

Laparoscopic hysterectomy: should the complications redefine the classification?

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Abstract The laparoscopic route for the removal of uteri for benign conditions represents a well-established surgical route over the last 20 years, gaining popularity throughout the world. The modifications of the original technique and the variable involvement of the laparoscopic component necessitated the description of this surgical procedure, and therefore, classification systems were introduced. An attempt was hence made to standardize laparoscopic hysterectomy so that we all understand the same meaning when we describe a specific type. This standardization, however, has not incorporated factors such as simplicity, different types of energy use, and complications that have to be audited to a set standard that probably does not exist yet, due to the variable complication rates in the literature. We look into the different major proposed classification systems and their benefits and drawbacks and try to redefine a system that is simple to use and may improve our audit purposes. In order to achieve this, we review the complications of laparoscopic hysterectomy in the literature, using the Cochrane collaboration, the Medline, and Embase databases.

Keywords Laparoscopic hysterectomy · Laparoscopically assisted vaginal hysterectomy · Total laparoscopic hysterectomy · Complications · Classification

Laparoscopic hysterectomy (LH) and laparoscopically assisted vaginal hysterectomy (LAVH) represent an approach to the removal of uteri for benign and malignant gynecological diseases that has been evolving the last 20 years [1]. The

slow uptake in this approach to hysterectomy may be due to variable complication rates and training necessary to standardize this procedure and reduce complications [2].

The surgical approach to hysterectomy was also addressed by the Cochrane collaboration which found complication rates in the laparoscopic groups to be variable [3]. Comparisons were made with vaginal (VH) and abdominal hysterectomies (AH) in different groups and complications were categorized in primary and secondary. All urinary tract injuries were higher in the LH group when compared to AH and in the total LH (TLH) when compared to the VH groups with more intraoperative bleeding and postoperative blood transfusions in the LH versus the VH modalities, thereby Cochrane review shed some light in the subject of benefits and risks associated with LH. The individual bladder and ureteric injuries though, when LH and AH were compared did not reach statistical significance, when the confidence intervals of the odds ratios were seen. Similar findings were observed in the LH to VH arm, with even no significant increase, with regards to LH, in the combined ureteric and bladder injuries. The only group that showed statistical significance was the comparison of TLH to VH, where the combined urinary tract injuries favored the VH. This subgroup consisted of two studies, one underpowered showing no statistical significance and the randomized controlled trial by Morelli et al. describing 12 urinary tract injuries in 200 women who had LH, a 6% occurrence which is well above the expected rate for such a complication [3]. No differences were seen in individual visceral organ injury, in the Cochrane review, between LH and total AH (TAH), LH and VH, or TLH and LAVH.

The e-VALuate study, representing the largest multicenter randomized controlled trial, compared LH, AH, and VH in two arms. It showed major complication rates for LH as high as 11.1% in the abdominal arm comparing LH to AH and

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9.8% in the vaginal arm, comparing LH and VH [4]. Ureteric injuries varied in the two arms for LH between 0.3% and 0.9% and bladder lacerations were seen between 0.9% and 2.1%, the first being somewhat higher than other studies such as the large retrospective review from Donnez et al. [5], with a 0.32% ureteric injury rate quoted and the 0.1% rate occurring in an 11-year period review of urinary tract injuries among 7,725 LAVH in a single center [6]. The e-VALuate study represents a well-designed and conducted trial with power calculation and intention to treat analysis, but with a wide variation in experience of the surgeons, despite the minimum 25 necessary operations to satisfy the personal learning curve, and without standardization or classification of the laparoscopic procedures. This would represent therefore a bias that can seriously undermine the primary endpoint results and may not describe complication rate and operating times in the hands of a proficient laparoscopic surgeon. A 1.2% ureteric injury rate was observed prospectively in a large multicenter survey which included 1,165 LH and with a clear drop in the rate during the second and final year of the study [7]. Although the data collection was from 1993 and 1994 and therefore experience and technique of laparoscopic hysterectomy has changed, modifying the complication rates, this was a well-designed and conducted prospective series, which described complications as its endpoint and with a considerable number of patients at follow-up. This rate dropped to 0.34% in a 6-year retrospective case series review performed in the same country, probably when proficiency was reached [8]. Conversely, the bladder lacerations are quoted below 2%, varying between 0.3–0.4% in retrospective reviews [5, 6, 9] and almost 1.5% in prospective cohorts [7, 10]. A meta-analysis of three randomized controlled trials (RCTs) of TLH and TAH showed significantly more total complications in the TAH group and no difference concerning the urinary tract injuries [11], similar to the RCT by Marana of LAVH and TAH [12].

