Chapter

Single Port Laparoscopic Assisted Hysterectomy

Michael L. Nimaroff and Eric Crihfield

Abstract

This chapter describes the necessary steps to perform single port laparoscopic hysterectomy. This surgical approach is an innovative method to offer all of the benefits of multi-port laparoscopy through one single incision usually in and around the umbilicus. Using core surgical principles and instruments available for single port surgery external triangulation and full range of motion can be maintained to achieve the required internal manipulation of instruments and tissue dissection. All single port surgeries require a specialized port used along with an angled or flexible laparoscope for visualization. Traditional laparoscopic instruments may be used for the surgical dissection and completion of the procedure.

Keywords: single port, laparoscopic surgery, LESS, single site surgery

1. Introduction

Laparoscopic hysterectomy was first described in 1989 and, with its superior surgical results and outcome metrics compared to the abdominal route, the number of laparoscopic hysterectomies has increased significantly over the past three decades [1–3]. Additionally, investments in product development over the last thirty years has further supported adoption of the procedure and the birth of the field of minimally invasive surgery in general. In gynecology, acceptance of the technique in all surgical subspecialties has further helped drive the increased procedure volume even when dealing with complex pathology. The improvements in surgical outcomes over the abdominal route demonstrated with all forms of laparoscopic surgery or, any minimally invasive approach, has led to further innovation in the minimally invasive field and the birth of single port access surgery (SPA). Single port surgery was developed in an effort to further decrease the invasiveness of the procedure and maximize the benefits of laparoscopy [4, 5].

Single port access surgery, as its name implies, is a route of laparoscopic surgery that involves performing the entire procedure through one incision and one port (as opposed to the usual 3–5), usually at the umbilicus, that is generally 2–3 cm in length [6]. This route of surgery goes by many names including SPA, laparoendoscopic single-site surgery (LESS), single-site laparoscopic (SSL), single-port laparoscopy (SPLS), and single incision laparoscopic surgery (SILS) amongst others, with SILS and LESS the two most common nomenclatures used [7]. However, all of the above names are acceptable and indicate the identical surgical procedure. The first single port laparoscopic hysterectomy was described in 1991, but did not gain initial acceptance likely due to both the steep learning curve required and the lack of appropriate instrumentation available at the time. The route did not begin to gain

popularity until general surgery began publishing about SILS cholecystectomies and appendectomies in the mid-2000s [4, 5]. The main advantage to single port hysterectomy over the traditional laparoscopic approach is cosmetic, as the incision needed can often be well hidden in the umbilicus [6, 8]. There is also evidence that this route may reduce pain and result in a faster recovery for the patient [6, 8]. These improved outcomes must be balanced with the potential disadvantages of single port compared to multi-port laparoscopy, resulting from the technical challenges of the procedure. Having all the instruments passing through the same port site can certainly make the procedure more challenging due to instrument crowding, limits on visualization, and loss of triangulation [6, 8]. There is also some concern that the larger incision required may be more at risk for wound complications and hernias [6, 8]. However, with appropriate instrumentation and surgical technique these limitations can managed and overcome. Here we will review the key principles, strategies, and available instrumentation that can help mitigate the challenges of single port hysterectomy, as well as, discuss the clinical outcomes data comparing single port hysterectomy to multi-port hysterectomy.

2. Patient selection

Performing any new surgical technique requires education, observation, and/or simulation/proctoring before attempting the surgical approach independently. In addition, appropriate patient selection is key to achieving early success. Single port hysterectomy certainly falls into this category and once completing your education and training process, the surgeon should initially perform SPA adnexal surgery successfully before attempting hysterectomy. Also, patient selection is critical in achieving early success with this approach. During the surgeons first 5–10 cases limiting procedures to patients without a history of pelvic (especially cesarean sections) or gastrointestinal tract surgery and with less complex pelvic pathology (ie. fibroids < 14 weeks size, no history of endometriosis). However, after gaining experience with the technique, the proficient surgeon can use this approach with virtually the same patients and pathology as can be addressed with multi-port laparoscopy. Even with experience the single port dissection of an adherent bladder and approaching a very large and distorted fibroid uterus can be challenging and one should never hesitate to add an additional 5 mm port if necessary.

