New Technique for Defining the Right Anterior Section Intraoperatively Using Ultrasound-Guided Finger Counter-Compression

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It is generally considered that for delimitation of the hepatic area to be resected, once anatomic sectionectomy is planned, preventive division of the sectional vascular pedicles by an extrahepatic approach is required.[1-7] But all proposed techniques are technically demanding and time consuming, with associated drawbacks, although these are not numerically defined. We have shown that intraoperative ultrasound (IOUS)-targeted bimanual liver compression can be an effective method for disclosing subsegmental and segmental areas of the liver and removing them in an anatomic fashion.[8] We describe a new technique based on IOUS-guided liver compression for accomplishing a right anterior sectionectomy (RAS).

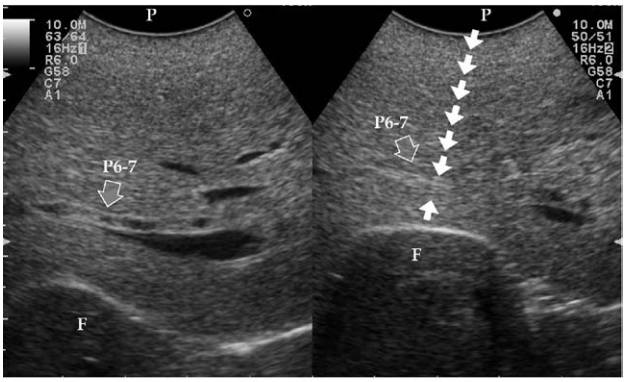
METHODS

Terminology

The terminology for liver anatomy and resection is based on the Brisbane classification.[9] Segments and section abbreviation are shown according to the classification of Takayasu and colleagues.[10]

Operative procedure

A J-shaped laparotomy is usually performed; a J-shaped thoracophrenolaparotomy is carried out when the tumor is located at the hepato-caval confluence and control of the hepatic veins at this level cannot be achieved because of patient characteristics. By dividing the round ligament, the falciform ligament, and by pulling the round ligament, the liver can be fully explored by IOUS. Briefly, we use an Aloka Alpha 10 (Aloka Ltd) equipped with the standard 2- to 6-MHz convex probe, 5- to 10-MHz T-shaped probe, and the 5- to 10-MHz microconvex probe; the microconvex and convex probes are those used for the compression. After that, if surgical planning is confirmed by IOUS findings, the hepatic hilum is encircled with a tourniquet but not dissected. The right triangular and right coronary ligaments are divided, and the right hemiliver is mobilized.



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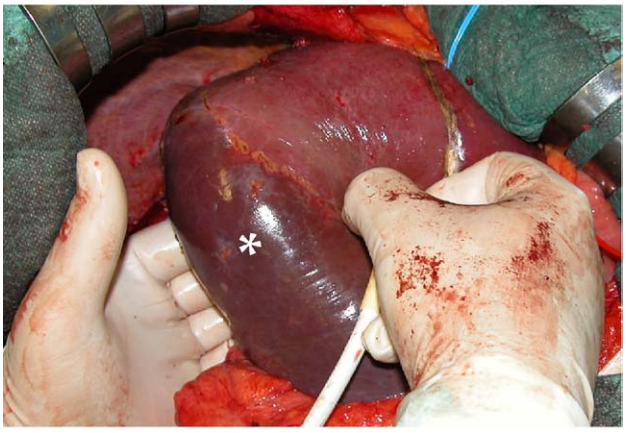

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Figure 1. (A) Intraoperative ultrasound (IOUS) on the left shows the P6-7 at the site at which the surgeon aims to start the compression maneuver; on the right the compression is carried out (white arrows) using the probe (P) itself and the surgeon's finger (F), resulting in P6-7 compression. (B) The left hand posteriorly and the probe anteriorly compress the liver at the point targeted by IOUS, causing the discolored area (*); the demarcation line has been marked with electrocautery.

