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Surgeon at work

Pancreaticoduodenectomy in portal hypertension: use of the Ligasure

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Abstract
Background Purpose. The Ligasure Vessel Sealing System (LVSS) is a new bipolar device, put on the market in 1999, which provides safe and quick hemostasis, sealing blood vessels up to 7 mm in diameter or tissue bundles without dissection or isolation. We tested this instrument in a patient with portal hypertension who had to be submitted to a complex abdominal procedure.
Methods. A male patient (aged 57 years) with well-compensated cirrhosis of the liver, related to hepatitis C virus (HCV) (Child A) was diagnosed with a neoplasm of the pancreatic head. We performed a Whipple pancreaticoduodenectomy and hemostasis was almost entirely performed with the LVSS. All the blood vessels up to 7 mm in diameter were sealed in this way. Larger vessels were suture ligated primarily.
Results. No post-application bleeding was seen. No postoperative hemorragic complications occurred. A significant reduction in blood loss and in surgical time was noted.
Conclusions. We believe that the LVSS could be extremely useful in all the fields of hepatopancreatobiliary surgery, especially in patients with portal hypertension with large intestinal and omental varices. The LVSS guarantees excellent hemostasis, reducing the risk of serious blood loss and shortening the time of surgery, so improving the prognosis.

Key words Pancreatic surgery · Pancreatic neoplasms · Hemostasis · Ligasure

Introduction

Effective and quick hemostasis is fundamental in modern surgery. Thanks to continuous developments in the technology, surgeons have several methods for achieving this objective: suture ligatures, hemoclips, staplers, bipolar or monopolar electrosurgery, and ultrasonic coagulators. Each method offers advantages and has limitations. Clips are easily placed but can become dislodged and represent a foreign body; sutures are tedious and time-consuming; bipolar and ultrasonic coagulation can be used only for small blood vessels (up to 3 mm); staplers are expensive.[1,2]

Recently a new electrothermal bipolar vessel sealer (Ligasure Vessel Sealing System [LVSS]; Valleylab, Boulder, CO, USA) was developed as a useful alternative to the hemostatic methods mentioned above. This system can be used for ligating vessels 1 to 7 mm in diameter and tissue bundles without dissection or isolation. The result is a permanent and translucent seal that completely obliterates the vessel lumen. This device was tested, with excellent results, in different fields of surgery (gastrointestinal, hepatopancreatobiliary, urologic, gynecologic, laparoscopic, etc), as demonstrated by several recently published studies.[3–5]

Because of these characteristics, we decided to employ this instrument in a Whipple pancreaticoduodenectomy in a cirrhotic patient with portal hypertension for whom it was mandatory to obtain safe and rapid hemostasis.

Patient and methods

A male patient, aged 57 years, came to our department with a diagnosis of obstructive jaundice. He had an anamnestic history of diabetes mellitus type II and well-compensated cirrhosis of the liver related to hepatitis C virus (HCV) (Child A). Ultrasound and abdominal computed tomography (TC) showed hepatic cirrhosis, splenomegaly, dilatation of the intra- and extrahepatic bile ducts, and increased size of the head of the pancreas. During endoscopic retrograde cholangio-

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pancreatography (ERCP) a stenosis of the inferior third of the common bile duct, due to a periampullary neoplasm, was diagnosed and nasobiliary drainage was positioned. The suspicion of a tumor of the pancreatic head without invasion of the vascular structures was confirmed by magnetic resonance (MR) imaging. Therefore, we decided to perform a Whipple pancreaticoduodenectomy, using the LVSS. This system is a feedback-controlled high-current (4 Amps) low-voltage (<200 V) bipolar radiofrequency instrument.[6] The energy delivered is four times the current of a standard electrosurgery generator and one fifth to one twentieth the voltage. The high current fuses the collagen and elastin within the tissue bundles and vessels, which quickly reform to create a plastic-like sealed zone.[7] LVSS was the primary means of ligation of vessels that were 1 to 7 mm in size. Large vessels (more than 7 mm) were suture ligated primarily. The LVSS is applied sequentially without dissection of the vessels. For thinner tissues, one seal is performed and sectioned in the middle of the transparent seal. For thicker tissues, the device is applied twice, with the second application at a distance of 3–4 mm from the first, and the section is made between the two applications.

In the present patient, the LVSS was employed both for opening the abdominal wall and at all the main points of the procedure. After an accurate abdominal exploration, which confirmed significant hepatic cirrhosis with high portal hypertension, we performed a cholecystectomy by suture ligating and sectioning the cystic duct, but the sealing of the cystic artery and the dissection of the gallbladder was obtained with the LVSS. Successive sealing of the gastroduodenal artery, duodenal mobilization (Kocher maneuver), supraduodenal dissection (including nodes), sectioning of the right gastric and gastroepiploic vessels and of the uncinate veins, sealing of the pancreatic vessels and of the veins between the uncinate and the portal vein and those between the uncinate process and the superior mesenteric artery (SMA), dissection of the proximal jejunal mesentery and of the retroperitoneum, and sectioning of the gastrocolic ligament were performed, almost entirely, with the LVSS. However, we did not use this device for parenchymal transection of the pancreas in order to preserve the main pancreatic duct, and so we performed a end to side pancreaticojejunostomy. The reconstruction was completed with a end to side hepaticojejunostomy, and a end to side gastroenteric anastomosis was done in a fashion described previously.[8]

Results

Although no formal comparative study has been done we noted a significant reduction in blood loss (considering the portal hypertension) and in the procedural time.

