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ORIGINAL ARTICLE

Every setback is a setup for a comeback: 3D laparoscopic radical prostatectomy after robotic radical prostatectomy

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Summary

Purpose: *To assess whether previous experience in robotic surgery has a role in the transition to 3D laparoscopy and influences the perioperative results and short term oncological and functional outcomes of the first patients that undergo laparoscopic radical prostatectomy (LRP).*

Methods: *We analyzed 248 patients that underwent robotic radical prostatectomy (RALP) between 2009-2015 and 98 patients that underwent 3D HD LRP from 2015-present in our department. The procedures were performed by the same two surgeons, who crossed from open to robotic surgery, and afterwards to 3D laparoscopy.*

Results: *The patients in the study groups were comparable in terms of age, pre-operative PSA levels, clinical staging and D'Amico risk groups. The operative time was significantly shorter in favor of the laparoscopic approach (a difference of 110 min, p<0.0001). The overall rate of positive surgical margins was similar, with the biggest difference from 40.8% to 25% in pT3 patients in favor of the laparoscopic approach. The mean time to catheter removal was 7 days for RALP and 8 days for LRP. We did not identify any significant difference between the two groups in terms of biochemical recurrence, continence or potency at 3 and 6 months after the procedure.*

Conclusions: *Previous experience in robotic surgery ensured a fast transition to 3D laparoscopic approach for radical prostatectomy, with comparable oncologic and functional outcomes, but with a shorter operative time and reduced costs.*

Key words: *3D laparoscopy, prostate cancer, radical prostatectomy, robotic surgery*

Introduction

After its emergence, robotic surgery has been rapidly implemented worldwide, regardless of not having any prospective randomized controlled trials to support its superiority. A number of open urologic surgeons have crossed directly to the robotic approach, which enables complex surgical gestures in restricted spaces like the male pelvis and also particular reconstructive procedures. Ten years after the first robotic radical prostatectomy, reported by Binder and Kramer [1], approximately 80% of the radical prostatectomies were performed robotically in the United States [2].

An extensive review by Coelho et al. [3] concluded that RALP is a safe option for the treatment of prostate cancer in terms of postoperative complications rate and associated with lower blood loss and lower transfusion rates in comparison with the open approach. Also, in high-volume centers, RALP can ensure a lower rate of positive surgical margins and higher rates of continence and potency in comparison with laparoscopic or open approach. However, the robot is only a tool

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and the greatest factors that warrant the trifecta outcomes (cancer control, continence and potency) seem to be the skill and experience of the surgeon [4].

The cost of robotic surgery is a controversial subject that has been widely debated since the implementation of this technique. The robotic systems are sold for prices ranging from 1 to 2.5 million US dollars, to which it is necessary to add the maintenance and consumables. Performing a radical prostatectomy in a department that has done this technique by open approach so far, will increase the cost with up to 4.800 US dollars per procedure (when including the amortized cost of the system) [5]. Advocates of robotic surgery state that shorter hospital length-of-stay, lower complications rate and faster return to work compensate for the high consumables costs [6,7]. However, a recent study by Leow et al. confirms that RALP does offer a morbidity advantage, but at a higher cost [8]. Selective referral to high-volume surgeons has been shown to ensure a cost saving of almost 29 million US dollars/ year for radical prostatectomy [9], with the drawback of associating increased patient travel and delay of treatment [10], which might alter the oncological outcomes for high-risk patients [11]. Another possibility of reducing the costs of robotic surgery, as shown by Delto et al. [12] is by minimizing the instrumentation used during RALP. The authors conclude that by eliminating the vascular sealer or Ligasure and a second needle driver, the costs of the instrumentation can be reduced by 40%, without compromising patient outcomes [12,13].

The new 3D HD laparoscopic systems have emerged as a more accessible alternative to robotic surgery in terms of costs for the healthcare systems. LRP performed by fellowship trained surgeons in high-volume centers demonstrates favorable perioperative, oncological and functional outcomes when compared with the other types of approach [14]. The 3D HD vision provides advantages with regards to intraoperative steps, blood loss and higher probability of reaching pentafecta (cancer control, continence, potency, no postoperative complications, no positive surgical margins) [15]. Also, the new 3D visualization facilitates the acquisition of laparoscopic skills for novices, with improved working speed, accuracy and less mental workload in comparison with 2D vision [16].

