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Review Article

Fluoroscopy-guided gastrojejunostomy: A work in progress

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A B S T R A C T

Surgical gastrojejunostomy (GJ) has traditionally been the mainstay of treatment for malignant gastric outlet obstruction (GOO). However, most patients preferentially choose to undergo self-expandable metal stent (SEMS) placement due to its minimally invasive nature, although it is well-recognized that surgical GJ is associated with longer patency and less reinterventions than SEMS placement. Endoscopic ultrasound (EUS)-guided GJ has recently emerged as a novel procedure for the treatment of malignant GOO. This procedure offers a non-surgical means of performing GJ, but its widespread use is limited because it could only be performed by experienced endoscopists with expertise in EUS-guided procedures. The authors performed fluoroscopy-guided GJ in eight domestic pigs by puncturing the proximal jejunum from the stomach using a Rösch-Uchida transjugular liver access set followed by the placement of a lumen-apposing metal stent across the puncture tract. The results showed that fluoroscopy-guided GJ may be a technically feasible and simple procedure but, before clinical trials can be undertaken, further technical refinements are required to reduce the risk of inadvertent transgression of non-target organs.

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Keywords: Endosonography; Gastric bypass; Gastric outlet obstruction; Prostheses and implants

Introduction

Surgical gastrojejunostomy (GJ) has traditionally been the mainstay of treatment for malignant gastric outlet obstruction (GOO).¹ However, most patients preferentially choose to undergo self-expandable metal stent (SEMS) placement due to its minimally invasive nature, although it is well-recognized that surgical GJ is associated with longer patency and less reinterventions than SEMS placement.^{2–5} Two techniques can be used for SEMS placement: a through-the-scope technique under endoscopic guidance and an over-the-wire technique under fluoroscopic guidance.⁶ The former technique is almost exclusively used by endoscopists, whereas the latter is usually used by interventional radiologists. It is well-perceived the outcomes of SEMS placement are the same, regardless of which technique is used.⁷ Recently, endoscopic ultrasound (EUS)-guided GJ has emerged as a novel procedure for the treatment of malignant GOO.⁸ This procedure offers a non-surgical means of performing GJ, but its widespread use is limited because it could only be performed by experienced endoscopists with expertise in EUS-guided procedures.

The idea of fluoroscopy-guided GJ first came to the author

(JT) when he was viewing a procedural video of EUS-guided GJ shown by an endoscopist during the 12th annual meeting of the Society of Gastrointestinal Intervention (SGI). The author left the meeting with the belief that fluoroscopy-guided GJ may be technically feasible because much of the EUS-guided GJ procedure shown in the video was performed with fluoroscopic assistance. This belief was further solidified when the author learned that the technical steps of EUS-guided GJ were somewhat similar with that of transjugular intrahepatic portosystemic shunt (TIPS) creation, a procedure by which our team has vast experience in performing. Immediately after the author returned to our institution, planning for an animal study to evaluate the technical feasibility and safety of fluoroscopy-guided GJ was underway. Recently, this animal study has been published with interesting results.⁹ Herein, the author reviews the results of this animal study and discusses the perceived advantages and disadvantages and future research directions of fluoroscopy-guided GJ.

Fluoroscopy-Guided Gastrojejunostomy

Fluoroscopy-guided GJ consists of four major steps: (1) punc-

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Fig. 1. Fluoroscopy-guided GJ procedure. (A) The 5-Fr pigtail catheter (Cook Medical; arrow) in the proximal jejunum and the Rösch-Uchida transjugular liver access set (Cook Medical; arrowhead) in the stomach. (B) The 0.038-IN trocar stylet (arrow) in the peritoneal cavity pointing towards the 5-Fr pigtail catheter (arrowhead) in the proximal jejunum. (C) The 0.038-IN trocar stylet (arrow) advanced towards the 5-Fr pigtail catheter (arrowhead) in the proximal jejunum. (D) Iodinated contrast medium injected through a multipurpose coil catheter (S&G Biotech; arrow) passing through the EGIS S-PD (S&G Biotech; arrowhead). Reused from the article of Li et al (Cardiovasc Intervent Radiol. 2020;43:1687-94)⁹ with original copyright holder's permission.

ture target placement; (2) proximal jejunum puncture; (3) puncture track dilation; and (4) lumen apposing metal stent (LAMS) placement.

