Segment 1: Laparoscopic Approach

26

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26.1 Introduction

The hepatic caudate lobe (S1), or Spiegel lobe, has been widely considered a "nonlaparoscopic" segment due to its particular anatomical location between the hilar plate and inferior vena cava, which technically restricts the use of a conventional laparoscopic approach when treating segment 1 primitive and metastatic lesions. Since the early 2000s, the increasing detail in understanding liver segmental anatomy, improved preoperative imaging and intraoperative anesthesiologic management, as well as improvements in laparoscopic surgical skills and equipment, have allowed a significant increase in the adoption of minimally invasive procedures. Initially confined to wedge resections and segmentectomies of the anterior liver (laparoscopic segments), more advanced minimally invasive liver resections, such as in left and right sections, are now extensively performed and attain acceptable morbidity and mortality rates, with 3- and 5-year survival rates reported for hepatocellular carcinoma (HCC) and colorectal metastases comparable with those of open procedures [1]. Even though extremely rare, isolated laparoscopic resection of hepatic segment 1 (S1) has also been reported in the context of technically dyshomogeneous series. With the exception of a couple of reports, there is substantial lack, however, of a systematic technical description of the procedure.

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26.2 Anatomical Background

Hepatic S1 is usually divided into three portions according to Kumon's classification: the Spiegel lobe, the caudate process, and the paracaval portion. The Spiegel lobe is located underneath the lesser omentum on the left part of the inferior vena cava (IVC). The paracaval portion lies in front of the intrahepatic portion of the IVC, just to the right of the Spiegel lobe, and is surrounded by the right and middle hepatic veins. The caudate process is projected between the IVC and portal vein, just to the right of the paracaval portion. Kumon defined the paracaval portion as the liver parenchymal portion ventral to the IVC between the Spiegel lobe and the right hepatic lobe, adjacent to the middle hepatic vein ventrally; Coinaud also demonstrated and confirmed the existence of a paracaval portion, classifying this area as a separate S9 [2, 3]. The dorsal side of the IVC is sometimes covered by a parenchymal bridge of the S1 and often by a membranous structure called the IVC ligament. One or two thick (2–3 mm in diameter) veins, usually termed caudate veins, and several thin veins ensure S1 drainage, with some presenting as proper drainage for the S1 Spiegel lobe and others with common drainage with the paracaval portion of S1 and/or S4, 7, and 8. Thick veins enter the IVC, whereas thin veins merge with the IVC and middle and/or right hepatic veins. Almost half of the two to four S1 ducts merge with the posterior sectorial hepatic duct (B6 and 7) originating from S6 and 7, usually showing an epiportal course; the remaining S1 ducts join the left hepatic duct, formed by the joining of B2, 3, and 4 [4].

Arterial supply is represented by multiple small branches arising from the left (LHA) and right (RHA) hepatic arteries; singular branches from these arteries only are present in 35% and 12% of individuals, respectively. More frequently (53%), vascularization is guaranteed by both arterial branches. Artery for S1 does not designate a single vessel, but some large branches can be identified at angiography. Artery for S1 arising from the RHA courses posteriorly and medially and mainly supplies the lateral portion of S1 (the paracaval portion); Artery for S1 arising from the LHA, courses posteriorly, and mainly supplies the medial portion of S1 (caudate process, Spiegel lobe) [5].

Hepatic S1 presents an articulated and variable vascular supply. All three portions present vascular inflow from primary glissonian branches originating from the right and left portal vein, with the hilar bifurcation branch supplying not only the paracaval portion but also the left Spiegel lobe (29%) and the right caudate process (21%), allowing possible metastatic spreading of hepatic tumors to the entire liver [6].

26.3 Previous Clinical Experience

Experience in laparoscopic isolated resection of S1 is extremely limited, and data interpretation is confounded by the fact that S1 resection series are often included in wider sets of different laparoscopic approaches [1]. Therefore, it is impossible at the present time to draw definitive conclusions on safety and oncologic efficacy of such a procedure due to the lack of sufficiently large, focused studies. However, a few series report acceptable rates of adverse events associated with the approach, suggesting encouraging safety profiles.

Indeed, even though an isolated laparoscopic approach to lesions located in the posterosuperior segments (S1, 7, 8, and 4a) are significantly associated with longer operative time (331.4 vs. 258.5 min, $P = 0.009$) and intraoperative transfusion (47.2% vs. 25%, $P = 0.015$) compared with procedures on the anterolateral segments (S2, 3, 5, and 7), the approach was technically feasible and safe, with morbidities comparable with open surgery (19.4% vs. 16.3%, NS) in a recent monocentric series [7]. Dulucq and colleagues described the two cases to be reported in the literature and the surgical technique for isolated laparoscopic R0 resection of S1 for single colorectal metastasis using a six-trocar approach and the Pringle maneuver: operative time was 150 and 105 min, respectively, with no major complications or significant blood loss [8].

