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Transition from Open Surgery to Robotic Assisted Partial Nephrectomy (RAPN): The Learning Curve for Experienced Open Surgeon

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What's known on the subject? and What does the study add?

It is known that surgeons used to performing laparoscopic surgeries and naturally to migrate to robotic surgery. However, it is known that the learning curve for surgeons used to performing only open surgery present more difficult when they migrate to robotic surgery, and there are few publications about this and for this reason the study is significant.

Abstract

Objective: The robotic platform has become the most accessible minimally invasive surgery, even for surgeons with no previous training in laparoscopy. Partial nephrectomy is a well-established procedure that is highly complex and requires a long learning curve. To describe the learning curve of robotic assisted partial nephrectomy (RAPN) for a single surgeon with little previous experience in laparoscopy.

Materials and Methods: This was a retrospective study with a prospective collection of data from 58 patients undergoing RAPN by a single surgeon. Variables regarding the patient, tumor, RENAL score, and perioperative complications were analyzed in addition to factors connected with "Trifecta". Trifecta was defined as ischemia time 25 min, negative surgical margin, and absence of severe complications (Clavien >2). A proctor followed the surgery, making small interventions during the first 8 cases.

Results: The mean age of the patients was 54.5 years (18-84 years), the mean tumor size was 31 mm (8-115 mm), and the surgery was performed within a mean ischemia time of 22 min. All the anatomopathological tests showed negative surgical margins and no angiolymphatic invasion. Trifecta was achieved in 86.2% of the cases.

Conclusion: RAPN presents good functional and oncological outcomes; it is safe and effective, even for surgeons transitioning directly from the open technique to the robotic one.

Keywords: Kidney neoplasms, learning curve, nephrectomy, partial nephrectomy, robotic surgery, robotic surgical procedures, teaching, urooncology

Introduction

Surgical treatment is the gold standard in localized carcinoma cases. Nephron-sparing surgery is one of the procedures that should always be performed when possible, given its oncological and functional benefits (1,2). The most adequate access depends on the tumor characteristics and surgeon's experience (3,4).

Partial nephrectomy is a highly complex procedure that requires a highly trained team (3). The TRIFECTA concept (negative surgical margins, ischemia time (IHT) shorter than 25 minutes, and no severe complications) described by Gill et al. (5) is a way for the surgical success of partial nephrectomy to be assessed (6).

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Experience in renal cancer acquired over the years and evidenced through studies and publications shows that the indication for partial nephrectomy has grown exponentially in our country, particularly within the private network, as small renal masses have been accidentally more frequently found (7,8). The nephron-sparing technique, despite oncological outcomes similar to those of radical nephrectomy, provides better functional outcomes, with longer global survival and quality of life in the long term (9,10).

The robotic platform has been applied within the minimally invasive PN field, facilitating the realization of this challenging procedure, largely adopted worldwide (11). Nevertheless, the RAPN learning curve for a surgeon highly experienced in open surgery, however small experience in laparoscopy, has not been broadly assessed.

This study aims to show the learning curve for a single senior surgeon, largely experienced in open surgery, who transitioned directly to robotic surgery. It highlights the period in which a "proctor" was used and emphasizes the "Trifecta".

Materials and Methods

This retrospective study involved a prospective collection of data from 58 patients undergoing robotic assisted partial nephrectomy (RAPN) between January 2014 and November 21, at two private hospitals in São Paulo/SP (São Luiz and Sírio-Libanês), by a single surgeon with little previous training in video laparoscopy.

All procedures were performed by a single senior surgeon, highly experienced in open partial nephrectomy in private hospitals and teaching in urologic residency services at Universidade Federal de São Paulo (Unifesp), Universidade de São Paulo, and Casa de Saúde Santa Marcelina/SP.

The surgeon, at the beginning of this series, counted more than 50 robot-assisted radical prostatectomy and had a large experience in open PN; however, he had no experience in RAPN. RAPN was performed by transperitoneal approach in all cases.

Intraoperative ultrasonography (USG) was used in 13 patients with endophytic tumors to assess tumor depth and plan the excision margins. The renal nodules were classified according to RENAL score nephrometry and considered highly complex upon a >6 score. During the pre-operative period, the following information was obtained: age, gender, laterality, symptoms, and renal function (assessed according to serum creatinine). During surgery, the following data were collected: operative time, need for intraoperative USG, complications, and warm IHT. After surgery: hospital stay time, renal function, and complications (registered and classified according to the Clavien-Dindo system).

A successful surgery (TRIFECTA) was defined, according to Gill et al. (5), as follows: IHT 25 min, negative surgical margin, and no severe complications (Clavien ≤2) (6).

The entire analysis was descriptive. This is a retrospective study that analyses the records and lab tests of patients undergoing robotic partial nephrectomy and open surgery comparing both techniques to clarify whether they exist and what the differences might be, considering the oncological, functional and perioperative aspects. From January/2014 and November/2021, it was approved by the Institutional Review Board of Santa Marcelina Hospital under number 1,014,385 on February 25, 2015.

Statistical Analysis

The data analysis process began with a descriptive exploration of the data collected from electronic medical records, including the distribution of variables frequencies and calculation of parameters as mean, standard deviation, median and interquartile range.

For comparison of histological type, the chi-square test or Fisher's exact test were used for qualitative variables; and t-tests or Mann-Whitney test for quantitative variables. We used IBM SPSS 26 (IBM corp., 2019) and Microsoft Excel 365® Software. All tests carried out took into consideration a two-tailed 0.05 α significance and a 95% confidence interval (CI).

