Optimal port placement during laparoscopic radical prostatectomy

Ashis Chawla, MD, Adnan Qureshi, MD, Aziz Alamri, MD, Edward D. Matsumoto, MD
Department of Surgery, Division of Urology, McMaster University, Hamilton, Ontario, Canada

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Introduction: *Placement of anterior abdominal wall trocars during laparoscopic radical prostatectomy (LRP) carries the risk of inadvertent injury to the inferior epigastric artery (IEA) and crossover confliction between midline and lateral ports. We described and evaluated a new measured port placement approach.*

Materials and methods: *The intervention group included patients who underwent LRP with a specifically measured five port approach. The medial 10 mm ports were placed 5 cm from the patient's midline at a level mid-way between the anterior superior iliac spine (ASIS) and the umbilicus. The control group had five ports placed at the surgeon's discretion. We prospectively compared intraoperative blood loss, need for port repositioning, and incidence of adverse surgical events.*

Results: *In the interventional cohort patients (n = 112) the course of the IEA was found to be lateral to the medial 10 mm port in all cases. There were no adverse surgical outcomes in this group. In the control group patients (n = 97), three demonstrated IEA injuries ($p < 0.01$) and three required port repositioning ($p < 0.01$). The mean blood loss reported between groups was not significant ($p = 0.70$).*

Conclusion: *Our specifically measured port placement approach predictably allowed for the placement of the trocar medial to the IEA. This minimized the risk of injury to the IEA, allowed for adequate instrument manipulation and minimized the need to reposition ports.*

Key Words: laparoscopic, radical prostatectomy, minimally invasive surgery, hemostasis, trocar

Introduction

Prostate cancer is the leading diagnosed cancer in men in economically developed countries, and sixth leading cause of cancer mortality worldwide.[1] In Canada alone, the Canadian Cancer Society estimated 25,500 new cases of prostate cancer in 2011, which represents 27.5% of all new diagnosed cancers.[2] Despite the high incidence of diagnosed prostate cancer, estimates of this disease in the population are expected to alarmingly increase as a consequence of the aging population, and greater utilization of screening modalities.[3-6] Even in populations with lower incident rates of prostate cancer, such as in Asian countries like China and Japan, the rate of this disease is rapidly increasing.[7-9]

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Address correspondence to Dr. Edward Matsumoto, Department of Urology, St. Joseph's Hospital, 50 Charlton Avenue East, Hamilton, Ontario L8N 4A6 Canada

Surgical approaches include retropubic, perineal, extraperitoneal and robotic assisted prostatectomy. Our study examines the port placement for the extraperitoneal approach. We selected this approach because of popularity of this method amongst urologists that perform laparoscopic radical prostatectomy (LRP) and the gap in the literature concerning port placement for this cohort. Extraperitoneal LRP was initially reported by Raboy and colleagues in 1997.[10] Laparoscopy allows for increased magnification of the operating field facilitating meticulous dissection, improved hemostasis and effective excision of the prostate gland. Increasing popularity of LRP in Europe and North America over the years has allowed it to develop as a comparable alternative to open radical prostatectomy for organ confined prostate cancer.[11,12]

Equivalent oncologic long term outcomes in several large case series as well as equivalent short term outcomes including continence and potency rates have established the laparoscopic approach as an ideal method for radical prostatectomy.[13-16]

As with other advanced abdominal laparoscopic surgeries the importance of optimal trocar placement in LRP is critical in limiting adverse surgical outcomes.

