Converting to Open Surgery

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Oscar Vidal, Martí Manyalich Blasi, and David Saavedra-Perez

10.1 Introduction

Adrenal masses are one of the most prevalent human tumors. Its incidence is approximately 3% in middle age and increases to 10% in the elderly [1]. In this sense, laparoscopic adrenalectomy (LAdr) has become the gold standard for the treatment of adrenal diseases in recent decades [2]. Two alternative surgical methodologies are currently promoted: the transperitoneal laparoscopic approach (TLA) and the posterior retroperitoneoscopic adrenalectomy (PRA) [3]. Interestingly, most adrenalectomy procedures during the early and mid-1990s were performed using an open approach. According to the study by Murphy et al., from 1998 to 2006, the number of adrenal resections in the United States increased significantly from 3241 to 5019 cases, and the majority (83%) of adrenalectomies were performed using an open approach. Currently, the surgeon's increased experience, advanced laparoscopic techniques, improved technology, and better short-term patient outcomes have led to laparoscopy displacing open surgery, making LAdr the procedure of choice in most cases [4].

However, LAdr shows some complications, with a reported overall complication rate of approximately 10% (range 2.9–20), with bleeding being the most prevalent complication. Organ injury, including damage to the liver, spleen, pancreas, kidney, large bowel, and diaphragm, has also been observed [5, 6]. Nevertheless, several studies have reported that LAdr has greater benefits in terms of patient outcomes, decreasing postoperative pain and disability, length of hospital stay, complication rate, and blood loss compared to open surgery. In addition, LAdr allows patients to return to normal activity faster [5, 7].

Despite the advantages of laparoscopic approach (LA) and the fact that there are no contraindications to LAdr, the review study by Assalia and Gagner indicates that the mean conversion rate is 3.6% (range 0–12) [6]. Several factors may increase the risk of open conversion, giving a less encouraging scenario. Identification of these risk factors would improve preoperative stratification, patient safety, and postoperative expectations, enhancing the cost-benefit balance and giving a better perspective to the medical team.

O. Vidal · M. Manyalich Blasi (✉)
D. Saavedra-Perez
General & Digestive Surgery Department, ICMDIM, Hospital Clinic Barcelona, IDIBAPS, University of Barcelona, Barcelona, Spain
e-mail: ovidal@clinic.cat; manyalich@clinic.cat; dsaavedr@clinic.cat

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The aim of this chapter is to discuss the risk factors that determine when and how to convert LA to open surgery.

10.2 Definition of Conversion to Open Surgery

Conversion to open surgery has been defined as an abdominal wall incision larger than 5 cm performed to make other manipulations different from specimen retrieval. In general, the conversion rate is expected to decrease as the laparoscopist experience level increases. However, some causes for conversion to open surgery even when there is sufficient experience include difficult dissection, severe bleeding, injuries to adjacent organs or tissues, risk for tumor rupture, inadequate intraperitoneal insufflations, and inability to identify the target lesion [8].

10.3 Risk Factors Associated with Conversion to Open Surgery during Transperitoneal Laparoscopic Adrenalectomy

Variables such as age, American Society of Anesthesiologists (ASA) physical status classification, sex, previous abdominal surgery, and laterality have not been related to the necessity for conversion from laparoscopic to open adrenalectomy. In addition, although right-sided tumors have been reported to be more predisposed to bleeding because of the short adrenal vein draining immediately to the inferior vena cava (IVC), in some studies, it has not been associated with the conversion to open surgery [8, 9].

On the other hand, several studies have associated risk factors such as obesity (body mass index (BMI) $\geq$30 kg/m^2), large adrenal masses (tumors >5 cm in diameter), and pheochromocytoma, with conversion to open surgery [8, 9]. Therefore, the proper selection of patients and identification of their associated risk factors are crucial.

10.3.1 Obesity

The association between obesity and conversion to open adrenalectomy is based on the difficulty of dissection, difficult cannula placement, difficult anatomical visualization due to excessive intraperitoneal fat, difficult instrument manipulation through an excessively thick abdominal wall, and longer operating time, which may result in an increased risk of major bleeding and other complications. In addition, morbid obesity may require high intra-abdominal insufflation pressure to establish an adequate working space, and high-pressure pneumoperitoneum may impede venous return [9].

Therefore, transperitoneal approaches (anterior and lateral) or the use of longer instruments are better choices than retroperitoneal approaches when there are large adrenal masses. However, the retroperitoneal approach seems to be better in small adrenal masses in obese patients [9, 10]. In addition, laparoscopic ultrasound can be helpful for locating the left adrenal vein, especially when it is obscured by a large amount of retroperitoneal fat, helping some obese patients to be candidates for LAdr (TLA or PRA) [11].

