

Endoscopic techniques and common pitfalls for nasobiliary catheter placement to facilitate delivery of high-dose intraductal brachytherapy in cholangiocarcinoma



Jerry Yung-Lun Chin, MBBS,¹ John A. Martin, MD,¹ Christopher L. Hallemeier, MD,² Michael G. Haddock, MD,² Barham K. Abu Dayyeh, MD, MPH,¹ Andrew C. Storm, MD,¹ Mark Topazian, MD,¹ Michael J. Levy, MD,¹ Bret T. Petersen, MD,¹ Vinay Chandrasekhara, MD¹

BACKGROUND AND AIMS

Liver transplantation has been increasingly offered as a curative treatment option to a highly selected group of patients with unresectable perihilar cholangiocarcinoma.¹ Patients who meet the transplant criteria at our institution undergo a protocolized therapy with neoadjuvant chemoradiation and brachytherapy followed by liver transplantation, with a 5-year disease-free survival rate of 55% to 65%.²

High-dose-rate (HDR) intraductal brachytherapy is an adjunct to external beam radiation therapy for cholangiocarcinoma. HDR brachytherapy allows safe delivery of higher doses of radiation targeted at the tumor site and is an integral part of the regimen to maximize tumor response and local control.³ ERCP is used to place nasobiliary catheters (NBCs) to facilitate HDR biliary brachytherapy. Previously published experiences from our institution have described high technical and clinical feasibility of endoscopically inserted NBC for HDR brachytherapy.^{3,4} This video ([Video 1](#), available online at



Figure 2. Insertion of nasobiliary catheter.

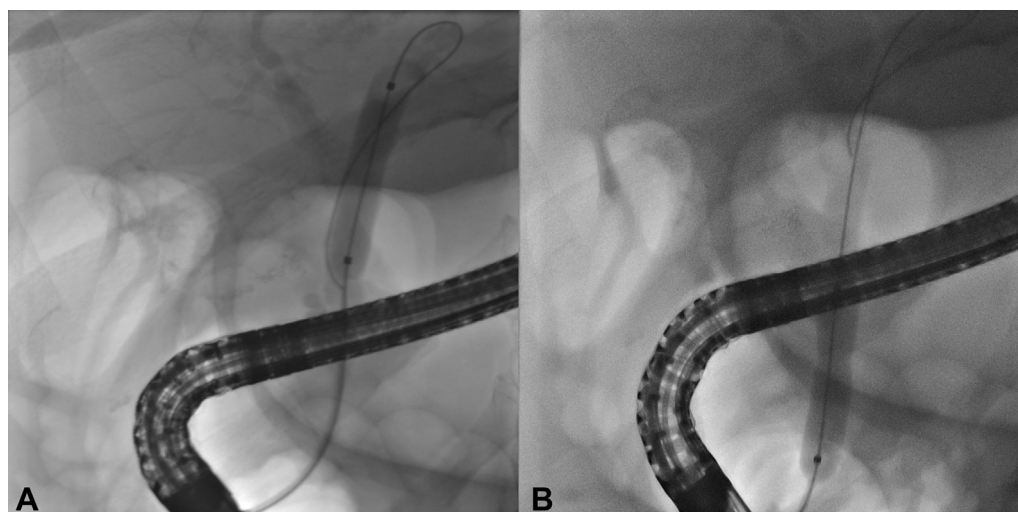


Figure 1. A and B, Selective balloon dilation of the biliary tract before insertion of nasobiliary catheters.

