Mesh hernioplasty for complicated ventral hernia – is it safe?

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Background
The application of prosthetic mesh hernioplasty of ventral hernias in emergency potentially infected conditions is still a matter of debate because of the high possibility of infection of the surgical site (SSI), and still many surgeons in clinical practice do not favor the application of prosthetic mesh in emergency circumstances. Our study compared the repair of ventral hernias in complicated conditions together with either application of synthetic mesh or not and reviewed their outcomes regarding surgical site occurrence and incidence of recurrence of hernia.
Patients and methods
During the period from January 2020 to May 2021, 86 cases of incarcerated or strangulated ventral hernias admitted to Tanta University Emergency Hospital were randomized to be repaired with either the application of synthetic mesh or without. Data were collected and tabulated.
Results
A total of 86 patients were included. Overall, 31 (36%) presented with incarcerated ventral hernias and 55 (64%) patients presented with strangulated ones, of whom 11 patients required bowel resection. Moreover, 43 (50%) patients were managed by onlay mesh repair, and the other 43 (50%) patients had only primary suture repair. SSI occurred in eight (9.3%) patients, with nearly equal presentation in both groups. Six patients presented with recurrence during the 12-month follow-up; five of them were in the suture repair group. Diabetes mellitus, multiple comorbidities, American Society of Anesthesiologists score III, bowel resection and previous recurrence were independent predictors for SSI.
Conclusion
Prosthetic mesh repair of emergency-presenting ventral hernias showed a lower incidence of recurrence and acceptable rate of surgical site occurrence.

Keywords:
complicated, hernia, mesh

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Background

According to the European Hernia Society, ventral hernia is a hernia of the abdominal wall excluding the inguinal area, the pelvic area, and the diaphragm, including umbilical, epigastric, Spigelian, lumbar, and incisional hernias [1]. The high incidence of incarcerated and/or strangulated hernias that need quick intervention is also associated with high incidence of surgical site occurrence (SSO) and recurrence [2].

No delay is allowed in the presence of strangulated hernia, and early intervention is mandatory, as with time, the bowel viability is more compromised and the incidence of bowel resection increases. Not only the risk of anastomotic leakage after bowel resection but also strangulation itself increases the chance of wound contamination, which leads to a higher risk of infection in the surgical site (SSI) and higher recurrence rate [3]. Although the World Society for Emergency Surgery (WSES) recommended the use of prosthetic mesh in condition of incarcerated ventral hernia that does not need bowel resection, in case of strangulated hernias with concomitant intestinal resection, prosthetic mesh should be used with caution (grade 2C recommendation) [3–5]. Choi *et al.* [6] documented a higher incidence of SSI after evaluating the results of the mesh repair of 33 000 cases with strangulated ventral hernia. Xourafas *et al.* [7] reported that prosthetic mesh after bowel resection for strangulated hernia repair carries a higher risk of postoperative SSI compared with those treated without mesh. Our study was conducted to review the feasibility and safety of prosthetic mesh use in circumstances of complicated ventral hernias regarding the short-term postoperative complication and recurrence.

Patients and methods

This study is a prospective randomized clinical trial that was conducted on 86 patients who presented to Tanta

University Emergency Hospital with complicated ventral hernia between January 2020 and May 2021 (the number was determined by power calculation). Patients were randomly assigned to one of the both groups using the closed envelope method. This research was performed at the Department of General Surgery, Tanta University Hospitals. Ethical Committee approval and written, informed consent were obtained from all participants.

