



ORIGINAL ARTICLE

Confirmation of correct placement of nasogastric / orogastric tube on Point of Care Ultrasound (POCUS) in pediatric critical care unit patients.

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ABSTRACT... Objective: To determine frequency of correct placement of nasogastric /orogastric tube on POCUS in pediatric critical care unit patients. **Study Design:** Descriptive cross-sectional. **Setting:** High Dependency Unit and Pediatric Intensive Care Unit, Indus Hospital Health Network, Karachi, Pakistan. **Period:** November 2022 to April 2023. **Methods:** Patients of age 1 months to 15 years of age requiring NGT placement were enrolled into the study. Patients with nasal surgery, fracture of skull base/ face, bleeding, coagulopathy, esophageal varices, stricture, upper gastrointestinal surgery were excluded from this study. NG tube was passed by principal investigator after evaluating correct size and length measurement. After passing the NG tube, gastric aspiration and gastric auscultation were also performed by principal investigator. **Results:** In this study we enrolled 147 children with median age of patient was 3 (IQR=0.75-07) years. Majority of patient in our study were male (63.9%). Gastric aspiration and gastric auscultation was seen in all of the study patients. Based on POCUS, frequency of correct placement of nasogastric tube in children admitted in PICU was 83%. Sensitivity of POCUS against gastric aspiration and gastric auscultation was 82.5% with 100% positive predictive value (PPV). Specificity was unable to compute as there was no negative finding in reference standard and hence there was also no false positive case. **Conclusion:** POCUS seems to be helpful and could help with the placement of NGT in paediatric clinical settings. Nevertheless, NGT envision in the stomach was difficult, and if the operator is not skilled or there is abdominal distention, it may go unnoticed.

Key word: Nasogastric Tube, Orogastric Tube, Pediatric Critical Care Area, Pediatric Intensive Care, Point of Care Ultrasound.

INTRODUCTION

Nasogastric/orogastric tube placement is common in pediatric intensive care units usually passed by nursing staff for purpose of enteral feeding, sampling of gastric contents, gastric lavage (detoxification), medication administration and gastric decompression.^{1,2} NG tube placement is done in almost every patient admitted in PICU.³

Misplacement of NG/OG tube varies from 0.5-89% and misplacement can cause serious problems like aspiration pneumonia, pneumothorax, pneumomediastinum, pulmonary laceration, pulmonary hemorrhage, broncho pleural fistula, perforation of esophagus or airway.^{2,4}

In clinical practice various methods like gastric

aspiration, and auscultation methods (whoosh test) are used to confirm NG/OG tube placement but neither of these methods are confirmatory for correct placement and can render harm to the patient like instilling air/water into tube misplaced in trachea.⁵ Previous research has studied role of capnography, fluoroscopic guided insertion, role of PH measurement. The gold standard, adjunct to clinical confirmation is chest radiography for simultaneous confirmation of endotracheal tube, CVP line placement.^{5,6} But, doing x-ray render patient to radiation exposure and is time consuming, so other alternatives are desirable for confirmation.^{3,6}

Point of care ultrasound (POCUS) is safe alternative rapid technique without radiation

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exposure which is available at bedside 24hrs a day/7days/week and will be used for confirmation of NG/OG tube placement.³ This study will give us insight into the role of POCUS ultrasound as searching literature does not show any study in our country. It can give us as an alternative method for confirmation as clinical and x-ray are not without risk and POCUS is not having any radiation or other complications. Furthermore x-ray is time consuming and radiation exposure. POCUS will spare time and prevent radiation exposure and clinical methods confirmation complications. The present study was planned to determine frequency of correct placement of nasogastric /orogastric tube on pocus in pediatric critical care unit patients.