3. Procedure

The surgical approach to single port hysterectomy is based on two fundamental principles: 1. The need for external triangulation of the surgical instruments to avoid internal clashing and 2. Viewing the internal procedure (video monitor) should appear identical to the view seen with any other multi-port laparoscopic procedure. These two principles are the key foundation to performing safe and successful SPA hysterectomies. Accomplishing the above principles begins with port selection. Over the past decade we have seen a number of ports developed for this procedure, however, we currently prefer the GelPOINT Mini (Applied Medical Corporation) and use this port with virtually all types of single port surgeries (**Figure 1**).

This port provides tremendous flexibility for instrument insertion, ability to triangulate, and ease of specimen removal when performing laparoscopic supracervical hysterectomy (**Figure 2**).

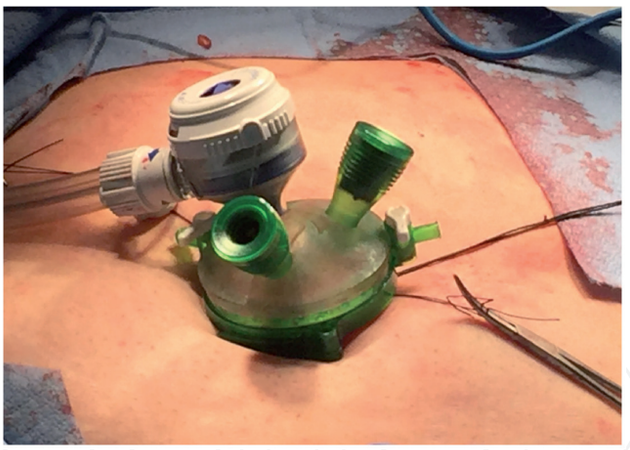

Figure 1.
GelPOINT mini in the umbilicus.

Figure 2.
External triangulation creates the necessary spacing to prevent clashing of instruments both inside and outside of the body.

Performing single port hysterectomy requires the patient to be placed in dorsal lithotomy with placement of a uterine manipulator if possible. When approaching a large myomatous uterus the manipulation and traction may be accomplished from above using either a myoma screw or laparoscopic tenaculum, however, when possible manipulating from below is preferable. The patient should have both arms tucked at the side and secured per routine for placement in trendelenburg positioning. The SPA port can be placed anywhere in the upper abdomen but typically is placed in the umbilicus for superior cosmetic results. The skin incision may be periumbilical, directly in the midline of the umbilicus, or inserted through an omega incision just inside the lower ridge of the umbilicus (**Figure 3**). With an omega incision a 2 cm fascial incision is made transversely below the skin incision and the fascia is tagged with two interrupted sutures at both angles to aid both in port insertion and closure when the procedure is completed (**Figures 4** and **5**). An omega incision is preferable for superior cosmetic result and the ability to close a

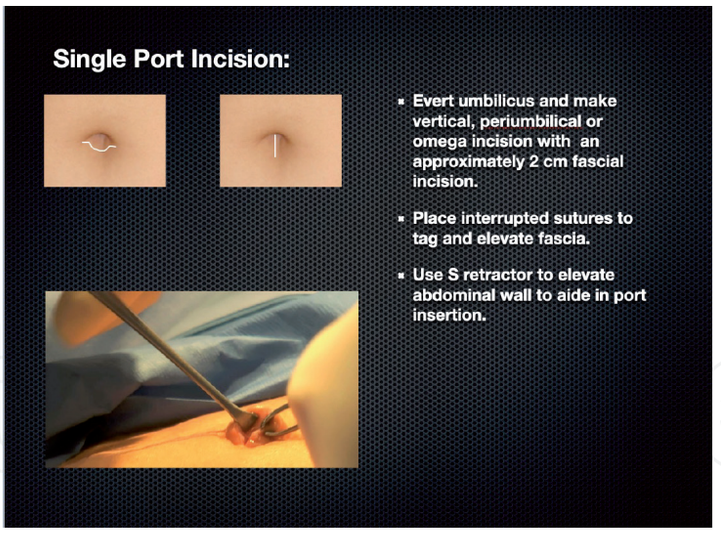

Figure 3.
Single port incision options.

