Irish Journal of Medical Science (1971 -) (2019) 188:1357–1362
https://doi.org/10.1007/s11845-019-02012-9

ORIGINAL ARTICLE

Laparoscopic ventral hernia repair with intraperitoneal onlay mesh—results from a general surgical unit

Joshua De Marchi[1] · Florin Remus Sferle[1] · Dermot Hehir[1]

Received: 8 January 2019 / Accepted: 21 March 2019 / Published online: 4 April 2019

Abstract

Background Symptomatic ventral herniation is a common clinical presentation. The treatment, whether elective or as an emergency, can be difficult and a variety of surgical repairs are utilised. Intraperitoneal onlay mesh (IPOM) involves the placement of a reinforcing prosthesis, usually supported by primary closure of the defect. Intra-abdominal adhesions have been highlighted as a potential complication in utilising this form of mesh placement. Several methods of laparoscopic mesh placement outside of the peritoneal cavity are gaining prominence as potential alternatives to IPOM.

Aims This study reviews our experience with IPOM in the repair of ventral hernia by a single surgical team.

Methods A prospectively maintained electronic database of all laparoscopic ventral hernia repair (LVHR) performed within the study period was analysed and reported. Follow-up questionnaires were sent to patients to follow long-term outcomes.

Results One hundred eight patients underwent LVHR over a 7-year period. Demographics demonstrated an obese patient group (BMI 30.89 ± 4.9 kg/m^2), with a variety of hernia sizes and morphologies. Hernia recurrence was found in two patients (1.8%). Twenty-nine (26.8%) patients suffered a complication, but only eight (7.4%) of those required intervention beyond pharmacotherapy. Two patients required mesh explantation.

Conclusions IPOM for the general surgeon is a relatively safe and effective method of repairing ventral hernias, with a low recurrence rate.

Keywords Intraperitoneal onlay mesh · Laparoscopy · Recurrence · Ventral hernia

Introduction

Ventral hernia (VH) is a common presentation in surgical patients with approximately 300,000 incisional hernias repaired every year in Europe [1]. Herniation may be primary, (i.e. umbilical, paraumbilical, epigastric and Spigelian) or secondary (incisional hernia) [2]. When the integrity of the abdominal wall is disrupted by surgery, multiple factors may lead to inadequate healing resulting in an hernia [3].

Many surgical methods have been utilised for VH repair with ongoing debate regarding the most appropriate form of repair [4–14]. Conventional repair focuses on closing the fascial defect and reinforcing the tissue with a supportive mesh [14–16]. Siting of the mesh remains controversial. Options include onlay, bridging, retro-rectus, pre-peritoneal and intraperitoneal onlay mesh (IPOM).

Evidence suggests that laparoscopic ventral hernia repair (LVHR) with IPOM mesh is superior to open onlay technique in hernia with a fascial defect greater than 2 cm with fewer overall perioperative complications, decreased length of hospital stay, decreased mortality and lower total hospital [1, 10–12, 17–23]. However placement of foreign mesh material can be associated with mesh adhesion [24, 25], fistulation [8], migration [26–28], erosion [28, 29] and chronic pain [9, 30–33].

The aim of this article is to detail our experience with IPOM meshes in LVHR as a potentially safe and effective option for patients.

Methods

All patients undergoing laparoscopic IPOM for ventral hernia in a single surgical service from 01/01/2010 to 01/12/2016

✉ Joshua De Marchi
Joshdemarchi@rcsi.ie

[1] Department of Surgery, Midlands Regional Hospital, Tullamore, Republic of Ireland

were included. Data on all patients were recorded on the day of surgery in a prospectively maintained database. As this prospective series had no control or intervention groups, and patient care was not altered, ethical approval was not sought. Exclusion criteria included patients with an emergency condition such as acute incarceration/strangulation and those undergoing either open or mesh free repair.

Technique was standardised over the 7-year period. Intraperitoneal access was gained by establishing pneumoperitoneum with a Veress needle or Optiport™ placed at Palmer's point. Subsequent placement of a 5-mm bladeless trocar at least 1–2 cm away from the fascial defect was performed under direct vision. We used a 0°, 10-mm laparoscope. Exact 5 mm port sites where based on hernia site and previous incision sites.

