Single Incision Pediatric Endoscopic Surgery: Advantages of a Relatively Large Incision
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ABSTRACT

Objective: To describe Single Incision Pediatric Endoscopic Surgery (SIPES) performed on children with various diagnoses, emphasizing its advantages.

Study Design: An observational case series.

Place and Duration of Study: Department of Pediatric Surgery, Dr. Sami Ulus Maternity and Child Health Hospital, Ankara, Turkey, from January 2011 to November 2014.

Methodology: A review of patient charts was conducted in which SIPES was preferred as the surgical procedure. Patient demographics, operative details, operative time, clinical outcomes, postoperative pain and cosmesis were analyzed.

Results: SIPES was performed on 45 patients (21 girls, 24 boys). Thirty-three appendectomies, 5 varicocelectomies, 3 oophorectomies, 2 ovarian and one paratubal cyst excision, and one fallopian tube excision were performed. All except one procedure were performed through our standard 2 cm umbilical vertical or smile incision. In 18 cases, abdominal irrigation/aspiration was easily performed through the existing larger incision, as is done with open surgical technique. None of the patients had postoperative shoulder/back pain since complete disinflation of CO₂ could be ensured. All of the patients/parents were satisfied with the cosmesis.

Conclusion: SIPES has the advantages of limiting the surgical scar to within the umbilicus and providing easy disinflation of CO₂, allowing intraabdominal cleaning and extraction of large volume tissue samples through a single large umbilical incision.


INTRODUCTION

Today, minimally invasive procedures with conventional laparoscopy have become almost a standard approach for various thoracic, abdominal and pelvic procedures in adults and children.¹,² Over the course of time, surgeons have tried to reduce the number of access points for reaching the surgical area. Moreover, the expectation of rapid wound healing and efforts to decrease postoperative pain, as well as efforts to improve better cosmesis, have resulted in an innovative novel procedure in which all the laparoscopic equipment is introduced through a small single incision with or without the use of a special port.¹⁻⁵ The procedure, which the authors prefer to call “Single Incision Pediatric Endoscopic Surgery” (SIPES), indicating a single incision procedure in children and therefore, easily distinguished from any publication in the adult literature, though several nomenclatures are used, has become an alternative to conventional laparoscopy for performing various surgical applications.⁶ Owing to innovations in medical technology and to surgeons' efforts, SIPES has recently become an approach used for many pediatric surgical procedures.²⁻³⁻⁵⁻¹¹ The aim of this study was to describe the advantages for children in whom SIPES was performed for miscellaneous diagnoses.

METHODOLOGY

This observational case series was conducted at Department of Pediatric Surgery, Dr. Sami Ulus Maternity and Child Health Hospital, Ankara, Turkey, from January 2011 to November 2014. Charts of patients referred to the study centre, and treated with SIPES were analyzed. Institutional Ethic Committee approval was obtained before this study. Patients were assessed for demographic data, characteristics of the operations, treatment results, frequency of postoperative shoulder/back pain and satisfaction relevant to cosmesis.

Patients on whom SIPES was performed were selected by the surgeon with regard to time and equipment compatibility, considering also preferences of the parents/patients. Prior to surgery, all of the parents were
informed that the risks of SIPES were not different from those of Conventional Laparoscopic Procedures (CLP), and when required, the switch to CLP and/or open surgery was elucidated. Informed parental consent was obtained. All of the procedures were performed by the four authors, who had experience with CLP.

All patients were placed in supine position under general anaesthesia with endotracheal intubation and surgical area and meticulous umbilicus cleaning was done with povidone-iodine. Infiltration anaesthesia was provided with two millilitres of lidocaine HCl including epinephrine to reduce bleeding and postoperative pain. After performing a single 2 cm long smile or vertical incision on the umbilicus, both fascia edges were held with hanging sutures, and the device for SIPES (SILSTM Port, Covidien, Mansfield, USA) was inserted. Three 5mm trocars were placed in this device. If required, one of these trocars was replaced with a 12 mm trocar. Following CO2 insufflation at 10 - 12 mmHg pressure to provide sufficient pneumoperitoneum, display was ensured with a 50 cm length and 5 mm diameter 30° telescope (Karl Storz, Tuttingen, Germany), which was inserted from the lower trocar. The other two trocars were inserted from the upper side of the telescope to provide the use of two mutual working devices (Figures 1 a,b).

