Original Article

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☑ Knowledge translation and advances in health and nursing practices

Bedside ultrasonography for the confirmation of nasogastric tube placement: agreement between nurse and physician

Ultrassonografia à beira do leito para localização da sonda nasoenteral: concordância entre enfermeiro e médico

Ultrasonografíaa la cabecera para localización de la sonda nasoenteral: concordancia entre enfermero y médico

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ABSTRACT

Objective: To evaluate the agreement between nurse and physician in verifying the positioning of the nasogastric tube by ultrasonography and describe the difficulties faced by nurse in performing the technique.

Method: Cross-sectional study conducted in 2021, including critical patients after nasogastric tube insertion who were independently evaluated by a nurse and physician, using bedside ultrasonography. The tube was considered adequately positioned when viewed in infradiaphragmatic location in the topography of the stomach.

Results: In the 30 peer evaluations there was almost perfect agreement (k = 0.93; 95%CI: 0.65 – 0.99). In only one case the nurse was uncertain about the positioning. Some difficulties were reported: abdominal distention (n=2), gas interposition (n=3) and patient movement during the exam (n=2).

Conclusion: A trained nurse obtained very similar results to those found by a physician in identifying the nasogastric tube placement by means of ultrasonography, suggesting a reproducible and safe technique.

Keywords: Intubation, gastrointestinal. Ultrasonography. Nursing. Intensive care units. Enteral nutrition.

RESUMO

Objetivo: Avaliar a concordância entre enfermeiro e médico na determinação da localização da sonda enteral por ultrassonografia e descrever as dificuldades encontradas pelo enfermeiro na execução da técnica.

Método: Estudo transversal, realizado em 2021, incluindo pacientes críticos após a inserção da sonda enteral, avaliados de modo independente por enfermeiro e médico, utilizando ultrassonografia à beira do leito. A sonda foi considerada adequadamente posicionada quando visualizada em posição infradiafragmática na topografia do estômago.

Resultados: Nos 30 pares de avaliações houve concordância quase perfeita (k = 0,93; IC95%: 0,65 – 0,99). Em apenas um caso houve dúvida do enfermeiro sobre o posicionamento. As dificuldades relatadas foram: distensão abdominal (n=2), interposição de gás (n=3) e movimentação do paciente durante o exame (n=2).

Conclusão: Um enfermeiro capacitado obteve resultados semelhantes aos encontrados por um médico na identificação do posicionamento da sonda enteral por meio de ultrassonografia, sugerindo tratar-se de uma técnica reprodutível e segura.

Palavras-chave: Intubação gastrointestinal. Ultrassonografia. Enfermagem. Unidades de terapia intensiva. Nutrição enteral.

RESUMEN

Objetivo: Evaluar la concordancia entre enfermero y médico en la verificación del posicionamiento de la sonda nasoenteral por ultrasonido y describir las dificultades enfrentadas por el enfermero en la realización de la técnica.

Método: Estudio transversal, realizado en el 2021, incluyendo pacientes críticos después de la inserción de la sonda nasoenteral, que fueron evaluados de manera independiente por enfermero y médico, utilizando ultrasonido al lado de la cama. La sonda fue considerada correctamente posicionada cuando visualizada en posición infradiafragmatica en la topografía del abdomen.

Resultado: En los 30 pares de evaluaciones hubo concordancia casi perfecta (k = 0,93; IC95%: 0,65 – 0,99). En apenas un caso hubo duda de la enfermera acerca del posicionamiento. Fueron relatadas algunas dificultades: distensión abdominal (n=2), interposición de gases (n-3) y movimiento del paciente durante el examen (n=2).

Conclusión: Un enfermero capacitadoobtuve resultados muy semejantes a los obtenidos por un médico en la identificación del posicionamiento de la sonda nasoenteral por medio de ultrasonido, sugiriendo tratarse de una técnica reproducible y segura.

