Improving Nurses' Performance Regarding Care of Neonates with Hyperbilirubinemia Undergoing Blood Exchange: An Educational Program

Dalia Zaghloul El Sayed[1], Khadiga Mohamed Said[2] and Reda Mohamed Abdullah[3]

(1) B.Sc, Nursing (2008), Nursing Specialist, Kafr El-Sheikh General Hospital, (2) Professor of Pediatric Nursing, Faculty of Nursing, Benha University and (3) Lecturer of Pediatric Nursing, Faculty of Nursing, Benha University, Egypt.

Abstract

Background: Blood exchange is the second- line treatment for sever hyperbilirubinemia. It involves removing aliquots of the neonate blood and replacing with donor blood in order to remove abnormal blood components and circulate toxins whilst maintaining adequate circulating blood volume. **Aim of the study:** Was to improve nurses' performance regarding caring of neonates with hyperbilirubinemia undergoing blood exchange**. Research design:** A quasi-experimental design was utilized. **Settings:** Neonatal Intensive Care Units at Benha University Hospital and Benha Specialized Pediatric Hospital **Sample:** A convenient sample of 80 nurses working in the previously mentioned settings and a purposive sample (43) of neonates with hyperbilirubinemia undergoing blood exchange. **Tools: Tool I:** A structured interviewing questionnaire sheet including the following parts; **Part (1):** Personal characteristics of the studied nurses. **Part (2):** Personal characteristics of neonates. **Part (3):** Nurses' knowledge assessment sheet. **Tool II:** Observational checklists. **Results:** There was a highly positive statistical correlation between total knowledge and total practices scores of the studied nurses pre and post-implementation of the educational program. **Conclusion:** The educational program was effective in improving nurses' knowledge and enhancing their practices regarding care of neonates with hyperbilirubinemia undergoing blood exchange. **Recommendation**: Periodical follow-up of nurses' knowledge and practices regarding care of neonates with hyperbilirubinemia undergoing blood exchange to detect the points of strength and weakness to act on.

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Keywords: Blood Exchange, Care of Neonates, Educational Program, Hyperbilirubinemia, Nurses' Performance.

Introduction

Neonatal jaundice occurs when the neonate has a high level of bilirubin in the blood. Bilirubin is a yellow substance that the body creates when it replaces old red blood cells. The liver helps break down the substance so, it can be removed from the body in the stool. The causes of hyperbilirubinemia were classified as follows: Rh incompatibility that is defined as jaundice with the presence of hemolysis in Rh-positive neonate from Rh-negative mother.

Hemolytic disease due to ABO incompatibility is the presence of jaundice, elevated reticulocyte count, a peripheral smear suggestive of hemolysis and anemia with or without direct Coombs positivity in a neonate with blood group A or B from a mother with blood group O. Minor blood group incompatibility is due to minor erythrocyte non-D Rh antigens with direct Coombs positivity **(Aygün & Semerci, 2022)**.

Blood exchange (BE) is the removal of an newborn's blood with high bilirubin levels

and/or antibody-coated red blood cells (RBCs) and replacement with fresh donor blood. It is indicated when hyperbilirubinemia remains at high levels despite intensive phototherapy and is particularly useful when there is excessive hemolysis. Another indication for BE is moderate-severe Acute Bilirubin Encephalopathy (ABE), regardless of the bilirubin level at the time **(Dilfuza et al., 2022).**

Nurses play a vital role by monitoring treatments, educating parents, and keeping the team apprised about changes in the pediatric patient's condition. As per the American Academy of Pediatrics, every newborn must have a pre- discharge bilirubin check and should also be assessed for risk factors associated with the development of severe hyperbilirubinemia to improve the newborn's outcomes. Pediatric nurses have an important role in ensuring blood exchange safety, knowing the indications for blood exchange, checking data to prevent errors, guiding neonate's parents on blood exchange, detecting and acting in compliance with blood exchange reactions and documenting the procedure **(Aygün & Semerci, 2022).**

Significance of the study:

