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Original Research Article

Prospective study of midline abdominal incisional hernia repair by component separation technique augmented with prosthetic mesh

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ABSTRACT

Background: In our tertiary care hospital, we receive a large number of acute abdomen cases. Raised intra-abdominal pressure (IAP) makes laparostomy mandatory initially and abdominal wall approximation cannot be completed due to compromised state in most cases. Large incisional hernias were seen on complete healing and this study was done to see the feasibility of component separation technique (CST) with mesh augmentation.
Methods: 30 patients were subjected to CST with mesh augmentation. Preoperative defect size mapping, Pre- and post-operative monitoring of IAP were done. Pain scoring by visual analogue scale (VAS), early and late complications was noted. Patients were followed up for 60 months.
Results: CST with mesh augmentation was found to be feasible with 96.77% success rate as no recurrence was noted in follow up. Preoperative average Basal metabolic index was 26.09. Size of defect varied from 17-20×9-16 cm^2 (length X width). Seroma seen in 50% of patients was managed without any intervention. Skin necrosis in 6.6% and wound dehiscence in 3.33%, managed with minimal debridement & local wound care respectively. Respiratory compromise and hematoma were not seen and no patient required any active ICU care. Average length of hospital stay was 5.22 days. Close monitoring of IAP in immediate post-operative period was found to be significant.
Conclusion: Physical acceptance of stable abdominal wall gives a psychological boost to patients with early recovery in form of ambulation and early return to work.

Keywords: IAP, CST, Open ventral hernia repair

INTRODUCTION

Incisional hernia is defined as any abdominal wall gap with or without bulge in the area of post-operative scar, perceptible or palpable by clinical examination or imaging.[1,2] Incisional Hernia is frequent complication of abdominal surgery (11%) that can remain asymptomatic (8-29%)[3] and may result in significant functional impairment as they enlarge, in addition to presenting obvious cosmetic concerns with abdominal bulge that cause pain and complications as incarceration or strangulation.[4] Among these, 80-95% develop within 6 months to 3 years after initial surgery.[3] Initially, only sutures provide support to the approximated facial edges. With time and wound healing, the musculotendinous layers of the abdominal wall recover structural integrity. If the abdominal wall cannot resist IAP, a hernia may form.[5,6] Scar tissue from incisional hernias expressed more soluble (immature) collagen, increased ratios of early wound matrix collagen iso-forms (collagen III), and increased tissue matrix metalloprotease levels and decreased ratio of type I: type III collagen mRNA and protein.[5] Failure of recovery of the abdominal fascia can be influenced by biological and surgical factors.[3,5-7] The objective of abdominal wall reconstruction include restoring structural support, providing stable soft-tissue

coverage, and optimizing aesthetic appearance while minimizing morbidity and postoperative disability.[8-11] Diagnostic tools such as ultrasonography or computed tomography may be useful in diagnosing small and early hernias.[4] Primary repair is rarely successful with a recurrence rate ranging from 18%-62% depending on defect size. The use of a mesh prosthesis to repair incisional hernias has immerged as the most effective approach for reducing recurrence.[12,13] On addition of synthetic mesh the recurrence rate drops from 2%-32%. Although recent reports indicate that 70% to 86% of incisional hernias are repaired with mesh the type of mesh use varies according to surgeon and hospital where the surgery is performed.[14-17] Large abdominal wall defect still could not be approximated without tension. CST could overcome this problem but alone had recurrence of 36%-40%. Hence the proposed study was intended to see the feasibility of repair by CST augmented with prosthetic mesh and to study the early and late complications.

METHODS

Study site

This was a Prospective Study conducted from October, 2011 to March, 2016 in Department of General Surgery, Safdarjung Hospital and Vardhman Mahavir Medical College, New Delhi.

Sample size

30 patients of Midline Abdominal Incisional Hernia regardless of the etiology were included. Sample size calculation was done as per the study "Repair of Giant Midline Abdominal Wall Hernias: Components Separation Technique versus Prosthetic Repair Interim Analysis of a Randomized Controlled Trial" by de Vries Reilingh.[21] For feasibility of the repair by CST and augmentation by mesh prosthesis the operative time along with seroma formation were two primary parameters along with many other parameters.