Following confirmation of peritoneal access, adhesiolysis was performed when required utilising a combination of sharp and blunt dissection. The necessity for adhesiolysis was variable as several procedures were performed for recurrent incisional hernias or for herniation following major abdominal surgery. Use of diathermy and ultrasonic scalpel was limited to minimise risk of iatrogenic intestinal injury. If required, the falciform ligament was taken down to facilitate adequate space for mesh placement in abdominal wall defect. The herniation was reduced in its entirety. Primary closure of the fascial defect was then performed with intra-abdominal suturing using nonabsorbable monofilament suture. The predominant suture material was Endoknot® suture (Ethicon), although nonabsorbable locking suture (V-Lock by Medtronic) was utilised in later cases.

Adjuvant component separation was not performed. The mesh was placed intraperitoneally via the 10-mm camera port. Meshes included composite Physiomesh™ (Ethicon, subsequently withdrawn) or Parietex™ (Medtronic). A minimum overlap of 5 cm outside the sutured fascial defect was utilised to allow for mesh shrinkage. The mesh was secured with absorbable tacks in a double crown pattern (AbsorbaTack™ Medtronic). Patients were discharged on the day of surgery.

Patients were initially reviewed in the surgical outpatient's department post-operatively with long-term follow-up achieved utilising a postal questionnaire. Nonresponders were surveyed by telephone. Any patient reporting difficulty was again recalled to the surgical outpatient department for re-examination. Primary outcome was recurrence of the hernia at time of long-term follow-up. Secondary outcomes included 30-day morbidity, re-admission and prolonged hospital stay.

Results

In total, 108 patients were included in this study. Patient demographics and comorbidities are included in Table 1. Details on hernia morphology, including laparoscopic primary epigastric (16), incisional (31) and paraumbilical/umbilical (61) hernias were recorded (Table 2). Six of the paraumbilical hernia repairs had a second concurrent hernia repaired simultaneously, four were epigastric hernia and two were incisional hernia. Three hernias were recurrent following previous open repair. Defects were sized as small (less than 4 cm), medium (4–10 cm) or large (> 10 cm). At operation, all defects greater than 1 cm were closed using intraperitoneal suturing. Eighty-seven patients (80.5%) had repair using Parietex™ composite, a hydrocolloid-treated lightweight polyester mesh (Medtronic.) The remainder were repaired with Physiomesh™, a composite polypropylene (Ethicon). Absorbable polydioxanone tacks (AbsorbaTack™ (Medtronic)) were the primary method of mesh fixation. The mean operating time was 82.98 ± 33.5 min. Seventy-four (68.5%) of the patients were admitted on the day of surgery and stayed an average of 2.9 days (median 1 day with a range from 1 to 55 days).

Table 1 Patient demographics

Age (mean)	55 ± 12.9 years
Sex	M 82 (75.9%) F 26 (24%)
Smoker	15 (14%)
Medical history	
Type 2 diabetes	4 (3.7%)
Hypertension	2 (1.8%)
Ischaemic heart disease	3 (2.7%)
CCF	2 (1.8%)
Atrial fibrillation	4 (3.7%)
Liver cirrhosis	3 (2.7%)
Asthma	15 (14%)
COPD	4 (3.7%)
Renal failure	2 (1.8%)
ASA score	
I	35 (32%)
II	63 (58%)
III	10 (9%)
BMI	30.89 ± 4.9 kg/m^2

Complications were defined as any deviation from the normal post-operative course, with or without the requirement for additional intervention including pharmacotherapy, occurring within 30 days of the procedure. They were classified using the Clavein-Dindo score (Table 3). There were 29 complications, 15 of these were minor (Clavein-Dindo I)—including mild desaturation during recovery, acute post-operative pain requiring analgesics, wound haematoma and a single patient who had a self-limiting thrombocytopenia post-operatively. Six patients were classified as Clavein-Dindo II complications, requiring pharmacological treatment beyond the normal requirements in the post-operative period such as analgesics, laxatives or antiemetics. Seven patients required intervention

Table 2 Hernia characteristics

Characteristics	Number	Recurrent	Incarcerated	Size (small/med/large)		
Epigastric	16	1	1	16	0	0
Incisional	31		2	15	11	5
Paraumbilical/umbilical	55	2	3	46	8	1
+ epigastric	4			3	1	0
+ incisional	2			2	0	0
Total	108	3	6	82	20	6

for management of post-operative ileus, urinary retention, liver haematoma or intraperitoneal haematoma.

