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ORIGINAL ARTICLE

Does onlay mesh placement in emergency laparotomy prevent incisional hernia? A prospective randomized double-blind study

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Abstract

Purpose The objective of this study is to assess the effectiveness and safety of onlay mesh closure of emergency midline laparotomy to prevent incisional hernia.

Methods This is a prospective randomized double-blind study and was carried out in the General Surgery Clinic, Konya City Hospital, from August 1, 2020 to August, 1, 2021. The study included 108 patients who were randomly grouped in 2 groups: patients with conventional abdominal closure and closure using additional onlay mesh (1:1). The follow-up period was for a year. The primary outcome was the incidence of incisional hernia and secondary outcomes were clinical data like complications, hospital length of stay, re-operations.

Results It was observed that incisional hernia was present in 14 patients (27.4%) in conventional abdominal closure group and was in 2 patients using mesh (4%), ($p=0.001$). Clavien–Dindo 3B complications were in rise in conventional closure group ($p=0.02$). Of all complications, burst abdomen was significantly more common in conventional closure group ($p=0.04$). The rate of surgically treated complications were higher in conventional closure group ($p=0.02$). Clavien–Dindo 3A complications were more common in patients with contaminated wound in mesh group ($p=0.02$).

Conclusion The use of mesh while closing the abdomen in emergency midline laparotomy reduces the risk of incisional hernia. Thus, to lower the risks of incisional hernia and its complications, prophylactic mesh can be used in high-risk patients.

Keywords Abdominal hernia · Abdominal wound closure techniques · Emergency · İncisional hernia · Laparotomy

Introduction

The incidence rate of incisional hernia is between 11 and 20% in general population. In some high-risk cases, the rate might go up to 40–69% (abdominal aortic aneurysm, morbid obesity, colorectal surgery) [1–4]. It was also reported that the incidence rate was observed up to 54% in patients with peritonitis [3–5].

The occurrence of incisional hernia during post-operative period is known to cause emergency surgeries like incarceration and strangulation, to have a high part in health care expenditures and to affect life quality of individuals adversely [1, 6–9].

One of the most effective ways to prevent incisional hernia is prophylactic mesh reinforcement. The European Hernia Society's guideline suggests that prophylactic mesh should be considered to prevent incisional hernia in high-risk patients with midline laparotomy [10].

The aim of this study is to compare and assess conventional abdominal closure and mesh closure techniques to prevent and lower the risk of incisional hernia and its complications occurring after emergency midline laparotomy.

Materials and methods

Trial design

This prospective randomized double-blind study was carried out in the General Surgery Department in the University of Health Sciences, Konya City Hospital. The ethics

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committee of Clinical Studies of the University of Health Sciences approved the study (Nr:20-87, Date: 08/09/22) and written informed consent was obtained from the participants. The protocol of the study was in compliance with Consort instructions and the study was registered in ClinicalTrials.gov (NCT04700956) [11]. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Participants and eligibility criteria

The population of the study was included the patients that were operated for an emergency reason from August, 1, 2020 to August, 1, 2021. The risk factors defined by Fischer et.al. were used: male sex, history of laparotomy, age (> 65), malign disease, chronic obstructive lung disease (COPD), hypoalbuminemia (< 3 mg/dl), sepsis, obesity (BMI > 30 kg/sqm), anemia (hemoglobin < 12 g/dl), diabetes mellitus (DM), use of steroids, smoking, chemical therapy (CT), abdominal wall radiotherapy (RT), defect in abdominal wall after a surgical, cardiovascular disorders, chronic renal failure (CRF), (creatinine > 15 mg/dl) [12].

The patients having at least one of the risk factors mentioned above were accepted to be in high-risk group for incisional hernia. The inclusion criteria were: age (over 18), having abdominal midline laparotomy, all surgical emergency indications, having at least two of the risk factors. The exclusion criteria were: age (under 18), elective operations, non-midline incisions, having hernia or diastasis recti at the same time, laparoscopic operations, metastatic cancer, short lifespan expectation (< 2 years), pregnancy, reproductive age group (15–49), having less than two of the risk factors.

Sample size

The sample size was calculated based on the incisional hernia rate. Group sample sizes of 49 and 49 achieve 80% power to detect a difference of 20% between the 2 groups with a significance level of 0.05 using a two-sided Mann–Whitney *U* test. We enrolled 108 patients to cover any patients lost to follow-up.

Randomization

All included 108 patients were assigned into two groups, conventional closure group or mesh closure group, randomly using a computed randomization sequence (1:1). The study was double blind. The surgeon was informed by a medical resident whether or not the mesh would be placement after the fascia closure procedure was completed.

