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Review article

Current surgical technique and outcomes of laparoendoscopic single-site adrenalectomy☆

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ABSTRACT

In this paper, we describe the surgical technique, summarize the outcomes of comparative studies, and provide updates on other advanced surgeries in laparoendoscopic single-site (LESS) adrenalectomy. A systemic literature search in the PubMed databases was performed to identify all publications related to LESS adrenalectomy. LESS adrenalectomy performed using transumbilical, transperitoneal subcostal, or retroperitoneal approaches has been demonstrated to be a safe and feasible alternative to conventional laparoscopic adrenalectomy. Its advantages include shorter hospital stay and less pain, although the longer operative time is a concern. Additional well-designed randomized control trials are required. Furthermore, LESS partial adrenalectomy and robotic-assisted single-port adrenalectomy may be the development trends of the future.

1. Introduction

Since laparoscopic adrenalectomy was first described by Gagner et al[1] in 1992, this minimally invasive approach has gradually replaced open surgery as the gold standard of treatment for most adrenal lesions.[2,3] Previous studies also demonstrated several advantages of laparoscopic adrenalectomy, such as lower blood loss, less pain, less ileus, faster convalescence, and shorter hospital stay.[3]

Because of the expectation of less skin trauma, laparoendoscopic single-site (LESS) surgery has been applied to adrenalectomy to pursue the continuous improvement of adrenalectomy in the past years. Since single-incision, gasless, retroperitoneoscopic adrenalectomy was first reported by Hirano et al[4] in 2005, increasing studies have shown its feasibility and safety for adrenalectomy using transperitoneal or retroperitoneal approaches. A multinational, multicenter study revealed that the use of LESS adrenalectomy increased at an average rate of 6% per year from 2008 to 2013.[5] This surgery has disseminated faster than other minimally invasive techniques, such as robotic-assisted or mini-laparoscopic adrenalectomy, particularly in Asia and South America.

In this paper, we describe the surgical technique, summarize the outcomes of comparative studies, and provide updates on other advanced surgeries in LESS adrenalectomy.

2. Methods

A systemic literature search in the PubMed databases was performed to identify all publications related to LESS adrenalectomy. The following search terms were used: “single port,” “single site,” “single incision,” “single access,” “laparoendoscopic,” and “adrenalectomy.” All studies written in English were reviewed. The search was conducted on January 8, 2017.

3. Surgical technique

3.1. Indications

The indications for adrenalectomy include a functional adrenal mass, tumor size > 4 cm, or a malignant adrenal tumor.[6] For benign adrenal tumors or select cases of adrenocortical carcinoma without adjacent organ involvement, laparoscopic surgery is considered the first-line therapy.[3] In general, all patients eligible for laparoscopic adrenalectomy may be suitable for LESS adrenalectomy.

Considering the dissection difficulties during LESS surgery, “beginners ” should only perform this advanced technique on nonobese patients with small tumors (< 4 cm).[7] With increasing

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experience, indications can be extended to more challenging cases, such as obese patients, or those with large tumor, pheochromocytoma, or localized adrenocortical carcinoma.[8,9]

For pheochromocytoma, creation of pneumoperitoneum and tumor excessive manipulation in LESS adrenalectomy may cause elevation of plasma catecholamine.[10] The manipulations should be more concerned in pheochromocytoma. Yuan et al[9] successfully performed 21 LESS adrenalectomies for pheochromocytoma and raised some important manipulations to decrease the chance of irritating the tumor, including early ligation of the adrenal central vein, lower pneumoperitoneal pressure (<10 mmHg), and blunt finger dissection rather than balloon dilation during creating retroperitoneal space.

In the current literature, the maximum adrenal tumor size managed by LESS surgery is 8 cm,[11] but the potential of malignancy should be concerned for large adrenal tumor (> 4 cm). In previous study, laparoscopic adrenalectomy for adrenocortical carcinoma with large size had higher rate of positive surgical margin, which was related to mortality, than open surgery.[12] Therefore, LESS adrenalectomy for adrenocortical carcinoma should be taken more seriously.

3.2. Position, access, and instruments

LESS adrenalectomy can be performed using three approaches: transumbilical, transperitoneal subcostal, and retroperitoneal (Table 1). An incision of only 2–3 cm is required for different types of commercial single-port devices or homemade devices for entry.[13–16] The surgical strategy follows that of the conventional transperitoneal or retroperitoneal laparoscopic adrenalectomy.

