Cost-conscious minimally invasive hysterectomy: A case illustration

This case demonstrates the importance of knowing which surgical tools are available to you and then providing value by considering cost without compromising safety or the best chance of a good outcome

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IN THIS ARTICLE

CASE Cost-conscious benign laparoscopic hysterectomy

A 43-year-old woman undergoes laparoscopic hysterectomy for treatment of presumed benign uterine fibroids and menorrhagia. Once she is prepped with ChloraPrep with tint, a RUMI II uterine manipulator is placed. Laparoscopic ports include a Kii Balloon Blunt Tip system, a Versaport Plus Pyramidal Bladed Trocar, and 2 Kii Fios First Entry trocars.

The surgeon uses the Harmonic ACE +7 device (a purely ultrasonic device) to perform most of the procedure. The uterus is morcellated and removed using the US Food and Drug Administration (FDA)-approved Olympus Contained Tissue Extraction System, and the vaginal cuff is closed using a series of 2-0 PDS II sutures. Skin incisions are closed using Dermabond skin adhesive.

Total cost of the products used in this case: $1,592.40. Could different product choices have reduced this figure?

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Health-care costs continue to rise faster than inflation: Total health-care expenditures account for approximately 18% of gross domestic product in the United States. Physicians therefore face increasing pressure to take cost into account in their care of patients.[1] Cost-effectiveness and outcome quality continue to increase in importance as measures in many clinical trials that compare standard and alternative therapies. And women's health—specifically, minimally invasive gynecologic surgery—invites such comparisons.

Overall, conventional laparoscopic gynecologic procedures tend to cost less than laparotomy, a consequence of shorter hospital stays, faster recovery, and fewer complications.[2-5] What is not fully appreciated, however, is how choice of laparoscopic instrumentation and associated products affects surgical costs. In this article, which revisits and updates a 2013 OBG MANAGEMENT examination of cost-consciousness in the selection of equipment and supplies for

minimally invasive gynecologic surgery,[6] we review these costs in 2018. Our goal is to raise awareness of the role of cost in care among minimally invasive gynecologic surgeons.

In the sections that follow, we highlight several aspects of laparoscopic gynecologic surgery that can affect your selection of instruments and products, describing differences in cost as well as some distinctive characteristics of products. Note that our comparisons focus *solely* on cost—not on ease of utility, effectiveness, surgical technique, risk of complications, or any other assessment. Note also that numerous other instruments and devices are commercially available besides those we list.

Importantly, 2013 and 2018 costs are included in **TABLE 1**. Unless otherwise noted, costs are per unit. Changes in manufacturers and material costs and technologic advances have contributed to some, but not all, of the changes in cost between 2013 and 2018.

Variables to keep in mind

Even when taking cost into consideration, tailor your selection of instruments and supplies to your capabilities and comfort, as well as to the particular characteristics of the patient and the planned procedure. Also, remember that your institution might have arrangements with companies that supply minimally invasive instruments, and that such arrangements might limit your options, to some degree. Last, be aware that reprocessed ports and instruments are now available at a reduced cost. In short, we believe that it is crucial for surgeons to be cognizant of all products available to them prior to attending a surgical case.

Skin preparation and other preop considerations

Multiple preoperative skin preparations are available (**TABLE 1**). Traditionally, a povidone–iodine topical antiseptic, such as Betadine, has been used for skin and vaginal preparation prior to gynecologic surgery. Hibiclens and ChloraPrep are different combinations of chlorhexidine gluconate and isopropyl alcohol that act as broad-spectrum antiseptics.

ChloraPrep is applied with a wand-like applicator and contains a much higher concentration of isopropyl alcohol than Hibiclens (70% and 4%, respectively), rendering it more flammable. It also requires longer drying time before surgery can be started. Clear and tinted ChloraPrep formulations are available.

Uterine manipulators

Cannulation of the cervical canal allows for uterine manipulation, increasing intraoperative traction and exposure as well as visualization of the adnexae and peritoneal surfaces.

The Hulka-Kenwick is a reusable uterine manipulator that is fairly standard and easy to apply. Specialized, single-use manipulators also are available, including the Advincula Delineator and VCare Plus uterine manipulator/elevator. The VCare Plus manipulator consists of 2 opposing cups: one cup (available in 4 sizes, small to extra-large) fits around the cervix and defines the site for colpotomy; the other helps maintain pneumoperitoneum once a colpotomy is created.

