MINI REVIEW

Laparoscopic Radical Prostatectomy: A Literature Review of the Causes, Risk Factors and Consequences of Open Conversion

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ABSTRACT

Background: The incidence of laparoscopic radical prostatectomy (LRP) has increased dramatically over the past decade, compared to open prostatectomy, due to its benefits in terms of lower blood loss, faster recovery time and less postoperative pain. However, little is known about the reasons, risk factors, and consequences of open conversion (OC) during laparoscopic radical prostatectomy. **Aims:** The aims of the study were to evaluate the main risk factors and reasons for conversion during laparoscopic radical prostatectomy, as well as complications and costs associated to it. **Methods:** A review of the literature was performed in January 2018, searching PubMed database. A "free text" protocol using the terms "laparoscopic radical prostatectomy," and "conversion to open surgery," was applied. A total of 140 records were found. The authors reviewed the records to identify suitable studies to include in the review. **Results:** The authors only found 3 articles in the literature that fully addressed the goal of the review. With regard to the reasons for OC, the failure to progress seems to be the main cause, followed by iatrogenic injuries of other organs. Major risk factors identified were: Obesity, periprostatic and peritoneal adhesions, and low surgeon's experience in laparoscopic radical prostatectomy. Conversion to open surgery seems to carrier a significant risk for post-operative complications, increased duration of hospital stay and associated in-hospital costs. Only one study addressed the functional outcome in open converted surgery patients: Apparently, there were good outcomes in terms of continence and erectile function, albeit an absence of comparison to non-converted surgeries. **Conclusion:** OC during LRP is an uncommon event, more likely to occur in the beginning of the learning curve. The post-operative complications, prolonged hospital stay, and higher associated costs should guide surgeons in the beginning of their experience with LRP to elect their patients carefully to minimize the need for conversion to open surgery.

Key words: Laparoscopy, open conversion, radical prostatectomy

INTRODUCTION

Every year, millions of men worldwide are diagnosed with prostate cancer. Radical prostatectomy is still the gold standard treatment for localized prostate cancer, but there has been a concern to the aggressiveness of this approach. In this context, the range of focal and minimally invasive treatments available has increased and gained notoriety, from cryotherapy, high-intensity focused ultrasound, brachytherapy, laparoscopic, and robotic-assisted surgery. The evolution of the treatments available was thus toward a less invasive approach and less morbidity.

Laparoscopic radical prostatectomy (LRP) was first described by Schuessler *et al*. in the 1990s.[1] At that time, the long operative time and the high degree of technical demand led to this approach not being considered as a viable alternative to open surgery. Thus, since its introduction, this approach has undergone numerous changes in surgical technique, including the approach (transperitoneal vs. extraperitoneal), anterior and posterior dissection, ascending and descending dissection, and more recently, robotic-assisted surgery.[2-4] The evolutions of the surgical technique and the laparoscopy materials have made this approach a reproducible technique, accessible to most hospitals and suitable for most surgeons

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with laparoscopic skills.[5] At present, it is one of the main approaches to radical prostatectomy in developed countries. The benefits identified compared to open surgery are mainly due to the shorter hospital stay, lower blood loss, shorter recovering time, less need for analgesia, and at least similar oncological, and functional results.[5-7]

Despite these advantages, it was concluded that the learning curve is long and it is estimated that a plateau is reached after 200–250 laparoscopic radical prostatectomies.[8,9]

The need for conversion to open surgery is a risk inherent to every laparoscopic surgery: Given the complexity of the radical prostatectomy technique, there are various circumstances precipitating it. It is estimated that the conversion rate in centers of large surgical volume is approximately 2–8% for LRP and 0–1% in robotic-assisted radical prostatectomy (RARP).[10-14] Little has been known about surgical procedures that begin as Minimally Invasive Radical Prostatectomy (MIRP) but are converted to open surgery. Taking into consideration that open conversion (OC) is not uncommon, it is important to recognize major risk factors and understand its influence on functional and oncological outcomes and estimate the costs of such an event.

In this study, we have reviewed the current literature concerning conversion to open surgery in laparoscopic radical prostatectomy, to evaluate the main risk factors and reasons for conversion, as well as complications and costs associated to it.

METHODS

A review of the literature was performed in January 2018, searching PubMed database.

A "free text" protocol using the terms "laparoscopic radical prostatectomy," and "conversion to open surgery," was applied. A total of 140 records were found.

Only full-length English language articles identified during this search were considered for this analysis. A preference was given to the articles with large series with more than 100 patients. The authors reviewed the records to identify suitable studies to include in the review.

Only three articles of scientific relevance were found focusing on this specific topic:

- "Laparoscopic radical prostatectomy: A multi-institutional study of conversion to open surgery," by Bhayani *et al*. published in Urology 2004; 63:99.[12]

Bhayabi *et al*. reviewed the records of 670 consecutive LRP performed by 8 surgeons of 7 different institutions in the US, between 2000 and 2002. The study period reflects all the surgeons' initial experience, as neither had previous practice in LRP. The aim was to assess the incidence of OC, the most common steps at which conversion occurred, reasons for conversion, comorbidities, and functional outcome.

