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Review Article

Laparoendoscopic Single-Site Surgery in Gynecology: Review of Literature and Available Technology

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ABSTRACT The objective of this article was to review the published literature on laparoendoscopic single-site surgery (LESS) in gynecology and to present current advances in instruments used in LESS surgery. Inasmuch as LESS surgery is relatively new, the current literature on use of this technique in gynecology is somewhat limited. Sixteen articles were available for the literature review: 10 case series, 2 comparative studies, 3 case reports, and 1 surgical technique demonstration. In recent years, however, improvements in traditional laparoscopic techniques and availability of more advanced instruments has made single-incision laparoscopy more feasible and safer for the patient. There is increasing interest in LESS surgery both as an alternative to traditional laparoscopy and as an adjunct to robotic surgery when performing complicated procedures through a single incision. Although LESS surgery provides another option in the arena of minimally invasive gynecologic surgery, the ultimate role of this approach remains to be determined. Journal of Minimally Invasive Gynecology (2011) 18, 12–23 © 2010 AAGL. All rights reserved.

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With the success of laparoscopic surgery in gynecology during the last decade, most gynecologic surgeons would agree that minimally invasive surgery in appropriately selected patients provides a clear advantage in terms of both patient outcome and cost [1,2]. One of the more recent advances in the field of minimally invasive gynecology is the increasing use of single-port laparoscopic surgery. This minimally invasive approach to surgery requires only 1 entry point, typically in the umbilical region.

Single-port laparoscopic surgery has been described in the literature using a number of terms including "single-port access surgery" (SPA), "single-incision laparoscopic surgery" (SILS), "embryonic natural-orifice transumbilical endoscopic surgery," and "transumbilical endoscopic surgery." A recently convened consortium at The Cleveland Clinic agreed to use the term "laparoendoscopic single-site surgery" (LESS surgery) to describe techniques in which a single incision is used to accomplish laparoscopic surgery [3].

LESS surgery is another attempt at improving cosmetic results, decreasing hospital stay, and facilitating faster recovery. Reduction in the number of ports also means reduction in port-associated complications such as hernias, vascular and soft-tissue traumatic injuries during trocar insertion, and nerve injuries. Thus far, the comparative perioperative outcomes and short-term measures have established the safety of LESS surgery in both gynecologic surgery [4] and other surgical specialties [5–8]. The objectives of this article was to review the published literature on LESS surgery in gynecology, discuss current advances in instrumentation for LESS surgery, and discuss potential future roles for LESS surgery.

Development of LESS Surgery in Gynecology

The concept of single-port minimally invasive surgery in gynecology dates to 1969, when Wheeless [9] reported single-incision laparoscopy for female sterilization. In the

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1970s, several gynecologists performed laparoscopic tubal sterilization through a single umbilical incision [10].

The ability to perform complex procedures through a single incision has only recently been realized. Former limitations included limited instrumentation, lighting, and access ports. In recent years, however, improvement in traditional laparoscopic techniques and availability of more advanced instruments has made single-incision laparoscopy more feasible and safer for the patient. To date, LESS surgery has been described for cholecystectomy [11–15], appendectomy [16–24], nephrectomy [5,6,25–27], colectomy [28–30], adrenalectomy [31–33], and bariatric surgery [34]. LESS surgery has also been described in gynecology; although experience with this approach is limited and the accompanying literature is sparse (Table 1).

Instruments Used in LESS Surgery

Abdominal Access

There are 3 approaches to completing laparoscopic surgery via a single incision. The first is to use an operative laparoscope; this approach has been widely used by gynecologists to perform tubal sterilizations. An operative scope with a channel along the scope shaft enables entry to perform coagulation or banding of the fallopian tubes. The second is to make a single incision in the skin and multiple incisions in the fascia, with small bridges cut between the fascial incisions to enable organ retrieval [8,49]. With this approach, multiple 5- to 10-mm trocars are inserted next to each other to access the abdominal cavity. The third, more recent option is to use specialized access ports with multiple channels to access the abdominal cavity. These commercially available specialized access ports are discussed in the following paragraphs and are summarized in Table 2.

AirSeal Dynamic Pressure System

AirSeal ports (SurgiQuest, Inc., Orange, Connecticut) (Fig. 1A) use air pressure to create pneumoperitoneum. The flow of air around the port at a pressure much higher than pneumoperitoneum creates the "air seal." The best advantage of this system is that it eliminates smoke accumulation because of the constant circulation of air. The new AirSeal port oval design is advantageous for single-port laparoscopy because it enables better access for multiple instruments. The major disadvantages of the AirSeal system are the noise associated with the device and the absence of a fulcrum point because the device is open at the instrument entry site.

Ethicon Endo-Surgery SSL Access System

A new single-port access system was recently introduced (SSL Access System; Ethicon Endo-Surgery, Inc., Cincinnati, Ohio). The system consists of two 5-mm seals and a larger 15-mm seal in a low-profile design that enables surgeons to use a wide variety of instruments across several different procedures. The device consists of a retractor and a seal cap. The 2 sizes of the retractors enable proper placement, depending on the depth of abdominal wall: the smaller 2-cm retractor for walls up to 4 cm deep, and the larger 4-cm retractor for abdominal walls up to 7 cm deep. A single 1.5- to 3.5-cm incision is required for insertion of this port. Unique to the device is the 360-degree rotation of the seal cap, which enables quick reorientation of instruments during procedures and reduces the need for instrument exchanges.

GelPort and GelPOINT Systems

The GelPort laparoscopic system (Applied Medical Resources Corp., Rancho Santa Margarita, California) (Fig. 1B) consists of a wound retractor with a flexible inner ring connected to an outer ring with a clear sheath. The inner ring is inserted using an open technique; the retractor can be used in incisions from 1.5 to 7 cm. The outer ring has a diameter of approximately 10 cm. A GelSeal cap fits over the outer ring. The GelPort system has previously been used for hand-assisted laparoscopy. Passing multiple trocars of varying lengths through the gel interface easily modifies the GelPort for single-port laparoscopy. The advantages of the GelPort system for LESS surgery include the versatility of the GelSeal cap, which enables placement of instruments of different shapes and sizes, and the 10-cm diameter of the outer ring, which reduces instrument crowding. Fader and Escobar et al [40] used the GelPort system for robotic-assisted LESS surgery in gynecology, and reported that the larger outside dimension of the GelSeal cap reduces crowding of the robotic arms (Fig. 2). A recent retrospective review of the GelPort system in pelvic surgery concluded that this system is favorable for single-port surgery because the device provides circumferential access and retraction [50].

The GelPOINT (Applied Medical Resources Corp.) platform is a dedicated modification of the GelPort system available for single-port laparoscopy in which, along with the GelSeal cap, 4 small cannulas are provided by the manufacturer for easier insertion of laparoscopic instruments through the gel interface. One disadvantage of the GelPort system is the large slit in the GelSeal, which can sometimes leak gas. The addition of the GelSeal cap in the GelPOINT platform has alleviated this problem (Fig. 1B).

SILS Port

Covidien (Mansfield, Massachusetts) offers 2 products for LESS surgery: the SILS port (Fig. 1C) and the SILS kit. The SILS port is a flexible laparoscopic port that necessitates a fascial incision of 1.8 to 3 cm and can accommodate 1 to 3 instruments through a single incision. The SILS kit includes the SILS port and roticulator instruments. The port is made of elastic polymer, and fits fascial incisions of approximately 2 cm. The advantages of the SILS port include the availability of the dedicated SILS kit with multiple compatible instruments and open entry into the peritoneal cavity. Another advantage of the SILS port is that individual ports