Two patient developed serious post-operative infections and ultimately failed mesh repair. An elderly man developed seroma and had repeated aspiration which unfortunately was complicated by surgical site infection, wound breakdown and enterocutaneous fistula. He subsequently required mesh explant; at his most recent review 5 years later (now in his nineties), he was managing satisfactorily with the assistance of an abdominal binder. One patient sustained an iatrogenic jejunal injury presumably during extensive adhesiolysis. He presented on the fourth post-operative day with peritonitis. At laparoscopy, there was peritoneal soiling requiring lavage, endoscopic repair and mesh removal. He required a prolonged post-operative stay. Subsequently, he had repair of the hernia which was not included in this series.

The average follow up duration was 40.4 months with a range of 3 to 78 months. Two patients died during the study follow-up from unrelated causes—streptococcal endocarditis 3 months post-operatively and head injury secondary to a fall 14 months post-operatively. There were two late recurring hernias—a recurrent, medium-sized, paraumbilical hernia and a large, midline, incisional hernia. A further four patients thought they had recurrence which was not confirmed on subsequent clinical examination. Radiological investigations concurred with clinical exam and a diagnosis of a seroma was made. Two patients complained of pain several months following hernia repair. One required laparoscopic adhesiolysis with subsequent referral for pain management and the other required no intervention.

Table 3 Post-operative complications

Clavein-Dindo grade	Complication	Number
I	Desaturation	7
	Acute pain	6
	Haematoma	1
	Thrombocytopenia	1
II	Acute pain	2
	Nausea	3
	Ileus	1
III	Urinary retention	3
	Ileus	1
	Haematoma	2
	Enterocutaneous fistula	1
IV	Iatrogenic perforation	1
Total		29

Discussion

Methods of ventral hernia repair vary considerably in regard to location of mesh. Commonly used sites for placement include onlay, bridging, retro-rectus, pre-peritoneal and intraperitoneal onlay mesh (IPOM). There is increasing concern that IPOM utilisation is associated with higher rates of long-term complications [1, 24, 34] and include mesh erosion into the stomach, eosophagus and other viscera [28, 29]. IPOM frequently does result in pain post-operatively. Chronic pain from the mesh and from mesh adhesions has been reported in 2–4% of patients [9, 30–33]. We observed this in two of our patients in the long-term follow-up. One patient in our series required laparoscopic adhesiolysis of predominantly mesh-related adhesions and eventual referral to a chronic pain specialist. Intraoperatively, we utilised a variety of anaesthetic measures including TAP block and local anaesthetic. We add Chirocaine when hydrating the mesh.

The overall complication rate in the study cohort group was 26.8%. Careful observation was made to record all adverse outcomes at all stages. This has resulted in a larger number of relatively minor complications requiring no additional pharmacological, radiological or procedural treatments beyond those allowed as part of the normal therapeutic regimen (Clavein-Dindo I) or some pharmacotherapy without intervention (Clavein-Dindo II). However, only 8 (7.4%) patients required additional intervention despite our patient population having risk factors for increased operative time and post-operative complications such as obesity and large hernia sizes.

The risk of long-term complications relating to intraperitoneal mesh exposure has resulted in the development of newer techniques for hernia mesh placement, such as robotic mesh repair and laparoscopic extraperitoneal repairs with conflicting published results [35–37]. Data from a national database review have not demonstrated significant benefit in robotic

hernia repair compared to laparoscopic [38]. In contrast, other studies revealed decreased pain and length of stay, including a recent comparative analysis [39]. No study thus far published has demonstrated lower long-term complications when compared to IPOM.

