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Enteral nutrition tube placement assisted by ultrasonography in patients with severe acute pancreatitis

A novel method for quality improvement

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Abstract

To evaluate the effect of a novel procedure using real-time ultrasonography to assist nasojejunal tube placement at bedside in patients with severe acute pancreatitis (SAP).

Single center, prospective descriptive study in a 15-bed surgery intensive care unit of a university hospital. Thirty SAP patients were enrolled. The whole procedure of placing nasojejunal tube was performed by a single physician, who places nasojejunal tube at the bedside and performs ultrasonography to guide the tube positioning. The final nasojejunal tube position was confirmed by abdominal radiograph. The successful rate of the procedure as well as the time it took, the time from the decision of enteral feeding to commencement of feeding, and complications were recorded.

Thirty-six intubations were performed in 30 patients by using ultrasonography-assisted method at bedside. Nasojejunal tubes were successful placed in 28 of 30 patients (93.3%). The average time of successful placement was 22.07 ± 5.78 minutes. The median time between physician's decision for tube placement and feeding initiation was 5.5 (2, 24) hours. No adverse events occurred in all of patients.

This novel method of nasojejunal tube placement under ultrasound guidance is practical, less time consuming and reliable.

Abbreviations: BMI = body mass index, EN = enteral nutrition, ICU = intensive care unit, NS = normal saline, SAP = severe acute pancreatitis, SICU = surgery intensive care unit.

Keywords: Doppler, early enteral nutrition, nasojejunal tube placement, severe acute pancreatitis, ultrasound

1. Introduction

Both clinical guidelines and recent studies recommend enteral nutrition (EN) as a major component of treatment for patients with severe acute pancreatitis (SAP).[1–5] However, gastrointestinal dysfunction is common in such patients, part of them are intolerant of gastric feedings or at an increased risk of aspiration, so nasojejunal tube that is located distal to the ligament of Treitz should be applied in those patients.[4] On the other hand, clinical studies and guidelines suggest that EN should be started at 24 to 48 hours since intensive care unit (ICU) admission in critical patients.[5–7] Placing nasojejunal tube is, therefore, an important but challenging procedure.

Techniques for placing nasojejunal tube include fluoroscopical guide, electromagnetical guide, endoscopic placement, bedside placement, and so on.[8] However, all those methods have technical limitations, such as expensive or complex, making the placement of nasojejunal tube still a challenging task in clinical practice. Placing nasojejunal tube guided by fluoroscopy is laborious, time-consuming and often limited by equipment. The pivotal problem with blind technique is determining tube position real-timely, because a malpositioned tube can lead to catastrophic outcomes.[9] All of above methods have limitations in time-bound goal, that starting EN within 24 to 48 hours after admission in ICU.[6]

Here we came up with a novel method for placing nasojejunal tube at bedside with the monitoring of ultrasound in real time. The prospective study was used to evaluate the safety and effectiveness of this method.

2. Patients and methods

This study was performed in a surgery intensive care unit (SICU) of a university-affiliated tertiary hospital. The protocol was approved by the institutional review board of Jinling Hospital (Fig. 1), and informed consent was obtained from each patient or

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GL and YP contributed equally to this work.

