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Anatomical Resection of Left Liver Segments

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Hypothesis: Anatomical resection of the left liver segments are rarely mentioned in the literature. We describe an anatomical access to the left liver segments' pedicles without hilar dissection.

Design: Original surgical technique.

Patients and Methods: This technique was used in 26 consecutive resections involving left liver segments between July 2001 and December 2003. There were 15 men and 11 women with mean age of 57.1 years. Eleven patients had liver metastasis, 8 had primary liver cancer, 6 had benign lesions, and 1 had gallbladder cancer. The technique consists of small liver incisions according to anatomical landmarks such as the Arantius and round ligaments. In a systematized way, it was possible to reach every glissonian sheath of segments II, III, and IV.

Results: Liver resection was feasible using the proposed technique in every patient of this series, and the Pringle maneuver was not required in any patient. Intraoperative blood loss was minimal in all cases, and 23 patients did not require blood transfusion. There was no postoperative death.

Conclusions: This operative procedure allows easy, fast access for anatomical resection of the left liver segments. It is useful for performing controlled hepatectomies without clamping the main hepatic pedicle and may facilitate the recognition of all left liver segment sheaths, with excellent immediate results.

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TECHNIQUE OF LIVER RESECTION has evolved such that many centers throughout the world are reporting liver surgery with minimal morbidity and mortality. The indications for segmental liver resection are increasing, but most segmental liver resection techniques emphasize the removal of right liver segments.[1-3] Therefore, left segmental liver resections are rarely seen in the literature.

There is no better example in surgery of the usefulness of a precise knowledge of anatomy than liver anatomy. We describe an anatomical way to identify and isolate the glissonian sheaths of the left liver segments without hilar clamping or digital maneuvers. This can be accomplished very quickly and safely, avoiding tedious hilar dissection and with minimal blood loss. This technique uses anatomical landmarks such as the Arantius and round ligaments as a guide and mini parenchymal incisions.

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TECHNIQUE

The left liver is mobilized by sectioning the falciform, left triangular, and coronary ligaments. The left lobe is pulled upward, and the lesser omentum is divided exposing the Arantius ligament (ligamentum venosum). This ligament runs from the left branch of the portal vein to the left hepatic vein or to the common trunk,[4] which makes it a useful anatomical landmark for the identification of the left hepatic and portal veins.

The Arantius ligament is then encircled and divided. The cephalad stump can be used to dissect the left hepatic vein and the common trunk as described elsewhere.[5] The caudal stump of the ligament (**Figure 1**) is grasped and dissected downward toward the left portal vein. This maneuver discloses the posterior aspect of the left glissonian pedicle. A small (3 mm) anterior incision is made in front of the hilum (Figure 1, site B), and a large curved clamp (Mixter or Gray) is introduced through the left side of the left glissonian sheath behind the caudal stump of the Arantius ligament toward the anterior incision (Figure 1, site B), allowing the encircling of the left main sheath (**Figure 2**). This maneuver spares the caudate lobe (segment I) portal branches.