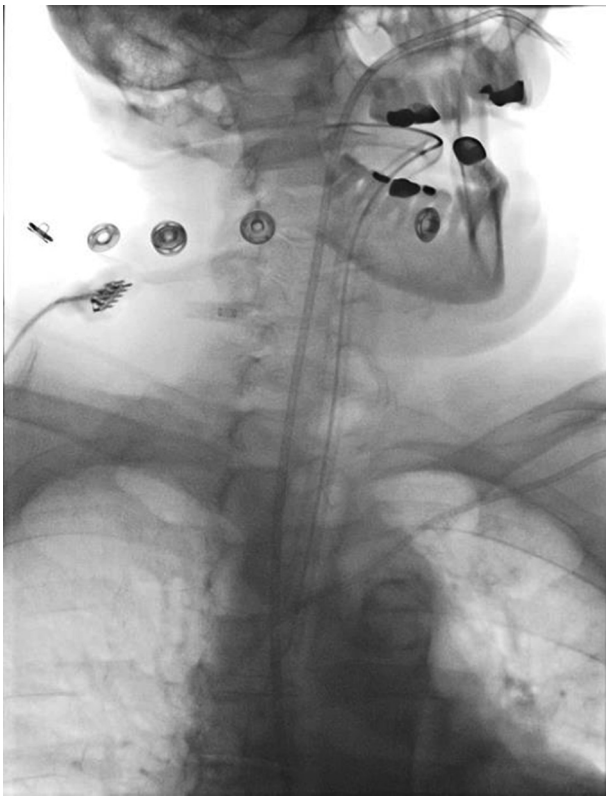


Figure 3. Radiographic confirmation of correct position of the oropharyngeal portion of the nasobiliary catheter.

www.giejournal.org) reviews the technical aspects associated with NBC insertion and describes potential challenges and how they are managed.

The study was deemed exempt by the institutional review board at Mayo Clinic Rochester (IRB no. 20-003809; 5/5/2020).

ENDOSCOPIC TECHNIQUE

ERCP is performed using a standard duodenoscope (TJF-Q180V; Olympus, Center Valley, Pa, USA) with the patient under general anesthesia. Any preexisting plastic stents are removed to facilitate placement of the NBC. We preferentially place bilateral NBCs in all patients to maximize therapy delivery and efficacy. Selective dilation of the stricture areas of the biliary tree are undertaken with a balloon dilator of the appropriate diameter (Hurricane RX; Boston Scientific, Marlborough, Mass, USA) before placement of an 8.5F or 10F 250-cm NBC (no. ENDB-10; Cook Ireland Inc, Limerick, Ireland) (Fig. 1A and B).

The straight portion of the catheter should extend as far upstream from the proximal extent of the malignant stricture as possible (a minimum of >1 cm) to allow the afterloader and source wire to reach the desired location and enable therapy delivery (Fig. 2). The endoscope is



Figure 4. Final confirmation of nasobiliary catheter placement with dummy 4.7F intraluminal catheter appropriately situated at the biliary end.

withdrawn from the NBC under fluoroscopic guidance while ensuring correct positioning of the NBC. The gastroduodenal portion of the catheter should be gently curved, without excessive loops or kinks. Looping in the stomach is avoided by having the NBC follow the lesser curve.

Oronasal transfer of the external component of the NBC is then performed using a nasopharyngeal transfer tube supplied with the NBC kit. The wire is retained in the NBC during this step to reduce the propensity to kink the tube, which could render the afterloader unable to deliver the source wire. The operator's finger pushes the posterior pharyngeal aspect of the tube against the area of the tonsillar pillar when pulling the NBC through the nasal passage to reduce the risk of out-migration of the NBC from its target position in the bile duct. Fluoroscopy may be used to ensure the NBC is not coiled in the oropharynx (Fig. 3) before the catheter is secured to the nose with a nasogastric strip. Immediately after securing the NBC, a 4.7F intraluminal brachytherapy catheter (#AL13114000; Varian Inc, Palo Alto, Calif, USA) with a preinserted dummy wire to enhance its rigidity is advanced to the biliary end of the NBC and secured with a Y-shaped connector (no. PTBYC-RA; Cook Inc, Bloomington, Ind, USA). This forms the treatment catheter.