For quantitative: $n \geq \left(\frac{\sigma(Z_{\alpha/2}+Z_{1-\beta})}{\mu-\mu_0}\right)^2$ σ = 0.05, 95% CI (confidence Interval) B = 0.2, 80% power)

For qualitative: $n \geq p(1-p)\left(\frac{Z_{\alpha/2}+Z_{1-\beta}}{p-p_0}\right)^2$

Hence keeping operative time as primary objective n=126 with, time 113 minutes, SD =112/4

n==26 μ_0-120=28 (n=28)

Seroma, P = 4.8%, $P_0 = 20\ \%$ (n = 16)

So, for operative time validity 28 cases were needed and for seroma validity 16 cases were needed so we kept the sample size of 30 cases.

Sampling technique used was convenience sampling. All the patients who were meeting our inclusion and exclusion and ready to give consent were taken in our study.

Descriptive statistics like mean, median, standard deviation were taken out for quantitative data. For qualitative data, proportions were worked out and stated in the study. Diagrammatic representation is done wherever required along with photographs. Student's t-test is done to compare other studies. P<0.01 considered significant.

Exclusion criteria

Pregnant women, children below 12 years and elderly above 75 years of age, presence of associated groin or other hernias, Patients on steroid therapy, coagulopathies, Patient with associated malignancy, local tissue irradiation were considered under exclusion criteria.

IAP monitoring once preoperatively then after the operation and first post-operative day was done. Hernia repair was performed in the standard fashion by incising the aponeurosis of the external oblique muscle longitudinally about 2 cm laterally of the rectus sheath and dissecting the external oblique muscle until the internal oblique fascia was encountered. This mobilization was augmented with mesh (sublay) with minimal tension using an interrupted figure-of-eight 0 polypropylene suture (Prolene; Ethicon, Inc, Somerville, NJ). Plication of the midline abdominal wall from the xyphoid to the pubis was performed, thereby approximating adjacent fascia over the hernia repair, reinforcing the repair, and improving the contour and tone of the lax abdominal wall using an uninterrupted 2/0 polydioxanone suture (Vicryl, Ethicon, Inc). Suction drains were used routinely. After meticulous hemostasis, layered skin closure was performed with interrupted deep 2/0 polydioxanone suture (Vicryl), dermal 3/0 poliglecaorone 25 (Monocryl, Ethicon, Inc), and uninterrupted cutaneous 3-0 nylon (Ethilon, Ethicon, Inc). If the umbilicus had previously been released from the abdominal wall, it was reattached. Using a Foley Catheter an intravenous infusion set, a 50 ml syringe, a measuring scale and a hemostat, provides a low-cost assessment of the IAP. The connecter of the intravenous infusion set was detached from the infusion tubing and was connected to a syringe filed with 50 ml saline. This was then connected to the main drainage channel of the Foley catheter, and saline was installed into the empty bladder. The connecter was then be clamped using a rubber hemostat. The empty syringe was then removed leaving behind the conductor attached to the Foley catheter. The intravenous set tubing was next be connected to the connector and held vertically above the symphysis. Once the hemostat was released, the saline flows out of the catheter drainage tubing and reaches a height (in cm of saline multiplied by 1.36 for conversion into mm of Hg) corresponding to the IAP.[18]

RESULTS

From October 2011 to March 2016, 30 patients of midline abdominal incisional hernia repaired by CST augmented with mesh. In our study there were 23 females and 7 males and accounts to 77% of female patients. Out of 30 patients 22 patients were operated under General anaesthesia accounting to 73% of patients whereas rest of the 8 patients got operated under Combined Spinal Epidural anaesthesia. 18 out of 30 patients had split thickness skin cover, accounting for 60% of the patients whereas rest of the 12 patients had intact skin cover. Out of 15 patients developing complications 11 had Split thickness skin cover and 4 had Intact skin cover.

The mean age of the patients in our group was 42.9 years and the majority of patients are of 40-60 years age group. In our study the mean BMI of the patients was 26.09 Kg/m^2.

The mean hernia defect size was 215.63cm2. All the patients with split thickness skin cover were of the BMI range group of 25kg/m^2-30kg/m^2 whereas intact skin cover was noticed in patients belonging to all the BMI range groups.

Mean operative time in our study was 170.8 minutes and majority of the patients got operated within the time span of 120 minutes to 210 minutes. In the study it was found that patients in group having a larger defect size had longer operative timing and larger blood loss.