The round ligament is then retracted upward, exposing the umbilical fissure be-

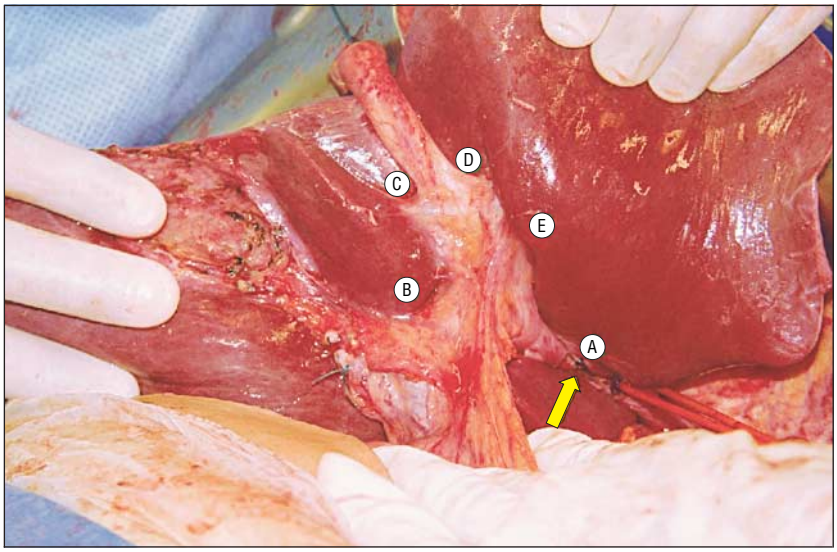

Figure 1. Intraoperative photograph showing the landmarks for access of the left liver segments' glissonian pedicles. Site A indicates the caudal stump of the Arantius ligament; B, the anterior incision in front of the hilum; C, the basis of the round ligament, right side; D, the basis of the round ligament, left side; E, midway between sites D and A. When a clamp is passed from site A to site B, it provides access to the left main sheath (containing the arterial, portal, and bile duct branches of segments II, III, and IV); from site A to site D, the left lobe sheath (segments II and III); from site E to site A, the segment II sheath; from site D to site E, the segment III sheath; and from site C to site B, the segment IV sheath.

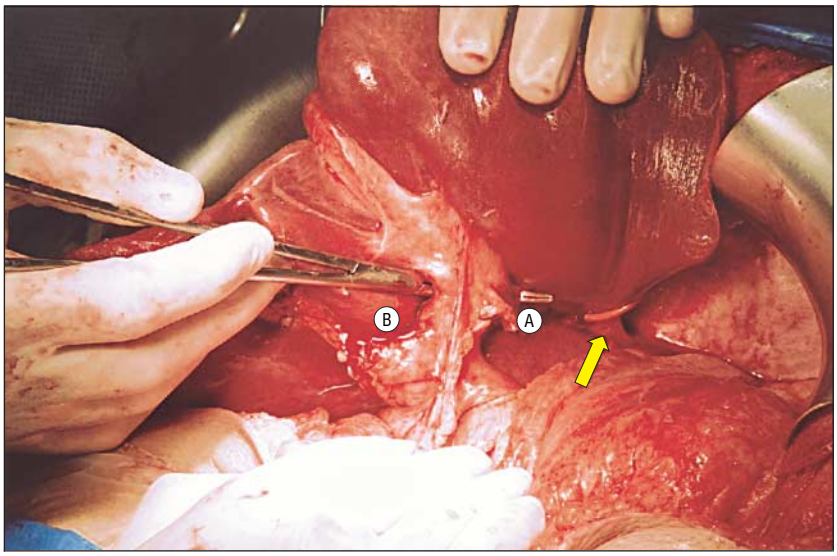

Figure 2. Intraoperative access for the left main sheath (from site B to site A). Note the left hepatic vein is encircled (arrow).

tween segments III and IV. In about one third of the patients, a parenchymal bridge connecting these 2 segments is present and must be divided. Using the round ligament as a guide, 2 small incisions (Figure 1, sites C and D) are performed on the left and right margins of the round ligament where it is possible to identify the anterior aspect of the glissonian pedicle of segment IV on its right side and segment III on its left side.

With a clamp introduced through incisions B and C, it is possible to isolate the glissonian pedicle of the left medial sector or segment IV (**Figure 3**). By combining incisions A and D (Figure 3), it is possible to isolate the glissonian pedicle of the left lateral sector (segments II and III). Another small incision can be performed midway between incisions D and A (Figure 3, site E), permitting individual access either to segments II or III, allowing monosegmentectomies (**Figure 4** and **Figure 5**). All these steps are performed without hilar dissection or clamping.

RESULTS

We have successfully used this technique in 26 consecutive liver resections involving left liver segments between July 2001 and December 2003. There were 15 men and 11 women with mean age of 57.1 years (range, 34-75 years). Eleven patients had liver metastasis; 8, primary liver cancer; 6, benign lesions; and 1, gallbladder cancer. One patient underwent resection of segment II alone, 4 underwent resection of segment III alone (Figure 4 and Figure 5), 2 underwent resection of segment IV alone, 8 underwent bisegmentectomy of segments II and III, 5 underwent left hepatectomy (II, III, and IV), 2 underwent left trisegmentectomy (resection of segments II, III, IV, V, and VIII), 1 underwent bisegmentectomy of segments V and IVb, and 1 underwent mesohepatectomy (resection of segments IV, V, and VIII). Two patients underwent double bisegmentectomies: segments II and III associated with segments V through VIII in 1 patient, and segments II and III associated with segments VI through VII in another patient.

