Original Article

Usefulness of ultrasound in confirming the correct placement of Ryle's tube compared to the traditional method of auscultation in normal versus overweight and obese patients

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Abstract

Background and Aims: Auscultation to verify Ryle's tube position is difficult in obese patients. We compared the usefulness of ultrasonography (USG) versus auscultation in confirming the correct Ryle's tube placement in normal versus overweight or obese patients, time taken for confirmation, and incidence of reinsertion.

Material and Methods: A prospective, observational study was carried out on 80 patients. Patients with a body mass index (BMI) >25 kg/m^2 formed group O and those with BMI <25 kg/m^2 constituted group N. After Ryle's tube insertion correct placement was first confirmed by auscultation. The presence of a gurgling sound over the epigastrium was graded (definite/doubtful/absent). During USG evaluation, if Ryle's tube was not visualized at the subxiphoid region, 20mL of air was injected, looking for dynamic fogging in the stomach. If auscultation yielded doubtful or absent results and USG also failed to confirm, Ryle's tube was repositioned and confirmed.

Results: Group O had a significantly higher BMI. Auscultation time and the time taken for USG confirmation were significantly longer in group O. The percentage of patients with definite auscultatory signs was significantly higher in group N. Significantly higher number of patients in group O had doubtful/absent auscultatory signs. Ryle's tube and fogging visualization with USG and the requirement of reinsertion were comparable in both groups. The percentage of patients with definite auscultatory confirmation and definite USG confirmation were comparable in group N. However, in group O, significantly lesser patients had definite auscultatory confirmation compared to definite USG signs.

Conclusion: Confirmation of the correct placement of Ryle's tube using ultrasound is easier than auscultation in overweight and obese patients. In normal patients, both techniques are equally useful.

Keywords: Auscultation, obesity, overweight, Ryle's tube, ultrasound

Introduction

Ryle's tube insertion is a common procedure both in operating theaters and intensive care units. It is performed either to decompress the stomach or for feeding purposes. Although nasogastric tube placement is generally considered safe, it can result in complications such as perforation, bleeding, pneumothorax, pulmonary hemorrhage, or pneumomediastinum.[1] Moreover, administering drugs or feeds via a misplaced Ryle's tube in the trachea can result in severe pneumonia. Therefore, it is necessary to verify the correct placement of Ryle's tube as early as possible.

The various methods used to verify the location of Ryle's tube include auscultation, chest radiography, pH measurement, and ultrasound.[2-5]Because the traditional method of

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auscultation is difficult in obese patients due to the thick abdominal wall, other techniques are depended on. The "gold standard" method of X-ray/computed tomography (CT) is a source of radiation for patients and carries a potential risk of adverse effects, additional costs, and a delay in prompt imaging. On the other hand, recent studies have reported that ultrasonography (USG) provides good diagnostic accuracy in the confirmation of proper nasogastric tube placement.[6-8]We hypothesized that ultrasound could be a promising alternative to auscultation in confirming nasogastric tube placement, especially in overweight and obese patients compared to normal patients.

The primary objective of the present study was to determine the usefulness of ultrasound versus auscultation in confirming correct Ryle's tube placement in normal versus overweight or obese patients. The secondary objectives were the estimation of the time taken for confirmation with both techniques and ease of confirmation in overweight and obese patients, the incidence of reinsertion of Ryle's tube, and X-ray confirmation in both groups.

Material and Methods

This prospective, non-randomized, observational study was conducted after obtaining approval from the institutional ethical committee (IEC-AIMS-2019-ANES-256 dated 02.12.2019) and consent from patients. The study was registered with Clinical Trial Registry India (CTRI/2020/01/022746). All consenting patients undergoing surgical procedures and requiring Ryle's tube insertion were included in the study. Patients with coagulopathy, midfacial and base of skull fractures, history of gastric bypass, esophageal strictures or alkali injury, and upper gastrointestinal bleeding were excluded. There were two groups in the study with an equal number of patients. Patients with body mass index (BMI) >25 kg/m^2 formed group O, whereas those with a BMI <25 kg/m^{2}constituted group N.

