REVIEW ARTICLE

Tip palpation of the intraduodenal biliary segment for needle-knife fistulotomy

Allison Franz, MD,[1] David Liu, MD,[1] Cristina Chiodi, MD,[1] Garvit Chabra, MD,[1] Peter V. Draganov, MD,[2] Nanlong Liu, MD[1]

Louisville, Kentucky; Gainesville, Florida, USA

Background and Aims: Needle-knife access fistulotomy (NKF) involves using a needle-knife to cut into the intraduodenal segment of the bile duct, thereby avoiding the papilla. Previous studies suggest this procedure decreases the risk of post-ERCP pancreatitis and increases successful biliary cannulation compared with conventional methods. In this case series, we introduce an advanced endoscopic technique aimed at aiding endoscopists with successful NKF and broadening use of this procedure.

Methods: Here we describe a technique in which we use the sphincterotome and needle-knife to palpate the intraduodenal biliary segment before needle-knife instrumentation. Careful dissection is then performed along this axis before achieving biliary cannulation with the sphincterotome and guidewire.

Results: All videos shown led to successful biliary cannulation with next-day discharges from the hospital and clinical success with biliary decompression.

Conclusions: Previous palpation for the bile duct may aid endoscopists with NKF. This may lead to wider adoption of NKF. Further prospective research is needed. (VideoGIE 2025;10:434-8.)

INTRODUCTION

Successful biliary access is an essential component of both diagnostic and therapeutic ERCP. Difficult cannulation is an independent risk factor for adverse events like post-ERCP pancreatitis.[1] Factors such as surgery, tumors, and strictures can alter anatomy and contribute to complexity of biliary access; however, even among therapeutic ERCPs performed on patients with normal anatomy, about 11% may be considered difficult cannulations.[2] Previous studies have estimated failure rates of biliary sphincterotomy to be between 16% and 44%.[3] Expertise in advanced ERCP-based adjunct techniques, including needle-knife access fistulotomy (NKF), can help specialized endoscopists safely obtain biliary access and prevent adverse events when conventional wire-guided cannulation fails.

NKF involves using a needle-knife to cut into the intraduodenal segment of the bile duct, thereby avoiding the papilla. Although there is no superiority of NKF compared with standard transpapillary cannulation, early NFK has been shown to decrease the risk of pancreatitis when initial attempts with standard cannulation fail and access fistulotomy is indicated. One study found success rates of NKF to be >90% when performed by an experienced endoscopist.[3] Previous studies suggest this technique has been shown to increase successful biliary cannulation compared with conventional cannulation (89.3% vs 78.1%) as well as decrease the relative risk of post-ERCP pancreatitis by up to 0.46.[4,5] In addition, rates of adverse events including bleeding and perforation have been found to be similar to other precut[1,5] and conventional cannulation methods.[6,7] The European Society of Gastrointestinal Endoscopy guidelines recommend NKF as the preferred technique for precutting.[8] Of note, guidelines emphasize that NKF should only be performed by endoscopists with specialized training and proficiency in needle-knife.[1,8]

This case series will review the NKF approach and demonstrate the use of our technique involving palpation

Abbreviation: NKF, needle-knife access fistulotomy.

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Current affiliations: Division of Gastroenterology, Hepatology and Nutrition, University of Louisville, Louisville, Kentucky, USA (1), Division of Gastroenterology, Hepatology and Nutrition, University of Florida, Gainesville, Florida, USA (2).

Corresponding author: Allison Franz, MD, Division of Gastroenterology, Hepatology and Nutrition, University of Louisville, 550 S. Jackson St., Louisville, Kentucky 40202, USA. E-mail: allison.franz@louisville.edu.