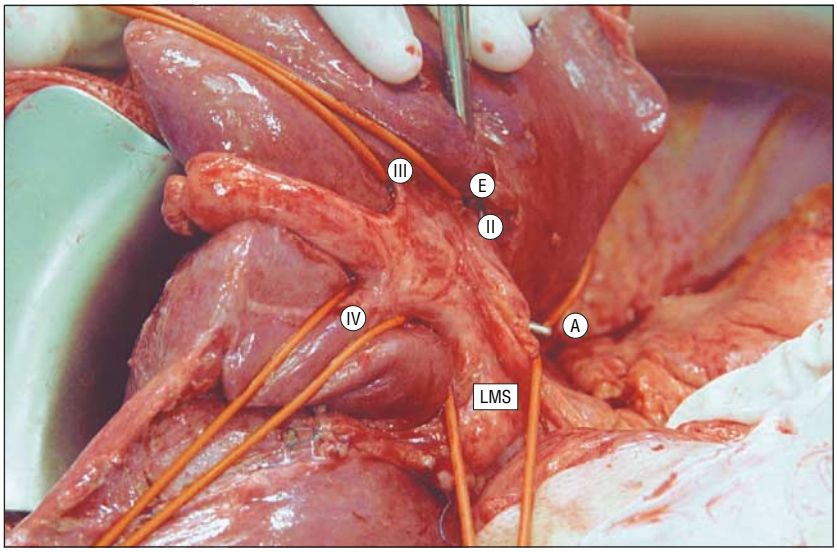

Figure 3. Intraoperative view of the left liver segments approach. The left main sheath (LMS) as well as the segment III and IV sheaths are already encircled. The large clamp is encircling the segment II sheath.

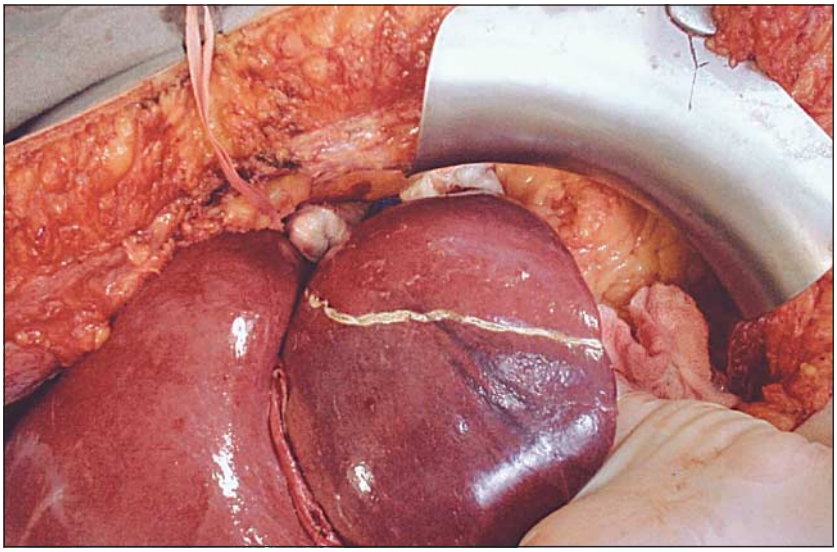

Figure 4. Intraoperative view of segment III delineation.

