



**Early outcomes of Emergency ventral hernia repair**

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**Abstract:**

**Background:** Strangulated and obstructed ventral hernias require emergent repair to mitigate the risk of life-threatening complications. When compared to elective ventral hernia surgeries, emergency ventral hernia repairs have a higher rate of surgical complications and recurrence. The goal of this study was to see how patient factors, hernia features, and surgical characteristics affected post-operative outcomes in patients who needed emergency ventral hernia repairs.

**Methods:** Data were collected from a prospectively held database on 43 consecutive patients undergoing emergency ventral hernia repairs between January 2019 and January 2020 at NRI Hospital. Patient, hernia and operative characteristics were collected for analysis and reporting.

**Results:** Of the 43 patients, 14 (34%) developed a surgical complication, of which 9 patients (59%) had surgical site infections. We identified obesity ( $P = 0.017$ ), history of smoking ( $P = 0.008$ ), American Society of Anesthesiologists class of III–IV ( $P = 0.008$ ), hernia defect size  $\geq 3$  cm ( $P = 0.048$ ) and concomitant small

bowel resection ( $P = 0.028$ ) to be associated with post-operative surgical complication. Multivariate analysis identified smoking ( $P = 0.005$ ) and concomitant small bowel resection ( $P = 0.026$ ) as independent predictors for developing surgical complications. Recurrence was seen in four patients (8%) at a median of 220 days. Incisional hernias ( $P = 0.001$ ), recurrent hernias ( $P < 0.001$ ), greater than one defect ( $P < 0.001$ ) and bowel involvement ( $P = 0.049$ ) were associated with higher rates of hernia recurrence.

**Conclusion:** In the emergency repairs, patient factors have a major impact on outcomes. Given that this cannot be changed after surgery, more focus should be made on optimizing the physical and behavioral variables of patients with early symptomatic hernias who are considering an elective repair.

**Keywords:** Hernia, LOS, BMI

**Introduction**

Ventral hernias include both primary (epigastric and umbilical) and incisional hernias, which are caused by a defect in the anterior abdominal wall. <sup>(1)</sup> Hernias account for a considerable percentage of general surgical

admissions, and they contribute significantly to healthcare expenses as well as long-term morbidity and mortality<sup>(2,3)</sup>. Patients with ventral hernias with symptoms of acute incarceration or strangulation in the emergency room require quick diagnosis and correction to avoid life-threatening consequences.<sup>(4)</sup> The kind of hernia repair (suture vs. mesh) and the approach (open vs. laparoscopic) are mostly determined by hernia features as well as patient-related factors.<sup>(5)</sup> The impact of such variables on crucial post-operative outcomes following emergency hernia repair has been thoroughly studied in a number of large-scale investigations.<sup>3,5,6</sup>

Patient variables that contribute to poor outcomes include advanced age, smoking status, immunosuppression, diabetes, and higher American Society of Anesthesiologists (ASA) scores.<sup>3,5,6</sup> Surgical factors including the use of mesh and the laparoscopic method, on the other hand, are frequently linked to better outcomes.<sup>7-10</sup> Suture repairs of incisional hernias should be abandoned totally in favour of mesh repairs, according to a landmark randomised controlled trial by Burger et al., because recurrence rates are much greater in suture repairs in the elective situation.<sup>11</sup> Furthermore, the number of mesh-related problems did not rise. Emergency ventral hernia repairs, on the other hand, are substantially different, casting doubt on the relevance and applicability of findings from elective surgery. A higher frequency of acute complications is linked to patient variables.

The aim of this study is to see how various patient, hernia, and various surgical modalities affect post-operative outcomes such length of stay (LOS), complication rates, and early recurrence rates. NRI Hospital serves a low-income neighbourhood with a high number of obese and comorbid patients. A

retrospective follow-up analysis of consecutive patients undergoing emergency ventral hernia repairs over a one-year period will be used to analyse our outcome data.

