

Original Research Article

Comparative outcomes of open retrorectus versus laparoscopic intraperitoneal onlay mesh repair of ventral hernia in a tertiary care center

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ABSTRACT

Background: The combined Rives-Stoppa technique has been adopted as the gold standard for open incisional hernia repair. Laparoscopic intraperitoneal onlay mesh (IPOM) hernioplasty is a newer technique in managing ventral hernia. Based on this we have done single institution retrospective study of IPOM and open retrorectus mesh repair for ventral hernia with size less than 5 cm.

Methods: This study was single institution retrospective study, where we have analyzed the data of 30 patients in each group of ventral hernia, with median 18 months of follow up. Their data analyzed for demographics, surgical site occurrence and short terms recurrence.

Results: Our study consists of 30 heterogenous population with similar age distribution in each group, mean time for surgery was 70.83 min for open and 66.33 minutes for IPOM. There was surgical site infection in 3 patients operated by open procedure and 2 patients in IPOM procedure. Duration of hospital stay which is more in open retrorectus repaired patients, 5.47 (mean) days and less in laparoscopic IPOM repaired patients, 5.07 (mean) days. Recurrence in both groups of patients is not seen in 6 months follow up in our study.

Conclusions: Study supports safety in terms of duration of surgery, postoperative pain, surgical site infection, duration of hospital stays and efficacy in terms of return of normal activity and recurrence, equally effective in both open retrorectus and laparoscopic IPOM repair of ventral hernia with size less than 5 cm.

Keywords: IPOM, Retrorectus, Ventral hernia

INTRODUCTION

Ventral hernias are common problem in surgical practice. A large number of ventral hernias are incisional hernia and port hernia, which are complications of previous surgery. The most important distinctions in describing surgical management of ventral hernias are primary vs mesh repair and open vs laparoscopic repair. Mesh repair became the gold standard in elective management of most ventral hernias.

The ideal method of hernia repair would cause minimal discomfort to the patient, both during the surgical procedure and in the postoperative course. Finally, cost-effectiveness is important. These patients are generally surrounded by mistrust on surgeons, financial load of a second surgery, fear of recurrence and subsequent surgery. Managing these patients is not only a procedural challenge but also a socio-economic challenge to regain the faith of the patient and offer a cost effective, minimum recurrence option for the patient. Repair of hernia by a prosthetic mesh is a well-recognized, low recurrence procedure.¹ But whether the procedure is to be

done by open or laparoscopic technique is still a topic of debate. Open hernioplasty has a recurrence rate of 12.5% -19%.^{2,3} Moreover, this method has several drawbacks, such as, extensive soft tissue dissection, raising of flaps, and placement of drains. This leads to a complication rate of up to 20% involving the wound, exposure and infection of mesh, fistula formation and other problems.⁴⁻⁶ On the other hand, laparoscopic intraperitoneal onlay mesh (IPOM) hernioplasty is a newer technique in managing ventral hernia in our country.

Trials and systematic reviews comparing laparoscopic with open surgical techniques showed reduced complications, less surgical site infections (SSI), and a shorter hospital stay in patients undergoing laparoscopic incisional hernia repair.⁷⁻¹⁶ In open incisional hernia surgery, meshes are most frequently positioned in sublay or preperitoneal position, while in laparoscopic hernia surgery the most frequent operation is an intraperitoneal onlay mesh (IPOM).¹⁷⁻¹⁹ Objective of study was to find out safety in terms of duration of surgery, postoperative pain, surgical site infection, duration of hospital stays and efficacy in terms of return of normal activity and recurrence in open retrorectus and laparoscopic IPOM repair of ventral hernia with size less than 5 cm.

METHODS

Study of comparison between open retro rectus and laparoscopic intraperitoneal onlay mesh repair of ventral hernia, carried out at GSMC and KEM hospital, a tertiary care centre, in department of surgery for 18 months. Sample size will be calculated by complete enumeration method. Ventral hernia operated cases by open retro rectus mesh repair were 24 and laparoscopically intraperitoneal onlay mesh repair were 26 in 2017 from January to December. Including 20% dropout, calculated estimated sample size of each group was 30. For this ethics clearance was taken from ethics committee of KEM hospital, Mumbai.