Abdominal wall vascular trocar injury is potentially serious but preventable complication occur in up to 2% of laparoscopic surgery.[17-20] There is limited literature describing the path of the inferior epigastric artery (IEA) in an effort to limit its inadvertent injury during trocar placement. Both superficial and epigastric vessels are at risk for trocar injury. Transillumination provides some benefit in identifying superficial vessels in normal weight individuals but is ineffective in identifying inferior epigastric vessels thus necessitating other techniques to minimize injury to these vessels.[21] Using a conventional five port placement for LRP risks injury to the inferior epigastric vessels. We describe an approach to avoid the course of the inferior epigastric vessels especially with the insertion of the 10 mm medial trocars while allowing for adequate distance between the medial and lateral ports. There has been a paucity of studies examining port placement for LRP. There were two published studies that described port placement for robotic assisted LRP.[22,23] The study by Cestari et al primarily dealt with port placement to reduce the "chasing swords phenomenon" and optimal Trendelenburg position but did not consider vessel injury.[22] The study by Pick et al similarly described port placement for robotic LRP; however, briefly mentions the epigastric artery having variable course through the rectum abdominis muscle and that it should be avoided.[23] Their recommendations were to place trocars 5 cm to 6 cm from the midline and < 18 cm from the pubis for efficient robotic assisted laparoscopic radical prostatectomy.[23]

Our study investigated patients undergoing non-robotic LRP using specific 10 mm port placement to lower the risk of IEA injury and also the need to reposition trocars due to "swording" of instruments.

Materials and methods

Our study was an analysis of two consecutive patient cohorts undergoing LRP from January 2008 to June 2010. The two cohorts we compared differed by an intervention which provided guidelines for port placement. The control cohort represented patients from January 1, 2008 until June 30, 2009. This data was obtained through our REB approved prospective database. The intervention cohort had their data collected prospectively from July 1, 2009 until June 30, 2010. The same surgeon operated on both groups of patients. This project received ethics approval through our institution's Ethics Committee.

Intervention group

The retroperitoneal space was developed bluntly using the Optiview (Ethicon Endo-Surgical Corporation, Cincinnati, OH, USA) visual obturator followed by dissection using the laparoscope. The peritoneum was mobilized superiorly. CO_2 was used to insufflate this space. The patient's midline was marked using a skin marker and a 5 cm measurement was marked lateral from the midline at a level mid-way between the anterior superior iliac spine (ASIS) and the umbilicus using a disposable ruler, Figure 1.

A 10 mm skin incision was made lateral to this 5 cm mark followed by insertion of a 10 mm blunt Optiview port with the aid of a handheld obturator. Intra-abdominal visualization was used for confirming that the IEA was lateral to the 10 mm port. Secondary 5 mm ports were then inserted 2 cm cephalad and medial from the ASIS. The same sequences of steps were repeated on the contra-lateral side. The final port configuration is displayed in Figure 2.

Control group

The retroperitoneal space was mobilized in a similar fashion. After placement of the Optiview trocar at the umbilicus the remaining 10 mm medial and 5 mm lateral ports were placed in a "fan" orientation at the surgeon's discretion.

Analysis

We used t-test to compare parametric data between the intervention and control group. For comparison of injury and repositioning rates we used Fischer's exact test.

