



Review article

Hand-assisted laparoscopic surgery and its applications in gynecology

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ABSTRACT

Laparoscopic surgery has been used extensively since it was first applied in the 1980s. The advantages are generally accepted and include less pain, smaller incisions, faster recovery, and shorter hospital stays. However, several limitations associated with standard laparoscopic surgery (SLS) have become apparent and include the loss of tactile sensation, problems with the removal of bulky and intact specimens, and the restriction of visualization of the entire operating field. These problems with SLS helped to inspire the development of laparoscopically assisted surgery followed by hand-assisted laparoscopic surgery (HALS). In a hand-assisted laparoscopic procedure, an incision is made in the patient's abdomen. Then, a uniquely designed appliance is introduced into the abdominal cavity through the incision to maintain pneumoperitoneum. With the inserting hand, surgeons can provide manual exposure, traction, palpation, and dissection because of the feedback of tactile sensation. HALS has gained acceptance for a wide range of abdominal procedures in general surgery and urology and is now feasible for complicated surgeries such as splenectomy, nephroureterectomy, and colectomy. It has been demonstrated in numerous specialties that HALS is a safe and efficacious technique that combines the benefits of laparoscopy with the advantages of a conventional laparotomy. Standard laparoscopic surgery also has limitations in gynecological surgery. A patient may have high risks with conventional laparoscopic surgery when she has deep invasive endometriosis, multiple or massive myoma, or dense pelvic adhesions from prior surgery. HALS overcomes many of the aforementioned limitations, has less conversion to open surgery, and broadens the indications for minimally invasive surgery, not only for benign tumors but also for pelvic malignancies.

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Introduction

Laparoscopic surgery was first used to perform a cholecystectomy in 1985 and has had a rapid expansion since that time. Laparoscopic surgery offers a multitude of benefits to patients because it is associated with less pain, smaller incisions, faster recovery, and shorter hospital stays.^{1–3} However, several limitations have surfaced with the standard laparoscopic surgery (SLS); these include the loss of tactile sensation, problems with the removal of bulky and intact specimens, and restricted visualization of the entire operating field.^{4,5}

These problems with SLS helped to inspire the development of laparoscopically assisted surgery, such as hand-assisted laparoscopic surgery (HALS). HALS was first described in the early 1990s. In 1995, Kusminsky⁶ reported a successful splenectomy using the HALS technique.

In the hand-assisted laparoscopic procedure, an incision is made in the patient's abdomen, the size of the incision is based on the surgeon's hand and the tumor size, and then a uniquely designed appliance is introduced into the abdominal cavity through the incision. The type of sealing device has developed from the Pneumo Sleeve to the hand port. Currently, surgeons commonly use the sealing device called LAP DISC to complete the surgery. It is made of three layers of rings connected by a rubber membrane, which covers the peritoneum and abdominal wall. The upper ring can adjust to the surgeon's hand size for insertion.⁷ The device can maintain pneumoperitoneum throughout the operation. With the inserting hand, surgeons can provide manual exposure, traction, palpation, and dissection. Because of the feedback of tactile sensation, HALS seems to be safer and more accurate.

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Dundee Multitool system

Cuschieri designed a new multitool for hand-assisted advanced laparoscopic surgery—the Dundee Multitool (DMT). The instrument was designed to enable the assisting internal hand to undergo HALS operations. When not in use, the closed DMT is attached to and hangs from the little finger. The DMT incorporates three functions: pickup, needle driver, and suture scissors. When it is needed in an operation, it is capable of extruding only one instrument at a time. Both the laboratory and clinical evaluation have confirmed its functionality and ease of use.⁸

HALS in surgery

HALS has gained acceptance for a wide range of abdominal procedures in general surgery and urology. It is feasible for complicated surgeries, such as splenectomy, right hemicolectomy, nephroureterectomy, live donor nephrectomy, and colectomy.^{9–13} It has been demonstrated in numerous specialties that HALS is a safe and efficacious technique, which combines the benefits of laparoscopy with the advantages of a conventional laparotomy.