### Methods

Patient who underwent an emergency repair of an acutely obstructed or strangulated hernia at NRI Hospital, GUNTUR, between 1 January 2019 and 31 January 2020 were identified for retrospective review. Patients with irreducible hernia but without symptoms of strangulation or obstruction were not considered for emergency repair and processed down the elective surgical procedures. For the purposes of case identification and study inclusion, ventral hernias were defined as all primary umbilical, para-umbilical and epigastric hernias. Incisional hernias were defined as hernias arising from a previous surgical incision sites through the linea alba. Recurrent hernias were defined as a recurrence after a previous hernia repair. Lateral abdominal wall hernias including spigelian and lumbar hernias, groin hernias including inguinal and femoral hernias were excluded. Elective ventral hernia repairs and patients younger than 18 years were excluded to ensure homogeneity.

### Data Collection

Patient, hernia and operative characteristics were collected for reporting and analysis. Patient characteristics included the following: age, sex, body mass index (BMI), ASA classification, smoking history, medication use (anticoagulants and corticosteroids) and other comorbidities (type 2 diabetes mellitus, chronic obstructive pulmonary disease, asthma and concurrent cancers). The following hernia parameters were examined: hernia location (epigastric, umbilical, or incisional), primary versus recurrent hernia, number of defects, largest defect dimension (cm), and contents of the hernia sac. The diameter of defect was measured

from ultrasound. If an ultrasound was not conducted, the greatest diameter of the largest defect was measured from the from the surgeon's operation note. The following operational variables were examined: operation duration, operation time, days to theatre, suture versus mesh closure, and laparoscopic versus open technique.

### Post-operative follow-up

Any post-operative complications (surgical and non-surgical) that occurred within 30 days of the surgery were reviewed in the patient's records. Surgical complications included surgical site infections, small intestinal obstruction, sepsis from a wound infection, and the formation of an abscess or fistula. The Clavien–Dindo classification system was used to categorise all problems. Patients were also followed up on until January 1, 2021, for any clinical recurrences, which were noted via clinic reviews or re-presentations to the emergency department, and confirmed with radiological imaging.

### Statistical analysis

SPSS software was used to analyse the data. For statistical analysis, all continuous variables were grouped into categorical variables based on the median value for that category. The chi-squared test was used to compare categorical data, and the student's t-test was used to evaluate continuous variables. Statistical significance was defined as a P value of less than 0.05. The recurrence-free period was calculated using the Kaplan–Meier method. The logistic regression model was used to examine multivariate analysis of categorical data and its predictive impact on surgical complications. The Cox regression model was used to assess potential independent predictors of recurrence (all variables with a P value of 0.10 were included in the model).

## Results

**Patient characteristics:** Between January 2019 and January 2020, forty-three patients with a complicated ventral hernia underwent emergency surgery. There were 22 men (51.2%) and 21 women (48.8%) in the study population, with a median age of 54.5 years (range 21–93) and a mean BMI of 39.6. (SD 10.8). Twenty-three patients (52.3%) had history of smoking, ten (23.3%) had type 2 diabetes, and sixteen (37.2%) had a history of serious respiratory disease. The ASA classification of the majority of patients (55.8%) was III–IV. Table 1 contains a summary of all additional patient features. Twenty-five patients (59.3%) had umbilical hernias, fifteen had incisional hernias, and two patients had epigastric hernias (4.7 percent). The majority of these were primary hernias (80.2%), with a single defect (82.6%) and a mean dimension of 32 mm (SD 2.1). One patient (2.3%) had an emergent laparoscopic repair; the rest of the procedures were done openly. Twelve patients (67.6%) had sublay mesh, three patients (16.4%) had onlay mesh, and three patients (19.4%) had inlay mesh among the seventeen patients (39.5%) who had mesh repairs. One patient died of respiratory failure within 30 days of the operation.

Table 1: Summary of patient characteristics.