Statistical testing was conducted with SPSS Statistics 23.0 (SPSS Inc., Chicago, IL, USA). Results for quantitative variables like size of the incision in case of open, duration of hospital stay, pain on VAS scale will be expressed as mean (\pm SD), median (range), IQR. Results for qualitative variables like percentage of recurrence, percentage of complications, age group gender proportion of will be expressed as frequency and percentages. The one-sample Kolmogorov-Smirnov test was used to determine whether data sets differed from a normal distribution.⁹ The comparison of normally distributed quantitative variables between two independent groups were performed using unpaired student's 't' test. The pre-post comparison of normally distributed quantitative variables between two groups was performed using paired student's 't' test.

Nominal categorical data between the groups was compared using the 2 test or Fisher's exact test (for

expected frequencies <5) as appropriate. Non-normal distribution continuous variables were compared using the Wilcoxon rank sum test. The $p < 0.05$ considered significant. Statistical test Mann Whitney test was used for comparison of efficacy and safety of open retrorectus versus laparoscopic intraperitoneal onlay mesh repair of ventral hernia, for which 'p' value < 0.05 was taken significant.

Study population

Sample will be taken from operated laparoscopically onlay mesh repair and open retro rectus mesh repair of ventral hernia cases from general surgery department in the age group greater than 18 years of age and less than 60 years of age of either sex during January 2018 to December 2018. Cases presenting with swelling in anterior abdominal wall were screened in the OPD as well as the inpatient setting. Patients were included in the study after they fit the inclusion criteria and after a formal written, informed consent. The inclusion and exclusion criteria for the study were as follows:

Inclusion criteria

Age > 18 years and < 60 years of either sex, ventral hernia less than or equal to 5 cm in diameter, undergoing elective surgery for ventral hernia (including irreducible).

Exclusion criteria

Pregnant women, patients with complicated ventral hernia (obstructed, strangulated, incarcerated and recurrent).

Sample size

Sample size was calculated by complete enumeration method. Last year ventral hernia operated cases by open retro rectus mesh repair were 24 and laparoscopically intraperitoneal onlay mesh repair were 26 in 2017 from January to December. Including 20% dropout, calculated estimated sample size of each group was 30.

A total of 60 patients were included in the study. Patients were randomly allocated to the two study groups. 30 patients were included in the open retro rectus (group A) and 30 patients were included in the laparoscopic intraperitoneal onlay mesh repair group (group B).

Methods

Standard method for ventral hernia repair was laparoscopic repair. Recently open retrorectus mesh repair gaining advantages over rest open repair methods of ventral hernia.

Patients of ventral hernia which were operated laparoscopically intraperitoneal onlay mesh repair and open retro rectus mesh repair from different units in

general surgery department will be included in study during their routine follow ups postoperatively on day 7th, 14th, 28th, 2nd month and lastly 6th monthly after taking consent. Size defect was calculated by doing USG scan. Patients from these two different methods of surgery were taken in two groups. After written informed consent, patients was observed for.

Table 1: Follow up.

Parameter	Recorded by
1) Duration of surgery	From insertion of trocher to placement of mesh in case of lap and incision to placement mesh in case of open
2) Postoperative pain	VAS (visual analogue scale)
3) Surgical site infection	Southampton grading
4) Duration of hospital stay	Post op day 1 to day of discharge
5) Return to normal activity	Follow up will be done on 7 th (usual day suture removal), 14 th and 28 th day postoperatively
6) Recurrence	Follow up will be done on 2 nd and 6 th monthly postoperatively

The one-sample Kolmogorov-Smirnov test was used to determine whether data sets differed from a normal distribution.⁹ The comparison of normally distributed quantitative variables between two independent groups will be performed using unpaired student's 't' test. The pre-post comparison of normally distributed quantitative variables between two groups will be performed using paired student's 't' test.