Eligibility criteria

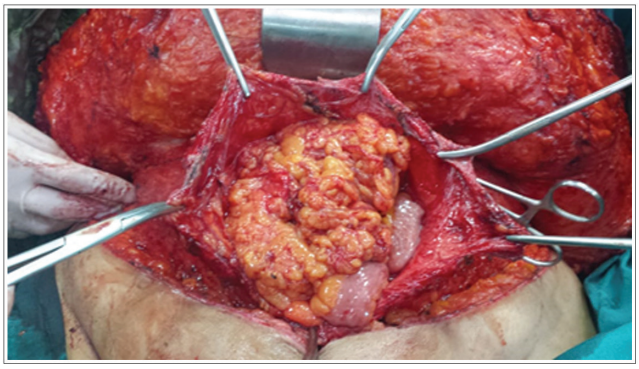
Our definition of ventral hernias included all hernias that pass through a defect in the anterior abdominal wall such as Spigelian, umbilical, epigastric, and incisional hernias. We included all adult patients who presented to our emergency hospital with complicated anterior abdominal wall hernias even those who had gangrenous intestine and required resection.

Those presenting with other types of hernia, those electively operated for their hernias following reduction of incarcerated hernia manually, and those with stoma after colonic resection were excluded from our study. An approval of the study was obtained from research ethical committee of Faculty of Medicine in Tanta University.

Our maneuver and outcomes

The diagnosis of hernia to be either incarcerated or strangulated was confirmed intraoperatively. Incarcerated ventral hernia included irreducible hernias with symptoms of bowel obstruction, despite maintained blood supply of the bowel confirmed by normal bowel color, persistence of luster, and normal bowel motility, as shown in Fig. 1. On the contrary, ischemia or gangrene of the bowel marked strangulated hernias as shown in Fig. 2. Hot fomentation was applied to the doubtful bowel, which either returned viable and reduced back to the peritoneal cavity or remained nonviable, and then we proceeded to resection with anastomosis.

Figure 1



Incarcerated omentum and small bowel that was easily reduced after widening of the defect.

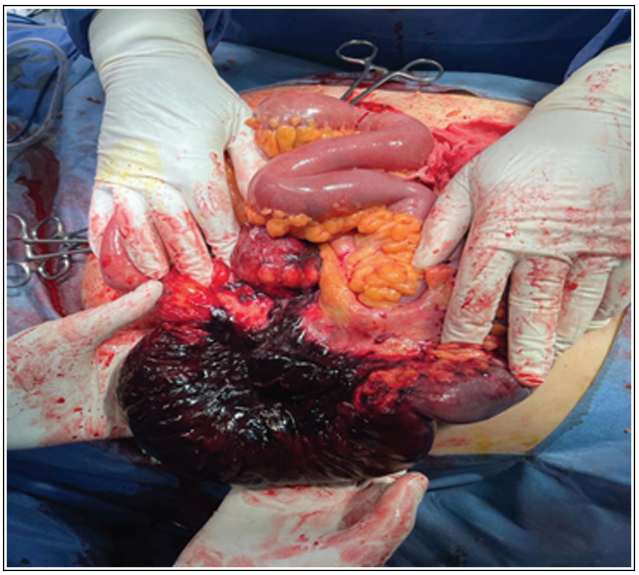
According to the Center for Disease Control and Prevention surgical wound classification [8], we had three classes of wound presentations: clean (class I) in incarcerated hernias, class II (clean contaminated) for strangulated hernias without resection, and strangulated hernias that require intestinal resection as class III (contaminated).

Patients' performance was assessed according to the American Society of Anesthesiologists (ASA) score. Surgical field care was applied in both groups including, perioperative antibiotics that included third-generation cephalosporins and metronidazole, thorough irrigation of the field with saline solution, and debridement of tissues with questionable viability or previous mesh in the situation of complicated recurrent hernias.

Subcutaneous drains were routinely applied in all patients, and we just removed them when it gives less than 50 ml/day. Postoperative antibiotics were continued in both groups for the first 2 days except if there were manifestations of wound infection that was managed according to culture and sensitivity of wound swab. Thromboprophylaxis using low-molecular-weight heparin was started 12 h postoperatively if there was no bleeding for all patients older than 50 years, patients with BMI more than 40 kg/m^2, or patients with BMI less than 40 with multiple comorbidities.