The ZUMI (Zinnanti Uterine Manipulator Injector) is a rigid, curved shaft with an intrauterine balloon to help prevent expulsion. It also has an integrated injection channel to allow for intraoperative chromotubation.

The RUMI II System fits individual patient anatomy with various tip lengths and colpotomy cup sizes. The Advincula Arch Uterine Manipulator Handle is a reusable alternative to the articulating RUMI II and works with the RUMI II System Disposable Tip (**TABLE 1**).

Entry style and ports

The peritoneal cavity can be entered using either a closed (Veress needle) or open (Hasson) technique.[7,8] Closed entry might allow for quicker access to the peritoneal cavity. A 2015 Cochrane review of 46 randomized, controlled trials of 7,389 patients undergoing laparoscopy compared outcomes between laparoscopic entry techniques and found no

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Surgeons need to be cognizant of all products available to them prior to attending a surgical case

TABLE 1 Cost of commonly used equipment for minimally invasive gynecologic surgery: 2018 compared with 2013[a]

Skin preparations			
Product	**Manufacturer**	**2013 Cost**	**2018 Cost**
Betadine, 118 mL	Medline	$0.64	$0.64
Hibiclens, 118 mL	Mölnlycke Health Care	$2.13	$2.12
ChloraPrep with tint, 26 mL	Becton, Dickinson	$6	$5.93

Uterine manipulators					
Product	**Manufacturer**	**Reusable**	**Dye-instillation capability**	**2013 Cost**	**2018 Cost**
Hulka-Kenwick	Novo Surgical	Yes	No	$103.50 plus $13 reprocessing fee	$103.50 plus $40 reprocessing fee
VCare Plus (medium)	CONMED	No	No	$88.51	$88.51
ZUMI Zinnanti	CooperSurgical	No	Yes	$29	$378.97 (12/box); $31.58 each
RUMI II Koh-Efficient (all sizes)	CooperSurgical	No	No	$90	$496 (5/box); $99.20 each
RUMI II System Disposable Tip (all sizes)	CooperSurgical	No	No	$43.87	$235.50 (5/box); $47.10 each
Advincula Delineator	CooperSurgical	No	No	—	$315 (3/box); $105 each
Advincula Arch Uterine Manipulator Handle	CooperSurgical	Yes	No	—	$579.50 plus $40 reprocessing fee

Entry devices and ports (selected)			
Product	**Manufacturer**	**2013 Cost[b]**	**2018 Cost**
SurgiNeedle, 120 mm	Covidien	—	$71.23 each
Bluntport Plus, Hasson 5-12 mm	Owens & Minor	$49.46	$26.26 ea
Pediport Locking Trocar, 5.5 mm	Covidien	$37.13	$202 (5/box); $40.40 each
VersaOne Bladed Trocar, 5 mm	Covidien	—	$109.08 (6/box); $18.18 each
Versaport Plus Pyramidal Bladed Trocar, 10 mm-15 mm	Covidien	—	$43.43
Step Insufflation Needle, 14G	Covidien	$15.72	$12.12 each
VersaStep Bladeless Trocar, 5 mm	Covidien	$43.28	$40.40
VersaStep Plus Bladeless Trocar, 12 mm	Covidien	$51.51	$151.50 (3/box); $50.50 each
Kii Fios First Entry, 5 mm × 100 mm	Applied Medical	$26.50	$360 (6/box); $60 each
Kii Balloon Blunt Tip, 12 mm × 100 mm	Applied Medical	$36.50	$420 (6/box); $70 each
ENDOPATH XCEL Bladeless Trocar, 5 mm × 100 mm	Ethicon	$160c	$180 (6/box); $30 each

[a]Costs are those at a typical large academic medical center.
[b]Prices are per unit, unless otherwise noted.
[c]The 2013 OBG MANAGEMENT article[6] included the price for the box but not for the individual unit.