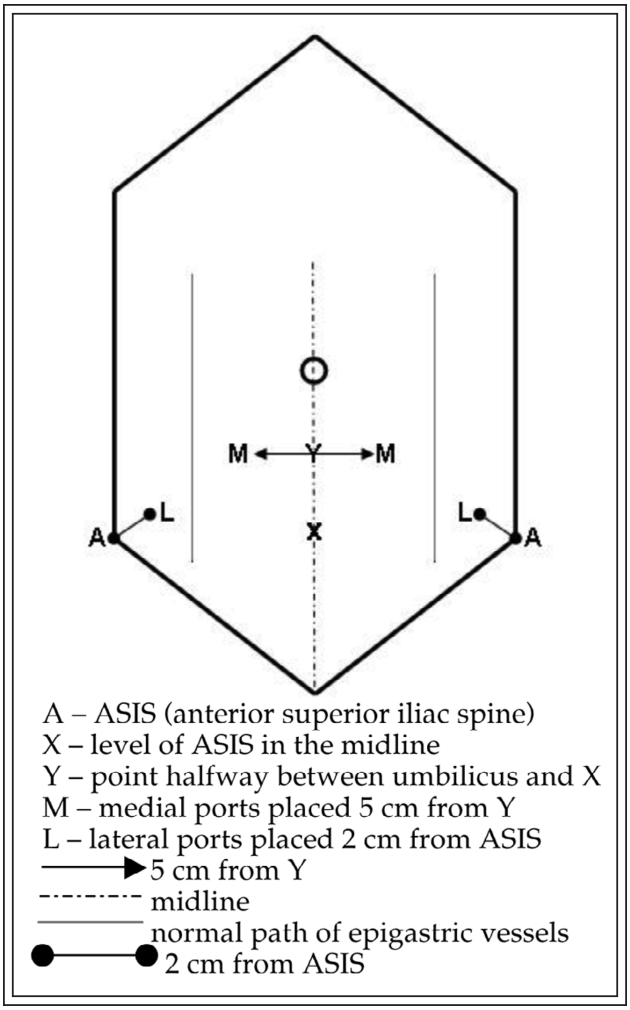

Figure 1. Schematic diagram of port placements.

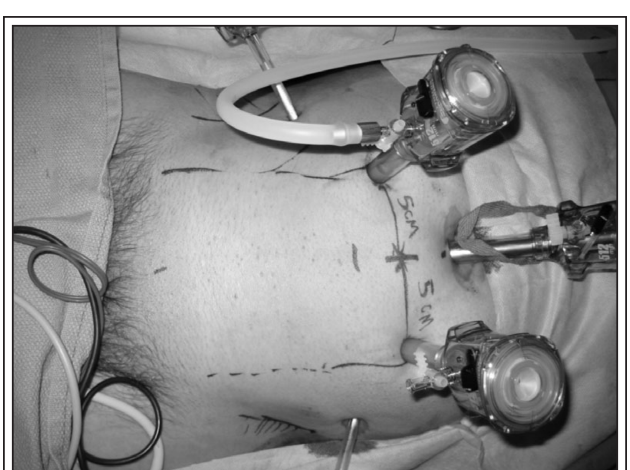

Figure 2. Final port configuration for laparoscopic radical prostatectomy. Insertion of 10 mm Optiview port and 5 mm ports.

$P < 0.05$ was considered statistically significant. SPSS version 15.0.0 (IBM Corporation, Sommers, NY, USA) was used for data analysis.

Measurements

We collected prospective data on injury to the IEA and location of the artery to the medial trocar with the observations recorded during trocar placement and confirmed upon removal of port. We also recorded the intraoperative blood loss and the incidence of conversion to an open procedure. Patient characteristics that may confound our results such as body mass index were recorded and included in our results.

Results

There were a total of 209 consecutive patients who underwent LRP and were included in our study. There were 112 patients in our intervention group who underwent LRP using the measured port placements. In all of these cases the IEA was found to travel lateral to the insertion of the 10 mm medial port.

No injury to the IEA was sustained in our interventional group. The mean operative time was 187 minutes (90-360) with a mean estimated blood loss of 277 cc (100 cc-1000 cc). No patients were transfused postoperatively. In addition, no ports required repositioning due to crossover confliction between the medial (10 mm) and lateral (5 mm) ports. No patients required conversion to open procedure, Table 1.

In our control group we had 97 patients where the medial port was not measured from midline. Three patients had sustained injury to the IEA resulting in intraoperative repair. Three patients in the control group necessitated repositioning of trocars due to excessive crossover confliction with the midline and lateral ports.