Neonates undergoing blood exchange most frequently during hospitalization due to hyperbilirubinemia. The significance of this study was management of hyperbilirubinemia by prevention of neurotoxicity, impairment, and disability. The definite method is removing bilirubin from blood via blood exchange**.** Blood exchange is a common therapeutic procedure in NICUs, and it also carries the risk of complications associated with blood exchange **(Korean, 2018).**

Extremely high levels of bilirubin can lead to brain damage. Severe jaundice in newborns can occur as a result of a variety of causes including Rhesus hemolytic disease, ABO incompatibility or atypical antibodies **(Shakoor et al., 2018)**. Therefore, it is crucial for nurses to have sufficient knowledge and skills of the situation to maintain safe blood exchange. So, this study aims to improve nurses' performance regarding caring for neonates with hyperbilirubinemia undergoing blood exchange **(Atia et al., 2022).**

Aim of the study

The aim of this study was to improve nurses' performance regarding care of neonates with hyperbilirubinemia undergoing blood exchange

Research hypothesis

The total level of the nurses' knowledge and practices regarding care for neonates undergoing blood exchange was improved after implementation of the educational program.

Research design:

Quasi-experimental design (pre &post-test) was utilized to conduct this study.

Research settings:

This study was conducted at at the Neonatal Intensive Care Units (NICUs) at Benha University Hospital and Benha Specialized Pediatric Hospital.

Research subjects:

Two main subjects were included in the study:

Sample I - A convenient sample of 80 nurses (45 at Benha University Hospital and 35 at Benha Specialized Pediatric Hospital) who are working full-time nurse providers at the previously mentioned settings, regardless of their characteristics.

Sample II – A purposive sample of 43 neonates with hyperbilirubinemia undergoing blood exchange from the previously mentioned settings (27 neonates from Benha University Hospital and 16 neonates from Benha Specialized

Pediatric Hospital) under the following inclusion criteria:

-Neonates not responding to phototherapy and undergoing blood exchange.

-Free from blood diseases.

-No umbilical cord infection.

-No falling of umbilical stump.

Tools of data collection:

Data of the current study was conducted through using the following tools:

Tool (I): A Structured interviewing questionnaire:

It was designed by the researcher in the light of the current relevant research and literatures in a simple Arabic language after reviewing the related and recent literatures **Rajan et al., (2020) and Boskabadi et al., (2021)**. It included the following parts:

Part (1): Personal characteristics of the studied nurses such as; age, gender, educational level, years of experience and attendance of training courses related to care of neonates with hyperbilirubinemia undergoing blood exchange.

Part (2): Characteristics of the studied neonates such as; gestational age, gender, birth weight and current weight.

Part (3): Nurses' knowledge assessment sheet (pre / post educational program): It included:

Nurses' knowledge regarding hyperbilirubinemia:

It consisted of close- ended questions about definition, types, causes of hyperbilirubinemia, symptoms of hyperbilirubinemia, definition of physiological jaundice, definition of pathological jaundice, diagnosis of hyperbilirubinemia, treatment and complications of hyperbilirubinemia (10questions)**.**

Nurses' knowledge regarding blood exchange:

It consisted of close-ended questions regarding definition of blood exchange, indications, benefits, types, used equipment, complications of blood exchange, nursing role before, during and after blood exchange (9 questions).

Scoring system for nurses' knowledge:

- All knowledge variables weighted according to items included in each question. Each item was given a score (2) when the answer was complete correct answer, a score (1) when the answer was incomplete correct answer and a score (0) when the answer was incorrect answer or don't know. The total level of nurses' knowledge was classified as the following:

- Good knowledge (≥75% correct answer)
- Average knowledge (60%to <75% correct answer)
- Poor knowledge (<60% correct answer)

Tool (II): Observational Checklist (pre/post designed guidelines):

It was adapted from **Evans, (2011) and Northern Devon Health Care, (2018)** to assess actual nurses' practice regarding care of neonates with hyperbilirubinemia undergoing blood exchange. It included the following:

- Care before blood exchange, including**.** (preparation of blood, hand washing).
- Care during blood exchange (technique).
- Care post blood exchange (post procedure).