The objective of this study was to assess whether previous experience in robotic surgery has a role in the transition to 3D laparoscopy. We aimed to evaluate the influence of robotic experience on the perioperative results and short term oncological and functional outcomes of the first patients that underwent 3D laparoscopic radical prostatectomy.

Methods

In the present study we included 248 patients that underwent RALP between 2009-2015 and 98 patients that underwent 3D HD LRP from 2015-present in our department. The procedures were performed by the same two surgeons, who had previous experience in open approach for radical prostatectomy. After the emergence of robotic surgery, they crossed directly to the robotic approach. In 2015, due to the high costs of robotic procedures, they started 3D HD laparoscopy as a minimally invasive alternative.

The preoperative evaluation of patients included digital rectal examination, multiparametric MRI when available and bone scan according to the recommendations of the European Association of Urology Guidelines [17]. All patients signed informed consent and an electronic database was created.

For the RALP, we used the transperitoneal approach with 6 trocars (3 for the robotic arms, 1 for the camera and 2 for the assistant surgeon), following the technique described by Patel et al. [18].

For 3D LRP we used the properitoneal approach with 5 trocars, and followed the same surgical steps as for the robotic approach.

The operative time was calculated from the time of incision of the skin until suturing the last trocar site and included the docking of the robot for RALP.

For both types of approach, nerve-sparing was performed for sexually active patients with regards to clinical staging (cT2 – unilateral/ bilateral nerve-sparing, cT3 – no nerve-sparing). Also, pelvic lymph node dissection was carried out when the probability of lymph node involvement on Memorial Sloan Kettering Center nomograms exceeded 4%. We used one pelvic drainage for patients with no lymphadenectomy and two when lymphadenectomy was performed, which were removed when draining was less than 50ml/24 hr. The urinary catheter was removed only after having performed a control cystography. The follow-up of the patients in terms of oncological and functional results was assessed at months 3 and 6 after the procedure. We defined potency as erection sufficient for intercourse (with or without PDE5 inhibitors) and continence as the use of 0-1 pads/day. Biochemical recurrence was defined as a PSA >0.2 ng/ml for patients with postoperative undetectable PSA.

Statistics

For statistic analysis we used Mecalc v.12.4 (MedCalc Software bvba, Ostend, Belgium; https://www.medcalc.org). For comparison between the two groups either

Chi-square test, or Independent samples t-test were used. P<0.05 was considered statistically significant.

Results

The characteristics of the patients included in the study are summarized in Table 1. The patients were comparable in terms of age, preoperative PSA levels and the number of positive biopsy cores.

A slightly lower percentage of clinically localized prostate cancer patients in the RALP group (76.1 vs 77.8% in LRP group) was observed, but this did not reach statistical significance. Also, the Gleason score was similar in both study groups. Regarding the preoperative D'Amico risk groups, we observed that 88.1% of the patients in the LRP group were intermediate and high-risk in comparison with 82.7% in the RALP group (p=0.06).

Regarding the operative time, we identified a significant difference between the LRP and RALP groups, with 110 min shorter time in favor of LRP. The mean blood loss was insignificantly higher for LRP. The type of nerve-sparing performed depended on the clinical stage and did not differ significantly between the two groups.

The rate of intra- and postoperative complications was similar. In each study group, one case of rectal wall injury was encountered, but the lesion was indentified during the procedure and sutured. Also, we performed one reintervention for bleeding for a patient that underwent RALP. The pathological staging revealed 67.1% of clinically localized prostate cancer patients in the LRP group vs 60.4% in the RALP group, with a rate of upstaging from cT2 to pT3 of 18.6% in the LRP group and 24.4% in the RALP group, none of which reached significance.

The median number of excised lymph nodes was 8 in both RALP and LRP groups, with a minimum of 5-maximum 21 lymph nodes for RALP and a minimum 5-maximum 11 lymph nodes for LRP. We observed a significant difference in the range depending on the type of approach (p=0.003).

