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Comparison of Nasal Tragus Length and Formula For Correctness of Endotracheal Tube Placement in Neonates

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ABSTRACT

Objective: To compare the nasal tragus length and weight+6 cm formula for correctness of endotracheal tube placement in neonates.

Study Design: Comparative Prospective Study.

Place and Duration of Study: Pak Emirates Military Hospital, Rawalpindi Pakistan, from Jul 2019 to Apr 2020.

Methodology: A prospective study was conducted on the neonates requiring endotracheal intubation in the neonatal intensive care unit. Patients were randomly divided into two groups via lottery method. In Group A nasal tragus length +1cm was used to estimate the length of intubation while in group B weight+6 cm formula was used for the same purpose. Correct placement of the endotracheal tube was ascertained by the chest x-ray in both the groups.

Results: A total of 300 patients were included into the final analysis. Out of them 249(83%) had correct placement of tube while 51(17%) had incorrect placement on chest x-ray. 167(55.7%) underwent endotracheal intubation with formula of weight+6 cm while 133(44.3%) underwent with nasal tragus length+1 cm. Chi-square analysis revealed that nasal tragus length has statistically significant relationship with correct placement of the endotracheal tube among the neonates managed at nursing intensive care unit (p-value<0.05).

Conclusion: Considerable number of neonates had incorrect placement of endotracheal tube in our study on chest x-ray. Nasal tragus length +1 cm emerged as a better method for correct placement of endotracheal tube in our target population as compared to weight +6 cm formula used for the same purpose.

Keywords: endotracheal intubation; methods; neonates; Neonatal intensive care unit

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INTRODUCTION

Neonatal intensive care units (NICU) have really been busy in last decade with a lot of neonates requiring admission and airway support due to various reasons.[1] Situation is not different in Pakistan and NICU settings have high burden of admission may it be public or private setting.[2] Various medical or surgical causes may be responsible for these admissions and mortality rate varies depending upon the underlying condition and various other factors.[3] Intubating the patient with endotracheal tube is commonly done at critical care settings may it be adult, pediatric or neonatal unit.[4] This procedure becomes quite tricky among the neonatal population and various methods and mathematical formulas have been in practice for years to pass the tube with accuracy and place it in the correct procedure.[5,6]

A study was done in 2017 by Grey *et al.*, concluded the neonatal resuscitation program (NRP) gestational age/weight-based chart and nasal tragus length (NTL)+1 cm formula both had certain advantages and disadvantages and both can be used with precaution by the trained person.[7] A randomized control trial published in 2019 by Uygur *et al.*, had similar findings that both the methods were equally effective. In premature infants tube was frequently placed below the T" especially in those in which NTL+1 formula was used but still there was no statistically significant difference between the two methods.[8]A similar study done by Flinn *et al.*, in 2015 compared gestation and weight methods to find the correct length to insert endotracheal tube and they concluded that both methods were equally good for this purpose.[9]

Endotracheal intubation has always been a challenge for neonatologists, and they have always been in search of best and most accurate method in this regard. A recent local study has been planned at Agha Khan Hospital Karachi involving a novel training simulator for portable

ultrasound identification of incorrect newborn endotracheal tube placement.[10] Due to limited local data in this important area we planned this study with

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the rationale to compare the nasal tragus length and weight+6 formula for correctness of endotracheal tube placement in neonates at a neonatal intensive care unit of our hospital.

METHODOLOGY

This comparative study was conducted at the neonatal intensive care unit of Pak Emirates military hospital Rawalpindi from August 2019 to April 2020. Sample size was calculated by WHO Sample Size Calculator by using population prevalence proportion of successful insertion of endotracheal tube in neonates as 87.5%.[11] Non probability Consecutive sampling technique was used to gather the sample and then they were randomly divided into two groups via lottery method.

Inclusion Criteria: All patients less than 28 days of age admitted in nursing intensive care unit of our hospital who required endotracheal intubation during the given time period were included in the study.

Exclusion Crteria: . Exclusion criteria were the neonates with severe congenital malformations or those who could not survive till the x-ray was done to ensure the correct placement of the tube.[12]

Patients who were referred from other military, public sector and private hospitals who required NICU admission and endotracheal intubation were also included in the study After ethical approval from the ethical review board committee via IREB letter no. 170 and written informed consent from the parents or guardians of the potential participants or their care-givers, patients who were admitted and intubated in the neonatal intensive care unit of PEMH RWP fulfilling the above mentioned inclusion and exclusion criteria were included in the study. They were randomly divided into two groups via lottery method. Group A were intubated with the help of weight plus 6 formula.[13] while group B was intubated via nasal tragus length (NTL)+1 formula.[14] After intubation chest of neonate was auscultated for bilateral equal air entry and then the neonate underwent chest x-ray to confirm the correct placement of the endotracheal tube.

Characteristics of neonates participating in the study and the correct placement of the endotracheal tube were described with the help of descriptive statistics. Chi-square were done to ascertain the relationship of age, gender, birth weight and the method used to pass the endotracheal tube among the neonates with the correct placement of the tube. Statistics Package for Social Sciences version 24.0 (SPSS-24.0) was used for all the above-mentioned analysis. *p*-values ≤0.05 were considered significant for ascertaining the association between variables.

