

Surgical Trend and Volume Effect on the Choice of Hysterectomy Benign Gynecologic Conditions

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Abstract

With the advance of minimally invasive surgery (MIS), the surgical trends of hysterectomy changed significantly during past 2 decades. Total number (age-standardized) of all types of hysterectomy decreased, which may be due to the availability of some other alternatives, e.g. hysteroscopy, laparoscopic myomectomy. However, laparoscopic hysterectomy (LH) still remains the mainstream of surgical treatment. LH significantly increases for benign gynecologic conditions in Taiwan and worldwide. The increase of LH was accompanied with decrease of TAH; VH kept stationary, and SAH increased slightly. The increase in popularity of LH and SAH; provides evidence of surgical trends and a paradigm shift for hysterectomy. This time-frame shift suggests LH has reached a u during the later years. Older patients tend to receive AH, while middle-aged women tend to receive LH. Older surgeons tend to perform AH, while younger surgeons tend to perform LH. However, all type hysterectomy and LH were more commonly performed by older surgeons aged over 50 years. It means both patients and surgeons became older during the time-frames. The above phenomena may also happen due to less young surgeons entered in the gynecologic practice. Most of the LHs were performed by high-volume surgeons, however, there is a shift from high-volume, to medium- and low-volume surgeons. The above scenario may be due to the wide spread of LH techniques. Surgical volume has important impacts on both complications and costs. The high-volume surgeons have lower complications, which result in lower costs. In the future, how to increase the use of LH, to improve the training and monitoring system deserves more attentions.

Keywords: Hysterectomy, surgical trend, volume effect

INTRODUCTION

Minimal invasive surgery (MIS) has become state-of-the-art for benign hysterectomy in Taiwan and worldwide. With the MIS era, the laparoscopic approach for hysterectomy has gained its popularity, especially for benign gynecologic conditions. Laparoscopic hysterectomies (LH) have increased worldwide owing to its minimal invasive characters, for example, less postoperative pain, shorter hospital stay, and faster recovery.^[1] Previous studies showed an increase

in LH and subtotal abdominal hysterectomy (SAH), which was associated with a decrease in total abdominal hysterectomy (TAH), in the United States,^[2] Austria,^[3] Netherlands,^[4] Australia,^[5] and also in Taiwan.^[6-8] We reviewed the surgical trends of the use of hysterectomy in Taiwan and worldwide. It changed significantly during the past two decades, which provides evidence of a paradigm shift for hysterectomy. However, there are some questions arising from this surgical trend shifts. In this review, we will

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try to answer the following questions: (i) Have LHs reached its plateau yet? (ii) What are the affecting variables in addition to gynecologic diagnosis, for example, patient factors (age, income, race, insurance systems), surgeon factors (age and gender), and/or hospital factor (accreditation levels)? Furthermore, what are the impacts of surgical volume on the choice of hysterectomy types for benign hysterectomy?

CHRONOLOGIC SURGICAL TREND FOR ALL TYPES OF HYSTERECTOMY

Total number (age-standardized) of all types of hysterectomy decreased during the past two decades

Age-standardized, all hysterectomy rate for benign gynecologic conditions in Australia decreased from 316/100,000 women in 2002 to 206/100,000 women in 2014, with a decline of 25%.^[3] A similar annual number decrease happened in the United States; the number of hysterectomies decreased from 681,234 in 2002 to 311,820 in 2012, a 54.2% decline;^[9] also in Sweden, the annual overall hysterectomy rate decreased from 232/100,000 person-years in 1999 to around 210/100,000 person-years in 2003.^[10] Taiwan, as compared with other countries of the Organization for Economic Co-operation and Development, the hysterectomy rate of Taiwan is among the middle (156/100,000), in which the lowest is in Spain (106/100,000); and the highest in the U. S. (325/100,000).^[11] With the advantages of big data from Taiwan's National Health Insurance Research Database (NHIRD), which covered over 99% of the Taiwan population, we conducted a retrospective analysis.^[12] A total of 329,438 women aged 20 years and older, who underwent various types of hysterectomy during a 15-year time-span (1998–2012), with an aim to investigate the time-frame surgical trends of hysterectomy types.^[12] We found that the annual number of all hysterectomy decreased from 23,502 in 1998 to 17,988 in 2012 during the 15-year follow-up study [Figure 1]. The hysterectomy rate also decreased after age-standardization in Huang *et al.* report.^[11]

