Updates Surg (2017) 69:479–483
DOI 10.1007/s13304-017-0482-4

ORIGINAL ARTICLE

Laparoscopic repair of ventral/incisional hernias with the "Slim-Mesh" technique without transabdominal fixation sutures: preliminary report on short/midterm results

Silvio Alen Canton[1] · **Claudio Pasquali**[1]

Received: 31 January 2017 / Accepted: 12 July 2017 / Published online: 8 August 2017

Abstract This study details our experience with a new laparoscopic technique called "Slim-Mesh" without using transabdominal full-thickness stitches, to treat ventral and incisional hernias (V/IH). Since 2009–May 2015, 28 consecutive patients with V/IH were treated in our center, with this new SM technique. Fifty percent males were included in this retrospective study, averaging 59 years (range 31–81 years). Mean body mass index was 26 and VH size was <10 cm in 24 cases and in 4 cases was larger, up to 22 cm. Mean operative time in the 28 V/IH patients was 97 min (range 57–160 min) and in those with V/IH larger than 10 cm it was 135 min. In 14.2% of patients laparoscopy diagnosed others V/IH previously undetected by physical examination and CT-scan. In all patients a composite mesh was used, up to 30 cm in size. In this series we had one intraoperative complication (3.6%) with transient bradycardia, but no conversion occurred; no early postoperative complication was detected. Mean length of hospital stay was 3.0 days. Mean follow-up time was 40 months (range 13–78 months). Late surgical complications included one case (3.6%) of incisional hernia recurrence and one case of 10 mm trocar site incisional hernia. This new surgical technique for V/IH repair, makes easy the handling and fixation of the composite mesh without using transabdominal fixation sutures, and appears in our experience fast, and simple.

✉ Silvio Alen Canton
alen@usa.com

[1] Department of Surgery, Oncology and Gastroenterology (DiSCOG), University of Padua, Padua, Italy

Keywords Ventral/incisional hernia repair · Slim-Mesh · Transabdominal fixation sutures · Operation time · Hernia recurrence

Introduction

Ventral hernias include all hernia in the anterior and lateral abdominal wall and are a frequent finding with a prevalence estimated to be approximately 44.3/100,000/year in Denmark [1]. Incisional hernias are delayed complications of abdominal open surgery [2] more commonly associated with vertical than with transverse incisions, or after laparoscopic procedure [3]. Ventral and incisional hernia (V/IH) may present with incarceration, pain, bowel obstruction [4], ischemia of the hernia contents and strangulation and for these reasons often surgical intervention is mandatory. Since the first report in 1992 [5] laparoscopic ventral hernia repair gain popularity for the related advantages of laparoscopy: short hospital stay, improved patient outcomes and fewer complications than open procedures.

Traditional laparoscopic V/IH repair technique with transabdominal fixation sutures (LRTS) is suitable for small and medium size V/IH repair and the mesh is used to reinforce a substantial part of the abdominal wall [3]. In this technique at least four non absorbable monofilament sutures are placed equidistantly along the mesh on the operative bench. Points of reference on the mesh and corresponding point on the abdominal wall were marked to aid in orienting the mesh after its introduction. The mesh was rolled-up and pushed or pulled into the abdomen through a 10 or 15 mm trocar site [5]. After the mesh was positioned intraperitoneally, the four sutures placed in the material before its insertion into the abdomen were pulled through the abdominal wall with a suture passer and tied

with knots buried in subcutaneous tissues. Then additional full-thickness stitches were placed circumferentially every 3 or 6 cm using the suture passer [3, 5]. Due to the use of transabdominal sutures in LRTS, persistent pain in these sites [4–6] has been reported.

Aim of this study was to evaluate the operative, short- and mid-term results of a new laparoscopic approach called "Slim-Mesh" without using transabdominal full-thickness stitches, to treat V/IH [7] including giant type (those larger than 10 cm in size according to EHS classification [8]).