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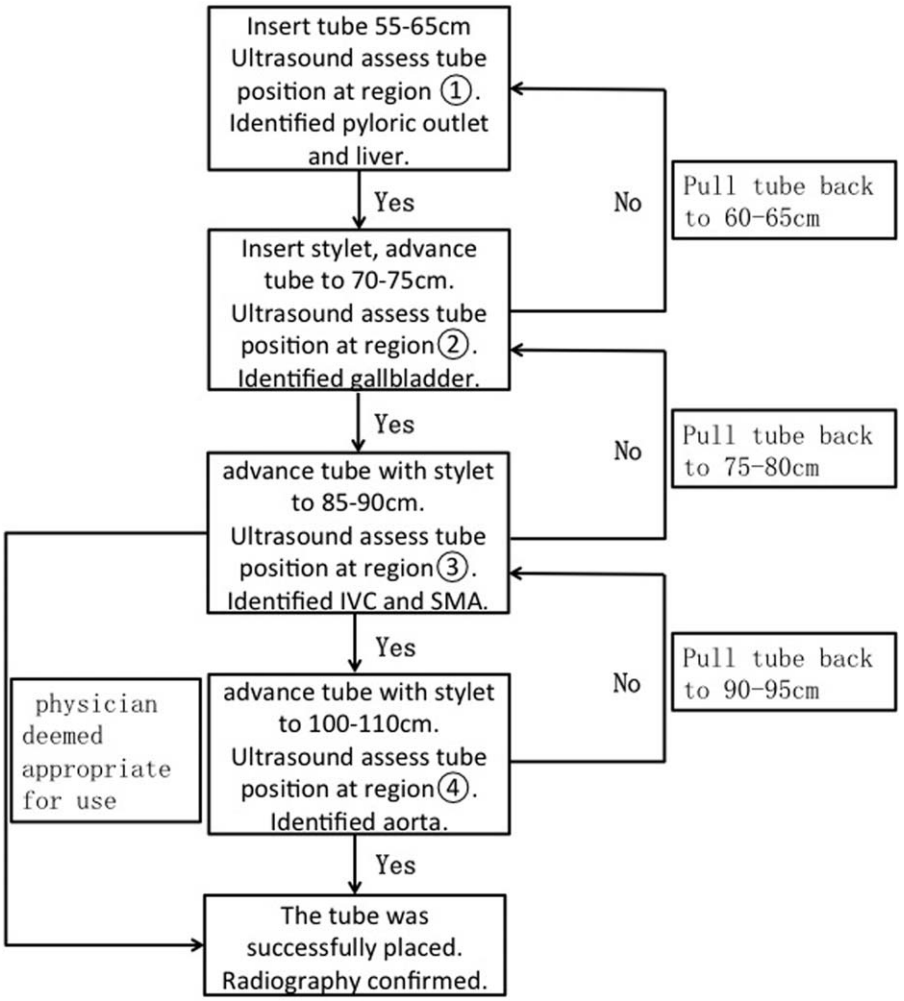

Figure 1. Procedure protocol. IVC = inferior vena cava, SMA = superior mesenteric artery.

the next of kin. No commercial components had a role in any aspect of this study.

Thirty patients (15 male and 15 female), aged 20 to 77 years (median 45 years), body mass index (BMI) 19.34 to 38.89 (mean 26.63), were enrolled for the study. Thirty percent (9/30) of these patients were ventilated mechanically at the time of the study. The scores of APACHE II and SOFA were recorded for severity classification. All of those information include other characteristics of the enrolled group are presented in Table 1.

The diagnosis of SAP was made according to the revision of Atlanta classification.[10] Patients with any of the following conditions were excluded from participation: esophagitis; recent oral, esophageal, or abdominal surgery; upper gastrointestinal bleeding; coagulopathy; cardiac pacemakers; or pregnancy.

The procedure of nasojejunal tube placement was performed by a single ICU physician. Patients were placed in a comfortable, semi-upright position and promotility agent metoclopramide (10 mg) was administered intravenously 10 minutes before the procedure. The physician starts inserting nasojejunal tube (CORPAK MedSystems, 10FR 55″, Buffalo Grove and Illinois) along the naris and advances it slowly until it is in the posterior pharynx. Then request the patient to repeatedly swallow to promote esophageal placement, if the patient was conscious and cooperative. Nasojejunal tube should be advanced to approximately 55 to 65 cm for placement into the stomach. Then, a standard 3.5-MHz and curvilinear array probe was placed at epigastrium and below the xiphoid to detect nasojejunal tube. Nasojejunal tube was identified as demonstrating a fine, long, and slightly hyper echoic structure (Fig. 2). However, we cannot find the definite structure in a large part of the study patients. For these ones, we used color Doppler scan the area, then 5 mL normal saline (NS) was injected into nasojejunal tube. The color Doppler

Table 1

Characteristics of the enrolled patients.

