LAPAROSCOPIC PARTIAL NEPHRECTOMY IMPACT OF SURGEON'S LEARNING CURVE ON THE PERIOPERATIVE TRIFECTA

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ABSTRACT

Background: Laparoscopic partial nephrectomy is at the high end of surgical refinement in laparoscopic urology, with significant technical challenges associated with the operation. We aim to assess the learning curve impact of a single surgeon on the perioperative outcomes, manifested by the previously described trifecta.

Methods: A retrospective review of records of 142 consecutive patients who underwent laparoscopic partial nephrectomy during the three years between March 2014 and March 2017. All cases were performed by a single surgeon at a tertiary center, Belfast City Hospital. The further patient analysis was done according to their demographics and renal nephrometry score. The impacts of the surgeon's experience on the perioperative outcomes were assessed retrospectively, as manifested by the trifecta (ischaemia time <25 min, negative surgical margins, and no surgical complications) using multivariable regression. The outcomes for cases 42–92 (Group-1) were compared with those for cases 93–142 (Group-2). StatsDirect was used for the statistical analysis. A paired *t*-test was used to compare the outcomes in both groups. A *p*-value ≤ 0.05 was considered statistically significant.

Results: There was no significant difference in patients' demographics nor renal scoring system (p=0.09 and 0.4, respectively). There was also no significant difference in perioperative blood loss (p=0.24, 95% CI: 0.4 to 0.7). Warm ischemia time (WIT) was significantly less in Group-II (p=0.043). There was no significant difference in the positive surgical margins in the two groups (p=0.63). Perioperative urine leak was significantly higher in group-1 (p=<0.001). The median hospital stay was similar in both groups. At three months of follow up, the renal function, manifested by estimated glomerular filtration rate (eGFR), was stable. No patient needed renal replacement therapy.

Conclusion: Laparoscopic partial nephrectomy represents a steep learning curve. There is an improvement in the perioperative outcomes, mainly in terms of urine leak. However, the learning curve plateau is yet to be reached at the number of cases assessed. More cases are needed to be evaluated, and longer follow-up would be helpful.

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Keywords: Laparoscopy, Learning curve, Partial nephrectomy.

Renal preservation therapy is now considered the gold standard when dealing with localized renal cell cancer (traditionally T1a and selective cases of T1b tumors), with an increasing indication towards larger tumours[1,2]. Although laparoscopic partial nephrectomy (LPN) requires advanced laparoscopic abilities, The surgical outcome and results when carried out by an experienced surgeon could be comparable to those of the traditional open partial nephrectomy

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(OPN) with shorter inpatient stay and comparable perioperative and oncologic outcomes[3,4].

Since LPN is a complex operation that necessitates high technical dexterity, a defined minimum number of cases to achieve an aspired level of competency is lacking[5]. Since the trifecta model, defined as a combination of minimal renal function decrease and no perioperative complications, with negative surgical margins, was introduced to evaluate partial nephrectomy outcomes, it became the benchmark for assessing the success of the nephron-sparing surgery[6]. Hence, this review aims to evaluate the impact of a single surgeon's learning curve on the perioperative outcomes manifested by the previously described trifecta.

PATIENTS AND METHODS

The medical records of 142 patients who underwent LPN by the same surgeon between March 2014 and March 2017 were reviewed. Data were obtained for these patients from the Electronic Care Record (ECR) and tumor complexity assessed by imaging review using the RENAL nephrometry scoring system by two independent clinicians. We retrospectively assessed the impact of the surgeon's experience on the perioperative outcomes, as manifested by the trifecta (ischemia time <25 min, negative surgical margins, and no surgical complications) using multivariable regression. The outcomes for cases 42–92 (Group-1) were compared with those for cases 93–142 (Group-2). StatsDirect was used for the statistical analysis. Paired-t-test was used to compare the outcomes in both groups. A

p-value ≤ 0.05 was considered statistically significant.

Perioperative outcomes were assessed in terms of recorded blood loss, transfusion requirements, conversion to open procedures, complications including postoperative sepsis, and urine leak were noted. Changes in the estimated eGFR were also assessed pre and post-operatively, which was checked prior to their discharge from the hospital. The data were analyzed using a two-tailed t-test.