Palabras clave: Intubación gastrointestinal. Ultrasonografía. Enfermería. Unidades de cuidados intensivos. Nutrición enteral.

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INTRODUCTION

Despite the frequent use of nasogastric tube (NGT) for administration of diet, water and medication in different care settings and even at home, establishing reliable means to identify the anatomical positioning of the NGT remains a challenge. Examinations performed at the bedside prove to be flawed to ensure that the administration of therapy occurs in a safe way. The pH check can be affected by factors such as diet and the use of gastric acid inhibitors, commonly used in critically ill patients; aspiration for assessment of gastric content not always can be obtained, or may have nonspecific characteristics; and the epigastric auscultation test is considered inadequate to distinguish gastric from pulmonary positioning[1]. Thus, an imaging examination is mandatory, and the abdominal X-ray is the "gold standard" for checking the NGT positioning after its insertion[2].

Frequent situations, such as patient mobilization, coughing, procedures for aspiration of secretions, vomiting and transportation, can result in displacement of the tube[3]. In critically ill patients, adds the risk of bronchoaspiration related to sedation, alteration in the level of consciousness or reduction in the cough reflex[1]. In this patient profile, therefore, the systematic verification of the tube positioning becomes even more important.

In this context, ultrasonography (US) to verify NGT positioning has been presented as a promising alternative, due to the possibility of performing it at the bedside, with real-time interpretation, without the need for patient displacement or radiation exposure[4].

In a study that evaluated 41 NGT insertions with guide wire in patients using NGT and invasive mechanical ventilation, abdominal ultrasonography detected 38 patients with adequate positioning and three with inadequate positioning. The demonstrated sensitivity was 97% (95%CI 84.9–99.8%) and the specificity was 100% (95%CI 19.7–100%)[5].

Ultrasonography has been shown to be reliable in supporting the diagnostic decision and as a guide to procedures. In last years, this technology has been incorporated into procedures performed by nurses, such as venous and arterial puncture, evaluation of device positioning (such as urinary catheters), skin evaluation and urinary volume evaluation[6,7].

Recently, the Federal Nursing Council (*Conselho Federal de Enfermagem* – COFEN) stated the regulation of the use of US by trained nurses both in the pre-hospital setting and at the bedside; this was classified as a support technique to perform more complex nursing procedures and as a strategy to improve the safety of professionals and patients[8].

In the field of nutritional therapy, ultrasonography gained space[9] and the accuracy of bedside ultrasonography in detecting NGT positioning has been investigated. Researchers obtained excellent results, with sensitivity varying between 93% and 100% and specificity between 97% and 100%[5,9–12].

However, adequate training of professionals who use ultrasonography is essential, since its application is operator dependent. Errors in its interpretation can underestimate clinical conditions, or overestimate them, leading to unnecessary procedures[13]. Besides training, it is important to evaluate agreement in practice of US.

Like other procedures that require skill development, ultrasonography is subject to measurement bias, as it can be affected by the performance of the observer. For this reason, the evaluation of agreement between observers, aiming to identify if different professionals produce identical results when performing an US in the same patient, under the same conditions, becomes important in the assessment of US reliability[14].

A cross-sectional study evaluated the agreement between three intensive care physicians, who received the same training in pulmonary bedside US, in the identification of pulmonary B-lines in 67 adult patients. Moderate to substantial agreement was identified (Kappa from 0.41 to 0.79; 95% CI) in 80% of the pulmonary areas evaluated, suggesting good reproducibility of the technique[15].

When analyzing the agreement between nurses and physicians in the use of ultrasonography to assess quadriceps thickness in 45 critically ill patients, a study identified excellent agreement (ICC: 0.97-0.99; 95% CI). The authors state that trained nurses can develop this assessment with quality, similar to that of an experienced physician, contributing to the care of critically ill patients[16]. This opinion was affirmed by another study, in which the learning curve of nurses was similar to that of physicians and physical therapists[17].

