



## Review article

## The trends of minimally invasive surgery for benign gynecologic lesions, 1997–2007 in Taiwan

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## ABSTRACT

The use of minimally invasive surgery (MIS) has grown over the past two decades in Taiwan and worldwide. Laparoscopic surgery has been applied to manage the adnexal mass, and ectopic pregnancy since 1989, followed by the first case series of laparoscopic-assisted vaginal hysterectomy (LAVH) in 1992 in Taiwan. These cases successfully advanced the development of the laparoscopic field. The most significant finding for hysterectomy is the significant increase of laparoscopic hysterectomy (LH) from 5.75% to 37.50%, which is accompanied by the decrease of total abdominal hysterectomies (TAH) from 77.93% to 48.12%, in 1997 and 2007, respectively. Laparoscopic surgery increased significantly from 35.78% to 71.66% for benign ovarian tumor; laparoscopic procedures significantly increased from 18.9% in 1997 to 73.95% in 2007 for ectopic pregnancy. Surgeon acceptance and a rapid evolution of instrumentation have enabled the use of laparoscopy to flourish in recent years. Based on nationwide population-based studies, the choices of surgical procedures are found to be dependent on patient factors, surgeon factors, and hospital factors. The academic activities launched by the MIS-related medical associations significantly lower the threshold for entering the field of endoscopy for gynecologists. This review demonstrates a considerable shift in the use of laparoscopic surgery as MIS in the approaches of benign gynecologic conditions, hysterectomy, ovarian tumor, and ectopic pregnancy, during the past 15 years in Taiwan. As a minimally invasive approach, laparoscopic surgery represents a profound change in patients, surgeons, and hospitals where the surgeries were performed.

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## Introduction

Minimally invasive surgery (MIS) has become more popular worldwide over the past two decades. It contains innovative technologies (e.g., laparoscopy, hysteroscopy, and electrosurgery), as well as the concepts (e.g., smaller incision, organ preservation). In the gynecologic field, laparoscopy was used mainly for diagnostic procedures in the female pelvis in the 1980s.<sup>1</sup> Additional surgical procedures were introduced later, including ovarian surgery,<sup>2</sup> ectopic pregnancy, myomectomy, and hysterectomy. In the following decade, advanced surgical procedures for pelvic organ

prolapse and urinary incontinence were performed.<sup>3–6</sup> Meanwhile, MIS was further implemented into the treatment of gynecologic cancers.<sup>7,8</sup> A rapid instrumental evolution and surgeon acceptance have enabled laparoscopy to become more popular in recent years.<sup>1</sup> The shorter recovery time and aesthetic advantages also have fueled patient advocacy. Industry, partnered with pioneer surgeons, has been primarily responsible for the advances. Laparoscopy currently is integrated fully into pelvic surgery and is essential to the gynecologic surgeon.<sup>1</sup> In Taiwan, laparoscopic surgery has been applied to manage the adnexal mass and ectopic pregnancy since 1989; Lee and Soong<sup>9</sup> published the first series of laparoscopic-assisted vaginal hysterectomy (LAVH) in 1992. These cases successfully advanced the development of the laparoscopic field.

This review describes trends and related variables of MIS in Taiwan during the past 15 years based on the data sources of the

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National Health Insurance Research Database (NHIRD). The NHIRD was established by the National Health Research Institute in cooperation with the National Health Insurance (NHI) Bureau, with the objective of promoting research into current and emerging medical issues in Taiwan. The insurance system in Taiwan is a single payer by the NHI program.<sup>10</sup> The NHI program in Taiwan was put into effect in the March of 1995, and is primarily funded by payroll taxes with additional subsidies from general government revenues. The coverage rate of NHI increased from 96.29% in 1997 to 99.14% in 2007 of the total population in Taiwan. The average proportion of the NHI-contracted western medical hospitals from 1997 to 2007 was 96.2%.<sup>11</sup> The diagnosis codes and surgery codes were based on the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM).