Currently, intraperitoneal mesh augmentation has been implicated in post-operative adhesions, fistula formation, intestinal obstruction and mesh migration. In our study, one patient required laparoscopic adhesiolysis. This was a failed attempt to manage wound pain—which was unrelated to hernia surgery, rather was probably due to his original flank incision. With this exception, we did not discover clinically symptomatic mesh related adhesions.

While LVHR has been shown superior to open on lay repair in terms of overall complications [1, 7–9, 25, 30, 32, 40], some studies show that up to 23% of the complications that do occur require surgical intervention [20, 22, 41]. Our cohort had two serious complications of the 29 reported that required surgical intervention—an undetected enterotomy requiring re-operation and an infected mesh requiring explantation. A 2007 review of existing literature [42] suggested the incidence of iatrogenic enterotomy during LVHR is 1.78% and that management should include explantation of the infected mesh, while the rate of infected mesh after LVHR is low, around 1% [6].

The recurrence rate was 1.8%—average follow-up time of 40.4 months. Other series suggest the majority of recurrences are identified in the first year following hernia repair [20, 41, 43, 44]. Multiple causal factors have been identified for increased hernia recurrence rates, including occurrence of peri-operative complications [30], defect size [8, 34, 41, 45], previous hernia repair [30, 34, 43–45], infection [1, 8, 10, 12, 20, 30, 34, 45–47], multiple concurrent fascial defects [34, 41, 43, 45], ASA [4, 48–50] and obesity [4, 12, 13, 21, 23, 30, 41, 44, 49–55]. Despite the inclusion of patients with elevated BMI and hernias with large or multiple fascial defects, our recurrence rate was comparable to reported outcomes for LVHR with IPOM in the literature [9, 12, 20, 34, 45, 56]. Overall reported recurrence rates range from 2 to 32%.

Limitations of the study include a heterogeneity in mesh use where there was a switch from Physiomesh™ to Parietex™. All cases were performed in a single centre, by a single surgeon, although this also had the effect of providing a degree of homogeneity in the surgical technique.

Conclusions

Overall, our experience in LVHR with IPOM has shown that it can be safely and effectively used in a variety of hernia morphology and is suitable for large and recurrent hernias. Complication and recurrence rate was lower than open repair and comparable to other laparoscopic techniques for mesh repair. There is a need for long-term observational studies to assess for mesh complications well beyond a typical 5-year follow-up as mesh implantation is a life-long prosthetic device.

Acknowledgements The authors thank Jennifer Mannion (BMBS, MRCS) for editing and the comments on the manuscript.

