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Education To Nurses On Post-Extubation Nebulization For Pediatrics After Repair Of Congenital Heart Disease: Measuring Impact On Nurse's Knowledge, Practice, And Patient Care Outcomes By Using A Quasi-Experimental Study Design.

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ABSTRACT
Background: *Transformation of care from individual to a multidisciplinary approach is essential to managing complex congenital heart disease (CHD). For achieving quality patient care, nurses need a standard guideline as they are primary health care providers. This study aims to develop and implement post-extubation nebulization (PEN) protocol and assess effectiveness in terms of nurses' knowledge, practice, and patient outcomes of post-extubation nebulization for pediatrics admitted to Cardiothoracic Vascular Surgery Intensive Care Unit (CTVS-ICU).*
Methods: *A pre-test post-test for assessing nurses' knowledge and practice and post-test-only quasi-experimental study designs for patients' outcomes were used after conducting a teaching program. 47 nurses in experimental and 41 in control group and 60 patients in each group were enrolled by total enumeration and consecutive sampling, respectively. After a month, another post-was test was conducted only for experimental group nurses.*
Results: *Nurses' knowledge and practices of experimental group positively changed with reference to control group ($p<0.001$). Both group's knowledge and practice scores also significantly increased in post-assessment from pre-assessment ($p<0.001$) but it decreased significantly 1 month later within experimental group. Day of patient shifting was earlier in experimental group than control group and 2 patients were reintubated in control group. All patient care outcomes showed an insignificant change in experimental group with reference to control group from pre-nebulization to day of shifting but no additional harm.*
Conclusion: *This Protocol's execution by a structured teaching program, improves nurses' knowledge and practice and also keeps the patients safe.*
Keywords: *Congenital heart disease, Knowledge, Practice, Post-extubation nebulization, Nurses.*

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I. Introduction:

Estimated prevalence of CHD at birth worldwide in 2017 was approximately 1.8/100 live births [1]. New diagnostic and surgical treatments are paving the door for survival [2] by reducing complications of CHD [3]. Commonest affected organ, respiratory system, is injured due to surgical traumas or prolonged intubation after repair[4]. Despite some studies showing protocolized nebulization treatment effectiveness in some pediatric

conditions[5] none have mentioned PEN protocol for CHD patients. Nurses' knowledge gap regarding inhaled medications and devices was shown in some studies, which emphasizes need for periodic training on this[6]. This study was aimed at developing a PEN protocol for CHD patients admitted to CTVS ICU after repair and implementing it through nurses to empower them in this area.

II. Methodology

A quasi-experimental research design was followed. Pre-test post-test design for nurses and post-test only design was used for patients. The setting was Cardiothoracic Vascular System Intensive Care Unit (CTVS-ICU) of AIIMS, New Delhi. Two separate ICUs were undertaken for this study. CTVS-ICU A and CTVS-ICU B was chosen as experimental and control group, respectively for both nurses and patients. With total enumeration 47 and 41 nurses were selected for experimental and control group, respectively and 120 patients with congenital heart disease were selected following consecutive sampling. The study included Grade II nurses who participated in direct care and were present at the time of data collection. Pediatric patients below 12 years of age with RACHS-1 (Risk Adjustment in Congenital Heart Surgery -1) categories 1 & 2 who were admitted to CTVS-ICU after congenital heart defects repair were selected for the present study. The teaching for nurses was conducted only in experimental group with a group of 5 to 6 members and nebulization administration procedure was also demonstrated at bed-side. The teaching included name of different drugs, it's doses, appropriate times, and methods of administering specific drug. The nurses in both groups underwent pre- and post-tests with a 15-day gap between each assessment, while the experimental group only underwent a separate post-test one month later. For patients, the outcomes were assessed from pre-nebulization to post-nebulization twice in a day for four days including day of shifting from ICUs. The assessment of both groups was conducted after 15 days of implementation of protocol. A Self-structured questionnaires with 20 questions and a checklist were used for assessing knowledge and practice of nurses. The content validity index was 1 for both tools and reliability scores were 0.75 and 0.95 for knowledge questionnaire and practice checklist respectively. For patient, a self-structured questionnaire of demography and clinical variables and a data sheet includes oxygen saturation, heart rate, respiratory rate, pH, PO2, PCo2, Chest-X-ray were used. The mean value of each variable regarding patient care outcomes were taken for analysis. Content validity index and reliability score was 1 for all the above tools. The ethical permission was taken from institutional ethical committee (IECPG-223/24.03.2021, RT-34/28.04.2021) and trial also registered under Clinical Trial Registry-India (CTRI number – CTRI/2021/07/034923). All the data was entered in master data sheet and descriptive and inferential statistics was used.