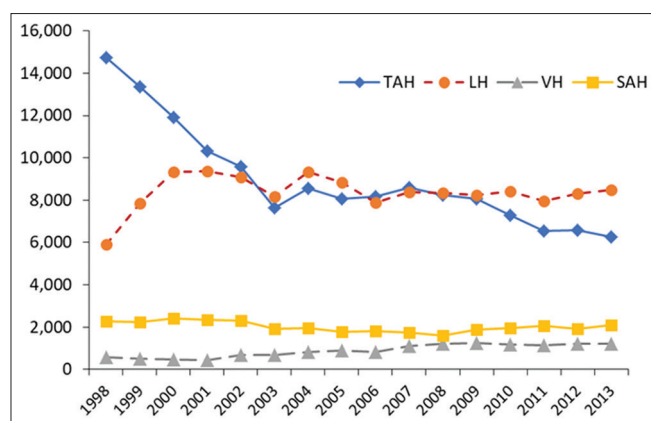


Figure 1: Surgical trend of different hysterectomy types (by number) for benign gynecologic conditions, by year (modified from^[12])

A possible explanation is the popularity of hysteroscopy use as an alternative in treating the uterine disorder. In Denmark, 3200 women received an operative hysteroscopy as a minimal invasive alternative to hysterectomy each year.^[13] Furthermore, some novel hysteroscopic techniques, for example, endometrial ablation, can improve abnormal uterine bleeding without uterine removal and fewer complications than hysterectomy.

In Taiwan, 5406, fewer hysterectomies (−19.5%) were performed in 2010 when compared with those performed in 1999. The number of hysterectomies performed decreased from 1997 to 2010 for precancerous lesions (−55.6%), chronic pelvic pain (−35.2%), uterine leiomyoma (−13.1%), and uterine prolapse (−7.2%). The declining trend is consistent with the findings reported by both Wright *et al.*^[14] (36.4% decline from 2002 to 2010) in the United States and Spilsbury *et al.*^[15] (23% decline from 1981 to 2003) in Australia.

The possible reasons for the decreasing trend of hysterectomy could be the introduction of nonsurgical treatment options, such as uterine artery embolization and endometrial ablative therapy of uterine leiomyoma or the more conservative uterine-preservation management for symptomatic benign uterine disease.^[16] Since 1995, the nationwide Papanicolaou smear screening programs for precancerous cervical lesions have been highly effective for young women, 61% of women aged ≥ 30 y/o had at least one smear test by 2001 in Taiwan. The early detection of precancerous lesions allows earlier treatment by local excision procedures rather than hysterectomy.^[8] With the development of medical technology and patient's demand for treatment of myoma, the less invasive uterine-preserving procedures such as high-intensity focused ultrasound (HIFU) therapy, endometrial ablation, and myomectomy with minimally invasive surgery, and uterine arterial embolization, have become increasingly popular with patients. The popularity of US-guided and magnetic resonance-guided HIFU offers an alternative treatment for uterine myoma, with/without abnormal uterine bleeding. Its indication extends from premenopausal women with no further childbearing plan to those women who still want child-bearing.^[17] Endometrial ablation/resection is also an effective and possibly cheaper alternative to hysterectomy for heavy menstrual bleeding, with faster recovery.^[18] However, how many cases indicated for hysterectomies were replaced by the uterine preserving facilities mentioned above are difficult to estimated. However, we believe diverse facilities may offer alternatives for the women to choose.

The choices of different types of hysterectomy have changed during time-frame comparison

According to our time-frame comparison study, although the most frequently used surgical type was TAH, of which

137,694 cases (45% of all cases) over 15-year period, followed by 125,410 (41%) LH, 30,168 (9.8%) vaginal hysterectomy (VH), and 12,985 (4.2%) SAH, however, there were dramatic changes. LH and SAH increased significantly from 25.2% and 2.4% in 1998 to 46.2% and 6.7% in 2012, respectively. It was concomitantly associated with a decrease in TAH from 62.7% to 36.5%. The transition of TAH predominance to LH predominance occurred between 2003–2005 and 2008–2012 [Figure 1].^[12] The rate of TAH decreased from 51.8% in the 1st period (1998–2002), 42.2% in the 2nd period (2003–2007) to 39.3% in the 3rd period (2008–2012). Over the same time period, LH increased from 35.9%, 43.9% to 44.2%; VH varied from 10%, 9.5% to 10.1%; SAH increased from 2.3%, 4.4% to 6.4%, respectively ($P < 0.001$). This population-based nationwide study elucidated the changes of different types of hysterectomies in Taiwan, which is in concordance with other studies. In the U. S., relative to 2003, when 66.1%, 21.8%, and 11.8% of hysterectomies were performed abdominally, vaginally, and laparoscopically, respectively, in 2012 the hysterectomy route has shifted considerably from abdominal to laparoscopic. VH rates, however, declined slightly since 2003 but remained stable after 2010. Half of the benign hysterectomies (51.2%) were performed abdominally, and 31.8% and 16.9% were performed via laparoscopic and vaginal approaches, respectively.^[19] Rates of VH by prolapse indication increased by a five-fold in Sweden. Total and sub TAH decreased from 63% and 32%, respectively, in 1987, to 48% and 18% in 2003.^[10]