HALS in urology

The first published comparison of hand-assisted and standard transperitoneal laparoscopic nephrectomy was by Wolf and colleagues¹⁰ in 1998. Their study represented the first hand-assisted and standard transperitoneal laparoscopic nephrectomies performed at the University of Michigan and the University of Wisconsin. The hand-assisted approach was associated with an operating time 90 minutes shorter than standard laparoscopy. In 2000, a report from the University of Michigan concluded that, with increasing experience, there was still a time benefit from the hand-assisted procedure.¹⁴

Two non-randomized, retrospective studies compared 77 standard transperitoneal laparoscopic nephrectomies with 123 hand-assisted donor nephrectomies. The hand-assisted procedures tended to be faster, produced fewer complications, required conversion less frequently, and were associated with a shorter hospital stay.^{15,16}

HALS in colorectal surgery

A report by Yang and colleagues¹⁷ agreed that hand-assisted laparoscopic colorectal surgery retained the short-term benefits of conventional laparoscopic surgery, such as smaller incision, less pain, faster recovery, and shorter hospital stay. A randomized clinical trial published in 2002 compared standard transperitoneal and hand-assisted laparoscopic colectomy and found no differences in operating time or complications. However, conversion to open surgery was more frequent in the standard laparoscopic group.¹⁸

Heneghan et al¹⁹ compared HALS and SLS colorectal surgery performed on obese patients (body mass index > 30). He showed that length of stay, operating time, morbidity, and mortality rates were comparable between the two groups. However, conversion to open surgery was necessary less often with HALS. HALS may save a high-risk group conversion to formal laparotomy in obese patients.

Ozturk et al²⁰ evaluated outcomes after hand-assisted laparoscopic and standard laparoscopic techniques for the initial laparoscopic total abdominal colectomy procedures performed by surgeons starting their laparoscopic careers. These results were in accordance with several other reports that emphasized that the hand-assisted laparoscopic technique can provide the short-term benefits of laparoscopic colectomy even at the beginning of the learning curve.^{18,21,22}

While the surgery is performed, the assisting-hand site should be considered as an operating port and triangulated with the other laparoscopic operating port, so that the two ports form equal azimuth angles with the laparoscopic viewing port. If the assisting hand is too close to the target organ, it can obscure vision and make operative movements difficult; if it is too far from the organ, hand fatigue may become significant.²³

Cost is another important consideration. Most of the current hand-assistance devices are expensive and disposable; adding to the overall cost of a procedure. When comparing standard and hand-assisted laparoscopic procedures in radical nephrectomy, the median intraoperative cost of the latter was 1% less than the former.¹⁴

HALS in gynecology

Standard laparoscopic surgery also has limitations in gynecological surgery. The reasons for the limited extension are varied, including a restricted ability to manipulate the specimen, reduced tactile feedback, and a restricted visualization and evaluation of the entire operating field, such as the posterior aspect of the diaphragmatic leaves, spleen, pouch of Douglas, and retroperitoneum.^{23,24} A patient may have high risks with conventional laparoscopic surgery when she has deep invasive endometriosis (DIE), multiple or massive myoma, or dense pelvic adhesions from prior surgery. HALS overcomes many of the aforementioned limitations, has less conversion to open surgery, and broadens the indications for minimally invasive surgery. In DIE procedures, blunt dissection can be performed through the hand port. The assumed injuries to the bladder, ureter, and intestines are associated with sharp instruments and electrical implements and can be minimized.

HALS in myomectomy and hysterectomy

Although HALS has been utilized in abdominal surgery, limited data exist on its feasibility and safety in gynecologic oncology. Pelosi and Pelosi²⁵ published their first case report on the use of HALS for complex hysterectomy in 1999, where the procedure was safely performed by hand-assisted laparoscopy using the Pneumo Sleeve system through a 7.5-cm transverse suprapubic incision and the specimen weighed 3050 g. In 2000, the same researchers reported a myomectomy of massive size. The uterus reached the level of the liver and the total weight of the myomas was 3120 g.²⁶ These studies showed that hand-assisted procedures appeared to be an alternative to laparotomy for patients with massive pelvic tumors. In 2012, Tusheva et al²⁷ presented the largest series to date of 15 patients undergoing HALS: 10 hand-assisted hysterectomies and five hand-assisted myomectomies. This technique appeared to be beneficial in challenging laparoscopic cases with careful patient selection.²⁷

The hand-assisted incisions are typically made above the pubis within the hand's reach in the area of dissection. The surgeons should consider the need to convert to laparotomy so that it can be extended. The placement of laparoscopic ports should create a triangle on the palm side of the incision, with the base pointing toward the area of dissection. It is important to keep the other laparoscopic ports on the palm side of the hand to prevent blocking use of the ports.²⁸