Characteristics	Value (n= 43)
Age in years [mean (SD)]	54.4 (14)
Sex M (%) / F (%)	22(51.2)/21(48.8%)
Obesity (%)	38(82.7%)
Diabetes (%)	10(23.3%)
Smoking history	23(52.3%)
Anticoagulant use	7(16.3%)
Corticosteroid Use	8(19.8%)
Chronic obstructive pulmonary disease (%)	5(11.6%)
Asthma (%)	11(25.6%)

ASA class (%) I-II	19(44.2)
III-IV	24(55.8)
ASA- American Society of Anesthesiologists	

**Post-operative complications**

A total of 16 patients (37.2%) developed post-operative problems. One patient developed exacerbation of bronchitis, while another developed respiratory distress, necessitating post-operative admission to an intensive care unit and eventual death. Within 30 days following their procedure, 14 individuals (33.7 %) suffered a surgical complication. Nine patients (58.6%) developed surgical site infections, two (14.2%) developed bowel obstruction, one patient (6.8%) developed an intra-abdominal collection, one patient (6.8%) developed a wound seroma, one patient (6.8%) developed sepsis secondary to wound infections, and one patient (6.8%) developed a Colo cutaneous fistula (Table 2) for which vacuum assisted dressings done after reduction of fistula, fistulous tract excision and resection and anastomis done. A post-operative drain was required for another patient with a collection.

Table 2 : Surgical Complications.

Complications	Number (percentage)
Surgical site infections	9(58.6)
Small bowel obstruction	2(14.2)
Seroma	1(6.8)
Sepsis	1(6.8)
Intra-abdominal collection	1(6.8)
Colo cutaneous fistula	1(6.8)

Seroma in a patient developed in a patient treated for Obstructed incisional hernia



Figure 1



Figure 2

Marked part – Enterocutaneous fistula

Vaccum assisted dressing for Entero-cutaneous fistula



Figure 3



### Predictors of post-operative surgical complications

Table 3 shows the patient-related and surgical characteristics of individuals who had a surgical complication versus those who did not. Univariate analysis revealed that patients with a BMI greater than 30 (62.1 % versus 35.1 %; P = 0.017), a smoking history (72.4 % versus 42.1 %; P = 0.008), an ASA classification of III–IV (72.4 % versus 42.1 %; P = 0.008), a hernia defect diameter greater than a median of 3 cm (65.5 % versus 42.9 %; P = 0.048), and a need for small bowel resection (13.8% versus 1.8%; P=0.024) were more likely develop surgical complications. Those who had a

LOS greater than the median of three days were more likely to have a surgical complication (75.9% versus 51.8 %; P = 0.026). A history of smoking (odds ratio 6.11; 95 % confidence interval 73–21.67; P = 0.005) and small bowel resection (odds ratio 24.1; 95 % confidence interval 1.46–398.83; P = 0.026) were independent predictors of surgical complications when all clinically relevant factors with a P-value of 0.10 were included in the logistic regression model. Notably, there was no significant difference in surgical complication rates between suture and mesh repair (P = 0.237), nor between the types of mesh repair (P = 0.630).

Table 3: Univariate and multivariate analyses of surgical complications versus no surgical complications.

		Univariate		Multivariate		
	Surgical complications	No surgical complications	P value	Odds ratio	95 % CI	P value
n (%)	14(33.7)	29(66.3)				
Age ≥54.5 years (%)	5 (37.9)	16(54)	0.128			
Obesity (%)	9 (62.1)	10 (35.1)	0.017	2.82	0.82–9.74	0.102
Diabetes (%)	5(34.5)	5(17.5)	0.079	1.30	0.36–4.64	0.687
Smoking history			0.008	6.11	1.73–21.67	0.005
Yes	10 (72.4)	13 (42.1)				
No	4 (27.6)	18 (57.9)				
Corticosteroid use (%)	6 (31.0)	3(14.0)	0.061	1.88	0.51–6.91	0.344
Anticoagulation (%)	2 (17.2)	5(15.8)	0.863			
COPD (%)	2 (13.8)	3(10.5)	0.655			
Asthma (%)	5 (31.0)	6 (22.8)	0.408			
ASA class			0.008	1.88	0.51–6.91	0.344
I-II	4 (24.1)	15 (54.4)				
III-IV	11 (75.9)	13 (45.6)				
Ventral hernia type			0.344			
Umbilical (%)	9 (62.1)	16 (57.9)				
Incisional (%)	5 (37.9)	10 (35.1)				
Epigastric (%)	0 (0)	2(7.0)				