Considering the findings in the literature, we postulate that a trained intensive care nurse can properly identify the NGT positioning by US, which adds autonomy to their care practice, assists in decision-making and promotes patient safety in the care of critically ill patients using NGT. Thus, this study aimed to evaluate the agreement between nurse and physician in determining the nasogastric tube placement by US and to describe the main difficulties faced by nurses in performing the technique.

METHOD

A cross-sectional study was conducted from January to April 2021, in the general ICU of a large hospital in southern Brazil. Adult patients (age >18 years), who had an indication for NGT insertion were included; patients with operative wounds, drains, using peritoneostomy or other conditions

that prevented US abdominal exam, as well as patients with indication for endoscopy-guided of the NGT were excluded.

Patients were selected by convenience, when there was simultaneous availability of both evaluators (a nurse and a physician), and the screening for inclusion of patients was carried out after the dismissal of NGT by the satellite pharmacy of the ICU.

The nurse, considered an evaluator in test, has specialization in intensive care and short-term training in ultrasonography applied to nursing procedures. The physician (reference evaluator) has a specialty in intensive care, 10 years of experience in the ICU, is experienced in the use of Point-of-Care ultrasonography (POCUS) and has experience in its use to verify NGT positioning.

Before the beginning of data collection, the nurse received training to assess the NGT positioning by US. Two moments of training were carried out, each lasting about one hour; this occurred at the bedside and included theoretical and practical aspects related to the use of ultrasonography, handling the equipment, recognizing anatomical structures and the parameters for verifying the NGT positioning. Next, the nurse performed five assessments supervised by the physician and was considered "able" for the beginning of data collection. This training strategy was designed based on the experience of professionals in other training courses, and also on experiences described in the literature, although there is no formally recommended strategy[18–20].

The US for the evaluation of agreement were performed independently, consecutively, with both evaluators being blind to the evaluation of the other. Data about the nurse's impression of the anatomical position of the NGT and notes regarding the difficulties in performing the US were recorded in a form developed for research.

The ultrasonography equipment used was the Sono Site Edge II®, with a transducer for curvilinear abdominal US 5-2 Mhz. In all insertions, a radiopaque probe with weight at the distal tip, Dobbhoff type,12 French, with guide wire was used. Its insertion was performed via the nasal route, by ICU nurses with no bond with the research and without the presence of the evaluators, following the measure standardized by the institution (from the nostril wing to the ear lobe, from there to the tip of the xiphoid process, and from there to the umbilical scar, or adding 10 cm from the xiphoid process[21]), the guide wire was removed after insertion, being absent at US assessment.

In all evaluations, the patients were under the same environmental conditions and in the same position, preferably in dorsal decubitus position with the headboard kept at 30º; the test comprised the abdominal assessment, starting with the epigastric region, extending to the left upper quadrant, scanning the region with the transducer in a sagittal and transverse position; the tube was considered as visualized and properly positioned when it was identified in the stomach topography, therefore, in an infradiaphragmatic position.

In compliance with the institutional protocol and the literature recommendation[3,22], after insertion, all patients underwent an abdominal X-ray, performed in bed, with portable equipment. Upon evaluation of X-ray images by the ICU medical team, which did not participate in the study, the NGT was released (or not) for use. The parameter for release (adequate NGT placement) was the presence of the distal tip of the probe in an infradiaphragmatic position[23].

The number of evaluations performed in the study was defined from research on POCUS learning and studies of interobserver agreement that suggest that the acquisition of skills of US to guide procedures seems to have a short learning curve, with a mean of 25 to 50 evaluations[24,25].

The Shapiro-Wilk was performed to test the normality in the distribution of variables. Continuous variables were presented as mean ± SD, while categorical variables as absolute and relative frequency. Interobserver agreement was evaluated using the adjusted Kappa coefficient (k) (PABAK – *Prevalenceand Bias Adjusted Kappa*) and its 95% confidence interval. The StatisticalPackage for the Social Sciences – SPSS® and Rstudio® software were used.

