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Combined suture retraction of the falciform ligament and the left lobe of the liver during laparoscopic total gastrectomy

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Abstract
Background The inferior surface of the liver's left lobe overlies important structures such as the hepaticoduodenal ligament, the lesser omentum, and the gastroesophageal junction. Exposure of these structures is mandatory during dissection of lymphatic basin when total laparoscopic gastrectomy is performed. This report describes a liver retraction technique using a suture that simultaneously retracts both the falciform ligament and the left lobe of liver.
Methods The reported technique involves placement of a suture through the mid pars condensa of the lesser omentum and its retrieval through a single subxyphoid stab wound after one limb has been passed through the avascular segment of the falciform ligament. The end result is a V-shaped formation that maintains the falciform ligament and the left lobe of liver in a retracted cranial and anterior position.
Results In this prospective study, 55 patients (34 men and 20 women) with gastric cancer underwent laparoscopic total gastrectomy using the reported liver retraction technique between August 2008 and November 2009. The mean age of the patients was 59 years (range, 31–86 years), and their mean body mass index (BMI) was 24 kg/m^2 (range, 18.2–31.9 kg/m^2). The mean time required to complete the procedure was 4 min (range, 3–7 min). All the patients had adequate exposure of the dissection field without the need for an additional retraction device. No failures or complications resulted from this pars condensa suture liver retraction technique.
Conclusion The technique of combined falciform and left lobe of the liver retraction using a single suture is a safe, effective, and efficient method for exposing the hepaticoduodenal ligament, lesser omentum, and gastroesophageal junction in patients undergoing total laparoscopic gastrectomy.

Keywords Falciform ligament · Laparoscopic total gastrectomy · Left liver lobe · Retraction

Laparoscopic gastrectomy for the treatment of gastric cancer is becoming increasingly popular [1]. The proven short-term benefits of laparoscopic procedures in surgical practice cannot be disputed. The oncologic outcome of laparoscopic gastrectomy is similar if not superior to that of open surgery [2] In gastric surgery, the compact anatomy of the supracolic compartment with the left lobe of the liver overlying most of the gastroesophageal junction, lesser curvature of the stomach, and lesser omentum makes liver retraction absolutely mandatory for any surgery to proceed in this area.

We describe a liver retraction technique using a suture that retracts the falciform ligament and the left lobe of the liver simultaneously. Previously, we used either a Nathonson's retractor or a snake retractor to elevate the left lobe of the liver. Both of these techniques required an additional 5-mm subxyphoid port. We found our new technique to be safe, effective, efficient, easy to reproduce,

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and economical. This technique obviates the need for multiple puncture wounds or a sizable incision for insertion of retractors and spares the assistant for more important jobs during laparoscopic total gastrectomy.

Operative technique

At our institution, all patients with gastric cancer irrespective of their body mass index (BMI) who fulfill the criteria for laparoscopic total gastrectomy receive liver retraction by the following technique. Under general anesthesia, the patient is placed supine on the operating table with both arms outspread. The operating surgeon completes the entire procedure from the right side.

After the patient has been prepped, a 10- to 12-mm supra- or infraumbilical camera port is inserted by open technique. Carbon dioxide (CO_2) pneumoperitoneum is created, and a 5-mm working port is inserted in the right upper quadrant lateral to the duodenum. A diagnostic laparoscopy then is performed using a flexible scope, and the decision to proceed with laparoscopic resection is reaffirmed. Next, three additional trocars are placed: two 5-mm assistant trocars inserted respectively in the left hypochondrium and the left anterior lumbar region and one right anterior lumbar 10- to 12-mm working trocar.

A puncture wound is made approximately 2–3 cm below the xyphoid in the midline. One end of a Vicryl 2-0 suture (Ethicon Inc., Somerville, NJ, USA) is loaded on the Berci fascial closure device (Karl Storz GmbH & Co., KG, Tuttlingen, Germany), advanced into the abdominal cavity, and passed to an assistant grasper. The surgeon pierces the suture passer through an avascular portion of the falciform ligament and retrieves the suture back from the assistant grasper to the anterior abdominal wall. Both ends of the suture are held together and fixed snugly on the anterior abdominal wall with a clamp. The suture looping around the falciform ligament provides safe retraction of the falciform ligament during the initial operation.

The gastrocolic ligament, the left and right gastroepiploic vessels together with their lymph nodes, and, if needed, the station 14 V lymph node are dissected. The assistant then uses a 5-mm endopath retractor (Ethicon Endo-surgery, LLC, Guaynabo, USA) to lift up the left lobe of the liver. A supraduodenal window is created by division of the duodenal vessels, and the right gastric vessels are isolated. The surgeon then divides the pars flaccida of the lesser omentum. Next, the duodenum is transected using a laparoscopic linear cutting stapler. To proceed further with dissection of any of lymph node stations 1, 2, 3, 5, 7, 8a, 12a, 11p, and 11d, we retract the liver as follows.