LH versus total abdominal hysterectomy

There has been a significant decline in the hysterectomy rate in Australian and the one joint point was detected with a significant increase in age-standardized rates of LH, from 10/10,000 women to 15.9/10,000 women.^[20] Similar situations happened in U. S.,^[2,21] Portugal,^[14] Denmark,^[13] LH, and Taiwan, first increased from 1st to 2nd time-frame, and then kept stationary in the plateau phase, which was accompanied with the decrease and subsequent stationary phase of TAH during the time-frame comparison study. From the above findings, whether LH has reached its full potentials and popularity remains unknown. Further continuous surgical trends deserve careful and continuous observation. As for subtypes of LH, Desai *et al.* reported that, total laparoscopic hysterectomy (TLH) increased with a concomitant decrease of laparoscopic-assisted VH (LAVH), and laparoscopic supra-cervical hysterectomy (LSH).^[22] The advanced technique in laparoscopic gynecologic surgery, such as improved uterine manipulation, visualization, and advanced laparoscopic suturing devices, may also have facilitated the completion of TLH. The trend away from LAVH reported in studies calls for attention to surgeon proficiency and resident

training in vaginal surgery. Limited power morcellation may decrease LSH utilization even further, while specimen removal constraints may hamper the growth of TLH procedures.^[22] LH is also possibility limited by the complexity of the case or the pathology. Among them, multiple previous abdominal surgeries, for example, increasing Cesarean sections (the global average Cesarean sections rate increased 12.4% (from 6.7% to 19.1%) between 1990 and 2014),^[9] myomectomy, high prevalence of pelvic endometriosis (10%–15% of all women of reproductive age and 70% of women with chronic pelvic pain),^[23] obese patient (body mass index ≥ 30 kg/m²),^[24] pelvic inflammatory diseases, and pelvic adhesion, may predispose patients to access-related injuries and increase the complexity of the LH. In gynecologic surgery populations, the incidence of abdominal or pelvic adhesions has been estimated to be almost 100% in patients with a history of previous surgery and 28% in those without earlier surgery.^[25] When surgeons consider one specific approach to hysterectomy as more difficult, they may be reluctant to perform this type of hysterectomy. LH is also considered more difficult than AH, which might be a reason for its slow implementation and reaching plateau.^[26]

Vaginal hysterectomy

According to The American College of Obstetricians and Gynecologists (ACOG) recommendation, the vaginal route for hysterectomy is the first option, which is considered the preferred choice of treatment for women with benign indications whenever feasible, even in the era of MIS.^[13] VH is less invasive, with fewer risks than LH or AH, and allows excellent access for pelvic support.^[27] VH is considered preferred by Danish physicians for treating patients with benign indications when feasible, even in undescended uterus.^[13] In Austria, VH was most commonly used for benign hysterectomy, at about 50% and stable in 2002–2014.^[3] However, the use of VH was less common in Taiwan. The rate of VH in Taiwan is lower than that of European countries, which was 31% in 2004 and 22% in 2014 in the Danish database studied by Topsoe *et al.*^[13] The plausible explanation is the preference and training background of surgeons, that is, VH is only used for genital prolapse in Taiwan, which accounts for 83.2%. The top three most common indications are uterine myoma, adenomyosis, and carcinoma *in situ*, which accounts for only 14.9% of all indications. Transvaginal natural orifice transluminal endoscopic surgery (vNOTES) was developed to meet the advantages of transvaginal route and the advantages of endoscopic surgery, total vaginal NOTES hysterectomies builds on the indications for VH and gets the better of its limitations. Furthermore, the transvaginal approach avoids abdominal wall wounds and trocar-related complications.^[28]