Retrorectus repair

Over the past few decades, fascial closure with internal reinforcement for hernia repair has become the "standard of care" in ventral hernia surgery. The retrorectus technique is relatively easy to learn, can be performed in a broad range of patients, and is associated with lower ventral hernia recurrence rates compared with either onlay or inlay prosthetic synthetic mesh and acellular dermal matrix (ADM) hernia repair.²⁰⁻²³ Additionally, the retrorectus approach: prevents the device from having direct contact with the abdominal viscera. Contact with abdominal viscera could possibly lead to adverse events such as adhesions between the device and viscera, bowel obstruction, and fistula formation. Maintain the functionality and integrity of the abdominal wall by leveraging the intraabdominal pressures to stabilize the prosthetic device against the rectus muscle and fascial closure. Minimizes the need for skin flap undermining, thus allowing for preservation of skin-flap perforating vessels. This technique also enables additional surface contact between the rectus muscle and rectus sheath,

increasing exposure to vascularization and aiding tissue ingrowth.

Laparoscopic ventral hernia intraperitoneal repair

The laparoscopic repair of ventral hernia utilizes the principles of the open technique popularized by Stoppa et al, and Wantz.²⁴⁻²⁶ Laparoscopic repair of ventral hernia (LVHR) was described by LeBlanc and Booth in 1993.^{27,28} LVHR was performed by using an angled (30- or 45-degree), 5 mm or 10 mm laparoscope, 5 mm bowel graspers, scissors, and clip applicators. An antibiotic, usually a first-generation cephalosporin, was given prophylactically before the incision was made and often again if the operation continued for more than 2 hours. General anaesthesia was induced, and the patient was positioned; most remained supine with their arms at their side. In most cases, the bladder and stomach were decompressed with catheters. Pneumoperitoneum was established by using a Veress needle and pen abdominal access technique in the others. Most often, a window of access is present, even in the multiply operated abdomen, between the patient's costal margin and iliac crest on one side or the other. The initial entry site was usually just inferior to the tip of the eleventh rib. In many cases in which the open access method was used, a balloon-tipped trocar was inserted to avoid air leakage. After exploration of the abdomen, additional trocars were typically placed laterally in the abdomen, as needed, under direct visualization. Port placement for non-midline defects depended on the location of the hernia. Adhesions to the anterior abdominal wall surrounding the hernia were lysed, and the hernia contents were reduced. The peritoneal sac was left in situ.

After completion of the dissection, the hernia defect was measured and an appropriately sized prosthetic mesh was tailored to overlap all margins of the defect by at least 3 cm early in the series. As the surgeon experience increased, an overlap of at least 4 cm was considered desirable. Expanded polytetrafluoroethylene (ePTFE) mesh (Gore-Tex Dual Mesh Biomaterial; W.L. Gore and cjs0038; Associates, Flagstaff, AZ) was used in 97% of cases.

At least 4 nonabsorbable monofilament or ePTFE sutures were placed equidistantly along the mesh. Points of reference on the mesh and corresponding points on the abdominal wall were marked to aid in orienting the mesh after its introduction into the abdomen. The mesh was rolled up and pushed or pulled into the abdomen through a 5- or 10-mm trocar site. After the mesh was positioned intracorporeally, the sutures placed in the material before its insertion into the abdomen were pulled through the abdominal wall with a suture passer and tied with the knots buried in subcutaneous tissues.

Additional full-thickness stitches were placed circumferentially every 3 to 6 cm by using the suture passer. The perimeter of the mesh was then stapled (with

5-mm spiral tacks) to the posterior fascia at locations no more than 1 to 1.5 m apart. Early in the series, tacks alone were used to secure the mesh in several cases, but this practice was subsequently discontinued. No drains were inserted. Fascial closure using sutures was performed at all 10-mm trocar site

RESULTS

Study of comparison is shown in following Table 2. Our study consists of heterogenous population with similar age distribution. As patient related factor linked to ventral hernia formation include male factor, but in our study shows no such male factor relation.

Table 2: Summary of comparison.