Results

The patients' mean age was 54.5 years (18-84 years); the mean tumor size was 31 mm (8-115 mm), and the surgery was performed within a mean IHT of 22 min (13-44 min). Regarding tumor complexity, 44.82% were classified as highly complex (RENAL score >6) (Tables 1,2).

As few as 2 patients (3.38%) had early symptoms (hematuria) and both had a histopathological diagnosis of clear cell renal cell carcinoma (RCC). The mean surgical time was 125 min (85-330 min), while 13 patients required intraoperative USG owing to the endophytic lesion characteristics.

Following histopathological analysis, 74.13% (43/58) of the cases were diagnosed with RCC, most of which were of the clear cell subtype. Oncocytomas, angiomyolipomas, and complex cysts (Bosnian III and IV) accounted for 25.86% (15/58) of the samples. Among the cancer lesions, 59.25% were Fuhrman 2 grade, and all cases had negative surgical margins and no angiolymphatic invasion (Table 3).

The mean hospital stay was 3 days, and none of the patients had any renal function alteration in the immediate postoperative. One patient alone had postoperative complications (respiratory failure), but required no invasive procedure.

Successful treatment (Trifecta) was achieved in 86.2% of the patients.

Discussion

This study shows the experience of a surgeon with little previous video laparoscopy training during the first 58 RAPN cases. From the beginning, the results were satisfactory, "Trifecta" being reached in 86.2% of the cases.

The robotic platform has made minimally invasive surgery more accessible, including for surgeons with no previous experience in video laparoscopy (12). The technology allows the learning curve to be shortened, thereby ensuring functional and oncological outcomes similar to those in conventional surgery (13).

At the private institutions where the surgeries for this study were performed, the robotic platform allowed for a broader access to the minimally invasive procedure, thus increasing the number of urologists applying the technique. Ghani et al. (14) reported a significant increase in the use of the robotic platform compared with laparoscopic surgery in partial nephrectomy in the USA. It was also suggested that it is possible to go from open surgery to robot-assisted surgery without learning video laparoscopy.

The rate of conversion to open surgery, complications, and positive margins are closely related to the surgeon's experience. Some series have reported greater conversion to open surgery during the first case, such as that of Haber et al. (13), where all conversions occurred in the first 20 patients. The satisfactory outcomes in this series, from the very first case, can be explained by the surgical standardization adopted, assisted by a PROCTOR to follow the first procedures, enabling a safe transition. The highest rate of complications in the literature ranges from 8% to 22% (15), whereas in our series it was 1.69 % (Clavien ≥3).

The warm IHT has already been largely studied and debated, particularly its relevance regarding renal function preservation (16). Originally, a 30-min time was considered the limit for preservation of the renal parenchyma (17); however, that value has been shortened over time. The concept used in our series was the one proposed by Gill et al. (5), who established a time goal of less than 25 min. The mean warm IHT in our series was 22 min. No significant changes in renal function were registered, which shows the safety of the nephron-sparing technique.

Regarding oncological outcomes, no positive margins were found in the patients in this study. It is always important to seek negative margins to ensure good oncologic surgery practice. However, it was not possible to demonstrate in the literature a greater risk for local recurrence or progression to metastatic disease in patients undergoing partial nephrectomy with positive margins (18). In our series, with a follow-up of approximately 5 years, no patient had local or systemic recurrence.

Table 1. Demographic data

Variables	Mean or number
Total of patients	58
Asymptomatic	56
Symptomatic	2
Age (years)	54.5
Gender	
Female	17 (29.3%)
Male	41 (70.7%)
Side of the tumor	
Left	27 (46.5%)
Right	31 (53.5%)
Tumor size	31 mm
Tumor location	
Upper	14 (24.1%)
Middle	22 (37.9%)
Lower	22 (37.9%)
RENAL score	
Low	32 (55.2%)
Intermediate	25 (43.1%)
High	1 (1.7%)
Preoperative Cr	0.9
Postoperative Cr	0.94
Hospital stay (days)	3

Table 2. Postoperative variables

Variables	Mean or number
Operative time	125 min
Vascular clamping	49 (84.5%)
Warm ischemia time	22 min
Patients with intraoperative USG	3 (22.4%)

USG: Ultrasonography

Table 3. Pathological data

Variables	Mean or number
Malignant histology	43 (74.1%)
Clear cells	27 (46.5%)
Papillary	14 (24.1%)
Chromophobe	2 (3.4%)
Fuhrman grade (clear cells)	
1	3 (11.1%)
2	16 (59.2%)
3	8 (29.6%)
Negative margins	100 %
No angiolymphatic invasion	100%
Benign tumors	15 (25.8%)
Oncocytoma	3
Angiomyolipoma	8
Complex cysts	4

In the study by Khalifeh et al. (19), a higher than 60% rate of trifecta was reached mainly after the first 50 patients, in line with other studies that reported a short and safe learning curve (20). We consider our outcomes favorable from the start of the learning curve, probably because of the standardization of the technique, in addition to a proctor's assistance in the first case (21).

Study Limitations

It is important to emphasize that this study has a few limitations. It is a small series with a short follow-up time compared with some other series already published in large centers in developed countries.

Conclusion

This study showed RAPN to present good functional and oncological outcomes, so that it is safe and effective, including for a surgeon transitioning directly from the open technique to the robotic one.

Ethics

Ethics Committee Approval: It was approved by the Institutional Review Board of Santa Marcelina Hospital under number 1,014,385 on February 25, 2015.

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: M.F.D., Concept: M.F.D., Design: M.F.D., Data Collection or Processing: M.M.P., F.K., J.O., Analysis or Interpretation: J.A.F.S.J., Literature Search: M.M.P., Writing: F.K., J.A.F.S.J.

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