Blood loss and defect size in various size in various groups of patients divided according to BMI

In our study patients with BMI of >30 kg/m^2 had an average blood loss of 451ml and an average defect size of 244.67 cm^2. Patients with BMI between 25 kg/m^2 and 30 kg/m^2 had an average blood loss of 450 ml and an average blood loss of 230.8 cm^2. Patients with BMI between 18.5kg/m^2 and 25 kg/m^2 had an average blood loss of 354.58 ml and an average defect size of 203.93 cm^2. To conclude there was a direct relationship between BMI, blood loss and the defect size.

Out of 30 patients, 15 patients had seroma formation, 2 patients developed skin necrosis, 1 patient had wound dehiscence and none had Hematoma formation. Failure of components separation techniques of defined as the Recurrence of the hernia which could be as a result of either uncontrolled infection involving the mesh and/or increased IAP in early post-operative period. The formations of seromas/hematomas were not included in the failures as those were managed conservatively. When there was collection in the wound, the discharge was sent for culture and sensitivity tests and dressing was changed twice a day. If the discharge was found to be sterile, it was labelled as seroma and if there was purulent discharge and bacterial growth was found on culture, it was termed as wound infection. In the patients with wound discharge, skin sutures were partly removed and a dressing was applied.

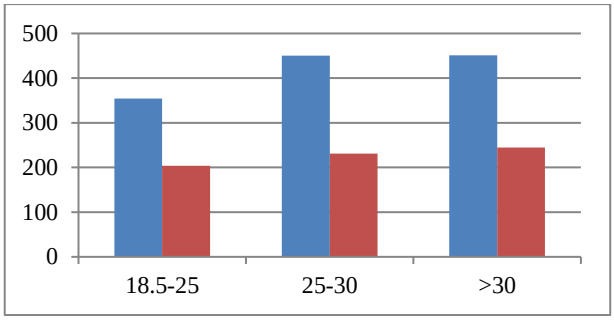

Figure 1: Relation between BMI, blood loss & defect size.
Blue: blood loss, red: defect size.

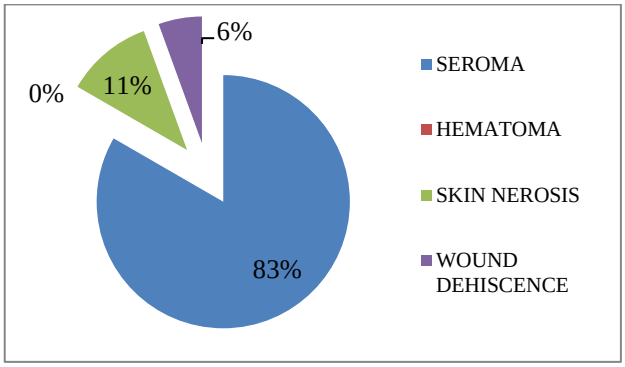

Figure 2: Distribution of early and late complications among patients.

IAP Distribution

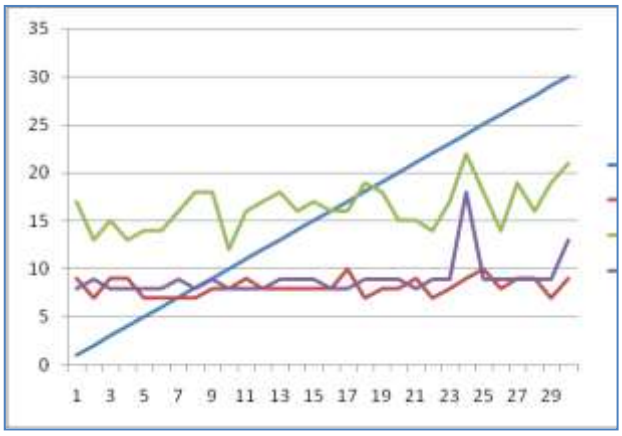

Figure 3: IAP measurements in pre- and post-operative period.
Red: pre-operative IAP, Purple: Immediate post-operative IAP, Green: post-operative day 1

IAP was <20 mm Hg in immediate post-operative period in all except 2 patients (22- and 21-mm Hg respectively) who also responded to conservative management. No other cases of prolonged increased pressure were noted.

Hospital stay

In our study the mean hospital stay was 5.2 days.