Characteristics	
No. of patients	30
Male/female, n	15/15
Age, median (low, high)	45 (20, 77)
Phases of severe acute pancreatitis	
Early (<1 wk), n	17
Later (>1 wk), n	13
APACHE II score, mean ± SD	13.04 ± 5.55
SOFA score, mean ± SD	5.37 ± 3.82

SD = standard deviation.

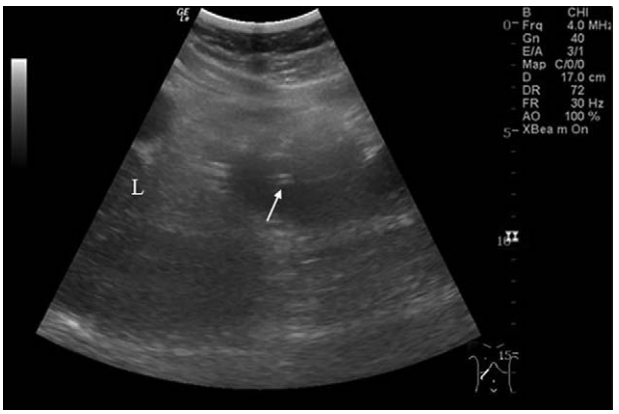

Figure 2. Ultrasound images showed nasojejunal tube (arrow) as a fine and slightly hyperechoic structure in the second portion of the duodenum. Nasojejunal tube in the duodenum (the white arrow). L=liver.

imaging reveals the presence of nasojejunal tube (Fig. 3). Transabdominal bowel ultrasonography examination was performed along with nasojejunal tube inserting, and usually we focused the following 4 areas to confirm nasojejunal tube position: the pyloric outlet, in a scanned longitudinal section, has a ring appearance and lies anteriorly as it crosses the spine or in transverse scan, has a funnel shaped appearance adjoins liver; the second portion of the duodenum usually locates very close to the gallbladder neck in an axial scan; the third portion lies in front of the inferior vein cava and behind superior mesenteric artery; in axial scans, along the third portion, the fourth portion is visualized once the aorta is passed.

The final nasojejunal tube position was confirmed by abdominal radiograph as the golden standard. Positioning was considered correct when the distal end reached the ligament of Treitz according to the abdominal radiograph report. Once the procedure was confirmed successfully, enteral feeding was initiated. We recorded the time consumed between physician order for tube placement and feeding initiation.

3. Results

All of the patients in this study were diagnosed with SAP. Patient demographics are detailed in Table 1. In those enrolled patients, 36 procedures of nasojejunal tube placement attempts were made: we abandoned the attempt because of edema around the pylorus in 2 patients after 2 unsuccessful procedures for each one, 3 patients required reinsertion after the first was obstructed, and 1 patient needed reinsertion due to nasojejunal tube came out accidentally.

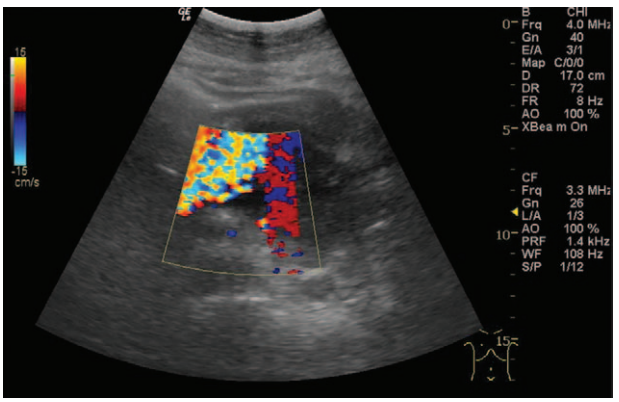

Figure 3. The color Doppler imaging is similar to the blood flow signals (areas outlined in yellow) when injecting fluid to reveal the presence of nasojejunal tube.