Materials and methods

From September 2009 to May 2015, 28 consecutive patients affected by V/IH observed and operated (by a single operator S. A. C.) in our Department of Surgery, underwent laparoscopic repair according to Slim-Mesh technique using a composite mesh (25 Proceed prosthesis and 3 Dual Mesh) with high shape memory. The technique we used, named Slim-Mesh (SM), has been previously reported in details [7]. Here the technique is briefly summarized: laparoscopic exploration of the whole abdominal cavity with adhesiolysis, mobilization and reduction of V/IH content is made, looking for incisional hernias undetected by preoperative clinical examinations. Marking of the four peritoneal axial points and SM peritoneal fixation area like a "tattoo", are made with bipolar forceps [7] or colored with methylene blue using the grasping forceps, 3–5 cm around the hernia edges (according to Italian Laparoscopic Ventral Hernia Guidelines 2013-ILVHG). Laparoscopically, the operator applies external finger pressure on the four skin axial points corresponding to the four peritoneal axial points. Using a marking pen, the operator marks the four skin axial points; they are symmetrical to the four peritoneal points. Then the borders of the defect are marked with a circle or oval 3–5 cm far from the V/IH edges on the abdominal wall, like the peritoneal fixation area. According to the size and shape of the circle/oval marked on the skin, a composite mesh is selected and tailored on the operative bench. Operator then check the rough side of the mesh is facing upwards to ensure the correct peritoneal fixation. The mesh is then rolled up very tightly and fixing stitched sutures are made as described in details previously [7], before intra-abdominal introduction. Intra-abdominal SM insertion through the 12 mm trocar, is now made and, then the mesh free-end should be oriented to the west-side peritoneal point (or east-side). Operator have to superimpose the first SM prosthesis axial point onto the west (or east) peritoneal point for fixation. The mesh fixation with stapler to the posterior fascia is made applying a double crown of straps superimposing the margins of SM prosthesis onto the peritoneal "tattoo" [7]. An informed consent for operation with SM technique and for publication of the clinical and video records was expressly obtained by all patients. The study design is retrospective.

The following data were retrieved from the clinical (and follow-up) records: gender, age, body mass index (BMI), American Society of Anesthesiologists (ASA) score, hernia size at physical examination, preoperative size of fascial defect at physical examination, abdominal wall ultrasound (US) and/or CT-scan, eventual enema X rays or/and colonoscopy, V/IH recurrence, type of abdominal wall hernia (ventral or incisional), time of incisional hernia onset after surgery, eventual emergency procedure, operative size of V/IH, operative time, estimated blood loss, eventual conversion to open surgery, operative and postoperative complications (within 30 days), postoperative day to return to regular diet, use of abdominal drainage, length of hospital stay, hernia recurrence, reoperation, readmission to the hospital and finally the final outcome at follow-up. Sensitivity to predict a correct size of hernia using CT-scan was determined.

Last follow-up for mid-term results was done in June 2016, with a minimum of 13 months after surgery. Patients were interviewed during an outpatient visit.

Results

We enrolled in this study 14 females and 14 males averaging 58.6 ± 2.8 years (mean ± SEM; range 31–81 years). Others preoperative characteristics of our series are detailed in Table 1.

Seventeen patients (60.7%) were affected by incisional hernias with a mean time of onset of 30.8 ± 15.4 months (mean ± SEM; range 1–420) after open surgery. Five of those cases presented sign of recurrence of umbilical open repair (29.4%). Four cases of incisional hernia were related to open surgery followed bowel surgery, two cases after open cholecystectomy, two cases after pancreatico-duodenectomy, one case after distal pancreatectomy, one case after nephrectomy, one case after hysterectomy, one case after laparotomy for hepatic trauma and one case was a trocar incisional hernia. Eleven patients presented ventral hernia (39.2%), six cases with umbilical hernia and five with para-umbilical hernia.

