Criticism of learning curve in laparoscopic adrenalectomy: a systematic review

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Abstract

Background. Laparoscopic adrenalectomy (LA) has become the treatment of choice for benign adrenal lesions. Lateral Transperitoneal Laparoscopic Adrenalectomy (LTLA) is considered the gold standard. The number of LTLAs a surgeon must perform, in order to complete his learning curve, is not well defined in Literature. Moreover, the few papers dealing with the learning curve for LTLAs show controversial results and consider different evaluation parameters.

Methods. The systematic review has been carried out according to PRISMA statement. The literature search included PubMed and Scopus database. Hand searching of reference lists of previous review articles and relevant studies was also performed. The search string was “learning curve AND laparoscopic adrenalectomy”.

Results. A total of 9 papers met the inclusion criteria out of 94 non duplicate citations. The aim of this systematic review is to provide a multidimensional evaluation by bringing into focus evaluation parameters of surgical performance, (operative time, intraoperative complications, conversion rate and blood loss), factors related to patient’s pathology (side, size, adrenal pathology) and surgeon-specific properties.

Conclusion. Operative time, intraoperative bleeding, intraoperative complications and conversion rate are the main parameters that have been considered for the achievement of learning curve, and for each there are discrepancies, mainly due to the relative rarity of adrenal tumors, and so for difficulties in obtaining approper analysis that could establish an effective learning curve. So, further evaluations in larger experience are needed.

Key words: Laparoscopic adrenalectomy, learning curve, lateral transperitoneal laparoscopic adrenalectomy, adrenal tumor

Introduction

Laparoscopic adrenalectomy (LA) has become the treatment of choice for benign adrenal lesions. (1, 2). The advantage of laparoscopic adrenalectomy in terms of blood loss, operative time, pain and hospital stay is undisputed (3-5). LA can be performed by different approaches (3), but Lateral Transperitoneal Laparoscopic Adrenalectomy (LTLA) is considered the gold standard (3, 6).

Surgeons who access the adrenal gland laparoscopically, should gain an acceptable level of ability, experience and technical skills (3, 7). Commonly advanced laparoscopic procedures such as adrenalectomy, commences after training through less complex procedures, such as cholecystectomy, appendectomy or hernia repair (7). The method of learning curve evaluate surgeon’s performance for any procedure, predicting the minimum number of procedures required to reach intra and post-operative results comparable to experienced surgeon performing the same technique. This progression can be viewed graphically as inexperienced physicians gradually reach a level of improved individual performance in the initial phase of their curve (8, 9). To assess the learning curve for any surgical procedure, evaluation parameters must be identified and compared (8).

So, the aim of this study was to perform an extensive review on this matter, comparing the different methods used and the outcomes to be evaluated to achieve the learning curve.

Materials and Methods

The systematic review has been carried out according to PRISMA statement (10). The literature search included PubMed and Scopus database up to the end of December 2018. Hand searching of reference lists of previous review articles and relevant studies was also performed. The search string was “learning curve AND laparoscopic adrenalectomy”. Advanced search options including synonyms, partial word and combinations were used: “laparoscopic lateral transperitoneal adrenalectomy”, “LTLA”, “LTLA AND learning curve”. Inclusion criteria were represented by articles had enough information regarding laparoscopic monolateral adrenalectomy performed by lateral transperitoneal approach. In case of duplicate publications, the latest and most complete one was included in this review. The results were restricted to articles published in English. Exclusion criteria

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were represented by article regarding robotic adrenalectomy, partial adrenalectomy, retroperitoneal adrenalectomy and open adrenalectomy.

**Data extraction**

Data were extracted from each study study, using a pre-defined database form, by two independent reviewers (GC and DC), which resulted in high inter-observer agreement. Informations included name of the authors, title of the study, journal in which the study was published, country and year of the study, surgical technique, considering only laparoscopic adrenalectomy by lateral transperitoneal approach (Lateral Transperitoneal Laparoscopic Adrenalectomy, LTLA), and learning curve strategy. We also evaluated operative time, blood loss, adrenal gland pathology, lesion side, conversion rate, intra- and postoperative complications (using the Clavien-Dindo classification) (11).