Subtotal abdominal hysterectomy

Hysterectomy is one of the most frequently performed operations in the world, accounting for 500,000–600,000 procedures annually in the USA; the abdominal route for hysterectomy is the preferred route in 60%–80% of these operations. Although the number of total abdominal hysterectomies performed annually has decreased, the number of subtotal abdominal hysterectomies increased by > 400%.^[29] The rate of SAH increased during our time-frame comparison report in Taiwan.^[12]

The possible explanation is that the preservation of the cervix that may reduce urinary and bowel symptoms and subsequent pelvic organ prolapse the improvement in patient sex life.^[30] However, no evidence was found of a difference in the rates of multiple outcomes that assess urinary, bowel, or sexual function between TAH and SAH, either in the short (up to 2 years after surgery) or long-term (9 years after surgery).^[31] Operative time and amount of perioperative blood loss were significantly reduced, as compared with TAH. The length of operation (difference of 11 min) and amount of blood loss during surgery (difference of 57 ml) were significantly reduced during SAH, as compared with TAH. However, these differences are unlikely to constitute a clinical benefit, and no evidence was found of a difference in the odds of blood transfusion.^[22] There was a significant increase in sexual pleasure in all the groups regardless of the hysterectomy type.^[32]

Meanwhile, postoperative cyclic spotting is a bothersome symptom. Persson *et al.* reported a long-term follow-up study of pelvic floor dysfunction that showed basically no significant differences in subjective or objective measurements of pelvic organ prolapse, or in specific pelvic floor quality-of-life aspects after SAH and TAH.^[33] Cyclic bleeding occurs in 5%–20% of women. Reoperation rates for symptoms related to the retained cervix are significant. Sexual pleasure increased significantly in all the groups regardless of the type of hysterectomy, but no significant difference was found in the incidence of difficult sexual problems.^[32]

PARAMETERS AFFECTING THE CHOICE OF ALL TYPES OF HYSTERECTOMY, AND LH

Patient age and socioeconomic status

Age at time of hysterectomy increased in the US. The average age of patients undergoing hysterectomy was 46.9 ± 10.9 years for LH, 51.3 ± 12.1 years for AH, and 51.7 ± 14.1 years for VH. There was no significant difference in the average age of the patients undergoing VH compared with AH. From 2000 to 2010, there was a significant trend of increasing patient age for all surgical approaches to hysterectomy. It means that younger women choosing

alternatives to hysterectomy, such as progestin-based intrauterine devices, uterine artery embolization, endometrial ablation, or leuprolide, and more elder women are willing to receive hysterectomy for their diseases.^[2] In Taiwan, the peak age for women to undergo hysterectomies was 40–44 years old [Figure 2]. Older women aged over 50-year-old, tended to received AH, middle-aged women <50-year-old, tended to received LH. This may reflect the necessity of earlier return to work and less loss of work productivity during the middle and younger women <50-year-old.^[12] VH was more commonly adopted in older patients (aged 60 years and older), due to a higher prevalent uterine prolapse and other complex comorbid conditions in older women.^[8] SAH was also more adopted in the youngest patients (<40 years) due to obstetric reasons or desiring better sexual life in younger women.^[11] There were significant differences in the distribution of various surgical types of hysterectomy in patient's age groups in Taiwan, but also a significant trend of increasing patient age for receiving hysterectomy.

In addition to the medical reason, some other socioeconomic status may affect the choice of LH. In U. S., higher income (as compared with low income), white race (as compared with Hispanic and black races), private insurance (as Medicare and Medicate insurance), have a higher possibility to choose LH.^[34] Their explanations were the broader possibility that other race Americans are less likely than Caucasian to have a usual source of health care, leading to more progression of disease at the time of diagnosis, thus limiting the use of laparoscopic surgery.^[34] Since LH was covered by single payer National Health Insurance (NHI) system in Taiwan, which covers over 99% of the total population, insurance seems not to play major roles. Our study indicated that LH increased in patients aged 50–59 years (from 14.9% in the 1st period, 17.4% in the 2nd period to 19.8% in the 3rd period).^[12] It means that more elder patients were willing to receive surgery for their treatment, possibly due to minimal invasive characters in LH.

