

Endo Mini-Retract™ Laparoscopic Retractor with a Novel Short-cut Nelaton Catheter for Dividing the Vasculature in Laparoscopic Liver Resection

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Abstract

Laparoscopic hepatectomy has become a widespread procedure in Japan, now that the national medical insurance system covers partial resection and lateral segmentectomy. An important procedure during laparoscopic hepatectomy is the division of the vascular pedicles. In this paper we report a practical and useful method for vascular division with an Endo Mini-Retract™ retractor and a shortened Nelaton catheter (2.5-mm-diameter) developed in our department.

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Key words: device, laparoscopic liver resection, Endo Mini-Retract, vascular dividing

I. Introduction

The number of patients undergoing laparoscopic hepatectomy has markedly increased in Japan since April 2010, when the national medical insurance system started covering partial resection and lateral segmentectomy. There are 3 key maneuvers in the laparoscopic hepatectomy procedure: ablation around the liver, liver parenchymal resection, and division of the vascular pedicles. The adaptation and further spread of laparoscopic hepatectomy would advance greatly if surgeons had a technique for easily and safely performing vascular division. Cho et al. have reported a method for dividing the first

branch of Glisson's sheath with an Endo Retract™ Maxi laparoscopic retractor (Covidien, Mansfield, MA, USA)^{1,2}. In the present paper we report a practical and useful method for vascular division using an Endo Mini-Retract™ retractor and a shortened Nelaton catheter (2.5-mm-diameter) developed in our department. This method improves the ease and safety of laparoscopic hepatectomy when Glisson's sheath is extrahepatically encircled, the vasculature is divided during resection of the liver parenchyma, and the liver-hanging maneuver is performed.

II. Description of Method

In the first step of this new method, a size 3 (2.5-

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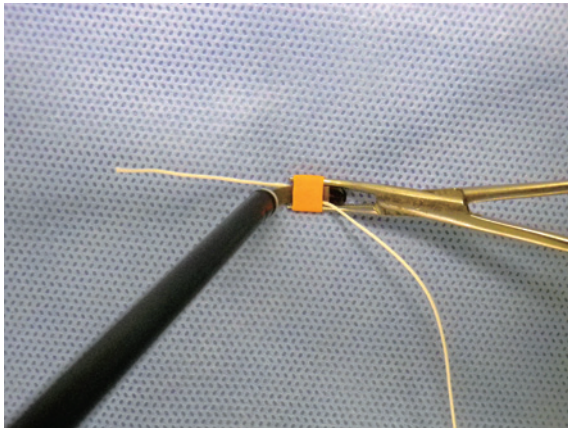


Fig. 1 A size 3 (2.5-mm-diameter) Nelaton catheter is cut to a length of about 7 mm and is attached with mosquito forces to the tip of an Endo Mini-Retract™ retractor.

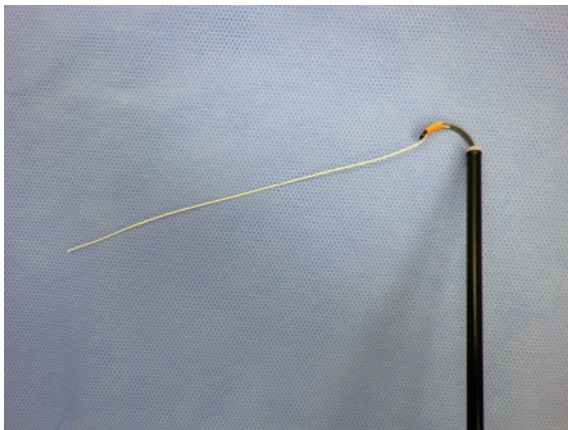


Fig. 2 A short segment of thread or cotton vascular tape is set using mosquito forceps from inside.

mm-diameter) Nelaton catheter is cut to a length of about 7 mm and attached to the tip of an Endo Mini-Retract™ retractor with mosquito forceps (Fig. 1). Next, a short length of thread or strip of tape (depending on the surgical purpose) is fed through the Nelaton catheter at the tip of the Endo Mini-Retract™ retractor from the inside using mosquito forceps (Fig. 2). A sufficient length of thread or tape from the tip must be kept in reserve in this step. If the mosquito forceps are forced into the Nelaton catheter, the catheter can burst. Bursting can be avoided by pinching the thread or vessel tape with mosquito forceps and feeding it through the Nelaton catheter before attaching it to the Endo Mini-Retract™ retractor. This maneuver prevents injuries from bursting catheters and facilitates preparation.