The overall rate of positive surgical margins was also similar between the two groups, with the biggest difference from 40.8% to 25% in pT3 patients in favor of the laparoscopic approach. Also, we observed that among the patients with positive surgical margins, in the RALP group there was a significantly higher percentage of anterior, postero-lateral and multiple positive surgical margins. On the contrary, in the LRP group the incidence of apex positive surgical margins was higher, albeit not statistically relevant. Table 2 illustrates the perioperative details of the patients in the study groups.

The mean time to catheter removal was 7 days for RALP (minimum 7- maximum 21 days) and 8 days for LRP (minimum 7- maximum 25 days), after performing a control cystography (p=0.1).

Table 1. The preoperative characteristics of the patients in the study groups

Patient characteristics	*Robotic radical prostatectomy*	*3D HD Laparoscopic radical prostatectomy*	*p value*
Patients (n)	248	98	
Age, years median; 95% CI	63; 62-64	63; 62-64.1	0.61
Preoperative PSA, ng/ml median; 95% CI	8.54; 8-9	9; 8-11.9	0.14
Number of positive biopsy cores median; 95% CI	3; 3-4	4; 2-6	0.18
Clinical stage (%)			0.89
cT1c	14.8	9.3	
cT2a	19.6	24.1	
cT2b	18.7	18.5	
cT2c	23	25.9	
cT3a	20	18.5	
cT3b	3.9	3.7	
Gleason score (%)			0.36
6(3+3)	39.7	39.5	
7(3+4)	42	33.3	
7(4+3)	11.2	18.5	
≥8	7.1	8.6	
D'Amico risk groups (%)			0.06
Low risk	17.2	11.9	
Intermediate risk	32.3	46.4	
High risk	50.4	41.7	

Table 2. The perioperative details of the patients in the study groups

	Robotic radical prostatectomy	*3D HD Laparoscopic radical prostatectomy*	*p value*
Operative time (min) median; 95% CI	260; 240-270	150; 117-190	<0.0001
Blood loss (ml) median; 95% CI	300; 250-350	325; 244-500	0.81
Nerve-sparing (%)			0.33
Bilateral	30.4	27.7	
Unilateral	30.4	40	
No	39.2	32.3	
Intra-operative complications (%)	0.4	1.02	0.52
Post-operative complications *(%)*			0.31
Clavien III	0.4	0	
Pathological stage (%)			0.24
pT2a	8.1	5.2	
pT2b	4.9	9.3	
pT2c	47.4	52.6	
pT3a	25.5	17.5	
pT3b	14.2	15.5	
Gleason score (%)			0.15
6(3+3)	26	21.5	
7(3+4)	54.9	54.4	
7(4+3)	16.2	16.5	
≥8	3	7.6	
Upstaging rate (%)	24.4	18.6	0.34
Number of excised lymph nodes median; 95% CI	8; 7-9	8; 6-8	0.003
Positive surgical margins (%)			
Overall	25.4	17.3	0.14
pT2	15.4	13.8	0.92
pT3	40.8	25	0.16
Base	54.3	32	0.09
Anterior	20	0	0.03
Postero-lateral	48.6	4	0.0002
Apex	68.6	76	0.65
Multiple	55.7	16	0.0014

Table 3. The early oncological and functional outcomes after RALP and LRP

Follow-up	*Robotic radical prostatectomy*	*3D HD Laparoscopic radical prostatectomy*	*p value*
Biochemical recurrence (%)			
3 months	0	0	N/A
6 months	2.3	3.8	0.97
Continence (%)			
3 months	77.6	80.9	0.71
6 months	90.6	91.4	0.92
Potency (%)			
3 months	36.9	30	0.86
6 months	49.5	67.3	0.68

N/A: not available

We did not identify any significant difference between RALP and LRP in terms of biochemical recurrence, continence, or potency at 3 and 6 months after the procedure, although the functional outcomes seemed to be more favorable for LRP group. Table 3 summarizes the follow-up data of the patients.

Discussion

The results of the present study illustrate the discreet change in the profile of a prostate cancer patient in the last year in our department, which appears to have a higher probability of presenting in localized stage and harboring intermediate-risk features. The RALP group included almost 10% more patients with high-risk disease. We believe that the decline in the number of high-risk patients might be a result of improved screening for this malignancy. Still, the percentage of low-risk patients that underwent surgery is lower for LRP, excluding the issue of overtreatment, so we consider that the criteria for indicating radical prostatectomy in our department have remained constant, irrespective of the type of approach.