### The trends of MIS for hysterectomy, benign ovarian tumor, and ectopic pregnancy

#### Laparoscopic hysterectomy

Hysterectomy is the most common nonpregnancy-related procedure performed in the United States and other countries.<sup>12</sup> Surgical interventions remain the mainstay of treatment, although some nonsurgical treatments are available. Laparoscopy is indicated for benign uterine lesions including uterine myoma and adenomyosis, intractable pelvic pain, severe abnormal uterine bleeding, and poor response to medical treatment. The nonsurgical alternative treatments for benign uterine conditions have been developed to be first-line therapy, including levonorgestrel-releasing intrauterine device, hysteroscopic polyp or myoma removal, and endometrial ablation.<sup>13</sup> However, the influence of these procedures on hysterectomy rates currently remains uncertain, due to the lack of long-term research studies that aim to identify the effectiveness of various treatment methods.<sup>12</sup> In the United States, hysterectomy was performed in a rate of 5.38 per 1,000 women-years, and 4.81 per 1,000 women-years for benign disease.<sup>14</sup> The rates of hysterectomy ranged from a low of 114 per 100,000 women in Mexico to a high of 526 per 100,000 women in Norway, according to the 2002 report from Organization for Economic Co-operation and Development.<sup>15</sup> In Taiwan, the incidence of hysterectomy was approximately 268 to 303 per 100,000

women from 1996 to 2001.<sup>16</sup> The abdominal route of hysterectomy was reportedly the most common (66.1%), followed by vaginal (21.8%) and laparoscopic (11.8%) routes in the United States in 2003. Despite a shorter hospital stay, vaginal and laparoscopic approaches remain far less common than the abdominal approach for benign disease.<sup>14</sup>

There were some subdivisions or modifications of laparoscopic hysterectomy (LH), e.g., LAVH, in which vaginal hysterectomy (VH) is assisted using laparoscopic procedures with or without uterine artery ligation; total laparoscopic hysterectomy (TLH), in which there is no vaginal component and the vaginal vault is sutured laparoscopically<sup>17</sup>; and laparoscopic supracervical hysterectomy (LSH), in which the cervix and attached ligaments are left intact.<sup>18</sup> According to a nationwide population-based NHIRD database, Wu et al.<sup>19</sup> reported the trends in various types of hysterectomy (abdominal, vaginal, laparoscopic, and subtotal) in Taiwan. The most significant finding for hysterectomy is the increase of LH from 5.75% in 1997 to 37.5% in 2007, which was accompanied by the decrease of total abdominal hysterectomies (TAHs) from 77.93% to 48.12%<sup>19</sup> (Fig. 1). During the same period of time, subtotal abdominal hysterectomies (SAH) increased (from 3.12% to 5.90%); VH decreased (from 13.20% to 8.48%).<sup>19</sup> The simultaneous decrease of VH was in concordance with the report by Babalola et al.<sup>20</sup> Postulated possibilities were a decrease in the incidence of uterine prolapse, the lack of exposure in vaginal surgery during gynecologic training, or the concept of uterine preservation during pelvic floor reconstruction.<sup>19,21</sup> This finding is indicative of the considerable increasing adoption of LH in treating uterine lesions in Taiwan over the past decade.<sup>19</sup>

#### Laparoscopy for benign ovarian tumor

With the same database and study design, a total of 146,298 women (103,069 in the laparoscopic group and 43,229 in the laparotomy group) who underwent either laparotomy or laparoscopy for benign ovarian pathology were identified from 1997 to 2007 (Wu MP et al. 2012, Taiwan, unpublished data). The annual total number of procedures for benign ovarian pathology increased after 2004 and remained stationary thereafter (Fig. 1). Laparotomy decreased significantly (64.22 % in 1997 and 28.34% in 2007); laparoscopic surgery increased significantly (35.78 % to 71.66%).