When a vessel or Glisson's sheath is to be divided



Fig. 3 Extrahepatically encirclement of the main left Glisson's pedicle (arrow shows the tip of the Endo Mini-Retract™ retractor).

during liver resection at our department, a 1-0 silk or Vicryl suture is cut to either of 2 lengths: a 10-cm length to encircle the vessel or sheath or a 17-cm length to ligate the vessel or sheath. To prepare for use, the tip of the Endo Mini-Retract™ is pulled to the proximal edge of the attached soft catheter. The catheter must not be pulled excessively at this point, as undue pulling can cause the soft catheter to slip off. In most cases there is little risk of soft catheter slippage, however, as the catheter is designed to stay at the tip of the retractor when the tip is pulled to the end.

III. Use

Extrahepatic Encircling of Glisson's Sheath (Fig. 3)

Before an attempt is made to extrahepatically encircle the main branch of Glisson's sheath, the liver parenchyma around the sheath must be removed to the fullest extent possible with a Cavitron ultrasonic surgical aspirator (Valleylab, Inc., Boulder, CO, USA) or similar device. The parenchyma should be removed from around both the insertion and exit points of the Endo Mini-Retract™. In our department we use a ball-type-tip electrode with saline enhanced soft coagulation for both the hemostasis and division of Glisson's sheath from the liver parenchyma. We can perform the procedure easily and safely with this electrode, with almost no bleeding. Next, the tip of the Endo Mini-

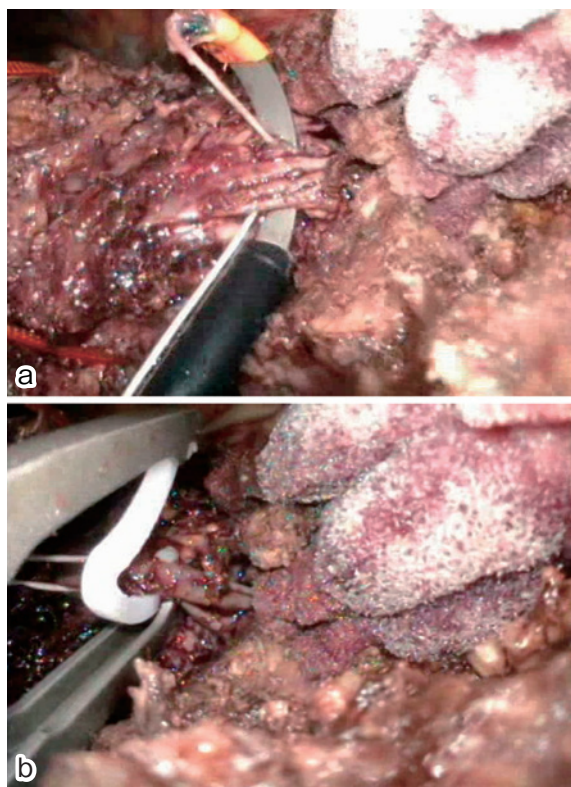


Fig. 4 **a.** Dividing of V3 with the Endo Mini-Retract™ retractor during resection of the liver parenchyma.
b. By pulling the thread encircling the vessels, the completely circumferential clipping of the vasculature using the Hem-o-lok® ligation system could be performed.

Retract™ retractor fixed with the soft catheter is placed into the insertion point, and the slider is pushed forward by thumb. The slider resistance should be easily palpable to the fingers, and the slider should never be pushed forward with undue force. The surgeon must also be careful to avoid injuring the vessels to the caudal lobe. The insertion can be easily and safely performed, as the surgeon can use both hands together to hold and pull Glisson's sheath with forceps. The smaller and sharper tip and more precise curve dimension of the Endo Mini-Retract™ retractor also make the procedure easier and safer than a similar procedure performed with the Endo Retract™ Maxi retractor (Covidien).

When the retractor tip is exerted, the thread fed through the shortened Nelaton is extended like a bowstring between the retractor tip and Glisson's sheath. At this point, an assistant can hold the

thread with forceps and pull. Glisson's sheath can be encircled after the slider is slowly pulled toward the proximal side, as the thread easily detaches from the Nelaton catheter. If the slider is pulled too far at this point, the Nelaton catheter could move to the retractor tip and come off by contact. The slider, therefore, should be pulled only from the position to the preparation point as previously explained.