While angle adjustable instruments for SIPES were the laparoscopic dissector, hook cautery, and clamps, conventional laparoscopic equipment such as scissors, knot pusher and LigaSure® (Covidien, Mansfield, USA) were the non-angled instruments for the procedures. During the operation, a cross combination of two angle adjustable instruments or a cross combination of an angle adjustable instrument with a non-angled straight instrument were used. After finalizing SIPES and removing the single port laparoscopy device, complete disinflation of CO2 was ensured in all operations. Afterwards, if needed, intra-abdominal washing and aspiration were easily performed via the umbilical incision, as is done in open surgical techniques. The fascial edges were closed with interrupted absorbable sutures (2/0 polyglycolic acid sutures). Skin incision closure was done with absorbable sutures (5/0 polyglycolic acid sutures) in subcuticular fashion to ensure better cosmesis. All of the standard postoperative analgesic treatments applied for CLP were exercised for all patients receiving SIPES during the first 24 hours. During the postoperative period, patients that were able to communicate and comprehend were asked concerning back and/or shoulder pain. Postoperative pain scoring was not done, but the existence of back and/or shoulder pain was recorded. Except for patients with perforated appendicitis, all of the patients were discharged on postoperative day one. Discharge instructions included appointments for 15 days and 2 months post-surgery office visits. During these visits, patients were asked for their opinion about wound cosmesis and the answers were recorded.

Version 13.0 of the Statistical Package for Social Sciences for Windows software (SPSS, Inc., Chicago, IL) was used for statistical analysis of the results. Continuous variables were assessed as mean, standard deviation and percentages. Mean values and standard deviation were calculated for continuous variables, while frequencies and percentages were calculated for categorical variables.

RESULTS

SIPES was performed on a total of 45 patients, consisting of 21 (47%) girls and 24 (53%) boys whose ages ranged from 4.5 to 17 years. The mean age of the patients was 11.7 ± 3.6 years. Thirty-three appendectomies (29 acute, 4 perforated; 73%), 5 (11%) varicocelectomies, 3 (7%) oophorectomies (ovarian teratoma), 3 (7%) ovarian cyst excisions, and 1 (2%) salpingectomy (fallopian tube torsion) were performed (Table I). Initially, an infrabulimal 2 cm smile incision was implemented (n=10; 22%), but later a vertical 2 cm long incision on the umbilicus (n=35, 78%) was preferred because of better cosmesis and easy access to the abdominal cavity.

<table>
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<th>Table I: Clinical features of SIPES performed patients.</th>
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<td><strong>Diagnosis</strong></td>
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<tr>
<td>Acute appendicitis (n=29)</td>
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<tr>
<td>Perforated appendicitis (n=4)</td>
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<tr>
<td>Mature ovarian teratoma (n=3)</td>
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<tr>
<td>Ovarian follicle cyst (n=2)</td>
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<td>Paratubal cyst (n=1)</td>
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<td>Fallopian tube torsion (n=1)</td>
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<tr>
<td>Varicocele (n=5)</td>
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<td>Total (n=45)</td>
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All appendectomies except for one patient were performed with the intracorporeal endoloop technique. As an exception, an ovarian teratoma with a diameter of 13 cm was easily removed from the abdominal cavity (Figure 2). After excision of this huge teratoma it was placed in an endobag to reduce the risk of spilling of tumour cells and hung onto the umbilical incision. In order to extract it from the wound a needle aspirator was introduced into the cystic component of the teratoma and aspirated safely. Afterwards, the umbilical incision was extended only one-cm longer and the teratoma was removed within the endobag.