III. Result

Table 1: Demographic characteristics and pre-assessment results of experimental and control groups nurses

Variable	Experimental (n1=47) (Mean±SD)/ f (%)	Control (n2=41) (Mean±SD)/ f (%)	t-value/χ^2 value	p-value
[a]**Total years of Prof. Experience**	7.74 ± 4.75	4.14 ± 2.61	-2.4818	**0.0075***
[a]**Years of experience in CTVS ICU**	5.08 ± 3.69	2.93 ± 1.78	-2.938	**0.0033***
[b]**Professional qualification**			1.146	0.812
General Nurse & Midwifery				
Bachelor of Nursing	5 (11%)	4 (10%)		
Post-Basic Nursing				
Master of nursing	30 (64%)	30 (73%)		
	3 (6%)	2 (5%)		
	9 (19%)	5 (12%)		
Pre-assessment of Knowledge	14.15 ± 2.52	12.17± 2.91	-3.381	**0.001***
Pre-assessment of Practice	10.53 ± 1.25	10.46 ± 1.64	-0.218	0.828

*Significant at $p<0.05$

[a]Two Sample t-test

[b]Chi-square test

Mean year of professional experiments as well as experience in current setting was higher in experimental group nurses than control. Majority of them was holding a Bachelor of Nursing degree in both experimental (64%) and control (73%). Though the mean value of pre-assessment knowledge score was significantly higher in experimental group than control group, the difference in term of pre-assessment practice score was insignificant. It was concluded that both groups were comparable on the basis of professional qualification and pre-assessment score of practice (Table 1).

Table 2: Comparison of knowledge and practice score between experimental and control group after 15 days of teaching to the nurses.

Variables	Groups	Mean± SD	Co-efficient	95% [c]CI	p-Value
Knowledge	Experimental (n1 =47)	17.23 ± 2.07	3.42	2.786 4.066	**<0.001***
	Control (n2 =41)	12.66 ± 3.11	0		
Practice	Experimental (n1 =47)	14.53 ± 0.55	4.007	3.664 4.351	**<0.001***
	Control (n=41)	10.51 ± 1.63	0		

*Significant at p<0.05
Generalized linear regression analysis
[c]CI – Confidence interval

For comparing the total knowledge and practice score between two groups (experimental and control), generalized linear regression analysis was used and there was a significant positive change in experimental group with reference to control group after the teaching with p<0.001 (Table 2).

Table 3: Comparison of knowledge and practice score between pre-assessment and post-assessment scores within experimental group
n1= 47

Variables	Assessment	Mean± SD	t-value	p-Value
Knowledge	Pre-assessment score	14.15 ± 2.52	-9.768	**<0.001***
	[#]Post-assessment 1 score	17.23 ± 2.07		
	[#]Post-assessment 1 score	17.23 ± 2.07	2.565	**0.014***
	[¶]Post-assessment 2 score	16.79 ± 1.68		
Practice	Pre-assessment score	10.53 ± 1.25	-20.293	**<0.001***
	Post-assessment 1 score	14.53 ± 0.55		
	[#]Post-assessment 1 score	14.53 ± 0.55	4.369	**<0.001***
	[¶]Post-assessment 2 score	13.83 ± 1.03		

*Significant at p<0.05
[#]Post-assessment 1 –after 15 days of teaching
[¶]Post-assessment 2 – After 1 month
Paired t-test

By applying paired-t-test, the knowledge and practice was assessed within experimental group and result showed that both the score was significantly increased from pre-assessment to post-assessment 1. However, after one month of follow-up, the experimental group's knowledge (p=0.014) and practise score (p<0.001) was decreased significantly from post-assessment 1. This was assessed by using paired t-test (table 3).