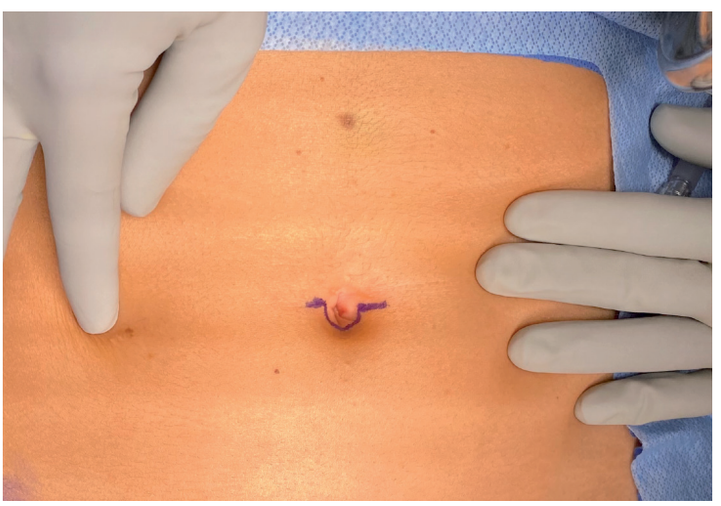

Figure 4.
Outline of omega incision.

well-developed transverse fascial layer that is found subumbilical and below the skin incision, in contrast to the less prominent fascial layer found when going directly through the midline of the umbilicus.

The port is inserted after the peritoneal cavity is entered and digital and visual inspection is satisfied for the absence of abdominal wall adhesions. See **Table 1** for the list of recommended instrumentation needed for the successful completion of a single port hysterectomy. A zero degree laparoscope should not be considered and the surgeon must use a 30 degree, 45 degree, or flexible scope to obtain the necessary external triangulation and internal visualization to complete the procedure easily (**Figure 6**).

The accessory instruments may be rigid or one may use flexible graspers, scissors, and vessel sealers if available at your institution, however, the procedure can be accomplished without additional flexible or angled instruments except for angled or flexible laparoscope. The hysterectomy is performed using the same surgical technique as is used with any multi-port approach including a retroperitoneal dissection and ureteral identification as indicated. To review, the basic setup and instruments needed for single port hysterectomy begins with the patient in dorsal lithotomy with both arms tucked at the side. Next an angled or flexible low

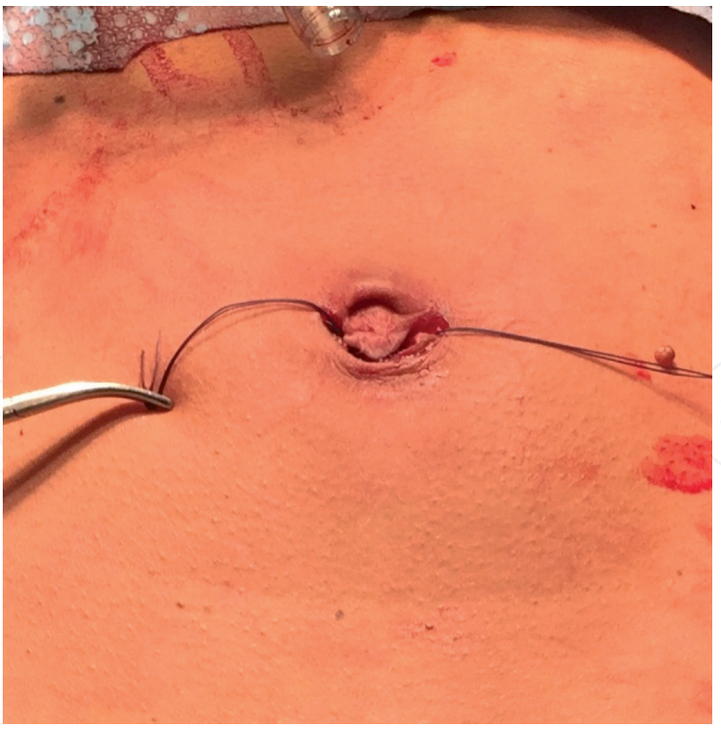

Figure 5.
Omega incision with two sutures tagging the fascia.