Compliance with ethical standards

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

References

1. Sauerland S, Walgenbach M, Habermalz B, Seiler CM, Miserez M (2011) Laparoscopic versus open surgical techniques for ventral or incisional hernia repair. Cochrane Database Syst Rev 3:CD007781. https://doi.org/10.1002/14651858.CD007781.pub2
2. Sajid MS, Bokhari SA, Mallick AS, Cheek E, Baig MK (2009) Laparoscopic versus open repair of incisional/ventral hernia: a meta-analysis. Am J Surg 197(1):64–72. https://doi.org/10.1016/j.amjsurg.2007.12.051
3. Sabiston DC, Townsend CM (2012) Sabiston textbook of surgery: the biological basis of modern surgical practice, 19th edn. Elsevier Saunders, Philadelphia
4. Claes K, Beckers R, Heindryckx E, Kyle-Leinhase I, Pletinckx P, Claeys D, Muysoms F (2014) Retrospective observational study on the incidence of incisional hernias after colorectal carcinoma resection with follow-up CT scan. Hernia 18(6):797–802. https://doi.org/10.1007/s10029-014-1214-z
5. Bittner R, Bingener-Casey J, Dietz U, Fabian M, Ferzli G, Fortelny R, Kockerling F, Kukleta J, LeBlanc K, Lomanto D, Misra M, Morales-Conde S, Ramshaw B, Reinpold W, Rim S, Rohr M, Schrittwieser R, Simon T, Smietanski M, Stechemesser B, Timoney M, Chowbey P (2014) Guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias (International Endohernia Society [IEHS])—part III. Surg Endosc 28(2):380–404. https://doi.org/10.1007/s00464-013-3172-4
6. Bittner R, Bingener-Casey J, Dietz U, Fabian M, Ferzli GS, Fortelny RH, Kockerling F, Kukleta J, LeBlanc K, Lomanto D, Misra MC, Morales-Conde S, Ramshaw B, Reinpold W, Rim S, Rohr M, Schrittwieser R, Simon T, Smietanski M, Stechemesser B, Timoney M, Chowbey P (2014) Guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias (International Endohernia Society [IEHS])—part 2. Surg Endosc 28(2):353–379. https://doi.org/10.1007/s00464-013-3171-5
7. Chelala E, Debardemaeker Y, Elias B, Charara F, Dessily M, Alle JL (2010) Eighty-five redo surgeries after 733 laparoscopic treatments for ventral and incisional hernia: adhesion and recurrence analysis. Hernia 14(2):123–129. https://doi.org/10.1007/s10029-010-0637-4
8. Ching SS, Sarela AI, Dexter SP, Hayden JD, McMahon MJ (2008) Comparison of early outcomes for laparoscopic ventral hernia repair between nonobese and morbidly obese patient populations. Surg Endosc 22(10):2244–2250. https://doi.org/10.1007/s00464-008-0039-1
9. Christoffersen MW, Brandt E, Helgstrand F, Westen M, Rosenberg J, Kehlet H, Strandfelt P, Bisgaard T (2015) Recurrence rate after absorbable tack fixation of mesh in laparoscopic incisional hernia repair. Br J Surg 102(5):541–547. https://doi.org/10.1002/bjs.9750