A biliary drainage bag (no. 505003, Cook Inc) is attached to the other channel of the Y connector. A final fluoroscopic image is taken of the catheter pathway to confirm patency and correct positioning of the treatment catheter (Fig. 4). In the setting of bilateral NBC placement, a

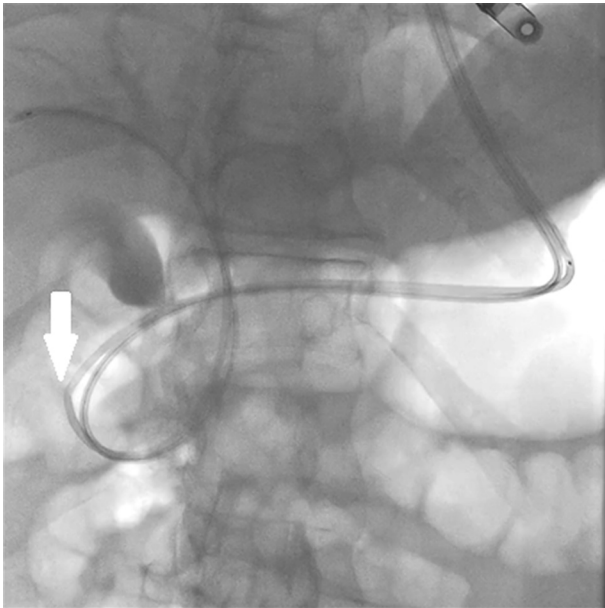


Figure 5. Catheter kink detected at the level of the duodenal sweep using fluoroscopy.

specialized marker wire (no. AL13111600, Varian Inc) is placed in 1 catheter to distinguish individual paths on imaging. The length of the NBC is measured from the patient's naris, and the length of the 4.7F catheter is measured from the side-arm connector. Treatment measurements are recorded for the subsequent therapy, which takes place on the same day. The NBC is removed after treatment completion. All patients are given intravenous antibiotics during the procedure and receive oral antibiotics for 5 to 7 days post-ERCP. Patients with preexisting plastic biliary stents are scheduled for a repeat ERCP the following day for stent replacement; patients who underwent concomitant placement of biliary stents to stabilize the NBC, but do not require ongoing stenting for biliary drainage, undergo repeat EGD for stent retrieval.

Between 2007 and 2017, 122 patients underwent endoscopic NBC insertion, with a total of 3 procedure failures (2 cases of catheter migration between NBC placement and time of brachytherapy and 1 case of failure of the HDR afterloader to advance the radiation source to the desired treatment site).³

COMMON PITFALLS AND MANAGEMENT STRATEGIES

1. Severe biliary strictures with acute angulation.

The majority of patients with cholangiocarcinoma with underlying primary sclerosing cholangitis have diffusely distributed biliary strictures, which inherently increases procedural complexity. In addition, malignant compression at the hilar bifurcation can create tortuous anatomy, making selective access with straight guidewire

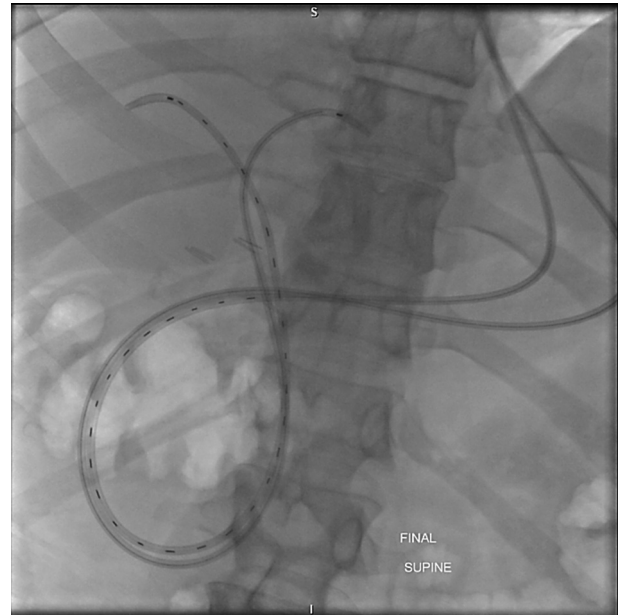


Figure 6. Bilateral nasobiliary catheter placement in Bismuth III/IV strictures, with special marker wire to differentiate right and left biliary catheter.

technically challenging. To overcome this, we often use angled guidewires (NaviPro; Boston Scientific, Marlborough, Mass, USA) to negotiate the acute angulations and to obtain selective access to targeted sectoral branch ducts (Video 1, available online at www.giejournal.org).