The classic defect repair by approximation of the edges using continuous running polyprolene 0 sutures was done in all patients followed by abdominal wall reinforcement using a 15 × 15 cm or 30 × 30 cm synthetic polyprolene mesh in prosthetic mesh group according to the size of the defect (Prolene mesh; Ethicon, Johnson-Johnson Inc., Langhorne, Pennsylvania, USA) fixed using polyprolene

Figure 2

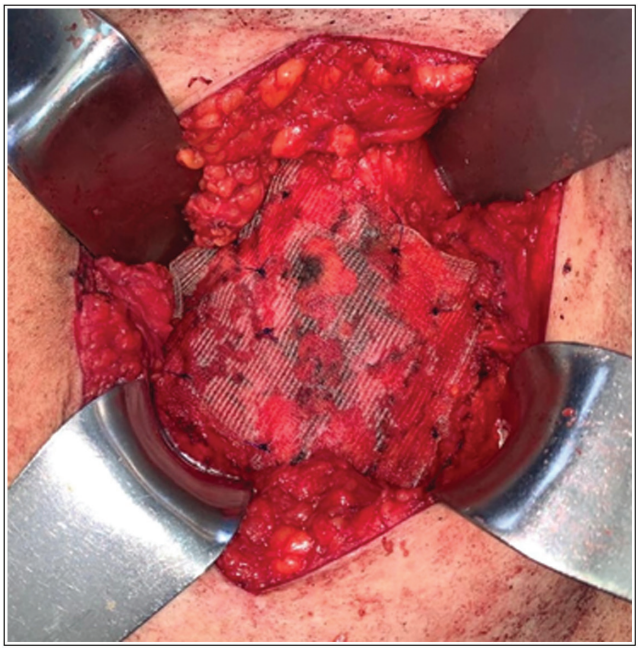


Gangrenous small bowel in strangulated hernia.

2/0 sutures. We used the classical onlay technique in all our series patients, as shown in Fig. 3.

Follow-up was done for all patients at the outpatient clinic at 2 weeks, 1, 6, and 12 months postoperatively. SSO was defined as cellulitis, wound necrosis, SSI, seroma, wound dehiscence, or hematoma [4]. Recurrence was confirmed clinically and radiologically.

Figure 3



Incarcerated hernia after onlay mesh hernioplasty.

Statistical analysis of the data

Data were fed to the computer and analyzed using IBM SPSS software package, version 20.0 (IBM Corp., Armonk, New York, USA). The Kolmogorov–Smirnov was used to verify the normality of distribution of variables. Comparisons between groups for categorical variables were assessed using χ^2 test (Fisher or Monte-Carlo). Student *t* test was used to compare two groups for normally distributed quantitative variables, whereas Mann–Whitney test was used to compare between two groups for not normally distributed quantitative variables. Significance of the obtained results was judged at the 5% level.

Results

This study is a prospective randomized clinical trial that was conducted on 86 patients who presented to Tanta University Emergency Hospital with complicated ventral hernia between January 2020 and May 2021. The patients' demographic criteria are documented in Table 1. A total of 45 (52.3%) patients had associated comorbidities, as shown in Table 1 with 11 (12.8%) patients having more than one comorbidity. Overall, 78 (90%) patients had ASA score of I–II, whereas the other eight (10%) patients were graded as ASA III.