- "Population-based analysis of incidence and predictors of OC during minimally invasive radical prostatectomy" by Weiner *et al*. published in J Urol. 2015 Mar; 193 (3): 826-31.[13]

This study retrospectively analyzed the records of US National Cancer Database regarding 87,415 patients submitted to minimally invasive radical prostatectomy (RARP and LRP) in the years 2010 and 2011, without prior irradiation therapy. Surgical outcomes, patient, disease, and treatment facility characteristics were compared between converted and non-converted surgeries in a multivariable analysis.

- "OC during minimally invasive radical prostatectomy: Impact on perioperative complications and predictors from national data," by Sharma and Meeks published in J. Urol 2014 Dec; 192 (6): 1657-62.[14]

The authors performed a retrospective analysis of data collected from the nationwide inpatient sample (NIS) from the years 2004 to 2010. During that period there were 134,398 MIRPs, and 359,192 ORP performed in the US and registered in the NIS database. Complication rate, comorbidities, total charges, length of stay and several patient, and hospital and surgeon factors predicting OC were analyzed.

RESULTS

Bhayani *et al*. focused on 670 transperitoneal LRPs (Montsouris technique) performed by 8 different US surgeons at the beginning of their learning curve. The rate of conversion was 1.9% (13 patients). The most common clinical stage was T1c (12 out of the 13 converted surgeries), despite major differences on the final pathologic stage: 5 patients pT2b, 3 patients pT2a, 2 patients pT3b, and 1 patient pT3a. In one patient open-converted radical prostatectomy could not be completed due to severe pelvic lipomatosis, and the patient subsequently underwent radiotherapy. Mean length of hospitalization after the conversion was 4, 2 days and mean duration of bladder catheterization was 12, 7 days. Only one patient presented a positive surgical margin (pT3b).

Weiner *et al*. retrospective analyzed the records of 82,338 patients submitted to robotic-assisted and 5077 laparoscopic radical prostatectomies and 1080 conversions. The global rate of conversion was 1.2% (1080 MIRP), respectively, 0.9% (750) in RARP group and 6.5% (330) in LRP group. In their study, there was no reference to the most frequently used technique. Most patients (62.5%) underwent MIRP at facilities in the highest quartile of yearly MIRP (>72 procedures/year). Converted patients did not present any significant difference to non-converted patients in terms of

positive surgical margin (20.4% and 20.5%, respectively) or rate of nodal dissection.

Sharma *et al*. focused on 359,192 ORP and 134,398 MIRPs with a 1.8% (2360) OC rate, performed in the United States between 2002 and 2010 according to the NIS. OC rate decreased gradually from 7.2% in 2004 to 0.7% in 2010, parallel to an increase in MIRP volume from 3,205 to 43,864 during the same time.

Causes of conversion

Bhayani *et al*. reviewed the main causes of conversion to open surgery. In 7 cases (54%), there was a failure to progress due to several different factors: Dense periprostatic adhesions or absence of clear dissection planes, extreme obesity (body mass index >30) conditioning difficulty in reaching the target region with standard-length instruments and difficulty in ligating the dorsal venous plexus. Iatrogenic injury of other organs was the second most common cause for conversion to open surgery: Rectal laceration - 2 cases, both in the apical dissection step and in previously treated patients with androgen blockage; transection of the ureter and bladder injury - 2 cases (15%). Two conversions were due to hypercapnia, unresponsive to hyperventilation and decreased in CO_2 insufflation pressure. At last, the doubt of free surgical margin in the bladder neck determined the conversion to open surgery in one patient.

Surgical step at which conversion occurred

According to Bhayani *et al*. 38% of the conversions occurred during apical dissection, 31% during dissection of the seminal vesicles, 15% during dissection of the bladder neck, 8% in the dorsal venous complex of the prostate, and another 8% after radical excision of the prostate.

Risk factors for OC

Weiner *et al*. have identified several predisposing factors for conversion to open surgery:

- Black race: 16.1% of converted surgeries corresponded to black patients versus 12% of unconverted surgeries (odd ratio 1.4; $P = 0.012$). According to the authors, these differences can be due to anatomical variances in this race such as narrower pelvis, making it more difficult to perform the surgery;
- Surgical volume: The median yearly treatment facility volume of MIRP was 32, IQR 10–72. Facilities in the lowest quartile of yearly MIRP volume comprised only 3.8% of all MIRPS, although they accounted for 22.9% of all conversions. For hospitals in the first, second, third, and fourth quartiles of yearly minimal invasive radical prostatectomy volume the conversion rate was 7.4%, 1.7%, 1.2%, and 0.8% at $P < 0.001$, respectively.
- Laparoscopic versus robotic surgery: Conversion rate was 6.5% and 0.9%, respectively ($P < 0.001$), probably due to the longer laparoscopy learning curve and to a gradual decrease in the number of laparoscopic surgeries performed in USA (in 2011 95% of the radical prostatectomies were performed with the aid of robotics).

