

Nurses' Performance in Caring of Neonates undergoing Exchange Blood Transfusion in Neonatal Intensive Care Units

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Abstract

Background: Exchange transfusion is emergency procedure for severe neonatal hyperbilirubinemia in the world. This procedure need a medical continued expertise for life-saving intervention and nursing care for preparation pre, during and post procedures **Aim:** Assess nurses 'performance in caring of neonates undergoing blood exchange transfusion in Neonatal Intensive Care Units. **Design:** A descriptive design was utilized. **Subjects and Setting** of the study included forty nurses working in different places namely Elshohada Hospital, University Hospital affiliated to Elmonfia, General Shoubra Hospital and 7 Ahmad Maher Teaching Hospital. **Tools:** Two tools:1. Predesigned Questionnaire, 2. Observational checklists. Results: the study results revealed that one quarter of the studied nurses had good knowledge regarding exchange transfusion for the neonates. Also, more than two thirds of the studied nurses had competent practices regarding care of neonates undergoing exchange transfusion. There was statistically significant relation between total score level of nurses' knowledge regarding exchange transfusion for the neonates and their total score level of practices. **Conclusion:** Based on findings of the current study, it can be concluded that minority of studied nurses had good knowledge and more than half of them had competent practices regarding care of neonates undergoing exchange transfusion. **Recommendations:** Encourage nurses to improve and update their knowledge and practices through attending training programs, conference and workshops about care of neonates undergoing exchange transfusion.

Keywords: Exchange transfusion, Blood exchange, Neonatal hyperbilirubinemia, Nurses' Performance.

Introduction

The neonatal period is possibly the most fragile in a human's lifespan. The neonate moves from intrauterine to extra uterine life and adjusts to a different environment during these few days. During this period, focusing of nursing care is to guard and support the neonates as they go through several physiological fluctuations and adjusts to extra uterine life (Stroustrup et al., 2018).

Neonatal hyperbilirubinemia, (defined as a total serum bilirubin level exceeding 5mg/dl) is a frequent problem as neonatal jaundice affects 60% of full- term infants and 80% of preterm infants in the first 3 days of life. Although it is a transient problem, the condition accounts for up to 75% of hospital readmissions in the first week after birth (Sharma, 2021).

In the vast majority of newborns, jaundice is a benign condition. Physiological

aspects that contribute to NH include increased bilirubin production, less efficient hepatic conjugation, and enhanced bilirubin absorption by the enter hepatic circulation (Njoku, et al., 2020).

Neonatal jaundice can be divided into physiologic and pathologic jaundice. Physiologic jaundice is the most common type, occurring usually after the first 24 hours of the life and last no longer than one week. While pathological jaundice usually appears during the first 24 hours of the neonate life and lasts more than one week (Yanli, et al., 2021).

Jaundice occurs when the liver cannot clear a sufficient amount of bilirubin from the plasma. When the problem is excessive bilirubin appears in the blood and indirect hyperbilirubinemia is the predominant from jaundice found in the newborn. The primary goals in the treatment of hyperbilirubinemia are to prevent bilirubin encephalopathy and, as in any blood group incompatibility, to reverse the

hemolytic process. The main form of treatment involves the use of pharmacological management; phototherapy and exchange transfusion is generally used for reducing dangerously high bilirubin levels that may occur with hemolytic disease (Tinti, et al., 2021).

Phototherapy alone is not effective in the management of hyperbilirubinemia when levels are at critical level or are rising rapidly; it is designed primarily for treatment of moderate hyperbilirubinemia. Exchange transfusion becomes the second-line treatment when phototherapy failed to control serum bilirubin levels (Mitra, and Rennie, 2017).

Exchange transfusion (ET) is most commonly done for infants with hyperbilirubinemia of any origin when the serum bilirubin level reaches or exceeds a level that puts the infant at risk for central nervous system toxicity, serum levels of bilirubin for which to begin an ET are under considerable debate. Double-volume ETs taking 50–70 minutes are used for removal and reduction of serum bilirubin. Efficiency of bilirubin removal is increased in slower paced exchanges to allow for time of extravascular and intravascular bilirubin equilibration (Shapiro, and Popelka, 2011).

The nurse undertaking the role of preparation infants for blood component transfusion and providing the written instruction, will be working at a level beyond initial registration, exerting an advanced level of knowledge, expertise, clinical reasoning and diagnostic skills. They will have a high level of professional autonomy and accountability to fulfill their role and responsibilities, working interdependently within a healthcare team. (Edward, et al., 2017).