Minimum fasting of 6 hours before anesthesia was ensured in all patients. Intravenous (IV) access was obtained preoperatively for the administration of IV medications. General anesthesia was administered as per the institutional protocol. Ryle's tube was inserted after securing the airway with a cuffed endotracheal tube. Correct placement was confirmed initially by auscultation. The presence of a gurgling sound over the epigastrium was graded (definite/doubtful/absent).

USG evaluation was performed using SonoSite (FUJIFILM SonoSite, Inc. Bothell WA 98021 USA), a C60 convex 5-2MHz probe to visualize the subxiphoid and gastro-esophageal region. The thickness of the anterior abdominal wall at the epigastrium was documented. In the subxiphoid region, Ryle's tube was attempted to be visualized [Figure 1]. If not visualized, 20mL of air was injected through a syringe, simultaneously looking for dynamic fogging in the stomach with USG. The identification of USG signs was performed by anesthesiologists who have performed more than 20 similar procedures before taking part in the trial.

Confirming Ryle's tube position by auscultation, and USG were performed by two different anesthesiologists, and the time taken with both techniques was noted. In the auscultatory method, it was calculated as the time from placement of the stethoscope over the epigastrium till the gurgling sound was identified. The time from placement of the USG probe on the epigastrium to the identification of Ryle's tube or dynamic fogging was noted in the USG method. If auscultation yielded doubtful or absent results and USG also failed to confirm correct placement, Ryle's tube was repositioned and confirmation by both techniques was repeated. The number of attempts taken for correct placement was noted. All patients were screened by direct radiography during the postoperative period, and the findings of USG were confirmed. Time taken for X-ray confirmation was calculated from the time of shifting the patient to the postoperative intensive care unit (ICU) to the time at which the digital image was made available for assessment.

As there is no similar study published, a pilot study with ten patients in each group was initially conducted, of which half the patients had a BMI <25 kg/m^2, whereas others had a BMI >25 kg/m^2. The percentages of patients with definite auscultatory confirmation in both groups were calculated to be 90 versus 60%, respectively, in normal versus overweight/obese patients. Based on these values with a 95% confidence

Figure 1: USG image of Ryle's tube in the subxiphoid region with a probe placed longitudinally and slightly tilted

interval and 90% power, the minimum sample size required was calculated to be 39 per group using the formula

$$n = (Z_{\alpha/2} + Z_{\beta})^2 * (p_1 (1 - p_1) + p_2 (1 - p_2))/(p_1 - p_2)^2,$$

where $Z_{\alpha/2}$ is the critical value of the normal distribution at $\alpha/2$, Z_{β} is the critical value of the normal distribution at β, and p_1 and p_2 are the expected sample proportions of the two groups. We included 40 patients in each group during our study period.

The differences between the observed means in two independent samples were compared using the independent sample t-test, and the Chi-squared test was used for the comparison of proportions. MedCalc Software Ltd (Version 20.110) was used for statistical analysis.

Results

Data of 80 patients were analyzed. The mean age and distribution of gender were comparable in both groups. The height, weight, and BMI were significantly different in both groups, with group O having a significantly higher BMI ($P < 0.001$, Table 1). The mean abdominal wall thickness was significantly higher in group O. The auscultation time and time taken for USG confirmation were significantly longer in group O compared to group N. The time taken for X-ray confirmation in the ICU was comparable in both groups [Table 2].

The percentage of patients in whom Ryle's tube positioning could be confirmed with definite auscultatory signs was significantly higher in group N ($P < 0.006$). A significantly higher number of patients in group O had doubtful or absent auscultatory signs for confirmation of Ryle's tube ($P < 0.006$). The percentages of patients in whom Ryle's tube and dynamic fogging could be visualized with USG were comparable in both groups. The requirement of reinsertion of Ryle's tube did not show any significant difference between the groups (P: 0.399). Correct position confirmation by X-ray was similar in both groups [Table 3].

