Safety and Efficacy of Laparoscopic Access in a Surgical Training Program

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Abstract: Our study evaluated outcomes of laparoscopic access in a surgical residency program and identified variables associated with adverse outcomes. Following IRB approval, we reviewed prospectively collected data from consecutive laparoscopic surgeries from a single surgeon August 2008 to November 2011. Descriptive statistics were generated, and successful and unsuccessful access techniques were compared using the *t* test, Fisher exact test, and χ^2 test of independence, with $P < 0.05$ considered significant. Five hundred consecutive laparoscopic surgeries were evaluated; the average patient age was 47 years and 55% of patients were female. The most common procedures included laparoscopic cholecystectomy (29%), laparoscopic ventral hernia (15%), laparoscopic appendectomy (12%), laparoscopic colon/small bowel (11%), and laparoscopic inguinal hernia (10%). Successful laparoscopic access was obtained in 98% of patients. The most common access techniques were umbilical stalk technique (57%) and Veress followed by optical trocar technique (29%). The complication rate was 7% and included multiple access attempts in 3.4%, attending physician having to take over access in 1.6%, bleeding/solid organ injury in 0.8%, insufflating peritoneum in 0.6%, and bowel injury in 0.2%. There was a significant relationship between entry technique and failure rate. Open cutdown away from umbilicus had a higher failure rate than other techniques ($P = 0.0002$). There was also a significant relationship between type of surgery and failure rate of technique, with laparoscopic ventral hernia and laparoscopic small bowel cases having the highest failure rate ($P = 0.005$). We observed no difference in success rate based on age, sex, race, previous surgery, and resident training level ($P > 0.05$). Laparoscopic access using appropriate techniques can be safely performed in a residency training program. Laparoscopic ventral hernia and small bowel procedures for obstruction can be difficult cases to obtain access, and surgeons should be able to use multiple strategies to obtain access.

Key Words: general laparoscopy, access, training, residency

(*Surg Laparosc Endosc Percutan Tech* 2016;26:17–20)

Obtaining safe abdominal access is essential for a successful laparoscopic procedure. While often an overlooked step in most laparoscopic cases, failure or difficulty in obtaining laparoscopic access can drastically change the planned operative procedure. In most cases, laparoscopic access can be easily obtained using safe surgical techniques and following some basic tenets of access, such as avoiding entry at previous incisions. However, in some cases, laparoscopic access can be quite difficult and is not without complications, some of which can lead to significant morbidity and even mortalities.[1–3]

Access can be obtained through either open or closed techniques. The most common open technique is the Hassan approach, which is an open cutdown and entry into the peritoneum under direct visualization. The easiest place on the abdominal wall to obtain open access is likely the umbilicus, but this technique can also be done at any other site on the anterior abdomen. The closed technique is usually initiated with a Veress needle or direct optical trocar access. The Veress needle is a small-bore, hollow needle with a spring-loaded protective obturator that clicks when the needle passes through the peritoneum. Pneumoperitoneum is then obtained, and an optical trocar can be placed at a separate site or through the same tract after the Veress needle is removed. The Veress needle can be placed near the umbilicus, however, is often placed in the left upper quadrant subcostal area in attempts to avoid major vascular injuries or injuries to the liver.[4]

The safety and efficacy related to abdominal access during laparoscopic procedures in surgical residency programs has not been well studied. The purpose of this study was to evaluate outcomes of laparoscopic access in a surgical residency program and identify potential variables associated with adverse outcomes.

METHODS

Following IRB approval, we reviewed prospectively collected data from consecutive laparoscopic surgeries from a single surgeon from August 2008 to November 2011. Demographic data included age, race, sex, and previous abdominal surgery. The primary endpoint was success of abdominal access relative to the access technique. In our study, the surgeon selected the initial access technique, and the resident undertook the access. Successful access was defined as achievement of pneumoperitoneum using the access technique initially selected. Failure was defined as the need to use a second access technique. Abandoning the initial technique and using a second technique was not considered a complication but rather a failure of access. Additional endpoints included complications and the resident (training) level assisting with the surgery. Complications were defined as multiple attempts at the access technique, the attending physician obtaining access after the resident's failure, bleeding or solid organ injury, insufflating the peritoneum, and bowel injury. All complications were based on intraoperative findings, and patients were not assessed for complications in the postoperative period.

Received for publication February 26, 2015; accepted October 22, 2015.
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Presented in poster form at the Southeastern Surgical Congress, February 21–25, 2014, Savannah, GA.
The authors declare no conflicts of interest.
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Descriptive statistics were generated, and successful and unsuccessful access techniques were compared using the t test, Fisher exact test, and χ^2 test of independence. A $P < 0.05$ was considered significant.

