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Research Article

Comparison of Robot-Assistance versus Conventional Laparoscopy on Uptake of Minimally Invasive Technique during Partial Nephrectomy from Perspective of Surgeon Preference

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Keywords

- Robot-assisted
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Abstract

Introduction: Partial nephrectomy is considered the standard of care for small renal tumours. We aim to ascertain if the availability of robot assistance may increase the use of minimally invasive surgery (MIS) during partial nephrectomy (PN).

Methods: All cases of PN performed from 2005 to Oct 2015 in the department were reviewed. Forty-five scans of PN were selected. Of the 45 cases, 12 were open PN performed before robot availability (Group A), 11 were open PN after robot-assistance (RA) was available (Group B), and 22 were RAPN (Group C). Three MIS trained urologists from 3 different centers were asked to review de-identified, standardised CT images of all 45 tumours. They were provided with patients' age, estimated glomerular filtration rate and nephrometry scores but were blinded to the actual surgical approach used. The experts were asked to choose: (1) between open or laparoscopic approach; (2) between open or robotic approach.

Results: Overall, there was significantly higher responses indicating a preference for RAPN compared to laparoscopic PN (86.2% vs 74.6%, p=0.004). With availability of robotic-assistance, higher nephrometry score tumors were performed (Grp A 5.7 vs Grp C 7.1 , p=0.04). In group C, significantly higher responses indicated they will perform RAPN compared to laparoscopic PN (95.2% vs 77.5%, p=0.004).

Conclusion: In this novel study, we demonstrated that significantly more surgeons will offer RAPN compared to laparoscopic PN thus increasing the penetrance of MIS, especially for tumours with higher nephrometry scores.

ABBREVIATIONS

MIS: Minimally Invasive Surgery; PN: Partial Nephrectomy; RA: Robot-Assistance; OPN: Open Partial Nephrectomy; LPN: Laparoscopic Partial Nephrectomy; RAPN: Robot-Assisted Partial Nephrectomy

INTRODUCTION

Partialnephrectomy (PN) is considered the standard of care for small renal tumours (T1) by most international guidelines [1, 2]. Open partial nephrectomy (OPN) is the traditional method and the adoption of laparoscopic partial nephrectomy (LPN) has been limited due to its steep learning curve [3].

The development of robot-assistance (RA) has decreased the barrier to application of minimally invasive approach to PN [4,5]. While contemporary studies have shown the effects of RAPN on uptake of PN [6-9], the aim of this study is to determine the effect of robotic surgery on the pattern of surgical approach on PN based on surgeon's decision.

MATERIALS AND METHODS

All 57 cases of PN performed from 2005 to Oct 2015 in our tertiary center were retrospectively reviewed. Before 2010, both conventional laparoscopy and open approaches were available. Robot-assisted partial nephrectomy (RAPN) became available in 2010 using the Da Vinci® Surgical System (Intuitive Surgical Inc, Sunnyvale, CA, USA). The choice of surgical approach was decided by the attending urologist based on patient and tumour factors.

As the intention of this study was to determine if open cases could have been done minimally invasively if robot-assistance was available, only open cases were included with the robot cases as control. Conventional LPN cases were excluded from this study. Overall, forty-five scans of PN were selected. Of the 45 cases, 12 had undergone open PN performed before robot availability (Group A), 11 were open PN after robot-assistance was available (Group B), and 22 had undergone RAPN (Group C). Analysis was done on the subgroups to study the effects of robot-assistance on uptake of MIS. Three urologists who were experts in laparoscopic and robot-assisted PN from 3 different tertiary centers were asked to review de-identified, standardised CT images of all 45 tumours. They were provided with patients' age, estimated glomerular filtration rate (MDRD) and nephrometry scores but were blinded to the actual surgical approach used. The experts were asked to choose: (1) between open or laparoscopic approach; (2) between open or robotic approach.

Responses were tabulated and statistical analysis was performed using SPSS software v22 (SPSS Inc., Chicago, IL). Comparison was done using t-test and chi-square tests for continuous and categorical data respectively. Statistical significance was defined as $P< 0.05$.

RESULTS AND DISCUSSION

Patient characteristics are tabulated in Table (1). The mean nephrometry scores of the 3 groups were 5.7, 7.2 and 7.1 respectively, of which Group C was significantly higher than Group A (Group A *vs* B: p=0.07, B *vs* C: p=0.89, A *vs* C: p=0.03).

Analysing all 45 tumours together, significantly higher responses indicated a minimally invasive approach with the availability of robot assistance (86.2% *vs* 74.6%, p=0.004). This confirmed our hypothesis that robot assistance has a positive effect on the surgeon's willingness to attempt MIS.

Analyses of the subgroups were performed, and the results are summarized in Table (2). In group A (actual OPN cases in the pre 2010 era), 80% of responses indicated they will perform LPN as opposed to OPN. With availability of the robot, 98.6% will perform RAPN (p=0.32). In group B (OPN cases in the robot era), 66.7% will perform laparoscopic PN while 75.8% will perform RAPN (p=0.41). In group C (RAPN cases), significantly higher responses indicated they will perform RAPN compared to laparoscopic PN (95.2% *vs* 77.5%, p=0.004).