Characteristics	Open retrorectus		IPOM	P value
	Group-A (n=30)		Group-B (n=30)	
Age (mean) years	41.00		41.77	0.640 (t-test=-0.471)
Gender	Female		16	0.795 (chi-sq-0.067)
	Male		14	
Pain	Yes		8	0.126 (chi-sq-1.832)
	No		12	
Previous surgery	Yes		4	0.076 (chi-sq- 4.356)
	No		26	
Comorbidity	DM		2	-
	DM+HTN		0	-
	HTN		0	-
	hypothyroidism		0	-
	No comorbidity		25	28
Duration of surgery (minutes)	70.83		66.33	0.267 (t-test-1.122)
Type of anaesthesia	GA		30	0.0001 (chi-sq-56.124)
	SA		29	
Mesh	Prolene		0	0.0001
	Epramesh		30	
Post of pain	6 hours		7.03	0.681 0.171
	48 hours		3.53	
SSI	Yes (Southampton)		2	0.640
	No		28	
Hospital stay (days)	5.47		5.07	0.433
Return to normal activity (days)	9.27		7.93	0.57
Recurrence	0		0	-

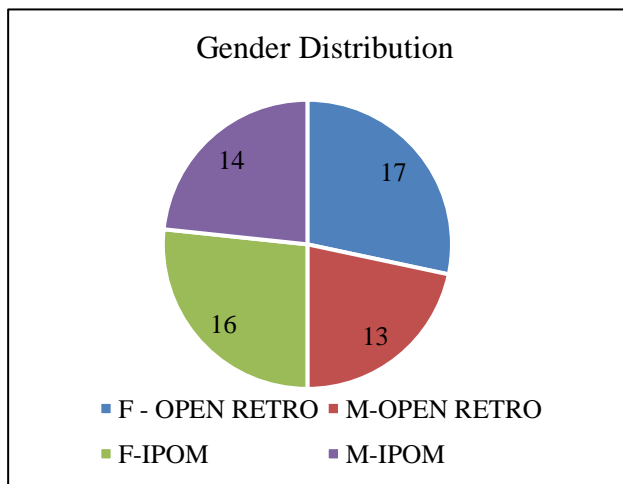


Figure 1: Gender distribution.

In our study, out of n=60, 21 patients having pain associated with hernia. Out of operated for open retrorectus and laparoscopic IPOM having pain are 43.3% and 26.7% respectively.

Table 3: Pain associated with hernia.

		Surgery		Total	
		Open retrorectus	IPOM		
Pain	Yes	Count	13	8	21
		%	43.3	26.7	35.0
	No	Count	17	22	39
		%	56.7	73.3	65.0
Total	Count	30	30	60	
	%	100.0	100.0	100.0	

Chi square = 1.832 p value= 0.176

15 patients having history of previous surgery out of n=60 (Table 4).

Table 4 and Figure 2 showing percentage of comorbidity. 88.3% patients not having any comorbidity. Out of 11.7%, DM, HTN and hypothyroidism having each 3.3% and DM+HTN contribute 1.7%.

Table 4: Previous surgery associated with ventral hernia.

		surgery		total	
		Open retrorectus	IPOM		
Previous surgery	Yes	Count	11	4	15
		%	36.7	13.3	25.0
	No	Count	19	26	45
		%	63.3	86.7	75.0
Total		Count	30	30	60
		%	100.0	100.0	100.0

Chi square = 4.356 p value= 0.076

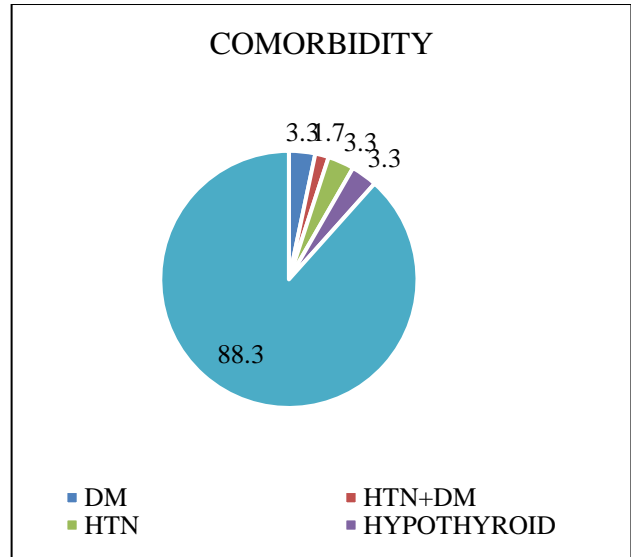


Figure 2: Comorbidity distribution.

Table 5: Duration of surgery.

