Editorial

Evaluating the learning curve for posterior retroperitoneoscopic adrenalectomy

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Background

The introduction of laparoscopic capabilities revolutionized the surgical approach to adrenalectomy, as it has for many other surgical procedures, and is now the "gold standard" for surgery of the adrenal glands (1,2). The first reports of lateral transperitoneal laparoscopic adrenalectomy (TLA) by Gagner *et al.* date back to 1992, and this was soon followed by descriptions of the lateral retroperitoneal (LRA) and posterior retroperitoneal (PRA) approach in 1995 (3-6). The benefits of each technique over the others is still a matter of debate amongst surgeons (7,8). The PRA approach was further developed and popularized by Walz, and has become increasingly utilized internationally over the last two decades (2). It has been shown that PRA confers a shorter operating time, shorter hospital stay, less post-operative pain and similar incidence of complications when compared with TLA (9-12).

There are also several intraoperative advantages to PRA. Due to the position of the adrenal glands, the TLA approach necessitates mobilization and retraction of intraperitoneal organs including liver, pancreas, spleen and colon to obtain access. Furthermore, TLA is performed with the patient in the lateral position, and requires repositioning of the patient for bilateral adrenalectomy. PRA allows the surgeon a direct approach to the adrenal glands via the retroperitoneum, and the ability to access both adrenal glands from the prone jack-knife position. However, the retroperitoneoscopic space is an anatomically unfamiliar region to many surgeons. The technique can be especially difficult with larger tumours, as the working space is significantly smaller (11). Several recent studies have aimed to evaluate the learning curve for PRA (13).

Literature review

A recent study by van Uitert *et al.* assessed the learning curve of PRA in a high-volume center and concluded that a short learning curve can be expected for a surgeon already experience in laparoscopic surgery. This study is one of the largest prospective case series published, including 290 consecutive patients operated on by two experienced laparoscopic surgeons over a seven-year period, from 2007–2014. After 2011, 113 underwent PRA by one of the surgeons. Inclusion criteria for the study were: tumours <7 cm, BMI <35 kg/m^2 and low suspicion of malignancy. They assessed the data by dividing the PRA patients chronologically into groups of twenty patients and demonstrated a clear decrease in PRA operating time between groups one, two and three from a mean of 100 to 83 to 60 min, respectively. After the first sixty patients, the operating time was found to plateau with no significant difference in complications or outcomes (9). The results compared favourably to the TLA cohort, demonstrating shorter operating time, less blood loss, and shorter hospital length of stay. These results were similar to those found by Barczyński *et al.* who demonstrated an initial average operating time for PRA of 110 min that decreased to 75 min after 20 patients and 65 min after 60 patients (1).

Other studies have suggested that the learning curve for PRA is even shorter. We (Cabalag *et al.*) published our series of 50 PRA performed by a single surgeon and demonstrated that the operating time decreased to 61 min after only 15 cases with few complications, no conversions to open surgery and no deaths (14). Similarly, Bakker *et al.* showed that in a relatively small case series of 14 patients, median operating time for PRA decreased to under 1 hour after only ten cases (13). In both these studies a single surgeon was the primary operator for all surgeries and this shorter learning curve may be a reflection of individual technical abilities. Also of note, the surgeons involved in these two studies were trained under the direct guidance of Walz—the pioneering surgeon of PRA. Furthermore, remote telemonitoring techniques were safely and effectively implemented for the first three PRA cases performed in our series, which may have assisted in decreasing the learning curve (15).

When implementing a new surgical procedure, two distinct phases of learning should be recognized. The first phase is that in which a completely new technique is being developed and the learning curve is inevitably long; the second phase is when a new technique is introduced to an institution or surgeon with the requisite skills, in which case the learning curve is typically much shorter (1). This concept is appropriately explored in the study by van Uitert *et al.* Their study included patients operated on by two experienced urological surgeons thus was typical of the second phase of learning (9). This is evidenced in Walz's landmark paper of 560 PRA over 12 years [1994–2006]. Walz *et al.* demonstrated a mean operating time of 106±46 min for the first 112 cases, which decreased to 40±15 min for cases number 448 to 560. This relatively long learning curve is expected given that Walz *et al.* were developing PRA as a completely new technique (16).