Discussion

The complexity of advanced laparoscopic procedures such as LRP necessitates placement of large diameter (10 mm) trocars through the anterior abdominal wall. This can result in an inadvertent injury to the abdominal wall vessels in up to 2% of cases.[16-20]

Injury to the epigastric vessels can have varying clinical presentations including oozing around the external port sites or dripping internally around shaft of the cannula.[24,25] This injury may go unrecognized due to intraoperative tamponade by cannula and pneumoperitoneum and subsequently may only

TABLE 1. **Sample characteristics and adverse surgical outcomes**

	Intervention group	**Control group**	**p value**
Sample size	112	97	
Body mass index (kg/m^2) Mean (range)	26.3 (19-35)	27.0 (19-39)	0.85
Mean inter-operative Blood loss (range)	277 cc (100-1000)	256 cc (120-300)	0.70
Incidence of postoperative transfusion	0	1	0.20
Conversion to open	0	0	
Inferior epigastric artery injury	0	3	0.01
Location of inferior epigastric artery	lateral to 5 cm port		
Mean operative time Minutes (range)	187 (90-360)	196 (120-300)	0.67
Incidence of repositioning of ports	0	3	0.01

become apparent as a postoperative hematoma or pseudoaneurysm.[26,27] Other potential adverse consequence of IEA injury in addition to notable blood loss includes necrosis of abdominal wall musculature secondary to insufficient blood flow via collateral blood vessels.[28]

Treatments of abdominal wall bleeding due to injury of IEA are full thickness abdominal wall suture ligature, as well as Foley catheter balloon tamponade through the trocar site.[18,20] Should these maneuvers fail, surgical exploration of the wound is indicated.

There is limited literature describing the path of the IEA in an effort to limit its inadvertent injury during trocar placement. Based on the existing literature a minimum distance of 5 cm from the midline was used for lateral 10 mm trocar placement to limit any injury to the IEA. During observation of placement of a 10 mm trocar 5 cm lateral to midline it was found that there was no injury to the abdominal wall vasculature. This distance of 5 cm from the midline for port placement is supported by various studies. Sabre and colleagues mapped the epigastric vessels in over 100 patients based on CT scan results of the abdomen and pelvis.[29] They concluded that midway between the umbilicus and symphysis pubis the IEA was between 5.25 cm-5.32 cm from the midline. We had found upon insufflation of the abdomen that the IEA were displaced laterally by another 1 cm-3 cm, depending on patient habitus. In our study the 10 mm medial ports measured 5 cm from midline, half way between the ASIS and umbilicus avoiding the IEA which were consistently lateral and away from harms way.

Nezhat and colleagues who evaluated the course of the IEA intraoperatively with optical visualization in patients with varying BMI also supported these measurements. They concluded that the mean distance from the midline to the IEA was 5.5 cm with the right IEA having a tendency to travel more lateral than the left.[30,31] Noteworthy in this study was that all of the patients were females. They also determined that an increased BMI resulted in impaired optical intra-peritoneal visualization of these vessels. Surprisingly, they were not able to identify any significant variation between BMI and measured distance from midline to the IEA.

These studies support the strategy of placing the medial 10 mm trocar 5 cm from the midline of the patient. This placement appears to avoid the IEA and allows for adequate distance between the lateral and medial ports minimizing crossover confliction between these instruments. This was reflected by none of the patients from the intervention group requiring repositioning of trocars. Our control group which utilized port placement at the surgeon's discretion, had three patients who required repositioning of trocars and three required repair of the IEA injury.

There were limitations to our study. Port placements may vary depending on the surgeon as well as the robotic approach, transperitoneal versus extraperitoneal; hence, IEA vessel location may not be an issue. Also the use of dilating trocar systems such as the VersaStep (Autosuture, Mansfield, MA, USA) may mitigate injury to epigastric vessels.

Conclusion

LRP is a common procedure which has gained increasing acceptance and practice in the urologic community. Much of the success of limiting adverse surgical outcomes of this approach relies on optimal trocar placement. Important anatomic considerations including predicting the course of the IEA and avoiding its inadvertent injury are paramount to minimizing patient complications post-operatively. We recommend measuring 5 cm at a level midway between the anterior superior iliac spine (ASIS) and the umbilicus for the 10 mm medial trocar placement to eliminate inadvertent injury to the epigastric vasculature and to provide optimal intra-pelvic positioning of laparoscopic instruments. The additional time required to measure 10 mm trocar placement using a disposable ruler and skin marker may be offset by reduced time required to manage a higher incidence of IEA injury and port reposition. □

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