Partialnephrectomy (PN) is considered the standard of care for small renal tumours (T1) by most international guidelines [1], with the open approach the traditional method of choice [10]. Although laparoscopy has been widely popular due to the advantages of minimally invasive surgery (MIS) in terms of post-op recovery [11], its adoption with respect to PN has been limited due to its steep learning curve [12]. Renorrhapy requires intracorporeal suturing which may be difficult laparoscopically especially given the time constraints due to clamping of vessels. The development of robot-assistance [13] has decreased the barrier to application of minimally invasive approach to PN as the articulating arms make suturing easier [9,14-16]. Equivalent surgical outcomes can be achieved with robot-assistance [17] and even posterior lesions can be approached retroperitoneally [18]. In addition, various studies have shown that RAPN has increased the overall uptake of nephron sparing surgery [6-8]. Operative outcomes will continue to improve as surgeons become more familiar with RAPN [19] and undergo robotic fellowship [20].

This novel multicentre study reveals that with the availability of the robot-assistance, surgeons are more likely to attempt a minimally invasive approach based on overall responses. When comparing all tumors together, there were significantly higher opinions that these lesions could be attempted with robot assistance as compared to pure laparoscopy. This is likely because robot assistance overcomes the technical difficulties of pure laparoscopy.

In our subgroup analysis, we looked at open cases in the pre robot era (group A) and found that even with availability of the

Table 1: Patient Characteristics.

	Group A (pre robot era open cases)	Group B (robot era open cases)	Group C (robot cases)	Univariate Analysis	Multivariate analysis
No. of Cases (N)	12	11	22		
Age at op (Range)	58.3 (45- 70)	61.3 (41 – 76)	60.1 (38 – 78)	A *vs* B: p = 0.42 B *Vs* C: p = 0.36 A *vs* C: p = 0.29	P = 0.72
% of Renal impaired (eGFR<60 ml/min)	16.7%	27.2%	4.7%	A *vs* B: p = 0.54 B *Vs* C: p = 0.07 A *vs* C: p = 0.25	P = 0.411
AvgNephrometry Score (Range)	5.66 (4- 9)	7.18 (4 – 11)	7.09 (4- 10)	A *vs* B: p=0.07 B *vs* C: p=0.89 **A *vs* C: p = 0.03**	P=0.13

Table 2: Summary of opinion on approach for.

	% amenable to laparoscopic PN	% amenable to RAPN	P value
Group A (pre robot era open cases)	80%	88.63%	P = 0.32
Group B (robot era open cases)	66.7%	75.8%	P = 0.41
Group C (robot cases)	77.5%	95.2%	P = 0.004
Overall	74.6%	86.2%	P = 0.004

robot, there was no significant impact on use of MIS. Although we expected to see a significant uptake of MIS with availability of robot-assistance, the small increment may be due to lower nephrometry scores in this group and therefore a high response rate that laparoscopy alone could be attempted. In contrast, analysing the open cases done in the robot era (Group B), there was a lower percentage of response for laparoscopy or RAPN which is appropriate given that the original surgeons chose to do the case open despite availability of the robot. Analyzing the robot group (Group C), the results confirm our hypothesis that availability of the robot will lead to higher uptake of MIS. In addition, the significantly higher nephrometry scores seen in this group are also consistent with the observation that the robot has led to a higher penetrance of nephron sparing surgery [6-8]. The advantages of minimally invasive PN have been well documented in contemporary studies [21-23], including lower blood loss, complications and length of stay. Our results provide useful information for centres considering starting a robotic program to enhance their MIS program.

Our findings also show that for simpler cases of lower nephrometry scoring, the effect of having robot-assistance is not apparent from a surgeon perspective, as see in group A. However, when attempting more technically challenging lesions of higher nephrometry score, robot-assistance has a significant impact on the uptake of MIS as seen in group C. This is consistent with recent studies which show that more challenging lesions[24] including larger masses[25] can be treated with MIS when robot-assistance is available.

There are several limitations to our study. Firstly, the observation that robot-assistance will lead to more PN performed with minimally invasive approach is purely from a technical standpoint and does not take into consideration operative cost or other economic and social factors. Secondly, choice of approach is dependent on surgeon preference in addition to patient and tumor factors. Being MIS trained, there is a potential for bias in surgeon opinions. There is also a degree of subjectivity on nephrometry scoring [26], hence all PNs in the department are discussed and the best approach is recommended as a consensus. Thirdly, this is a retrospective study with inherent bias and the sample size is small. Larger prospective studies will be required to really ascertain the impact of RAPN for treating T1 renal cell carcinoma.

CONCLUSION

The application of robotic surgery is believed to increase the penetrance of MIS technique for partial nephrectomy. In this novel study, we demonstrated that significantly more cases will be offered RAPN compared to laparoscopic PN, especially for tumours with higher nephrometry scores.

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