The most relevant comparison for the learning curve of PRA is that of TLA. Traditionally, it was thought that TLA had a shorter learning curve for most surgeons compared to PRA. This may be due to the familiarity of most surgeons with the intraperitoneal space and anatomy. However, a number of studies have suggested that this may not be the case. Pędziwiatr *et al.* found that TLA had relatively long learning curve. They presented 500 cases retrospectively and found no significant difference in mean operating time when comparing the first 125 cases to the last 125 cases (85.7 and 104.6 min, respectively), and no difference in the rate of open conversion. However, there was a significant decrease in complication rates (14.4% and 5.6%, respectively) and length of hospital stay (4.9 and 2.4 days, respectively) (17).

Other groups reported significantly quicker learning curves for TLA. In 2008, Guerrieri *et al.* analyzed 241 consecutive cases and estimated that the learning curve for TLA is roughly 30 and 40 cases for right and left TLA, respectively (18). A similar learning curve for TLA was found by Eto *et al.* who separated their cases by pathology of tumour and assessed both operating time and blood loss as primary end points (19). Accordingly, Ali *et al.* analysed 134 TLA on 127 patients over a ten-year period by dividing their cases into early (first 40 cases) and late (next 87 cases) groups. They found a statistically significant decrease in both operating time (140.1±42.8 to 118.1±40.4 min) and rate of conversion to open (10% to 1.1%). There was no significant difference in length of stay, 30 day re-operation rate or morbidity (20). Goitein *et al.* presented a series of 90 consecutive cases and found that the mean operating time decreased from a mean of 169 min (cases 1 to 30) to 116 min (cases 31 to 60). Although the operative time did not significantly decrease from cases 31 to 60 compared with cases 61 to 90, there were significantly fewer conversions to open (seven compared to none) and post-operative complications for the last thirty cases (21).

A comparison can also be made between PRA and other established laparoscopic procedures such as laparoscopic cholecystectomy and laparoscopic prostatectomy. When it was first popularized in the late 1980's and early 1990s, laparoscopic cholecystectomy was thought to have a learning curve of between ten to thirty-five cases (22,23). However, it must be noted that at this time laparoscopy as a technology was still in its infancy and therefore surgeons learning laparoscopic cholecystectomy were developing a completely new skill set. Laparoscopic prostatectomy, on the other hand, is more directly comparable to PRA, and believed to have a learning curve of approximately 50 cases (24).

Discussion

Learning curves in surgery are difficult to assess due to the high number of variables. Aside from the aforementioned phases of learning, the learning curve of any procedure is dependent on the surgeon, training opportunities, tumour pathology, patient factors, equipment factors, hospital factors, and case volume, amongst many other independent variables. Anecdotally, most surgeons would agree that continuous, life-long learning is requisite of surgery and that even after hundreds of cases one should still be learning

and refining one's technical skills. There is no universally accepted end point to assess completion of a learning curve. Most of the studies assessing the learning curve of PRA assessed operative time and perioperative complications, but it is difficult to directly compare these patient cohorts due to the heterogeneity of the analyses. We would propose that an appropriate definition of the adequacy of learning is a plateau in operative time and a low incidence of perioperative complications, with an adequate case volume to draw meaningful conclusions.

Van Uitert *et al.*'s study adds to the growing consensus that PRA, despite its anatomical re-orientation, has many advantages, including a short learning curve for appropriately skilled and trained surgeons. The study by van Uitert *et al.* is a large, prospective study of PRA which identified appropriate exclusion criteria and concluded that a relatively short learning curve of no greater than 40 patients was achievable. Our own data (Cabalag *et al.*) showed a plateau in operative time after 15 cases with no significant perioperative morbidity (14). Therefore, although the unfamiliarity of the retroperitoneal space may be daunting at first, this should not serve as a deterrent for a surgeon to learn PRA. There is now sufficient evidence in the literature to conclude that the learning curve for PRA is comparable, if not shorter than that of TLA with no significant difference in morbidity, conversion to open surgery or other perioperative complications. This, combined with shorter overall operating time, shorter hospital stay, and less post-operative pain should encourage the development of PRA as an alternative "gold standard" for adrenal surgery (11).

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