Surgical methods

The following method is used in conventional closure: All patients were closed with an easy-absorbable suture as a linea alba (USP 2-0 PDS Plus II-Ethicon, Somerville, NJ, USA—with a 31 mm needle). Sutures were closed with linea alba, 5 mm aside the fascia and 5 mm between two sutures. Each suture went through the fascia only, fat and muscular tissues were avoided. The length of the suture (SL) was at least four times longer than the total length of the abdominal incision (WL) (4:1). The aim was to reach a 4:1 or a higher SL/WL rate. For the value of SL/WL measurement, all surgical suture leftovers were measured by a sterile ruler and the deducted from the total length of sutures to calculate SL. The length of incision was measured after closing fascia to calculate WL. Afterwards, the subcutaneous tissue was closed with 3/0 polyglactin suture. The skin was closed with staplers (Fig. 1). The patients were administered cefazolin and metronidazole as an antibiotic for prophylaxis. All patients were treated according to their comorbidities (e.g., blood sugar regulation of DM patients, blood pressure regulation of HT patients, etc.)

The following method is used in mesh group: Following the closure of the fascia with the same method, the subcutaneous tissue was dissected up to 5 cm from edge of the fascial defect. The mesh supra-aponeurotic (onlay) was spread up to 5 cm from the fascia and placed in lateral and craniocaudal positions. A mesh 10 cm longer than the length of the incision and 10 cm wide was used. The mesh used was polypropylene, partly absorbable, light and macroporous (Ultrapro, Ethicon, NJ, USA). The mesh was fixed on the abdominal wall using one polypropylene suture at 4 sides (USP 2-0 Prolene, Ethicon). Following this step, the borders of the mesh were fixed to the abdominal wall circumferentially using polypropylene sutures. Drainage catheters with subcutaneous negative pressure were used

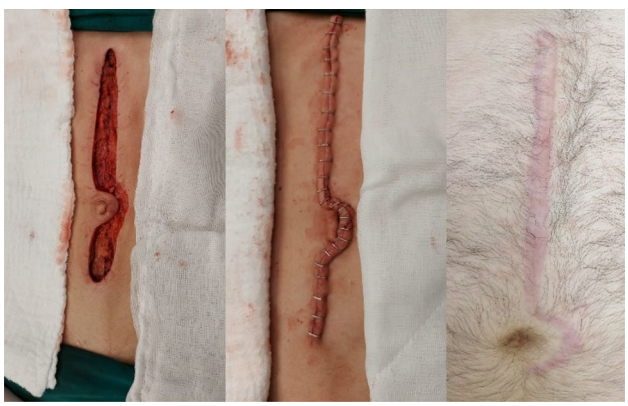


Fig. 1 Surgical technique in the conventional group

on all patients with mesh (Fig. 2). During follow-ups, when the volume drained was 25 cc or less, the catheters were taken out. The patients were administered low-molecular weight heparin, antithrombotic prophylaxis, cefazolin and metronidazole as an antibiotic for prophylaxis. All patients were treated according to their comorbidities (e.g., blood sugar regulation of DM patients, blood pressure regulation of HT patients, etc.)

Outcomes

All clinical data including demographic characteristics such as age, sex, height and body weight along with other diagnoses, comorbidity, the scores of American Society of Anesthesiologists (ASA), risk factors, implemented surgical procedures, duration of surgery, wound classification, the length of incision, hospital length of stay, drainage volume, follow-up period were recorded.

The primary outcome of this study was the incidence of incisional hernia and secondary outcomes were seroma, surgical site infection, hematoma, burst abdomen, pulmonary and cardiac problems along with post-operative complications, duration of surgery, hospital length of stay, chronic pain, life quality measurements (EQ-5D), re-operation requirement, mesh reaction/excision, trunk flexion–extension ranges, the measurement of finger–surface distance and umbilicus–xiphoid distance. All post-operative complications were recorded according to Clavien–Dindo classification.

Follow-up period

The minimum follow-up period was 12 months. Following the discharge, all patients were followed at the end of the first month and then once every three months in the outpatient clinic. All patients were instructed not to lift heavier than 2 kg until 2 months after surgery. They were all also asked to apply to the hospital in case they had complaints. During the follow-ups, all patients listened and examined. During this period, patients who died, re-operated with midline laparotomy (due to another reason apart from the incisional hernia) and lost to follow-up patients were excluded. All follow-up procedures were performed by another surgeon who was not included in this study and had no idea about the randomization and patient groups.

After routine follow-ups, ultrasonography was asked from every patient after 12 months. Computed tomography (CT) was performed for the patients whose diagnosis was hesitant as a result of examination and USG, and the diagnosis was confirmed. During follow-ups, all patients were asked to grade their pain level on a visual analogous scale (VAS) form 0 to 10 and to fulfill life quality scale form (EQ-5D) [16].