The mean operation time of the procedures was 58 ± 23 minutes, and no intra-operative complications were encountered. None of the patients had back or shoulder pain during the postoperative period. Three patients with perforated appendicitis (n=2) and acute appendicitis (n=1) had wound infection in the postoperative course and two of the patients had concomitant intra-abdominal abscess. They were treated with antibiotic therapy and wound care without any additional surgical procedure. One patient, who had been operated for acute appendicitis and discharged on the first postoperative day, was re-hospitalized on the postoperative fifth day with the diagnosis of adhesive bowel obstruction, and adhesiolysis was performed by open surgical technique with extension of the previous vertical SIPES incision by two more centimetres. This patient was assumed to have early adhesive bowel obstruction since there was no bowel loop trapped in the incision during the operation. Though none of the SIPESs required conversion to CLP, conversion to open surgery was chosen in one patient with mature ovarian teratoma. In one patient with acute appendicitis who had mobile cecum, the appendix was removed extra-corporeally with open surgery via the umbilical incision.

After removal of the SIPES device, abdominal cleaning, irrigation and aspiration was implemented in 18 patients (2 perforated and 16 acute appendicitis) through the umbilical incision efficiently and easily, similar to open surgical technique, and the aforementioned patients did not experience any wound infection or intra-abdominal abscess. During postoperative day 15 and later control examinations, incision scars were minimal and cosmetic appearances were satisfactory (Figure 3).
DISCUSSION

CLP is performed via two or more small incisions. This technique has the advantages of decreased postoperative pain and better cosmesis when compared with open surgery.4,5,8,9 However, the ultimate goals of surgery should be expediting wound healing, shortening the length of hospital stay, and decreasing postoperative pain, as well as hiding and shrinking the incision at inconspicuous locations, even ensuring completely incision-less, safe and successful techniques to be done. Pelosi et al. reported to have performed laparoscopic appendectomy and hysterectomy via single incision successfully, defining single incision laparoscopic surgery for the first time.12 In time, owing to the innovation of novel equipment, it has been possible to reach the surgical space via a single incision and to perform intracorporeal surgical procedures through this incision in pediatric patients, though this has been practiced previously in adults. During this time, Ates et al. have become one of the pioneers of SIPES by defining single port appendectomy in children by means of a transabdominal hanging suture passing through the mesoappendix, which provided for retraction of the appendix.7 Efforts towards these goals and innovations in medical technology have resulted in the development of SIPES, which has provided the way to perform surgical procedures via a single small incision.

Today, SIPES is implemented in children for appendectomy,7,10,13,14 cholecystectomy,9,14 splenectomy,14 inguinal hernia repair,15 adnexal pathologies,16 stomach6 and thoracic pathologies,14 and urogenital system pathologies5,8,11 as also successfully done in adults. In this study, as a preliminary experience, the majority of surgical procedures, such as appendectomy, ovarian cyst excision, oophorectomy, fallopian tube excision, and varicocelectomy have been performed intra-corporeally with SIPES.

In this study, extra-corporeal appendectomy was performed by taking out the appendix through an umbilical incision with a SIPES device on a patient having mobile cecum. Similar approaches have been reported in the literature.13 Therefore, in suitable cases this procedure can be sustained extra-corporeally without the concern of completing the procedure intra-corporeally, which can be considered as an advantage of SIPES.

The reasons for performing an operation with a laparoscopic approach are: decreasing tissue damage and postoperative pain, shortening the hospital stay, expediting wound healing, and better cosmesis.1-5 However, when SIPES is compared with CLP, the technical difficulties of SIPES have been suggested to present significant potential risks for the surgeon, despite providing the aforementioned benefits to the patients. The most important of these challenges are the crowding of tools, interference of the tools with each other by overlapping, and this eventually resulting in complications of the procedure. This situation can be prevented by inserting the instruments at wide distances during CLP. Additionally, CLP has the advantages of providing efficient tissue traction and dissection, as well as ease of suturing and securing knots. Moreover, the sense of depth is better and the visual angle is wider, since the camera is not parallel to the instruments. These advantages disappear with the use of SIPES.1 Although SIPES is performed by surgeons who have CLP experience and requires similar technical skills,1,4 owing to the reasons mentioned above, it has been criticized because of the concerns that it could endanger the safety of the operation and is suggested to be contrary to the fundamental principles of laparoscopy.1 Despite all these concerns, none of our patients experienced complications due to SIPES and we achieved better cosmesis, with which the parents/patients were satisfied.