RESULTS

Five hundred consecutive laparoscopic surgeries were evaluated for this study. The patients had an average age of 47 years (range 6 to 95 y), 55% were female, and 47% had previous abdominal surgery. Seventy percent of patients were white, 23% African American, and 7% Hispanic. The most common procedures were laparoscopic cholecystectomy in 29%, laparoscopic ventral hernia in 15%, laparoscopic appendectomy in 12%, laparoscopic colon/small bowel in 11%, and laparoscopic inguinal hernia in 10%. The most common access techniques were open umbilical stalk technique with 57% and Veress needle with optical trocar technique with 29% (Table 1). Residents were involved in 93% of the cases; the majority were senior residents (PGY 3, 4, or 5), although no difference was found for success of peritoneal access with residents at different levels of training and in cases with no resident present (Table 2).

Successful laparoscopic access was obtained in 98% of patients (492/500). There was a significant relationship between technique of entry and failure rate, with open cutdown away from umbilicus having a higher failure rate than other techniques (Table 3). Peritoneal access was achieved using either the first or the second technique in all cases where laparoscopic access was achieved. We also observed a significant relationship between type of surgery and failure rate of technique; laparoscopic ventral hernia and laparoscopic small bowel cases had the highest failure rate (Table 4). We observed no difference in success rate based on patient age, sex, race, and previous surgery ($P > 0.05$). The complication rate was 7% and included multiple attempts in 3.4%, attending physician taking over access in 1.6%, bleeding or solid organ injury in 0.8%, insufflating peritoneum in 0.6%, and bowel injury in 0.2%.

TABLE 1. Access Techniques and Procedure Types

	N (%)
Access technique	
Umbilical stalk	283 (56.6)
Open cutdown not at umbilicus	29 (5.8)
Veress + Optiview	143 (28.6)
Optiview only	7 (1.4)
Hand port	17 (3.4)
Balloon port through colostomy for colostomy takedown-open cutdown	1 (0.2)
SILS open cutdown at umbilicus	19 (3.8)
Through colostomy takedown	1 (0.2)
Procedure	
Lap cholecystectomy	145 (29.0)
Lap inguinal hernia	51 (10.2)
Lap ventral hernia	77 (15.4)
Lap appendectomy	58 (11.6)
Lap splenectomy	5 (1.0)
Lap colon/small bowel	56 (11.2)
Lap nephrectomy/urologic	38 (7.6)
Lap adrenal	7 (1.4)
Lap foregut-Nissen/Heller/PEH/other	18 (3.6)
Lap small bowel	13 (2.6)
Diagnostic lap/LOA/other	31 (6.2)
Lap liver	1 (0.2)

LOA indicates lysis of adhesions; PEH, paraesophageal hernia repair; SILS, single-incision laparoscopic surgery.

TABLE 2. Comparison of Access Success and Failure Rates by Resident Training Year

Variable	Training Year	Success [n (%)]	Failure [n (%)]	P
Resident participation	First year	19 (3.9)	0	0.8
	Second year	15 (3.1)	0	
	Third year	144 (29.3)	3 (37.5)	
	Fourth year	100 (20.3)	2 (25.0)	
	Fifth year	180 (36.6)	2 (25.0)	
	None	34 (6.9)	1 (12.5)	

DISCUSSION

Our study showed that accessing the peritoneum for laparoscopy is safe using many different techniques, even in a teaching hospital with residents undertaking the access. Successful access was achieved in most of our patients using the first technique chosen and in all of our patients using either 1 or 2 techniques. We did not compare open and closed techniques in general, as these are extensively compared in the literature. A previous report comparing open and closed techniques found that open access to the abdomen had a significantly lower failure rate compared with the closed techniques.[5] We observed a difference between the 2 most common open and closed techniques, although we did not compare these statistically. Just as Hasson et al[6] showed in a review of their laparoscopic data, we found that the open cutdown at the umbilicus had a 100% success rate, whereas the use of the Veress needle occasionally resulted in access failure. That being said, no conclusions can be definitively drawn from this comparison as our data showed open cutdowns away from the umbilicus having some failures also.

Our complication rate of 7% is much higher than the complication rates reported in historical data, ranging from 5 in 10,000 to 3 in 1000.[7–9] One reason for our higher complication rate is our inclusion of multiple attempts at access and other occurrences as complications in our data. Most studies include only visceral, solid organ injuries, and bleeding as complications. Using these criteria only in

TABLE 3. Comparison of Access Success and Failure Rates by Access Technique

Variables	Success [n (%)]	Failure [n (%)]	P
N	492	8	
Access technique			
Umbilical stalk	283 (57.5)	0	0.0002
Open cutdown not at umbilicus	25 (5.1)	4 (50.0)	
Veress + Optiview	140 (28.5)	3 (37.5)	
Optiview only	6 (1.22)	1 (12.5)	
Hand port	17 (3.5)	0	
Balloon port through colostomy for colostomy takedown-open cutdown	1 (0.2)	0	
SILS open cutdown at umbilicus	19 (3.9)	0	
Through colostomy takedown	1 (0.2)	0	

SILS indicates single-incision laparoscopic surgery.