The intragroup analysis showed that the percentage of patients with definite auscultatory confirmation and definite USG confirmatory signs were comparable in group N. However, in group O significantly lesser patients had definite auscultatory confirmation compared to definite USG signs (60 vs. 90%, $P < 0.002$). The percentage of patients in whom the USG method was successful in confirming proper Ryle's tube position who had absent/doubtful auscultatory signs was significantly higher in Group O compared with Group N (12.5 vs. 40%, P: 0.006, Table 4).

Discussion

In the present study, it was observed that the auscultatory sign in confirming proper Ryle's tube placement was more definite in normal patients. A significantly higher number

Table 1: Comparison of demographic variables and BMI

Variables	Mean±SD		*P*
	Group N *n* (%)	Group O *n* (%)	
Age in years	51.65±15.38	53.73±18.29	0.502
Height in cm	166.79±8.92	158.75±8.63	<0.001
Weight in kg	61.83±7.14	82.03±11.51	<0.001
BMI in kg/m^2	22.31±2.75	32.49±3.25	<0.001
Gender			
Male	18 (45)	14 (35)	0.364
Female	22 (55)	26 (65)	

Table 2: Comparison of abdominal wall thickness, time required for auscultatory, ultrasonographic, and X-ray confirmation

Variables	Mean±SD		*P*
	Group N	Group O	
Abdominal wall thickness in cm	1.79±0.25	4.95±0.71	<0.001
Auscultation time in sec	11.67±4.18	59.83±47.84	<0.001
Time for USG confirmation in min	3.34±0.77	5.81±0.75	<0.001
Time for X-ray confirmation in min	126±24.66	134±21.76	0.062

Table 3: Distribution of auscultatory and ultrasonographic findings and incidence of reinsertion

Variables	*n* (%)		*P*
	Group N	Group O	
Auscultation			
Definite	35 (87.5)	24 (60)	0.006
Doubtful/absent	5 (12.5)	16 (40)	0.006
Ryle's tube seen	13 (32.5)	10 (25)	0.462
Fogging seen	38 (95)	36 (90)	0.399
Reinsertion	2 (5)	4 (10)	0.399
X-ray correct position	39 (97.5)	38 (95)	0.559

Table 4: Intragroup and intergroup analysis of confirmatory signs by auscultation and ultrasound

Groups	*n* (%)		*P*
	Confirmation with presence of definite auscultatory signs	Confirmation with the presence of definite USG signs	
Group N	35 (87.5)	38 (95)	0.238
Group O	24 (60)	36 (90)	< 0.002
Variable	**Group N**	**Group O**	
Successful USG confirmation in patients with absent/doubtful auscultatory signs	5 (12.5)	16 (40)	0.006

of overweight or obese patients had absent or doubtful auscultatory signs compared with normal patients, but the USG method was successful in confirming proper Ryle's tube position in them. Ryle's tube and dynamic fogging visualization with USG could be performed with comparable success in normal and obese patients.

Ryle's tube insertion is a common procedure in hospitals, and the correct placement is routinely confirmed with auscultation. In overweight and obese patients, due to thicker abdominal walls, auscultation usually yields uncertain results. Because ultrasound machines are now an integral part of most ICUs and operation theaters, they can be utilized for confirming Ryle's tube position. The use of ultrasound for verifying Ryle's tube placement has several advantages such as it is fast, cheap, widely available, easy, provides repetitive evaluations and bedside evaluation, lacks ionizing radiation, and provides dynamic imaging. Furthermore, recent studies have demonstrated the effectiveness of ultrasonography in proper nasogastric tube placement.[5-8] Ultrasonography is now suggested as a promising diagnostic tool for the determination of Ryle's tube location in most patients, and it thus can eliminate the need for radiography.