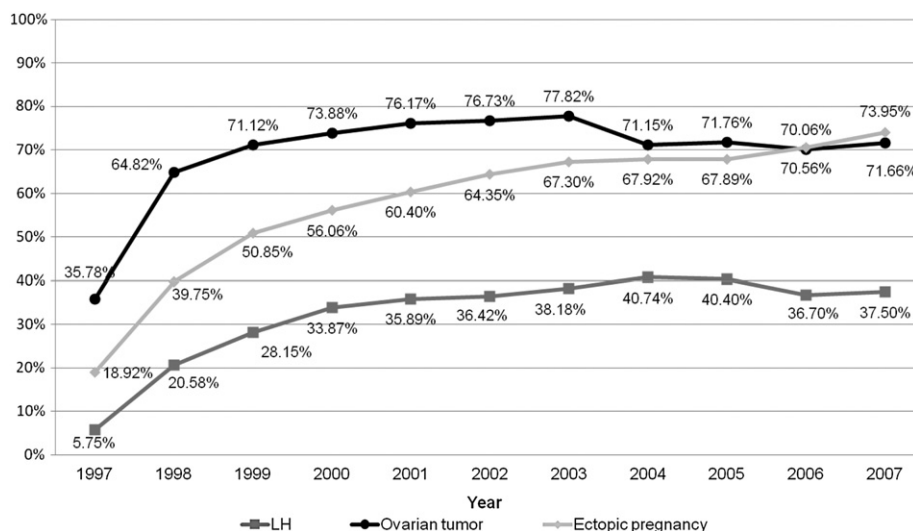


Fig. 1. Trends in laparoscopy for hysterectomy, ovarian tumor, and ectopic pregnancy in Taiwan, 1997–2007, modified from references 19 and 31. LH = laparoscopic hysterectomy.

### Laparoscopy for ectopic pregnancy

An ectopic pregnancy is a common and serious condition with considerable health risks for women of reproductive age.<sup>22</sup> It occurs in approximately 1.5% to 2.0% of pregnancies and can produce potentially life-threatening hemorrhaging.<sup>23,24</sup> The associated mortality markedly decreased to 0.5 deaths per 1000 pregnancies, mainly because of early diagnosis and treatment before rupture.<sup>24</sup> Nevertheless, ruptured ectopic pregnancies continue to occur, often because of unrecognized early signs and symptoms of the condition.<sup>25</sup> An early diagnosis has led to the development of minimally invasive surgical and nonsurgical options. Although women with unruptured ectopic pregnancies can be treated with intramuscular administration of the folic acid antagonist methotrexate,<sup>26,27</sup> surgical intervention is still the mainstay treatment, especially in the presence of contraindications to medical therapy.<sup>28</sup> The success rate of medical treatment was shown to be most effective in early ectopic pregnancies when the risk of subsequent tubal rupture is small.<sup>29</sup> It also requires continuous laboratory monitoring after drug administration.<sup>30</sup> The advantages of surgical treatment for ectopic pregnancy include less time for resolution of an ectopic pregnancy and avoidance of the need for prolonged monitoring.<sup>30</sup> Surgical treatment of an ectopic pregnancy may also affect the prognosis for subsequent fertility.<sup>22</sup>

Based on the same database, a total of 44,928 women who underwent either a laparotomy or laparoscopy for an ectopic pregnancy were identified. The annual number of procedures for ectopic pregnancies decreased in later years during the 11-year study period. As for ectopic pregnancy, laparotomy significantly decreased from 81.08% in 1997 to 26.05% in 2007; laparoscopic procedures significantly increased from 18.9% in 1997 to 73.95% in 2007<sup>31</sup> (Fig. 1).

### The variables affecting the choices of MIS

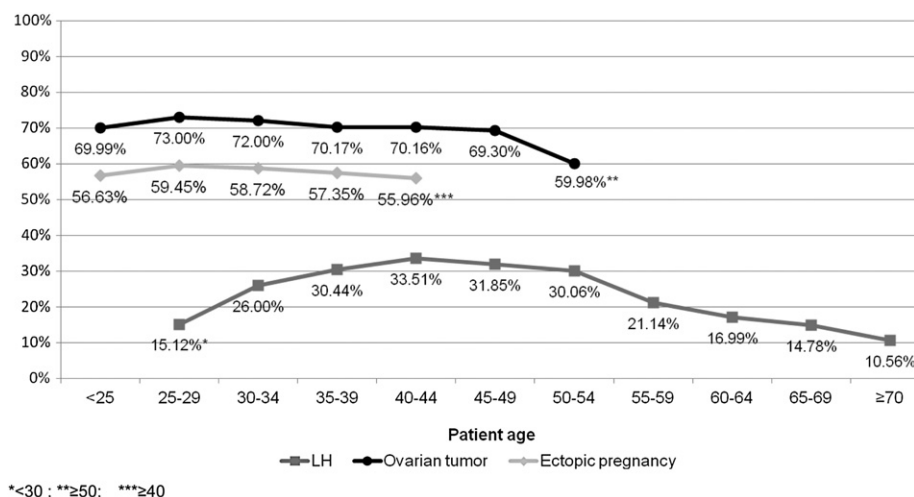
Patient-, surgeon-, or hospital-related factors might influence the choice of a laparoscopic approach for benign gynecologic lesions.