TABLE 4. Comparison of Access Success and Failure Rates by Procedure Type

Variables	Success [n (%)]	Failure [n (%)]	*P*
N	492	8	
Procedure			
Lap cholecystectomy	145 (29.47)	0	0.005
Lap inguinal hernia	51 (10.37)	0	
Lap ventral hernia	74 (15.04)	3 (37.5)	
Lap appendectomy	58 (11.79)	0	
Lap splenectomy	5 (1.02)	0	
Lap colon/small bowel	55 (11.18)	1 (12.5)	
Lap nephrectomy/urologic	38 (7.72)	0	
Lap adrenal	6 (1.22)	1 (12.5)	
Lap foregut-Nissen/Heller/ PEH/other	18 (3.66)	0	
Lap small bowel	11 (2.24)	2 (25.0)	
Diagnostic lap/LOA/other	30 (6.10)	1 (12.5)	
Lap liver	1 (0.20)	0	

LOA indicates lysis of adhesions; PEH, paraesophageal hernia repair.

calculating our complication rate would have produced a rate much closer to the historical data.

We did not compare complication rates between open and closed access techniques, and the actual difference between the 2 is still debated. Jansen et al[9] found a higher overall rate of complications with the open technique, whereas Molloy et al[10] reported a higher rate of bowel injuries with the open technique and few vascular injuries. Current guidelines generated from extensive literature review recommend use of either technique, as the authors found no difference in complications between the techniques.[4,5]

We observed that patients undergoing repair of ventral and incisional hernias and laparoscopic cases for small bowel obstructions have the highest failure rates. This is not surprising as patients with ventral incisional hernias and small bowel obstructions tend to have an extensive abdominal surgical history and often have intra-abdominal adhesions or distention making laparoscopic access quite difficult. Perrone et al[11] examined laparoscopic access in 121 laparoscopic ventral hernia operations and reported successful first attempt in 88% using a closed Veress needle access in the right flank as their primary attempt. If this closed technique failed, an open cutdown technique was used, and they reported only 1 enterotomy related to laparoscopic access in this patient population.[11] In one of the largest series on laparoscopic ventral hernia, Heniford et al[12] used an open cutdown in the majority of cases (75%) with the remaining being a closed technique (25%). The authors reported that, even in the multiply operated abdomen, there is usually an area with minimal adhesions on either of the patient's flanks between the lower costal margin and the iliac crest where safe access can be obtained.[12] A review of laparoscopy for small bowel obstruction recommended an open cutdown technique over closed Veress needle due to intestinal perforation with the latter technique.[13] In either case, technique selection can determine successful laparoscopic abdominal entry, and discretion must be used preoperatively when selecting patients for these procedures. Surgeons should be aware that access may be difficult in patients with previous surgeries and in laparoscopic incisional hernia and small bowel obstruction cases.

Although laparoscopic access was obtained using our first technique in the majority of patients, in 8 patients alternative access techniques were needed. This highlights the importance of mastering several different abdominal access techniques, so that if one technique fails another can be safely used to obtain access and complete the laparoscopic procedure. Three of our access failures were ventral hernia cases and 2 were small bowel cases, highlighting the potential for difficulty in obtaining access during these procedures. Surgeons should be aware of this and have additional options available if initial access attempts fail. One access failure occurred during a laparoscopic adrenalectomy with the patient in the lateral decubitus position. Surgeons should be skilled obtaining laparoscopic access in patients that are supine and in other positions such as lateral decubitus during complex laparoscopic surgery. We found no other preoperative predictive factors associated with access failure in this group of patients; however, surgeons should be skilled in multiple techniques and have a plan for alternative access in high-risk patients, such as patients with previous abdominal surgery or morbid obesity.

While we found no difference in laparoscopic access success when comparing residents at different training levels and cases with no resident participating, other studies have found statistically significant differences in patient outcomes comparing cases with residents present and absent. One study found an increase in 30-day "mild" and "surgical" complications in cases in which surgical residents participated; the complications were largely surgical site infections and were believed to potentially be the result of the longer operative times required in these cases.[14] Similarly, another study reported longer operative times and an increase in morbidity in laparoscopic cases performed by surgical residents.[15] The authors of both of these studies stated that although the results were statistically significant, the clinical significance was likely negligible and concluded that operating with surgical residents overall is safe.[14,15] We agree with their conclusions, and our data support their sentiments.

Laparoscopic access can be safely and successfully performed in residency training programs with the selection of appropriate techniques and with the understanding that certain procedures and techniques may be more prone to failure. Laparoscopic surgeons can and should safely and efficiently use multiple techniques to gain access to the peritoneum.

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