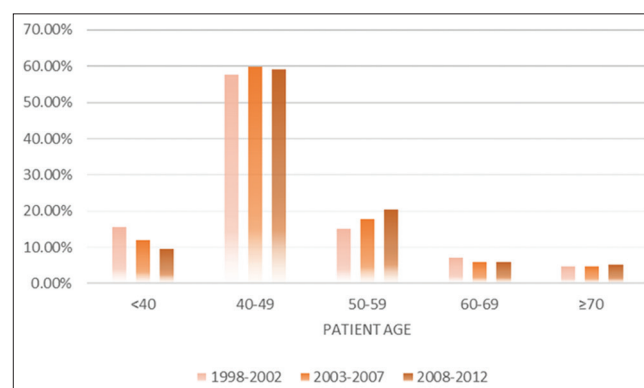


Figure 2: Patient age distribution among three time-frames comparison for hysterectomy (modified from^[12])

There is a similar finding worldwide and Taiwan among younger women to more likely choose other alternatives to hysterectomy, such as progestin-based intrauterine devices, uterine artery embolization, endometrial ablation, or leuprolide, etc., On the contrary, more elder women are willing to receive hysterectomy for their diseases. In summary, the age distribution difference among women who receive hysterectomy in Taiwan is younger than in other countries. The possible explanations may be additional reimbursement to enrollees if they undergo hysterectomies before the age of 45 years. Whether this may reinforce the motivation of younger women <45 years remains unknown.^[8] The racial and income factors do not affect the choice of either MIS or laparotomy in Taiwan (single-payer NHI system with coverage over 99% of the total population), which is different from the insurance system in the US.

Surgeon age, and gender

Significant differences were presented in the distribution of various types of hysterectomy by surgeon age and surgeon gender.^[12] Most hysterectomy was performed by the female (60.1%) and had been in practice >21 years (56.3%) in the US.^[35] In Taiwan, the time-frame comparison study indicated that all types of hysterectomies were more performed by surgeons aged over 50 years, 28.1%, 30.4%, and 35.0% in the 3 periods [Figure 3]. Similar finding was observed in LH, 20.9%, 22.6%, and 24.5% in 3 periods. It reflects the aging phenomenon happens in surgeons, as well as patients. The older surgeons accounted for a substantial amount of all surgeons in Taiwan.^[6,36] Another explanation may be that there was less young doctors choose to enter gynecology training and practice.^[35,37] As for surgeon age, LH was performed more by surgeons aged <49-year-old, as compared with TAH and VH in older surgeons aged more than 50-year-old. Similar situations happened in female surgeons; i.e., LH was performed more by female surgeons, as compared with male surgeons. The surgical decision about the type of hysterectomy depends not only on the patients' age

but also surgeon age and gender,^[36] in addition to the clinical indications.^[8,14,22,38] The phenomenon that LH was relatively more commonly performed by surgeons aged <50 years may reflect the different training background^[39] and surgical practice patterns^[36,37,40] and resource availability.^[35] Although older surgeons may learn minimally invasive or advanced techniques with more difficulty than younger counterparts,^[37] however, the relation between surgeons age and surgical patterns and performance was not linear because older surgeons also performed more LH during the time-frame comparison.

As for the surgeon gender parameters, hysterectomies were more performed by female surgeons during the study period. It may be due to relatively more female residents or fellows engaged in the gynecological field. Future researches are needed to examine in more detail about different surgical patterns of these surgeons. The older surgeons accounted for a substantial amount of all surgeons, both in Taiwan and the US. The aging phenomenon may happen to surgeons worldwide. As for LH, younger surgeons performed LH; however, there are no available data about LH practice in other countries.

Hospital accreditation levels

All types of hysterectomy rates increased in regional hospitals (from 33.1%, 38.8% to 42.2%), with a decrease in local hospitals. A similar phenomenon happened in LH, i.e., LH rate also increased in regional hospitals (from 37.5%, 41.4% to 41.3%), with a decrease in local hospitals. The surgical trend of LHs among different hospital levels, by three time-frames is shown in Figure 4. LH was initially regarded as an advanced technique, which may start from medical centers.^[41] After the maturity of techniques, and trainees, the techniques widespread into regional hospitals.^[11] The disappearance of local hospitals up to 150 hospitals was noted during the time-frame. A recent survey found that 58% of graduating residents were “completely prepared” to perform an abdominal hysterectomy compared with only