TABLE 1 Cost of commonly used equipment for minimally invasive gynecologic surgery: 2018 compared with 2013[a] (continued)

Cutting and coagulation devices (selected)			
Product	**Manufacturer**	**2013 Cost[b]**	**2018 Cost**
Endo Shears (reprocessed)	Stryker Sustainability Solutions	—	$150 (6/box); $25 each
LigaSure Maryland LF1937	Covidien	—	$2,610 (6/box); $435 each
LigaSure Dolphin Tip, 5 mm/37 cm	Covidien	$395	$395
LigaSure Blunt Tip, 5 mm/37 cm	Covidien	$435	$1,920 (6/box); $320 each
Laparoscopic L Hook	ConMed Corp.	—	$172.80 (5/box); $34.56 each
PKS LYONS Dissecting Forceps	Olympus America	$221[c]	$221 (5/box); $44.20 each
HALO PKS Cutting Forceps, 5-mm/ 33-cm	Olympus America	—	$2,501.25 (5/box); $500.25 each
Thunderbeat	Olympus	$550	$1,900 (5/box); $380 each
Harmonic ACE +7, 5-mm/ 36-cm	Ethicon	—	$3,119.20 (6/box); $519.87 each
Enseal Curved Jaw, 5-mm/35-cm	Ethicon	$444.60	$2,481.69 (6/box); $413.62 each
Enseal Straight Jaw, 5-mm/45-cm	Ethicon	$446.47	$2,603.86 (6/box); $433.98 each

Tissue-removal devices				
Product	**Manufacturer**	**Reusability**	**2013 Cost**	**2018 Cost**
Olympus Contained Tissue Extraction System (PK Morcellator with Pneumoliner)	Olympus	Morcellator Yes Pneumoliner No	—	Morcellator $2,750 (5/box); $550 each (plus $40 reprocessing fee) Pneumoliner $2,750 (5/box); $550 each
Endo Catch	Covidien	No	$70	$35.35
LapSac Surgical Tissue Pouch	Cook Medical	No	—	$74.25

Sutures and skin adhesives (selected)			
Product	**Manufacturer**	**2013 Cost**	**2018 Cost**
2-0 PDS II, 27 in	Ethicon	$5.79	$340.63 (36/box); $9.44 each
2-0 V-Loc, 9 in	Covidien	$4.08	$208.20 (12/box); $17.35 each
4-0 Polysorb, 18 in	Covidien	$1.29	$2.75
4-0 Caprosyn, 18 in	Covidien	$3.21	$3.35
LiquiBand, 0.8 mL	CardinalHealth	$13.75	$13.88
DERMABOND Advanced, 0.7 mL	Ethicon	$23.25 (0.5 mL)	$241.37 (6/box); $40.23 each

[a]Costs are those at a typical large academic medical center.
[b]Prices are per unit, unless otherwise noted.
[c]The 2013 OBG MANAGEMENT article[6] included the price for the box but not for the individual unit.

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difference in major vascular or visceral injury between closed and open techniques at the umbilicus.[9] However, open entry was associated with a greater likelihood of successful entry into the peritoneal cavity.[9]

Left upper-quadrant (Palmer's point) entry is another option when adhesions are anticipated or abnormal anatomy is encountered at the umbilicus.

In general, complications related to laparoscopic entry are rare in gynecologic surgery, ranging from 0.18% to 0.5% of cases in studies.[8,10,11] A minimally invasive surgeon might prefer one entry technique over another but should be able to perform both methods competently and recognize when a particular technique is warranted.

Choosing a port

Laparoscopic ports usually range from 5 mm to 12 mm and can be fixed or variable in size.

The primary port, usually placed through the umbilicus, can be a standard, blunt, 10-mm (Bluntport Plus Hasson) port, or it can be specialized to ease entry of the port or stabilize the port once it is introduced through the skin incision.

Optical trocars have a transparent tip that allows the surgeon to visualize the abdominal wall entry layer by layer using a 0° laparoscope, sometimes after pneumoperitoneum is created with a Veress needle. Other specialized ports include those that have balloons or foam collars, or both, to secure the port without traditional stay sutures on the fascia and to minimize leakage of pneumoperitoneum.

Accessory ports

When choosing an accessory port type and size, it is important to anticipate which instruments and devices, such as an Endo Catch bag, suture, or needle, will need to pass through it. Also, know whether 5-mm and 10-mm laparoscopes are available, and anticipate whether a second port with insufflation capabilities will be required.