According to Kappa coefficient values, agreement was classified as: none (k = 0.00); poor (k = 0.00 – 0.20); weak (k = 0.21 – 0.40); moderate (k = 0.41 – 0.60); substantial (k = 0.61 – 0.80); almost perfect or complete (k = 0.81 – 1)[14].

The study was approved regarding its ethical and methodological aspects by the Research Ethics Committee (REC) of the institution where the study was conducted (CAE: 39161820,8,0000,5530).

RESULTS

Thirty adult patients admitted to the ICU, whose mean age was 52±14.6 years, were evaluated in a paired manner, 60% were male; most (70%) used invasive mechanical ventilation, and half (50%) were sedated. The principal reason for ICU admission was COVID-19; as for previous pathologies, more than half of the patients (53.3%) were diabetic and hypertensive. The tube was indicated mainly due to the use of invasive or non-invasive mechanical ventilation (90%) (Table 1).

Table 1 – Characteristics of patients included in the study. Porto Alegre, Rio Grande do Sul, Brazil, 2021

Characteristics of patients	N (%)
Age (in years)	52±14.6*
Male	18 (60)
Main reason for hospitalization	
COVID-19	19 (63.3)
Sepsis	6 (20)
Respiratory insufficiency	2 (6.7)
Stroke	1 (3.3)
Cardiorespiratory arrest	1 (3.3)
Surgical	1 (3.3)
Previous pathologies	
Diabetes Mellitus	16 (53.3)
Systemic arterial hypertension	16 (53.3)
Obesity	8 (26.7)
Heart disease	5 (16.7)
Smoker/Ex-smoker	8 (26.7)
Chronic renal insufficiency	5 (16.7)
Chronic obstructive pulmonary disease	3 (10%)
Human immunodeficiency virus	3 (10%)
PAD	2 (6.7)
Alcoholic	1 (3.3)
Previously Healthy	5 (16.7)
Indication of NGT	
Altered level of consciousness	1 (3.3)
Dysphagia	2 (6.7)
Using mechanical ventilation	27 (90)

Table 1 – Cont.

Characteristics of patients	N (%)
Level of consciousness	
Lucid and oriented	4 (13.3)
Drowsy and/or confused	11 (36.6)
Sedated	15 (50)
Type of ventilatory support	
Invasive mechanical ventilation	21 (70)
Non-invasive mechanical ventilation	2 (6.7)
Nasal cannula oxygen supply	5 (16.7)
Ambient air	2 (6.7)

Source: research data, 2021.
Data expressed by absolute numbers and proportion in parentheses, or as * mean ±standard deviation, when flagged.

Considering the total of pairs of evaluations (n=30) there was almost perfect agreement between the evaluators (k = 0.93; 95% CI: 0.65 – 0.99). Moreover, it was observed that the US was related to the abdominal X-ray, indicated by a perfect agreement (k=1.0; 95% CI: 0.77 – 1.00) between these exams.

There was only one case of disagreement between observers, when the nurse reported not seeing the NGT clearly. He attributed the difficulty to the interposition of gas, which generated artifacts and hindered to interpret the image with safety.

In seven other evaluations, the nurse reported some difficulty in performing the exam: two patients had a distended abdomen; in three patients, the delimitation of the structures was considered more difficult to obtain, also by gas interposition, increasing the duration of the evaluation; one of the patients had cough and another patient was confused and restless during the exam.

We highlight that, in the 30 evaluations, no tube was identified in a risk position for the administration of diet, which was corroborated by the X-ray examination.

DISCUSSION

The present study showed that a trained nurse can replicate the technique of verifying the NGT positioning, using US, with a low incidence of doubt in the interpretation of findings. Moreover, this investigation showed that US is related to X-ray findings.