Table 4: Sociodemographic distribution of the patients of experimental group and control group

SL No	Variable	Experimental (Mean± SD)/ f(%) (n1 =60)	Control (Mean± SD)/ f(%) (n2 =60)	t-value/ χ^2 value	p-value
1.	[a]**Age (Months)**	49.68 ± 41.93	38.13 ± 35.05	-1.639	0.104
	6-12 (Infants)	23 (38.3)	22 (36.7)		
	13-36 (Toddler)	10 (16.7)	18 (30)		
	37-72 (Pre-schooler)	7 (11.7)	9 (15)		
	73-144 (Schooler)	20 (33.3)	11 (18.3)		
2.	[a]**Weight (Kg)**	12.67 ± 7.07	11.82 ± 6.14	-0.696	0.104
3.	[b]**Gender**			2.627	0.105
	Male	47 (78.3)	39 (65)		
	Female	13 (21.7)	21 (35)		

*Significant at p<0.05
[a]Two Sample t-test
[b]Chi-square test

In the present study, majority of patients were in infant age group (Experimental - 38.3%; Control – 36.7%) and male gender (Experimental -78.3%; control – 65%) in both groups and the weight was almost similar. Based on the p-value of above variables, it was concluded that both groups of patients were comparable in terms of age, weight as well as gender (Table 4).

Table 5: Comparison of patient care outcomes between experimental and control group after extubation

Variables	Group	Pre-intervention Mean ± SD	Post-intervention Mean ± SD	Co-efficient	95% €CI	p-value
SpO2	Experimental (n1 =60)	95.42± 6.8	95.93± 5.6	0.32	-1.812 2.453	0.769
	Control (n2 =60)	95.22± 6.94	95.02± 7.26	0		
HR^	Experimental (n1 =60)	132.22± 21.38	124.81± 17.66	0.29	-5.581 6.178	0.921
	Control (n2 =60)	131.07± 16.70	124.13± 17.63	0		
RR#	Experimental (n1 =60)	28.07± 7.89	28.78± 5.68	-1.94	-4.218 0.326	0.093
	Control (n2 =60)	30.13± 9.41	30.85± 6.82	0		
pH	Experimental (n1 =60)	7.39± 0.03	7.4± 0.03	-0.00625	-0.016 0.004	0.227
	Control (n2 =60)	7.39+ 0.04	7.4+ 0.03	0		
pCo2	Experimental (n1 =60)	33.36± 5.48	34.55± 4	0.58	-0.741 1.910	0.388
	Control (n2 =60)	32.86± 5.29	33.9± 3.41	0		
pO2	Experimental (n1 =60)	154.68 ± 99.65	128.96±79.88	-21.87	-52.081 6.950	0.134
	Control (n2 =60)	172.88±114.11	161.55±174.22	0		

*Significant at $p<0.05$
Generalized regression linear model analysis
^HR: Heart rate
#RR: Respiratory rate
€CI – Confidence interval

For comparing patient care outcomes between experimental and control group, generalized regression linear model analysis was applied. There was no significant change in any of the parameter seen from pre-nebulization upto day of shifting in experimental group with reference to control group (Table 5).