Almost 25% of RALP patients were understaged preoperatively in comparison with 18.6% of LRP patients due to the fact that multiparametric MRI was available for the preoperative staging only from 2012. Before this, the clinical T staging was based on digital rectal examination alone. Multiparametric MRI has confirmed its role in the preoperative evaluation of prostate cancer patients by reliably identifying clinically significant disease [19] and locally advanced stage [20]. Also, it was shown to have a predictive value for the upstaging of prostate cancer, PIRADS 5 lesions having a higher risk of extracapsular extension and positive surgical margins in patients who would have been classified as low-risk based on preoperative characteristics [21].

The operative time was 110 min, significantly lower for the LRP group in comparison with RALP group, as we also included the docking of the robot in the RALP operative time. Operating room time has been shown on multivariate analysis to be associated with higher direct costs of the procedure. Other factors that have been identified as independently associated with higher costs of RALP are transfusion requirement and hospital length of stay [22]. Also, the 3D visualization has been shown to ensure a reduction of the operative time for radical prostatectomy of 79 min in comparison with standard 2D vision [23].

The median number of retrieved lymph nodes was the same for both types of approach, but with a significant difference in the range (maximum of 11 for LRP and 21 for RALP). The explanation for the lower number of retrieved lymph nodes during LRP is that the properitoneal approach limits the access on the common and external iliac blood vessels. A possibility to overcome this drawback might be to perform the LRP in properitoneal approach and continue with the lymph nodes dissection transperitoneally. Eden et al. [23] published a study on 500 patients with prostate cancer that underwent LRP with extended pelvic lymph node dissection and concluded that the learning curve to achieve a number of 14 lymph nodes consists in 150 cases in comparison with 60 cases for the robotic approach [24].

The overall rate of positive surgical margins for LRP is consistent with what has been published in the literature [25]. We observed that positive surgical margins were lower in the LRP group, although not statistically significant, and this was similar for overall, pT2 and pT3 positive surgical margins. Interestingly, anterior, postero-lateral and multiple positive surgical margins were significantly higher in the robotic approach, which are an indication of a more aggressive disease [26]. Apex positive surgical margins were more frequent in the laparoscopic approach, although not statistically significant, probably as a consequence of trying to maximize urethral length.

The early biochemical recurrence and continence at 3 and 6 months after the procedure were similar in both types of approach. We observed that although the erectile function was lower at 3 months for LRP, at 6 months after the procedure it increased by almost 20% more in comparison with the RALP group. Erectile dysfunction is the most common reason pentafecta is not achieved after LRP (either 2D or 3D) [23], but it has been observed that there is a high probability of recovery of erectile function even after 12 months from radical prostatectomy [27].

Skill development in laparoscopic or robotic surgery is different from open approach. The robotic approach needs a shorter time for the development of surgical skills, regardless of the previous experience in laparoscopy. It can be, therefore, of help for inexperienced laparoscopic surgeons to acquire the laparoscopic surgical skills and improve their proficiency [28]. For laparoscopic expert surgeons, the use of a robotic system for training leads to a decrease in the total instrument pathlength, which is a surrogate of the ability to perform precise dissection in limited access areas (narrow pelvis, during radical prostatectomy) [29].

Fourth generation 3D laparoscopic systems ensure superior depth perception and higher resolution in comparison with the first systems, they simplify complicated urologic procedures in comparison with 2D vision by improving orientation in the abdominal cavity [30] and the measures of performance (eg. speed) even for surgeons with no previous experience in laparoscopy [31].

Conclusions

We consider that previous experience in

RALP ensured a fast transition to 3D laparoscopic approach for radical prostatectomy, with comparable oncologic and functional outcomes, but with a shorter operative time and reduced costs. If the costs of robotic systems and instruments remain at the present level, the new generation 3D laparoscopic systems will probably become the much expected alternative and the robotic systems will find their place only during the training period.

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Conflict of interests

The authors declare no confict of interests.

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