In our institution, Glisson's sheath is divided with a linear stapler during the resection of the liver parenchyma.

Division of the Vasculature during Resection of the Liver Parenchyma (Fig. 4a, b)

It is also useful to divide the vasculature with an Endo Mini-Retract™ retractor and a shortened Nelaton catheter during liver resection. As much of the liver parenchyma as possible is removed on both sides of the vasculature requiring division, and the tip of the retractor should be slowly and gently advanced across the vasculature. The surgeon should proceed to the root, which should be free of resistance, and should refrain from any crude or abrupt maneuvers. If any resistance is felt during the maneuver, the surgeon should proceed with the utmost care in performing further division. The surgeon may be able to more easily perform the division procedure by agitating the tip of the Endo Mini-Retract™ retractor with a subtle twitching motion during the insertion. If a small amount of bleeding from the vasculature is recognized during the procedure, it can be controlled by encircling the vasculature and pulling the thread. The pull of the thread encircling the vascular also facilitates the further division of the vasculature and enables the complete circumferential clipping of the vasculature with the Hem-o-lok® ligation system (Teleflex Medical, Research Triangle Park, NC, USA) or a metal clip. Furthermore, the device could be useful for simplifying the division of the ligamentum venosum in confined spaces with little leeway for working.

Liver-hanging Maneuver (Fig. 5)

In left lateral segmentectomy or hemihepatectomy with the liver-hanging maneuver, pulling the tape

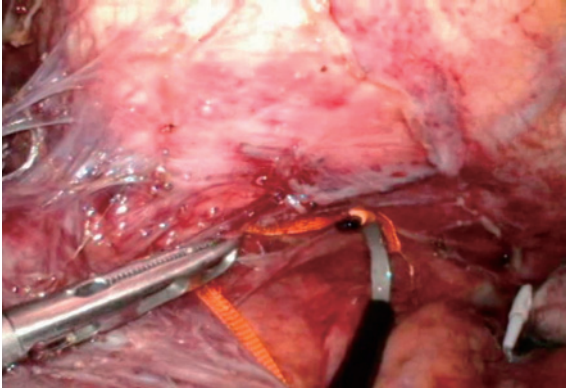


Fig. 5 After cotton vascular tape, rather than the thread, is put through the soft catheter, the tip of Endo Mini-Retract™ retractor proceeds from the dorsal to the cranial side of the liver, and the tip emerges over the thick liver parenchyma. After that, pulling the vascular cotton tape makes liver-hanging maneuver becomes easier.

through the dorsal side of the liver parenchyma allows the direction of resection of the liver parenchyma to be easily recognized and decreases blood loss. The liver-hanging maneuver is widely used for both open and laparoscopic resection of the liver. After placing a strip of cotton vascular tape through the soft catheter in place of a thread, the surgeon advances the tip of the Endo Mini-Retract™ retractor from the dorsal to cranial side of the liver and over the remnant portion of the liver parenchyma. The device can simplify encircling the liver parenchyma with vascular cotton tape in the liver-hanging maneuver.

IV. Discussion

In April 2010, the Japan medical insurance system began covering laparoscopic partial hepatectomy and left lateral liver resection. Since their coverage started, these procedures and laparoscopic hepatectomy have been performed more often in Japan. Laparoscopic hepatectomy can be divided into 3 key maneuvers: perihepatic division, resection of liver parenchyma, and vascular division. If more advanced devices and surgical techniques are developed for each of these procedures, laparoscopic hepatectomy could be established as a stable and safe intervention.