Significance of the study:

At developing countries. Exchange blood is still widely used in the management of severe jaundice, G6PD and severe sepsis, recent report is showed that more than 5% of neonatal admitted into a newborn unit had ET done, while over the world approximately 6/100,000 needs blood exchange (Gottstein et al., 2016).

About 60% of term and 80% of preterm infants have clinical jaundice in the first week after birth but only 2% to 16% of them develop severe hyperbilirubinemia (total serum bilirubin > 25mg/dl), which is an emergency because it may cause neonatal bilirubin encephalopathy (kernicterus), which can result in death or irreversible brain damage in survivor. Therefore, it is necessary to change the blood to prevent these complication (Ahmed et al., 2019).

Exchange Transfusions decreases the mortality of this group of critically ill newborn infants. Newborn infants in NICU, especially those born premature are at particular risk for exchange transfusion adverse effects. Moreover, ET carries a significant risk of morbidity and mortality due to vascular accidents, cardiac complications, biochemical and hematological disturbances and a low risk of blood borne infections. Therefore, it should be initiated only when the benefit of preventing kernicterus outweighs the complications associated with the procedure.

Operational Definition of Clinical Outcomes: the clinical outcomes involved in this study include ABO incompatibility, Hemolytic disease, Kernicterus, Polycythemia & Pyruvate kinase Deficiency

Aim of the Study

The study aimed of to assess nurses' performance in caring of neonates undergoing blood exchange transfusion in Neonatal Intensive Care Units.

Research Question

- What is the nurses' knowledge regarding exchange transfusion?
- What is the nurses' performance regarding exchange transfusion?
- Is there a relation between nurses' knowledge and their practice regarding exchange transfusion?
- Is there a relation between nurses' performance regarding exchange transfusion and their characteristics?

Materials and Method

Study Design

A descriptive research design was utilized for conducting this study

Study Setting

The present study was conducted at NICU in the following Hospitals:

- 1- University Hospital affiliated to Elmonfia University Hospital in El-monfia.
- 2- Elshohada Hospital affiliated to Directorate of Hospital Affairs in El-monfia
- 3- General Shuobra Hospital affiliated to Directorate of Hospital Affairs in Cairo
- 4- Ahmad Maher Teaching Hospital affiliated to General Organization of Teaching Hospitals and Institutes in Cairo.

These places have been chosen as they accommodate a large number of neonates and the exchange transfusion for a large number of these neonates intensive care unit which consists of 5 wards, each ward **contains** 6 beds (The capacity of the unit includes 30 beds). Data was gathered over a time of approximately 9 months from beginning of December, 2019 to the end of October, 2020.

Subjects

A convenience samples included forty nurses working in Elshohada Hospital, University Hospital affiliated to Elmonfia, General Shuobra Hospital Ahmad maher Teaching Hospital

Inclusion criteria.

Who agreed to participate in the study regardless of their age, gender, nurses' qualification and years of experience.

All neonates suffering from jaundice undergoing exchange transfusion regardless their gestation age and birth weight.

Tools of the study

Data for this study were collected through using the following two tools:

Tool (I) Predesigned Questionnaire Sheet:

It was designed by the researcher in simple Arabic language in the light of relevant studies based on Stewart et al. (2020), it was consisted of the following parts:

Part one

Characteristics of nurses such as; age, gender, qualification, years of experience and attending previous training courses in the area of neonatal care and exchange transfusion.

Characteristics of neonates under exchange transfusion; age, sex, ranking, data of the medical history, Diagnosis, gestational age

Part two: Assessment of nurses' knowledge regarding the following: - Neonatal period, it includes 7 questions such as definition, characteristics of normal neonates, characteristics of premature, complication of procedure.

Diseases require exchange transfusion for neonates. It includes 8 questions such as definition of jaundice, causes, types, signs and symptom, complication.

Care for neonates under exchange transfusion: It includes 26 questions It was included items related to definition of exchange transfusion, causes, types, indication, complication, and follow up.

Medication uses for exchange transfusion. It includes 6 questions such as uses, dose, side effect

❖ Knowledge Scoring System:

A scoring systems to assess nurses knowledge researcher was calculated using a model key answer as the following: complete correct answer was giving one score, and incorrect and don't know answer were giving zero. A total nurses knowledge scores were 47 scores. The scores of all knowledge items were summed up and the total divided by the number of items, these scores were converted into a percentage score. According to the nurses' responses, their level of knowledge was categorized as the following:

Good knowledge: if score $\geq 75\%$.

Average knowledge: if score from 60- <75%.