- Wire retraction during catheter placement.** The hydrophilic angled guidewires used to access the biliary segments may slip back during the catheter placement. To prevent loss of guidewire access, once the desired biliary segment has been accessed with the angled guidewire, it may be exchanged for a stiffer, PTFE-covered 0.035-inch guidewire (Jagwire, Boston Scientific) to increase stability and thus minimize wire slippage and catheter displacement during NBC deployment.
- Catheter migration during the exchange phase.** Once the NBC is advanced to the desired portion of the biliary system with its proximal tip situated adequately upstream from the target location, the endoscope is carefully withdrawn while maintaining catheter position under fluoroscopic guidance. This is done by simultaneously advancing the catheter/wire combination in equal increments, thereby keeping the position of the NBC in the bile duct and keeping the GI lumen stable (Video 1, available online at www.giejournal.org).
- Excessive curving and looping.** While removing the endoscope, we continuously monitor the catheter contour using fluoroscopy to prevent sharp angulation or excessive loop formation. The 2 areas where excessive angulation is likely to occur are in the duodenal sweep and the gastric body. To minimize gastric looping, all insufflated air is aspirated from the gastric lumen before

TABLE 1. Less-common scenarios encountered and proposed management options

Scenario	Management
Patient presents to the elective NBC placement procedure with acute cholangitis	<p>If symptomatic (fever, abdominal pain):</p> <ul style="list-style-type: none"> - Postpone NBC placement - Proceed with stent exchange to improve biliary drainage and achieve source control - Reschedule NBC placement once cholangitis episode resolved <p>If asymptomatic:</p> <ul style="list-style-type: none"> - May consider proceeding with endoscopic NBC insertion followed by stent exchange after multidisciplinary discussion involving endoscopy, radiation oncology, and transplant teams. May consider a prolonged course of antibiotics (7-10 days)
NBC dislodgement/kinking between end of ERCP and start of brachytherapy treatment	<p>Options:</p> <ol style="list-style-type: none"> 1. Attempt to troubleshoot in the radiation suite, with fluoroscopic guidance 2. Return to endoscopy suite for another attempt at endoscopic NBC placement 3. Deliver HDR brachytherapy through the working catheter if bilateral NBC is placed 4. Cancel brachytherapy and perform external beam boost treatment instead

NBC, nasobiliary catheter; HDR, high dose rate.

the duodenoscope is withdrawn into the esophagus. If a sharp angulation is identified, advancing the NBC will often resolve the problem.

5. **Coiling in the oropharynx.** Once the NBC is rerouted transnasally, we routinely confirm that the catheter is not coiled or looped in the mouth or oropharynx (Video 1, available online at www.giejournal.org) by digital examination of the catheter position or fluoroscopic examination of the nose, mouth, and oropharynx. Coiling of the NBC within the oropharynx can be rectified by gently holding the catheter against the posterior oropharynx while pulling the additional catheter out of the naris. This provides tactile feedback when the pharyngeal aspect of the catheter has been fully straightened while preventing dislodgement from the bile duct. Fluoroscopy may occasionally be used to ensure the catheter is straight.
6. **Catheter kinks.** Small kinks along the NBC can occur as a result of use of the elevator mechanism during catheter advancement into the biliary tract (Fig. 5). Such kinks can make it difficult or impossible to pass the internal 4.7F intraluminal brachytherapy catheter or for the afterloader to pass the source wire, particularly in 8.5F NBCs. Avoiding excessive excursion of the elevator will help maintain the smooth integrity of the catheter. In our experience, the larger diameter 10F NBC is preferred to minimize the negative effect of kinking and promote stability of the catheter during the exchange phase. Careful catheter inspection on fluoroscopy can help detect potential kinks (Video 1, available online at www.giejournal.org). Occasionally, the kinked catheter may need to be removed in its entirety and replaced.
7. **Bismuth III/IV strictures.** Perihilar cholangiocarcinoma often leads to bilateral ductal stenosis. We preferentially place bilateral NBCs to ensure optimal delivery of brachytherapy (Fig. 6). Although 10F stents are preferentially placed to ensure improved performance