10. Colavita PD, Tsirline VB, Belyansky I, Walters AL, Lincourt AE, Sing RF, Heniford BT (2012) Prospective, long-term comparison of quality of life in laparoscopic versus open ventral hernia repair. Ann Surg 256(5):714–722; discussion 722-713. https://doi.org/10.1097/SLA.0b013e3182734130
11. Colavita PD, Tsirline VB, Walters AL, Lincourt AE, Belyansky I, Heniford BT (2013) Laparoscopic versus open hernia repair: outcomes and sociodemographic utilization results from the nationwide inpatient sample. Surg Endosc 27(1):109–117. https://doi.org/10.1007/s00464-012-2432-z
12. Forbes SS, Eskicioglu C, McLeod RS, Okrainec A (2009) Meta-analysis of randomized controlled trials comparing open and laparoscopic ventral and incisional hernia repair with mesh. Br J Surg 96(8):851–858. https://doi.org/10.1002/bjs.6668
13. Bageacu S, Blanc P, Breton C, Gonzales M, Porcheron J, Chabert M, Balique JG (2002) Laparoscopic repair of incisional hernia: a retrospective study of 159 patients. Surg Endosc 16(2):345–348. https://doi.org/10.1007/s00464-001-0018-2
14. Bittner R, Bingener-Casey J, Dietz U, Fabian M, Ferzli GS, Fortelny RH, Kockerling F, Kukleta J, Leblanc K, Lomanto D, Misra MC, Bansal VK, Morales-Conde S, Ramshaw B, Reinpold W, Rim S, Rohr M, Schrittwieser R, Simon T, Smietanski M, Stechemesser B, Timoney M, Chowbey P, International Endohernia S (2014) Guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias (International Endohernia Society (IEHS)—part 1). Surg Endosc 28(1):2–29. https://doi.org/10.1007/s00464-013-3170-6
15. Franklin ME Jr, Gonzalez JJ Jr, Glass JL, Manjarrez A (2004) Laparoscopic ventral and incisional hernia repair: an 11-year experience. Hernia 8(1):23–27. https://doi.org/10.1007/s10029-003-0163-8
16. Luijendijk RW, Hop WC, van den Tol MP, de Lange DC, Braaksma MM, JN IJ, Boelhouwer RU, de Vries BC, Salu MK, Wereldsma JC, Bruijninckx CM, Jeekel J (2000) A comparison of suture repair with mesh repair for incisional hernia. N Engl J Med 343(6):392–398. https://doi.org/10.1056/NEJM200008103430603
17. Ecker BL, Kuo LE, Simmons KD, Fischer JP, Morris JB, Kelz RR (2016) Laparoscopic versus open ventral hernia repair: longitudinal outcomes and cost analysis using statewide claims data. Surg Endosc 30(3):906–915. https://doi.org/10.1007/s00464-015-4310-y
18. Misra MC, Bansal VK, Kulkarni MP, Pawar DK (2006) Comparison of laparoscopic and open repair of incisional and primary ventral hernia: results of a prospective randomized study. Surg Endosc 20(12):1839–1845. https://doi.org/10.1007/s00464-006-0118-0
19. Moreau PE, Helmy N, Vons C (2012) Laparoscopic treatment of incisional hernia. State of the art in 2012. J Visc Surg 149(5 Suppl): e40–e48. https://doi.org/10.1016/j.jviscsurg.2012.09.001
20. Pierce RA, Spitler JA, Frisella MM, Matthews BD, Brunt LM (2007) Pooled data analysis of laparoscopic vs. open ventral hernia repair: 14 years of patient data accrual. Surg Endosc 21(3):378–386. https://doi.org/10.1007/s00464-006-9115-6
21. Itani KM, Hur K, Kim LT, Anthony T, Berger DH, Reda D, Neumayer L, Veterans Affairs Ventral Incisional Hernia I (2010) Comparison of laparoscopic and open repair with mesh for the treatment of ventral incisional hernia: a randomized trial. Arch Surg 145(4):322–328; discussion 328. https://doi.org/10.1001/archsurg.2010.18
22. Kaafarani HM, Hur K, Campasano M, Reda DJ, Itani KM (2010) Classification and valuation of postoperative complications in a randomized trial of open versus laparoscopic ventral herniorrhaphy. Hernia 14(3):231–235. https://doi.org/10.1007/s10029-009-0593-z
23. Kaoutzanis C, Leichtle SW, Mouawad NJ, Welch KB, Lampman RM, Cleary RK (2013) Postoperative surgical site infections after ventral/incisional hernia repair: a comparison of open and laparoscopic outcomes. Surg Endosc 27(6):2221–2230. https://doi.org/10.1007/s00464-012-2743-0