All patients were investigated with CT and/or US and hernia size was measured according these examinations (Table 1).

During laparoscopic exploration, 24 V/IH resulted smaller than 10 cm and 4 were larger, up to 22 cm (Table 2). Overall mean operative size of V/IH was 7.2 ± 0.9 cm (mean ± SEM).

The average operating time with SM technique in overall 28 patients was 97 ± 7.4 min (mean ± SEM)

Table 1 Preoperative characteristics of patients

Parameters	nr.	Mean ± SEM	Range
M/F (nr.)	14/14		
Age (years)		58.6 ± 2.8	31–81
BMI		27.1 ± 0.8	20–28
ASA score 3/2	12/13		
VH/IH	11/17		
CT-scan/US	19/9		
CT-scan and US	3		
Preoperative hernia size <10 cm/>10 cm	25/3		

BMI body mass index, *ASA* American Society of Anesthesiologists, *VH/IH* ventral hernia/incisional hernia, *CT* computerized tomography, *US* ultrasound

Table 2 Operative features and postoperative outcome of patients

Parameters	
Operative hernia size <10 cm	24
Operative hernia size >10 cm	4
Operative time ($n = 28$) min (±SEM)	97 ± 7.4
Operative time ($n = 24$) min (±SEM) for V/IH <10 cm	91 ± 5.8
Operative time ($n = 4$) min (±SEM) for V/IH >10 cm	135 ± 10.0
Intraoperative visceral iatrogenic lesions	0
Intraoperative blood loss (mL/range)	3/0–12
Intraoperative bleeding/hematoma	0
Conversion	0
Cardiac event (bradycardia)	1/28 (3.6%)
LOH (days ± SEM)	3.0 ± 0.2
Post-operative bleeding/hematoma	0
Reoperation (within 30 days)	0
Persistent pain	0
Wound and mesh infection/suture sites infection	0
Recurrence	1/28 (3.6%)
Trocar site hernia	1/28 (3.6%)

V/IH ventral/incisional hernia, *LOH* length of hospital stay

(range 57–160 min). Operative times in cases with more or less of 10 cm of hernia size are reported in Table 3. No patients had conversion in laparotomy. Operative blood loss and complication (nr. 1) are reported in Table 2.

In five cases preoperative hernia size and intraoperative measurement showed wide discrepancies (Table 3).

In 15/19 cases in which CT scan was performed the size of the defect was correctly confirmed at operation, with a sensitivity of 78.9%.

Time to return to regular diet was first p.o. day in 93% of patients and mean length of hospital stay was 3.0 ± 0.2 days (mean ± SEM). No complication occurred during hospital stay or within 30 days (Table 2).

The mean duration of follow-up was 39.2 ± 4.5 months (mean ± SEM) (range 13–78 months); two patients were lost to follow-up. Twenty-six patients had at least one follow-up physical examination and interview. Postoperative late complications were observed in two cases (7.2%): one case (3.6%) had recurrence of incisional hernia 8 months after SM repair who do not required reoperation at present. Another patient was affected by 10 mm trocar site incisional hernia 7 months after surgery for which open surgery was made (Table 2).

Discussion

Abdominal wall hernias are the most common indication for major surgery in the USA and are a common finding at abdominal imaging [2]. Incisional hernias occur in 3–20% of laparotomies, necessitating repair of approximately 90,000 cases annually in USA [5].