Table 1 illustrates all parameters in detail.

Statistical analyses

Following the conduction of Kolmogorov–Smirnov normality test, analyses were carried out. In case we could not provide normality within one group, we were used non-parametric test methods. Then, Mann–Whitney *U* test was used to compare variables between two groups.

To compare categoric variables, chi-square and Fisher exact tests were used. All risk factors and possibilities regarding the analyses were presented in tables with 95% confidence intervals and *p* values.

All comparable results and other characteristics were given in qualitative variable rates and quantitative variables were shown in mean and median values (min–max).

For analyses, SPSS, version 17.0 (SPSS Inc., Chicago, IL, USA), software was used and $p < 0.05$ was accepted to be statistically significant value for the results.

Results

This study was completed with 51 patients in conventional closure group and 50 patients in mesh closure group, with the exclusion of 3 in conventional closure group and 4 in mesh closure group. All patients in both groups were operated due to emergency reasons such as splenic injury, peptic ulcer perforation, ileus, complicated appendicitis, sigmoid

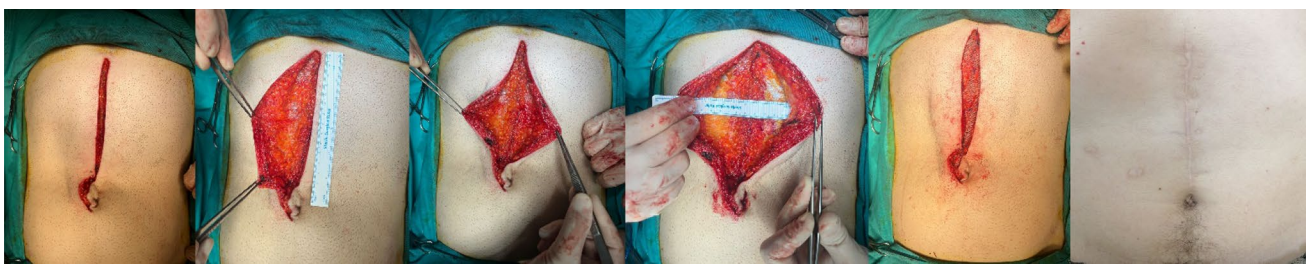


Fig. 2 Surgical technique in the mesh group

Table 1 Parameters and follow-up times

Parameters	Hospitalization	6 h	1 day	1 week	1 month	3 months	6 months	9 months	12 months
Informed consent	✓								
Inclusion/exclusion criteria	✓								
Demographic data (gender, age, weight, height, BMI)	✓								
Medical history/comorbidity	✓								
Physical examination	✓	✓	✓	✓	✓	✓	✓	✓	✓
ASA classification	✓								
Surgical procedure	✓								
Duration of surgery	✓								
Incision length	✓								
Wound classification	✓								
Hospital length of stay	✓								
Postoperative complications	✓	✓	✓	✓					
Drain removal time	✓								
USG									✓
VAS score		✓	✓	✓	✓	✓	✓	✓	✓
EQ-5D scale				✓	✓	✓	✓	✓	✓
Finger–surface distance									✓
Umbilicus–xyphoid distance									✓
Trunk flexion range									✓
Trunk extension range									✓

volvulus, firearm injury, stab wound, diverticulitis perforation, mesenteric ischemia and appendix mucocele.

The flow diagram is shown in Fig. 3. Table 2 shows demographic and clinical characteristics of the patients in the study. The number of ASA 3 patients was higher in conventional closure groups ($p=0.007$). The duration of surgery was longer in mesh closure group ($p=0.004$). The risk factors that the patients in both groups possess are shown in Table 3.

The number of male patients in mesh closure group was higher ($p=0.034$). The number of patients with COPD was higher in conventional closure group ($p=0.01$) and the number of the obese patients in the mesh closure group was higher ($p=0.0025$).

The wound classification of the patients in both group is shown in Table 4.

Complications

The complications and ways of treatments are shown in Table 5.

The complications developed in conventional closure group were: Clavien–Dindo 2 in 6 patients, Clavien–Dindo 3A in 1 patient and Clavien–dindo 3B in 5 patients.

