

The Use of Stab Incisions for Instrument Access in Laparoscopic Operations

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Background/Purpose: Traditional laparoscopic approaches require cannulas for instrument access to the abdominal cavity. This study reports the authors' experience using minimal access (MA) stab incisions, rather than cannulas, for insertion of laparoscopic instruments into the peritoneal cavity.

Methods: All patients undergoing MA procedures by the authors from November 1999 through March 2003 were included. Procedures included foregut, biliary, adrenal, splenic, colonic, and genitourinary operations. A single cannula was used for insertion of the telescope. In select cases, a second cannula was needed for unique instruments (staplers/ultrasonic shears). Abdominal wall stab incisions (SI) were used for introduction of the remaining instruments.

Results: A total of 511 MA procedures were performed during the study period. Pneumoperitoneum was maintained in all cases. There were no complications associated with creation of the SI. A single-Step reusable (partially reusable,

partially disposable) cannula and expandable sheath were used in 308 cases, whereas a second-Step reusable cannula and sheath were needed in 203 children. In total, 1,337 cannulas were saved using this MA technique. The cost to the patient was \$140/Step cannula and sheath; overall cost savings were \$187,180.

Conclusions: MA procedures can be performed safely and effectively with a single or, occasionally, 2 cannulas. The cosmetic result is superior, and there are significant cost savings related to the elimination of accessory cannulas. The authors believe this technique of SI for instrument access is superior to the traditional cannula approach and can be utilized in most laparoscopic operations.
J Pediatr Surg 38:1837-1840. © 2003 Elsevier Inc. All rights reserved.

INDEX WORDS: Stab incisions, reduced cannulas, laparoscopy.

THE TRADITIONAL approach for access to the abdominal cavity in laparoscopic operations utilizes cannulas or ports through which the instruments are inserted. The use of cannulas has proven to be effective and safe for the multitude of laparoscopic procedures now being performed throughout the surgical community. In the fall of 1999, we began using a new technique whereby select operative instruments are placed directly through transabdominal wall stab incisions (SI), reducing the number of cannulas required for any given procedure and ultimately leading to a cost reduction in operative charges as well as a superior cosmetic result. This report details our experience to date with this technique.

MATERIALS AND METHODS

After obtaining approval from the Children's Mercy Hospital Institutional Review Board (IRB#0211-115X), the charts of all children undergoing laparoscopic operations by the authors from November 1999 through March 2003 were reviewed. Charts were reviewed for the operation performed, the number of cannulas utilized, the indication for any extra cannulas (beyond the initial telescope cannula), the number of SI used, the location of the telescope cannula, the ability to maintain pneumoperitoneum, the closure method for the cannula sites and SI, any operative complications associated with cannula or SI insertion sites, and postoperative complications. The institutional expense and charge to the patient for the Step reusable (partially reusable, partially disposable) system (Veress needle expandable sheath, plastic cap with reducer, US Surgical, Norwalk, CT) and the Ethicon bladeless (Ethi-

con, New Brunswick, NJ) cannulas were obtained for financial calculations.

RESULTS

A total of 511 laparoscopic operations were performed by the authors during the study period. In all cases, except the 20 laparoscopic pull-through procedures, the initial cannula was inserted into the abdominal cavity under direct vision through a vertical incision in the umbilicus. In the laparoscopic pull-through procedures, this initial cannula was introduced into the abdominal cavity through a 5-mm incision in the patient's right upper abdomen. In all of these operations, after insertion of this initial cannula, insufflation through this cannula was initiated, followed by introduction of the telescope. The insertion of operative instruments into the abdomen

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Presented at the 36th Annual Meeting of the Pacific Association of Pediatric Surgeons, Sydney, Australia, May 12-16, 2003.

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0022-3468/03/3812-0035\$30.00/0

