

## Predictors for duration of hospital stay after abdominal wall hernia repairs

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### Rezumat

#### **Factori predictorii pentru durata de spitalizare după chirurgia herniilor abdominale**

**Premize:** identificarea variabilelor ce prezic durata de spitalizare separat pentru hernii inghinale, hernii ventrale și hernii incizionale.

**Metodă:** un total de 1170 hernii inghinale, ventrale primare și incizionale (959/132/79) și variabilele lor perioperatorii au fost analizate. A fost utilizat modelul de regresie logistică multivariată pentru determinarea variabilelor independente care prezic durata de spitalizare în fiecare grup de pacienți cu hernii. **Rezultate:** din 1170 operații pentru hernie 959 au fost pentru hernii inghinale, 132 pentru hernii ventrale primare, 79 pentru hernii incizionale. Strangularea ( $p=0,021$ ), clasa ASA III-IV ( $p<0,001$ ), timpul operator mare ( $p<0,001$ ), complicațiile locale postoperatorii ( $p<0,001$ ) au fost asociate cu o lungime mai mare a duratei de spitalizare la herniile inghinale operate; procedura chirurgicală aleasă ( $p=0,028$ ), timpul operator mare ( $p<0,001$ ) și complicațiile sistemice postoperatorii ( $p=0,006$ ) au fost asociate cu o lungime mai mare a duratei de spitalizare la herniile ventrale primare operate; clasa ASA III-IV ( $p=0,027$ ) și timpul operator mare ( $p=0,003$ ) s-au asociat cu o durată mare de spitalizare la herniile incizionale operate.

**Concluzii:** durata spitalizării postoperatorii poate fi prezisă

înainte de operație evaluând anumiți factori dependenți de pacient sau procedură. Timpul operator mare prezice o durată de spitalizare mare pentru toate tipurile de hernii ventrale în timp ce strangularea, clasa ASA mare, complicațiile locale și postoperatorii, și tehnica chirurgicală folosită pot prezice o lungime mai mare a duratei de spitalizare în diferitele tipuri de hernie ventrală.

**Cuvinte cheie:** lungimea duratei de spitalizare, timpul operator, hernia inghinală, hernia primară ventrală, hernia incizională, operație pentru hernie

### Abstract

**Background:** to identify variables those predict length of hospital stay separately after groin, primary ventral and incisional hernias.

**Methods:** A total of 1170 groin, primary ventral, and incisional hernia repairs ( $n=959, 132, 79$  respectively) and their peri-operative variables were analyzed. For each subgroup of hernia type, univariate analysis was performed. Multivariate logistic regression model was used to determine independent variables that predict length of hospital stay in each group of hernia.

**Results:** Out of 1170 repairs; 959 were inguinal, 132 were primary ventral repairs and 79 were incisional hernia repairs. Strangulation ( $p=0.021$ ), ASA III-IV class ( $p<0.001$ ), longer duration of surgery ( $p<0.001$ ), systemic postoperative complications ( $p<0.001$ ), and local postoperative complications ( $p<0.001$ ) were associated with longer length of hospital stay in inguinal hernia repairs; type of repair procedure ( $p=0.028$ ), longer duration of surgery ( $p<0.001$ ), and systemic postoperative complications ( $p=0.006$ ) were associated with longer

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length of hospital stay in ventral primary hernias repairs; ASA III-IV class ( $p=0.027$ ) and longer duration of surgery ( $p=0.003$ ) were associated with longer length of hospital stay in incisional hernia repairs.

**Conclusions:** Postoperative hospital stay can be predicted before the operation by evaluating certain factors related to the patient or procedure. Longer duration of surgery predict longer hospital stay in all types of ventral hernias where as strangulation, high ASA class, systemic-local postoperative complications, and type of repair procedures may predict longer length of hospital stay in different ventral hernia types.

**Abbreviations:** ASA: American Society of Anesthesiologists, LOHS: length of hospital stay, LOP: length of procedure, POC: postoperative complications.

**Key words:** length of hospital stay, operation time, inguinal hernia, primary ventral hernia, incisional hernia, hernia repair

## Introduction

Hernia repairs are the most common elective procedures performed by surgeons. Especially inguinal hernia repairs constitute a great number of procedures in general surgery with significant cost for health care (1,2). Ventral hernias are the second most common abdominal hernias after inguinal hernias (3). Incisional hernia is a common complication of abdominal surgery which occurs in 11 to 23 % of patients after abdominal surgery (4). In general, inguinal and primary hernia repairs have been associated with short length of hospital stay (LOHS), length of procedure (LOP), and lower rates of wound complications and recurrence. However every abdominal wall hernia repair can pose a challenge to the surgeon, with various patient and hernia related factors that potentially affect postoperative outcomes. The aim of this study is to identify the variables that significantly predict LOHS in all types of hernia repair.