The Pediport Locking Trocar is a user-friendly, 5-mm bladed port that deploys a mushroom-shaped stabilizer to prevent dislodgement. The Versaport bladed trocar has a spring-loaded entry shield, which slides over the blade to protect it once the peritoneal cavity is entered.

VersaStep Bladeless Trocars are introduced after a Step Insufflation Needle has been inserted. These trocars create a smaller fascial defect than conventional bladed trocars for an equivalent cannula size (**TABLE 1**).

Cutting and coagulating

Both monopolar and bipolar electrosurgical techniques are commonly employed in gynecologic laparoscopy. A wide variety of disposable and reusable instruments are available for monopolar energy, such as scissors, a hook, and a spatula.

Bipolar devices also can be disposable or reusable. Although bipolar electrosurgery minimizes injury to surrounding tissues by containing the current within the jaws of the forceps, it cannot cut or seal large vessels. As a result, several advanced bipolar devices with sealing and transecting capabilities have emerged (the LigaSure line of devices, Enseal). Ultrasonic devices, such as the Harmonic ACE, also can coagulate and cut at lower temperatures by converting electrical energy to mechanical energy (**TABLE 1**).

Suture material

Aspects of minimally invasive gynecologic surgery that require the use of suture include, but are not limited to, closure of the vaginal cuff, oophoropexy, and reapproximation of the ovarian cortex after cystectomy. Synthetic and delayed absorbable sutures, such as PDS II, are used frequently. The barbed suture also has gained popularity because it anchors to tissue without the need for intracorporeal or extracorporeal knots (**TABLE 1**).

Tissue removal

Adnexae and pathologic tissue, such as dermoid cysts, can be removed intact from the peritoneal cavity using an Endo Catch Single Use Specimen Pouch, a polyurethane sac. Careful use, with placement of the ovary with the cyst into the pouch prior to cystectomy, can contain or prevent spillage outside the bag.

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A large uterus that cannot be extracted through a colpotomy can be manually morcellated. Appropriate candidates can undergo power morcellation using an FDA-approved device. (**TABLE 1**), allowing for the removal of smaller pieces through a small laparoscopic incision or the colpotomy.

Issues surrounding morcellation continue to require that gynecologic surgeons understand FDA recommendations. In 2014, the FDA issued a safety communication that morcellation is "contraindicated in gynecologic surgery if tissue is known or suspected to be malignant; it is contraindicated for uterine tissue removal with presumed benign fibroids in perimenopausal women."[12] A black-box warning was issued that uterine tissue might contain unsuspected cancer.

A task force created by AAGL addressed key issues in this controversy.

AAGL then provided guidelines related to morcellation[13]:

- Do not use morcellate in the setting of known malignancy.
- Provide appropriate preoperative evaluation with up-to-date Pap smear screening and image analysis.
- Increasing age significantly increases the risk of leiomyosarcoma, especially in a postmenopausal woman.
- Fibroid growth is not a reliable sign of malignancy.
- Do not use a morcellator if the patient is at high risk for malignancy.
- If leiomyosarcoma is the presumed pathology, await the final pathology report before proceeding with hysterectomy.
- Concomitant use of a bag might mitigate the risk of tissue spread.
- Obtain informed consent before proceeding with morcellation.

Skin closure

Final subcuticular closure can be accomplished using sutures or skin adhesive. Sutures can be synthetic, absorbable monofilament (Caprosyn), or synthetic, absorbable, braided multifilament (Polysorb).

Skin adhesive closes incisions quickly, avoids inflammation related to foreign bodies, and can ease patients' concerns that sometimes arise when absorbable suture persists postoperatively (**TABLE 1**).

The impact of physician experience

Physician experience has been shown to reduce cost while maintaining quality of care.[14] That was the conclusion of researchers who undertook a retrospective study, addressing cost and clinical outcomes, of senior and junior attending physicians who performed laparoscopic-assisted vaginal hysterectomy on 120 patients. Studies such as these often lead to clinical pathways to facilitate cost-effective quality care.