Poor knowledge: if score < 60%.

Tool II Observational Checklists:

Observational checklists was adopted from Beardsall, et al., (2018), Perry & Lebon, (2015), Lynn & Lebon (2014) and MacDonald, et al., (2012). It was used to assess nurses practice regarding care of neonates undergo exchange transfusion. Included the following parts:

Part 1: This part included 8 procedures about using practice namely; pulse oximeter 14 steps, emergency medication used for exchange transfusion 15 steps, flushing an umbilical venous catheter 10 steps, bundle for prevention of infection when maintaining a central venous catheter CVC or umbilical catheter (UC) 13 steps, oropharyngeal and nasal suctioning 18 steps, ryle Insertion 19 steps, taking blood sampling 14 steps and blood glucose sampling 15 steps.

Part 2: This part included 4 procedures namely; standardized procedures needed for neonates under exchange transfusion namely; preparation for exchange transfusion 25 steps, procedures before exchange transfusion 9 steps, procedures during exchange transfusion 8 steps and procedure after exchange transfusion 3 steps.

Practice Scoring System: The total number of observational Checklists were 12 and total number of steps in the observational checklists were 155 steps, where score one were given for "done" adequately and score zero for "not done". The total practices scores were 155 scores, the scores of steps were summed up and the total divided by the number of the steps, these scores were converted into percentage score. Accordingly the practices was considered as Competent if score $\geq 85\%$, and Incompetent if score $< 85\%$.

II. Operational Design:

Included preparatory phase, content validity & reliability, pilot study, field work and ethical consideration

Preparatory phase:

It included reviewing of related literature and theoretical knowledge of various aspects of the study using books, articles, scientific journal and internet with the aim of acquiring in-depth knowledge about the study.

Content Validity and Reliability:

Content validity was tested through panel of experts 2 from pediatric nursing department, to ensure its validity for comprehensiveness, accuracy, clarity and relevance. The necessary modification were done accordingly. Reliability

of the tools were tested using Cronbach Alpha Test equal 0.737 for the questionnaire and 0.860 for observational Checklists which means that the tool was reliable.

Pilot Study:

A pilot study was carried out after the development of the study tools and before starting the data collection. It was conducted on 10% of the total sample size of the studied nurses (4 nurses) to test the clarity, applicability, feasibility and relevance of the study tools used and to determine time consumed for filling in study tools. After obtaining the results of the pilot study, the ambiguous items were omitted, other items were added and others were modified according to the study subject's response and the final form was developed. The pilot sample was excluded from the main study sample.

Field Work:

The purpose of the study was simply explained to the studied nurses. The actual work of the study was carried out in a period of eleven months from the beginning of December, 2019 to the end of October, 2020. The researcher was available in each study setting during morning and afternoon shift two days per week alternate to observe the flow of neonates needed exchange transfusion. Data were collected by the researcher through interviewing each nurse individually according to the mitigates circumstances of the study setting in addition to the physical and mental readiness of each study subject in the previously mentioned settings. The studied nurses were directly observed and assessed during their actual care provided for neonates undergoing exchange transfusion. The time needed for completing the tools was about 15-20 minutes for each nurse.

Ethical Consideration

The research approval was obtained from the Scientific Research Ethical Committee\ Faculty of Nursing at Ain Shams University before starting the study. An oral approval was obtained from each study subject after the researcher clarified the aim of the study to gain their confidence and trust. The researcher assured maintaining anonymity and confidentiality of subjects' data. Nurses were informed that their participation is voluntary

and that they have the right to withdraw from the study at any time without giving any reasons. The information collected were treated confidentially and used only for the study purpose.

III -Administrative Design:

Written letter was issued from the Dean of Faculty of Nursing Ain Shams University to the directors of the previously mentioned study settings to seek their approval for carrying out the study. An official permission was obtained from the director of each study setting, after explanation of the aim, expected outcomes and duration of the study.

IV- Statistical Design:

The collected data was organized, revised categorized, tabulated and statistically analyzed using number and percentage distribution. Statistical analysis was done by computer using statistical package of social science (SPSS), version 20. The following statistical techniques were used for data analysis: descriptive statistics, frequency, percent distribution, arithmetic mean. Qualitative categorical variable were compared using chi-square test, Pearson correlation test. The observed differences and associations were considered as follow:

P-value >0.05 Insignificance (no difference).

P-value <0.05 Significance difference.

P-value < 0.001 Highly significance difference.

