Laparoscopic Habib™ 4X: a bipolar radiofrequency device for bloodless laparoscopic liver resection

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Abstract

Background. In recent years the progress of laparoscopic procedures and the development of new and dedicated technologies have made laparoscopic hepatic surgery feasible and safe. In spite of this laparoscopic liver resection remains a surgical procedure of great challenge because of the risk of massive bleeding during liver transection and the complicated biliary and vascular anatomy in the liver. A new laparoscopic device is reported here to assist liver resection laparoscopically.

Methods. The laparoscopic Habib™ 4X is a bipolar radiofrequency device consisting of a 2x2 array of needles arranged in a rectangle. It is introduced perpendicularly into the liver, along the intended transection line. It produces coagulative necrosis of the liver parenchyma sealing biliary radicals and blood vessels and enables bloodless transection of the liver parenchyma.

Results. Twenty-four Laparoscopic liver resections were performed with LH4X out of a total of 28 attempted resections over 12 months. Pringle manoeuvre was not used in any of the patients. None of the patients required intraoperative transfusion of red cells or blood products.

Conclusion. Laparoscopic liver resection can be safely performed with laparoscopic Habib™ 4X with a significantly low risk of intraoperative bleeding or postoperative complications.

Key Words: laparoscopic liver resection, liver resection technique, radiofrequency, Habib 4X
insulated area to allow 5 cm in length for RF. The
device can be introduced via a 10–12 mm laparoscopic
port and is connected to a 500-kHz generator (Model
1500X Rita Medical Systems, Inc. California, USA)
which produces up to 250 W of RF power. It allows
measurement of the generator output, tissue impe-
dance, temperature, and time. The system also consists
of a pneumatic foot pedal used to turn the RF energy on
and off. The generator can be run in manual or
automatic mode. On connecting the device and switch-
ing on the generator, the RF power setting defaults to
125 W and this can be modified according to user
experience and the thermal requirement of the indivi-
dual tissue types.

Operative technique
Under general anaesthesia, for resections of segments
II through V, patient is placed in the supine position.
For lesions in segment VI, the patient is placed in the
left lateral decubitus position, to expose the lateral
and posterior aspect of the right lobe. The open
technique for creation of pneumoperitomeum was
used to avoid possible damage to intraabdominal
organs as a result of adhesion from previous abdom-
inal operation. Pneumoperitoneum was maintained
throughout the procedure on a high flow rate with
CO₂ at a pressure of 12 mmHg. The operation was
performed via three 12 mm and one 5 mm ports
placed along the subcostal margin depending on the
site of liver tumour (Figure 2). In general, two 12 mm
were inserted to one side and, one 12 and 5 mm
respectively to the other. Any perihepatic and perito-
neal adhesions related to the previous laparotomy
were divided to allow examination of the entire
peritoneal cavity for either local recurrence at the
site of previous colorectal resection or for peritoneal
deposits. Laparoscopic intraoperative ultrasound
(IOUS, Aloka Co., Ltd, Tokyo, Japan) was applied
in all patients to obtain further information on the
extent of disease and the anatomical relationship
between the portal pedicles, hepatic venous branches
and the tumour.

The technique of laparoscopic liver resection as-
isted with LH4X is similar to previously described
using this for open approach. In brief, LH4X was
used to produce coagulative necrosis along the line of
intended parenchymal transection without vascular
clamping of either portal triads or major vessels. In
contrast to the open approach in which the whole
resection line was coagulated before cutting, the liver
parenchyma was progressively transected with a pair
of scissors after each RF application in laparoscopic
approach. Following routine LIOS examination of
liver prior to starting LH4X assisted liver resection;
the intended transection plane was marked on the
surface of liver with diathermy. Then, LH4X was
inserted first to the most difficult part of the intended
plane of transection in the deepest and farthest areas
from the surface of liver under the guidance of

Figure 1. Laparoscopic Habib™ 4X.