Surgery	N	Mean	Std. deviation	Std. error mean	T test	P value
Duration of surgery (minutes)	Open retrorectus	30	70.83	17.175	1.122	0.267
	IPOM	30	66.33	13.705		

Table 6: Post-operative pain after 6 hours and 48 hours.

Surgery	N	Mean	Std. deviation	Std. error mean	T test	P value
Pain (after 6 hours)	Open retrorectus	30	6.93	0.907	-0.414	0.681
	IPOM	30	7.03	0.964		
Pain (after 48 hours)	Open retrorectus	30	3.80	0.887	1.385	0.171
	IPOM	30	3.53	0.571		

Mean duration of surgery in open retro rectus repair was 70.83 minutes and mean duration of laparoscopic IPOM surgery was 66.33 minutes. Study having t-test value 1.122 and p value was 0.267 which was insignificant. Expertise surgeon hands may reduce this time bound difference in open and lap surgeries.

In our study, all cases done by laparoscopically were performed in GA, retro rectus repair performed in SA except one which is done in GA due to some technical error as that patient not getting induced by SA, as one attempt of failed SA done. Dual mesh, sepramesh was used in laparoscopic IPOM repair and prolene mesh used in open retro rectus repair.

Postoperative pain evaluated in our study by VAS. Pain after 6 hours and 48 hours in open retrorectus repair 6.93 and 3.80 and in laparoscopic IPOM repair was 7.03 and 3.53 respectively with respective p values were 0.681 and 0.171. Hence nonsignificant in our study as t test values for postoperative pain after 6 hours and 48 hours were -0.414 and 1.385 which was also inconclusive (Table 6).

Southampton grading was used in our study for category and identifying SSI. SSI seen in 5 patients out of n=60, seen in open retro rectus repaired 3 patients and laparoscopic IPOM repaired 2 patients with p value of 0.640, which is insignificant. Open retro rectus repair having more grade (Southampton scale) in SSI in comparison to laparoscopic IPOM (Table 7).

Table 7: Surgical site infection.

		Surgery		Total	
		Open retrorectus	IPOM		
Surgical site infection (Southampton grading)	Yes	Count	3	2	5
		%	10.0	6.7	8.3
	No	Count	27	28	55
		%	90.0	93.3	91.7
Total		Count	30	30	60
		%	100.0	100.0	100.0

Chi square =0.218 p value =0.640

Duration of hospital stay which was more in open retro rectus repaired patients, 5.47 (mean) days and less in laparoscopic IPOM repaired patients, 5.07 (mean) days with having p value of 0.433 which was insignificant. T test values also 0.789 (Table 8).

Laparoscopic IPOM operated patients having return of normal of activity on 7.93 (mean) days earlier than the patients operated for open retro rectus repair which was on 9.27 (mean) days, but having p value was 0.53, which was not significant (Table 9).

Table 8: Duration of hospital stay.

Surgery		N	Mean	Std. deviation	Std. error mean	T test	P value
Duration of hospital stay (days)	Open retrorectus	30	5.47	1.961	0.358	0.789	0.433
	IPOM	30	5.07	1.964	0.359		

Table 9: Return of normal activity.

Surgery		N	Mean	Std. deviation	Std. error mean	T test	P value
Return of normal activity	Open retrorectus	30	9.27	2.728	0.498	1.972	0.053
	Ipom	30	7.93	2.504	0.457		

Recurrence in both groups of patients was not seen in 6 months follow up in our study.

DISCUSSION

When comparing laparoscopic IPOM and open retro rectus approaches in the repair of incisional ventral hernias, the current prospective data obtained from the Herniated Hernia Registry identified no difference in the proportion of patients experiencing chronic pain or recurrence after 1-year follow-up. However, to its disadvantage, the laparoscopic IPOM technique was found to be associated with significantly increased rates of intraoperative complications, particularly bleeding, bowel, and other organ injuries. On the other hand, patients operated on with the open retro rectus approach experienced significantly higher rates of surgical postoperative complications, predominantly surgical site infection, seroma, and bleeding combined with higher rates of complication related reoperations. Furthermore, rates of general postoperative complications were also observed to be increased with the open retro rectus technique. Additionally, the hospital stay was significantly longer for the open retro rectus technique. Therefore, in the context of a population of patients found in our clinical routine study, the current analysis challenges the findings of the meta-analyses mentioned in literature.²⁹⁻³² Beyond that, this study establishes a direct comparison between the best open technique consequently, the expertise of the surgeon and rigorous adherence to guidelines are of paramount importance in the prevention of intraoperative complications.³³⁻³⁷ The major disadvantage of the open retro rectus technique is the highly significantly increased rate of surgical site infection, seroma, and bleeding, which is closely associated with the requirement to re-operate. In accordance with these findings, the laparoscopic IPOM technique should be favoured over the open retro rectus approach in the repair of incisional hernias, given that surgical expertise is evident.