The bowel injury rate in LH has been between 0% and 0.2% in the e-VALuate study, indifferent to that in other large studies [5, 7] and not significantly higher when compared to TAH or VH [3]. There does not seem to be considerable variance in this complication.

Hemorrhage and blood transfusion as occurring in 4.6% to 5.1% of the LH in the e-VALuate study interpreted into more intraoperative bleeding and transfusions in the laparoscopic as opposed to the vaginal access, but less mean blood loss and drop in hematocrit compared to AH. This was reiterated in the meta-analysis of TLH and TAH [11]. No difference in hematoma formation was identified. The Finnish national register of LH documented a 3.8% of blood transfusion, with 1.2% vascular complications. Again, these figures may be due to the learning curve observed especially in the first year of the study since during the review of hysterectomies performed laparoscopically in

Finland between 2000 and 2005, there were no major vascular injuries observed [8]. It is though possible that this retrospective case series of complications based on a national register and initiated by the patients seeking compensation to their injuries is biased by underreporting. Whether this has affected the results significantly is not known, but seems unlikely due to the large number of patients included. A relatively recent randomized clinical control trial comparing laparoscopic to vaginal hysterectomy for benign pathology, having as primary end point the duration of hospital stay, demonstrated statistically significant less intraoperative blood loss in the laparoscopic group [13]. Febrile morbidity was described in many ways and therefore cannot directly be compared. A temperature of more than 38.5°C after the first 48 h of surgery was used as criteria to include in the minor complications of the review by Donnez et al. [5], seen in 0.76% of the LH performed, but that represented a rate of 4.9% to 5.4% in the e-VALuate RCT [4], equivalent to the 5.6% of infections in the Finnish national register, half of which represent febrile morbidities of unknown origin [7]. Similar rates are described in TAH and LH [11], with fewer wound infections among laparoscopic routes of hysterectomy [3].

Other rare complications varied between studies and ranged from 0.1% for venous thromboembolism [7] to 0.7% for pulmonary embolism and 0.7% for deep vein thrombosis [10], similar to the RCT by Garry et al. [4]. Vaginal vault dehiscence is thought to be higher in hysterectomies performed via the laparoscopic route [14] and quoted as 1.14% using this route. Wound dehiscence shown in the e-VALuate study [4] was 0.2–0.3% in the LH groups, similar to TAH (0.3%) but higher than VH (0%). Mortality rates were 0.12–0.034 per 1,000. Laparoconversions are not more frequent when LH is performed, as opposed to VH [3], and are prevalent in 2.7% to 3.9% of LH in the e-VALuate RCT study [4], as opposed to 0.76% in a retrospective review from Australia [9] and 7.5% in a prospective study from France [15].

Some of the above morbidities pose small risk to the patients' recovery, but others have serious implications and therefore their prompt diagnosis and management is crucial. Ureteric injuries represent a major complication, and despite the belief they mainly occur at the level of the infundibulopelvic ligament, during LH, they can occur at any level from the pelvic brim to the ureteric canal [16]. Their occurrence is probably directly related to the experience of the operator [17] and is significantly decreased by as much as 44% as the surgeon becomes more confident with the approach [2]. Vault dehiscence is related to early sexual intercourse resumption after surgery and vaginal blood loss and is associated with vaginal evisceration [14]. There have also been suggested relations of the risks of LH with increased uterine size, BMI, uterine

width more than 10 cm, previous cesarean deliveries, and the mode of hemostasis of the ovarian pedicle [4].

Therefore, with increasing experience and patient selection, laparoscopic hysterectomy can be safe to perform and replace most of the instances when the laparotomy route is used. The necessity to standardize the procedure and record the level of laparoscopic involvement imply the use of an efficient, simple, and reproducible classification.

Laparoscopic hysterectomy has been classified by different authors and in various ways, and a consensus was reached by the American Associations of Gynecological Laparoscopists [18] to adopt the one proposed by Munro and Parker [19]. This systematic method to describe the laparoscopic hysterectomies using anatomical landmarks involved during the operations has a five-stage stratification using the type 0 class for preparation purposes. It very thoroughly covers possible alterations to the procedure and provides the surgeon subclassification methods (A–E) to describe it. Its complexity though led to the abbreviated system which again uses the same five types, but only describes the anatomical landmarks involved laparoscopically during the procedure, together, either unilaterally or bilaterally (Table 1).