The abdominal X-ray is the "gold standard" for checking NGT placement. However, it is a method that adds cost and time to the tube placement confirmation process. Furthermore, it exposes the patient to radiation and its interpretation also requires a trained professional, in order to avoid adverse events resulting from inadequate interpretation[3,26].

US is a promising alternative for checking the NGT positioning, as it can be performed at the bedside, quickly, safely and at low cost[2]. The use of US to guide procedures, whether when obtaining images in real time (dynamic form) or at certain moments of the procedure (static form), has been expanding. In both cases, it can increase assertiveness and safety in the execution[27].

In the present study, US was used after the NGT insertion, evaluating the epigastric or subxiphoid region, therefore, in a static form. This was also the technique most frequently used in the studies that composed a systematic review that gathered 420 evaluated patients, mainly in the pre-hospital setting. The overall sensitivity and specificity were 93% (95% CI: 0.87 – 0.97) and 97% (95% CI: 0.23 – 1.00), respectively[9].

In another systematic review, in which 545 patients were included, the US to assess the positioning of the enteral

tube was used mainly in the ICU. The window used was also epigastric; sensitivity between 86 and 98% (95% CI: 0.50-1.00) and specificity between 67 and 100% (CI: 0.17-1.00) were identified, very variable values, which was attributed to heterogeneity of studies[28].

However, among the works analyzed in both reviews, the evaluation was performed by nurses in only one of them[9,28]. As US is an operator-dependent technique[29], it is reinforced the importance of evaluating agreement between observers. However, the findings of this study are in line with data from the literature, which point out the potential of nurses in the use of US[16,30].

A systematic review that evaluated the use of US by nurses in emergency services included 16 studies and 2,245 evaluations; it was identified that even professionals without previous experience, after training, can use US to perform procedures (such as venipuncture and assessment of NGT placement) and to assist in the physical examination, in a precise and safe way[30].

Evaluation of urinary retention (UR) with use of US is also a technique used by nurses. A study aimed at describe the incidence of urinary retention and the relationship between the patient's complaint, physical examination and US performed by nurses found excellent agreement between observers, all nurses (k = 0.783; 95% CI: 0.703 – 0.996)[7].

In the study about evaluation of UR, nurses were already experienced in this technique, while, in the present study, NGT placement evaluation was a newly acquired skill. This demonstrates that the training methodology used, in loco, positively interfered on the agreement obtained. This is relevant because, although the use of US by nurses is supported by COFEN, through Resolution 679/2021, there is no recommendation on the criteria for this training or its duration[8].

Although the overall agreement was excellent, some difficulties were found by the nurse when interpreting the images obtained in the evaluations. The interposition of gas and the patient's movement during the exam, due to cough or altered level of consciousness, which made the patient uncollaborative during the exam, were the biggest obstacles.

The interposition of gas is pointed out in several studies as a factor that can hinder to assess the gastrointestinal tract using US[9,10,12,20,31,32]. This is due to the characteristics of US: high-frequency sound waves penetrate the tissues and are reflected by them. When returning to the transducer these waves are converted into images. Therefore, US penetrates better in solid structures, such as organs, or liquids, but has limitations when interacting with air, which is often present in the digestive tract. This can lead to dispersion of sound waves in different directions, reducing the return to the transducer and compromising the formation ofimages[33].

To reduce this limitation, it has been suggested the use of saline solution[9] which generate a dynamic image at US, making it easier to visualization[10]. Due to the heterogeneity of the studies included in the systematic reviews, it became evident that US still does not have robust studies that support its use as a unique technique for verifying the placement of the enteral tube[9,18]. In this sense, the instillation of saline solution, without being sure of the anatomical positioning of the tube, constitutes an additional risk and, therefore, was not used in this study.

The literature presents other factors that may hinder the use of the US technique, reducing its diagnostic accuracy. Such as the presence of obesity[12,31], painful or distended abdomen[31], surgical wound, drains or open abdomen[9], and patients who are confused or uncollaborative during the examination[19].