Scoring system for nurses' practice:

- The score of practices ranged from (1) to (2), each statement scores as following: (2) if done completely and (1) if done incompletely. Total level of nurses' practices was classified as the following:

- Satisfactory level: ≥ 75%
- Unsatisfactory level:<75%

Content validity:

Tools of data collection were translated into Arabic language and submitted to a jury of three experts in Paediatric Nursing from the Faculty of

Nursing/Benha University to test the content validity of tools and judge its clarity, comprehensiveness, relevance, simplicity and accuracy.

Reliability:

The reliability of the developed tools was estimated using the Chronbach's Alpha co-efficient which revealed that, each of the two tools consisted of relatively homogenous items as indicated by high reliability for each tool. The internal consistency of the structured interviewing questionnaire was 0.85 and for the observational checklist was 0.80.

Ethical considerations:

The study was approved by the Ethics Committee at the Faculty of Nursing, Benha University. All ethical issues were taken into consideration during all phases. The researcher clarified the aim of the study and the expected outcomes to all studied nurses during the initial interview. The studied nurses were assured that all information would be confidential and their participation in the study was voluntary. Additionally, nurses were allowed to withdraw from the study at any time without giving any rational. Confidentiality of the gathered data and results were secured.

Pilot study:

A pilot study was conducted on 10% (8 nurses) of the study subjects to evaluate the clarity, feasibility, applicability of the study tools and time needed for each data collection tool to be filled in. Pilot study nurses were included in the present study sample.

Field work:

The process of data collection was carried out from the beginning of April 2022 to the end of September 2022, covering six months. The following phases were carried out to achieve the aim of the study, assessment, planning, implementation and evaluation.

Assessment phase:

The assessment phase involved interviewing the studied nurses individually to collect baseline data. First, the researcher visited Benha University Hospital and Benha specialized Pediatric Hospital three days/week (Saturday, Monday, Wednesday) by rotation in the morning and afternoon shifts It took nearly from 1to 3 hours. The researcher collected the neonate's medical assessment sheet from medical hospital records. This period took about two months (from the beginning of April 2022 to the end of May 2022), where 3-4 nurses were interviewed each time depending on their physical and mental readiness in addition to the work environment related factors.

Planning phase:

Based on baseline data obtained from the assessment phase and relevant literature reviews, an educational program was developed by the researcher in a simple Arabic language according to the studied nurses' needs (Appendix VI). The educational program was constructed, revised, and modified from the related literatures to improve the nurses' knowledge and actual practices regarding care of neonates with hyperbilirubinemia undergoing blood exchange.

Implementation phase:

The educational program was achieved through 6 sessions The researcher used different teaching methods such as; group discussion, role playing and lecture as teaching methods for knowledge sessions. Media utilized were educational program guided by an educational booklet, visual materials, colored pictures, videos and PowerPoint that was constructed by the researcher after reviewing the related literature.

Improving Nurses' Performance Regarding Care of Neonates with Hyperbilirubinemia Undergoing Blood Exchange: An Educational Program

Evaluation phase:

After the implementation of the educational program, the researcher carried out post- test immediately to assess nurses' knowledge and actual practices by using the same format of pretest. This phase took about 2 months (from the beginning of August to the end of September 2022).

Statistical analysis:

The collected data were organized, tabulated, and statistically analyzed using Statistical Package for Social Sciences (SPSS) version 20. Data were presented using descriptive statistics in the form of numbers and percentages for qualitative variables and mean and standard deviation for quantitative variables. Qualitative variables were compared using Chi-square test (X^2) which used to measure the relation between nurses' characteristics, their knowledge and practices. Correlation coefficient (r) was used for quantitative variables that were normally distributed. A highly statistical significant level value was considered when ($p < 0.001$). A statistical significant level value was considered when ($p< 0.05$), and No statistical significance difference was considered when ($p> 0.5$).