**Results**

A total of 9 papers met the inclusion criteria out of 94 non duplicate citations (Fig. 1). Included papers were evaluated using Jadad scale for RCTs checklist and the New Castle Ottawa Scale for cross sectional studies, case control or cohort studies. Results are summarized in Table I.

7 of the 9 examined studies reported a number of surgical interventions necessary to complete the learning curve. The number of procedures mentioned ranges from 20 to 50 (mean 31.57) (12-14, 16, 18-20) 3 of these 7 studies established the number according to the stabilization of operative time (12-14). 1 article considered the reduction of intraoperative blood loss (14). 1 study established the number of procedures required according to stabilization of intraoperative complications (3%) (16) while 1 study was based on stabilization of operative time in association with the reduction in conversion rate (1%) (18). Stabilization of operative time, reduction of intraoperative complications (2%) and conversion rate (4%) are considered by 1 study (19). Mean operative time, considered as time elapsed between first incision and last skin suture, is reported as a reference parameter for completing the learning curve by 6 included articles (range from 116 to 175 minutes, mean 149.8 minutes) (12, 13, 16-20). Adrenal pathologies were considered in 2 studies that showed as LA for Pheochromocytoma is the latest procedure to deal with for surgeons who are completing the learning curve (15, 17), while other Authors underlined that the left adrenalectomy should be performed earlier than right (20). Surgeon experience in Laparoscopy is emphasized in 2 works as parameter influencing the learning curve (17, 20).

**Discussion**

The term ‘learning curve’ typically describes a graph where the proficiency in a specific task is measured over time (21).

In surgery, the mastery of a skill against the time required is the result of several elements. Surgeon-specific properties (medical knowledge, aptitude factors, repetitive practice) joining to patient and procedure-related characteristics must be taken under consideration (7). The crucial topic is to establish which parameters must be examined in order to complete the learning curve on the specific task (7, 8). Then it is necessary to analyze any correlations of the evaluation parameters with the number of cases experienced by the surgeon. Finally it is mandatory fix the minimum number of procedures to achieve such a target (cut-off value) (8).
There are many publications regarding learning curve in both laparoscopic surgery (8, 9, 21-23) and regarding surgical approaches to LA (24), including lateral transperitoneal, anterior transperitoneal (25), posterior retroperitoneal and transthoracic approaches (3). The development of different approaches for LA is due to the anatomic location of the adrenal gland in the upper retroperitoneal space, close to the diaphragm, cranial and medial of the kidneys (3, 26-28). Nevertheless, LTLA is the most commonly used technique (3) since it offers advantages to the surgeon, in particular in its early learning curve, because the visualization of landmarks is similar to open surgery (3, 26).

Reports regarding learning curve for LTLA considered dissimilar parameters to achieve it (14, 16, 19). This variability is related to the lack of a standard definition of appropriate evaluation parameters.

The aim of this systematic review is to provide a multidimensional evaluation by bringing into focus evaluation parameters of surgical performance, (operative time, intraoperative complications, conversion rate and blood loss), factors related to patient’s pathology (side, size, adrenal pathology) and surgeon-specific properties.

Several studies proposed the stabilization of operative time as a measure of the learning curve. Valeri et al. (12) and Pillinger et al (13) first described in 2002 how achievement of a steady state in surgical time can be considered a valid endpoint for carrying out the learning curve. Later, some Authors added other evaluation parameters to the operative time: David et al. (16) showed that there was a significant reduction in mean operative time and in intraoperative complications. Authors pointed out the operative time and intraoperative complications reduction accruing the experience, leading to locating the flattening of learning curve after approximately 30 cases performed. This number of surgical procedures was suggested as a turning point of learning curve for LTLA (16). Ali et al. (18), in their 158 LTLAs, reported 5 open conversions (3.9%), 4 of these occurring during the first 14 procedure performed, demonstrating a significant reduction in conversion rate after the first 40 procedures. The same Authors also demonstrated a significant reduction in operative time (p: 0.011) after 40 procedures. Friszer et al. (19) demonstrated a significant reduction in operative time (216.2-131.9 minutes, p<0.01) during the learning curve, as well as the number of conversion to open surgery (18%-3.7%, p=0.013). Nevertheless, there was not any significant differences in the number of complications in this series.