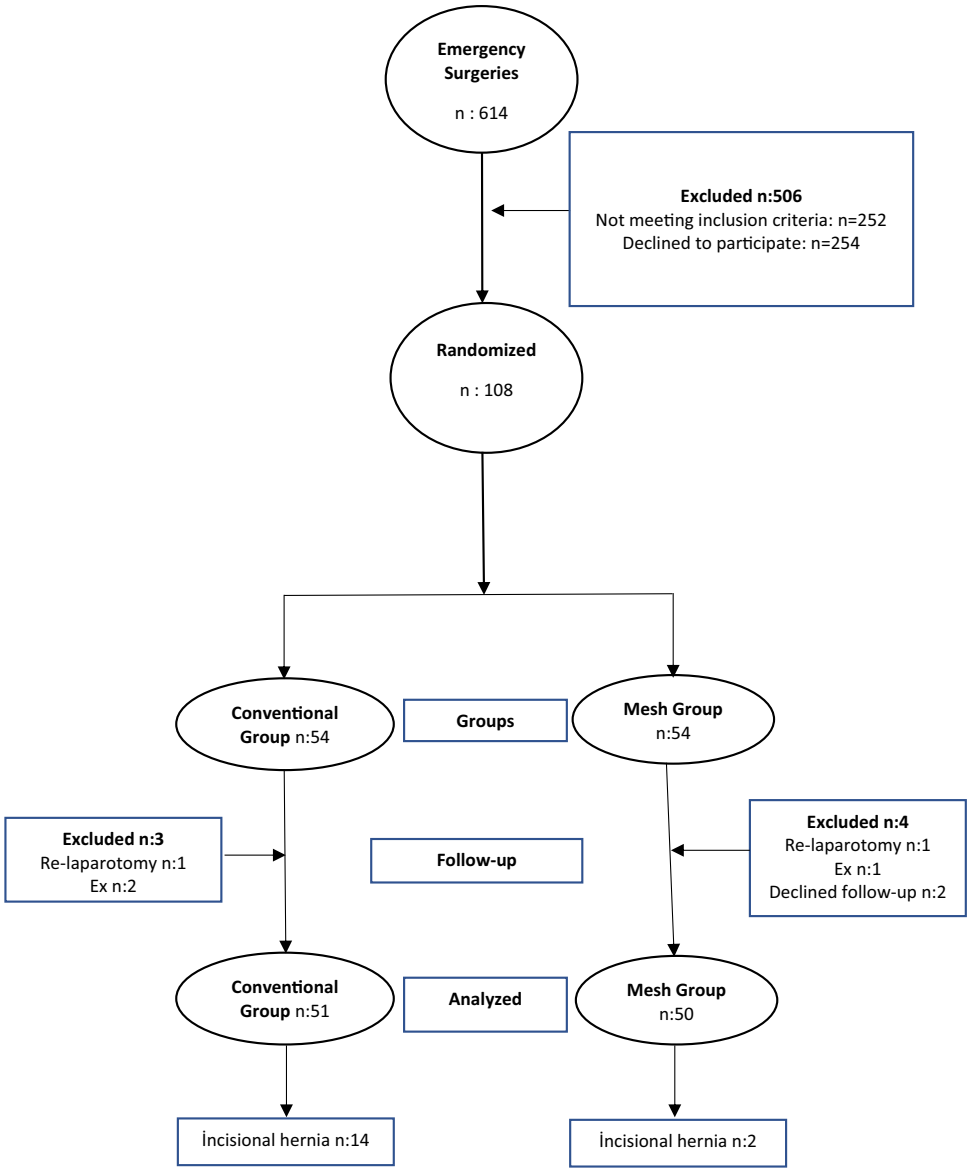
Six patients with superficial wound infection were treated with bedside interventions and medical methods. One patient with deep wound infection was administered percutaneous drainage. The hematoma developed in incision line in 1 patient during post-operation period was drained under general anesthesia. Burst abdomen developed in 4 patients during early post-operation period and the fascia and incision were sutured again under general anesthesia.

The complications developed in mesh closure group were: Clavien–Dindo 2 in 9 patients and Clavien–Dindo 3A in 2 patients. Six of seven patients who developed superficial wound infection were treated with bedside interventions and medical methods. One patient also had pancreas fistula, so negative pressure wound therapy were administered and the treatment was completed successfully (Fig. 4). Diarrhea with no known reason developed in 2 patients after discharge and these patients were medically treated. For 2 patients with deep wound infection, percutaneous drainage was implemented.

Clavien–Dindo 3B complications were higher in conventional closure group ($p=0.02$). Of all complications, burst abdomen was more common in conventional closure group ($p=0.04$). The rate of surgical treatment against the complication was higher in conventional closure group ($p=0.02$).

Depending on wound classification and complications, each group is assessed in Table 8. Clavien–Dindo 3A complications were observed to be more common in the patients with contaminated wounds in the mesh closure group ($p=0.02$).