Table 1 Comparison between the two studied groups according to demographic data

Demographic data	Mesh (*N*=43) [*n* (%)]	Suture (*N*=43) [*n* (%)]	Test of significance	*P*
Sex				
Male	23 (53.5)	17 (39.5)	χ^2=1.683	0.195
Female	20 (46.5)	26 (60.5)		
Age (years)				
Mean±SD	59.4±11.9	44.3±9	*t*=6.672*	<0.001*
Median (minimum–maximum)	59 (41–80)	42 (32–61)		
BMI (kg/m^2)				
Mean±SD	39.1±6.7	40.2±6.1	*t*=0.740	0.461
Median (minimum–maximum)	40 (28–50)	40 (28–50)		
ASA				
1	23 (53.5)	18 (41.9)	χ^2=1.362	^{MC}P=0.532
2	17 (39.5)	20 (46.5)		
3	3 (7)	5 (11.6)		
Comorbidities				
No	23 (53.5)	18 (41.9)	χ^2=1.165	0.280
Yes	20 (46.5)	25 (58.1)		
DM	10 (23.3)	14 (32.6)	χ^2=0.925	0.336
Hypertension	7 (16.3)	7 (16.3)	χ^2=0.0	1.000
Chronic liver disease	4 (9.3)	6 (14)	χ^2=0.453	^{FE}P=0.738
Cardiac	3 (7)	5 (11.6)	χ^2=0.551	^{FE}P=0.713
Multicomorbidities	4 (9.3)	7 (16.3)	χ^2=0.938	0.333

χ^2, χ^2 test; ASA, American Society of Anesthesiologist; DM, diabetes mellitus; FE, Fisher exact; MC, Monte-Carlo; *t*, Student *t* test.
P: *P* value for comparing between the studied groups
*Statistically significant at *P* value less than or equal to 0.05.

Characteristics of ventral hernia

A total of 77 (89.6%) patients presented with complicated umbilical hernias, six (7%) patients had epigastric, and three (3.4%) were incisional for midline exploratory incisions. Nine (10.4%) patients presented with recurrent hernias following previous repairs (two of them had onlay prosthetic mesh hernioplasty with recurrence due to small poorly fixed mesh and seven classic propylene suture repairs). The median defect size of all hernias was about 6 cm for the mesh group (range, 4–9 cm) and about seven for the suture group (range, 4–10 cm). Overall, 31 (36%) patients had incarcerated ventral hernias, whereas the other 55 (64%) presented with strangulated hernias. No differences of statistical significance were detected between the two groups regarding the criteria of hernias, as shown in Table 2.

Treatment and outcomes

A total of 43 (50%) patients were managed by onlay prosthetic mesh fixation, and the other half were repaired classically with polypropylene sutures. Mesh repair was done in 15 patients with incarcerated hernias and 28 of patients with strangulated hernias (Table 2).

Overall, 11 (12.8%) patients with strangulated hernias needed resection of gangrenous intestine with end-to-end anastomosis; five of these cases were in the mesh group and the other six were treated with suture repair. Contaminated wounds (Center for Disease Control and Prevention class III) were nearly equal in the two groups. The hernia contained small bowel alone in 45 (52.3%) patients, small bowel and omentum in 21 (24.4%) patients, large bowel alone in seven (8.1%) patients, and large bowel and omentum in 13 (15.2%) patients, as shown in Table 2.

Skin and subcutaneous complications (Table 3) were detected in 19 (22%) patients including nine (10.4%) patients with seroma, hematoma in two (2.3%) patients, and SSI in eight (9.3%) patients. The prosthetic mesh group was significantly higher regarding skin and subcutaneous overall complications than the suture group, particularly seroma formation with statistically significant difference, but regarding SSI, there was no statistically significant difference between the two groups. SSI was treated conservatively with antibiotics for 7–14 days based on the culture of the wound or needed drainage if necessary. Only one patient in the