Results:

Table (1): present that the mean age of the studied nurses was 29.15 ± 7.12 , and 85% of them were female and Regarding Nurses' Qualification, it was observed that 45% of them had diploma of schools in nursing, and 50% of them their years of experience were ≥ 6 years. Also, 80% of nurses were from urban area. Regarding workplace, 32.5% of them working at Al-Shuhada Hospital, affiliated to Menoufia, as well as 25% of them were attending training courses regarding exchange transfusion.

Table (2): display that the mean age of the studied neonates was 3.83 ± 2.33 , regarding

gender 50% of them were equal female and male. Regarding gestational age (wks) 50% of them were equal full-term and preterm, and 77.5% of neonate were low birth weight, also 70% of them delivered CS. Also 50% of neonates were from No kinship between parents. As well as 77.5% of neonates the common reason for exchange transfusion was failure to respond to phototherapy.

Table (3) and figure (1): display that one quarter (25%) of the studied nurses had good knowledge regarding exchange transfusion for the neonates. Also, 42.5% of them had average knowledge, while more than one third (32.5%) of them had poor knowledge.

Table (4): displays that three quarters (75%) of the studied nurses had competent practices regarding preparation during exchange transfusion, while less than half (45%) of them had incompetent practices regarding preparation after exchange transfusion.

Table (5) and figure (2): clarifies that more than two thirds (62.5%) of the studied nurses had competent practices regarding care of neonates undergoing exchange transfusion, while more than one third (37.5%) of them had incompetent practices.

Table (6): reveals that, there were highly statistically significant relation between total score level of nurses' knowledge regarding exchange transfusion for the neonates and their years of experience and training courses at p-value <0.001 . Also, there were statistically significant relation with qualification at $P < 0.05$. While there were no significant relation between nurses' age, gender and their total score level of their knowledge at $P > 0.05$,

Table (7): shows that there were positive correlation between total score level of nurses' knowledge regarding exchange transfusion for the neonates and the total score level of nurses' practices regarding care of neonates undergoing exchange transfusion at p-value <0.001 .

Table (1): Number and percentage distribution of nurses according to their characteristics (n=40).

Characteristics of nurses	No.	%
Age (years)		
19 -< 20	2	5.0
20 -< 30	22	55.0
30 -< 40	13	32.5
≥ 40	3	7.5
Mean±SD		29.15 ± 7.12
Gender		
Female	34	85.0
Male	6	15.0
Marital Status		
Married	33	82.5
Divorced	5	12.5
Widow	2	5.0
Qualification		
Bachelor in Nursing Science	12	30.0
Diploma Technical Institute in Nursing	10	25.0
Diploma of Schools in Nursing	18	45.0
Years of Experience		
< 3	14	35.0
3- < 6	6	15.0
≥ 6	20	50.0
Mean±SD		27.78 ± 7.07
Residence		
Rural	8	20.0
Urban	32	80.0
Workplace		
El-Shuhada Hospital	13	32.5
University Hospital at Elmonfia	12	30.0
General Shubra Hospital	8	20.0
Ahmed Maher Teaching Hospital	7	17.5
Training Courses		
No	30	75.0
Yes	10	25.0

Table (2): Number and percentage distribution of neonates according to their characteristics (n=40).

characteristics of neonates	No.	%
Age (days)		
<15	40	100.0
>15	0	0.0
	Mean±SD	3.83±2.33
Gender		
Female	20	50.0
Male	20	50.0
Gestation age (wks)		
Fullterm	20	50.0
Preterm	20	50.0
	Mean±SD	36.35±2.33
Birth weight (kg)		
Low birth weight	31	77.5
Normal birth weight	9	22.5
	Mean±SD	2.13±0.58
Mode of delivery		
Cesarean section	28	70.0
Normal vaginal delivery	12	30.0
Kinship between parents		
No kinship	20	50.0
First degree	17	42.5
Second degree	3	7.5
Reason for the exchange transfusion		
Failure to respond to phototherapy	6	77.5
Bilirubin continues to rise	31	15.0
The emergency of symptoms of acute cerebral degeneration	3	7.5

Table (3): Number and percentage distribution of nurses according to their total score level of knowledge regarding exchange transfusion for the neonates (n=40).