24. Halm JA, de Wall LL, Steyerberg EW, Jeekel J, Lange JF (2007) Intraperitoneal polypropylene mesh hernia repair complicates subsequent abdominal surgery. World J Surg 31(2):423–429; discussion 430. https://doi.org/10.1007/s00268-006-0317-9
25. Rosen MJ (2009) Polyester-based mesh for ventral hernia repair: is it safe? Am J Surg 197(3):353–359. https://doi.org/10.1016/j.amjsurg.2008.11.003
26. Liang MK, Clapp ML, Garcia A, Subramanian A, Awad SS (2012) Mesh shift following laparoscopic ventral hernia repair. J Surg Res 177(1):e7–e13. https://doi.org/10.1016/j.jss.2012.03.048
27. Tse GH, Stutchfield BM, Duckworth AD, de Beaux AC, Tulloh B (2010) Pseudo-recurrence following laparoscopic ventral and incisional hernia repair. Hernia 14(6):583–587. https://doi.org/10.1007/s10029-010-0709-5
28. Millas SG, Mesar T, Patel RJ (2015) Chronic abdominal pain after ventral hernia due to mesh migration and erosion into the sigmoid colon from a distant site: a case report and review of literature. Hernia 19(5):849–852. https://doi.org/10.1007/s10029-013-1182-8
29. Aziz F, Zaeem M (2014) Chronic abdominal pain secondary to mesh erosion into ceacum following incisional hernia repair: a case report and literature review. J Clin Med Res 6(2):153–155. https://doi.org/10.14740/jocmr1730w
30. Mercoli H, Tzedakis S, D'Urso A, Nedelcu M, Memeo R, Meyer N, Vix M, Perretta S, Mutter D (2017) Postoperative complications as an independent risk factor for recurrence after laparoscopic ventral hernia repair: a prospective study of 417 patients with long-term follow-up. Surg Endosc 31(3):1469–1477. https://doi.org/10.1007/s00464-016-5140-2
31. Wassenaar E, Schoenmaeckers E, Raymakers J, van der Palen J, Rakic S (2010) Mesh-fixation method and pain and quality of life after laparoscopic ventral or incisional hernia repair: a randomized trial of three fixation techniques. Surg Endosc 24(6):1296–1302. https://doi.org/10.1007/s00464-009-0763-1
32. Penttinen R, Gronroos JM (2008) Mesh repair of common abdominal hernias: a review on experimental and clinical studies. Hernia 12(4):337–344. https://doi.org/10.1007/s10029-008-0362-4
33. Shankaran V, Weber DJ, Reed RL 2nd, Luchette FA (2011) A review of available prosthetics for ventral hernia repair. Ann Surg 253(1):16–26. https://doi.org/10.1097/SLA.0b013e3181f9b6e6
34. Sharma A, Mehrotra M, Khullar R, Soni V, Baijal M, Chowbey PK (2011) Laparoscopic ventral/incisional hernia repair: a single centre experience of 1,242 patients over a period of 13 years. Hernia 15(2): 131–139. https://doi.org/10.1007/s10029-010-0747-z
35. Ballantyne GH, Hourmont K, Wasielewski A (2003) Telerobotic laparoscopic repair of incisional ventral hernias using intraperitoneal prosthetic mesh. JSLS 7(1):7–14
36. Schluender S, Conrad J, Divino CM, Gurland B (2003) Robot-assisted laparoscopic repair of ventral hernia with intracorporeal suturing. Surg Endosc 17(9):1391–1395. https://doi.org/10.1007/s00464-002-8795-9
37. Tayar C, Karoui M, Cherqui D, Fagniez PL (2007) Robot-assisted laparoscopic mesh repair of incisional hernias with exclusive intracorporeal suturing: a pilot study. Surg Endosc 21(10):1786–1789. https://doi.org/10.1007/s00464-007-9247-3
38. Armijo P, Pratap A, Wang Y, Shostrom V, Oleynikov D (2017) Robotic ventral hernia repair is not superior to laparoscopic: a national database review. Surg Endosc 32:1834–1839. https://doi.org/10.1007/s00464-017-5872-7
39. Gonzalez A, Escobar E, Romero R, Walker G, Mejias J, Gallas M, Dickens E, Johnson CJ, Rabaza J, Kudsi OY (2017) Robotic-assisted ventral hernia repair: a multicenter evaluation of clinical outcomes. Surg Endosc 31(3):1342–1349. https://doi.org/10.1007/s00464-016-5118-0

