Percutaneous radiologic gastrostomy in pediatric population: a modified Chiba-needle puncture technique with single gastropexy

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Aims and objectives

Enteral feeding plays an important role in children who are unable to feed though the mouth or who need to support in maintaining adequate nutrition [1,2]. Many studies have shown that children can have decreased caloric intake or increased nutritional requirements [3-5]. Percutaneous gastrostomy provides access for enteral nutrition in patients for whom oral intake is either impossible or unsafe, as well allows for palliative decompression in patients with proximal small bowel or gastric outlet obstructions [6-9]. If short-term (< 6-8 weeks) nutritional support is required, the use of a nasogastric, nasoduodenal, or nasoojejunual tube is preferred. When long-term enteral nutrition (>8 weeks) is required, a more permanent means of providing nutritional supplementation, such as percutaneous gastrostomy or gastrojejunostomy tube placement, is desirable [10.11].

Traditionally, the stomach is punctured using a 15-18-gauge bevelled needle preloaded with a Cope suture anchor. [12-16]. Puncture of the stomach with bevelled needles whose tips afford extensive cutting action can be associated with vascular injury [12]. There remains some controversy as to the number of Cope suture anchors that are sufficient. The number of anchoring devices for gastropexy varies from one through the same puncture tract to four placed in the form of a square around the tract [7, 14, 15, 17]. Theoretically, when the number of Cope suture anchor increases, the fixation force of stomach to the abdominal wall also increases. Consequently, such risks as extragastric catheter placement, leakage to the peritoneum, and peritonitis decrease; however, in parallel, the risk of bleeding or infection increases [12]. To date, reports on percutaneous radiologic gastrostomy (PRG) using a 21 gauge Chiba-needle with single gastropexy in pediatric patients are limited [14, 17, 19, 20]. The purpose of this study was therefore to evaluate the technical feasibility, safety, and clinical effectiveness of PRG with a modified Chiba-needle puncture technique with the use of single gastropexy in pediatric population.
Methods and materials

Patient population

From July 2006 to February 2013, PRG was attempted in 12 consecutive pediatric patients using the modified Chiba-needle technique with single gastropexy. Ten males and two females were included in this study (median age, 21 months; range, 6 - 46 months). The majority of indications for PRG were either the inability or difficulty in swallowing due to neurodegenerative disease in five patients (42%), head and neck disease in four patients (33%), and esophageal disease in three patients (25%). All patients provided informed consent to undergo PRG. And the present retrospective review was approved by the institutional review board.

Technique

All the gastrostomy tubes were placed either with IV sedation and local anesthesia or with local anesthesia only. An 8-Fr nasogastric tube was used to inflate the stomach with approximately 150-200 mL of air. This increased stomach size made it an easier target for puncture and also brought the anterior stomach wall into contact with the anterior abdominal wall. Anteroposterior and lateral radiographs were then performed to ensure that the stomach lay in contact with the anterior abdominal wall with no interposing bowel and that the transverse colon had been deflected inferiorly. Our technique consists of a single puncture of the stomach, creating a single tract for both a Cope suture anchor and a guide wire over which serial dilation and tube insertion can be performed. Twenty milligrams of Buscopan was administered to inhibit bowel motility. Under fluoroscopic guidance, an appropriate puncture site was selected overlying the lower body of the stomach. After local anesthesia using 1% (w/v) lidocaine and a skin incision of approximately 5 mm in length, a 21-gauge Chiba-needle (Cook, Bloomington, IN) was advanced into the insufflated stomach toward the fundus. After confirming needle position by contrast injection, a 0.018-inch guide wire (Cook) was passed into the stomach. The Chiba-needle was then exchanged for a 6-Fr Neff catheter (Cook). A Cope suture anchor (Cook) was then deployed into the stomach lumen through the Neff catheter using a 0.035-inch superstiff guide wire (Cook, Bloomington, IN) for gastropexy. Once the stomach was anchored to the abdominal wall, the puncture site was serially dilated over the 0.035-inch superstiff guide wire to allow placement of a 12-14 Fr diameter locking pigtail catheter.