26.4 Technical Details

As for the other segmental laparoscopic hepatic resections, it is possible to identify at least three technical approaches: totally laparoscopic, hand-assisted, and laparoscopic-assisted open hybrid surgical techniques [1]. Before any further consideration regarding the most appropriate laparoscopic approach, however, it is important to recall that as far as the classic open, isolated resection of S1 is concerned, three common approaches have been described: left, right, and transparenchymal. The left approach is the most frequently described in laparoscopic resections, whereas the right approach, potentially indicated in the presence of masses located in the caudate process, is barely achievable by laparoscopy due to the difficult complete left rotation of the right hemiliver to expose the right row of spigelian veins. The anterior transparenchymal approach is theoretically applicable laparoscopically, primarily in association with right hepatectomy, even though S1 exposure with this technique is not always optimal.

With this in mind, it is clear that correct patient and trocar positioning is critical to patient safety and maximal comfort for the surgeon when performing minimally invasive S1 liver resection. In our experience, when a left approach is planned, the patient is positioned in the supine decubitus (30° anti-Trendelenburg), legs apart, with the surgeon standing between them and the assistant and the surgeon holding the camera standing on the patient's right and left side, respectively.

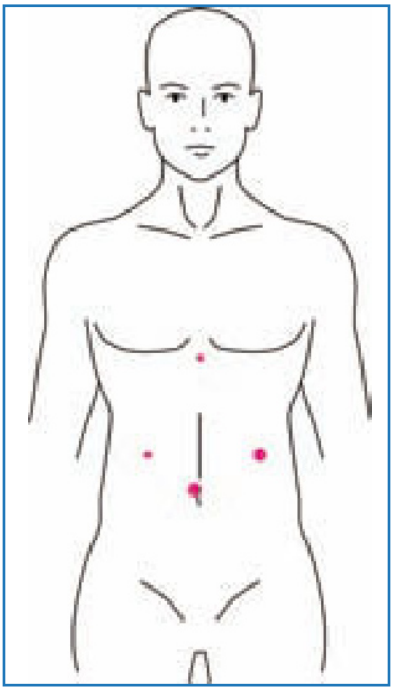

Fig. 26.1 Trocar positioning

Pneumoperitoneum (14 mmHg) is induced by positioning a supraumbilical 12-mm optical trocar (30°) using an open technique; 15-mm and 5-mm operative trocars are placed under direct vision in the left and right midclavicular lines, respectively, 5 cm above the transverse umbilical line. A 5-mm trocar is placed in the epigastrium, allowing inferior liver-surface retraction with adequate S1 and IVC exposure. Central venous pressure is maintained >5 mmHg (Fig. 26.1).

The peritoneal cavity is explored to rule out extrahepatic disease, and intraoperative liver ultrasonography is performed on the S1 before and after careful hepatoduodenal ligament dissection with a cautery hook (in search of the left hepatic accessory arteries) when looking for the presence of a lesion and possible IVC direct involvement.

The left lobe is not mobilized, and the liver is lifted upward with a 5-mm laparoscopic liver retractor, allowing glissonian pedicle interruption and hook cauterization of the peritoneal reflection of the IVC by gently grasping the spigelian lobe on the left side; blunt IVC dissection is continued, interrupted between clips, exposing the hepatic accessory veins. Once the spigelian lobe is completely released from the IVC, the glissonian pedicle is approached, with clip positioning on dorsal portal accessory veins. Indeed, we consider it safer to first mobilize the lobe, even though this interrupts venous outflow, to attain better control of the glissonian area.

Parenchymal transection is performed cephalad using radiofreqency forceps and bipolar cautery with intermittent water-drip irrigation until S1 resection is complete. The resection surface is meticulously checked for biliary leaks, and bleeding control is completed with bipolar cautery and water-drip irrigation. The tumor specimen is retrieved through the 12-mm supraumbilical port inside a dedicated laparoscopic plastic bag to prevent seeding. A small suction drain is positioned through the right 15-mm trocar at the bed of the hepatic resection. Pringle maneuver is not usually applied in our experience during parenchymal transection.

Due to the difficulty of this approach, laparoscopic S1 resection should be performed only in specialized centers by hepatobiliary surgeons with significant expertise in laparoscopic surgery.

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