse, level of education (Bachelor degree) and nurses who had previous training courses with knowledge and practice regarding intraosseous insertion. In similarity with this finding **Kwon, (2014)** reported that there were statistical significant relation

between gender (male nurse) and level of knowledge.

This was congruent with **Shahin (2012)** who reported that as regards the relationship between socio-demographic variables and the nurses' knowledgeand practice regarding enteral nutrition**,** the result revealed that there was no statistical significant difference between males and females in pre-test knowledge and practice.

Regarding the correlation between nurses' practice and knowledge, the present study revealed that knowledge was positive correlated with practice scores of nurses. This finding was in similarity with the finding of**Afzali**, **2017 andTahir, (2016)** who stated that a highly statistical significant correlation between participants' scores of knowledge and practice. In addition to**, Taha, (2014)** and **Shahin, (2012)** were supporting the present study findings. They found that a highly significant relation between nurses' knowledge and their total practice. This is may be due to absence of in-service education program as well as specialized training.

Trueman & Whitehead(2010) illustrated that nurses should attain and maintain a high level of nursing knowledge and nursing practice but to be effective in practice, nurses must gain knowledge before they enter practice.

The role of staff nurses in care of patient with vascular access device is an important one. Nurse is the one who can provide specialized assessment and interventions to the patients. From this study, it is seen that nurses should be periodically evaluated to determine their level of knowledge and skill based on which appropriate education program can be planned **(Smeltzer and Bare, 2008).**

Finally, the present study answered the stated research question that the nurses' level of nursing care regarding IO was unsatisfactory. So in conjunction with the policies and procedures, an educational process must be developed to provide practitioners both the didactic and hands-on experience necessary to become familiar with the intra-osseous device and its use.

The challenges of an interdisciplinary in-situ simulation program were found to be: ensuring protected time for nurses, building a critical mass of instructors/debriefers, providing appropriate, timely orientation to all users and developing a bank of scenarios.

Conclusion

Based on the findings of this study, it can be concluded that critical care and emergency nurses in the current study had unsatisfactory level of knowledge and practice regarding intraosseous cannulation care as an alternative vascular route in ICU, ER and Laboratory. As well as a significant correlation were existed between age and practice also between their level of knowledge and practice.

Recommendations

The current study recommends the following:

- Updating knowledge and practice of ICU and emergency nurses through continuing in-service educational programs.

- Emphasizing the importance of following latest evidence-based practices of vascular access difficulties and the other alternative

routes especially intraosseous cannulation in continuing education/training programs.

Recommendationsfor further researches:

- Replication of the study on a large probability of sample from different ICUs concentrated on emergency departments for benefits of emergency situations is required.
- Identification of factors predisposing to lack of using vascular access guidelines especially intraosseous cannulation in the ICUs.

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