Nevertheless, all these studies did not led to the same conclusions, reporting a different number of procedure to achieve the learning curve.

Maccabee et al. (14) established learning curve flattening at 20 cases performed. Unexpectedly, operative time did not decrease in this series, in contrast with complication rate and blood loss. The peculiar operative time pattern was explained by the constant training cycle and continuous changeover between the more competent surgeon observed in Maccabee’s experience (14).

There is a variability linked to the adrenal disease itself. Several studies discussed the size of the adrenal lesion but no one considered it as a parameter of inclusion or exclusion of patients from the learning curve period. Adrenal lesions larger than 8-10 cm can be challenging to resect at the beginning of LTLA experience because requires gentle handling for proximity to principal vessels and to adjacent organs (29). A wrong selection of patients undergoing LA might determine a bias during the learning curve period (7).

Several studies considered characteristics of the adrenal mass such as tumor side and pathology. LA for an Aldoste-
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rone Producing Adenoma or a non-functioning adrenal mass is recognized as being less challenging when compared to surgery for pheochromocytoma or Cushing’s disease (15, 30, 31) and, as underlined by Poulin et al. (15), surgeons should not perform LA for pheochromocytoma during their learning curve assessment. Accordingly, Eto et al. (17) reported that aldosterone producing adenoma is the most suitable disease among all adrenal disorders for beginners in performing LA. The study showed a descending learning curve in terms of operative time and blood loss for Cushing adenomas and aldosteronomas as the number of procedures increased; did not show significant operative time decrease over Pheochromocytomas (7, 17). Pheochromocytoma should be excluded because its surgical treatment seems to be more dependent upon the features of the tumors themselves than the learning curve of the operators (17).

LA performed on right or left side are different procedure due to anatomical relationship with surrounding structures and vascularization. The right adrenal vein is very short and empties into the vena cava (32). On the left side, the typical adrenal vein insertion can be seen on the left renal vein, though it may include branches from the inferior phrenic vein (5). Sommeray et al. (20) proposed that during the learning curve left adrenalecctomy should be trained first due to the proximity of the right adrenal to the vena cava (20).

Last but not least we should keep in mind surgeon’s experience. Surgeons who access the adrenal gland laparoscopically, frequently have already gained skills for other laparoscopic procedures (3, 33, 34). The safety of the operation depends mainly on the experience of the team performing the procedure. Eto et al. (17) reported a shorter learning curve for surgeons after participating in at least 10 procedures as assistant surgeon. Sommeray et al. (20) claimed that residents should be supervised by an experienced surgeon for at least 30 procedures. Several studies support the importance of referral centers to accomplish the learning curve. Although in recent years, thanks to the improvement of diagnostics, the number of adrenal pathologies needing surgery has greatly increased, they still have low incidence size, as well as procedure-related outcome, such as mean operative time, intraoperative complications, blood loss and conversion rate, and, finally, surgeon-related factors, meant as laparoscopic competence.

Nevertheless there are no numerical data reported univocally and significantly from the various studies reviewed. This is due to the limited number of cases reported by the studies which are carried out in long periods, given the rarity of the adrenal pathology.

Conclusion

There is no clear definition of the effective learning curve for lateral transperitoneal laparoscopic adrenalectomy. Results from studies in this systematic review are controversial for methods and evaluation parameters. Operative time, intraoperative bleeding, intraoperative complications and conversion rate are the main parameters that have been considered for the achievement of learning curve, and for each there are discrepancies, mainly due to the relative rarity of adrenal tumors, and so for difficulties in obtaining approper analysis that could establish an effective learning curve. So, further evaluations in larger experience are needed.

References