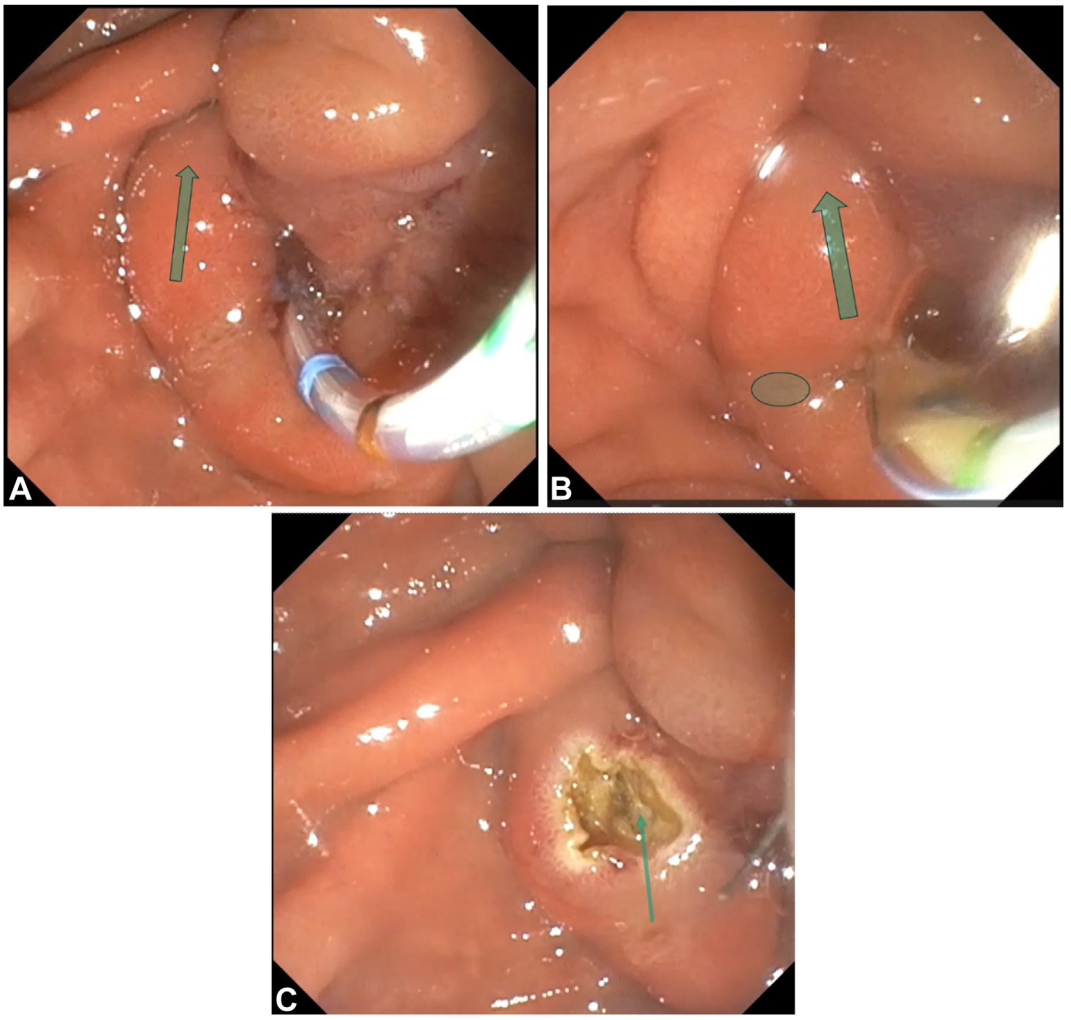

Figure 1. A, The *green arrow* indicates the intraduodenal biliary tube direction elicited by palpation with the sphincterotome. **B,** The *green circle* indicates the ampulla. The *green arrow* indicates the intraduodenal biliary segment. **C,** The *green arrow* indicates the "onion skin"—like appearance of the white biliary mucosa visualized after incision.

of the intraduodenal biliary segment before needle-knife instrumentation. The aim of this case series is to illustrate this technique and show its potential for improving rates of successful biliary cannulation, decreasing procedural adverse events, and hopefully leading to the greater adoption of NKF.

METHODS

In each of these cases, an endoscopic approach was used to reach the ampulla, standard cannulation was attempted, and NKF was performed only after failure. Failure of initial standard cannulation was defined as the inability to cannulate after 5 minutes or 2 failed attempts.