HALS in adnexal tumors

With laparoscopy, there may be a great risk of capsule rupture during the removal of large or densely adherent adnexal tumors. Intraperitoneal spillage of the contents may cause clinical problems

even in benign cysts. For example, intraperitoneal spillage of the contents of benign cystic teratomas or endometriomas can cause chemical peritonitis, and spillage of the contents of mucinous cystadenomas may cause pseudomyxoma peritonei.^{29–31}

The data are conflicting on prognosis after capsule rupture in malignant tumors. A retrospective study found that the 10-year survival rates for patients with Stage 1 and 2 ovarian cancers and intact capsule, punctured cyst, and ruptured cysts, respectively, were 78%, 87%, and 84%, thus indicating that intraoperative puncture and rupture of an adnexal tumor were not associated with survival.³² In contrast, Sainz de la Cuesta et al³³ demonstrated a worse prognosis with intraoperative iatrogenic rupture. HALS is obviously advantageous when intact specimen removal is required.

Trocar metastasis is another concern that has been reported in the literature. Kadar³⁴ reported on eight ovarian cancer patients who developed port site metastasis following laparoscopic surgery. In another study, port site metastasis occurred in 10–15% of patients.³⁵ In a series study on 1228 patients undergoing 1335 transperitoneal laparoscopic surgeries, laparoscopic-related subcutaneous tumor implantation rarely occurred (0.97%).³⁶ Depending on the specific and unique instruments and techniques, hand-assisted laparoscopic surgery can obviously overcome many of the aforementioned limitations. The sealing devices through the incision are considered as providing a potential barrier to malignant and bacterial contaminants.^{25,37,38}

HALS in pelvic malignancy

During the procedure, the intra-abdominal hand allows for the palpation of abdominal and pelvic viscera and peritoneal surfaces for metastatic disease. Varnoux et al²⁴ evaluated the resectability of peritoneal carcinomatosis using hand-assisted laparoscopy in 29 patients. HALS was superior over standard laparoscopy for assessing the gastrosplenic ligament, spleen, lesser omental sac, and pelvic and lumboaortic nodes.

Pelosi et al²⁸ found hand-assisted lymph nodes sampling to be an expeditious procedure. Enlarged nodes were identified by palpation through the peritoneum, held firmly between the thumb and index finger, then dissected free with laparoscopic scissors. Krivak et al³⁹ preferred to place the HALS port periumbilically to allow for the use of the intra-abdominal hand in the pelvis and upper abdomen for the lymph node chains palpation. To date, this study included the largest series of patients (25) with ovarian cancer to be treated with HALS. These data strongly suggest that hand-assisted laparoscopy may be employed in the initial management of early and advanced stage ovarian carcinoma.³⁹

One limitation of hand-assisted laparoscopy is that, with extensive adhesion, the procedure becomes too difficult and requires conversion to laparotomy.^{24,39}

Conclusion

In conclusion, minimally invasive surgery does not inherently mandate a completely standard laparoscopic approach. All reasonable options that promote patient care and well-being should be investigated.²³ Hand-assisted laparoscopy is a relatively new approach that combines traditional laparoscopy with the ability to place a hand intraperitoneally, thus allowing for improved exposure, manual exploration, blunt dissection, and immediate control of hemostasis.⁴⁰ To summarize this section, we list the typical advantages and disadvantages of HALS compared with standard laparoscopic surgery in Table 1. Published data have demonstrated that HALS is feasible and safe for general surgery and urology. HALS does not seem to be a bridge towards standard laparoscopic surgery but may be a unique type of surgery that has

Table 1

Typical advantages and disadvantages of HALS compared with standard laparoscopy.

Advantages
More and better control between tissue and operator's hand
Reduced operative time
Less need for conversion to open surgery
Shortened "learning curve" of laparoscopic surgical procedures
Disadvantages
Larger incision
The assisted hand may get in the way
More devices and instruments
Occasional increase in postoperative pain

HALS = hand-assisted laparoscopic surgery.

its own indications, including bulky cancer, adhesion, and the need for time-consuming surgery.⁴¹ It is also efficient for treating pelvic masses, even for gynecological malignancies, and may aid in diagnosis, staging, and cytoreduction. With further technical improvement and the development of instruments, the indications for HALS will be expanded. The exact role and best use of hand-assisted laparoscopy will require further study with longer follow up.

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