Various devices and instruments have been developed for SIPES.3,4 Notwithstanding, the use of cramped and overlapping instruments is inevitable in almost all variations of the procedure, and this situation is the most frustrating and notable feature, adversely affecting the duration of the procedure and the learning process.2,4 The use of different sized instruments has been proposed to avoid this situation,3,4 though conventional equipment has been reported to be suitable in SIPES performed on children.10 In these procedures, in addition to standard use of a 50 cm length 30° telescope, binary combinations of angle adjustable dissectors, forceps and hook cauteries, which are shorter than the telescope, or cross combinations of these instruments with short, straight, non-angled conventional instruments (scissors, knot pusher, LigaSure™) were preferred. The reverse working requirement caused by cross combinations of instruments causes orientation difficulty and overlapping of the instruments, which results in a prolonged operation. Therefore, SIPES requires more patience, technical skill, and experience than CLP does.

Within 24 hours following abdominal CLPs, shoulder pain is frequently encountered due to CO2 retention. For this reason, after disinflation of CO2 with the classical method, patients are placed in the Trendelenburg position and the lungs ventilated with positive pressure. This approach was reported to decrease shoulder pain after CLP.17 In another study, the use of low pressure CO2 pneumoperitoneum was suggested to decrease shoulder pain after CLP.18 Ergun et al. also reported that patients complaining of shoulder pain were given additional analgesia after SIPES.9 In this study, none of the patients had shoulder pain during the postoperative course, and we suggest that this was due to the fact that the umbilical incision for SIPES was relatively larger than that made in CLP, and effectively permitted the disinflation of CO2 without any additional method.
In this study, one patient had early adhesive bowel obstruction after appendectomy with SIPES, and open surgical adhesiolysis was performed on this patient through a 2 cm extension of the previous umbilical incision. In future, even if these patients for any reasons need an open surgical procedure, extending the previous single vertical umbilical incision may allow open surgery to be performed, and also limit the surgery related scar to a single site, such that additional trocar scars that are mandatory in CLP can be prevented. This situation can be partly considered as an advantage. Furthermore, a relatively larger incision may allow extraction of larger sized viscera, tissues and masses from the abdominal cavity. Even solid organs that require safe excision and gentle extraction from the abdominal cavity, such as donor nephrectomies, have been reported to be performed with SIPES with little extension of the incision. Also a single large incision has other additional advantages. St. Peter et al. reported that there was no advantage of irrigation of the peritoneal cavity over suction alone during laparoscopic appendectomy for perforated appendicitis. However, if the surgical area requires aspiration/irrigation for any reason, this may be performed easily with a larger umbilical incision. Laparoscopic aspiration/irrigation instruments used for abdominal cleaning may be time consuming and may unconsciously spread the existing abdominal infection from the operative area since these instruments use a common channel for both aspiration and irrigation. However, after completion of SIPES, the relatively larger umbilical incision provides advancement of conventional surgery aspiration/irrigation instruments and cleaning with efficient aspiration/irrigation, as is done with an open surgical technique. Since this study has some limiting aspects, such as the data collection being obtained by retrospective patient chart assessment, the absence of comparison with CLP and the limited number of patients, all aspects of SIPES should be prospectively evaluated in larger series.

CONCLUSION

SIPES provides marked cosmetic benefits by limiting the incision to the umbilicus, which is a natural scar. Easy disinflation of CO₂ via a single large umbilical incision is also feasible after SIPES. Thereby, patients do not experience shoulder and back pain during the postoperative period. Furthermore, if needed, this incision provides extraction of larger masses and tissue samples, and efficient washing and aspiration of the abdominal cavity.

REFERENCES