Table 6: Comparison of Chest-X-ray and Days of shifting between Control and Experimental Group

Variable	Experimental (n1 =60) (Mean ± SD)/ f(%)	Control (n2 =60) (Mean ± SD)/ f(%)	t-value/ χ^2 value	p-value
[a]Pre-nebulization Chest-X-ray			2.232	0.350
▪ Normal	▪ 19 (31.67%)	▪ 50 (83.33%)		
▪ Bilateral infiltration	▪ 12 (20%)	▪ 16 (26.67%)		
▪ Unilateral infiltration	▪ 29(48.33%)	▪ 21 (35%)		
[a]Post-nebulization Chest-X-ray			1.224	0.643
▪ Normal	▪ 47 (78.33%)	▪ 50 (83.33%)		
▪ Bilateral infiltration	▪ 1 (1.67%)	▪ 0 (0%)		
▪ Unilateral infiltration	▪ 12 (20%)	▪ 10 (16.67%)		
[b]Day of Shifting	2.9± 1.59	3.08±2.04	0.548	0.585

*Significant at $p<0.05$
[a]Chi-square test
[b]Two sample t-test

Chest-x-ray of experimental group showed a reduction of bilateral lung infiltration from 20% (Pre-nebulization) to 1.67% (Day of shifting). Similarly, in control group the percentage of bilateral of lung infiltration reduced from 26.67% (pre-nebulization) to 16.67% (day of shifting). However, the improvement were not significant. Although, there was an early shifting in experimental group than control group, the difference was not significant (Table 6).
In the control group, two patients (3.33%) required reintubation, but none did so in the experimental group.

IV. Discussion:

One of the excellent treatments of post-operative respiratory complication is nebulization therapy. Every nurse should have a good knowledge as well as a good skill on this nebulization administration and that will reflect in patients' improvement. The present study was proved that a structured individualized teaching program related to post-extubation nebulization therapy improved the existing knowledge and level of practice compare to control group as well as baseline knowledge of experimental group which was congruent to the findings of John Bosco Tamu Muhe (2018)[7] and Suhas Aithal et al (2017)[8]**.** After a one-month follow-up, there was a substantial reduction in knowledge and practice scores, indicating poor knowledge and practise retention among nurses and this demonstrating the necessity for a regular teaching programme.

The difference in experience between the groups could be related to the control group's unwillingness to participate in the study as well as lack of administrative support.

The assessment of patient care outcomes showed no deleterious changes in experimental and control group. This finding was partly congruent with a study done by Nur Eni Lestari et al (2018)[9] who found that there was no significant changes in heart rate after providing a combination of nebulization and chest physiotherapy to the patients with pneumonia and also with the study of Manuel Soler et al (1997)[10] who found a no significant statistical changes in Ph and arterial oxygen saturation as well as no clinical changes.

Because the patients were using oxygen via a face mask or nasal cannula, there were no significant changes in oxygen saturation and the participants in this study were all under the age of 12, there was a wide range of normal respiratory rates and heart rate, resulting in a statistically insignificant difference in respiratory rates across the groups.

Patients were all under continuous ABG monitoring and they were receiving treatment promptly if any alteration occur in values which might affect the result of the study. The Ph, PCo2 or other ABG parameters alteration might occur not only due to respiratory problem but also for metabolic disbalance. As the child undergone surgical correction of congenital heart disease, there is mismatch between body's demand and supply which might affect the ABG values. It has also seen that there was an early shifting in experimental group and no patient was reintubated in this group which could be considered as a positive outcome of this protocol.

The insignificant changes which was detected in patients, did not endanger the patients further. As the site was a single hospital, the experimental group received similar drugs as like control group but in a systematic way. So, this also might result in an insignificant changes in patient care outcomes. However, it would be unethical, if we did not provide the treatment in control group. It was recommended that the study could be used further in large sample for getting a more positive results. In addition to that, it would be great if a randomized control trial is followed with proper blinding and by using two different sites to increase the strength of this study.

V. Conclusion:

A regular teaching program for nurses must be implemented in every institute for achieving a good quality care for patients. Implementation of the protocol through a structured teaching program showed a significant improvement in nurses' knowledge and level of practices related to post-extubation nebulization administration but the retention was not satisfactory. Therefore, the administration of every health care facilities should take initiative to conduct in-service education programs periodically as well as systematically. There was no evidence of any increased risk to our patients and no additional harm. Thus, the protocol can be utilized for patients with congenital heart disease to provide a quality care and to get a more excellent patient care outcome.

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