We presented short and mid-term results of a new technique of laparoscopic repair of abdominal hernias

Table 3 Characteristics of patients with preoperative and operative discrepancy of hernia size measurement

Cases	BMI	Type of defect	Physical examination measurement (cm) of V/IH	US V/IH size (cm)	CT V/IH size (cm)	Intra-operative V/IH size (cm)	Satellites V/IH	Difference between preoperative and operative size (cm)
Case 1	31	Incisional	3	–	3	10	Yes	7
Case 2	29	Incisional	6	–	6	20	Yes	14
Case 3	27	Incisional	10	–	12	16	Yes	4
Case 4	31	Recurrence of incisional hernia	3	–	3	7	Yes	4
Case 5	24	Ventral	4	4	–	6	0	2
Mean difference between preoperative and operative size (cm)								6.2

BMI body mass index, *V/IH* ventral/incisional hernia, *US* ultrasound, *CT* computerized tomography

called Slim-Mesh (SM) previously described by the authors [7]. This laparoscopic approach is a tacks- or straps-only fixation technique for the treatment of ventral and incisional hernia (V/IH). In our series of 28 patients with V/IH treated with SM procedure from September 2009 to May 2015, the laparoscopic exploration of abdomen cavity for fascial defect research, showed in 14.2% of cases other V/IH undetected by CT-scan (Table 3). Sensitivity of CT-scan in predicting the correct size of the V/IH was 78.9% in our experience. However, laparoscopic exploration and measurement, in 17.7% of our cases highlighted the true size of V/IH, useful for tailoring an appropriate mesh with a correct size and shape. Our suggestion coming from the study is to recommend either a preoperative CT scan and laparoscopic exploration of abdominal cavity before tailoring the prosthesis.

In our technique, we always use a composite mesh with high shape memory, due to its elastic force, that is enhanced during the tight rolling in SM technique and slowly released during the operation when the fixing stitches are cut. The natural shape memory of SM and the tension, originated by its progressive fixation on posterior fascia, represent the two forces that really help surgeon during the fixation maneuvers, without any need for time-consuming manipulation [7].

The average operating time of SM procedure in our 28 patients was 97 ± 7.4 min (mean ± SEM), and for those with hernia size >10 cm was 135 ± 10.0 min (mean ± SEM, Table 2). Other authors report operating time of 100 min in 86 laparoscopically treated patients [9], or 152 min in Ferrari's experience on 100 cases of V/IH while time was 205 min in those larger than 15 cm [10].

SM approach, compared to LRTS where four axial fixation sutures are used, helps in reducing operative time due to a faster mesh handling. Even more difficult, risky and slow the LRTS compared to SM repair if additional full-thickness stitches are placed circumferentially every 3 or 6 cm [5], especially in giant hernias. Moreover, bleeding due to puncture of abdominal muscular arteries and of epigastric vessels that may occur in 5% of cases [3], associated to transabdominal sutures, is avoided with SM technique (Table 2).

SM technique, moves ventrally all the operative field and the related orientation and fixation maneuvers of the mesh, on the anterior abdominal wall, resulting unlikely a possible visceral iatrogenic lesion. In our experience, no patients had iatrogenic damages (Table 2). The only operative complication in our series was a transient bradycardia.

Analyzing our data [7] the functional and short term outcomes of SM repair also for the treatment of large size V/IH [7], are generally those of laparoscopic surgery. In fact mean time of intra-abdominal drainage was one day. Time to return to regular diet in our series was first p.o. day in 93% of patients and mean length of hospital stay was 3.0 ± 0.2 days (mean ± SEM). No early complication and no wound infection occurred (Table 2).

Concerning mid-term outcomes, of SM repair, lacking transabdominal fixation sutures, persistent pain, occurring in 1.6 up to 28%, mainly related to suture site, is avoided, gaining also some cosmetic advantage on the skin without additional scars [11]. SM repair avoids the risk of surgical site infection and hernia recurrence associated to breakdown of transfascial full-thickness stitches for mesh fixation in LRTS [11, 12]. Recurrence rate in our series was 3.6% (Table 2). These results are in agreement with other authors that report 4.7% of recurrences after 20 months [2, 5]. However, the follow-up is still not very long in our

study and this late complication may appear even after 5 years or later.

Finally in our series we have enrolled four patients with wall defects larger 10 cm up to 22 cm in which the minimally invasive approach is still controversial. Operative time in these patients was not longer (135 min in our series) when compared to other authors [10, 13] and the outcome in these subjects was not different from those having a smaller size hernia. No short- or mid-term complications were recorded in these four patients.