METHODS

This cross-sectional study was performed in high dependency unit (HDU) and pediatric intensive unit (PICU) in Indus Hospital Health Network, Karachi, Pakistan. The study was carried out during November 2022 to April 2023 after acquiring ethical approval from institutional review board (IRB#IHHN_IRB_2022_09_019). Written informed consent was sought from patients' parent/Guardian who was present in hospital at the time of study. Patients of age 1 months to 15 years of age requiring NGT placement were enrolled into the study. Patients with nasal surgery, fracture of skull base/ face, bleeding, coagulopathy, esophageal varices, stricture, upper gastrointestinal surgery were excluded from this study. Non-probability consecutive sampling technique was used to enlist patients. Pilot study was performed enrolling 30 patients. In pilot study, 80% were found to have correct NGT placement using POCUS. Therefore, at 95% confidence interval and margin of error of 7%, a sample size of 126 patients was calculated. Sample size estimation was performed on online available calculator Open-Epi.

NG tube was passed by principal investigator after evaluating correct size and length measurement. Lubricating gel was applied before placing NG tube. After passing the NG tube, gastric aspiration and gastric auscultation were also performed by principal investigator. A bedside, portable

POCUS ultrasound for NG tube confirmation was performed by using SONOSCAPE P-50 available with linear probe high frequency (5-7.5MHz) or convex probe low frequency (2-5MHz), placing probe in sagittal or longitudinal plane in epigastric region. Correct NGT placement was confirmed if either a single or double parallel lines of the tube were visualized in gastric antrum/pylorus or there was dynamic appearance of air entering the stomach instilled through the NGT. Patients' age, gender, diagnosis, POCUS finding, gastric aspiration and gastric auscultation status was recorded on a pre-designed proforma.

Data was entered in SPSS version 21 to perform statistical analysis. Categorical variables were expressed as frequency and percentage. Numerical variables were presented as median with inter-quartile range as they were non-normally distributed. Results were presented in tabular or graphical form.

RESULTS

In this study we enrolled 147 children with median age of patient was 03 (IQR=0.75-07) years. Majority of patient in our study were male (63.9%) with a male to female ratio 2:1 (Figure-1). The most common diagnosis of patient admitted in PICU was pneumonia (28.6%) followed by *B-acute lymphoblastic leukemia* (23.1%), sepsis (19%), bronchitis (6.8%), acute gastroenteritis (6.8%), lymphoma (4.1%), asthma (2.7%), Wilm's tumor (2%), abdominal tuberculosis (1.4%), renal mass (1.4%), angio edemia (1.4%), enteric fever (0.7%), esophageal replacement (0.7%), tetanus (0.7%) and intestinal obstruction (0.7%). Gastric aspiration and gastric auscultation was seen in all of the study patients.

Furthermore, frequency of correct placement of nasogastric tube in children admitted in PICU was 83% (Figure-2). Table-I shows the association of NG tube placement on ultrasound with age and gender in children admitted in PICU. There is no significant association was found correct NG tube placement, age and gender. Sensitivity of POCUS against gastric aspiration and gastric auscultation was 82.5% with 100% positive predictive value (PPV). Specificity was unable compute as there

was no negative finding in reference standard and hence there was also no false positive case.

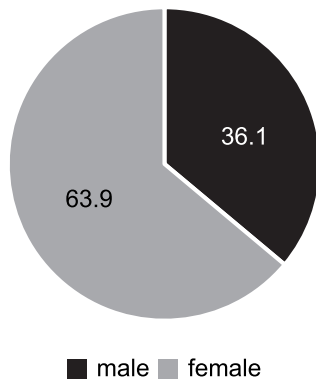


Figure-1. Distribution of gender

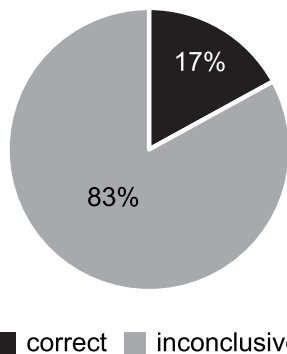


Figure-2. Distribution of correct nasogastric tube placement in children admitted in PICU.