Total score level of nurses' knowledge	No.	%
Good	10	25.0
Average	17	42.5
Poor	13	32.5
Total	40	100.0

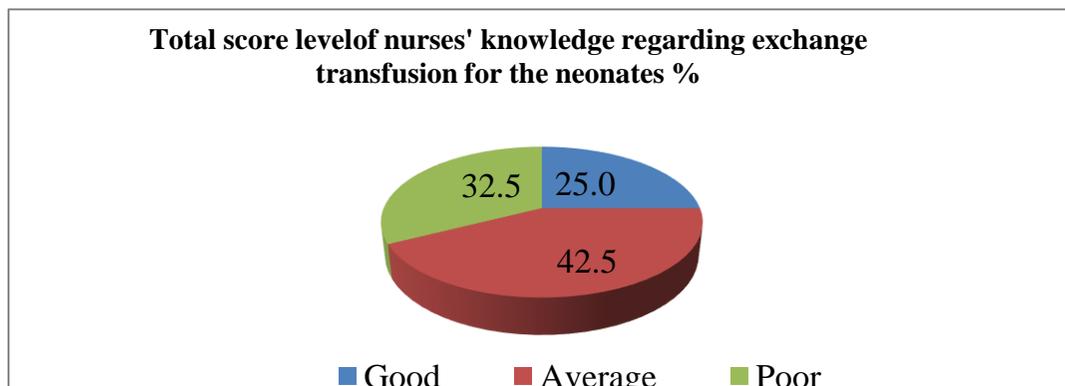
**Figure (1):** Percentage distribution of nurses according to their total score level of knowledge regarding exchange transfusion for the neonates.

Table (4): Number and percentage distribution of studied nurses according to their total score level of practices related to exchange transfusion.

Nurses' practices	Total score level of nurses' practices			
	Competent		Incompetent	
	No.	%	No.	%
Preparation needed for exchange transfusion	27	66.8	13	33.2
Preparation before exchange transfusion	23	57.5	17	42.5
Preparation during exchange transfusion	30	75.0	10	25.0
Preparation after exchange transfusion	22	55.0	18	45.0

Table (5): Number and percentage distribution of nurses according to their total score level of practices regarding care of neonates undergoing exchange transfusion.

Total score level of nurses' practices	No.	%
Competent	25	62.5
Incompetent	15	37.5
Total	40	100.0

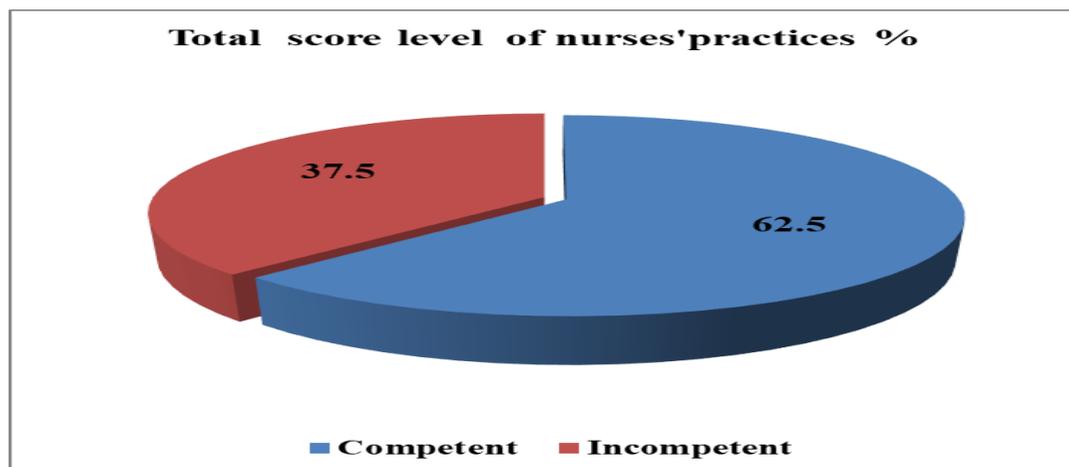


Figure (2): Percentage distribution of studied nurses according to their total score level of practices regarding care of neonates undergoing exchange transfusion.

Table (6): Relation between total score level of nurses' knowledge regarding exchange transfusion for the neonates and their characteristics (n=40).