of the afterloader, in this scenario we preferentially use 8.5F NBCs to successfully place 2 catheters, unless the overall duct diameter is large enough to accommodate 10F NBCs in 1 or both sides. Insertion of bilateral NBCs requires complete withdrawal and reinsertion of the duodenoscope to place the second NBC. This is often challenging because it risks dislodging the existing catheter. Therefore, great care is taken to ensure the stomach is not overdistended by insufflation.

Table 1 summarizes other clinical and technical considerations that are less common, but nonetheless encountered in our experience.

CONCLUSIONS

Endoscopic placement of NBCs for HDR brachytherapy has high technical success. Nonetheless, endoscopic- and catheter-related issues may arise, which can add to procedural complexity. The procedure requires patience and persistence by the endoscopy team in close collaboration with the radiation oncology team. We describe our experience, highlight the potential technical challenges, and propose troubleshooting mechanisms.

DISCLOSURE

Dr Chandrasekhara does consulting for Interpace Diagnostics and is a stock shareholder with Nevakar Corporation. Dr Dayyeh received grants/research support from Apollo, Aspire, Cairn Diagnostics, and Spatz; does consulting for BFKW, Boston Scientific, DyaMx, Endogastric Solutions, Metamodix, and USGI; does speaking for Endogastric Solutions, Johnson and Johnson, Medtronic, and Olympus; and does teaching for Olympus. Dr Storm does consulting for Apollo Endosurgery, Endo-TAGSS, ERBE, and GI Dynamics and research for Apollo

Endosurgery and Boston Scientific. Dr Petersen is a stock shareholder with 3M, Abbvie, Exact Sciences, Johnson and Johnson, and Medtronic; received grants/research support from Boston Scientific; and does consulting for Boston Scientific, GIE Medical, and Olympus America. All other authors disclosed no financial relationships.

ACKNOWLEDGMENTS

We would like to acknowledge Dr Christopher L. Deufel for his contribution to the revision of the manuscript and video.

Abbreviations: HDR, high dose rate; NBC, nasobiliary catheter.

REFERENCES

1. Heimbach JK, Gores GJ, Haddock MG, et al. Liver transplantation for unresectable perihilar cholangiocarcinoma. *Semin Liver Dis* 2004;24:201-7.
2. Rosen CB, Heimbach JK, Gores GJ. Liver transplantation for cholangiocarcinoma. *Transpl Int* 2010;23:692-7.
3. Deufel CL, Furutani KM, Dahl RA, et al. Technique for the administration of high-dose-rate brachytherapy to the bile duct using a nasobiliary catheter. *Brachytherapy* 2018;17:718-25.
4. Mukewar S, Gupta A, Baron T, et al. Endoscopically inserted nasobiliary catheters for high dose-rate brachytherapy as part of neoadjuvant therapy for perihilar cholangiocarcinoma. *Endoscopy* 2015;47:878-83.

Division of Gastroenterology and Hepatology, Mayo Clinic, Rochester, Minnesota (1), Department of Radiation Oncology, Mayo Clinic, Rochester, Minnesota (2).

If you would like to chat with an author of this article, you may contact Dr Chandrasekhara at Chandrasekhara.Vinay@mayo.edu.

Copyright © 2021 American Society for Gastrointestinal Endoscopy. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

<https://doi.org/10.1016/j.vgie.2020.10.007>

Endoscopyedia

Endoscopyedia has a new look! Check out the redesign of the official blog of *GIE* and *VideoGIE*. Keep up with the latest news and article discussions and post your comments or questions to *VideoGIE* authors. Visit us at www.endoscopyedia.com.