Study supports safety in terms of duration of surgery, postoperative pain, surgical site infection, duration of hospital stays and efficacy in terms of return of normal activity and recurrence, equally effective in both open retro rectus and laparoscopic IPOM repair of ventral hernia with size less than 5 cm. Duration of surgery, postoperative pain in open retro rectus and laparoscopic IPOM repair for ventral hernia not having significant difference. Comparing both open retro rectus and laparoscopic IPOM repair, surgical site infection, hospital stay, return of normal activity and recurrence in both groups of our study not having significant difference to say one method of operative is better than other. Well expertise management and expertise surgeons' hand in open as well as laparoscopic procedure (to eliminate long learning curve creating confounding factor) helps in proper outcomes of comparing open retro rectus versus laparoscopic IPOM repair for ventral hernia less than 5 cm. Therefore, in the context of a population of patients found in our clinical routine study, the current analysis challenges the findings of the meta-analyses mentioned in literature.³⁸⁻⁴¹ Beyond that, this study establishes a direct comparison between the best open technique consequently, the expertise of the surgeon and rigorous adherence to guidelines are of paramount importance in the prevention of intraoperative complications.⁴²⁻⁴⁶

Strengths of the study

Our study is prospective and includes heterogenous study population of patients, so results are applicable to wide range of population.

Scope for future research

Huge scope for double blind large scale RCT for standardization of study population, equally expertise surgeons in both operative groups. More clinical double-blind trials are needed with a long term follow up. Most of studies till now include large ventral hernia but, our

study is more specific include ventral hernia less than 5 cm.

CONCLUSION

Study supports safety in terms of duration of surgery, postoperative pain, surgical site infection, duration of hospital stays and efficacy in terms of return of normal activity and recurrence, equally effective in both open retrorectus and laparoscopic IPOM repair of ventral hernia with size less than 5 cm.

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Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