Results:

Table (1): Displays personal characteristics of the studied nurses. It is clear that, more than half (58.8%) of the studied nurses were in the age group of 20-30 years, with a mean age of 31.33±8.142 years. As regards the gender, this table reveals that, more than half (55.0%) of them were females. Concerning the educational level, more than two-fifths (41.3%) had nursing technical institute. Also, this table represents that, two-fifths (40.0%) of them had 5-10 years of experience, with a mean 8.88±5.21 years and less than two-thirds (63.8%) of them didn't attend any training courses related to care of newborns with

hyperbilirubinemia undergoing blood exchange.

Table (2): Reveals personal characteristics of the studied neonates. It is clear that, less than half (48.8%) of the studied neonates were born with gestational age 32-36 weeks, with a mean gestational age of 36.216±4.80 weeks. As regards the gender, this table demonstrates that, more than half (53.5%) of them were males. Concerning birth weight, this table reflects that, more than half (51.2%) of them weighted 2.5-3.5 kg, with a mean weight of 2278.54±473.14 gm. As regards current weight, this table shows that, less than half (48.8%) of studied neonates had current weight of 2.5-3.5 kg, with a mean weight of 2289.54±473.14 gm.

Figure (1): Displays that, more than one third (37.5%) and 18.8% of the studied nurses had good and poor total knowledge score regarding hyperbilirubinemia and blood exchange pre-intervention respectively. While, less than two-thirds (65.0%) and 13.8% of them had good and poor total knowledge score post- intervention respectively.

Figure (2): Displays that, more than half (56.3%) and more than two-fifths (43.7%) of the studied nurses had satisfactory and unsatisfactory total practices score pre-intervention respectively. While, more than three-quarters (78.8%) and more than fifth (21.2%) of them had satisfactory and unsatisfactory total practices score post-intervention respectively.

Table (3): Clarifies that, there was strong positive correlation between total knowledge and total practices scores of the studied nurses at pre- and post-intervention phase ($p≤0.001$).

Table (1): Distribution of the studied nurses according to their personal characteristics (n=80).

Personal characteristics	No	%
Age (years)		
20-30	47	**58.8**
> 30-40	20	25.0
> 40	13	16.2
Mean ±SD 31.33±8.142		
Gender		
Male	36	45.0
Female	44	**55.0**
Educational level:		
Secondary Nursing Diploma	30	37.5
Nursing Technical Institute	33	**41.3**
Bachelor of Nursing	13	16.2
Postgraduate Studies	4	5.0
Years of experience:		
≤ 5 years	23	28.7
5 - 10 years	32	**40.0**
> 10 years	25	31.2
Mean ±SD=8.88±5.21		
Attendance of training courses related to care of newborns with hyperbilirubinemia undergoing blood exchange?		
Yes	29	36.2
No	51	**63.8**

Table (2): Distribution of the studied neonates according to their characteristics (n=43).