First, a puncture target should be placed into the proximal jejunum. Technically, any catheter that is radiopaque (e.g., angiographic catheter and balloon catheter) could be used to serve as the puncture target as long as it could be placed into the proximal jejunum. The authors used a 5-Fr pigtail angiographic catheter (Cook Medical, Bloomington, IN, USA) to serve as the puncture target in our animal study because it could be easily placed into the proximal jejunum over a 0.035-IN hydrophilic guidewire (Fig. 1A). Alternative, a snare, which could be tightened to grasp the puncture needle, could also be used to serve as the puncture target.

Second, the proximal jejunum should be punctured from the stomach under fluoroscopic guidance. To achieve this, the authors recommend using a Rösch-Uchida transjugular liver access set (Cook Medical) (Fig. 2). This set of instruments is designed for TIPS creation and mainly consists of a 0.038-IN trocar stylet, a 5-Fr catheter, a 14-gauge stiffening cannula, and a 10-Fr introducer. The hallmark of the Rösch-Uchida transjugular liver access set is the 0.038-IN trocar stylet, which is a low-profile, atraumatic pencil-point needle. Theoretically, atraumatic needles dilate tissue and allow the tissue to gradually return to their original position following its removal. In contrast, the 16-gauge Ross modified Colapinto needle in the Ring transjugular liver access set (Cook Medical) is a traumatic bevel needle, which cuts the tissue instead of dilating it. The 14-gauge stiffening cannula could be rotated

Fig. 2. Rösch-Uchida transjugular liver access set (Cook Medical).

to control the puncture direction, and its angle could be manually adjusted to modify the puncture angle. In our animal study, the authors used a “two-step” puncture technique to reduce the risk of inadvertent transgression of non-target organs, such as the colon and the pancreas. This puncture technique was also used to reduce to risk of inadvertent transgression of non-target organs during percutaneous retroperitoneal splenorenal shunt creation.¹⁰ Briefly, the stomach was punctured with the 0.038-IN trocar stylet, and the tip of the 0.038-IN trocar stylet was retracted by approximately 5 mm into the 5-Fr catheter. The 5-Fr catheter was maneuvered in the peritoneal cavity, and when its tip reached the puncture target on both posteroanterior and lateral views (Fig. 1B), the proximal jejunum was punctured with the 0.038-IN tro-

car stylet (Fig. 1C). The 0.038-IN trocar stylet was withdrawn, and iodinated contrast medium was injected through the 5-Fr catheter to confirm entry into the proximal jejunum.

Third, the puncture track between the stomach and the proximal jejunum should be dilated to allow for the placement of stent delivery system. In our animal study, the authors simply advanced the 14-gauge stiffening cannula followed by the 10-Fr introducer into the proximal jejunum over the guidewire to dilate the puncture track. In the authors' opinion, this method, which is routinely used to dilate the liver parenchymal tract during TIPS creation, is less cumbersome than other methods, such as balloon dilation and electrocauterization. In addition, if the stent delivery system is ≤ 10 -Fr, it could be directly placed across the puncture track through the 10-Fr introducer.

Last, a LAMS should be placed across the puncture tract with the distal anchor flange in the proximal jejunum and the proximal anchor flange in the stomach. In our animal study, the authors used a 16-mm-diameter and 2-cm-length EGIS S-PD (S&G Biotech, Seongnam, Korea) (Fig. 3) but, technically, any LAMS (e.g., AXIOS; Boston Scientific, Marlborough, MA, USA and

SPAXUS; Taewoong Medical, Gimpo, Korea) could be used. The EGIS S-PD used in our animal study was preloaded in a 10.2-Fr stent delivery system and therefore, the authors had to exchange the transjugular liver access set for the stent delivery system over the guidewire. After LAMS placement, iodinated contrast medium should be injected through a catheter into the stomach to confirm technical success and to exclude complications (Fig. 1D).