Fig. 3 Flow chart



Incisional hernia

At the end of the follow-up period of the patients, incisional hernia developed in 14 patients (27.4%) in the conventional closure group and in 2 patients (4%) in the mesh closure group ($p = 0.001$) (Figs. 5, 6).

Scoring and measurements

There is no significant difference in VAS scores of the patients in both groups (Table 6). During all follow-ups, we did not observe any significant difference in EQ-5D life quality scale for both groups (Table 7). At the end of the 12th month, we did not observe any difference between the groups in trunk flexion–extension ranges, the measurement of finger–surface distance and umbilicus–xiphoid distance (Tables 8, 9).

The results of the intention-to-treat analyses were similar to those of the per-protocol analyses (Table 10).

Discussion

From the study results, we observed that during the closure of the abdomen in emergency midline laparotomy, the use of mesh to prevent incisional hernia is a successful method (27.4%, 4%) ($p = 0.001$). Lima et.al. reported in their study that the incidence rate of incisional hernia lowers from 13.5 to 0% [17]. In a meta-analysis on emergency cases, it was stated that the use of mesh reduces the risk of incisional hernia (risk ratio 0.15–95% CI 0.6–0.35, $p < 0.001$)

Table 2 Demographic and clinical data

	Conventional Group (51)	Mesh Group (50)	P Value
Age	57.1 ± 21.3 (18–91)	54.7 ± 19.9 (23– 92)	0.56
Gender (male/female)	25/26	34/16	0.05
BMI	26.7 ± 4.9	27.1 ± 4.4	0.61
ASA score			
1	4	3	0.72
2	20	27	0.14
3	23	10	**0.007**
4	4	10	0.08
Duration of surgery	116.9 ± 34.4	141.5 ± 48.9	**0.004**
Incision length	15.8 ± 1.9	15.9 ± 3.1	0.79
Hospital length of stay	7.7 ± 3.6	7.3 ± 4.8	0.63
Drain removal day	–	3.8 ± 1.4	
Follow-up	13.1 ± 5.6	12.2 ± 2.1	0.35
Seroma	2	4	0.39
BT use	22	2	–
USG use	51	50	–
Incisional hernia	14	2	**0.001**

Data are presented as mean ± standard deviation, median (minimum–maximum), and frequency

Bold values indicate statistically significant P values (p < 0.05)

Table 3 Risk factors

Risk factors	Conventional group (51)	Mesh group (50)	*P* value
Male	24	34	**0.034**
Laparotomy history	9	8	0.83
Over 65 years old	23	17	0.26
Malignant disease	9	5	0.27
COPD	6	0	**0.01**
Hypoalbuminemia	0	2	0.15
Sepsis	4	2	0.42
Obesity	6	15	**0.025**
Anemia	2	3	0.63
DM	13	10	0.51
Steroid use	0	0	1
Smoke	17	22	0.27
KT history	0	0	1
CVS disease	11	12	0.77
CRF	3	0	0.08
History of abdominal RT	0	0	1
Defect in the abdominal wall	1	0	0.32

Data are presented as mean ± standard deviation, median (minimum–maximum), and frequency

Bold values indicate statistically significant P values (p < 0.05)

Table 4 Wound classification

Wound classification	Conventional group (51)	Mesh group (50)	*P* value
Clean	5	12	0.06
Clean-contaminated	30	24	0.28
Contaminated	1	0	0.32
Dirty	15	14	0.88

Data are presented as mean ± standard deviation, median (minimum–maximum), and frequency

[18]. The European Hernia Society suggests to use prophylactic mesh in high-risk patients [19]. Onlay mesh placement as a fascia closure technique is more advantageous than other methods in terms of cost, operation time and ease of application [13–15].

We did not observe any significant increase in complications in the mesh closure group (23.5%, 22%, $p > 0.05$). Occurring complications were treated by medical treatments, simple bedside treatments and with negative pressure wound therapy. Kurmann and Arguda declared that there are no differences in complications occurred in the mesh and conventional closure groups [5, 20]. Lima et.al. stated in their study that the complications in the mesh closure group are prone to be higher in surgical site infection (20.6%, 7.7%, $p = 0.05$), seroma (19%, 5.8%, $p = 0.05$) and late wound recovery (23.8%, 5.8%, $p = 0.008$); however, there exists no significant difference in the morbidity rates after 30 days [17]. Sugrue et. al. reported that in clean-contaminated cases with mesh, the risks of surgical wound infection, wound dehiscence, pneumonia and sepsis are higher [10]. One of the complications "burst abdomen" was higher in conventional closure group in our study (7.8%, 0%, $p = 0.04$). It