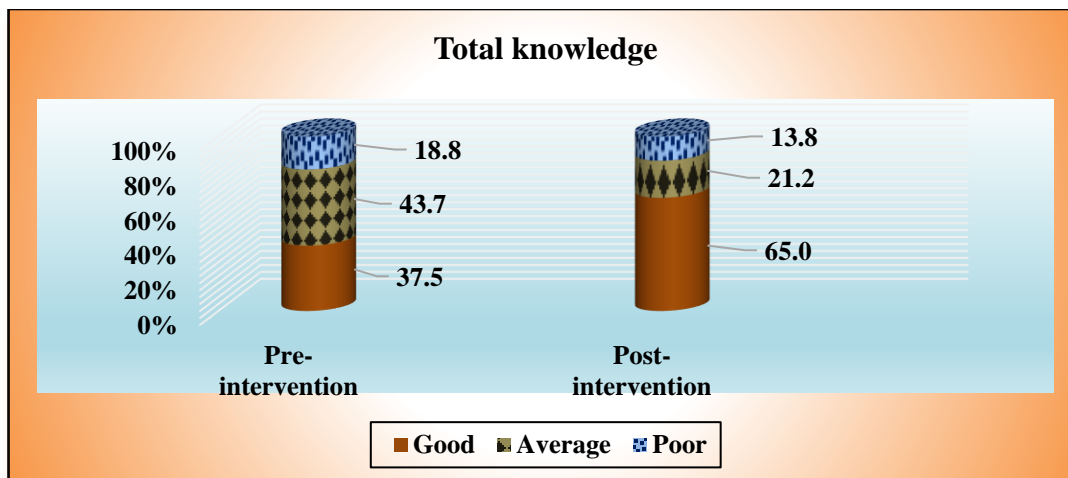| Personal characteristics	No	%
Gestational age /week		
<32	1	2.3
32-36	21	**48.8**
37-40	18	41.9
>40	3	7.0
Mean ±SD=36.216±4.80		
Gender		
Male	23	**53.5**
Female	20	46.5
Birth Weight / kg		
<2.5	15	34.8
2.5-3.5	22	**51.2**
>3.5	6	14.0
Mean ±SD= 2278.54±473.14		
Current Weight / kg		
<2.5	15	34.8
2.5-3.5	21	**48.8**
>3.5	7	16.4
Mean ±SD= 2289.54±473.14		

Figure (1): Percentage distribution of the studied nurses regarding their total knowledge score pre and post intervention phases (n=80)
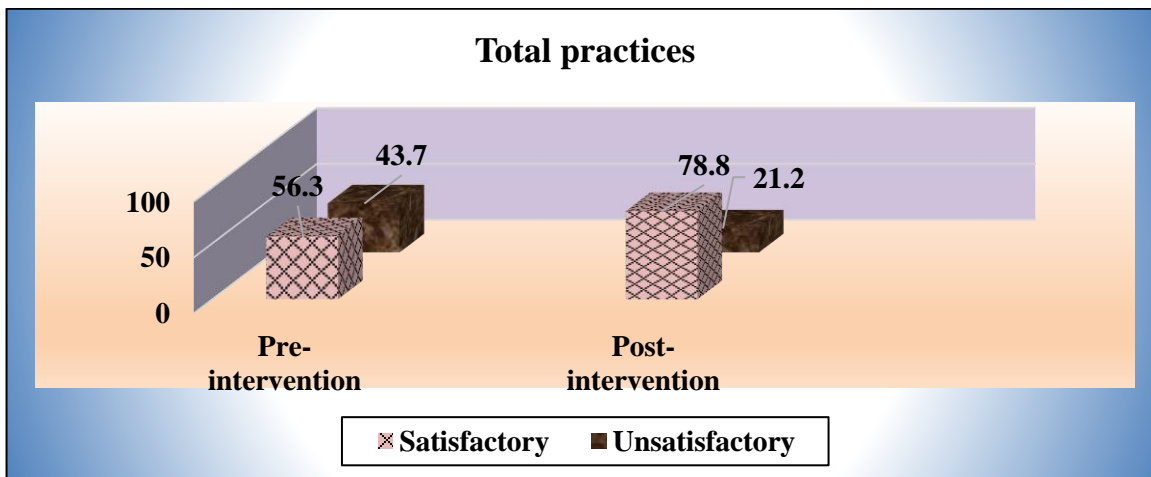
Figure (2) Percentage distribution of the studied nurses' total practices score regarding care of neonates with hyperbilirubinemia undergoing blood exchange (Pre-intervention & Post-intervention phases) (n=80).

Table (3): Correlation coefficient between total knowledge and total practices scores of studied nurses at pre-intervention and post- intervention phases (n=80)

Variables	Total knowledge			
	Pre-intervention		Post-intervention	
	R	P-value	R	P-value
Total practices	0.471	0.000**	0.452	0.000**

Discussion

The result of the present study showed that, more than half of the studied nurses were in the age group of 20-30 years, with a mean age of 31.33±8.142 years. These results were in agreement with **Noor et al., (2021),** who conducted a study entitled "Blood transfusion knowledge among nurses in Malaysia and showed that, the mean age of the studied nurses was (33.2±8.4 years).