Nurses' characteristics	Total Score Level of Nurses' Knowledge						Test of significance	
	Poor (n=13)		Average (n=17)		Good (n=10)		x ²	p-value
	No.	%	No.	%	No.	%		
Age (years)								
<20	0	0.0	0	0.0	2	20.0	9.416	0.151
20-<30	7	53.8	10	58.8	5	50.0		
30-<40	4	30.8	7	41.2	2	20.0		
≥40	2	15.4	0	0.0	1	10.0		
Gender							5.430	0.066
Female	10	76.9	17	100.0	7	70.0		
Male	3	23.1	0	0.0	3	30.0		
Qualification							16.833	0.002*
*Bachelors in Nursing Science	2	15.4	2	11.8	8	80.0		
*Technical Institute in Nursing	5	38.5	5	29.4	0	0.0		
*Diploma of Schools in Nursing	6	46.2	10	58.8	2	20.0		
Years of Experience							23.082	<0.001**
< 3	11	84.	3	17.6	0	0.0		
3 -< 6	1	7.7	2	11.8	3	30.0		
≥ 6	1	7.7	12	70.6	7	70.0		
Training Course							22.055	<0.001**
No	13	100.0	15	88.2	2	20.0		
Yes	0	0.0	2	11.8	8	80.0		

P-value >0.05 not significant; *p-value <0.05 significant.

Table (7): Relation between total score level of nurses' knowledge regarding exchange transfusion for the neonates and their total score level of practices (n=40).

Total Score level of Nurses' practices	Total score level of nurses' Knowledge						Total		Test of significance	
	Poor		Average		Good		No.	%	X ²	p-value
Competent	4	30.8	12	70.6	9	90.0	25	62.5	9.286	0.009*
Incompetent	9	69.2	5	29.4	1	10.0	15	37.5		
Total	13	100.0	17	100.0	10	100.0	40	100.0		

*p-value <0.05 Significant

Table (8): Correlation between total score level of nurses' Knowledge regarding exchange transfusion for the neonates and the total score level of nurses practices regarding care of neonates undergoing exchange transfusion (n=40).

		Total score level of nurses' Knowledge	Total score level of nurses' practices
Total score level of nurses' Knowledge	r-test		0.608
	p-value		0.001**
	N		40
Total score level of nurses' practices	r-test	0.608	
	p-value	0.001**	
	N	40	

**p-value <0.001 high Significant

Discussion

Immune and non-immune-mediated hemolytic disease of the neonates may be accompanied by hyperbilirubinemia requiring exchange transfusion. Exchange transfusion provides rapid reduction of circulating bilirubin, so

it could represent appropriate treatment in many cases of severe hyper-bilirubinemia in the neonatal period. (Bujandric & Grujic 2016 and Noor et al., 2021).

Concerning age of the studied nurses, results of the present study revealed that more

than half of studied nurses their age between 20-<30 years with mean 29.15 ± 7.12 years. This result was consistent with study of **Mostafa et al., (2016)** entitled "Assessment of Nurses' Performance Regarding Care of Children Undergoing Mechanical Ventilation" and found that more than half of the studied nurses their age between 20-<30 years with mean 28.2 ± 4.8 years. From the researcher's point of view, the advantages of nurses in this age that they were full of experiences, which is always required in such critical departments as NICU. This age category can easily achieve high quality nursing care and increase the ability to tolerate the working load.

The finding of the present study showed that the majority of nurses under study were females. This finding was in the same line with study of **Freixo et al., (2017)** about "Nurses knowledge in Transfusion Medicine in a Portuguese University Hospital" who found the majority of studied nurses were females. From the researchers' point of view, this might be due to the fact that most of the graduates of the nursing profession are females despite the difference in society's view of the profession and the entry of males into the field of nursing work, but the number of nursing staff in the profession remains females more than males.

Regarding nurses' qualification of the studied nurses, the finding of the present study illustrated that, less than half of the studied nurses had nursing diploma. This finding was matched with study of **Brooks & Combest (2018)** entitled "In-service training is useful in teaching transfusion children medicine principles" and revealed that more than half of the studied nurses had secondary nursing school diploma. From researcher's point of view, This result could be due to the fact that, the wide base for nurses' education in Egypt is diploma and nursing secondary schools provide the hospitals with large number of graduated diploma nurses than other agencies such as nursing faculties and technical nursing institutes. These findings were come in contrast with study of **Bakhshi et al., (2018)** about "Impact of Instructions on the Developmental Status of Premature Infants on the Clinical Practice of Neonatal Intensive Care Unit

(NICU) Nurses" who reflected that the majority of the NICU nurses had a master's degree.

Concerning attending of previous training courses related to exchange transfusion, in the light of the finding of the current study, it was revealed that three quarters of studied nurses did not attend any training courses. This finding was supported by study of **Gameel et al., (2020)** about "Assessment of Knowledge and Practices of Health Care Providers about Neonatal Jaundice in Primary Health Care Units in Fayoum Governorate", and revealed that the majority of studied nurses did not attend any specific training about neonatal jaundice and blood exchange.