Table 5 Complications and management

Complications	Conventional group (51)	Mesh group (50)	*P* value
None	39	39	0.86
Superficial SSI	6	7	0.38
Deep SSI	1	2	0.32
Hematoma, bleeding	1	0	0.32
Burst Abdomen	4	0	**0.04**
Diarrhea	0	2	0.15
Complication (Clavien–Dindo classification)			
1	39	39	0.86
2	6	9	0.38
3A	1	2	0.55
3B	5	0	**0.02**
4	–	–	–
Complication management			
Medical treatment	6	9	0.38
Interventional radiology	1	2	0.25
Surgical treatment	5	0	**0.02**

Data are presented as mean ± standard deviation, median (minimum–maximum), and frequency

Bold values indicate statistically significant P values ($p < 0.05$)

was reported that the incidence of burst abdomen is between 0.4% and 3.5% [21]. Brandsma et. al. reported they found burst abdomen in 2 of 72 patients in mesh closure group (2.7%) [22]. Lima et.al. observed in their study that the incidence of burst abdomen is higher in conventional closure group than mesh closure group (13.5%, 0%, $p = 0.003$) [17].

We did not observe any increase in seroma in mesh closure group (3.9%, 8%, $p = 0.39$). Pereria et. al. reported they found a significant increase in seroma in mesh closure group (9.3%, 21.3%, $p = 0.29$) [23]. However, they also added that this can be solved with conservative methods [7]. El-Khadrawy et. al. found no significant difference in seroma between both groups [24].

It is clear that there exists different concerns regarding laying mesh on a contaminated wound both in literature and practices. In some studies, contaminated wounds are excluded [25], whereas some studies report that a prophylactic mesh can be placed on contaminated and dirty wounds without increasing the rate of surgical site infection [3, 26]. Kurmann et al. reported that prophylactic mesh procedures can be performed even in infected abdomen, with low enterocutaneous fistula and mesh excision rates. [5]. In this study, we found that the number of Clavien–Dindo 3A complications increases of the patients with contaminated wound in mesh closure group ($p = 0.02$). These patients were treated by bedside interventions and drainage procedures without mesh excision.

The issue of which mesh to use is still controversial. There are those who recommend the use of biological meshes in contaminated surgical areas, but the high cost has limited this use. Among the other meshes, polypropylene-based meshes have also been reported to significantly reduce the risk of bacterial infection compared to polyester and polytetrafluoroethylene (PTFE)-based meshes [5]. Argudo et al., in a study conducted with emergency cases, showed that even in the presence of wound infection in patients treated with partially absorbable large-pore synthetic mesh, it can been treated without the need to remove the mesh [20]. In our case with wound infection in mesh group, treatment was successfully provided without remove of the mesh. In our study, we think that polypropylene, partially absorbable, lightweight and macroporous mesh can be used even in emergency cases without causing any major complications.

We did not observe any significant difference in hospital length of stay of both groups in our study (7.7 ± 3.6 to 7.3 ± 4.8, $p = 0.63$). In a meta-analysis published by Hassan, it was reported that the hospital length of stay of the patients with mesh closure is longer [27]. Lima et. al. declared no significant difference (19.7, 17.1, $p = 0.97$) [17].

In our study, the duration of surgery of mesh closure procedure was significantly longer than that of conventional closure procedure (116.9 ± 34.4, 141.5 ± 48.9, $p = 0.004$).