OPERATIVE PROCEDURE

Under general anesthesia, with the patient in a frog-leg position, cystoscopy is first performed with placement of an ipsilateral ureteric catheter, with the tip positioned in the renal pelvis. This is then secured to a urethral catheter and is later utilized to assess the integrity of the pelvicalyceal system. The patient is then placed in the lateral decubitus position. Laparoscopic ports (4 to 5) are then placed in the lumbar region for left or right-sided tumors, respectively. After establishing a pneumoperitoneum at a pressure of 12 mmHg, the renal vessels are fully dissected to allow clamping (if required). The kidney is then fully mobilized, and Gerota's fascia incised to obtain complete exposure of the tumor.

Prior to resection, intraperitoneal pressure is increased to 18 mmHg. This is to minimize venous ooze from resection lines, as previously described[6]. Monopolar scissors are used to open the renal capsule, 5-7mm away (non-measured surgeon's judgment) from the tumor and subsequently for cutting deep into the renal cortex slowly and carefully around the tumor. No frozen section was performed in

any of our procedures. Bipolar coagulation is applied if small arterial bleeding occurs. After complete excision of the tumor, the pelvicalyceal breach is then determined with an injection of methylene blue via the ureteric catheter. First layer renorrhaphy is performed using MedTronic V-Loc barbed suture. For the hilum controlled (HC) group, the laparoscopic clamp is removed at this stage. Early unclamping minimizes warm ischemia time (WIT), seeking to minimize ischaemic injury to the kidney. Evicel hemostatic agent (Ethicon) is applied over the first renorrhaphy layer. The second renorrhaphy layer is subsequently performed to approximate the parenchymal defect, with Weck Hem-o-lok clips applied to tighten and secure the sutures at each exit point.

RESULTS

The patients' demographics are as shown in table 1. No significant difference was observed in patients' demographics or RENAL scoring system (p=0.09 and 0.4 respectively), figures 1 and 2.

Table 1: Patient demographics and tumour characteristics:

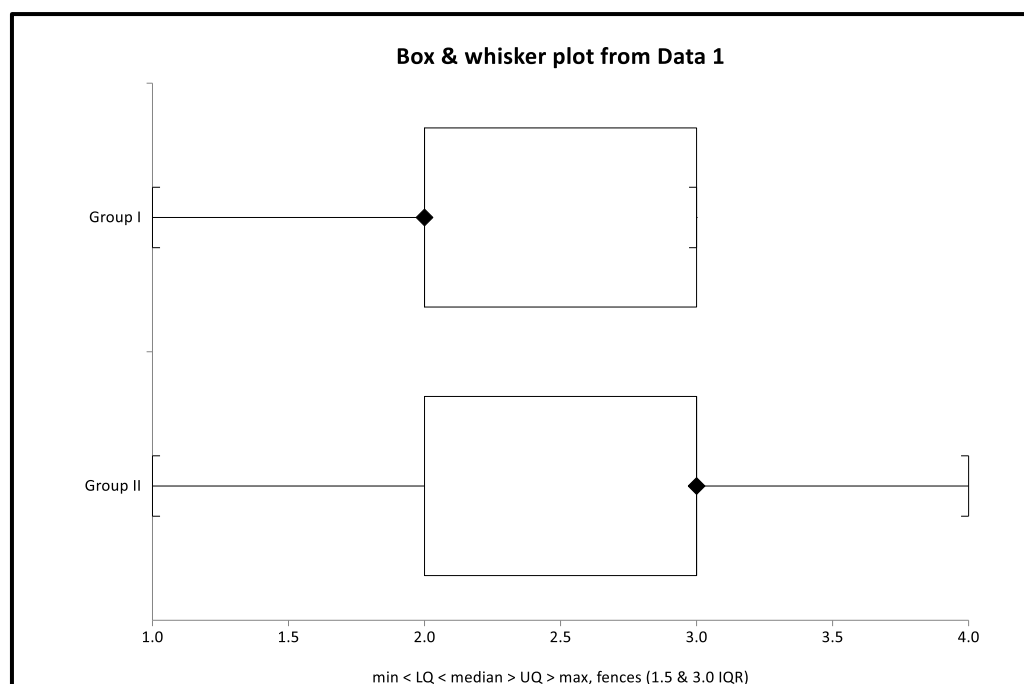| Variables	Group I	Group II	P value
Number of patients	50	50	
Mean Age (years)	57	58	>0.99
ASA 1	10	5	0.2
ASA 2	22	24	0.8
ASA 3	18	21	0.6
RENAL nephrometry scoring (mean)	8	5	0.4
Off clamp cases (n)	43	12	<0.001