The present study revealed that all of studied neonates' age < 15 days with the mean 3.83 ± 2.33 days. This finding was in the same line with study of **Kotwal et al., (2017)** entitled "Morbidity and mortality among neonates admitted to a neonatal intensive care unit of a tertiary care teaching hospital of Jammu and Kashmir (India)", and showed that most (91.6%) of the studied neonates' age < 15 days.

Related to gestational age (weeks), the present study showed that 50% of the studied neonates were equal full-term and preterm, this finding was matched with study of **Raikwar, (2018)** entitled "A study of neonatal admission pattern and outcome from rural Haryana" and reported that 49% of the studied neonates were preterm and 51% was full term.

As regards the weight of the studied neonates, the current findings revealed that more than three quarters of them were low birth weight. This result was in the same line with study of **Nurani et al., (2017)** entitled "Incidence of Neonatal Hyperbilirubinemia Based on their Characteristics at Dr. Hasan Sadikin General Hospital Bandung Indonesia" and reported that the majority of the studied neonates weigh less than 2500 gram. From researcher's point of view, this result might be due to the low birth weight was considered the risk factor for neonatal hyperbilirubinemia.

Concerning on diagnosis of the studied neonates, the current study revealed that the entire studied neonates was diagnosed as

jaundice. This finding was harmony with study of **Akintan et al., (2019)** about "Pattern and Outcome of Newborn Emergencies in a Tertiary Center, Lagos, Nigeria" and proved that the major reason for exchange transfusion among neonates was jaundice.

Regarding reason for the exchange transfusion, finding of the present study revealed that more than three quarters of the studied neonates was failure to respond to phototherapy, this finding was matched with study of **Bujandric & Grujic (2016)** about "Exchange transfusion for severe neonatal hyperbilirubinemia: 17 years' experience from Vojvodina, Serbia Indian" and reported that the major reason for the exchange transfusion was failure to respond to phototherapy among the studied neonates.

According to nurses' knowledge about the neonates, the result of the current study clarified that all of the studied nurses had correct knowledge regarding meaning of intrauterine growth retardation, the characteristics of premature infants, while more than half of the nurses had incorrect knowledge regarding definition of post term neonates, these results were supported with study by **Issa et al. , (2018)** about " Evaluation of Nurse's Knowledge in Management of Premature Baby in Neonatal Units" and showed that most of the studied nurses had knowledge about the characteristics of premature.

The results of the present study reported that the majority of the studied nurses had correct knowledge regarding meaning of Jaundice, types of hyper-bilirubinemia, treatment of hyperbilirubinemia and meaning of neonatal polycythemia, while less than half of the nurses had incorrect knowledge regarding causes of pathological Jaundice. These result disagreement with study of **Ibrahim et al., (2019)** about "Assessment of Nursing Care Provided to Neonates Undergoing Phototherapy" and showed that about three quarters of nurses had poor knowledge as regards definition, signs and symptoms of Jaundice.

The results of the present study clarified that, most of the nurses had correct knowledge

regarding preparation needed for exchange transfusion and also during exchange transfusion. Also more than half of nurses had correct knowledge regarding the medication used for exchange transfusion. These results were matched with study by **Aydin et al., (2021)** about " Is it necessary to give calcium infusion during the exchange transfusion in newborns" and found that the majority of the studied nurses had adequate knowledge of appropriate transfusion monitoring and required action in the event of a transfusion reaction.

On the investigating total score level of nurse's knowledge regarding exchange transfusion for the neonates, the present study displayed that one quarter of the studied nurses had good knowledge regarding exchange transfusion for the neonates. Also, nearly less than half of them had average knowledge, while more than one third of them had poor knowledge. These findings were supported with study of **Pandya & Ravindra (2015)** entitled "The Effectiveness of Planned Teaching Program on Knowledge regarding Care of the Neonate under Phototherapy among Diploma Internship Nursing Students in Selected Nursing Schools at Gujarat State" and illustrated that more than half of the studied nurses had poor knowledge regarding blood exchange.

Related to studied nurses' practices about preparation needed for exchange transfusion, the present study result displayed that, entire of studied nurses had adequate level of practices regarding preparation needed for exchange transfusion. While more than two thirds of them had inadequate level of practices regarding record of exchange transfusion. These results in same line with study by **Verma & Sharma (2020)** entitled " Descriptive Study to Assess the Knowledge Regarding Care of Newborn Under Phototherapy among Staff Nurses with The View to Develop Information Pamphlets in Muskan Hospital" and showed that majority of the studied nurses had good practices regarding phototherapy.