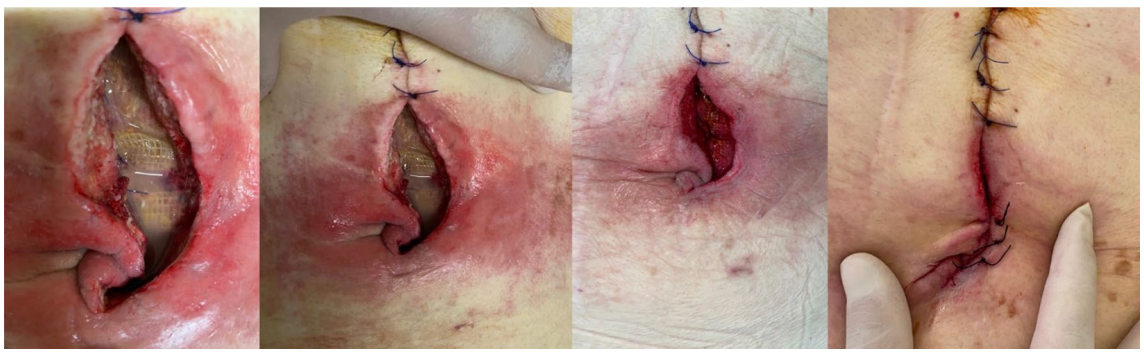


Fig. 4 Images of the patient who developed pancreatic fistula in the mesh group

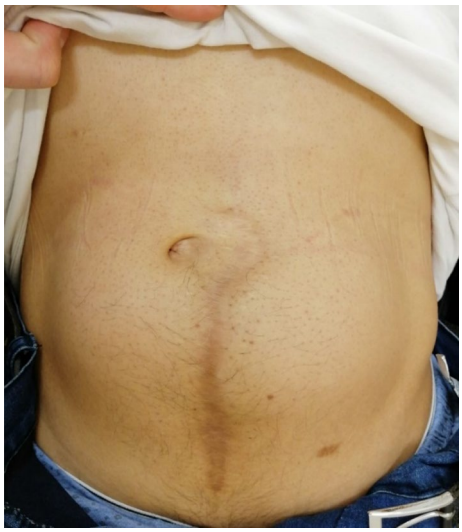


Fig. 5 Patients with incisional hernia in the conventional group

Table 6 Complications in the dirty wound group

Complications	Dirty wound	Other wound groups	Total	*P* value
Mesh group				
Clavien–Dindo 1		11	28	39	0.95
Clavien–Dindo 2		1	8	9	0.22
Clavien–Dindo 3A		2	0	2	**0.02**
Clavien–Dindo 3B		0	0	0	–
Conventional group				
Clavien–Dindo 1		13	26	39	0.27
Clavien–Dindo 2		2	4	6	0.82
Clavien–Dindo 3A		0	1	1	0.52
Clavien–Dindo 3B		0	5	5	0.13

Data are presented as mean ± standard deviation, median (minimum–maximum), and frequency

Bold values indicate statistically significant P values ($p < 0.05$)

Table 7 VAS scores

VAS scores	Conventional group (51)	Mesh group (50)	*P* value
Postop 6th-hour VAS	6.7 ± 1.2	6.2 ± 1.8	0.10
1st-day VAS	4.5 ± 1.4	4.1 ± 1.7	0.15
1st-week VAS	3.1 ± 1.4	2.9 ± 1.1	0.38
1st-month VAS	0.7 ± 0.5	0.9 ± 0.8	0.34
3rd-month VAS	0.05 ± 0.23	0.08 ± 0.27	0.68
6th-month VAS	0.05 ± 0.23	0.08 ± 0.27	0.68
9th-month VAS	0	0	–
12th-month VAS	0	0	–

Data are presented as mean ± standard deviation, median (minimum–maximum), and frequency

Lima et. al. stated that duration of surgery is longer with mesh group (258.8, 309.6, $p = 0.01$) [17]. But Pizza et. al. did not find any significant difference ($p > 0.05$) [25]. Since the surgical procedures implemented are not the same, we consider that differences the duration of surgery and hospital length of stay are understandable in studies regarding. Mesh placement is only one of the reasons that will affect the duration of surgery. Therefore, it might not be true to say that the duration of a surgery gets longer due to mesh placement procedure. Even the reason for a longer surgery is mesh, we are of the opinion that this duration is not important when we compare it to re-operation requirement that may occur in the future.

We did not observe any significant difference in VAS scores during early post-operation follow-ups and other follow-up periods. After 9 months, VAS scores of both groups lowered to 0. In mesh closure groups, few studies point out chronic pain and the rate is from 5% to 7.1%. Kohler et.al. and some other researchers reported that pain is more common in mesh closure groups during post-operative period (6 weeks) [1, 6, 9, 28].

Another question is whether patients might have mobility problems and restrictions in daily activities depending on the mesh. Kohler et.al. stated that trunk extension ranges