doi:10.1016/j.jpedsurg.2003.08.017

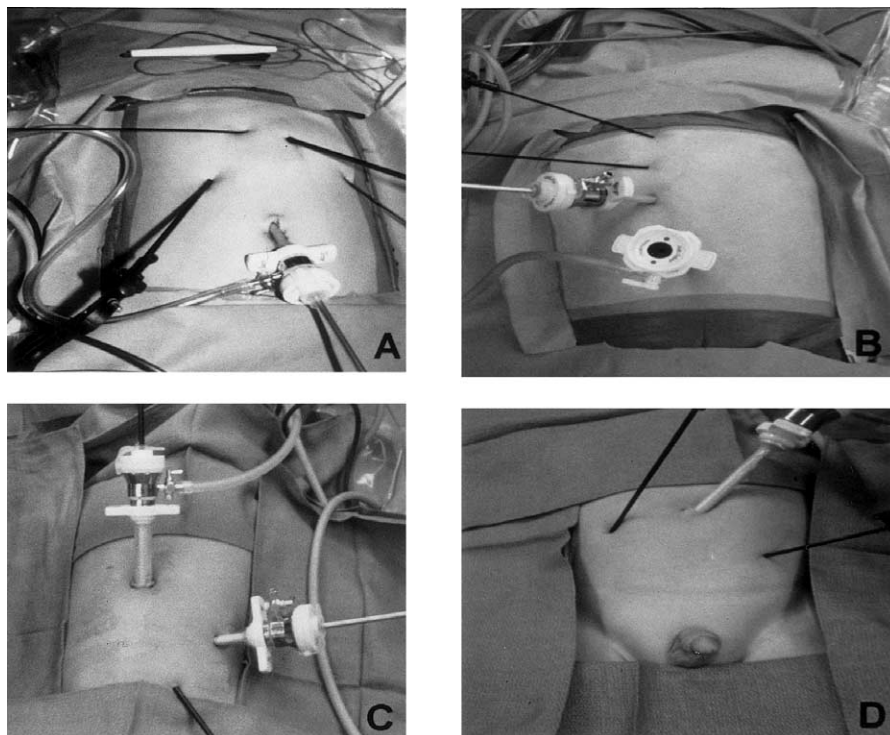


Fig 1. Four operations depicting the SI technique. (A) 12-year-old patient undergoing laparoscopic fundoplication. A single umbilical cannula was used along with two 5-mm and two 3-mm instruments inserted via SIs. (B) Technique of splenectomy with a 15-mm cannula in the umbilicus, a 5-mm cannula in the midline, and two 3-mm instruments in the upper epigastrium. (C) Laparoscopic appendectomy. A 12-mm cannula is in the umbilicus, a 5-mm cannula is in the left lower abdomen for telescope, and a 5-mm instrument in the left suprapubic region for grasping the appendix. (D) A 1-year-old with an intra-abdominal testis undergoing Fowler-Stephens operation. The 2 instruments are 3 mm in size.

then was accomplished through transabdominal wall SI. In creating these SI, a #11 blade (Becton-Dickinson, Franklin Lakes, NJ) was passed through the abdominal wall under direct vision.

The instrument is immediately passed through the SI after the path created by the #11 blade. The most commonly performed operation was a laparoscopic Nissen fundoplication ($n = 223$). In 209 cases, a single 5-mm umbilical cannula was used for the operating telescope, whereas the remaining 4 operative instruments were placed into the abdominal cavity through SI (Fig 1A). In the remaining 14 patients requiring Nissen fundoplication, the ultrasonic scalpel (Ethicon Endosurgery, Cincinnati, OH) was used for division of the short gastric vessels; therefore, a second 5-mm cannula was used in combination with 3 stab incisions. Similarly, in the 7 patients that underwent esophagomyotomy for achalasia, 2 5-mm cannulas and 2 stab incisions were used.

Laparoscopic appendectomy was the second most commonly performed operation ($n = 102$) and, in all cases, a 12-mm cannula was placed in the umbilicus with a 5-mm cannula in the left lower abdomen, and a stab incision was used in the left suprapubic region (Fig 1C). Two children underwent laparoscopic Meckel's diverticulectomy using the same approach utilized for laparoscopic appendectomy. There were 77 infants who underwent laparoscopic pyloromyotomy using a single umbilical cannula for the telescope in conjunction with 2

stab incisions, 1 in the right upper abdomen and 1 in the left upper abdomen.

Laparoscopic splenectomy was performed in 21 patients. In all cases, a 15-mm cannula (for removal of the spleen) was inserted through the umbilicus followed by introduction of a 5-mm cannula in the upper midline. The operating telescope and the ultrasonic scalpel, which was used for the division of the short gastric vessels and dissection of the ligamentous attachments to the spleen, were inserted through these 2 cannulas. Two stab incisions were created cephalad to the 5-mm midline port. Three-millimeter instruments were introduced through these stab incisions and were used for assisting and retracting purposes (Fig 1B).

Laparoscopic pull-through for Hirschsprung's disease was performed in 20 patients. In these cases, the 2 5-mm cannulas were inserted in the right subcostal and mid-abdominal positions for introduction of the telescope and the ultrasonic scalpel, respectively. A single stab incision for a 3-mm assisting instrument was positioned in the left midabdomen. Six children underwent laparoscopic adrenalectomy using 2 cannulas and 2 stab incisions. Finally, there were 22 patients that underwent operations for testicular or ovarian conditions. In all of these cases, a single umbilical cannula was used in conjunction with 2 stab incisions (Fig 1D). In total, there were 308 cases in which a single cannula was utilized, and 203 procedures

were performed using 2 ports. Overall, 1,337 cannulas were saved using this technique.