CASE Same outcome at lower cost

The hypothetical 43-year-old patient in the opening case undergoes laparoscopic hysterectomy for treatment of uterine fibroids and menorrhagia. In this scenario, however, the surgeon makes the following product choices:

- **The patient is prepped with Hibiclens.**
- **A VCare Plus uterine manipulator is placed.**
- **Laparoscopic ports include a VersaStep Plus Bladeless Trocar with Step Insufflation Needle; Versaport Plus Pyramidal Bladed Trocar; and 2 VersaOne Bladed trocars.**
- **The surgeon uses the PKS LYONS Dissecting Forceps and reprocessed Endo Shears to perform the hysterectomy.**
- **The uterus is enclosed in an Endo Catch bag and removed through the minilaparotomy site.**
- **The vaginal cuff is closed using 2-0 V-Loc barbed suture. Skin incisions are closed with 4-0 Polysorb, a polyglycolic acid absorbable suture.**

The cost of this set of products? $360.44 or, roughly, $1,231.96 less than the set-up described in the case at the beginning of this article (**TABLE 2**).

Summing up

Here are key points to take away from this analysis and discussion:

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Physician experience reduces cost while maintaining quality of care

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- As third-party payers and hospitals continue to evaluate surgeons individually and compare procedures from surgeon to surgeon, reimbursement might be stratified—thereby favoring physicians who demonstrate both quality outcomes *and* cost containment.
- There are many ways a minimally invasive surgeon can implement cost-conscious choices that have little or no impact on the quality of outcome.
- Surgeons who are familiar with surgical instruments and models available at their institution are better prepared to make wise cost-conscious decisions. (See "Caregivers should keep cost in mind: Here's why," in the Web version of this article at https://www.mdedge.com/obgyn.)

TABLE 2 Cost, and savings, for surgical products used in the opening and concluding cases[a]

Opening case		Concluding case		Savings
Tool	**Cost**	**Tool**	**Cost**	
Skin preparation				
ChloraPrep with tint, 26 mL	$5.93	Hibiclens, 118 mL	$2.12	$3.81
Uterine manipulator				
RUMI II system	$146.30 ($99.20 [cup] + $47.10 [tip])	VCare Plus (medium)	$88.51	$57.79
Laparoscopic ports				
Kii Balloon Blunt-Tip, 12 mm × 100 mm	$70	VersaStep Plus, 12mm + Step Insufflation Needle, 14G	$62.62 ($50.50 + $12.12)	$7.38
Versaport Plus Pyramidal Bladed Trocar, 10 mm-15 mm	$43.43	Versaport Plus Pyramidal Bladed Trocar, 10 mm-15 mm	$43.43	equal
Kii Fios First Entry, 5 x 100 mm	$120 (2 × $60)[b]	VersaOne Bladed Trocar, 5 mm	$36.36 (2 × $18.18)	$83.64
Energy devices				
Harmonic ACE +7, 5 mm/36 cm	$519.87	PKS LYONS Dissecting Forceps	$44.20	$450.67
—	—	Endo Shears (reprocessed)	$25	—
Tissue extraction				
Olympus Contained Tissue Extraction System (PK Morcellator with Pneumoliner)	$1,140 Morcellator $550 plus $40 reprocessing fee Pneumoliner $550	Endo Catch	$35.35	$554.65[c]
Sutures and skin adhesives				
2-0 PDS II, 27 in (6 interrupted sutures)	$56.64 (6 × $9.44)	2-0 V-Loc barbed suture, 9 in	$17.35	$39.29
DERMABOND Advanced, 0.7 mL	$40.23	4-0 Polysorb, 18 in (2 sutures)	$2.75 x 2 = $5.50	$34.73
Cost and savings				
Total cost	$1,592.40		$360.44	
Total savings				$1,231.96

[a]Costs are those at a typical large academic medical center.

[b]Two ports were used in this case.

[c]Because the initial purchase price of the reusable morcellator has been covered.

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- Cost is not the only indicator of value: The surgeon must know how to apply tools correctly and be familiar with their limitations, and should choose instruments and products for their safety and ease of use. More often than not, a surgeon's training and personal experience define—and sometimes restrict—the choice of devices.
- Last, it makes sense to have instruments and devices readily available in the operating room at the start of a case, to avoid unnecessary surgical delays. However, we recommend that you refrain from opening these tools until they are required intraoperatively. It is possible that the case will require conversion to laparotomy or that, after direct visualization of the pathology, different ports or instruments are required.

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