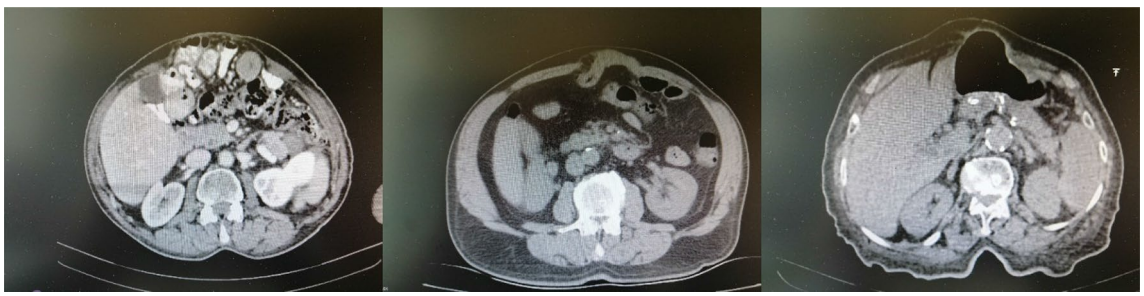


Fig. 6 CT images of patients with incisional hernia in the conventional group

Table 8 EQ-5D measurements

EQ-5D measurements	Conventional group (51)	Mesh group (50)	*P* value
1st-week EQ-5D	0.882 ± 0.16	0.897 ± 0.155	0.64
1st-month EQ-5D	0.882 ± 0.16	0.897 ± 0.155	0.64
3rd-month EQ-5D	0.883 ± 0.165	0.904 ± 0.147	0.49
6th-month EQ-5D	0.884 ± 0.162	0.916 ± 0.13	0.28
9th-month EQ-5D	0.884 ± 0.162	0.916 ± 0.13	0.28
12th-month EQ-5D	0.884 ± 0.162	0.916 ± 0.13	0.28

Data are presented as mean ± standard deviation, median (minimum–maximum), and frequency

Table 9 Trunk ranges and measurements

Measurements	Conventional group (51)	Mesh group (50)	*P* value
Trunk flexion range	94.3 ± 14.1	98.5 ± 14.5	0.14
Trunk extension range	22.35 ± 5.03	22.9 ± 5.9	0.62
Finger–surface distance	7.05 ± 6.15	6.5 ± 8.8	0.74
Umbilicus–xiphoid distance	19.5 ± 3.4	19.5 ± 3.7	0.92

Data are presented as mean ± standard deviation, median (minimum–maximum), and frequency

Table 10 Intention to treat analysis for demographic and clinical features

	Conventional group (54)	Mesh group (54)	*p* Values
Age	56.2 ± 21 (18–91)	54 ± 19.6 (23–92)	0.57
Gender (Male/Female)	26/28	36/18	0.05
BMI	26.7 ± 4.9	27.2 ± 4.4	0.59
ASA Score			
1	5	4	0.73
2	22	30	0.13
3	23	10	**0.007**
4	4	10	0.09
Concomitant disease	21 (38.8%)	24 (44.4%)	0.92
Duration of surgery	115.7 ± 33.9	138.6 ± 48.4	**0.005**
Incision length	15.8 ± 1.9	16 ± 3.1	0.79
Hospital length of stay	7.6 ± 3.6	7.2 ± 4.7	0.63
Postoperative complication	12 (22.2%)	11 (20.4%)	0.72
Clavien–Dindo 3B	–	5 (9.3%)	0.02
Incisional Hernia	14 (25.9%)	2 (3.7%)	**0.001**

Data are presented as mean ± standard deviation, median (minimum–maximum), and frequency (percent)

Bold values indicate statistically significant P values ($p < 0.05$)

lowers due to elongation the umbilicus–xyphoid distance in mesh closure group a year after the surgery; however, they could not find any significant difference 3 years after the surgery [28]. Since our study included emergency cases, these patients were severe pain and these patients had bad overall wellness. Therefore, trunk flexion, extension range, finger–surface distance and umbilicus–xyphoid distance could not be measured in the preoperative period. During postoperative follow-ups, we had measurements with goniometer during the first weeks and at the end of 12 months; however, we did not observe any significant difference. Moreover, when we checked EQ-5D scale, which is commonly used in literature as a life quality scale, no significant difference was observed between the two groups.

The most important limitation of this study is short duration of follow-ups. Another restriction is the heterogeneous range of the cases in our study groups. Many previous prospective randomized clinical studies in literature had similar restrictions [5, 14, 25]. We believe that studies in the future including groups of patients with the same indications and same surgical procedures might yield more reliable results.

As the current data cannot reliably assess mesh use in emergency settings, more randomized studies are required to examine this important clinical problem.

Conclusion

The use of mesh while closing emergency midline laparotomy reduces the risk of incisional hernia. The complications resulting from the use of mesh might be eliminated with bedside interventions or medical treatments. Instead of taking the risk of incisional hernia and its complications, prophylactic mesh can be used with especially high-risk patients. It should keep in mind that the incisional hernia repair is more challenging than closing the fascia with a simple prophylactic mesh.

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Declarations

Conflict of interest Mehmet Esref Ulutas, Alpaslan Sahin, Gürcan Simsek, Nevin Sekmenli, Ahmet Kilinc, Kemal Arslan, Mehmet Ali Eryilmaz and Adil Kartal declare that they have no conflict of interest. The authors declare that they have no conflict of interest.

Ethical approval The ethics committee of Clinical Studies of the University of Health Sciences approved the study (Nr:20-87, Date: 08/09/22). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent to participate Informed consent was collected from all participants included in this study.

Consent for publication Not applicable.

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