>SPA port
>30,45 degree or flexible laparoscope
>uterine manipulator
>vessel sealer
>articulating grasper (if available)
>bipolar forceps

Table 1.
Single port hysterectomy instrumentation.

profile scope (the light cord cannot attach at 90 degrees) must be used in addition to the selected single port. The remaining accessory instruments may be traditional devices preferred by the individual surgeon. In order to achieve adequate spacing for external triangulation and creating the necessary room for both external and internal range of motion, the camera should always be positioned in the midline port and instruments used for dissection and coagulation should be placed and approached from the contralateral side (**Figure 2**). In keeping with these key principles when performing single port procedures and, especially, hysterectomy when deviating the specimen laterally to the right the vessel sealer is inserted on the contralateral side (right to secure the left sided pelvic vessels) and the grasper (or tenaculum) is placed on the ipsilateral side. This approach ensures sufficient external triangulation (**Figure 7**).

The remainder of the dissection is approached using these same principles. Following dissection of the bladder peritoneum and securing the uterine vessels the colpotomy is made using a hook cautery, bipolar spatula, or harmonics (**Figures 8** and **9**).

Following removal of the specimen the colpotomy can be closed either transvaginally or from above, an extremely difficult challenge for even the most experienced surgeon. Alternatively, the surgeon can use a 2 mm needle grasper placed anywhere desired in the lower abdomen to aid in colpotomy closure from above (**Figure 10**).

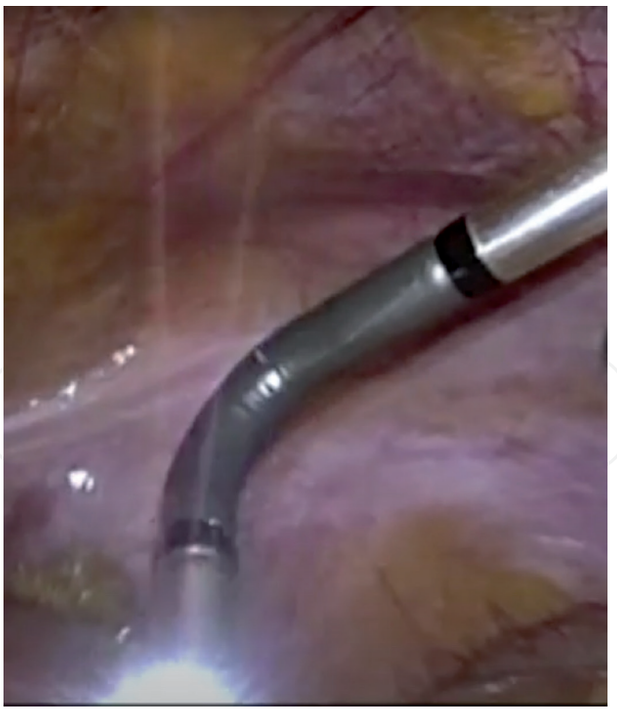

Figure 6.
Flexible laparoscope provides 360 degrees of visualization.