Initial inspection of the periampullary region was performed to locate the prominent bulge of the intraduodenal segment above the major papilla. The major duodenal papilla have been classified into 4 distinct groups on the basis of endoscopic appearance: "regular" with no distinctive features (type 1); small with diameter less than or equal to 3 mm (type 2); protruding, bulging, or pendulous, hanging caudally from duodenal lumen (type 3); and creased or ridged (type 4).[9,10] Type 2 papillae are favorable for standard cannulation and better suited for other advanced techniques such as Goff technique, transpancreatic sphincterotomy, or needle-knife sphincterotomy in the event of difficult cannulation. NKF should be avoided in small papillae. Types 1, 3, and 4 with large protruding intraduodenal segments are more favorable for NFK.[9,10] In each case, the ampulla was deemed conducive for NFK.

Next, the intraduodenal biliary segment is palpated using the sphincterotome and/or needle-knife cannula. The accompanying video (Video 1, available online at www.videogie.org) demonstrates this technique and its application in confirming the biliary borders and delineating the trajectory of the biliary duct. The bulging region corresponding to the intraduodenal segment is identified and

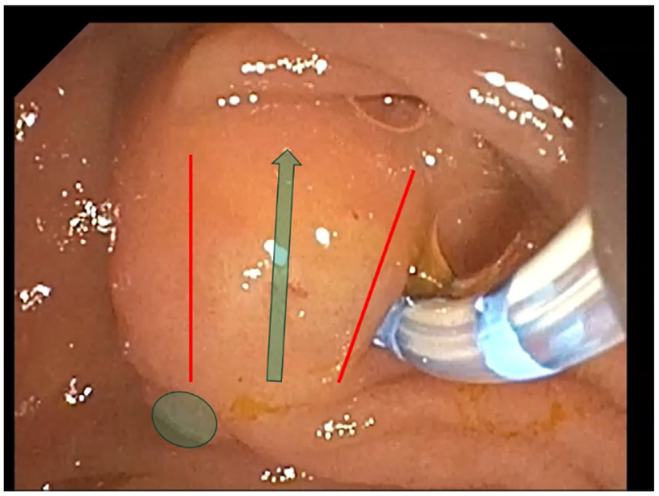

Figure 2. The *red lines* demarcate the outer borders of the bile duct. The *green arrow* illustrates the intraduodenal portion of the biliary duct. The *green circle* marks the ampulla.

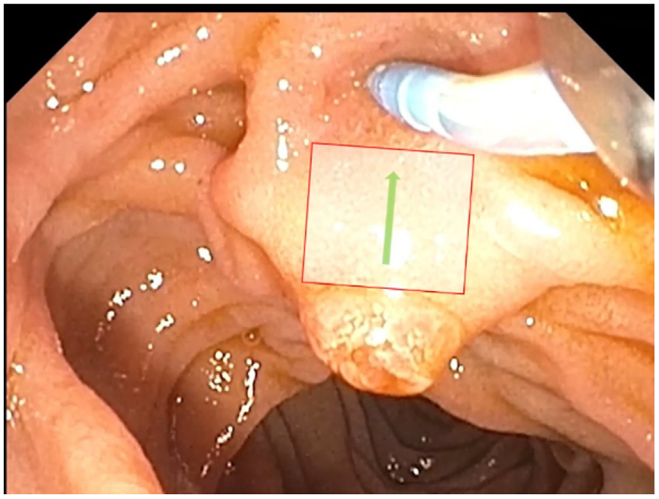

Figure 3. The ampulla, and the intraduodenal segment is small. Needle-knife palpation was used to confirm the borders of the intraduodenal segment of the bile duct (indicated by the *box*). The tip of the needle-knife is illustrated palpating the superior portion to determine the superior margin of the intraduodenal segment. No intraduodenal segment was palpated in this region. This step was crucial to identify to avoid perforation.

gently palpated using the tome. During palpation, the intraduodenal biliary duct can be distinguished from surrounding tissue by feeling for a firm, mobile cord among the tissue that terminates above the superior bile duct margin. Figures 1-4 are stills from the video that serve to visually highlight these anatomical landmarks. Careful palpation before dissection helps to avoid cutting into the submucosal tissue, thereby decreasing the risk of perforation. In our experience, there is no increased risk of edema with palpation of the intraduodenal bile duct; however, it is important to avoid palpation of the biliary/pancreatic orifice to prevent papillary edema. This technique is particularly valuable in cases with duodenal edema that mimics the bulging region of intraduodenal bile duct and type 4 papilla, in which redundant tissue folds can obscure anatomical landmarks.