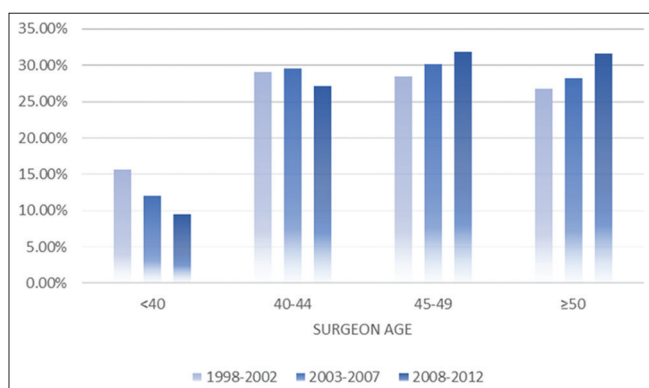


Figure 3: Surgeon age distribution among three time-frames comparison for hysterectomy (modified from^[12])

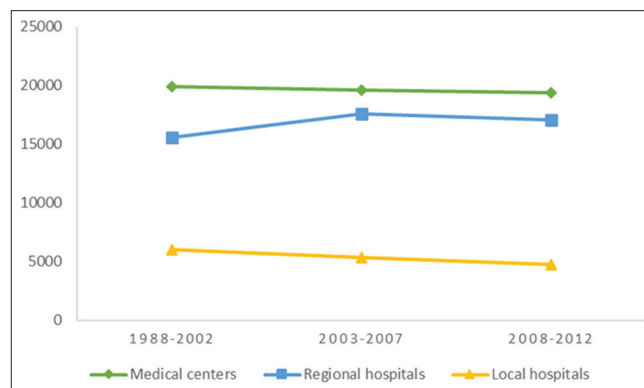


Figure 4: Surgical trend of LHs among different hospital levels, by 3 time-frames (modified from^[12])

28% for vaginal, 22% for laparoscopic, and 3% for robotic hysterectomy. A large number of residents are now obtaining postresidency training in minimally invasive surgery as well as other gynecologic subspecialties. Improved surgical simulation systems may partially compensate for decreasing teaching volume as well.^[21] Most LHs, as well as other types of hysterectomy, are performed in medical centers in Taiwan, but the phenomenon is not evident in other countries. The convenient access to medical care provided by the NHI system in Taiwan may also be a reason for the phenomenon.

SURGICAL VOLUME EFFECTS

LH was more commonly performed by high-volume surgeons, whereas total abdominal hysterectomy was more commonly performed by medium and low-volume surgeons)

In gynecologic surgery, the relationship between surgical volume and surgical approach has effects for patients, payers, and hospitals. High-volume surgeons were defined as those performing $12\% \pm 33\%$ (range, 8–16) procedures annually in Mowat *et al.* systematic review and meta-analysis.^[42] In the U. S., the low-volume surgeons are more likely to perform TAH (33% vs. 4%), which is associated with higher complications (4.5 times greater), as compared with LH.^[35,43] On the contrary, the high-volume surgeons are more likely to perform LH, are less likely to encounter perioperative complications and less expensive costs.^[42] It is a similar situation in our and other previous studies in Taiwan.^[27,36] In summary, it is similar among Taiwan and US surgical volume, i.e., the high-volume surgeon tend to choose LH among all types of hysterectomy. A similar phenomenon also happens in high-service volume hospitals. The performance of LH has a trend to shift from high-volume to middle-volume surgeons and hospitals in Taiwan. There were no data to show this finding in other countries.

The “bandwagon effect” decrease Service volume

An often used proxy for surgeon experience and expertise.^[42] Significant differences were presented in the distribution of various types of hysterectomy by surgical volume ($P < 0.001$).^[12] Patients who plan to receive hysterectomy were tent to cluster to high-volume surgeons, which was recognized as “bandwagon effect,” due to media report or introduction by friends and relatives.^[12] However, the proportion of hysterectomies by high-volume surgeons decreased from 49.1% to 37.1% in later years, whereas the percentage of all hysterectomies was accompanied by the increase of low-volume surgeons from 13.5% to 29.7% during the same time-frame periods. In addition, a similar trend was observed in LH, from 55.5% to 41% by high-volume surgeons, and from 8.8% to 26.9% by low-volume surgeons.

The use of LHs by high-volume surgeons decreased, while low-volume surgeons increased the surgical trend by three time-frames is shown in Figure 5. This means LH techniques spread from high- to median- and low-volume surgeons. Patients and their family used to label high-volume surgeons as reputable or famous surgeons. The myth to visit only high-volume surgeons as changed over the years [Figure 5]. The surgical techniques become more available in both high- and low-volume surgeons.^[12] This may have a great influence on patients and health-care providers. It is similar in hospital accreditation levels, the surgical skills and performance extended from medical centers initially, then into regional and local hospitals, high- to low-volume medical providers, as shown in Figure 4.