We begin by placing a full-length 2-0 polypropylene suture with a curved needle (Ethicon) through the 10- to 12-mm working port. Through the same subxyphoid puncture wound, a percutaneous suture passer is advanced into the abdominal cavity, and the free end of the polypropylene suture is exteriorized. The needle is driven through the mid pars condensa while a good bite is ensured and then removed (Fig. 1). The falciform ligament retraction suture placed earlier is removed. The suture passer is again passed into the abdominal cavity and pierced through the avascular segment of the falciform ligament from left to right, and the suture is exteriorized. A piece of gauze is spread between the liver surface and the suture. With the assistant gently elevating the left lobe of the liver, both ends of the suture are pulled and grasped snug over the skin of the anterior abdominal wall with a clamp. The end result is a V-shaped sling with gauze protecting the liver that retracts the liver cranially and anteriorly, lifting the left lobe off the stomach and also fixing the falciform ligament to the overlying anterior abdominal wall (Fig. 2).

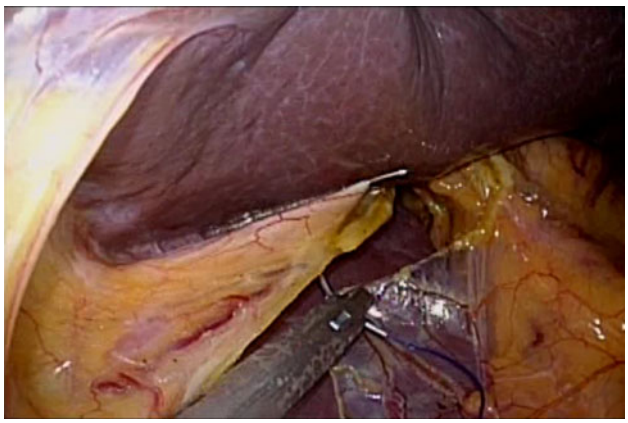

Fig. 1 Suture being driven through the mid pars condensa. The assistant lifts the left lobe to facilitate suturing

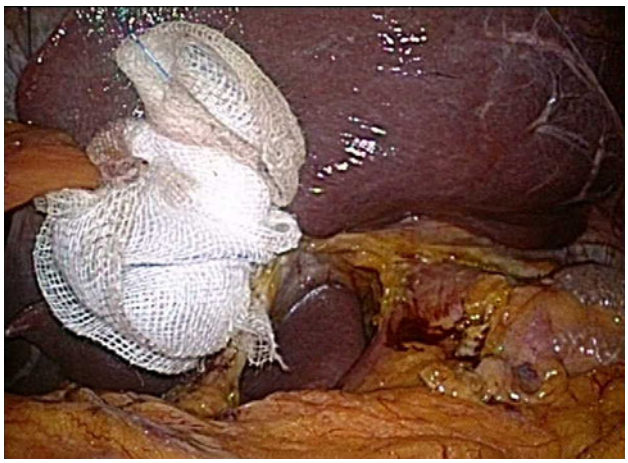

Fig. 2 Combined suture retraction of the falciform ligament and the left lobe of the liver. The left lobe is protected by gauze from suture-related injury

After completion of the dissection, the left lower assistant port is enlarged to 5 cm, and the port site is protected with the wound protector. This port site is used for insertion of a laparoscopic purse-string device, retrieval of specimen, and jejunojenunostomy. At the end of the procedure, the liver and falciform retraction suture is cut and removed.

Results

In this prospective series, 55 patients (34 men and 20 women) with gastric cancer underwent laparoscopic total gastrectomy using the described liver retraction technique between August 2008 and November 2009. Their mean age was 59 years (range, 31–86 years). The mean BMI of these patients was 24 kg/m^2 (range, 18.2–31.9 kg/m^2). Of these 55 patients, 15 were overweight and 5 were obese.

The mean time required to complete the procedure was 4 min (range, 3–7 min). All patients had adequate exposure of the dissection field without the need for an additional retraction device. No failures or complications resulted from this pars condensa suture liver retraction technique.