- Mudge M, Hughes LE. Incisional hernia: a 10 year prospective study of incidence and attitudes. *Br J Surg.* 1985;72(1):70-1.
- Bauer JJ, Harris MT, KreeI I, Gelernt IM. Twelve-year experience with expanded polytetrafluoroethylene in the repair of abdominal wall defects. *Mount Sinai J Med.* 1999;66(1):20-5.
- Koller R, Miholic J, Jakl RJ. Repair of incisional hernias with expanded polytetrafluoroethylene. *Eur J Surg.* 1997;163(4):261-6.
- Leber GE, Garb JL, Alexander AI, Reed WP. Long-term complications associated with prosthetic repair of incisional hernias. *Arch Surg.* 1998;133(4):378-82.
- Park A, Gagner M, Pomp A. Laparoscopic repair of large incisional hernias. *Surg Laparosc Endosc.* 1996;6(2):123-8.
- White TJ, Santos MC, Thompson JS. Factors affecting wound complications in repair of ventral hernias. *Am Surg.* 1998;64(3):276.
- Goodney PP, Birkmeyer CM, Birkmeyer JD. Short-term outcomes of laparoscopic and open ventral hernia repair: a meta-analysis. *Arch Surg.* 2002;137(10):1161-5.
- Keller DS, Delaney CP, Senagore AJ, Feldman LS. Uptake of enhanced recovery practices by SAGES members: a survey. *Surg Endosc.* 2017;31(9):3519-26.
- Itani KM, Hur K, Kim LT, Anthony T, Berger DH, Reda D, et al. Comparison of laparoscopic and open repair with mesh for the treatment of ventral incisional hernia: a randomized trial. *Arch Surg.* 2010;145(4):322-8.
- Misra MC, Bansal VK, Kulkarni MP, Pawar DK. Comparison of laparoscopic and open repair of incisional and primary ventral hernia: results of a prospective randomized study. *Surg Endosc Other Intervent Tech.* 2006;20(12):1839-45.
- Forbes SS, Eskicioglu C, McLeod RS, Okrainec A. Meta-analysis of randomized controlled trials comparing open and laparoscopic ventral and incisional hernia repair with mesh. *Br J Surg.* 2009;96(8):851-8.
- Rogmark P, Petersson U, Bringman S, Eklund A, Ezra E, Sevonius D, et al. 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.* 2013;258(1):37-45.
- Olimi S, Scaini A, Cesana GC, Erba L, Croce E. Laparoscopic versus open incisional hernia repair. *Surg Endosc.* 2007;21(4):555-9.
- Sauerland S, Walgenbach M, Habermalz B, Seiler CM, Miserez M. Laparoscopic versus open surgical techniques for ventral or incisional hernia repair. *Cochrane Database Syst Rev.* 2011(3).
- LeBlanc KA. Umbilical Hernia Repair. In: *The Art of Hernia Surgery.* Springer, Cham; 2018:507-514.
- Holihan JL, Nguyen DH, Nguyen MT, Mo J, Kao LS, Liang MK. Mesh location in open ventral hernia repair: a systematic review and network meta-analysis. *World J Surg.* 2016;40(1):89-99.
- Sauerland S, Walgenbach M, Habermalz B, Seiler CM, Miserez M. Laparoscopic versus open surgical techniques for ventral or incisional hernia repair. *Cochrane database of systematic reviews.* 2011(3).
- LeBlanc KA. Umbilical Hernia Repair. In: *The Art of Hernia Surgery.* Springer, Cham; 2018:507-514.
- Holihan JL, Nguyen DH, Nguyen MT, Mo J, Kao LS, Liang MK. Mesh location in open ventral hernia repair: a systematic review and network meta-analysis. *World J Surg.* 2016;40(1):89-99.
- Krpata DM, Blatnik JA, Novitsky YW, Rosen MJ. Evaluation of high-risk, comorbid patients undergoing open ventral hernia repair with synthetic mesh. *Surgery.* 2013;153(1):120-5.
- Bauer J, Harris M, Gorfine S, KreeI I. Rives-Stoppa procedure for repair of large incisional hernias: experience with 57 patients. *Hernia.* 2002;6(3):120-3.
- Nau PJ, Clark C, Fisher M, Walker G, Needleman BJ, Ellison EC, et al. Modified rives-stoppa repair for abdominal incisional hernias. *Health.* 2010;02(02):162-9.
- Gleysteen JJ. Mesh-reinforced ventral hernia repair. *Arch Surg.* 2009;144(8):740.
- Stoppa RE. The treatment of complicated groin and incisional hernias. *World J Surg.* 1989;13(5):545-54.
- Wantz GE. Incisional hernioplasty with polyester mesh. *Arch Surg.* 1998;133(10):1137-a-1137.
- Park A, Birch DW, Lovrics P. Laparoscopic and open incisional hernia repair: a comparison study. *Surgery.* 1998;124(4):816-22.
- LeBlanc KA, Booth WV, Whitaker JM, Bellanger DE. Laparoscopic incisional and ventral herniorrhaphy in 100 patients. *Am J Surg.* 2000;180(3):193-7.
- Kulaçoğlu H, Özer M. Hybrid repair for secondary lumbar hernias: Three cases with different