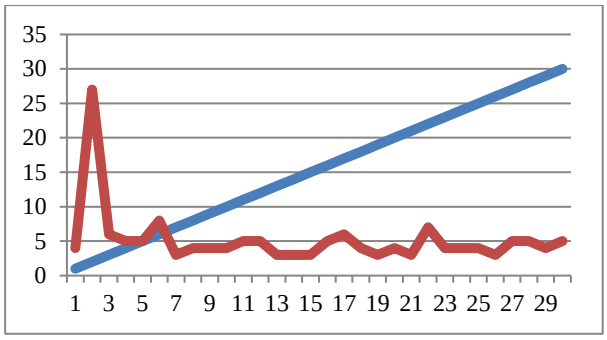

Figure 4: Hospital stay among the patients.

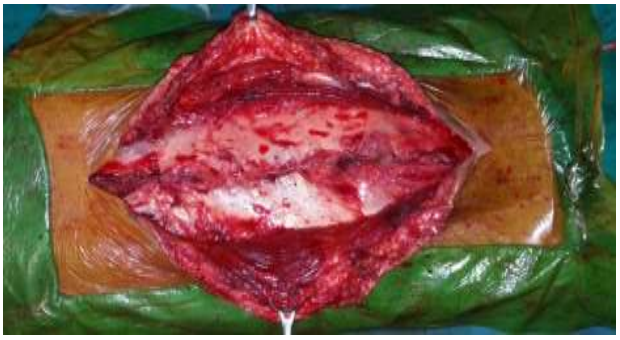

Figure 5: Peritoneum closed.

Figure 6: Release incision over the external oblique 2cm lateral to rectus muscle.

Figure 7: Mesh placement over the peritoneum in retro rectus plane followed by rectus closure.

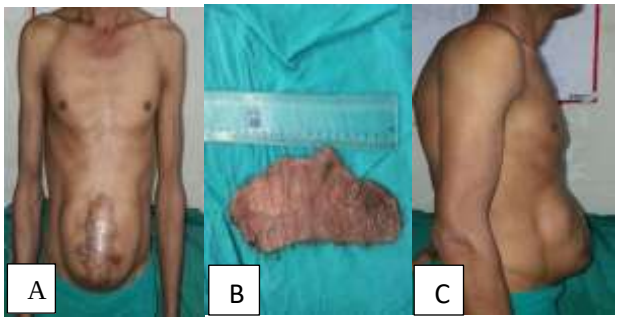

Figure 8: Pre-operative pictures (A) anteroposterior preoperative photograph, (B) skin over the defect, (C) lateral view preoperative.

Figure 9: Pictures of early complications (A) granulation over the wound dehiscence, (B) superficial skin necrosis.

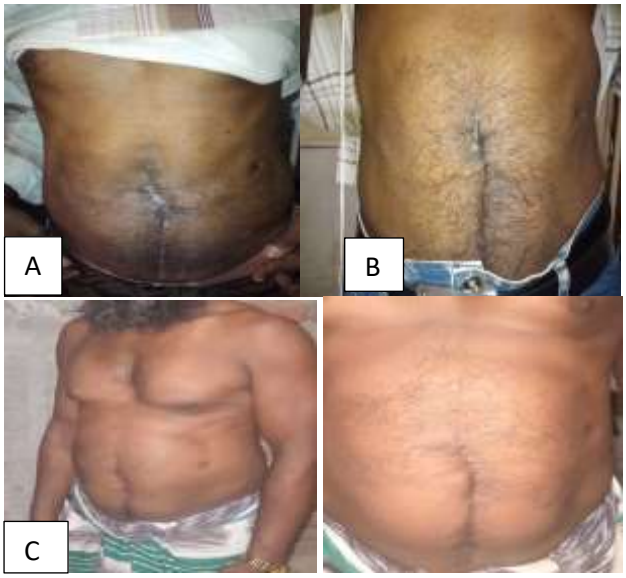

Figure 10: Pictures of the regular follow up (A) at 6 months, (B) at 1 year and (C) at 5 years (sent by the patient via social media).