Dissection is then performed along the biliary axis, avoiding the papilla, using a needle-knife. We used an RX Needle Knife XL (Boston Scientific, Marlborough, Mass, USA) for all cases with standard tome used for cannulation. The VIO 3 needle-knife (Erbe, Tübingen, Germany) was set to ENDO CUT, effect 1, duration 2, and interval 2. Although we typically use a bottom-up approach, both top-down and bottom-up approaches are valid and choice should be dependent on the individual endoscopist's preference. The important considerations are to transect along the biliary axis and avoid cutting the papillary orifice. After initial fistulotomy, retraction of the needle-knife and further palpation with the blunt end of the cannula can help improve visualization of the area. Intermittent palpation throughout the dissection allows the endoscopist to confirm landmarks before further incision. Visual anatomic landmarks of note include the ampullary complex, the biliary muscle, and the biliary adventitia. The ampullary complex appears like a firm, white bulge within the soft submucosal tissue, the biliary muscle appears like a white, "onion-skin"—like structure, and the biliary adventitia appears like a pink, glossy texture within the incision. An improved view of these structures can help guide the endoscopist during their dissection. Magulick et al[11] also highlight these anatomic landmarks in their video case series reviewing tips for successful access fistulotomy. Further dissection into the bile duct is then performed and may be confirmed by the expression of bile. Next, the sphincterotome is reintroduced and biliary cannulation is achieved with the guidewire. After cannulation, the opening can be extended using a sphincterotome if necessary, and further diagnostic and/or therapeutic interventions can be completed.

Although not included in our series, rare anatomical variations in which the biliary orifice is anterior to the pancreatic duct orifice with the bile duct wrapping around the pancreatic duct can present technical difficulties. In these cases, it is best to start dissection from the middle of the bulging region with careful layer-by-layer dissection. Nevertheless, in certain cases in which inadvertent pancreatic duct cannulation occurs, placement of a pancreatic duct stent can help reguide biliary cannulation similar to standard cannulation.

Case 1

A 58-year-old man presented with a 2.6-cm pancreatic head mass and biliary obstruction. ERCP with stent placement was performed. Initial cannulation was unsuccessful. A prominent bulge was identified above the major papilla and anatomy was determined to be appropriate for NKF. The sphincterotome was used to prod the region and delineate the intraduodenal segment of the bile duct. The tome was used to palpate to the left and right of the

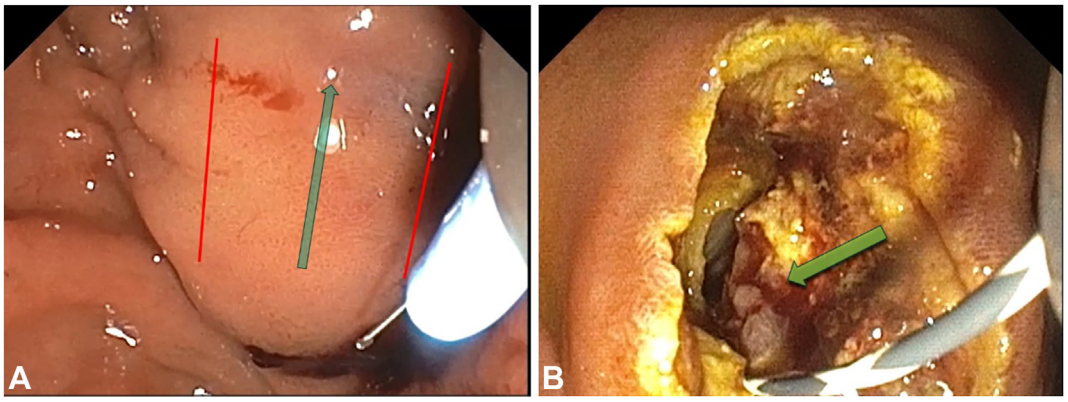

Figure 4. A, The *red arrows* demarcate the outer borders of the intraduodenal segment of the biliary duct. The *green arrow* shows the biliary axis and best point of contact. **B,** The *green arrow* is pointing to the tumor within the intraduodenal segment.