Although the authors exclusively used the Step reusable cannula system, in relation to the financial savings, calculations were based on the hospital cost and patient charge for the 2 most commonly used cannulas in our institution. The institutional expense and patient charge for the Step reusable cannula system, which we have defined as the Veress needle, expandable sheath, and plastic cap with the reducer, are \$62.00 and \$140.00, respectively. For Ethicon cannulas, these charges are \$41.00 and \$92.00. Although we did not use the Ethicon cannulas in any of these operations, calculations also were made for these cannulas. The overall charge savings for the patients undergoing the laparoscopic procedures in this report was \$187,180.00, and our hospital saved \$82,894.00. For those surgeons who use Ethicon cannulas, the savings would have been \$123,004 to the patients and \$54,817 to the institution.

We identified 3 minor postoperative complications associated with the stab incisions. All 3 cases involved omental herniation through one of the stab incisions. All were identified on postoperative day 1 and involved stab sites where an operating instrument was repeatedly passed in and out of the abdomen. The omentum was reduced and the skin closed with a 5-0 plain catgut suture. There were no complications associated with creation of the SI or insertion of the instruments. Pneumoperitoneum was maintained at 12 to 15 mm Hg in all cases; however, occasionally, a higher flow rate (4 to 5 L/min) was required to offset leakage from a site when an instrument was removed.

DISCUSSION

Since the advent of laparoscopic surgery, most surgeons have utilized cannulas for access to the peritoneal cavity for the insertion of instruments. As the use of laparoscopy has exploded over the last 10 years, this traditional method of introducing instruments has continued. Complications have developed with the introduction of these cannulas, and most of these complications have been related to the use of a sharp trocar when inserting the trocar and cannula.¹⁻⁸ In pediatric surgery, the Step cannula has gained popularity because of the safety of its use. With this technique, a Veress needle with an expandable sheath is introduced into the abdominal cavity, the Veress needle is removed, and a cannula with a blunt trocar is inserted through the expandable sheath into the peritoneal cavity. Not only does the expandable sheath provide a guide for entry of the blunt trocar and cannula, it also helps stabilize the cannula in the abdominal wall. Although this technique is extremely

safe, there is cost involved both to the hospital as well as to the patient.

Our concept of making an SI with direct insertion of the instrument through the abdominal wall developed from our experience with laparoscopic pyloromyotomy in which a similar technique is used routinely. After initially showing its safety, efficacy, and cost effectiveness with laparoscopic fundoplication, this technique has evolved as our standard method of instrument insertion over the last 3 years. Although this technique is quite easily adapted to infants with a thin abdominal wall, it also is readily applicable to young children and even adolescents (Fig 1A-C). Occasionally, a second cannula is required in locations in which a 5-mm instrument is continually changed or in whom the abdominal wall is extremely thick. In our experience, most of these second cannulas have been used in older patients requiring the 5-mm ultrasonic shears or 5-mm endoscopic clip applicator.

The use of SIs for instruments is especially applicable for 3-mm instruments, which are not removed and reinserted routinely. In our experience, examples of 3-mm instruments that are not exchanged routinely during a laparoscopic operation include the liver retractor; the grasping instrument in the surgeon's left hand and the assistant's grasping forceps used during a fundoplication; the 2 accessory instruments for splenectomy; the working instruments for varicocelectomy and ligation of testicular vessels in patients with varicoceles and intra-abdominal testes; the 2 right-sided instruments for laparoscopic cholecystectomy, which are used for retraction and assisting purposes; the 2 assisting instruments for laparoscopic adrenalectomy; and the grasper used for retracting the appendix during a laparoscopic appendectomy (Fig 1). Throughout our use of this technique, a loss of pneumoperitoneum has not been problematic, which may be because of the use of a higher CO₂ insufflation flow rate when necessary. In addition, there have not been any complications with direct insertion of the instruments through the abdominal wall nor with introduction of the Step cannulas. Our only complications related to this SI technique have occurred in the postoperative period. The incisions have been approximated using Steri-Strips (3M Co, St. Paul, MN). In 3 Nissen funduplications, omental evisceration occurred through the primary working site in the patient's left upper abdomen. These eviscerations developed in patients in whom the Steri-Strips were removed inadvertently or fell off prematurely. Because of these 3 complications, which developed early in our experience, we now close the fascia of this working site or any SI in which instruments are removed/reinserted repeatedly during the procedure. We continue to approximate the skin at these sites with a Steri-Strip.

This technique initially evolved as a way to minimize the incisions for access to the abdominal cavity. For instance, a 3-mm instrument actually requires a 3.5-mm cannula, and the incision usually is between 3.5 and 4 mm in length. However, using this technique, the financial savings have been overwhelmingly beneficial to the patient. In our hospital, there is a charge of \$140 to the patient per Veress needle, expandable sheath, and plastic

cap, which are the disposable parts of the Step reposable system. Thus, using this SI approach, there has been an overall charge savings to our patients of \$187,180.00 using this technique. We believe that this technique soon will become the standard method for instrument access in infants and young children and will result in reduced charges to these children undergoing laparoscopic procedures.

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