Follow-up and data analysis

One day and one week after the procedure, normal tube position and function were confirmed by contrast medium (Omnipaque 300, GE Healthcare, Cork, Ireland) injection through the tube. Tube feeding was commenced once the initial follow-up contrast study
demonstrated the absence of leakage or other complications related to tube placement. The external part of the suture string was cut at 1 week follow-up. Patients who required long-term gastrostomy catheter use underwent no specific tube exchange and were not routinely seen unless specific indications existed.

We evaluated for the following variables: the technical success of the procedure, the number of puncture attempts with the 21-gauge Chiba-needle, procedure time, complications, and treatment of complications.

Technical success was defined as correct positioning of the feeding tube in the stomach, which was documented fluoroscopically with 5 mL of contrast medium injection at the end of the procedure. The procedure time was defined as the time between lidocaine skin infiltration and confirmation of the feeding catheter within the stomach by contrast injection.

Major complications were defined as life-threatening complications or any complications that caused gastrostomy malfunction or required additional interventional procedures. Minor complications were defined as those requiring only minimal medical management or local wound care such as minimal leakage, need for tube exchange because of occlusion, breakage, and dislodgment.
**Fig. 1:** 23 month old male who underwent PRG for seizure due to infarction. (a) Radiograph shows the inflated stomach with 200 mL of air for confirmation of the intragastric location. (b) A Chiba-needle is advanced into the gastric fundus. (c) After confirmation of the intragastric location of the Chiba needle by contrast injection, the Chiba needle is exchanged for a Neff catheter (arrows).

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**Fig. 2:** (d) The puncture site is serially dilated with a dilator (arrows) in order to place a 14-Fr diameter. (e) A 14 Fr pig tail catheter (arrows) was placed into the stomach. (f) Radiograph shows a good patency of the catheter and the cope suture anchor is seen (arrowhead).

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Results

All 12 patients successfully underwent PRG using a modified Chiba-needle technique with single gastropexy under fluoroscopic guidance with no procedure-related complications. A single puncture attempt was all that was required in 10 patients (83%); two attempts were needed in two patients (17%). In two patients, the 0.035-inch superstiff guide wire was carelessly removed during serial dilation, but a second puncture into the stomach and the subsequent insertion of the gastrostomy tube was successful in both the cases. The subsequent Neff catheter insertion using the 0.018-inch guide wire was successful in all the patients. In all patients, the Cope suture anchor was easily introduced through the Neff catheter into the stomach. Only a single Cope suture anchor was used for each patient. The average procedure time was 10 min 25 sec (range, 5 min 5 sec - 25 min 24 sec). All patients were successfully placed 12 (n=7) and 14 (n=5) Fr locking pigtail catheter into the stomach.

During the follow-up period of one week to 34 months (mean, 11 months), major complications occurred in two of 12 (17%) patients with PRG. Two patients of them showed pneumoperitoneum two day and seven days after PRG, respectively. These two patients showed no improvement of symptom despite intravenous antibiotic treatment over seven days and thus the tubes were changed. There were no problems after tube changes. Two of 12 (17%) patients had minor complications associated with PRG. Two patients showed pain immediately after the procedure. However, the pain subsided with analgesics over two days and thus the complication was categorized as minor.
Conclusion

The results of our study demonstrate that PRG with the 21-gauge Chiba-needle puncture technique with use of single gastropexy in the same puncture tract was feasible. We were able to achieve 100% technical success in the placement of a gastrostomy. Kim et al. [21] who used one-anchor technique of gastropexy reported 99.6% technical success rate. And an earlier study involving a review of 453 charts of children (mean age 3.8 years) found that radiologic placement of gastrostomy tubes was successful 99% of the time [22].