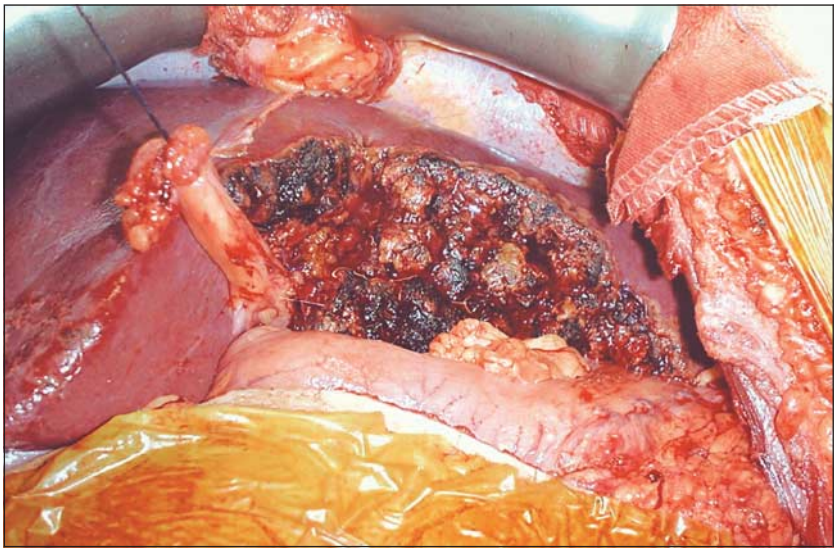

Figure 5. Intraoperative view of raw surface of the liver after segment III resection.

In 4 patients with cirrhosis, the technique was feasible (2 resections of segment III alone and 2 bisegmentectomies of segments II and III) and was not followed by further bleeding or postoperative liver failure.

Blood transfusion was required in 3 patients (11.5%; mean, 2 units). Both patients who underwent left trisegmentectomy required blood transfusion. One patient with liver cirrhosis had postoperative ascites and required diuretics. No postoperative mortality was observed.

COMMENT

The knowledge of segmental liver anatomy, as described by Couinaud,[6] has provided the basis for segmental liver resections. The liver can be divided into 8 different segments: segment I as the caudate lobe; segments II, III, and IV as the left liver; and segments V, VI, VII, and VIII as the right liver.

Removal of anatomical segments of the liver can be accomplished by several ways.[1,2,7] However, these techniques are not widely performed because of the difficulty of delineating anatomical liver segments. We have recently reported a standardized technique for right segmental liver resections[3] and, based on this experience, describe a systematized technique to reach the left glissonian pedicles and remove any left liver segments.

The main indication for the segmental approach is to preserve liver parenchyma, especially in cases with bilateral lesions or cirrhotic livers. This technique permits the complete anatomical clearance of the disease, leaving an adequate functioning liver, by removing individual hepatic segments.

The technique described in this article is a modification of the procedure proposed by Launois and Jamieson,[2] in which the main drawback is the large liver incision, which may cause substantial bleeding and is very difficult to perform in cirrhotic livers. With minimal incisions the exact size of the tip of a Mixter clamp, we can alleviate this maneuver and still be able to reach the glissonian pedicles for every left liver segment. Division of liver parenchyma around the left liver pedicles is time-consuming and may result in additional bleeding. The preclusion of the Pringle maneuver in our series was not followed by any additional bleeding.

The division of the Arantius ligament is a useful step to obtain quick access to the main left sheath. This maneuver, together with a very small incision anterior to the hilar plate, allows direct access to the main left sheath in less than a minute (Figure 2). When we intend to remove segments II and III (left lobectomy), we can insert the clamp from the incision behind the caudal stump of the Arantius ligament to the incision made on the left side of the round ligament and obtain access to the portal pedicles of these segments very quickly, also in less than a minute. To obtain individual access to the glissonian sheath of each segment of the left liver, further small incisions are performed (Figure 3) depending on the location of the lesions.

The main advantage over other techniques is the ability to gain rapid and safe access to the portal pedicles of the left liver segments, individually or not, precluding intraoperative ultrasound or other auxiliary techniques.

The combination of our previously reported technique[3] and the present one allows a safe approach to all liver segments. We believe that this technique allows an easy approach for anatomical resection of the left liver segments. It may also reduce the bleeding at the site of the incisions and the need for main hepatic pedicle clamping and may facilitate the recognition of left segment sheaths, with excellent immediate results. The knowledge and the use of glissonian pedicles of liver segments, as described in the present technique, is a logical approach in modern liver surgery.

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