Animal Study Results

In our animal study, fluoroscopy-guided GJ was performed in eight healthy domestic pigs weighing between 14.5–16.3 kg by two second-year radiology residents (JL and TG). Technical success rate was 100% as a LAMS was successfully placed across the puncture tract between the stomach and the proximal jejunum with confirmed patency in all animals. In the first procedure, 3 puncture attempts were required to obtain access to the proximal jejunum, and 62 minutes were required to complete the procedure. However, the procedures thereafter only required 1 or 2 puncture attempts to obtain access to the proximal jejunum and 29 to 44 minutes to complete. In addition, the mean fluoroscopy time was 6.4 ± 1.8 minutes only. These results suggest that fluoroscopy-guided GJ may be a technically feasible and simple procedure.

All animals survived until the end of the study (week 8) without change in their behavior, appetite, or bowel habits. In seven animals, gross inspection showed a matured and patent fistulous tract between the stomach and the proximal jejunum (Fig. 4A). In the remaining animal, gross inspection showed a matured and patent fistulous tract between the proximal jejunum and the colon (Fig. 4B). This was most likely due to inadvertent transgression of the colon during the procedure followed by migration of the proximal anchor flange from the stomach into the colon after the procedure. In one animal, gross inspection showed that the tail of the pancreas had been traversed by the fistulous tract between the stomach and the proximal jejunum. These results suggest that our technique requires refinement to reduce to risk of inadvertent transgression of non-target organs.

Advantages and Disadvantages

The perceived advantages of fluoroscopy-guided GJ are mostly associated with the use of fluoroscopic guidance and include: (1) minimal requirement for anesthesia with the aerosol spray of lidocaine hydrochloride; (2) consistent visualization of the puncture target in the proximal jejunum; and (3) precise LAMS placement

Fig. 3. EGIS S-PD (S&G Biotech). Reused from the article of Li et al (Cardiovasc Intervent Radiol. 2020;43:1687-94)⁹ with original copyright holder's permission.

Fig. 4. Gross inspection. (A) A mature fistulous tract between the stomach (arrow) and the proximal jejunum (arrowhead). (B) A mature fistulous tract between the proximal jejunum (arrow) and the colon (arrowhead). Reused from the article of Li et al (Cardiovasc Intervent Radiol. 2020;43:1687-94)⁹ with original copyright holder's permission.

across the puncture tract between the stomach and the proximal jejunum. However, the use of fluoroscopic guidance is also associated with an important disadvantage, which is that organs in between the stomach and the proximal jejunum cannot be visualized under fluoroscopy. Therefore, fluoroscopy-guided GJ is theoretically associated with a higher risk of inadvertent transgression of non-target organs than EUS-guided GJ.

Other perceived advantages of fluoroscopy-guided GJ are associated with the use of Rösch-Uchida transjugular liver access set and include: (1) minimal trauma with the low-profile, atraumatic pencil-point needle; (2) quick and easy dilation of the puncture tract between the stomach and the proximal jejunum with the 14-gauge stiffening cannula and the 10-Fr introducer; and (3) direct placement of ≤ 10 -Fr stent delivery systems across the puncture track through the 10-Fr introducer. Some endoscopists have inquired about the feasibility of using the Rösch-Uchida transjugular liver access set through the working channel of an endoscope. This is not feasible because the length of the Rösch-Uchida transjugular liver access set is insufficient (0.038-IN trocar stylet length, 62.5 cm).

Future Research Directions

Inadvertent transgression of non-target organs is a well-recognized complication of EUS-guided GJ.^{11–13} Since organs in between the stomach and the proximal jejunum cannot be visualized under fluoroscopy, the risk of inadvertent transgression of non-target organs is theoretically higher with fluoroscopic GJ than with EUS-guided GJ. In our animal study, a “two-step” puncture technique was used to reduce the risk of inadvertent transgression of non-target organs. However, inadvertent transgression of non-target organs still occurred in two of eight animals. Therefore, before clinical trials can be undertaken, animal studies are required to evaluate whether additional measures, such as preprocedural barium enema and intraprocedural cone-beam computed tomography, could further reduce the risk of inadvertent transgression of non-target organs.

Conclusions

Fluoroscopy-guided GJ appears to be a technically feasible and simple procedure in a porcine model. However, before clinical trials can be undertaken, further technical refinements are required to reduce the risk of inadvertent transgression of non-target organs.

Conflicts of Interest

Jiaywei Tsao is a paid consultant of Medtronic. Except for that, no potential conflict of interest relevant to this article was

reported.

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