In conclusion, SM for V/IH laparoscopic repair in our experience is simple. Operative, short- and mid-term postoperative [7] complications are low, and avoid risky maneuvers. CT-scan and laparoscopic exploration are mandatory for an optimal treatment planning. Due to the small number of treated patients and to limited follow-up period, further prospective studies are needed to draw conclusive results about the use of this technique.

Author contributions SAC was the surgeon who designed the operation, and was the responsible of the clinical management and wrote the draft of the manuscript. CP helped to write the manuscript and supervised the assembly of the manuscript.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interests.

Ethical approval All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Research involving human participants and/or animals This article does not contain any studies with animals performed by any of the authors.

Informed consent A written informed consent was obtained from the patient for publication of any imaging and video related to the operation. A copy of the written consent is available for review by the Editors-in-Chief of this journal.

References

1. Burcharth J, Pedersen MS, Pommergaard HC, Bisgaard T, Pedersen CB, Rosenberg J (2015) The prevalence of umbilical and epigastric hernia repair: a nationwide epidemiologic study. Hernia 19(5):815–819. doi:10.1007/s10029-015-1376-3 **(Epub 2015 Apr 4)**
2. Aguirre DA, Santosa AC, Casola G, Sirlin CB (2005) Abdominal wall hernias: imaging features, complications and diagnostic pitfalls at multi-detector row CT. Radiographics 25(6):1501–1520
3. Alexander AM, Scott DJ (2013) Laparoscopic ventral hernia repair. Surg Clin N Am 93:1091–1110
4. Turner PL, Park AE (2008) Laparoscopic repair of ventral incisional hernias: pros and cons. Surg Clin N Am 88:85–100
5. Heniford BT, Park A, Ramshaw BJ, Voeller G (2003) Laparoscopic repair of ventral hernias. Ann Surg 238(3):391–400
6. Cobb WS, Kercher KW, Heniford BT (2005) Laparoscopic repair of incisional hernias. Surg Clin N Am 85:91–103
7. Canton SA, Merigliano S, Pasquali C (2016) Prosthetic mesh "slim-cigarette like" for laparoscopic repair of ventral hernias: a new technique without transabdominal fixation sutures. Updates Surg 68:199–203. doi:10.1007/S13304-016-0348-1
8. Passot G, Villeneuve L, Sabbah C, Renard C, Regimbeau JM, Verhaeghe P et al (2016) Definition of giant ventral hernias: development of standardization through a practice survey. Int J Surg 28:136–140. doi:10.1016/jijsu.2016.01.097
9. Hasan HE, Hansson BME, Buunen M, Janssen I, Pierik REGJM, Hop WC et al (2013) Laparoscopic vs open incisional hernia repair: a randomized clinical trial. JAMA Surg 148(3):259–263
10. Ferrari GC, Miranda A, Di Lernia S, Sansonna F, Magistro C, Maggiori D et al (2008) Laparoscopic repair of incisional hernia: outcomes of 100 consecutive cases comprising 25 wall defects larger than 15 cm. Surg Endosc 22(5):1180
11. Bittner R, Bingener-Casey J, Dietz U, Fabian M, Ferzli GS, Fortenly RH et al (2014) Guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias International Endohernia Society (IEHS)-part-1. Surg Endosc 28(1):2–25
12. Bedi APS, Bhatti T, Amin A, Zuberi J (2007) Laparoscopic incisional and ventral hernia repair. J Minim Access Surg 3(3):83–90
13. Ferrari GC, Miranda A, Sansonna F, Magistro C, Di Lernia S, Maggioni D et al (2008) Laparoscopic management of incisional hernias $>$ or $=$ 15 cm in diameter. Hernia 12(6):571–576. doi:10.1007/s10029-008-0410-0