Primary versus recurrent			0.321			
Primary (%)	13 (86.2)	22 (77.2)				
Recurrent (%)	2 (13.8)	7 (22.8)				
Number of defects			0.525			
One defect	13 (86.2)	23 (80.7)				
> One defect	2(13.8)	5 (19.3)				
Defect size $\geq 3$ cm (%)	10 (65.5)	17 (42.9)	0.048	2.90	0.89–9.44	0.076
Small bowel resection (%)	2 (13.8)	1(1.8)	0.024	24.10	1.46–398.83	0.026
Hernia contents			0.820			
Fat/Omentum	7 (48.3)	15(50.9)				
Bowel	7 (51.7)	14 (49.1)				
Mesh versus suture repair (%)	8/9 (48.3)	10/16 (35.1)	0.237			
Procedure within 24 h (%)	8 (58.6)	15 (53.6)	0.598			
LOS $\geq 3$ days (%)	11 (75.9)	15 (51.8)	0.026	1.61	0.46–5.59	0.454
Recurrence (%)	1 (3.7)	3(10.5)	0.246			

**Impact of smoking status on outcomes**

Smokers had a higher prevalence of type 2 diabetes (33.3 % versus 12.2 %; P = 0.020), more fat- and omentum-containing hernias (64.4 % versus 34.1 %; P = 0.005), and a higher surgical complication rate (46.7 % versus 19.5%; P = 0.008), according to a univariate analysis. Smokers exhibited no differences in clinical recurrence rates (4.4 % against 12.2 %; P = 0.189), LOS (4.5 versus 4.6 days; P = 0.745), or mesh use (33.3 % versus 46.3 %; P = 0.218) when compared to non-smokers.

**Impact of BMI on outcomes**

Obese individuals were more likely to have an ASA score of III–IV (65.7 % versus 21.1 %; P = 0.001) and a longer mean LOS (5.1 versus 2.5 days; P = 0.046) when compared to patients with a BMI of 30 or less. Obese patients did not have a higher incidence of surgical complications (35.8% versus 21.1 %; P = 0.186) or clinical hernia recurrence (6.0 % against 15.8 %; P = 0.167) after surgery. Furthermore, there was no

significant difference in the usage of mesh repairs (41.8 % versus 31.6 %; P = 0.422) between these individuals.

**Recurrence-free outcomes**

Four patients (8%) suffered a recurrence after a median follow-up of 220 days (range 95–576 days). After 12 and 24 months, the recurrence rates were 2% and 6%, respectively.

**Predictors of recurrence**

Incisional hernias (100 percent versus 30.3 percent; p=0.001), recurrent hernias (71.4 percent versus 15.2 percent; P 0.001), the presence of more than one defect (28.6 percent versus 12.7 percent; P 0.001), and bowel involvement (85.7 percent versus 46.8%; P = 0.049) were all significantly associated with higher recurrence rates (Table 5) according to univariate analysis. None of these variables were independent predictors of recurrence when factors P 0.10 were included in a Cox regression model. Suture and mesh repair (P = 0.536) and mesh composition (P = 0.321) had no statistically significant

differences in recurrence. Similarly, there were no differences observed in patients who underwent small bowel resection ( $P = 0.318$ ).

### Discussion

Approximately 10% of patients with symptomatic ventral hernias will need an emergency repair to avoid intestinal ischaemia or perforation as a result of incarceration or strangulation.<sup>12</sup> In the case of elective hernia surgery, patient and procedural factors are major variables that influence outcomes, and there is a significant amount of literature outlining these characteristics. However, given to the wide range of surgical pathology that acute hernias include, extrapolation of these findings in an emergency context may be impossible. Furthermore, patients with acute ventral hernias are often comorbid with various medical conditions as well as unmodifiable risk variables that are known to predict both post-operative complications and recurrence in an elective procedure.<sup>13</sup> In the elective situation, laparoscopic surgery has been demonstrated to minimise surgical site infections and post-operative pain. Having said that, laparoscopy may not be used routinely in the acute setting, particularly in complex hernias involving the bowel. We gathered data on a group of patients who had emergency surgery for acute ventral hernias over the course of a year, and the results are the subject of this clinical study.