40. Capitano S, Del Pozo AC, Bartolotta V, De Fusco M, Chiodi L, Boccoli G (2016) Relaparoscopic approach for recurrence after laparoscopic incisional hernia repair—a video vignette. Color Dis 18(9):919–920. https://doi.org/10.1111/codi.13454
41. Moreno-Egea A, Carrillo-Alcaraz A, Aguayo-Albasini JL (2012) Is the outcome of laparoscopic incisional hernia repair affected by defect size? A prospective study. Am J Surg 203(1):87–94. https://doi.org/10.1016/j.amjsurg.2010.11.017
42. LeBlanc KA, Elieson MJ, Corder JM 3rd (2007) Enterotomy and mortality rates of laparoscopic incisional and ventral hernia repair: a review of the literature. JSLS 11(4):408–414
43. Moreno-Egea A, Bustos JA, Girela E, Aguayo-Albasini JL (2010) Long-term results of laparoscopic repair of incisional hernias using an intraperitoneal composite mesh. Surg Endosc 24(2):359–365. https://doi.org/10.1007/s00464-009-0573-5
44. Rosen M, Brody F, Ponsky J, Walsh RM, Rosenblatt S, Duperier F, Fanning A, Siperstein A (2003) Recurrence after laparoscopic ventral hernia repair. Surg Endosc 17(1):123–128. https://doi.org/10.1007/s00464-002-8813-y
45. Heniford BT, Park A, Ramshaw BJ, Voeller G (2003) Laparoscopic repair of ventral hernias: nine years' experience with 850 consecutive hernias. Ann Surg 238(3):391–399; discussion 399-400. https://doi.org/10.1097/01.sla.0000086662.49499.ab
46. Marx L, Raharimanantsoa M, Mandala S, D'Urso A, Vix M, Mutter D (2014) Laparoscopic treatment of incisional and primary ventral hernia in morbidly obese patients with a BMI over 35. Surg Endosc 28(12):3310–3314. https://doi.org/10.1007/s00464-014-3607-6
47. Rogmark P, Petersson U, Bringman S, Eklund A, Ezra E, Sevonius D, Smedberg S, Osterberg J, Montgomery A (2013) Short-term outcomes for open and laparoscopic midline incisional hernia repair: a randomized multicenter controlled trial: the ProLOVE (prospective randomized trial on open versus laparoscopic operation of ventral eventrations) trial. Ann Surg 258(1):37–45. https://doi.org/10.1097/SLA.0b013e31828fe1b2
48. Comajuncosas J, Hermoso J, Gris P, Jimeno J, Orbeal R, Vallverdu H, Lopez Negre JL, Urgelles J, Estalella L, Pares D (2014) Risk factors for umbilical trocar site incisional hernia in laparoscopic cholecystectomy: a prospective 3-year follow-up study. Am J Surg 207(1):1–6. https://doi.org/10.1016/j.amjsurg.2013.05.010
49. den Hartog D, Dur AH, Kamphuis AG, Tuinebreijer WE, Kreis RW (2009) Comparison of ultrasonography with computed tomography in the diagnosis of incisional hernias. Hernia 13(1):45–48. https://doi.org/10.1007/s10029-008-0420-y
50. Erdas E, Dazzi C, Secchi F, Aresu S, Pitzalis A, Barbarossa M, Garau A, Murgia A, Contu P, Licheri S, Pomata M, Farina G (2012) Incidence and risk factors for trocar site hernia following laparoscopic cholecystectomy: a long-term follow-up study. Hernia 16(4):431–437. https://doi.org/10.1007/s10029-012-0929-y
51. Asencio F, Aguilo J, Peiro S, Carbo J, Ferri R, Caro F, Ahmad M (2009) Open randomized clinical trial of laparoscopic versus open incisional hernia repair. Surg Endosc 23(7):1441–1448. https://doi.org/10.1007/s00464-008-0230-4
52. Anthony T, Bergen PC, Kim LT, Henderson M, Fahey T, Rege RV, Turnage RH (2000) Factors affecting recurrence following incisional herniorrhaphy. World J Surg 24(1):95–100 discussion 101
53. Novitsky YW, Cobb WS, Kercher KW, Matthews BD, Sing RF, Heniford BT (2006) Laparoscopic ventral hernia repair in obese patients: a new standard of care. Arch Surg 141(1):57–61. https://doi.org/10.1001/archsurg.141.1.57
54. Raftopoulos I, Courcoulas AP (2007) Outcome of laparoscopic ventral hernia repair in morbidly obese patients with a body mass index exceeding 35 kg/m2. Surg Endosc 21(12):2293–2297. https://doi.org/10.1007/s00464-007-9406-6
55. Sugerman HJ, Kellum JM Jr, Reines HD, DeMaria EJ, Newsome HH, Lowry JW (1996) Greater risk of incisional hernia with morbidly obese than steroid-dependent patients and low recurrence with prefascial polypropylene mesh. Am J Surg 171(1):80–84. https://doi.org/10.1016/S0002-9610(99)80078-6
56. Ferrari G, Bertoglio C, Magistro C, Girardi V, Mazzola M, Di Lernia S, Pugliese R (2013) Laparoscopic repair for recurrent incisional hernias: a single institute experience of 10 years. Hernia 17(5):573–580. https://doi.org/10.1007/s10029-013-1098-3