Despite almost a third of the patients of the present study had a diagnosis of obesity, this was not identified as a hinder factor in the evaluations performed. Less encouraging results were obtained by other authors who were able to have the tube with US confirmed positioning in 49 of the 54 patients evaluated, and attributed their difficulty to the interposition of gas and obesity[31].

The reduced number (n=30) of duplicate evaluations performed could constitute a possible limitation of the present study. However, previous research, with a similar number of participants, documented a learning curve with a mean of 25 to 50 evaluations for most US-guided procedures[24,25].

On the other hand, this study presents US as a technology reproducible by nurses, through training, which can increase access to safety practices in nutritional therapy. Although technical limitations may reduce the accuracy of US to identify NGT placement, many patients would still benefit from the use of this technology.

CONCLUSION

After undergoing a short-term training protocol, a nurse obtained similar results to those produced by an experienced physician when performing bedside US to identify NGT placement in critically ill adults. These findings suggest that the technique used is reproducible by nurses.

The main difficulties reported by the nurse were similar to those described in the literature, which suggests that this is a limitation of the method and not of the technology operator. Although more robust studies of diagnostic accuracy are still needed for the transposition of this technique to clinical practice, training nurses to apply US for the purpose of identifying the distal tip of the NGT can substantially improve the safety of the nutritional therapy process, reduce

diet breaks, patient displacement to the radiology area and the hospital costs.