Discussion

During laparoscopic gastric surgery, a bulky falciform ligament and the left lobe of the liver obscure the laparoscopic field of vision. During the early developmental phase of laparoscopy, accounts describe retraction of the falciform ligament using sutures [3, 4]. The technique of Hashimonai and Kopelman [4] that uses a 5-cm straight-needle polypropylene thread has served well over the years. However, especially for novice surgeons, maneuvering a 5-cm straight needle in and out of the abdominal cavity is not an easy task. It is even more difficult in obese patients, where the limited working space and thick abdominal wall pose an extra challenge. It also results in two separate puncture wounds. Our technique of using a suture passer is safer because its insertion is more controlled, and there is no need for intraabdominal maneuvering. An added benefit of our combined retraction technique is that of a single puncture wound.

Before using our current suture retraction technique, we used mechanical retractors, namely, the Nathanson Flex Arm Laparoscopic Liver Retractor (Mediflex Surgical Products, New York, NY, USA) and the Snake Liver Retractor (Snowden Penser, Inc., Tucker, GA, USA) to elevate bulky and floppy left lobes during laparoscopic total gastrectomies.

Although these mechanical retractors provide effective and efficient liver retraction, we found them to have some limitations as well. First, their insertion requires a 5-mm incision. Second, to fix the retractor, the mounting is positioned either next to the right outstretched arm or on the left side of the patient. Not only does this occupy precious space, but we found that it also limited our freedom of movement at the working port. If these retractors are not mounted, an assistant is required to maintain them in position.

Many innovative techniques have been devised to overcome these challenges. One such technique was a minimally invasive procedure for liver retraction described by Lee et al. [5]. These authors described liver elevation using a suture that pierced the liver edge. Although their study reported the technique to be safe and effective, it left many wondering whether this was the best method?

Over time, more innovative minimally invasive techniques evolved. Among these was that of using a Penrose drain and a J-shaped retractor (ENDO RETRACT MAXI; United States Surgical Corporation, Norwalk, CT, USA) for liver retraction during laparoscopic gastrectomy, as described by Sakaguchi et al. [6]. This technique, although simple, yet requires incising the coronary ligament of the liver's left lobe and blunt dissection in this area using a disposable retractor, adding to both increased operative time and risk. The addition of more disposable instruments also adds to the overall cost of the procedure.

Recently, de la Torre et al. [7] described a suture liver lift technique during their single-incision adjustable gastric band placement in one of their obese patients. Our techniques resemble theirs, but there are differences as well. Placing the suture at the mid pars condensa allows the whole of the liver's left lobe to abut the diaphragm and anterior abdominal wall, thus exposing the entire field under the left liver lobe, in contrast to their right crural technique, which mainly improves exposure of the hiatal region. Moreover, with their technique, the suture is anchored to the right crus of the diaphragm, allowing limited retraction followed by tearing of the crus, as opposed to our technique, in which a good bite through the fibrous par condensa can withstand considerable traction and is not easily torn. Also, as our assistant lifts the left lobe of the liver while the suture ends are being pulled and tightened, the suture largely thus suspends and bears the weight of the left lobe and is not pulled upon too much during the fixation process. This minimizes the risk of tearing the pars condensa. Another key advantage of our technique is that it allows retraction of the falciform ligament and left lobe of the liver together, greatly improving exposure of the operative field.

Five patients in the current series were classified as obese per the World Health Organization (WHO) [8] definition of obesity, and in these patients also, we had good exposure without any complication. One limitation in this series was

the absence of more severely obese cases. This was not something we could change because the general population in Korea is not obese. Hence, the application of this technique in obesity surgery needs to be investigated further. We use a flexible tip laparoscope to widen the view of the narrow dissection field at gastroesophageal junction. While, with the conventional rigid laparoscope, the mechanical retractors may provide wider visualization compared with our technique.

It could be asked why we have limited the use of the described technique to patients undergoing total laparoscopic gastrectomy and have not applied it while performing laparoscopically assisted subtotal gastrectomy. This limited usage of the technique is due to the difference in the surgical approach. During subtotal gastrectomy, after dissection along the greater curve, a 4- to 5-cm incision is made in the mid epigastrium either to the left or to the right of the midline depending on the type of reconstruction (i.e., Billroth I or Billroth II). Through this incision, a 1.2-cm port is introduced, and a fan retractor is deployed to retract the liver. The retractor is anchored to the camera port and left upper assistant port with cotton tape such that it requires no other formal fixation. This 10- to 12-mm port is later removed, and the incision deepened for entrance to the abdominal cavity to perform specimen extraction and anastomosis.

Conclusion

Our technique of combined falciform and left lobe of the liver retraction using a single suture is a safe, effective, and efficient method for exposing the hepaticoduodenal ligament, the lesser omentum, and the gastroesophageal junction in patients undergoing total laparoscopic gastrectomy.

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Disclosures Asim Shabbir, Ju-Hee Lee, Moon-Soo Lee, Do Joong Park, and Hyung Ho Kim have no conflicts of interest or financial ties to disclose.

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