Figure 1: Box plot showing ASA scoring in the two groups.
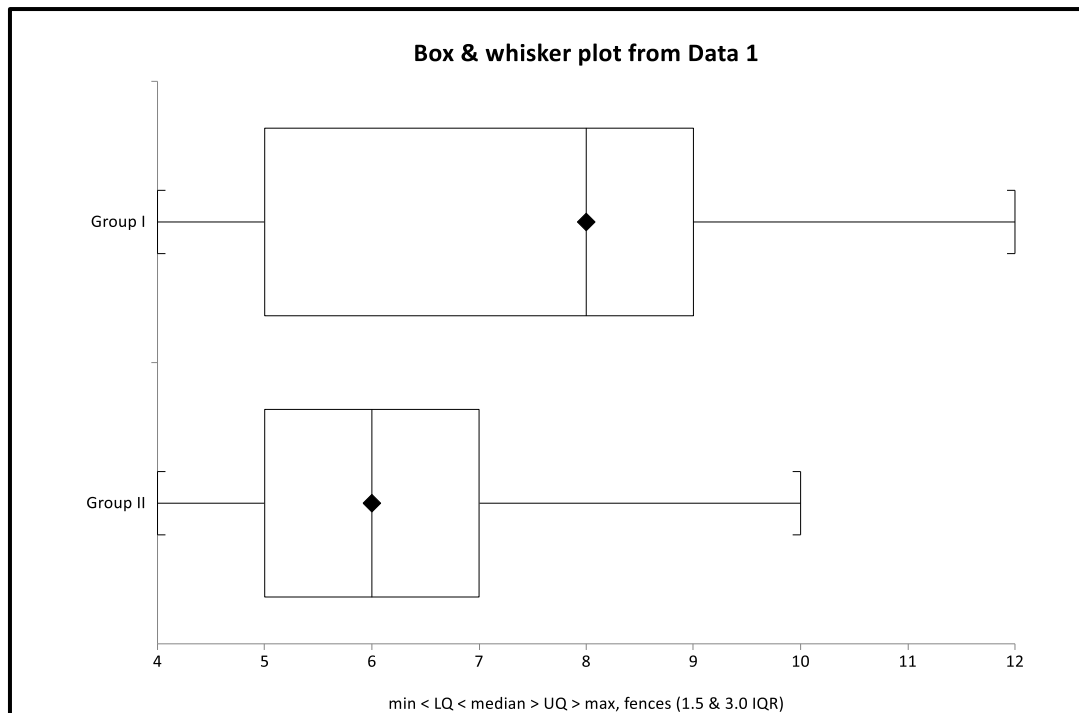
Figure 2: Box plot of the RENAL nephrometry scoring system in the two groups.

As for the per-operative trifecta, no significant difference in the perioperative blood loss (P=0.24, 95% CI: 0.4 to 0.7) was observed, figure 3. There were also no significant differences in the WIT (P=0.6) and in the positive surgical margins (P=0.63) in the two groups. Perioperative urine leak was much higher in the first group (P=<0.001), but the median hospital stay was found to be similar in both groups. At three months of follow up, the renal function manifested by eGFR was stable, and no patient needed renal replacement therapy.
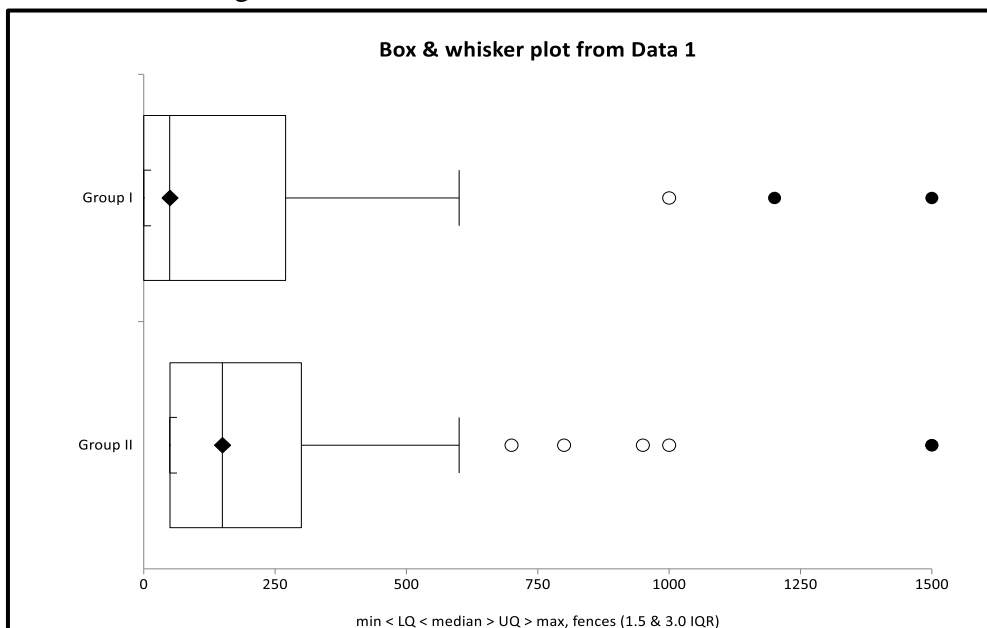