RESULTS

A total of 300 neonates were divided into two groups randomly via lottery method. Mean age of the patients included in the study was 11.5±3.628 days. Mean NICU stay when they underwent intubation was 2.6±2.134 days. Out of 300 patients, 192(64%) were male while 108(36%) were female. Table-I summarized the general characteristics of study population. 249(83%) had correct placement of tube while 51(17%) had incorrect placement on chest x-ray. 167(55.7%) underwent endotracheal intubation with formula of weight+6 while 133(44.3%) underwent with nasal tragus length +1. Out of total study participants, 212(70.7%) had normal birth weight, 60(20%) had low birth weight while 28(9.3%) had extremely low birth weight. Pearson chi-square analysis confirmed the association and revealed that NTL+1 had more chance of predicting correct placement of endotracheal tube (*p*-value-0.002) when compared to weight +6 formula while age (*p*-value-0.481), gender (*p*-value-0.908) and weight at birth (*p*-value-0.503) had no role in prediction of correct placement of tube (Table II).

Table-I: Characteristics of Study Participants

Parameters	
Age (days)	
Mean+SD	11.5±3.628 days
Range (min-max)	1 day- 25 days
Gender	
Male	194(64%)
Female	108(36%)
Placement of endotracheal tube	
Correct	249(83%)
Incorrect	51(17%)
Method used to place tube	
Nasal tragus length+1	133(44.3%)
Weight+6 formula	167(55.7%)
Weight at birth	
Normal	212(70.7%)
Low	60(20%)
Extremely low	28(9.3%)

DISCUSSION

Neonatal intensive care units are highly specialized units to support the wellbeing of neonates which need organ support. Airway or breathing problems may arise in these newborn babies due to multiple conditions and they may require intubation.

Sawyer *et al.*,, in 2019 published an interesting data of around 3 years and showed that 2009 intubations were done and out that 276(14%) met criteria of difficult intubations.[15] This highlights that intubation is not a simple procedure in neonates and require special expertise. Multiple methods have been used to get an idea regarding the correct placement of endotracheal tube among the young kids over past many years, but no method has been turned out to be fully perfect. We therefore planned this study with the rationale to compare the nasal tragus length and weight +6 formula for correctness of endotracheal tube placement in neonates at a nursing intensive care unit of our hospital.

Table-II: Comparison of Various Variables Including Methods used for Correct Placement of Endotracheal Tube

Factors	Correct placement of tube	Incorrect placement of tube	*p*-value
Age			
<14 days 14-28 days	106(42.6%) 143(57.4%)	19(37.2%) 32(62.8%)	0.481
Gender			
Male female	159(63.8%) 90(36.2%)	33(64.7%) 18(35.3%)	0.908
Weight at birth			
Normal	174(69.9%)	38(74.5%)	0.503
Low or extremely low	75(30.1%)	13(25.5%)	
Method used			
Weight+6 NTL+1	12(51.8%) 120(48.2%)	38(74.5%) 13(25.5%)	0.002

Wang *et al.,* in 2011 conducted a study with the rationale to assess the application of the nasal-tragus length (NTL) to predict the proper endotracheal tube (ETT) depth among the neonates managed at NICU in Taiwan. They came up with the conclusion that using the NTL to predict the optimal ETT depth with the formula, NTL plus 1 cm, was clinically practical for newborn infants in Taiwan weighing ≤ 2,500g, and a modified formula, NTL plus 0.5 cm, was more suitable for neonates weighing >2,500g.[16] We compared NTL+1 with weight +6 and found NTL+1 superior to weight +6 formula. Birth weight of newborn had no statically significant relationship with correct placement of endotracheal tube in our study participants.

Peterson *et al.,* in their study conducted in 2006 concluded that for underweight infants 7-8-9 rule may cause increased estimation of the length for passing the endotracheal tube and may lead to serious untoward effects for the baby.[17] Our study support this finding in a way that weight +6 formula was inferior to NTL+1 formula in our patients clearly highlighting to adopt the more frequent use of NTL+1 for this purpose.

Uygur *et al.,* conducted a very similar study to that of ours in 2019 with a design of randomized control trial and concluded that The NTL +1cm formula led to a higher rate of ETT placement below T2, especially in infants with a birth weight of <1,500 g as compared to weight plus 6 cm formula.[8] Our results strengthened their findings. Though, we did not segregate from weight point of view and weight also had no statistically significant relationship with correct placement of endotracheal tube but still NTL+1 cm method was superior to weight +6 cm method in our analysis.

Studies of Shukla *et al.,* I 1997 and Trivedi *et al.,* in 2015 conducted in our neighboring country India are very important in this regard.[18,19] Shukla *et al.,* demonstrated that NTL+1cm method has been very effective in predicting length of ETT and correct placement18 while Trivedi *et al.,* published that weight +6cm formula is a weak predictor of correct placement of endotracheal tube in the new born babies and is affected a lot by the weight of the baby so could not be applied on all the neonates for better results of intubation.[19] Our study was actually combination of both of their studies as we compared both methods in one study and found out that NTL+1 cm method is superior to weight+6cm method.

This was data from one nursing intensive care unit and could not be generalized. Adequate blinding was not ensured, and multiple physicians were involved so there could be bias in the results. More studies with involvement of multiple centers and better study design ma generate findings which could help us in formulation of local guidelines in this regard.

CONCLUSION

Considerable number of neonates had incorrect placement of endotracheal tube in our study on chest x-ray. Nasal tragus length +1cm emerged as a better method for correct placement of endotracheal tube in our target population as compared to weight +6cm formula used for the same purpose.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

KZ & AR: Data acquisition, data analysis, critical review, approval of the final version to be published.

MF & MS: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

5 & 6: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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