The success rate of the procedure for nasojejunal tube placement in the group we enrolled is 86.1% (31 procedures/36 procedures), and 93.3% (28/30) patient we established the nutritional access successfully using this method.

Mean procedure time was 22.07±5.78 minutes, with a range between 15 and 40 minutes (n=31 successful procedures). All patients initiated early EN within 24 hours after ICU admission. The median interval between physician order for tube placement and feeding initiation was 5.5 hours, with a range between 2 and 24 hours. In 2 patients nasojejunal tube insertion was not successful and the tube remained in the stomach, and the nasojejunal tube was inserted by endoscopic method instead. There were no complications or adverse events related to the procedures.

4. Discussion

This study demonstrates that bedside ultrasonography control of enteric tube placement is an efficient method for placing nasojejunal tube. Furthermore, we show that this method significantly reduces the time required to initiate early EN support in patients with SAP. Moreover, we confirmed the high sensitivity of this method in ICU patients, even when performed by a physician with limited ultrasonography training.[11] The only failure in our series was due to gas interposition, which remains a major limitation of ultrasonography.

Various techniques have been developed, and numerous types of nasojejunal tubes are available in the enteral feeding treatment of SAP. Jejunal tube may be accessed via nose, mouth, or through the abdominal wall. The required equipment of each method for placement varies as well.

Traditionally, nasojejunal tube placements were assisted by radiology or endoscopy. Recently, techniques for blind bedside placement have been described such as physical examination, electromyography, electrocardiography, and electromagnetic guidance. However, those methods are not appropriate for all of SAP patients, especially in the critical ones. For example, radiological method is cumbersome, expensive and it would carry risks of radiation exposure, and the success rate depends on the experience of investigator and anatomic conditions. Endoscopic methods (endoscopic nasojejunal tube placement or endoscopic percutaneous endoscopicgastrostomy) are even more expensive because the procedures need a skilled endoscopist and an experienced expert for anesthesia. What's more, SAP patients in acute phase have many potential risks during transportation or in the process of placement procedure, including respiratory insufficiency, aspiration, abdominal distention, and accidents of anesthesia. Variety of solutions for bedside placing nasojejunal tube, including blind placing and electromagnetically guided nasojejunal tube placement also contain many limitations and inconveniences.

Bedside methods with real-time ultrasound in SAP patients are the primary choice in our institute, and we started to use this method for nasojejunal tube placement in SAP patients since December 2014. The pylorus could be visualized in a large proportion of patients undergoing this method, and it solves the problem that no real-time controls of tip position while placing

nasojejunal tube at the bedside, and reduces time consuming and costs.

Our study indicates that this innovative method has a high success rate without any complication. Technical difficulties may exist in obese, patients with gas in bowel loop and so on. We used ultrasonography color Doppler technique in those patients by injecting NS into nasojejunal tube and display indirect information that nasojejunal tube is in the specific bowel loops.

However, our study also has some limitations. First, all procedures in the center were carried out by the same physician (GL), and we did not assess the success rate of operators without long-term training. Second, the form of nasojejunal tube could not be seen clearly under B-mode ultrasonography due to characteristics of gastrointestinal tract. We had to detect the tube tip position indirectly with color Doppler scan, and combined with scale mark in tube at the same time. Third, it was difficult to perform Type-B ultrasonic examination in patients with laparotomy, open abdomen, abdominal wall defect, or drainage tubes.

5. Conclusion

This study shows that the method of nasojejunal tube placement assisting by ultrasonography at bedside is of great clinical value, as it can establish nasojejunal feeding route effectively, therefore promote early EN support treatment in patients with SAP.

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