SURGICAL VOLUME HAS IMPACTS ON COMPLICATIONS, AND COSTS

High-volume surgeons have lower peri-operative complications

Surgical volume of gynecological surgeons may have impact on adverse outcomes in gynecology, gynecological oncology, and urogynecology.^[42] In a systematic review with large peer-reviewed studies and 741,760 patients, the low-volume surgeons group had an increasing rate of total complications (odds ratio [OR], 1.3, 95% confidence interval [CI] 1.2–1.5), intraoperative complications (OR, 1.6, 95% CI 1.2–2.1), and postoperative complications (OR 1.4, 95% CI, 1.3–1.4) in gynecology. In gynecological oncology, the low-volume surgeon group had higher mortality (OR, 1.9, 95% CI, 1.3–2.6). In the urogynecology group, a single study reported that the low-volume surgeon group had a higher rate of any complication (risk ratio, 1.4, 95% CI, –1.2–1.6). Surgeons performing procedures approximately once a month or less were found to have higher rates of adverse outcomes in gynecology, gynecological oncology, and urogynecology, with higher mortality in gynecological oncology.^[42] In another study by Healy *et al.*,^[44] low-volume surgeons had higher rates

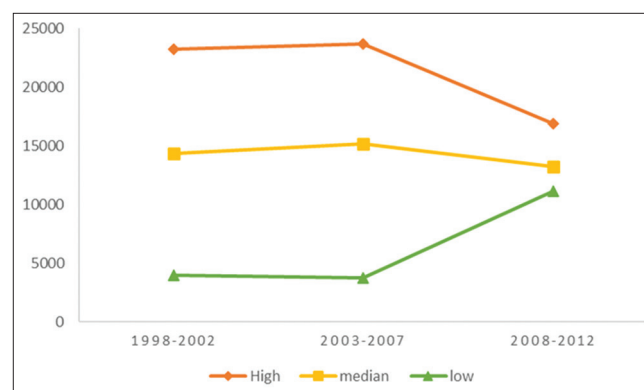


Figure 5: Surgical trend of LHs among different surgical volume surgeons, by 3 time-frames (modified from^[12])

of complications than high-volume surgeons (12.5% vs. 9.7%; OR 1.3; 95% CI 1.2–1.5), intra-operative (3.5% vs. 2.2%; OR 1.3; 95% CI, 1.2–1.5), postoperative medical (11.8% vs. 7.9%; OR 1.6, 95% CI, 1.5–1.6) and postoperative surgical complications (5.3% vs. 3.9%; OR 1.4; 95% CI, 1.3–1.4), more length of stay >2 days (6.3% vs. 8.4%; OR 1.4; 95%CI 1.3–1.4), but not significant in blood transfusion, readmission, and reoperation. The higher rates of complications were associated with higher costs \$867 (15.6%). To hospitals, these surgical complications result in a reduced profit margin, conversion of a small loss to a greater loss for patients with public insurance.^[45]

High-volume hospitals have lower costs

The demands on our health services and authorities are increasing, with hospitals having to provide evidence of cost containment and efficiency. Different health services around the world are costed and remunerated differently. The length of stay postoperatively differs between laparotomies, laparoscopies, and vaginal surgery. On-going costs, for example, associated morbidities such as wound infection and blood transfusion requirements, must be financially accounted for with regard to procedure selection in the same way that one-off capital investment in equipment is considered.^[44] The patients treated at high-volume hospitals had lower cost, that could be contributed to lower overall morbidity (OR = 0.79; 95%CI, 0.74–0.84), lower rates of reoperation (OR = 0.72; 95%CI, 0.53–0.98), prolonged hospitalization (OR = 0.54; 95%CI, 0.50–0.57), and nonroutine discharge (OR = 0.51; 95%CI, 0.37–0.71).^[46]

FUTURE PERSPECTIVES

How to increase the use of LH as MIS

Why can LH not increase more? The majority of hysterectomies were performed in older surgeons in Taiwan,^[6,36] while the aging process happened in surgeons, as well as in patients. Another explanation: Less new doctors choose to enter gynecology training and clinical practice.^[35,37] Older surgeons may find learning minimally invasive or advanced techniques more difficult than their younger counterparts.^[37] The decision regarding hysterectomy type depends also on surgeon characteristics and surgical practice, in addition to clinical indications.^[14,22,37,47] LH was more commonly by younger surgeons, trained more in LH than TAH,^[46] and resource availability.^[34] LH was commonly by high-volume surgeons. TAH by medium-and low-volume surgeons, which is in consistent with previous studies.^[35,36]