Neither intraoperative nor postoperative hemorrhagic complications nor pancreatic fistula occurred. No blood transfusion was administered. The patient was discharged 15 days postoperatively.

Discussion

The LVSS is an innovative, effective hemostatic device that can make the practice of open and laparoscopic surgery easier. In fact, it can be used safely to seal any type of vessel (up to 7 mm) in the abdomen, including large varices in cirrhotic patients.

It was developed in order to overcome the difficulties inherent with the use of other hemostatic systems, such as bipolar and ultrasonic energy systems (inability to seal vessels larger than 3 mm), suture ligatures (more time required), hemoclips (dislodgement), and staplers (expensive).

The LVSS uses electrothermal energy and, more precisely, a well-mixed combination of pressure and radiofrequency (high current and low voltage). The generator senses the density of the tissue bundle held between the forceps and automatically adjusts the amount of energy to be delivered. In consequence, the collagen and the elastin contained in the tissue bundle and in the blood vessels are denatured. The vessel walls fuse, obliterating the lumen. The vessels are sealed in approximately 2 to 5 s, depending on vessel size and tissue type, with a single application. So the blood flow is completely stopped, as it is when a hemoclip or a suture or a stapler is used. Seals created by the LVSS were shown to withstand a minimum of three times normal systolic pressure.[1]

Traditional energy systems, in contrast, work by dehydrating tissues. The intimal walls collapse, but do not fuse, and the obliteration of the lumen is sustained only by a proximal thrombus.

Another advantage of the LVSS is that an excessive amount of energy is not delivered. So the lateral thermal spread is always less than 2 mm beyond the tissue bundle or vessel. This method confines its effect precisely to the target tissue or vessel, with virtually no sticking or charring.[5] Furthermore, using this instrument, there is no danger of dislodged clips and no foreign material is left behind.

An experimental study demonstrated that the seal obtained with the LVSS progressed through a normal healing process and did not slough off. In fact, at 10 days, the seal was surrounded by connective tissues, and at 20 days, mature collagen was present and the healing process was regressing.[9]

Even if many studies demonstrate that the LVSS is safe and effective for the hemostatic control of blood

vessels, the efficacy of this energy source to control structures such as bile or pancreatic ducts is still unproven. Matthews et al.[7] reported that the LVSS failed to seal common bile ducts at 6 days in an animal model, and so they recommended not to use this device for bile duct ligation. The lack of sealing with the device could be related to the unique properties of the protein matrix in the bile duct wall or to the absence of the thrombogenic coagulum that occurs when vascular structures are ligated.[7]

In our department we have successfully tested this instrument in some complex abdominal procedures, such as hepatic pericystectomy for a large hepatic echinococcus, hepaticojejunostomy for a neoplasm of the common bile duct, distal pancreatectomy with splenectomy for cystadenocarcinoma of the pancreas, and gastric resection for adenocarcinoma of the stomach, as well as in many minor procedures. Until now we have not employed this device in patients with portal hypertension.

As previously confirmed by many authors, we think that the use of the LVSS presents many advantages that could be helpful, especially in resective pancreatic surgery:

a. It presents the possibility to operate more safely and more easily in tight or deep spaces.
b. The sealing of blood vessels does not require their direct exposure, which can cause unnecessary bleeding.
c. It saves time and makes it easier to perform a ligature with difficult vascular pedicles or when there is a difficulty in creating a space between two vessels (short mesentery of duodenum, short gastric vessels).
d. It is easy to use and does not require a learning curve or expert surgical skills.
e. It eliminates the use of appliances in vascular ligation, dramatically reducing procedural times in open surgery, especially in patients with portal hypertension and large varices or many collateral vessels. A team of North Carolina researchers, after performing 98 procedures with the LVSS (colon and small bowel resections, fundoplications, gastric resections, splenectomies, pancreatectomies, etc.) found that operating times were decreased by an average of 39 min per open procedure.[5]

In conclusion, this work confirms that the LVSS is an easy-to-use safe, and effective device which is particularly useful in patients with portal hypertension because it reduces the time of dissection and the risk of serious blood loss. In consequence, it enables a shorter surgical procedure and reduces the need for blood transfusions. This is important, especially in pancreatic surgery, in which the mortality and morbidity rates are tightly correlated with these factors.[10] Standard hemostatic systems are very rarely required after the use of the LVSS.

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