intraduodenal segment to identify the biliary axis (Fig. 1A and B). The sphincterotome was then exchanged for the needle-knife and before dissection further palpation with the blunt end of the needle-knife cannula was performed to reconfirm biliary anatomy. Careful upward dissection along the biliary axis with the needle-knife was performed, and the layers of the duodenum were carefully peeled back to expose the white strands of the biliary muscle (Fig. 1C). The needle-knife was then retracted, and the blunt end of the cannula was used to push back the cut duodenal tissue and improve visualization. Further dissection to enter the bile duct was then performed before guidewire cannulation. The incision was then extended with the sphincterotome after gaining biliary access. Subsequently, a fully covered metal stent was placed.

Case 2

An 86-year-old man presented with obstructive jaundice. Imaging was suggestive of biliary dilation and distal common bile duct stricture. ERCP with sphincterotomy was performed. After failure of initial cannulation, the papilla was determined to be suitable for NKF. The trajectory and borders of the bile duct were identified using palpation with the needle-knife cannula (Fig. 2). Careful dissection along the biliary axis was performed using the needle-knife. The "onion-like" layers of tissue were slowly peeled back, and intermittent palpation with the needle-knife retracted ensured proper visualization throughout this process. A small incision into the bile duct was made. Subsequent probing with the guidewire led to biliary cannulation.

Case 3

A 67-year-old woman with history of cholecystectomy presented with abdominal pain. Laboratory results were suggestive of obstructive jaundice. MRCP was performed, which showed choledocholithiasis. Initial standard cannulation was unsuccessful, and anatomy was then evaluated for access fistulotomy with the needle-knife. A prominent bulge above the major papilla was appreciated that delineated a long intraduodenal biliary segment and was favorable for NKF. Careful palpation with the needle-knife was used to identify the intraduodenal bile duct borders and biliary axis (Fig. 3). Upward dissection was performed along this axis using the needle-knife. The bile duct was identified, and bile was expressed before successful guidewire cannulation.

Case 4

A 67-year-old man presented with painless jaundice of 2 weeks in duration. Computed tomography showed a 1-cm pancreatic head mass with upstream biliary dilation. The decision was made to perform EUS and ERCP. Fine-needle biopsy of the mass was performed under EUS with pathology confirming intraductal ampullary adenocarcinoma. During ERCP, the mass obscured anatomical landmarks contributing to failure of initial standard cannulation. With the aid of the needle-knife cannula, the biliary duct borders and biliary axis were palpated and identified (Fig. 4A). Careful dissection with the needle-knife was then performed with intermittent palpation using needle-knife cannula with the needle-knife retracted to improve visualization. After initial exposure, the white strands of the biliary muscle were identified and repeat incisions were made. Further dissection led to expression of bile. This was followed by successful guidewire cannulation, and the incision was extended using the sphincterotome. After sphincterotomy, the tumor was seen inside the bile duct (Fig. 4B). The tumor was biopsied separately with biopsy forceps, and pathology confirmed adenocarcinoma at the ampulla of Vater of pancreatic/biliary origin. After biopsy, a full metal stent was placed to facilitate bile drainage.

CONCLUSIONS

This case series shows 4 successful biliary cannulations with NKF. All 4 patients were discharged the next day with no evidence of delayed bleeding or pancreatitis. In addition,

all these patients had down-trending liver enzymes and clinical success with biliary decompression. A limitation to this series is the lack of cases showing duodenal edema and the benefit of this technique in avoidance of unnecessary instrumentation. This case series highlights a new technique for performing NKF. We recommend endoscopists practice this technique as described here and shown in the accompanying video to best appreciate this technique. Previous palpation for the bile duct may aid endoscopists with NKF, improving successful cannulation and decreasing rates of adverse events. This may lead to increased endoscopist confidence with and thus wider adoption of NKF. Further prospective research is needed.

PATIENT CONSENT

The patients in this article have given written informed consent to publication of the case details.

DISCLOSURE

All authors declare no conflict of interest.

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