For an individual patient, the surgeon may consider the clinical factors and patients' best interests, and determine which route of hysterectomy will most safely facilitate removal of the uterus if indicated. The health-care providers,

surgical team as well as hospital optimize patient outcomes, given the clinical situation, surgeon training and experience, and hospitals where the surgeries are performed.^[48] In addition to the clinical situation, we found the significant differences presented in the distribution of types by surgeon age, surgical volume, and hospital levels. MIS can offer some advantages; therefore, we proposed the following 3 suggestions to increase the use of MIS, based on the available data from NHIRD, Taiwan, and the experiences of other countries.

First, it is important to recruit younger doctors to the clinical practice of gynecological surgery, since LH was performed more commonly by the younger doctor. However, there were fewer young doctors choose to enter gynecology training in the last 2 decades. To encourage medical students and/or postgraduate doctors, we may offer inspiring attachments for their core learning, providing special study components during their clerkship and PGY program in obstetrics and gynecology. Furthermore, some virtual reality game or competitions for endoscopic techniques may raise their interests and facilitate their participation.^[49] We, as endoscopists, must continue to behave as role models to encourage more junior doctors to enter our specialty as their career. The effect of improving the relations and contact between attending surgeons and students has been demonstrated clearly in research into the effects of role modeling and mentorship by surgeons in the interest of students in choosing subspecialty or further surgical careers.^[50]

Second, efforts must be made to improve the residency training program to increase the use of MIS through simulation model, e-portfolio, as well as postgraduate training and preceptorship. In the climate of restricted residency work hours, decreasing hysterectomy volume, and rising operating room costs, the development of training outside of the operating room becomes necessary.^[43] There are some tools or training programs that enhance theoretical and practical training, as virtual reality curriculum, dry laboratory, and cadaver workshop. In the past two decades, the Taiwan Association of Minimal Invasive Gynecology, in cooperation with Asia-Pacific Association for Gynecologic Endoscopy, has devoted their efforts in the postgraduate training programs with good progress. The innovations in the well-designed training program have resulted in the development of similar experiences of high-volume surgeons capable of performing LH to improve outcomes for patients undergoing gynecologic surgery.

Third, efforts need to continuously monitor and audit the safety and effectiveness of laparoscopy in gynecologic surgery. For example, the percentage of the use of laparoscopy

in hysterectomy can be used as a parameter of hospital accreditation.^[51] In-hospital or out-hospital audit systems may provide the quality assurance of MIS. The parameters may comprise of the complication rates, conversion rate, re-operation rate, morbidity, even mortality. These audit systems can be helpful for the improvement for MIS.

Although LH use has reached a plateau in the time-frame comparison study. However, we think LH performed can still be increased. Hopefully, LHs can increase after the suggestions mentioned in the session. Throughout the devotion and team collaboration of medical associations, hospitals, and endoscopists, we believe LHs can still increase in future.

MIS in gynecologic surgeries has some advantages over open laparotomy. The advantages include fewer complications, decreased pain, lower cost to the health-care system, Gutman (2017),^[42] for example, quicker return to normal activities (mean difference [MD]-15.17, 95% CI-17.21–13.14), shorter hospital stay (MD-1.82, 95% CI-2.34–1.31), and fewer wound or abdominal wall infections (OR 0.29, 95% CI 0.12–0.71) and fewer febrile episodes (OR 0.55, 95% CI 0.33–0.90).^[45] Therefore, we believe LH has more advantages over TAH in benign gynecology mentioned above. LHs are believed to replace TAH in certain situations, at least at part, if performed by an experienced surgeon with the appropriate assistance and equipment, with the above advantages.

CONCLUSION

The surgical trends of the use of LH changed significantly during the past two decades, which provides evidence of a paradigm shift for hysterectomy. This time-frame shift suggests LH has reached a plateau during the later years. Patient age, surgeon age and surgeon gender may affect the use of LH. Meanwhile, surgical volume has important impacts on both complications and costs. The high-volume surgeons have lower complications, which result in lower costs. In future, how to increase the use of LH for hysterectomy, how to improve the training and monitoring system, and the popularity of uterine-preserving alternatives deserve more attention.

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Conflicts of interest

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