Point-of-care USG can be used to guide the nasogastric tube in real time with the probe placed sequentially at the anterolateral neck and epigastrium. In the anterior neck, the cervical esophagus is to be identified, which is typically visualized to the left, posterolateral to the trachea, and an intraluminal curvilinear echogenic interface represents the esophageal placement of the tube. In the epigastrium with a longitudinal view of the gastro-esophageal junction, the nasogastric tube may be advanced into the stomach under direct visualization. In the oblique and sagittal scan planes visualizing the tube passing through the gastric fundus and terminating in the antrum confirms the correct placement.[8]

We tried to visualize Ryle's tube either at the fundus or antrum of the stomach in our study. The antrum is seen posterior to the left liver lobe and anterior to the pancreas. In the transverse section, in the fasting stage, the antrum usually appears like a finger glove with hypoechogenic walls with homogeneous content. In the medium-sagittal epigastric section, the antrum has an ovoid appearance (bull's eye pattern). With an increase in gastric volume, the antrum appears round with thin walls. It is generally difficult to visualize the antrum with USG without previous patient preparation.[8]

The gastric fundus is located in the left superior abdominal quadrant, under the diaphragm, anterior to the left kidney, and behind the spleen. It is difficult to visualize the fundus because it is deep and also due to the acoustic windows of the ribs. Visualization of the fundus may be easier through a left lateral intercostal trans-splenic section or a longitudinal section over the medium-axillary line.[8]

Identifying Ryle's tube in the stomach and dynamic fogging using ultrasound are techniques that can be learned with some training from a radiologist. Though it is slightly more difficult to identify Ryle's tube with USG, dynamic fogging can be visualized more easily, which usually is considered sufficient for the confirmation of proper Ryle's tube position. A thicker anterior abdominal wall in overweight and obese patients requires keeping the depth setting of the ultrasound machine at higher values for evaluation. Even then, the presence of increased intra-abdominal fat in obese patients makes it harder for sound waves to penetrate structures to obtain a good-quality signal and thereby a quality image. Though confirming Ryle's tube position with USG in obese patients is not as easy as in thin patients, with practice, the technique can be mastered in time.

Bedside ultrasonography has been used to verify naso/orogastric tube placement in neonatal intensive care patients, eliminating the need for abdominal radiography.[9] However, in patients in whom ultrasound cannot verify the correct placement of Ryle's tube by direct visualization or after water and air insufflation, confirmation with X-ray is necessary.[10] Rapid positioning of Ryle's tube in COVID-19 patients was made possible with a USG probe oriented towards the left upper abdominal quadrant to visualize the gastric area and if two parallel hyperechogenic lines were identified through cardia, or if dynamic fogging could be visualized on injection of air, proper placement was confirmed. It was a small-sized study, and most patients had a BMI of 22.8 ± 1.9kg/m^2.[11]

The strong point of our study is that the usefulness of USG in confirming correct Ryle's tube positioning in obese patients has not been studied so far. The major limitation of our study was that it was a single-blinded study. As we required normal patients in one group and overweight/obese patients in the other group, randomization was not possible. Though identification of USG signs was done by anesthesiologists who had performed more than 20 similar procedures before taking part in the trial, the possibility of subjective variability due to differing skills and experience cannot be ruled out. Time taken for X-ray confirmation was kept as a secondary objective in our study to highlight the time delay associated with it and to reinforce the usefulness of USG to avoid such delays in confirming correct Ryle's tube placement.

Conclusion

Confirmation of the correct placement of Ryle's tube using ultrasound is easier than auscultation in overweight or obese

patients. In normal patients, both techniques are equally useful. The use of ultrasound helps to identify the early detection of incorrect placements of Ryle's tube in obese patients, allowing scope for undertaking early corrective measures for proper placement.

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Conflicts of interest
There are no conflicts of interest.

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