Table 2 Comparison between the two studied groups according to operative data

Operative data	Mesh (*N*=43) [*n* (%)]	Suture (*N*=43) [*n* (%)]	Test of significance	*P*
Primary or recurrent				
Primary	38 (88.4)	39 (90.7)		
Recurrent mesh	1 (2.3)	1 (2.3)	χ^2=0.451	^{MC}P=1.000
Recurrent suture	4 (9.3)	3 (7)		
Anatomic location				
Umbilical	38 (88.4)	39 (90.7)		
Epigastric	3 (7.0)	3 (7)	χ^2=0.508	^{MC}P=1.000
Incisional midline	2 (4.7)	1 (2.3)		
Defect size				
Mean±SD	6.3 ± 1.5	6.81 ± 1.55	*U*=752.50	0.131
Median (minimum–maximum)	6 (4–9)	7.0 (4–10)		
Incarcerated or strangulated				
Incarcerated	15 (34.9)	16 (37.2)	χ^2=0.050	0.822
Strangulated	28 (65.1)	27 (62.8)		
Content				
Small bowel alone	24 (55.8)	21 (48.8)		
Small bowel and omentum	11 (25.6)	10 (23.3)	χ^2=1.598	^{MC}P=0.698
Large bowel alone	2 (4.7)	5 (11.6)		
Large bowel and omentum	6 (14)	7 (16.3)		
CDC class				
1	15 (34.9)	14 (32.6)		
2	24 (55.8)	24 (55.8)	χ^2=0.210	^{MC}P=1.000
3	4 (9.3)	5 (11.6)		
Resection and anastomosis				
No	38 (88.4)	37 (86)	χ^2=0.104	0.747
Resection	5 (11.6)	6 (14)		

χ^2, χ^2 test; CDC, Center for Disease Control and Prevention; FE, Fisher exact; MC, Monte-Carlo; *U*, Mann–Whitney test.
P: *P* value for comparing between the studied groups.
*Statistically significant at *P* value less than or equal to 0.05.

mesh group needed mesh removal because of resistant SSI that was nonresponsive to usual conservative treatment. There were no cases of latent mesh infection on further 12 months of follow-up. On subgroup analysis for the rates of SSI in the cases of incarcerated hernias and strangulated hernias, no significant differences were observed between mesh and suture repairs.

Six (6.97%) patients developed recurrence during the follow-up period, five of them occurred in the suture repair group, and this did not give advantage over the prosthetic mesh group in the statistical analysis (*P*=0.202).

Risk factors for infection of the surgical site

On univariate analysis for the risk factors for SSI (Table 4) in both groups, diabetes mellitus (DM), chronic liver disease, multiple comorbidities, ASA score III, previous recurrence, and intestinal resection were the significant predictors for SSI.

Discussion

Elective prosthetic mesh hernioplasty had been documented as the most-effective and long-lasting management for ventral hernia, as classic suture repair carries the risk of recurrence with significant higher rates, reaching in some series to 67% on their long-term follow-up [8,9]. On the contrary, the controversy of the best way

Table 3 Comparison between the two studied groups according to postoperative complications

Postoperative complications	Mesh (*N*=43) [*n* (%)]	Suture (*N*=43) [*n* (%)]	χ^2	*P*
Surgical site complications (all)				
No	29 (67.4)	38 (88.4)	5.472*	0.019*
Yes	14 (32.6)	5 (11.6)		
Seroma	8 (18.6)	1 (2.3)	6.081*	^{FE}P=0.030*
Infection	5 (11.6)	3 (7)	0.551	^{FE}P=0.713
Hematoma	1 (2.3)	1 (2.3)	0.0	^{FE}P=1.000
Surgical site infection in incarcerated				
No	42 (97.7)	43 (100)	1.012	^{FE}P=1.000
Yes	1 (2.3)	0		
Surgical site infection in strangulated				
No	39 (90.7)	40 (93)	0.156	^{FE}P=1.000
Yes	4 (9.3)	3 (7)		
Recurrence				
No	42 (97.7)	38 (88.4)	2.867	^{FE}P=0.202
Yes	1 (2.3)	5 (11.6)		

χ^2, χ^2 test; FE, Fisher exact.
P: *P* value for comparing between the studied groups.
*Statistically significant at *P* value less than or equal to 0.05.