#### Patient factors

Patient age is a very important factor in the choice of laparoscopy for hysterectomy, ovarian tumor, and ectopic pregnancy<sup>19,31</sup>

(Fig. 2). LH was more commonly performed in middle-aged women, between 35 to 54 years old.<sup>19</sup> The result indicated that the surgical types differed according to patient age.<sup>19,31</sup> In the Danish study, the age distribution for all hysterectomies changed, from a maximum in the 36- to 45-year age group in 1988 to the 46- to 55-year age group in 1998.<sup>32</sup> Laparoscopic surgery for benign ovarian tumor was more commonly performed in patients younger than 49 years (69.30–73.00%) than those older than 50 years (59.98%, Wu MP et al. 2012, Taiwan, unpublished data). Laparoscopic surgery for ectopic pregnancy decreased from 59.45% in patients 25–29 years old to 55.96% in patients age 40 years and older.<sup>31</sup> These finding may be attributable to higher expectations of quality of life among younger women.<sup>19,31</sup> The changes in patients' attitudes, however, were difficult to quantify. Information in the media/press about the various treatment methods and patients' rights have increased during the past decades. The reflection on information among patients' attitudes might also contribute to the change in LH.<sup>32</sup> Although a laparotomy may initially seem advantageous for the surgeon, the large abdominal incision, prolonged hospital stay, increased postoperative analgesic requirements, and increased morbidity are disadvantages for patients.<sup>33</sup> Thus, such factors also influence the surgical choices of patients and surgeons.<sup>34</sup> Therefore, patients' attitudes about body image, confidence, and psychological value may have influenced their surgical choice. Women will weigh certain factors, e.g., postoperative pain, hospital stay, recovery time, complications, and work absenteeism. Therefore, patients choose a procedure based on their personal goals for surgery, their general medical condition, and their expectation of body image. These studies observed that patient age is one of the correlative factors that should be taken into account when selecting an appropriate surgical type.<sup>19,31</sup>

In addition to patient age, the choice of laparoscopy was affected by the preoperative condition, e.g., anemia status and shock status, in ectopic pregnancy. Use of laparoscopy (58.1%) and laparotomy (41.9%) differed according to preoperative comorbidities. With older patients, those with preoperative anemic or shock, there was a higher likelihood that a laparotomy would be performed.<sup>31</sup> Preoperative laboratory data may also affect the choice of laparoscopy. Poncelet et al<sup>35</sup> reported the parameters in the choice of laparoscopy, e.g. abnormal tumor markers, large tumor size, bilateral tumors, and ascites visible on sonography. Lee et al<sup>36</sup> showed a borderline significant association of tumor mass size ( $p = 0.081$ ) with the choice of surgery type.<sup>36</sup> Although the feasibility of



**Fig. 2.** The patient age factor in laparoscopy for hysterectomy, ovarian tumor, and ectopic pregnancy in Taiwan, 1997–2007, modified from references 19 and 31. LH = laparoscopic hysterectomy.

laparoscopic surgery in ovarian cancer was reported, the concerns are still existing, e.g. inadequate staging, cyst rupture, port site metastasis, and recurrence.<sup>37,38</sup> This discussion is beyond the scope of this review.