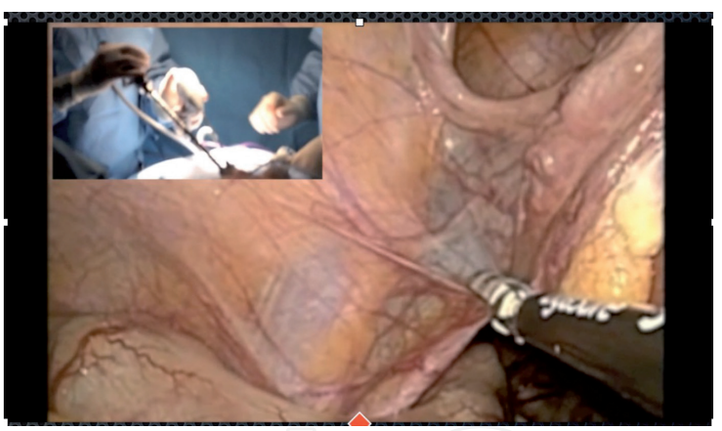

Figure 7.
The left infundibulopelvic ligament is secured by placing the vessel sealer through the contralateral port (right).

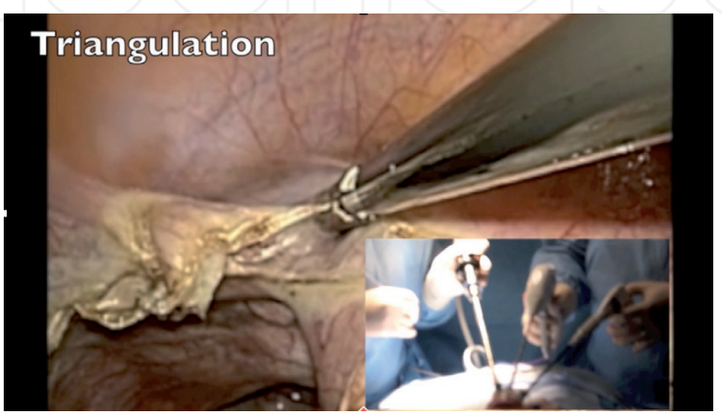

Figure 8.
Triangulation is achieved by placing the grasper on the left to deviate the uterus to the right. The left anterior bladder peritoneum is approached from the right port.

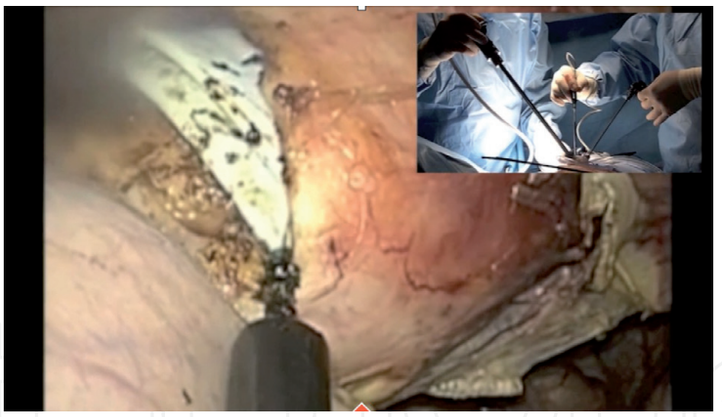

Figure 9.
Colpotomy incision.

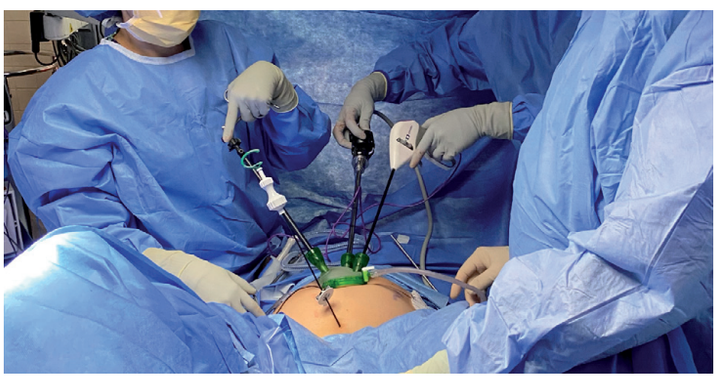

Figure 10.
Needle grasper placed suprapubically to assist with SPA hysterectomy.