This classification system does not mention the method of closure of the vaginal vault in a separate type or subtype, making it difficult to audit complication rates of vault dehiscence and hematoma formation, which may be related to vaginal or laparoscopic suturing. Being more complete than the system proposed by Johns and Diamonds [20], it also includes steps which may be of importance to know if they were performed vaginally or laparoscopically, such as the cardinal and uterosacral ligaments, as complications can be related to excessive fulguration or inappropriate suspension. Garry proposed a descriptive approach, which seems appealing due to simplicity and clear distinction. This was achieved by not using a numerical approach but rather describing the primary and if likely the secondary operations. Being simple to reproduce, this system has the drawback of not exactly defining the anatomical

landmarks of the operation, which by themselves will promote standardization of the technique and make easier the way we evaluate our operations and audit our results. It seems more reasonable therefore that a simple descriptive approach, incorporating the surgical anatomy and defining the method of vault closure, will serve the above purposes. It also appears that a diagnostic laparoscopy, which has been classified as stage 0 [20], or a preparatory procedure (type 0 by Munro) [19], does not contribute to the actual description of the hysterectomy and can be documented separately in order to explain comorbidities such as adhesions and endometriosis. Surgery furthermore aims to follow bilateral descriptions, and should there be any deviation from the standard, this should be described rather than classified as unilateral procedure (i.e., adnexectomy).

A different pattern was used by Nezhat to classify hysterectomies [21], where seven operative steps were used and these were acknowledged in a descriptive manner. These were the round and broad ligaments (step 1), the infundibulopelvic ligaments (step 2), the uterine vessels (step 3), the bladder flap and pillars (step 4), the uterosacral–cardinal complex (step 5), culdotomy (step 6), and finally the vaginal vault closure (step 7). They used the term TLH for the procedure being completely performed laparoscopically and subtotal laparoscopic hysterectomy for the supracervical version. Vaginally assisted laparoscopic hysterectomy (VALH) involves according to Nezhat's classification at least four steps laparoscopically and laparoscopically assisted vaginal hysterectomy (LAVH) involves three or two. This step-wise, very logical, and anatomically correct classification mentions steps like the round ligaments and the bladder dissection that are usually performed in the process, but probably are of minor importance in the classification process since their dissection is standardized and would not be necessary in the case of an LAVH, but always performed during the rest of laparoscopic hysterectomies. Moreover, VALH and LAVH seem to be separated by the number of steps and whether the culdotomy was done with energy laparoscopically or using cold knife vaginally is not distinguished in this classification process, but rather needs supplementation using the precise steps involved. One would not be able therefore when describing a standard laparoscopic intra-fascial hysterectomy with dissection of the cardinals and

Table 1 Abbreviated classification system for laparoscopic hysterectomy (modified from AAGL)

Type 0	Laparoscopic-directed preparation for vaginal hysterectomy
Type I	Occlusion and division of at least one ovarian pedicle, but not including the uterine artery(ies)
Type II	Type I plus occlusion and division of the uterine artery, unilateral or bilateral
Type III	Type II plus a portion of the cardinal–uterosacral complex, unilateral or bilateral
Type IV	Complete detachment of cardinal–uterosacral ligament complex, unilateral or bilateral, with or without entry into the vagina

Table 2 Proposed classification of laparoscopic hysterectomies

Description	Type
LAVH	I
LH	II
LH	III
LH	IV
TLH	IV

uterosacral ligaments laparoscopically to specify this by just using the term VALH, but would need to state step 5 LAVH. This is quite cumbersome and assumes consecutive steps, with the bladder preparation done after the uterine vessel desiccation, which is not often the case.

We would suggest four types of laparoscopic hysterectomy, using five descriptions, where type I LAVH (laparoscopically assisted vaginal hysterectomy) involves laparoscopic dissection of the infundibulopelvic ligaments. Type II LH (laparoscopic hysterectomy) involves transection of the uterine arteries and type III of the uterosacral and cardinal ligaments, laparoscopically. Finally, type IV LH involves laparoscopic culdotomy with vaginal suturing and type IV TLH involves a laparoscopic culdotomy and suturing (Table 2).

The combination of anatomical and descriptive classification retains the simplicity of use of Garry's descriptive method, incorporating different anatomical levels and defining the vaginal vault closure. The description of LAVH or TLH would need no further explanation, whereas LH would need to be typed as II, III, or IV. This may represent a simple, uniformly adapted way to describe LH, facilitating auditing complications and other variables by providing all the important anatomical levels of the procedure. The different forms of energy used, as well as other particulars of the operation, would need to be mentioned separately for the purposes of completion.

In conclusion, laparoscopic hysterectomy should be the preferred route of hysterectomy when the vaginal route is not deemed safe, complications should decrease with increasing experience and remain below 1%, and standardization of the procedure as much as possible, together with a simple, thorough, and applicable classification to audit our complication rates, should help achieve this [22].

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