Figure 3: Perioperative blood loss in both groups.

One patient in Group-1 was re-admitted 6 weeks after surgery with delayed bleeding needing re-exploration. The patient was commenced on triple anti-platelet therapy soon after her surgery by her general practitioner as she was a high-risk cardiac patient. Another patient in Group-2 needed an immediate angiography and embolization for an upper polar vessel bleed.

There was a significant decline in the frequency of patients having urine leak in Group-2. This may well be explained by adopting elective ureteric catheter insertion prior to the partial nephrectomy and testing for urine leaks with targeted construction. In addition, reverting to the clamped partial nephrectomy, thus avoiding excessive cauterization near the collecting system, would also be a contributory factor.

Table 2: Perioperative outcomes

Variables	Group I	Group II	P-value
Mean WIT (min)	30	19	0.043
Mean peri-operative blood loss (ml)	199	242	0.24
Mean peri-operative blood loss in the off clamp patients(ml)	194	200	0.87
Positive margins (n)	10	11	0.63
Peri-operative urine leak (n)	7	3	<0.001
Peri-operative bleeding needing intervention (n)	1	1	>0.99
Median length of stay (days)	4	4	>0.99

DISCUSSION

There was no significant difference in the RENAL nephrometry scoring system between the two groups, despite its variance in the two patient cohorts. There was only a marginal increase in the WIT in group-2; however, this was not statistically significant. This may be a reflection of increasing the selection criteria of complex renal masses for partial nephrectomy with increasing experience. However, this did not prove to be the case in these cohorts, as per the RENAL scoring system.

More cases were performed with the off-clamp approach in the first 50 cases. This could be explained by the limited suturing dexterity at the beginning of the learning curve, hence the surgeon's preference to persevere with the off-clamp partial nephrectomy aiming to minimize the ischemia time as much as possible. This, however, comes with its added risk of pelvicalyceal system diathermy injury resulting in a higher rate of perioperative urine leak.

Osaka *et al*[2] in their study looking at the perioperative trifecta in partial nephrectomy found a significant relationship with the learning curve, mainly at achieving the aspired warm ischaemia time of ≤25 min. We had similar challenges during the early stages of the learning curve hence the utilization of the off-clamp partial nephrectomy. Also, Paulucci *et al*.[7] in their work on the learning curve in robotic partial nephrectomy reported their significantly better perioperative trifecta with advancing learning curve, apart from the surgical margin status and perioperative complications (excluding blood loss). A similar recent study conducted by Xie *et*

al.[8], showed a predictable improvement of the per-operative trifecta with a parallel improvement in the learning curve for a consecutive 144 cases. These were also carried out by a single surgeon.

Our study however differs in showing the improvement in the perioperative complication rate, mainly manifested by less urine leak, with no significant difference with the other trifecta parameters. Obviously our cases were done laparoscopically, which may explain the need for a larger number of cases to be able to assess the perioperative trifecta. Therefore, for centers with no access to robotic surgery, this study demonstrates that laparoscopic approach of partial nephrectomy is a viable alternative to the traditional open partial nephrectomy, which concurs with the literature evidence[9].

We hypothesize that the decrease in urine leak is due to increasing experience towards the end of the series in addition to the utilization of intra-operative ureteric catheters and less diathermy injury to the pelvicalyceal system (PCS). However, in larger series, the use of ureteric catheters did not seem to make a significant difference in their outcomes. This may be explained by the larger number of their cases. hence the higher operative outcomes[10].