On the other hand, these results disagreed with **Bediako et al., (2021),** who conducted a study entitled "Safe blood transfusion practices among nurses in a major referral center in Ghana" and clarified that, most of the respondents were aged between 26 and 35 years.

Regarding gender, the findings of the current study revealed that, more than half of the studied nurses were females. This result was in the same line with **Bediako et al., (2021)**, who found that, more than three quarters of the studied subjects were females. Concerning the educational level, the results of the present study reflected that, more than two-fifths had nursing technical institute. This result contradicted with **Abdel-Gafour, et al., (2020),** in a study entitled "Effect of nursing intervention on care of neonates suffering from hyperbilirubinemia and clarified that, more than half of the studied nurses had diploma nursing. **Noor et al., (2021),** added that, most of the nurses possessed a diploma.

As regards years of experience, the current study represented that, two fifths of the nurses had 5-10 years of experience. This finding was in harmony with **Olanrewaju and Chalice, (2020**), in a study entitled "Effect of instructional module on knowledge and its management of neonatal jaundice among nurses in pediatric unit of two selected tertiary hospitals, Ogun State", who pointed that, the work experience of the respondents showed that, less than two thirds had 5-10 years work experience.

Regarding attendance of training courses regarding care of neonates with hyperbilirubinemia undergoing blood exchange, the present study clarified that, This result agreed with **Ahmed and Hani, (2017)**, who studied " Assessment of nurse's knowledge and practice working in district hospitals at Minia Governorate about neonatal hyperbilirubinemia" and concluded that, less than three quarters of nurses didn't received previous training in neonatal care.

Personal characteristics can play a significant role in determining the exact features of nurses that may affect their knowledge and practices during their work such as age, educational level and years of experience. So, these factors should be determined for the studied sample (**El-Sharkawy & Araby, 2020).**

In relation to **characteristics of the studied neonates,** the finding of current study illustrated that, less than half of the studied neonates were born with gestational age 32-36 weeks, with a mean gestational age of 36.216±4.80 weeks. The current study results matched with **Mohammed et al., (2016)**, who conduct a study entitled "Outcomes among newborns with total serum bilirubin levels of 25 mg per deciliter or more", reported that more

than one-third of studied neonates were born with gestational age <36-37 weeks.

As regards the gender, the findings of the current study revealed that, more than half of them were males. The current study results matched with **Mohammed et al., (2016)**, who illustrated that, about two-thirds of studied neonates were males. Concerning birth weight, more than half of the studied neonates weighted 2.5-3.5 kg with a mean weight of 2278.54±473.14 gm. This study matched **with Mohammed et al., (2016)**, who illustrated that, more than half of them with mean birth weight of 2228.04±657.88 grams.

Owing to **knowledge** of the studied nurses regarding hyperbilirubinemia and blood exchange, the current study findings clarified that, there was a statistical significant difference between the results of post-test compared to pre-test regarding all items of the studied nurses 's knowledge regarding hyperbilirubinemia and blood exchange. The current study findings were in the same line with **Abdel-Gafouret al., (2020),** who clarified that, a statistical significant difference (p<0.05) of the studied nurses' knowledge pre and post intervention regarding care of the neonates suffering from hyperbilirubinemia, where only 6% of the studied nurses had adequate knowledge pre intervention compared with majority of them post intervention.

To some extend our study result came in the same harmony with **Van Der Geest et al., (2021)**, who conducted "Assessing knowledge and skills of maternity care professionals regarding neonatal hyperbilirubinemia: a nationwide survey" stated that, background knowledge of nurses regarding neonatal hyperbilirubinemia was adequate, but can be improved by further training. Approaches to improve timely recognition skills of jaundiced neonates are needed.