- etiologies. *Laparosc Endosc Surg Sci.* 2018;25(4):149-56.
29. Al Chalabi H, Larkin J, Mehigan B, McCormick P. A systematic review of laparoscopic versus open abdominal incisional hernia repair, with meta-analysis of randomized controlled trials. *Int J Surg.* 2015;20:65-74.
 30. Awaiz A, Rahman F, Hossain MB, Yunus RM, Khan S, Memon B, et al. Meta-analysis and systematic review of laparoscopic versus open mesh repair for elective incisional hernia. *Hernia.* 2015;19(3):449-63.
 31. Jensen KK, Jorgensen LN. Comment to: meta-analysis and systematic review of laparoscopic versus open mesh repair for elective incisional hernia. Awaiz A et al. *Hernia* 2015;19:449-63. *Hernia.* 2015;19(6):1025-6.
 32. Awaiz A, Rahman F, Hossain MB, Yunus RM, Khan S, Memon B, et al. Reply to comment to Meta-analysis and systematic review of laparoscopic versus open mesh repair for elective incisional hernia. Jensen K, Jorgensen LN. *Hernia.* 2015;19(6):1027-9.
 33. Bittner R, Bingener-Casey J, Dietz U, Fabian M, Ferzli GS, Fortelny RH, et al. Guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias (International Endohernia Society (IEHS)- Part 1. *Surg Endosc.* 2014;28(1):2-9.
 34. Bittner R, Bingener-Casey J, Dietz U, Fabian M, Ferzli GS, Fortelny RH, et al. Guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias (International Endohernia Society [IEHS])- Part 2. *Surg Endosc.* 2014;28(2):353-79.
 35. Bittner R, Bingener-Casey J, Dietz U, Fabian M, Ferzli G, Fortelny R, et al. Guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias (International Endohernia Society [IEHS])-Part III. *Surg Endosc.* 2014;28(2):380-404.
 36. Silecchia G, Campanile FC, Sanchez L, Ceccarelli G, Antinori A, Ansaloni L, et al. Laparoscopic ventral/incisional hernia repair: updated guidelines from the EAES and EHS endorsed Consensus Development Conference. *Surg Endosc.* 2015;29(9):2463-84.
 37. Earle D, Roth JS, Saber A, Haggerty S, Bradley JF, Fanelli R, et al. SAGES guidelines for laparoscopic ventral hernia repair. *Surg Endosc.* 2016;30(8):3163-83.
 38. Al Chalabi H, Larkin J, Mehigan B, McCormick P. A systematic review of laparoscopic versus open abdominal incisional hernia repair, with meta-analysis of randomized controlled trials. *Int J Surg.* 2015;20:65-74.
 39. Awaiz A, Rahman F, Hossain MB, Yunus RM, Khan S, Memon B, et al. Meta-analysis and systematic review of laparoscopic versus open mesh repair for elective incisional hernia. *Hernia.* 2015;19(3):449-63.
 40. Jensen KK, Jorgensen LN. Comment to: meta-analysis and systematic review of laparoscopic versus open mesh repair for elective incisional hernia. Awaiz A et al. *Hernia* 2015;19:449-63. *Hernia.* 2015;19(6):1025-66.
 41. Awaiz A, Rahman F, Hossain MB, Yunus RM, Khan S, Memon B, et al. Reply to comment to Meta-analysis and systematic review of laparoscopic versus open mesh repair for elective incisional hernia. Jensen K, Jorgensen LN. *Hernia.* 2015;19(6):1027-9.
 42. Bittner R, Bingener-Casey J, Dietz U, Fabian M, Ferzli GS, Fortelny RH, et al. Guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias (International Endohernia Society (IEHS)- Part 1. *Surg Endosc.* 2014;28(1):2-9.
 43. Bittner R, Bingener-Casey J, Dietz U, Fabian M, Ferzli GS, Fortelny RH, et al. Guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias (International Endohernia Society [IEHS])- Part 2. *Surg Endosc.* 2014;28(2):353-79.
 44. Bittner R, Bingener-Casey J, Dietz U, Fabian M, Ferzli G, Fortelny R, et al. Guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias (International Endohernia Society [IEHS])-Part III. *Surg Endosc.* 2014;28(2):380-404.
 45. Silecchia G, Campanile FC, Sanchez L, Ceccarelli G, Antinori A, Ansaloni L, et al. Laparoscopic ventral/incisional hernia repair: updated guidelines from the EAES and EHS endorsed Consensus Development Conference. *Surg Endosc.* 2015;29(9):2463-84.
 46. Earle D, Roth JS, Saber A, Haggerty S, Bradley JF, Fanelli R, et al. SAGES guidelines for laparoscopic ventral hernia repair. *Surg Endosc.* 2016;30(8):3163-83.

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