REFERENCES

1. Metheny NA, Krieger MM, Healey F, Meert KL. A review of guidelines to distinguish between gastric and pulmonary placement of nasogastric tubes. Heart Lung. 2019;48(3):226-35. doi: https://doi.org/10.1016/j.hrtlng.2019.01.003.
2. Matsuba CST, Serpa LF, Pereira SRM. Diretriz BRASPEN de enfermagem em terapia nutricional oral, enteral e parenteral. Braspen J. 2021 [cited 2021 Nov 2];36(3 Supl 3):1-62. Available from: https://www.braspen.org/_files/ugd/66b28c_8ff5068bd2574851b9d61a73c3d6babf.pdf.
3. Boullata JI, Carrera AL, Harvey L, Escuro AA, Hudson L, Mays A, et al. ASPEN safe practices for enteral nutrition therapy [formula: see text]. JPEN J Parenter Enteral Nutr. 2017;41(1):15-103. doi: https://doi.org/10.1177/0148607116673053.
4. Piton G, Parel R, Delabrousse E, Capellier G. Echography for nasogastric tube placement verification. Eur J Clin Nutr. 2017;71(5):669-70. doi: https://doi.org/10.1038/ejcn.2016.276.
5. Nedel WL, Jost MNF, Franco Filho JW. A simple and fast ultrasonographic method of detecting enteral feeding tube placement in mechanically ventilated, critically ill patients. J Intensive Care. 2017 [cited 2021 Nov 2];5:55. Available from: https://www.embase.com/search/results?subaction=viewrecord&id=L617802965&from=export.
6. Cao Y, Kong X, Yang D, Li S. Endoscopic nasogastric tube insertion for treatment of benign afferent loop obstruction after radical gastrectomy for gastric cancer: A 16-year retrospective single-center study. Medicine. 2019;98(28):e16475. doi: https://doi.org/10.1097/MD.0000000000016475.
7. Ceratti RN, Beghetto MG. Incidence of urinary retention and relations between patient's complaint, physical examination, and bladder ultrasound. Rev Gaúcha Enferm. 2021;42:e20200014. doi: https://doi.org/10.1590/1983-1447.2021.20200014.
8. Conselho Federal de Enfermagem (BR). Resolução Cofen nº 678, de 19 de agosto de 2021. Aprova a atuação da Equipe de Enfermagem em Saúde Mental e em Enfermagem Psiquiátrica. Diário Oficial União. 2021 ago 26 [cited 2021 Nov 2];159(162 Seção 1):97. Available from: https://pesquisa.in.gov.br/imprensa/jsp/visualiza/index.jsp?data=26/08/2021&jornal=515&pagina=97&totalArquivos=97.
9. Lin T, Gifford W, Lan Y, Qin X, Liu X, Wang J, et al. Diagnostic accuracy of ultrasonography for detecting nasogastric tube (NGT) placement in adults: a systematic review and meta analysis. Int J Nurs Stud. 2017;71:80-8. doi: https://doi.org/10.1016/j.ijnurstu.2017.03.005.
10. Brun PM, Chenaitia H, Lablanche C, Pradel AL, Deniel C, Bessereau J, et al. 2-point ultrasonography to confirm correct position of the gastric tube in prehospital setting. Mil Med. 2014;179(9):959-63. doi: https://doi.org/10.7205/MILMED-D-14-00044.
11. Muslu B, Demircioglu RI, Gözdemir M, Usta B. Comparison of neck ultrasonography with a pH meter to confirm correct position of nasogastric tube. Clin Invest Med. 2016;39(6):27520. doi: https://doi.org/10.1177/0884533614567714.
12. Zatelli M, Vezzali N. 4-Point ultrasonography to confirm the correct position of the nasogastric tube in 114 critically ill patients. J Ultrasound. 2017;20(1):53-8. doi: https://doi.org/10.1007/s40477-016-0219-0.
13. Andersen CA, Holden S, Vela J, Rathleff MS, Jensen MB. Point-of-care ultrasound in general practice: a systematic review. Ann Fam Med. 2019;17(1):61-9. doi: https://doi.org/10.1370/afm.2330.
14. Miot HA. Agreement analysis in clinical and experimental trials [editorial]. J Vasc Bras. 2016;15(2):89-92. doi: https://doi.org/10.1590/1677-5449.004216.
15. Vieira JR, Castro MR, Guimarães TP, Pinheiro AJT, Figueiredo ACTC, Martins BJ, et al. Evaluation of pulmonary B lines by different intensive care physicians using bedside ultrasonography: a reliability study. Rev Bras Ter Intensiva. 2019;31(3):354-60. doi: https://doi.org/10.5935/0103-507X.20190058.
16. Kumar R, Shah TH, Hadda V, Tiwari P, Mittal S, Madan K, et al. Assessment of quadriceps muscle thickness using bedside ultrasonography by nurses and physicians in the intensive care unit: intra- and inter-operator agreement. World J Crit Care Med. 2019;8(7):127-34. doi: https://doi.org/10.5492/wjccm.v8.i7.127.