Table 4 Univariate analysis for factors affecting infection

	Noninfection (*N*=78) [*n* (%)]	Infection (*N*=8) [*n* (%)]	*P*	OR (95% CI)
Age (years)	51.4 ± 12.8	55.8 ± 15.3	0.374	1.025 (0.971–1.083)
Sex				
Male	34 (43.6)	6 (75)	0.110	3.882 (0.737–20.453)
Female	44 (56.4)	2 (25)	0.110	0.258 (0.049–1.357)
DM	18 (23.1)	6 (75)	0.007*	10.0 (1.855–53.911)
Chronic liver disease	7 (9)	3 (37.5)	0.030*	6.086 (1.194–31.011)
More than 1 comorbidities	7 (9)	4 (50)	0.004*	10.143 (2.071–49.668)
ASA III	3 (3.8)	5 (62.5)	<0.001*	41.667 (6.627–261.991)
Recurrent hernia	3 (3.8)	3 (37.5)	0.004*	15.0 (2.386–94.317)
Umbilical	70 (89.7)	7 (87.5)	0.844	0.800 (0.087–7.361)
Incisional midline	3 (3.8)	0	–	–
Strangulated	48 (61.5)	7 (87.5)	0.177	4.375 (0.512–37.348)
CDC class	7 (9)	2 (25)	0.180	3.381 (0.571–20.023)
Resection and anastomosis	8 (10.3)	3 (37.5)	0.043*	5.250 (1.052–26.197)
Mesh group	38 (48.7)	5 (62.5)	0.462	1.754 (0.392–7.852)
Suture group	40 (51.3)	3 (37.5)	0.462	0.570 (0.127–2.551)

ASA, American Society of Anesthesiologists; CDC, Center for Disease Control and Prevention; CI, confidence interval; DM, diabetes mellitus; LL, lower limit; OR, odds ratio; UL, upper limit.
*Statistically significant at *P* value less than or equal to 0.05.

to treat complicated hernias is still standing because of the fact that the operative field is potentially contaminated, which to most surgeons is the guide to refuse the use of synthetic mesh in such circumstances [5].

Biological meshes are a well-known substitute to synthetic mesh now, with a safer profile that solves this problem, but these alternatives are not widely used owing to their higher costs. Therefore, the surgeons face the same dilemma between higher risk for SSI with the use of prosthetic mesh and higher incidence of recurrence without mesh [5].

The WSES [4] recommended the use of prosthetic mesh for the management of incarcerated hernias, but in case of strangulated hernias either with intestinal resection or without, prosthetic mesh can be used with caution or biologic mesh, which is the best option in case of strangulation with bowel perforation.

Both groups in our study had comparable patient demographic data and the same also for hernia characteristics that abolish any potential risk of patient selection bias, except for the age variable, which showed that the suture repair group is significantly younger in age. There was a statistically significant difference between the two groups regarding age, and this reflects that there was no bias in randomization of the patients for both groups. This could have been found in the incidence of recurrence and postoperative complications, which would be higher in the mesh group if we considered the median age of this group (59 years); however, this actually did not happen. Moreover, our study was a randomized clinical trial that avoided bias in patient selection and also evaluated the effect on overall postoperative complications and could be used as a guide for patient selection in application of this technique later on.

Although the use of prosthetic mesh showed a higher incidence of overall SSO, no statistically significant difference between both groups was documented in the incidence of SSI. Of 11 patients who presented with strangulated hernias and underwent resection of gangrenous intestine, three developed SSI, of whom two had mesh repair and the other one had suture repair.

Our univariate analysis concluded that DM, chronic liver disease, multiple comorbidities, ASA score III, previous recurrence, and intestinal resection were the most important predictors for SSI.

The overall incidence of SSI following prosthetic mesh hernioplasty in our series was 11.6% (five patients); four of them had strangulated hernias mostly due to bowel ischemia in the sitting of strangulation that resulted in intestinal flora translocation together with the high risk of intestinal resection, which most probably increased the contamination of the operative field.

A randomized controlled trial [10] found that although prosthetic mesh application showed a higher incidence of SSO, SSI presented in both groups in a comparable manner with significantly higher incidence of recurrence with suture repair. Moreover, other retrospective studies [11,12] showed that no higher risk of SSI after mesh hernioplasty was detected in complicated hernias.

In our study, the rates of SSI was comparable to that shown by Nieuwenhuizen *et al.* [11] and by AbdEllatif *et al.* [13] but much lower than those of Carbonell *et al.* [14], which showed a higher incidence of SSI (14%) after mesh hernioplasty for contaminated ventral hernia.

