Technical note

Parenchymal transection with ultrasonic scalpel in liver resection

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Background
There is no ideal tool for parenchymal transection in liver resection and bleeding is still a major complication. The purpose of this study was to evaluate the usefulness of an ultrasonic scalpel and to describe our clinical experience in open liver resection.

Methods
An ultrasonic scalpel was used in seven consecutive patients undergoing liver resection. During parenchymal transection coagulation shears were used with the power level set at 2 or 3, and the blunt blades were selected.

Results
In each case, bleeding from the liver parenchyma was trivial, but haemostasis of large vessels required suture ligation. Postoperatively none of the patients experienced local technical complications such as haematoma, bile leak or infection.

Discussion
Although complete haemostasis of large vessels cannot be achieved, the ultrasonic scalpel may be used for parenchymal transection in liver resection to reduce blood loss. Larger series of patients are needed before a definitive statement regarding the efficacy of this method can be made.

Keywords
liver resection, ultrasonic scalpel, cirrhosis

Introduction
The ultrasonic scalpel (Ethicon Endo-Surgery, Cincinnati, OH, USA) is a new instrument that cuts and coagulates tissue with ultrasound, using higher frequencies than an ultrasonic aspirator [1]. This device can also serve as a grasper and basically involves a blade oscillating at 55 kHz, producing heat and coagulation of vessels. Primarily the ultrasonic scalpel has been used in endoscopic surgery, but recently its use and potential advantages in some open surgical procedures have been demonstrated [2–6]. We report our experience with the ultrasonic scalpel to evaluate its usefulness in open liver resection.

Patients and methods
Liver resections were performed through a bilateral subcostal incision. In right hepatectomy, right-sided pedicular structures were dissected, suture-ligated and transected. The right hepatic vein was isolated extraparenchymally and divided. The dissection plane was established after demarcation by devascularisation. Occlusion of the total vascular inflow (Pringle’s manoeuvre) was not used. Parenchymal transection was performed with the ultrasonic scalpel in the blunt mode at level 2 or 3. During the dissection of the parenchyma, the assistant secured the liver between his index finger and thumb. Centrally, the liver parenchyma was divided by a Kelly clamp and suture ligation was performed to control larger veins. Large portal branches and venous tributaries that continued to bleed after transection were secured by 4/0 or 5/0 polypropylene sutures. After heptectomy, collagen sheets or coagulant glue were not applied to the cut surface. Moistened gauze packs were placed against the raw surface for 5 min. Suction drains were left in place. In two patients with minor heptectomies, portal structures and hepatic veins were not dissected and parenchymal transections were performed in the same manner.

Results
The ultrasonic scalpel was used in seven consecutive patients (Table 1). The mean duration of the parenchymal transection was 42 ± 12 min. Intra-operative blood
transfusion was used in only one patient (2 units of erythrocyte suspension in patient no. 4). The mean total operative blood loss was 540 ± 160 mL for right hepatectomies, and the mean fall in haemoglobin level during the hospital stay was 0.29 mmol/L (1.85 g/dl). Postoperatively none of the patients required blood transfusion or experienced local technical complications such as haematoma, bile leak or infection.

**Discussion**

With the advances in the technique of liver resection, many centres are reporting resections with minimal mortality and morbidity rates [7–11]. The main technical advance relates to decreased intra-operative bleeding [12]. Despite this considerable improvement, major liver resections still carry a risk.

The liver surgeon can use a panel of techniques for parenchymal transection including ultrasonic aspiration (Cavitron Ultrasonic Surgical Aspirator), jet cutter, finger fracture (digitilcasy), crushing Kelly clamp (Kelly-clasy) and heat coagulative necrosis using radiofrequency energy [13]. Recently, ultrasonic aspiration has widely replaced the use of other techniques to divide the liver tissue [14]. Liver parenchymal transection with an ultrasonic scalpel is a new technique, and it is quite different from ultrasonic aspiration. The ultrasonic aspirator is an ultrasonic dissection tool that works at 25 kHz and allows aspiration of collagen-sparse tissue, leaving blood vessels intact. When this device is used the blood vessels must be ligated or coagulated with electro-surgery. In contrast, the ultrasonic scalpel cuts and coagulates the tissue at the same time without generation of smoke. This property eliminates the ligation or clipping of vessels. It does not char the liver parenchyma, and splitting planes can be clearly visualised at all times.

The ultrasonically activated scalpel is composed of a generator, handpiece and blade [1]. There is no vibration in the handpiece when the system is activated. The ultrasonic scalpel can also be used as a dissector and meets many characteristics of an ideal electromagnetic energy. It may have a role in the application of minimally invasive surgery to liver malignancies. In a recent multicentre study, Gigot and colleagues suggested that in a selected group of patients laparoscopic liver resection is safe and has an acceptable complication rate [15].

Although the ultrasonically activated scalpel has been used mainly in laparoscopic and thoracic surgery, its application in selected open surgical procedures has also been reported [2–6]. Tomita and associates investigated its usefulness for nephron-sparing operations in 10 patients with renal cell carcinoma [5]. They concluded that this technique is beneficial for obtaining a clear parenchymal stump and haemostasis, even though complete haemostasis of the larger vessels cannot be achieved. Maruta and co-workers described a technique of open abdominoperineal resection with the use of an ultrasonically activated scalpel in seven patients [6]. They reported the division of levator ani muscles and dissection of all pelvic vessels with no subsequent bleeding. There are some reports on the use of an ultrasonically activated scalpel in open liver resection [16–18]. Schmidler and colleagues [16] reported their experience with the ultrasonic scalpel (UltraCision) for open liver resections in 39 patients; blood loss averaged 820 mL, and there were no biliary leakages or abscesses. However, one patient died of postoperative bleeding.

Our data suggest that the ultrasonically activated scalpel can be used safely for parenchymal transection and that good haemostasis can be achieved. In our hands
the duration of parenchymal transaction and the amount of blood loss with this technique are similar to those of ultrasonic aspiration and Kellyclasy. Bile leak, which is one of the most feared complications of liver resection, was not encountered. The ultrasonic scalpel worked efficiently in cirrhotic livers. In our experience key points that optimise its use in liver resection are as follows: (1) at the periphery level 3, but centrally level 2 (higher coagulation power) blunt mode should be used; (2) major vessels such as large hepatic vein branches need suture ligation; (3) pressure applied on the handpiece should be kept low to achieve better haemostasis.

Although the ultrasonically activated scalpel seems to be a useful tool for parenchymal transaction in liver surgery, larger series of patients are needed before a definitive statement can be made regarding the efficacy of this method. With the use of this tool secure haemostasis can be achieved with minimal foreign matter such as sutures and surgical clips. In the deep parts of the liver blunt dissection should be used, as it might be difficult to achieve sufficient control of bleeding from large vessels using the harmonic scalpel alone. The generator (25 000 USD) and disposable handpiece (600 USD) costs are considerable but still reasonable when compared with some other techniques.

References