Regarding to practices of studied nurses about preparation before exchange transfusion, the current study displayed that entire of studied nurses had adequate level of practices regarding neonatal specimens, also more than two thirds of them

had inadequate level of practices regarding baseline observations HR, RR, BP, SaO₂, axilla/rectal temperature and aspirate stomach & leave NG. These result disagreement with study of **Sobeih et al., (2022)** entitled "Evaluation of Teaching Safety Procedure to Acquire Nurses, Best Practice for newborn Receiving Exchange Transfusion" and showed that lowest percentage of the studied nurses had good practices regarding preparation before exchange transfusion.

According to studied nurses' practices toward preparation during exchange transfusion, the current study results revealed that all of studied nurses had adequate level of practices regarding medical staff to remain with newborn and mix donor pack every 15 minutes. This result matched with study of **Salia et al., (2021)** about " Knowledge, attitudes and practices regarding neonatal jaundice among caregivers in a tertiary health facility in Ghana" and showed that less than two thirds of the studied nurses had good practices for blood specimens as ordered and document.

Regarding to studied nurses' practices about preparation after exchange transfusion, the current study results displayed that all of studied nurses had adequate level of practices regarding newborn specimens. While less than half of studied nurses were not done regarding continuous cardio-respiratory monitoring for a minimum 2 hours and discuss timing of restarting feeds with staff. These results were supported with study of **Salia et al., (2021)** about "Knowledge, attitudes and practices regarding neonatal jaundice among caregivers in a tertiary health facility in Ghana" and illustrated that less than two thirds of the studied nurses had good practices for newborn specimens.

On investigation the total score level of studied nurses' practices about care of neonates undergoing exchange transfusion, the present study finding clarified that more than two thirds of the studied nurses had competent practices regarding care of neonates undergoing exchange transfusion, while more than one third of them had incompetent practices. This result disagreement with study by **Mukhlif & Neamah (2021)** about "Effectiveness of an

Educational Program on Nurses' Practices about Exchange Transfusion Procedure in Neonatal Intensive Care Unit in Al-Ramadi Teaching Hospital for Maternity and Children" and revealed that the majority of the studied nurses had fair practices regarding exchange transfusion.

The current study results revealed that, there were statistically significant relation between total score level of nurses' knowledge regarding exchange transfusion for the neonates and their years of experience, training courses at p-value <0.001. Also, there were statistically significant relation with qualification at P<0.05. While there were no significant relation with their age, gender and their total score level of nurses' knowledge at P>0.05. These results matched with **Jain et al., (2018)** who conducted study about " Severe ABO hemolytic disease of fetus and newborn requiring exchange transfusion" and showed that there were statistically significant relation between knowledge of the studied sample and the nurses' qualification (P<0.05).

The results of the current study clarified that, there were statistically significant relation between total score level of nurses' knowledge regarding exchange transfusion for the neonates and their total score level of practices at p-value 0.009. This result in same line with study of **Santhi, (2020)** about "A study to Assess the Effectiveness of Protocol on Care of Newborn in Phototherapy on Knowledge and Practice among Nurses at Selected Hospitals in South India" and found a highly correlation between the overall mean level of knowledge and practices of nurses regarding care of neonates undergoing exchange transfusion.

The results of the current study presented that, there were positive correlation between total score level of nurses' knowledge regarding exchange transfusion for the neonates and the total score level of nurses' practices regarding care of neonates undergoing exchange transfusion at p-value <0.001. This result in same line with **Abdel-Gafour et al., (2020)** who conducted study about " Effect of Nursing Intervention on Care of Neonates Suffering from Hyperbilirubinemia". and displayed that there were positive correlation between total

score level of nurses' knowledge blood exchange and total score level of nurses' performance at (p-value <0.001).

Conclusions

Based on findings of the result study, one quarter of the studied nurses had good knowledge regarding exchange transfusion for neonates, as well as more than two thirds of nurses had competent practice regarding care of neonates undergoing exchange transfusion. Also, there was a positive correlation between total score level of nurses' knowledge regarding exchange transfusion for the neonates and the total score level of nurses' practices regarding care of neonates undergoing exchange transfusion.

Recommendations

- 1- Periodic assessment of nurses' performance regarding caring of neonates undergoing exchange transfusion in NICU.
- 2- Encourage nurses to improve and update their knowledge and practices through attending training programs, conferences and workshops about care of neonates undergoing exchange transfusion.
- 3- Procedure book should be available at NICU as a unified reference for all nurses who provide care for neonates undergoing exchange transfusion.
- 4- Further studies with a larger sample of the nurses working at NICU at different hospitals.

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