Variables	Ultrasound findings		P-Value
	Correct NGT placement N (%)	Inconclusive N (%)	
Age			
≤ 5 Years	86 (83.5)	17 (16.5)	0.804
> 5Years	36 (81.82)	8 (18.18)	
Gender			
Male	76 (80.85)	18 (19.15)	0.456
Female	46 (86.79)	7 (13.21)	

Table-I Comparison of patients' age and gender among those with correct and inconclusive ultrasound findings

DISCUSSION

In paediatric emergency treatment, the insertion of a NGT is frequently done. If the placement is not done correctly and causes major difficulties, it could be dangerous.⁷ Auscultation or aspiration methods are the traditional means of

clinically confirming NGT placement, and they are regarded as clinical reference standards. Advanced diagnostic ultrasonography, or POCUS, is done as a bedside test and read by the attending physician.⁸ Over the past fifteen years, there has been a considerable increase in the use and implementation of POCUS.⁹ POCUS is a commonly used quick diagnostic technique in several areas, particularly emergency care.¹⁰ While POCUS success in adults has been verified by a number of previous studies, there is a dearth of information about paediatric care.¹¹⁻¹³ We designed the current study for this reason.

In the present study, POCUS detected NGT placement among 83% cases whereas on one case it was found to be inconclusive in 17% patients. A similar recent investigated studied total 26 patients requiring NGT tube placement and it came out that NGT placement was correctly identified on 88.5% cases.¹⁴ A similar study was performed on 159 neonates for verifying gastric tube placement through ultrasonography. Out of 159 neonates, ultrasonograph detected gastric tube placement in 156 (98.1%) cases.¹⁵

AtalayYOetal¹⁶evaluatedbedsideultrasonography for confirming gastric tube placement in neonates and reported that the tube placement was unidentified in 7.8% cases. In a study of Choi E et al.¹⁷, successful gastric visualization was seen for 70% patients for age group of 3 to 6 years, 44% for 0 to 2 years and 40% for 3 to 6 years age group patients. Mainly there are three reasons for missing out the NGT tube placement on ultrasound; the skills of operator performing the procedure are not of mastery level, patients are uncooperative and agitated and there could be abdominal distension or obesity problem due to which stomach was not clearly visualized on ultrasonography. In the present study, there were sepsis patients which leads to abdominal gaseous distention. Moreover, there were some patients who had ascities. Last but not the least, most of the bedside ultrasound were performed by physician not radiologist. These could be the most likely reason of inconclusive finding in the present study.

Clinically NGT is confirmed either through gastric aspiration or auscultation technique.^{18,19} In addition, chest x-rays are done; however, because of the possibility of radiation exposure, we did not perform a chest x-ray for this investigation. Gurgling sounds in the epigastrium are confirmed by stethoscope auscultation when air is introduced following NGT insertion. An alternate technique to confirm tube insertion is to aspirate the contents of the NGT and assess the pH of the aspirates using litmus paper. It has been noted that using this technique to continuously monitor patients in the intensive care unit and to confirm the placement of the nasogastric feeding tube works well.²⁰ In this study both of the clinical methods gastric aspiration and auscultation showed that NGT was correctly placed in all of the patients thus, yielding POCUS sensitivity of 82.5% but specificity of 0% as there was no false positive. Most of the studies assessed POCUS accuracy in comparison to chest x-ray.¹⁵⁻¹⁷ According to Dias FSB et al.¹⁵, the positive predictive value was 0.99 and the sensitivity analysis was 0.98. Due to insufficient negative cases in the sample, a specificity analysis could not be completed. According to Atalay et al.¹⁶, ultrasonography confirmed the NOGT's precise placement with a 92.2% sensitivity and a 100% PPV. The sensitivity of ultrasonography for identifying a correctly positioned tube was found to be 88% (95% confidence range, 70.0%-97.6%) by Claiborne MK et al.¹⁴ The experience of a single institution in Karachi, Pakistan, is shared in this paper. A more extensive investigation should be done in the future to confirm the results of this one since different operators may have different techniques and levels of experience.

CONCLUSION

POCUS seems to be helpful and could help with the placement of NGT in paediatric clinical settings. Nevertheless, NGT envision in the stomach was difficult, and if the operator is not skilled or there is abdominal distention, it may go unnoticed.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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