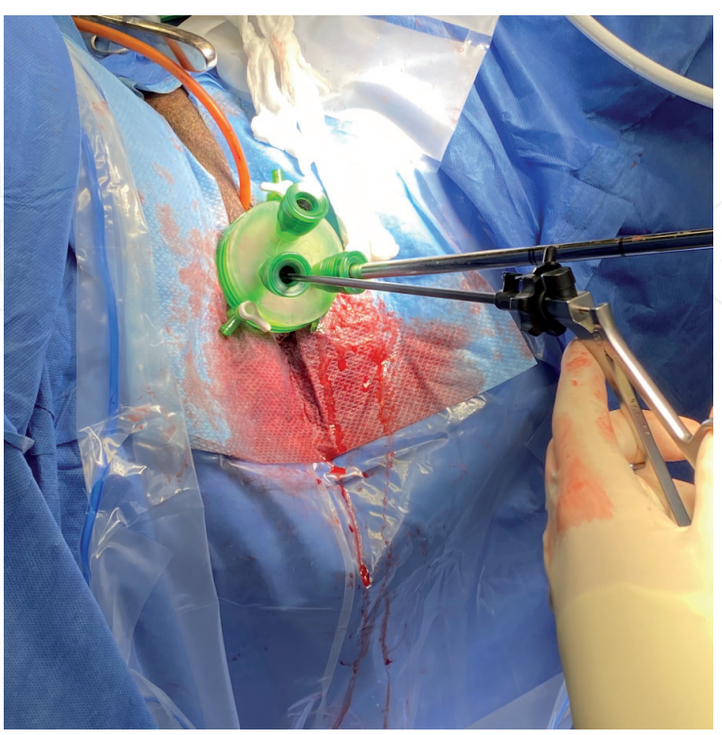

Figure 11.
VNOTES (vaginal natural orifice trans-luminal endoscopic surgery) hysterectomy.

Approaching the colpotomy closure form above standard laparoscopic instruments can be used, however, using both a self righting needle driver and an articulating grasper aids in colpotomy closure but these tools are not mandatory.

Prior to completing the procedure lower the abdominal pressure to inspect for bleeding before removing the port and closing the fascia. Once mastering single port hysterectomy from above a similar approach can be used to perform the procedure transvaginally using similar instrumentation (**Figure 11**). This procedure is called total hysterectomy by transvaginal natural orifice trans-luminal endoscopic surgical approach (VNOTES). The procedure begins as a traditional vaginal hysterectomy but following the creation of the anterior and posterior colpotomies and securing the uterosacral ligaments the single port is inserted and the remainder of the procedure performed via the laparoscope from below [9, 10]. With advancing experience and comfort virtually all forms of hysterectomy can be approached using the single port approach including radical hysterectomy [11, 12].

4. Discussion

When discussing SPA hysterectomies it is important to note that across surgical fields the safety of single port access surgery is well documented with most studies demonstrating equivalent rates of complications when compared to standard laparoscopy [8]. Aside from improved cosmesis, the benefits over multi-port laparoscopy are less well documented, and there is concern that the benefits may not be worth the increase in technical difficulty. In most cases these challenges can be overcome using the appropriate technique, instrumentation, and experience the outcomes of single port hysterectomy can match those achieved with multi-port hysterectomy. Additionally, it is critical to adhere to the core principles outlined above. In a study that evaluated the learning curve for SPA in TLH-BSO found that a significant improvement in operative time was attained after 10 cases (from 79.4 minutes to 56.8 minutes), with modest improvements after 20 cases [13]. A retrospective study of 190 laparoscopic supracervical hysterectomies with manual morcellation found that for uteri with a median weight of 245 g (range 100-1960 g), the median total operative time was 69 minutes (range 36–183 minutes) [14]. One RCT and a few observational studies that have looked at operative time for single port hysterectomy have found no significant difference in operative time when compared to multi-port hysterectomy [4, 5, 15]. A recent retrospective study looking at robotic single port surgery compared to conventional single port found an average decrease in operative time of 18 minutes that was statistically significant [16]. Expert single port surgeons have also demonstrated the feasibility of removing uteri as big as 20 weeks size when using articulating instruments [17]. One systematic review did however show an increased rate of "procedure failure" with single port hysterectomy, with an odds ratio of conversion to different route of 3.95 for single port hysterectomy [3]. However, of the 58 conversions amongst 1617 single port hysterectomies evaluated, 40 of them were conversion to multi-port laparoscopy with only 18 being conversion to open, compared to 7 of 1923 multi-port laparoscopic hysterectomies being converted to open. Conversion rate to open procedure was not statistically evaluated in their analysis. Overall, the literature generally demonstrates that single port hysterectomy can be accomplished efficiently with an appropriately experienced surgeon.