Regarding practices of the studied nurses about care of neonates with hyperbilirubinemia undergoing blood exchange, the current study findings clarified that, there was a statistical significant difference between the results of post-test compared to pre-test about the studied sample's practices related to management before, during and post blood exchange. In relation to total practices score, the current study findings displayed that, more than half and more than three-quarters of the studied nurses had satisfactory total practices score regarding care of neonates with hyperbilirubinemia undergoing blood exchange post-intervention respectively. While, it was revealed that, more than two-fifths and more than fifth of them had unsatisfactory total practices score regarding care of neonates with hyperbilirubinemia undergoing blood exchange pre-intervention respectively.

The present study results agreed with **Abdel-Gafour et al., (2020),** who clarified that, a statistical significant difference (p<0.05) of the studied nurses' practices pre and post intervention regarding care of the neonates suffering from hyperbilirubinemia, where more than one fifth of the study subject were competent pre intervention regarding their total care practices of the neonates suffering from hyperbilirubinemia compared with majority of them post intervention.

Furthermore**,** the current study results matched with **Mukhlif and Neamah, (2021)**, who showed that, practices of staff nurses working in NICU are in critical level before intervention, where nurses have poor practices about blood exchange procedure more than two fifths, after implemented educational program alter nurses' practices to good level.

These results were consistent with **Bediako et al., (2021)**, who reported that the study found that the majority of nurses had poor practices relating to all four phases of the blood exchange process in which nurses played an instrumental role. They also had gross practices deficit about the clinical blood exchange guidelines developed by the National blood service, Ghana.

There was strong positive correlation between total knowledge and total practices scores of the studied nurses at pre-and post-intervention phase (p≤0.001). Our study result was in the same harmony with **Abdel-Gafour et al., (2020),** who indicated that, there was a highly statistical significant correlation between total knowledge and total practices scores of studied nurses post intervention r = 0.81.

Conclusion:

The educational program was effective in improving nurses' knowledge and enhancing their practices related to care of neonates with hyperbilirubinemia undergoing blood exchange.

Recommendations:

Periodical follow-up of nurses' knowledge and practices regarding care of neonates with hyperbilirubinemia undergoing blood exchange to detect the points of strength and weakness to act on. Conducting in service training program.

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تحسين أداء الممرضين تجاه العناية بحديثي الولادة المصابين بارتفاع نسبة البيليروبين الخاضعين لتغيير الدم: برنامج تعليمي

داليا زغلول السيد السيد ـ خديجه محمد سعيد ـ رضا محمد عبدالله

يعد تغيير الدم هو الخط الثاني لعلاج ارتفاع نسبة البيليروبين عند حديثي الولادة في حالة فشل استجابة حديثي الولادة للعلاج الضوئي والتي قد تؤدي الي تدمير خلايا المخ . تغيير الدم هو عبارة عن إزالة أجزاء من دم حديثي الولادة الذي يحتوي علي نسبة بيليروبين مرتفعة واستبداله بدم متبرع للحد من تكسير كرات الدم الحمراء ومنع حدوث مضاعفات. لذا هدفت هذه الـدراسـة إلي تحسين أداء الممرضين تجاه العناية بحديثي الولادة المصابين بارتفاع نسبة البيليروبين الخاضعين لتغيير الدم. وقد أجريت هذه الدراسـة علي الممرضين المتاحين بوحدات العناية المركزة لحديثي الولادة بمستشفى الأطفال التخصصي ومستشفى بنها الجامعي التابعين لوزارة الصحة والسكان المصرية بمدينه بنها وعددهم٨٠ ممرض وممرضة . وقد أوضحت النتائج أنه توجد علاقة إيجابية للغاية ذات دلالة إحصائية بين مستوي معلومات وممارسات الممرضين تجاه العناية بحديثي الولادة المصابين بارتفاع نسبة البيليروبين الخاضعين لتغيير الدم قبل وبعد تنفيذ البرنامج التعليمي. كما أوصت الدراسة بالمتابعة الدورية لمعلومات وممارسات الممرضين تجاه رعاية حديثي الولادة المصابين بارتفاع نسبة البيليروبين الخاضعين لتغيير الدم للكشف عن نقاط القوة والضعف للعمل عليها