### Surgeon factors

The surgeon factor for laparoscopy for hysterectomy, ovarian tumor, and ectopic pregnancy is shown in Fig. 3. The choice of laparoscopy differed according to surgeon age.<sup>19,31</sup> Significant differences were discernible in the distribution of LH performed by surgeons in different age groups.<sup>19</sup> TAH and SAH were more commonly used by younger surgeons (younger than 30 years) and older surgeons (older than 60 years) compared with surgeons age 30 to 60 years; LH was more commonly performed by middle-aged surgeons.<sup>19</sup> Surgical experience and learning curve of surgeons may have effects on both costs and clinical outcomes of LH,<sup>39</sup> and the choice of VH.<sup>40</sup> Therefore, the training system of surgeons might be important in the choice of laparoscopy. Huang et al<sup>41</sup> reported the gynecologic characteristics for performing LH, e.g., sex, age, and practice volume of gynecologists after controlling for clinical and nonclinical factors. Male gynecologists (odds ratio [OR] 1.65, 95% confidence interval [CI] 1.55–1.76) were more likely to perform LH than their female colleagues; gynecologists age 60 years and older (OR 0.31, 95% CI 0.29–0.39) had the lowest likelihood of performing LH compared with their counterparts. In addition, surgeons with a low-volume practice (OR 0.31, 95% CI 0.29–0.33) also had a significantly lower probability of performing LH compared with other surgeons. Therefore, a higher likelihood of performing LH was observed among male and younger gynecologists with high-volume practices in Taiwan.<sup>41</sup> Lee et al<sup>41</sup> showed a borderline significant association of surgeon type (professor vs. clinical fellow;  $p = 0.094$ ) with the choice of surgery type.<sup>36</sup> These findings suggest that differences in practice patterns and surgical treatment decision may explain the variation in the approaches to LAVH. Similar trends were also found in the treatment of ovarian tumor and ectopic pregnancy.<sup>31</sup>

Whether this finding reflects surgeons' training background is still elusive. Eckert et al<sup>42</sup> reported that nationwide trends toward the increased use of minimally invasive, endoscopic techniques are altering the operative experience of surgeons and residents. This

may radically change the abilities and expectations for the field of general surgery. Wu et al<sup>19</sup> offered the correlative data between surgeon age and surgical choice, which is possibly influenced by the training background of surgeons.<sup>31</sup>

### Hospital factors

There were significant differences in choice of laparoscopy among hospitals with different accreditation levels. The hospital factor on laparoscopy for hysterectomy, ovarian tumor, and ectopic pregnancy is shown in Fig. 4. LH and laparoscopy for ectopic pregnancy were more often performed in medical centers and regional hospitals than in local hospitals.<sup>19,31</sup> A plausible explanation for this finding is that the generalization of MIS began in medical centers, followed by regional hospitals.<sup>19,31</sup> Different levels of hospital accreditation may have different specialized surgical training systems, including apprenticeship-style training, and curriculum- and case-based programs.<sup>43</sup> Therefore, the choices of surgical procedures are dependent, to some extent, on the hospital where the procedure was performed in addition to patient and surgeon factors.<sup>19,31</sup> Generally speaking, medical centers may have better equipment and sufficient medical staff, especially during the nighttime and on holidays when dealing with ectopic pregnancies.<sup>31</sup> Laparoscopy has become the standard approach for surgically managing ectopic pregnancies, as long as adequate expertise and equipment are available.<sup>22,31</sup>

### The contributions of MIS medical associations

In the 1980s, there were few training opportunities for surgeons in Taiwan to practice laparoscopic surgical skills and the use of instruments, which are the two essential elements to decrease the complication rate. With the development of the endoscopy field, the application of laparoscopy changed from diagnostic laparoscopy to surgical laparoscopy. The Taiwan Association for Minimally Invasive Gynecology (TAMIG) was established for the importance and urgency of academic training program. TAMIG launches academic symposia, educational training courses, dry laboratory, and animal workshops. These academic activities significantly lower the threshold for entering the field of endoscopy. In the meantime, the TAMIG fosters the NHI to subsidize laparoscopic