10.3.2 Size of the Tumor

The size of the tumor has been found to be the most important predictor of conversion. A large tumor will have a distended retroperitoneal vasculature due to compression, thus increasing the risk of bleeding. The growth of the adrenal tumor also causes reorganization of the surrounding tissues, making the tumor more difficult to excise, which leads to prolonging the time required for the surgical procedure [8, 9]. Although tumors larger than 5 cm are a risk factor for conversion, there is no consensus about which size of adrenal tumor is appropriate for an open or a LA. It has been reported that some surgeons laparoscopically resect adrenal tumors up to 15 cm in size [12]. In those cases, the use of laparoscopic ultrasound imaging may have been helpful and may have reduced conversions. Ultrasound helps to

define the relationship of tumors to adjacent structures, identifying the adrenal vein for direct dissection (especially for left-sided lesions), confirming the presence of pathology, and the resectability of large masses [11, 13].

Furthermore, some researchers have used the size of the adrenal tumor to predict the risk of malignancy. Adrenal tumors >5–6 cm in size have been found to have a high risk of malignancy (between 35% and 98%) [12].

10.3.3 Pheochromocytoma

Pheochromocytomas are catecholamine-producing tumors derived from chromaffin cells of the adrenal medulla [14]. The feasibility and efficacy of LAdr in cases of pheochromocytoma have been extensively confirmed, but patients with pheochromocytoma had significantly higher perioperative complication rates than those with benign, non-pheochromocytoma tumors [15].

There are several concerns about the LAdr to treat pheochromocytoma due to the potential hemodynamic effects of catecholamine secretion, which can induce malignant hypertension in the initial pneumoperitoneum or during minimal traction on surrounding tissues [16]. Likewise, the occurrence of both hypertensive and hypotensive intraoperative episodes during the same procedure has been reported [14].

LAdr (TLA and PRA) in patients with pheochromocytoma has been associated with a higher incidence of conversion to an open procedure [8]. Therefore, it has been suggested that in cases where a large pheochromocytoma (>5–7 cm) is observed, as well as in cases of difficult dissection, invasion, adhesions, and the need for preoperative hospitalization, patients may be more likely to require open adrenalectomy or a conversion to an open approach [14, 17, 18]. Understandably, the need for conversion was associated with increased intraoperative hypertensive episodes, increased mean operative time, mean anesthesia duration, postoperative complications, and length of stay [14].

However, enhanced anesthetic and laparoscopic techniques, as well as perioperative patient optimization, have significantly improved perioperative outcomes, with low conversion (<10%) and morbidity rates (<20%) [14].

10.4 How to Convert?

There are different incision options for open adrenalectomy approach when converting is required: median supraumbilical laparotomy, subcostal laparotomy, modified Makuuchi incision ("J"), and thoracoabdominal incision (also see Chap. 3).

A posterior approach can also be performed with the patient in a prone position through a curvilinear incision that runs from the ipsilateral paramedian line and extending laterally. This approach requires removal of rib 12 to extensively expose the retroperitoneal space. The remainder of the operation proceeds similarly to an endoscopic retroperitoneal adrenalectomy.

10.4.1 Choice of Incision

Several factors must be considered when deciding on the type of incision:

1. Size of the tumor and need for concomitant resection (e.g., nephrectomy or hepatectomy, anatomical or not), or vascular reconstruction.
2. Tumor location and direction of invasion.
3. Existing patient position during conversion of a minimally invasive procedure.

10.4.2 Open Right Adrenalectomy

The modified right Makuuchi or modified subcostal incision is the preferred incision because they provide adequate exposure for safe dissection. The right lobe of the liver needs to be fully mobilized by dividing the triangular ligament, while moving the liver superomedially to expose the infrahepatic and retrohepatic IVC, as well as the retrocaval collateral vessels.

10.4.3 Open Left Adrenalectomy

Typically, this operation is performed through a left subcostal or "J" incision on the left side. A midline supraumbilical laparotomy can be performed, but this incision may be insufficient for proper exposure.

10.5 Concluding Remarks

LAdr is a safe and effective procedure with significant advantages over the open procedure. Careful selection of surgical candidates should be based on both patient and tumor factors, given that patients with more comorbidities, obesity, large tumor sizes, and pheochromocytoma are at risk for conversion to open adrenalectomy and increased perioperative complications [15]. However, conversion to open surgery as well as the open approach should not be considered a failure. The surgeon should not hesitate to convert to an open procedure or indicate that the best procedure is an open approach, considering that open adrenalectomy is a perfect solution in cases of adrenalectomies with different associated risk factors. In addition, the preoperative analysis can assess the risk of conversion, which will lead to better planning of laparoscopic surgery. Thus, with the help of an accurate prediction, patients can also be fully informed to take the measures they deem appropriate [8, 9].

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