Obesity, smoking history, ASA class, hernia defect size 3 cm, and undergoing a concomitant small bowel resection were all found to be linked with post-operative surgical problems in the current study. Our findings revealed that smoking history and having a small bowel resection were independent predictors of post-operative surgical complications in a multivariate study using a logistic regression model. BMI, ASA class, open operations, and inpatient status were factors predictive of surgical site

infections in both reducible and incarcerated ventral hernias in a large study of the American College of Surgeons National Surgical Quality Improvement Program database, which included 28,269 patients, 18,263 with reducible ventral hernias and 6909 with acute incarcerated or strangulated ventral hernias.<sup>13</sup> In addition, in patients with reducible ventral hernias, tobacco use and recurrent hernias were associated with higher incidence of surgical site infection. Emile et al. found diabetes mellitus, recurrent hernias, and intestinal resection to be significant predictors of surgical site infection in a group of 122 patients undergoing emergency ventral hernia repair.<sup>14</sup> Patient factors remain a primary determinant of post-operative surgical problems after emergency ventral hernia repair, according to the findings of the previous studies and the findings of our investigation.

It should be noted that our cohort included a high percentage of obese patients (83%) and 56 % were classified as ASA III/IV, which we consider to be poorly optimised. As a result, we preferred an open operation in this poorly optimised population, with the majority of patients getting suture repair. Given the facts available in the current literature, it is timely for our department to reflect on our emergency hernia repair operating strategy. In their experience, Emile et al. evaluated patients who had mesh versus suture repair and found that suture repair was associated with somewhat higher recurrence rates than the mesh group, with no difference in surgical site infection rates<sup>14</sup>. Performing a small intestinal resection concomitantly during emergency ventral hernia repair with an onlay prolene mesh was also proven to be safe, with mesh-related infections occurring in only 1.25 percent of patients.<sup>15</sup> We now know that the pathophysiology and biomechanics of the abdominal

wall, as well as its predisposition for hernia formation, are increased in obese patients, resulting in larger stress on the linea alba and predisposing to ventral hernia formation.<sup>16</sup> Although it may result in a higher rate of recurrence, the rationale for our unit's selection to use an open suture approach rather than a mesh repair was to avoid compromising tissue planes that could damage the abdominal wall if a recurrent hernia was to be repaired later. Long-term mesh-related infections, sinus or enterocutaneous fistula formation, or later small bowel blockage may necessitate mesh explantation, which is now widely recognised as morbid and expensive.<sup>17</sup> We have not embraced the method to standardise the usage of mesh at our hospital since patients in need of emergency hernia repair are not optimal.

When comparing elective to emergency ventral hernia repair, large cohort studies have found that emergency repair had a much greater (up to 15-fold) 30-day mortality, reoperation, and readmission rate than elective surgery.<sup>12</sup> Given the high rate of morbidity and mortality associated with emergency ventral hernia treatment, surgeons must take this issue seriously in order to help patients who have symptomatic hernias but no indications or symptoms of incarceration or strangling. The focus should be on improving the physical condition of these people so that an elective repair can be performed.

### Conclusion

In conclusion, we found a low recurrence rate in the early follow-up period of a poorly optimised population of patients receiving emergency ventral hernia repair and discovered that patient characteristics are linked to surgical complications. We recognise that longer-term follow-up is required to determine the true recurrence rates. Given that these patient characteristics cannot be

changed in the acute condition, more focus should be made on physically optimising individuals with symptomatic hernias (i.e. weight loss) and implementing behavioural changes (i.e. smoking cessation) as a bridge to undertaking an elective repair. Furthermore, knowing the patient's risk profile will aid in predicting the likelihood of developing surgical problems during an emergency repair.

### Key Abbreviations

ASA- American Society of Anesthesiologists

LOS – Length of stay

BMI-Body mass index

SD- Standard deviation

CI- Confidence Interval

COPD- Chronic Obstructive Pulmonary disease

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