The average procedure time between lidocaine skin infiltration and confirmation of feeding catheter within the stomach was 10 min 25 sec. Reports on gastrostomy procedure times in pediatric patients are limited. Shin et al.[23] reported mean of 6 min for a modified Chiba-needle pucture technique with single gasropexy in adult population. And 10-15 min reported procedure time in a series with gastrostomy with a single gastropexy in adult using a 17-gauge puncture needle under ultrasonographic and fluoroscopic guidance [17]. Considering that we performed pediatric patients, our procedure time is considerably reasonable.

In the present study, we used a 6-Fr Neff catheter through which a Cope suture anchor was inserted for gastropexy after exchange of the 21-gauge Chiba-needle for the 6-Fr Neff catheter. Neff catheter is very useful for exchanging a micro guide wire for a 0.035-inch guide wire and its use has been reported in the procedure of PRG [19,20]. However, in our knowledge, introduction of the Cope suture anchor through the Neff catheter for gastropexy has not been reported in pediatric patients. A Cope suture anchor was introduced through the Neff catheter without any resistance. In the present study, only a single Cope suture anchor was used along the puncture tract, and minimization of puncture numbers with sufficient gastropexy effect was obtained during the procedure. The presence of the Cope suture anchor string and guide wire in the same puncture tract was not problematic during serial dilation and gastrostomy tube insertion in most cases. In spite of pediatric patients, there was no complications related procedure such as bleeding, pucture of liver left lobe or transverse colon.

Despite the many years gastrostomy tubes have been in use, they are not free from complications. A review of the literature [5, 24-26] reveals major complication rates range from 7% to 19% and minor complications occurred in 22% to 99% of pediatric patients. Kutiyanawala MA et al. reported that overall rate of complications in infants and children with gastrostomy tubes as high as 43% [25].

In our study, we found a major complication rate of 17 % and a minor complication rate of 17 % after PRG. Two patients of major complications showed pneumoperitoneum 1 and 7 days after PRG. This complication is believed to be related to anchor dislodgment with the one anchor technique. In one patient who had pneumoperitoneum and development of gastric juice leakage, the anchor dropped into the stomach within one day after PRG.
In other patient with pneumoperitoneum appeared to be related to the loosening of the anchor, which allowed gastric juice leakage beside the tube into the peritoneal space. They showed problems after tube change. When the large dilator was introduced over the guide wire, the anchor tended to be pulled tightly to prevent the stomach wall from being pushed back from the abdominal wall, resulting in occasional injury of the gastric wall by the anchor beside the tract and migration of the anchor into peritoneal space via the tract.

Gastrojejunostomy tube can be considered in certain circumstances such as when medical management for gastroesophageal reflux disease has failed and/or when the risk of aspiration of stomach contents needs to be decreased. Especially in pediatric patients, aspiration pneumonia risk is high resulting from esophagogastric reflux due to the small stomach size. In our study, three patients showed aspiration pneumonia resulting from esophagogastric reflux during the follow up period. And then, we underwent conversion percutaneous radiologic gastrojejunostomy (PRGJ) [27].

Pig tail catheter is widely used pediatric gastrostomy and secures tube in stomach [27]. It is available in variety of sizes(8.5 - 14Fr). So it may be an option for small pediatric patients.

In conclusion, PRG using a modified Chiba needle technique with single gastropexy is technical feasible and safe. Half of the patients showed complications, but it can be successfully managed by additional management. PRGJ can be an alternative option in patients with aspiration pneumonia resulting from esophagogastric reflux.
Fig. 3: Pneumoperitoneum requiring tube change in a 46-month-male with seizure due to propionic acidemia (a) Radiograph obtained immediately after the procedure shows a good passage and no leakage of contrast medium. (b) Pneumoperitoneum (arrows) occurred two days after the procedure. (c) 15 days later, after tube change under endoscopic guidance and antibiotic treatment, the pneumoperitoneum was improved.

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References