17. Snelling PJ, Jones P, Keijzers G, Bade D, Herd DW, Ware RS. Nurse practitioner administered point-of-care ultrasound compared with x-ray for children with clinically non-angulated distal forearm fractures in the ED: a diagnostic study. Emerg Med J. 2021;38(2):139-45. doi: http://doi.org/10.1136/emermed-2020-209689.
18. Mak MY, Tam G. Ultrasonography for nasogastric tube placement verification: an additional reference. Br J Community Nurs. 2020;25(7):328-34. doi: https://doi.org/10.12968/bjcn.2020.25.7.328.
19. Tai PH, Lau WS, Chan PY, Ng SY, Lam YC, Mak HT, et al. Nurse performed ultrasonography in confirming the position of nasogastric tube in the emergency department: A prospective single group diagnostic test study. Hong Kong J Emerg Med. 2016;23(6):340-9. doi: https://doi.org/10.1177/102490791602300603.
20. Kim HM, So BH, Jeong WJ, Choi SM, Park KN. The effectiveness of ultrasonography in verifying the placement of a nasogastric tube in patients with low consciousness at an emergency center. Scand J Trauma Resusc Emerg Med. 2012;20:38. doi: https://doi.org/10.1186/1757-7241-20-38.
21. Torsy T, Saman R, Boeykens K, Duysburgh I, Van Damme N, Beeckman D. Comparison of two methods for estimating the tip position of a nasogastric feeding tube: a randomized controlled trial. Nutr Clin Pract. 2018;33(6):843-50. doi: https://doi.org/10.1002/ncp.10112.
22. Conselho Federal de Enfermagem (BR). Resolução Cofen nº 453 de 16 de janeiro de 2014. Aprova a Norma Técnica que dispõe sobre a Atuação da Equipe de Enfermagem em Terapia Nutricional. Diário Oficial União. 2014 jan 28 [cited 2022 Apr 24];151(19 Seção 1):78. Available from: https://pesquisa.in.gov.br/imprensa/jsp/visualiza/index.jsp?data=28/01/2014&jornal=1&pagina=78&totalArquivos=80.
23. Wada DT, Rodrigues JAH, Santos MK. Sondas, cateteres e outros aparatos médicos na radiografia de tórax. Medicina. 2019;52(supl 1):57-71. doi: https://doi.org/10.11606/issn.2176-7262.v52isupl1.p57-71.
24. Díaz-Gómez JL, Mayo PH, Koenig SJ. Point-of-care ultrasonography. N Engl J Med. 2021;385(17):1593-602. doi: https://doi.org/10.1056/NEJMra1916062.
25. Arzola C, Carvalho JCA, Cubillos J, Ye XY, Perlas A. Anesthesiologists' learning curves for bedside qualitative ultrasound assessment of gastric content: a cohort study. Can J Anesth. 2013;60(8):771-9. doi: https://doi.org/10.1007/s12630-013-9974-y.
26. Bloom BA, Gibbons RC. Focused assessment with sonography for trauma. In: StatPearls [Internet]. Treasure Island, FL: Stat Pearls Publishing; 2022 [cited 2022 Feb 22]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK470479/.
27. Thind GS, Fox S, Gupta M, Chahar P, Jones R, Dugar S. Point-of-care ultrasonography for the hospitalist. Cleve Clin J Med. 2021;88(6):345-59. doi: https://doi.org/10.3949/ccjm.88a.20141.
28. Tsujimoto H, Tsujimoto Y, Nakata Y, Akazawa M, Kataoka Y. Ultrasonography for confirmation of gastric tube placement. Cochrane Database Syst Rev. 2017;4(4):CD012083. doi: https://doi.org/10.1002/14651858.CD012083.pub2.
29. Rajamani A, Shetty K, Parmar J, Huang S, Ng J, Gunawan S, et al. Longitudinal competence programs for basic point-of-care ultrasound in critical care: a systematic review. Chest. 2020;158(3):1079-89. doi: https://doi.org/10.1016/j.chest.2020.03.071.

30. Varndell W, Topacio M, Hagness C, Lemon H, Tracy D. Nurse-performed focused ultrasound in the emergency department: a systematic review. Australas Emerg Care. 2018;21(4):121-30. doi: https://doi.org/10.1016/j.auec.2018.09.003.
31. Liu Z, Guo J, Ren W, Tang S, Huang Y, Huang L, et al. Evaluation of ultrasound-guided Freka-Trelumina enteral nutrition tube placement in the treatment of acute pancreatitis. BMC Gastroenterol. 2020;20(1):21. doi: https://doi.org/10.1186/s12876-020-1172-0.
32. Zhang Q, Sun JH, Liu JT, Wang XT, Liu DW. Placement of a jejunal feeding tube via an ultrasound-guided antral progressive water injection method. Chin Med J. 2018;131(14):1680-5. doi: https://doi.org/10.4103/0366-6999.235874.
33. Moore CL, Copel JA. Point-of-care ultrasonography. N Engl J Med. 2011;364(8):749-57. doi: https://www.nejm.org/doi/full/10.1056/NEJMra0909487.

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