Figure 2. Port positions: 1, 2 & 3 are 12 mm ports and 4 a 5 mm
port.
LIOUS to ensure a correct position of the probe in order to avoid any inadvertent damage to any vascular or vital structures and at the same time to allow an adequate resection margin. This was done prior to starting RF to prevent interference of ultrasonic images from RF. To complete the transection of liver parenchyma along the ablated plane, a pair of laparoscopic dissection scissors was used. Finally, the specimen was extracted whenever possible with an endobag (Endocatch, Autosuture, United States Surgical Cooperation, Norwalk, CT) by enlarging a port-site incision. For a large specimen, incision was made between two adjacent ports to retrieve the tissue through this open incision. A 20 FG drain (Smiths Medical International Ltd., Hythe, Kent, UK) was routinely placed close to the resection margin.

Results

Twenty-four Laparoscopic liver resections were performed with LH4X out of a total of 28 attempted resections over 12 months. Of the patients 50% (n = 12) had single or multiple tumorectomies while three (12.5%) patients had resection of one segment and nine (37.5%) patients had bisegmentectomies. Pringle manoeuvre was not used in any of the patients. None of the patients required intraoperative transfusion of red cells or blood products. The average blood loss was less than 50 ml. All patients made good recovery from the procedure and there was no postoperative mortality.

Discussion

Major bleeding causes severe problems in laparoscopic liver surgery. In these cases immediate compression by a laparoscopic instrument or control by surgeons hand is not feasible. Therefore bleeding complications in laparoscopic liver resection requires special equipment which can control bleeding during parenchymal transection. By using this laparoscopic device, there was very little intraoperative bleeding encountered during transection of liver parenchyma making laparoscopic liver resection easier and quicker, and few postoperative complication rate.

A careful staging and selection of patients remains a key to success in laparoscopic surgery for cancer [17]. Although major liver resection has been reported to be performed laparoscopically [14,18], laparoscopic technique should ideally be considered for resection of small tumours located peripherally in lower or lateral segments of liver.

The benefits of the laparoscopic approach over open surgery are a quicker improvement in serum transaminase levels, a reduced postoperative analgesic requirement, a shorter delay to oral intake, and a reduced hospital stay [19]. Problems related to laparoscopic liver resection include difficulty in liver mobilisation, retraction and identifying tumour margins [12,14,20]. When using LH4X during laparoscopic liver resection, a less degree of mobilisation of the liver is required compared to open procedure for tumours in lower or lateral segments.

Most of the indications for liver resections are malignant lesions, including metastatic disease, mostly of colorectal origin, and Hepatocellular carcinoma (HCC). There is a debate about the specific risks of tumour seeding during laparoscopic surgery. The potential mechanisms for tumour seeding include direct contamination by technical errors during laparoscopic resection, cell exfoliation or cytokine activation secondary to pressure effects from pneumoperitoneum [21]. A potential complication of laparoscopic liver resection is gas embolism which is caused by pneumoperitoneum during resection of liver parenchyma [22,23]. There was no clinical evidence of air embolism in our serie. This potential complication seems to be rare and not reported in the largest studies of laparoscopic liver tumour resection [24–27].

A wider assessment of clinical data suggest similar tumour recurrence rates after laparoscopic and conventional surgery and lesser suppression of immune function due to lesser surgical insult in laparoscopic surgery, compared to open operations [28–30]. Moreover, in a prospective, randomised study Lacy et al. [31] reported that survival was better after laparoscopic colonic resection for cancer than with the traditional open resection.

Since our first description of RF ablation for unresectable liver cancer, the role of RF in liver surgery has been extended from mere ablation to actual liver resection by our group [32–34]. This technique has now been applied for liver resection laparoscopically by the development of this new device to assist laparoscopic liver resection. This is a safe and feasible device to assist laparoscopic liver resection when performed by surgeons with dual expertise in both laparoscopic and open liver surgery.

References