Several case reports and pilot studies have additionally demonstrated the feasibility in using single port for hysterectomy and lymph node dissection in low risk/early stage endometrial cancer both with the DaVinci robotic single port platform and with conventional single port [18–22]. The largest study available on single port

in gynecologic oncology cases out of the Cleveland Clinic was a retrospective study that, amongst cases for other pathology, included 339 cases for endometrial hyperplasia or malignancy [23]. Of patients included, 126 underwent a pelvic lymphadenectomy and 67 patients had a para-aortic lymphadenectomy. Their outcomes had a low rate of conversion at 3.2% with the addition of a hand-assist port in 5.0% of patients (22% of those were planned from the start of the case), though the study did not specify how many of those conversions were in the 339 endometrial pathology cases as the total n of the study was 908. The authors concluded that single port access surgery was safe and feasible in gynecologic malignant and premalignant conditions with a low rate of adverse outcomes. The most prevalent complication was incisional hernias at a rate of 5.5%, with higher rates being seen in patients with comorbidities such as obesity and diabetes. These studies show promising results in regards to surgical techniques and complication rates, but at this time there is limited evidence that evaluates the long term outcomes of disease free survival in endometrial cancer patients undergoing single port surgery when compared to multi-port laparoscopy.

Looking further into improved patient outcomes with single port access surgery, studies have shown some improvement in pain and satisfaction, but others report mixed results. In one RCT (n = 100) and another prospective cohort study (n = 70) both showed a significant decrease in pain levels for single port hysterectomy [4, 5]. However, a meta-analysis of RCTs for any laparoscopic gynecologic procedure and a meta-analysis of adnexal surgery found no difference in pain between single port access surgery and multi-port laparoscopy [24, 25]. Regarding patient satisfaction, a small RCT (n = 108) that looked at multiple outcomes for single port hysterectomy compared to four-port hysterectomy found increased patient satisfaction (93.8% vs. 89.5%), as well as decreased infection rate (1/52 vs. 5/56) and shorter duration of immobilization (14.6 hours vs. 15.7 hours) for single port hysterectomy compared to four-port [26]. One of the most consistent positive results for single port surgery is improved cosmetic results. Multiple studies have found improved cosmetics scores after single-incision hysterectomy when compared to multi-port both in the short and long term [27–29]. One of the biggest concerns with single port is incisional hernias, and while some smaller studies have not been able to find a difference, the most recent large meta-analysis that included both gynecologic and general surgery procedures did find an increased rate of incisional hernias with single port surgery (odds ratio 2.83), however the overall rate of the complication was low (1.69% for SILS vs. 0.39% for multi-port) and there was no statistically significant difference in the rate of hernias that requires surgical repair [30]. Also, key to avoiding postoperative incisional hernia is performing the initial incision and port insertion in an area with adequate fascia for closure. This is one potential limitation for direct midline umbilical insertions.

Given the comparable safety and outcomes, when considering performing a hysterectomy via single incision, the decision to use this approach will ultimately depend on both surgeon experience and patient medical history and pathology. With enough experience, single port hysterectomy is feasible and efficient making it comparable to multi-port for the right candidate. In terms of outcomes, cosmetic results are most consistently improved, while other outcomes are comparable to multi-port laparoscopic hysterectomy. These outcomes should be taken in consideration and discussed with the patient, and a shared-decision making process can help individualize the best route of surgery for each case.

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