Our study limitations are its retrospective nature and the small number of cases in both groups. As our concentration was on the perioperative outcomes in both groups, we lacked long term follow up, which would be interesting to know in terms of tumour recurrence, especially in those with positive surgical margins; which is a topic beyond our discussion at the moment as the authors are in the phase of writing up the long term oncological follow up outcome of their series, and the renal function in both groups, though the latter was not significantly affected during the perioperative period.

Conclusion: There is a longer learning curve needed to master laparoscopic partial nephrectomy. There seems to be an improvement in the perioperative outcomes mainly in terms of urine leak. However, the learning curve plateau is yet to be reached as the study was limited to 142 cases. More cases are needed and longer follow up would be helpful.

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الخلاصة

تأثير استئصال الكلية الجزئي بالمنظار الجراحي على منحنى تعلم الجراحين على التريفكتا الجراحي

اخلفية البحث

يعتبر استئصال الكلية الجزئي بالمنظار هو أعلى مستوى من التداخل الجراحي في جراحة المسالك البولية بالمنظار ، مع وجود تحديات فنية كبيرة مرتبطة بالعملية. تهدف الدراسة على تقييم تأثير منحنى التعلم لجراح واحد على النتائج المحيطة بالعملية، والتي تتجلى في الـ trifecta الموصوفة سابقًا.

المرضى وطرق البحث

تضمنت الدراسة مراجعة بأثر رجعي لسجلات 142 مريضًا متتاليًا خضعوا لاستئصال الكلية الجزئي بالمنظار خلال فترة ثلاث سنوات (مارس 2014 ومارس 2017). تم إجراء جميع الحالات بواسطة جراح واحد في مركز ثالثي بمستشفى مدينة بلفاست (المملكة المتحدة). تم إجراء مزيد من التحليل للمرضى وفقًا للتركيبة السكانية ودرجة قياس الكلى الكلوي. قمنا بتقييم تأثير تجربة الجراح بأثر رجعي على نتائج ما قبل الجراحة ، كما يتضح من الـ trifecta(وقت نقص تروية الدم أقل من 25 دقيقة ، والهوامش الجراحية السلبية وعدم وجود مضاعفات جراحية) باستخدام الانحدار متعدد المتغيرات. تمت مقارنة نتائج الحالات 92-42 (المجموعة 1-) مع الحالات 93-142 (المجموعة 2) .تم استخدام الدليل الإحصائي المباشرالحاسوبي للتحليل الإحصائي، أيضا تم استخدام اختبار(ت) الزوجي لمقارنة النتائج في كلا المجموعتين حيث اعتبرت (قيمة ب أقل من 0.05) ذات دلالة إحصائية.

النتائج

لم يكن هناك فرق معنوي في التركيبة السكانية للمرضى ولا في نظام التسجيل الكلوي (ب = 0.09 و 0.4 على التوالي). لم يكن هناك أيضًا فرق كبير في فقد الدم قبل الجراحة (ب= 0.24)، (فاصل الثقة 0.4 – 0.7). كان وقت نقص تروية الدم الدافئ (WIT) أقل بكثير في المجموعة الثانية (ب = 0.043) ، لم يكن هناك فرق كبير في الهوامش الجراحية الإيجابية في المجموعتين (ب = 0.63). كان تسرب البول قبل الجراحة أعلى بكثير في المجموعة 1 (ب أقل من 0.001)، كان متوسط الإقامة في المستشفى متشابهًا في كلا المجموعتين. بعد ثلاثة أشهر من المتابعة ، كانت وظيفة الكلى ، والتي تم تقييمها من خلال معدل الترشيح الكبيبي المقدر (eGFR) مستقرة، لم يحتاج أي مريض إلى علاج بديل كلوي.

الاستنتاجات

يمثل استئصال الكلية الجزئي بالمنظار منحنى تعليمي حاد .هناك تحسن في نتائج ما قبل الجراحة بشكل رئيسي خاصة من حيث تسرب البول .ومع ذلك ، لم يتم الوصول بعد إلى مستوى عالي لمنحنى التعلم عند عدد الحالات التي تم تقييمها، هناك حاجة إلى تقييم المزيد من الحالات وخاصة المتابعة الطويلة.