DISCUSSION

In our study, we used the CST augmented with mesh in repair of midline abdominal incisional hernia. In 2009, Jason et al in their study of 200 patients with incisional hernia repair sub divided them into 3 groups.[19] Repair

only by CST had a recurrence of 33.6% in comparison to repair by component separation augmented with biological mesh with a recurrence of 22.8% and when component separation segmented by polypropylene mesh the recurrence was 0%. This authentication further enforced us to use soft polypropylene mesh augmentation in all cases of incisional hernia repair by component separation technique. In our study all incisional hernias were repaired by CST augmented with light weight mesh (vipro II) with no recurrence. In 2007, Geffen et al in their study reported mesh augmentation CST reduced recurrence rate to 4% and without mesh it was 17% in a follow up period of 37 months.[20] In our series, sublay light weight mesh (Vipro II) was augmented with CST with no recurrence. Reilingh et al published their randomized trial in 2007 done at Department of Surgery, Radbond university, Nijmegen medical center, Netherlands on reconstruction of giant midline abdominal hernias by CST and prosthetic repair in 39 patients who were randomized with 19 patients in CST group and 18 in prosthetic repair (two patients were excluded peri-operatively due to gross contamination).[21] The mean age was 42.9 years in our series while in prosthetic repair group was 58.7 years and CST were 53.9 years but the average range of age of patients was similar in our study and CST study in their series. The gender distribution was 24 females and 6 males in our study group with 4:1: female: male while 1:2 in either group in their study, which may be because of randomization. In our series, there were 30 consecutive cases of midline abdominal incisional hernia included irrespective of the gender keeping the exclusion criteria in mind. The average BMI was 26.09 kg/m^2 in our series was comparable with their average BMIs in prosthetic group and CST groups i.e., 28.7 kg/m^2 and 28.2 kg/m^2 respectively. The average defect size was 240 cm^2 with length in range 17-22 cm and width in range of 9-16 cm in our study group and in their series in prosthetic repair group, the average length in range of 20-30 cm and width in range of 19-30 cm and in CST group, the average length in range of 20-33 cm and width in range of 7-25 cm. Since, they had only taken repair of giant midline hernias and randomized them so the defect size in their series was bigger than ours, where 30 consecutive cases of midline abdominal incisional hernia were taken up. Skin with intact full thickness cover in our study was present in 12 cases only while in their series in prosthetic repair group 14 cases and in CST group 12 cases had full thickness cover respectively. Split skin cover was encountered in 18 cases in our study while in their prosthetic repair group 4 cases and in CST group 7 cases had split skin cover respectively. The average operative time was 170.8 min in our study group while in prosthetic repair group in their study, the average operative time was 183 min and in CST group was 113 min. Since, in our study CST augmented with mesh so that time taken is comparable with prosthetic repair group while CST group with definitely less average operative time with significant p value ($p<0.001$) by student t-test. The average operative blood loss was 422 ml in our study group while in their series in prosthetic repair group it was 420 ml which was comparable with our study. The average blood loss in CST group was 289 ml which is less than our study group but on comparison with either group, the Mann Whitney U-test is not significant. Though in our study group none of our patients had pneumonias, atelectasis or any other pulmonary complications but in their series 2 patients each had pneumonia and atelectasis in prosthetic repair group and a patient had pneumonia and 3 patients had atelectasis in CST group, which was again not significant by student t-test and Fisher exact test in their series. The wound complication of hematoma was not encountered in our study group while 7 and 4 cases of hematoma in their series in prosthetic repair and CST group respectively, though again it was not again significant by Fisher exact test in their series. While seroma was encountered in 15 patients in our study while only 3 patients in prosthetic repair group and 2 patients in CST group respectively had seroma in their series. Skin necrosis was encountered in 2 cases in our study while in their series in 2 cases in prosthetic repair group and 3 cases in CST group which is again comparable in our study group. Excessive dissection in musculocutaneous plane resulting in perforator vessel damage, earlier intra-abdominal catastrophe and tight skin sutures were the causes for skin necrosis by hampering the blood supply of skin. Though no recurrence was noted during the 60 months of follow up in our study but in their series, recurrence noted 11 cases in prosthetic repair group and 10 cases in CST group respectively. The re-operation for wound complication was significantly higher with $p=0.05$ noted in their series with 7 and 2 patients taken in prosthetic repair and CST group respectively. Mesh infection was not encountered in any of the case in our study but in their series 7 patients of mesh infections noted in prosthetic repair group, in these cases mesh was removed and abdominal wall defect was reconstructed with CST repair. Though, recurrence occurred after mean period of 22 months in prosthetic repair group with a range of 6-36 months. In 2004, Jacobus et al at Erasmus University did a prospective study in 181 patients between 1992-1998, their study was compatible with our study of 30 patients.[12] They had divided their groups into incisional hernia repair by mesh and another group where repair was done by only suturing. Though the gender ratio was equal in suture group by randomisation and 1.5: 1:: male: female ratio in other group of meshplasty but our study had four times more females likely because of non-randomisation in our study. Mean age was 42.9 years in our study and 57 years and 63 years in each group respectively which corresponds to the vulnerable population between 40-60 years whereby co-morbid conditions prevail for incisional hernia to occur. BMI (in kg/m^2) of 26.09 in our study group very well corresponds to the meshplasty group BMI 26.2 and 26 in suture group which again precludes morbid obesity as co-morbid condition for incisional hernia formation. Immediate post-operative complication including infection was 6.6%