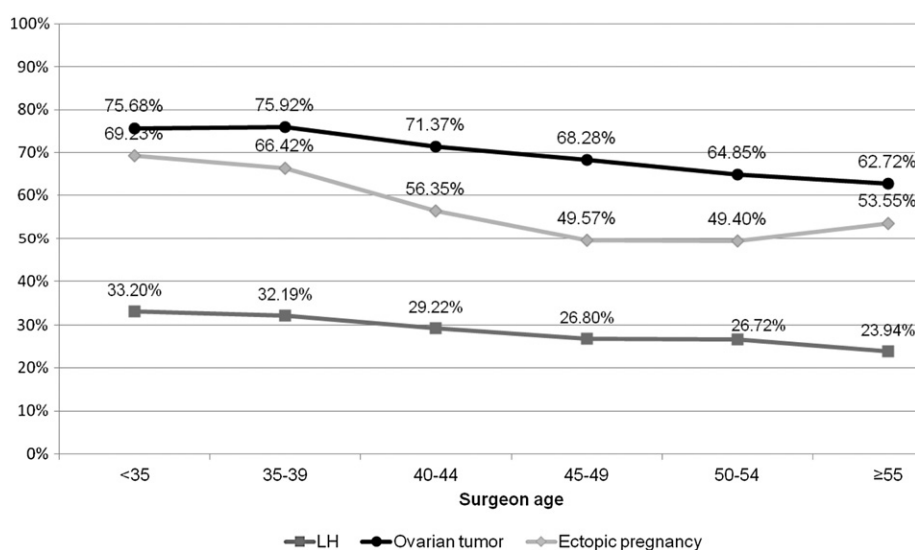
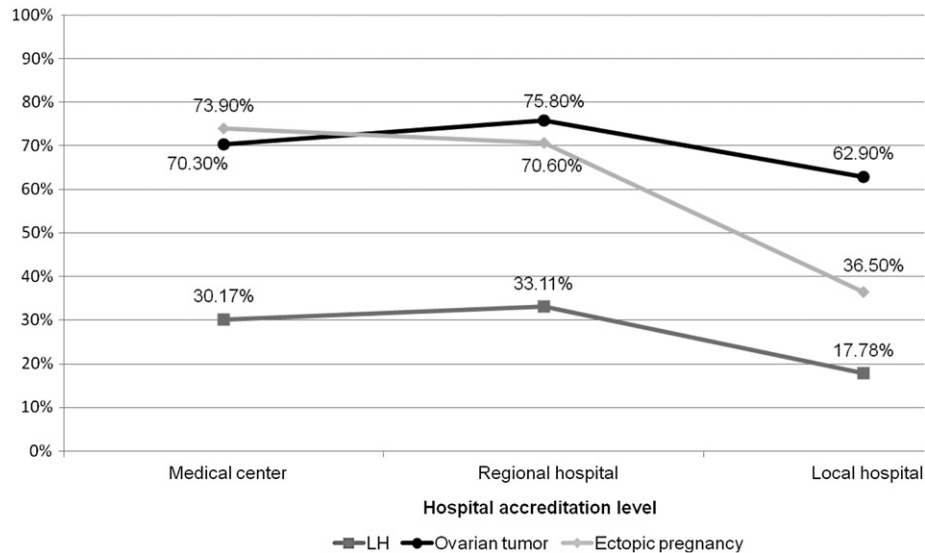


Fig. 3. The surgeon factor in laparoscopy for hysterectomy, ovarian tumor, and ectopic pregnancy in Taiwan, 1997–2007, modified from references 19 and 31. LH = laparoscopic hysterectomy.





**Fig. 4.** The hospital factor in laparoscopy for hysterectomy, ovarian tumor, and ectopic pregnancy in Taiwan, 1997–2007, modified from references 19 and 31. LH = laparoscopic hysterectomy.

costs. Therefore, it greatly promotes the development of the laparoscopic surgery in Taiwan. The Asia-Pacific Association for Gynecologic Endoscopy and Minimally Invasive Therapy (APAGE-MIT) was established in 2003. The annual congress of APAGE-MIT provides surgeons with a platform to exchange their experience and achievements in the Asian-Pacific region. Over the past two decades, the two associations have played important roles in the development of laparoscopy. Thereby, they perform the positive influences in promoting the popularization of laparoscopy in Taiwan, as well as the Asia-Pacific region.

## Conclusion

This review demonstrates the considerable shift in the use of MIS in the approaches of benign gynecologic conditions during the past 15 years. Laparoscopy is a learned technique, with a unique set of surgical skills and instruments that are not necessarily transferable to the seasoned surgeon trained before the advent of laparoscopy.<sup>1</sup> The novel instrumentation, challenges of exposure, reliance on electrosurgery, advanced bipolar instruments, the use of electrosurgical accessory safety equipment,<sup>44,45</sup> and nominal tactile feedback require a distinct surgical expertise.<sup>1</sup> During the past 15 years in Taiwan experience, it has become clear that laparoscopy is well suited to the female patient. Many procedures are accomplished with less blood loss, fewer wound complications, and shorter hospitalizations. In the era of MIS, laparoscopic surgery represents a profound change patients, surgeons, and hospitals where the surgeries were performed.<sup>19,31</sup>

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