Cho et al.^{1,2} have reported a novel technique for the extrahepatic encircling of Glisson's sheath using the Endo Retract™ Maxi retractor (**Fig. 6**), a technique that could increase the number of major hepatectomies performed in Japan. To date, however, this technique with the Endo Retract™ Maxi retractor poses several challenges in a clinical setting. In some cases, a surgeon may find performing subtle maneuvers difficult because the entire procedure requires the constant use of both hands. In other cases, the arm is too curved to encircle Glisson's sheath extrahepatically, or the surgeon has trouble locating the retractor tip during the procedure. A crucial precaution for vascular division is the complete circumferential division of the vasculature, including the back side, for the prevention of vascular injury. Maryland or right-angle forceps are usually used for this procedure³, but difficulties are sometimes posed by the relationship between the length of the retractor tip and the thickness of the vasculature, or between the direction of the vasculature and the direction of the inserted forceps. Exquisite surgical skills may be necessary to handle such difficulties when they emerge. Our alternate procedure with the Endo Mini-Retract™ retractor can be performed more easily and safely for several reasons: its arm is more gently curved than that of the Endo Retract™ Maxi retractor; the position of the retractor tip is easier to find through the coordinated actions of both hands; and the smaller, blunter shape of the retractor tip facilitates the detachment of a minimal amount of the vasculature.

Another disadvantage of the Endo Mini-Retract™ retractor is the absence of any hole at the tip of the arm. The absence of a hole adds more steps to the procedure: tying the thread to the tip, passing the tip through behind the vasculature, and finally cutting the thread. In our technique with the Endo Mini-Retract™ and shortened Nelaton catheter, the easier detachment of the thread improves both the safety and ease of the procedure.

In summary, we can list 6 advantages and 2 disadvantages of our device and procedure. The advantages are as follows. 1) Because the maneuver can be performed with one hand, the surgeon has

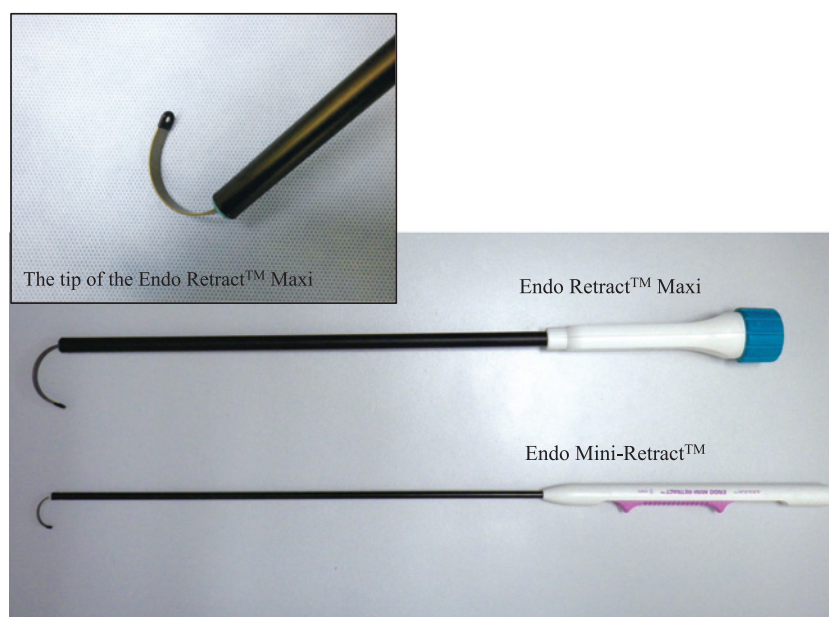


Fig. 6 Differences in shape between the Endo Retractor™ Maxi and Endo Mini-Retractor™ retractors. The upper left box shows the tip of the Endo Retractor™ Maxi retractor.

use of both hands to perform subtle movements and two-handed actions in concert. 2) Because the tip of the Endo Mini-Retractor™ retractor is small and dull, resistance during insertion is minimal. 3) The arm of the Endo Mini-Retractor™ is gently curved and can be used to detach both Glisson's capsule and minimal vasculature. 4) Insertion is possible via a 5-mm-diameter port. 5) The thread is easily detached. 6) This technique with short-cut soft catheter can be applied to the Endo Retractor™ Maxi retractor. The disadvantages are as follows. 1) The stalk of the arm is rather weak. 2) There is a risk that the soft catheter will drop off. To cope with the first disadvantage, forcible insertion of the retractor or any other maneuver likely to injure the vasculature should be avoided. Regarding the second disadvantage, the surgeon can reliably prevent the soft catheter from dropping by performing the proper procedure as described earlier.

V. Conclusion

The Endo Mini-Retractor™ retractor and a shortened Nelaton catheter improve the safety and ease of vascular division and can be widely applied under various conditions during laparoscopic hepatectomy.

Conflict of Interest: The authors declare no conflict of interest.

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