in our study group accounting for reasonably higher rate as compared to 3.65% in meshplasty group and 8.3% in suture group. CST involves larger dissection with mobilization of musculotendinous layer with increased incidence of seroma formation and technical difficulty in perforator preservation was probably the cause of skin necrosis and infection encountered in two cases of our study group. While comparing the recurrence rate of meshplasty group was 32% and nearly the double in suture group suggest that augmentation by mesh definitely adds to the strength of hernia repair than suture alone. Though, no recurrence was noted in our study. In 2003, Lowe et al in their study of 30 patients of incisional hernia operated by CST augmented with meshplasty.[22] The gender ratio was equal in their series while female outnumbered in our series ratio of 1:4 probably because post gynaecological intervention incisional hernia was seen in 40% of our study group. The mean age was 42.9 years in our study group and 45 years in their which shows both groups were of compatible range of age. The mean BMI in our study group was 26.9 kg/m^2 while it was 33.2 kg/m^2 in their group which again proves that morbid obesity is a co-morbid condition for incisional hernia occurrence. The mean hernial defect in our study group was 215.63 cm^2 while in their series; it was 240 cm^2 which again explains the longer operative time as well as increased BMI further adds to morbid obese population in their series. The hospital stay in our series was average 5.2 days with maximum length of stay of 27 days in one patient where skin necrosis was encountered along with wound dehiscence. The hospital stay in their series was 12.5 days which is related to obesity which increases seroma formation in early post-operative period which is an important detrimental factor for increase in hospital stay and also adds to the morbidity in early post-operative period and increases the cost of the hospital stay. In their study they also noted 10% recurrence rate in follow up period of 9.5 months while we have not reported any case of recurrence in our series in follow up of 60 months. Midline ischemia was 20% and infection rate of 40% noted in their series while in our study only 2 cases of midline ischemia with skin necrosis were noted. Morbid condition prior to hernia repair, increase surface area of hernia repair further adds to ischemia as mobilization of bilateral rectus and perforator preservation is cumbersome. However, ideal surgical handling of tissue can combat these two inter-related complications. This may lead to increase hospital stay and also disrupting the final cosmesis which is believed to be achieved. The wound dehiscence is again co-related to midline ischemia and infection which was reported as 43% in their series while again corresponding to 3.3% in our study which again signifies that midline ischemia is a stage short of wound dehiscence. Midline ischemia and infection if timely controlled with antibiotics and surgical intervention results in reduced rate of wound dehiscence. Proper prior counselling of the patient also goes a long way in preventing wound dehiscence, though it differs from actual recurrence seen late in follow up of patients.

Limitation of the study

The sample size of our study was small, lack of randomization and operation theatre availability were the concerns. In our tertiary care hospital, most of the patients are from lower socioeconomic strata so it has been a hard task to convince them for the secondary surgery and that too on the bread earner of the family. A long follow up though tedious but was done with the sharing of post-operative pictures via social media without having the patients visit the hospital.

CONCLUSION

In our study of 30 patients, of midline abdominal incisional hernia repaired by CST augmented with prosthetic mesh was found to be feasible and better than the routine primary repairs & mesh hernioplasties. Though the procedure required more time than regular repairs but, in the end, stable and durable abdominal wall was achieved with minimal scarring. Higher BMI was found to be associated with increased blood loss & increased operative time and seroma formation. Early complications were encountered and were managed conservatively. Late complications were not seen in any of the cases and no patients required active ICU care. Monitoring of the Pre- and post-operative IAP was found to be significant in deciding the management in emergency settings and at the time of definitive repair to avoid Abdominal compartment syndrome. Shorter hospital stays and early recovery to work made this procedure acceptable in our patients.

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