The series by Carbonell and colleagues reported that infected previous mesh, bowel resection, and stoma creation or reversal were risk factors for SSI after mesh hernioplasty for contaminated ventral hernia. In this study, patients with stoma were excluded as the management of stoma together with hernia repair predisposes to serious morbidities, as reported by the series by Carbonell and colleagues. We see that the application of prosthetic mesh in different tissue planes (e.g. retrorectus mesh) carries promising lower results for the incidence of SSI.

Another controversy is the feasibility of mesh hernioplasty together with bowel resection. We found that three (27%) of 11 patients with intestinal resection developed SSI, where two of them were managed by synthetic mesh repair. So, bowel resection seems to be a significant independent risk factor for SSI, attaining a rate close to that reported by Xourafas *et al.* [7] (22%), mostly due to the high risk of contaminated intestinal content spillage into the surgical field, supporting the WSES guidelines about the cautious use of prosthetic mesh in the setting of such a contaminated field.

Others found that prosthetic mesh employment could be acceptable with intestinal resection like Geisler *et al.* [15], which reported SSO rate of 7%, and Campanelli *et al.* [16], which recommended mesh repair even in potentially contaminated fields. Similarly, other studies [15,17] concluded that intestinal content spillage is not an absolute contraindication to the use of prosthetic mesh.

DM and previous surgery were also significant predictors for SSI in our study. Higher rates of infection after mesh repair of hernia in diabetic patients are known as it affects both the T-cell response and

humoral immunity [18]. Previous surgeries for ventral hernias, especially when prosthetic mesh is used, result in difficult dissection, longer operative time with higher risk of inadvertent bowel injury during adhesiolysis.

Indeed higher rates of recurrence and SSI were recorded with the onlay mesh hernioplasty than those with the sublay technique [19], but actually, we found that the onlay prosthetic mesh placement is technically easier and faster for the surgeon to perform in such an emergency sitting with these complicated hernias, unlike the sublay technique, which is more technically difficult, time consuming, and needs longer experience. Moreover, to us, the removal of onlay prosthetic mesh can be done with easier effort and safe dissection than the removal of sublay mesh if severe SSI occurred that required mesh removal.

The retrorectus placement of the prosthetic polyprolene mesh is advised by many surgeons, who also advised accurate dissection of the preperitoneal space and perfect hemostasis and local antibiotic treatment to get the best results with this technique and avoid possible SSI [19].

The use of biological mesh is now proposed as a safe and efficient approach for hernia repair under contaminated conditions, yet the long-term durability of biologic mesh has not been verified [20]. The COBRA study showed a higher efficacy of prosthetic mesh regarding recurrence in long-term follow-up, with a SSI of around 18% [21].

In our study, six (5.8%) patients had recurrence during the follow-up period, five of them in the suture group. Our results were comparable to similar studies like Emile *et al.* [10], which showed seven (5.7%) patients, all of them in the suture group; AbdEllatif *et al.* [13], which showed recurrence in four (2.4%) patients among 163 patients with strangulated ventral hernias that had mesh hernioplasty; and Venara *et al.* [22], which showed recurrence in 2.4% of 64 patients who underwent mesh hernioplasty for incarcerated hernias.

The limitations of our study were that it was a single institution study and had short-term follow-up for recurrence after repair in both groups, and we hope to continue our follow-up with a larger number of patients and long-term follow-up for a larger next series.

Conclusion

Prosthetic mesh hernioplasty is feasible and safe to be applied in emergency cases presenting with complicated ventral hernia without significantly increasing the rates of SSI and typically achieving the low recurrence rate, which is the main target of tension free repair.

Recommendations

We recommend the application of prosthetic mesh in the sitting of emergency cases presenting with complicated ventral hernias, but larger series with a longer period of follow-up is needed to confirm the low recurrence rate on long-term follow-up.

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Nil.

Conflicts of interest

No conflict of interest.

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