The type of institution (academic, comprehensive, or community), as well as disease characteristics (Gleason pattern, PSA, and stage), did not seem to exert a significant influence in the conversion rate, according to Weiner's study.

Sharma *et al*. have demonstrated in their studies that on univariate analysis, OC was related to the number of comorbidities, type of hospital (teaching hospital), surgical experience, chronic anemia, obesity, metastatic cancer, diabetes, tobacco use, and presence of peritoneal adhesions or undergoing lysis of adhesions. However, on multivariate logistic regression analysis only the surgeon's volume <25 cases per year, chronic anemia, obesity, and presence of adhesions retained statistical significance to OC.

Surgical learning curve

Both Weiner *et al*. and Sharma *et al*. studied reported generically the importance of surgical experience in reducing the conversion rate, emphasizing that hospitals and surgeons with a high volume of laparoscopic radical prostatectomies have a lower percentage of conversion. According to Sharma's study, OC rates decreased from 7.2% in 2004 to 0.7% in 2010, as MIRP volume increased from 3,205 to 43,864 during the same period. Similarly, surgeons that performed more than 25 LRP per year presented a significantly lower OC rate compared to lesser volume surgeons.

Bhayani *et al*. evaluated more thoroughly the importance of the learning curve in the OC rate: According to this study, 6 (46%) of the 13 conversions occurred in the first 5 laparoscopic surgeries of each surgeon, while the remainder occurred between the 22nd and 105th.

Morbidity of OC

According to Weiner *et al*., patients who underwent conversion presented an increase in the number of hospital readmissions at 30 days (4.4% vs. 2.7%, $P < 0.001$) as well as a post-operative hospital stay of >2 days (40.4% vs. 15.1%, $P < 0.001$) compared to those without conversion.

In terms of in-hospital outcomes, only Sharma's study quantifies this field in detail: According to this study, OC cases had a longer length of stay (mean time of hospitalization of 4.17 vs. 1.71 days, $P < 0.001$) and higher total hospital charges (41,049 vs. 37,418, $P < 0.001$) compared to non-converted surgeries. The prolonged length of hospital stay and the significantly increased surgical complication rate (45.2% in OC and 7.2% in MIRP, $P < 0.001$) translated into

a rise in total hospital charges of $ 13,500 per converted surgery.

Bhayani *et al*. was the only study to evaluate the functional outcome (continence and erectile function) in open conversion cases. With at least 6 months of follow-up, 11 (92%) of 12 patients converted to open surgery were fully continent, and 4 (44%) of the 9 patients with good pre-operative erectile function reported erections sufficient for satisfactory intercourse.

Concerning oncological outcome, Bhayani *et al*. and Weiner *et al*. studies concluded that conversion to open surgery does not seem to carry a higher risk of positive surgical margin. There were no references in these studies to biochemical recurrence-free survival or clinical progression-free survival rates in OC patients.

DISCUSSION

In any laparoscopic surgery, it may be necessary to convert to open surgery. In this matter, it is important to know the main reasons of conversion, adverse effects, and inherent costs. According to the studies analyzed, the initial phase of the learning curve/surgical experience seems to be one of the most important factors for conversion to open surgery.

Obesity, the presence of peritoneal adhesions or lack of clear surgical planes are some of the other factors commonly listed by these studies. Predictably, inadequate exposure due to increased visceral fat and the significant dissection needed to perform in obese patients may increase the likelihood of injury in nearby structures and contribute to increased surgical conversion rate. On the one hand, in the transperitoneal laparoscopic approach, peritoneal adhesions (by the history of intraperitoneal surgery, inflammatory diseases, radiotherapy, or other causes) and subsequent lysis of these may increase the risk of other organ and vascular injuries and, on the other hand, restrict pelvic access. The high rate of complications after conversion presented in Sharma's study (45%) stresses the need to predict the situations in which conversion is more likely to occur, to guide surgeons on the ideal surgical approach, especially to those at the beginning of their learning curve. These should be selective in the choice of their initial patients, especially avoiding obese patients, with multiple comorbidities such as chronic anemia or with a high probability of periprostatic or peritoneal adhesions. Another option is to refer patients with predictable high technical difficulty for high-volume surgeons. It is noteworthy that the surgical procedure of conversion to open surgery does not in itself entail an increased risk of post-operative complications. The underlying reason for conversion (injury to other organs, tissue adhesions, and among other reasons) coupled with the progressive decrease in open surgical training in the USA can be the main constraints to this high rate of complications. Interestingly, despite the high rate of complications, the oncological and functional results appear to be overlapping.

CONCLUSION

At present, open radical prostatectomy seems to have reached its limit of improvement. In comparison, the laparoscopic approach seems to be still in its early stages of development, already rivaling with open prostatectomy in the oncological and functional outcome. Once the full maturity of development is reached, it is expected that it will surpass its predecessor on a large scale.

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