Transumbilical LESS adrenalectomy, which was once the most common approach, has the benefits of an improved cosmetic effect and a wider working space.[14,17,18] However, due to the long distance between the umbilicus and the adrenal gland, poor angle of approach, difficult organ retraction, instrument clashing risk, and lack of true triangulation, the transumbilical approach is extremely challenging. The use of a flexible scope and articulating instrument might overcome these difficulties, but current articulating instruments are still challenging to use and are ergonomically suboptimal.[19] Furthermore, an additional miniport may be required for liver or spleen retraction during the transperitoneal approach.[13,14,20,21]

The advantages of the transperitoneal subcostal approach include a short distance to the adrenal gland, an improved angle of approach, and adequate working space, but the cosmetic effect is compromised. The operation can be performed using a 30° rigid laparoscope, but articulating instruments are still required.[16,22]

With more direct access to the adrenal gland, less need for organ retraction and a reduced the risk of intra-abdominal contamination, retroperitoneal LESS adrenalectomy has become more popular in recent years.[8,9,11,23] It can be performed effectively even when only using a 30° rigid laparoscope and conventional laparoscopic instruments.[9,23]

Table 1
Comparison of three approaches of laparoendocsopic single site adrenalectomy.

Approaches	Patient position	Access site	Instruments
Transumbilical (transperitoneal)	Modified flank	Umbilicus	Flexible scope, articulating instruments
Transperitoneal subcostal	Modified flank	Midclavicle line, below costal margin	30° rigid scope, articulating instruments
Retroperitoneal	Prone or flank	Below the tip of 12th rib	30° rigid scope, conventional instruments

Few studies with small sample sizes have compared these three approaches. Wang et al[24] retrospectively compared the outcomes of transumbilical, transperitoneal subcostal, and retroperitoneal LESS adrenalectomy by nine patients, 17 patients, and 16 patients in the respective groups, and showed a longer median operative time but lower postoperative pain in patients undergoing the transumbilical approaches. Byon et al[25] reported that compared with the transperitoneal subcostal approach, the retroperitoneal approach had a shorter operative time, shorter time of first oral intake, and shorter hospitalization for right-side adrenal tumors, but a longer mean operative time for left-side adrenal tumors.

4. Surgical outcomes

4.1. LESS adrenalectomy versus conventional laparoscopic adrenalectomy

To the best of our knowledge, no randomized control trial has compared LESS and conventional laparoscopic adrenalectomy, but > 20 retrospective comparative studies and three meta-analyses have been conducted.

In 2016, Wu et al[26] conducted the most recent meta-analysis of 10 retrospective studies, including 255 patients treated with LESS adrenalectomy and 449 patients treated with conventional laparoscopic adrenalectomy. That meta-analysis showed no significant difference in the dose of analgesic or pain medication required, operative time, estimated blood loss, time to oral intake, complications, conversion, and transfusion between the two groups. Patients undergoing LESS adrenalectomy had a significantly shorter hospital stay and improved postoperative visual pain scores. These findings were consistent with those of previous meta-analyses.[27,28]

Previous meta-analyses reported a longer operative time for LESS adrenalectomy.[27,28] However, the operative time is correlated to the experience of surgeons. The meta-analysis of Wu et al[26] included the latest reports from the same institution,[29] and the difference in the operative time between the LESS and conventional laparoscopic adrenalectomy groups may decrease after a period of learning. Therefore, the operative time was similar between the two groups in the meta-analysis of Wu et al.[26] Table 2 summarizes the advantages and disadvantages of LESS adrenalectomy obtained from published meta-analyses. These meta-analyses still had the limitation of considerable heterogeneity for some parameters. The previous experience of surgeons and the different surgical approaches among the studies may contribute to the heterogeneity.[27] Thus, additional well-designed randomized control trials are required.

Most previous studies have included patients with nonspecific adrenal tumors, and only three recent retrospective studies have compared LESS and conventional laparoscopic adrenalectomy for

Table 2
Comparison of outcomes of laparoendoscopic single site adrenalectomy and conventional laparoscopic adrenalectomy.

Better
Postoperative pain score
Length of hospital stay
Comparable
Estimated blood loss
Resumption of oral intake
Analgesia demand
Perioperative complications
Conversion
Transfusion
Probably worse
Operative time