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Abbreviations and Acronyms
IOUS = intraoperative ultrasound
LPV = left portal vein
RAS = right anterior segmentectomy

The portal pedicle feeding the right posterior section (P6-7)[10] is identified by IOUS and the level targeted for compression is then detected just after its origin from the right portal branch. Similarly, but without left hemiliver mobilization, the left portal vein (LPV) is identified by IOUS and the level targeted for compression is identified just after its origin from the main portal vein. The surgeon's left hand goes behind the right hemiliver; with the right hand the IOUS probe is positioned to show P6-7 at its origin. Using the left fingertips and the IOUS probe itself, the surgeon compresses the liver bilaterally at the targeted position, resulting in the compression of P6-7 in the previously identified tract (Figs. 1A and 2A). When there is not a common sectional pedicle, the pedicles to segment 6 and to segment 7 are selected and compressed separately, as has been reported for segmental resections.[11] This maneuver is constantly monitored in real time by IOUS with the probe used for compression (Figs. 1A and 2A). Compression is maintained until the surface of the right posterior section lateral to the compression site starts to discolor (Fig. 1B); at this time the assistant marks the discolored area with an electrocautery device and the compression is released. Similarly, LPV compression is carried out and released once Cantlie's line becomes evident by left hemiliver discoloration, and it is demarcated with electrocautery (Fig. 2B). Figures 3A and 3B show the demarcated resection area and the hepatic hilum still intact; Figure 4 shows the cut surface at the end of the resection.

Liver resection is now begun and is performed under intermittent Pringle's maneuver using Pean-clasia and bipolar forceps for vessel coagulation; vessels thicker than 2 mm are usually ligated with thin sutures (3-0). During the resection, IOUS is used to control the trajectory driving the dissection plane to the P5-8 branch to be ligated and divided. Resection is then completed, with exposure of the right hepatic vein and the middle hepatic vein on the cut surface.

DISCUSSION

Couinaud was the first to describe extrahepatic isolation of the right-sided sectional pedicles[1] to define the true anatomic sectional areas. Subsequently, several authors proposed techniques to carry out sectional resections: for this purpose, skeletonization of each sectional arterial and portal branch[2], or the encirclement as a whole of each sectional glissonian element[3] by means of hepatotomy[4,5] or not[6,7], were described. Both methods seem effective, but with some minimal rate of failure,[3] and are also possible sources

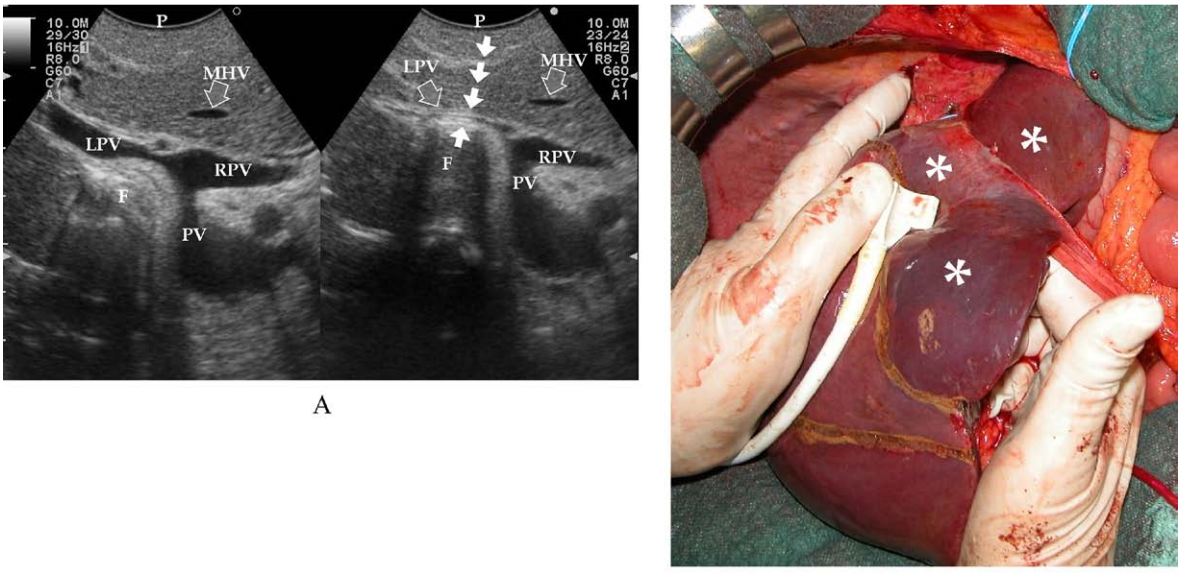

Figure 2. (A) On the left, intraoperative ultrasound (IOUS) shows the left portal vein (LPV) at the site the surgeon aims to start the compression maneuver (*); on the right, the compression (white arrows) is carried out using the probe (P) itself and the surgeon's finger (F), resulting in LPV compression. (B) The right hand posteriorly and the probe anteriorly compress the liver at the point targeted by IOUS, causing the discolored area (*); the demarcation line has been marked with the electrocautery. MHV, middle hepatic vein; PV, portal vein; RPV, right portal vein.