## Material and Methods

The records of elective and emergency repairs for preoperative diagnosis of inguinal, primary ventral (umbilical, paraumbilical, epigastric), and incisional hernia between December 2005 and September 2010 in our clinic were retrospectively analyzed. Data analyzed for each patient included age, sex, type of presentation, presence of coexisting systemic diseases, American Society of Anesthesiologists (ASA) class, strangulation, incarceration, type of anesthesia, surgical procedures, drain usage, postoperative complications (POC), LOP, length of stay and mortality.

Data were retrieved from an operating room database, the patients' medical file, the hospital's electronic medical records, and chart review of outpatient visits. Patients with age of 17

or younger were excluded from the study.

The results were analyzed statistically using SPSS 11.5 for Windows program (SPSS, Chicago, Illinois). Univariate analysis was performed using either chi-square or analysis of variance or t-test as appropriate. A multivariate logistic regression model was used to determine independent variables that predict hospital LOHS. P values less than 0.05 were considered as significant.

## Results

During the above mentioned period, a total of 1170 hernia repairs were carried out. Totally 959 of them were inguinal, 132 of them were primary ventral and 79 of them were incisional hernia repairs. Bilateral inguinal hernias were recorded in 58 of 959 (6%) repairs. Demographic, clinic, and surgical characteristics of the patients underwent inguinal, primary ventral and incisional hernia repairs are detailed in *Table 1*. Out of 22 patients who had strangulated inguinal hernias, 2 patients had resection of ileum, 9 patients had omentum resection, 3 patients had resection of the appendix, 2 patients had tuba ovarian resection. There was resection of ileum in one patient, omentum resection in 6 patients out of 9 patients with strangulated primary ventral hernias. There were resections in seventeen (2%) patients with incisional hernias. There were resection of ileum in 1 patient and resection of omentum in 4 patients with strangulated incisional hernias. The number of patients who were discharged on the same day or first postoperative day for inguinal, primary ventral, and incisional hernias were 678 (71%), 84 (64%), and 9(11%) respectively. LOHS was significantly higher for incisional hernia patients with incarcerated hernias. 5-day and longer LOHS in inguinal, primary ventral, and incisional hernia group was 6%, 9%, and 38% respectively.

Variables associated with significantly longer LOHS in univariate analysis for inguinal hernia repairs were age older than 60, recurrent hernia, emergency admission, incarceration, strangulation, coexisting disease, ASA III-IV class, LOP, systemic POC, and local POC. The potential factors for longer LOHS in primary ventral hernias were recurrent hernia, coexisting disease, ASA III-IV class, LOP, and systemic POC. Female gender, ASA III-IV class, type of repair procedure, anesthesia type, LOP, systemic POC, and local POC were associated with longer LOHS in incisional hernia repairs (*Table 2*).

Multivariate regression analyses were performed separately in the three hernia groups. Strangulation, ASA III-IV class, longer duration of surgery, systemic postoperative complications, and local postoperative complications were associated with longer length of hospital stay in inguinal hernia repairs; type of repair procedure, longer duration of surgery, and systemic postoperative complications were associated with longer length of hospital stay in ventral primary hernias repairs; ASA III-IV class and longer duration of surgery were associated with longer length of hospital stay in incisional hernia repairs (*Table 3*).

**Table 1.** Demographic, clinic, and surgical characteristics of inguinal, primary ventral, and incisional hernia repairs

	Inguinal hernia n= 959	Primary ventral hernia n= 132	Incisional ventral hernia n= 79
Age	51±17, range (17-89)	50±13, range (23-83)	56±13, range (35-86)
Gender	Male: 867 (90%)	Male: 59(45%)	Male: 21 (27%)
Type	Direct: 342 (36%) Indirect: 483 (50%) Mixed: 94 (10%) Femoral: 40 (4%)	Umbilical: 90 (68%) Paraumbilical: 24 (18%) Epigastric: 14 (11%) Spiegel: 4 (3%)	— — — —
Recurrent	89 (9%)	10 (8%)	30 (38%)
Type of Repair Procedure	Ant. Mesh: 905 (94%) Plug Mesh: 24 (3%) Bassini: 11 (1%) Other: 19 (2%)	Suture: 77 (58%) On lay Mesh: 52 (39%) Sub lay Mesh: 3 (2%)	Suture: 11 (14%) On lay Mesh: 53 (67%) Sub lay Mesh: 8 (10%) Dual Mesh: 7 (9%)
Strangulation	22 (2%)	9 (7%)	5 (6%)
Incarceration	113 (12%)	103 (78%)	61 (77%)
Drain	69 (7%)	46 (35%)	71 (90%)
Anesthesia	General: 585 (61%) Regional: 281 (29%) Local: 93 (10%)	General: 108(82%) Regional: 3 (2%) Local: 21 (16%)	General: 73 (92%) Regional: 2 (3%) Local: 4 (5%)
ASA Class	I: 507 (53%) II: 347 (36%) III: 101 (11%) IV: 4 (0.4%)	I: 66 (50%) II: 48 (36%) III: 18 (14%) IV: 0 (0%)	I: 26 (33%) II: 38 (48%) III: 15 (19%) IV: 0 (0%)
Emergency	92 (10%)	19 (14%)	8 (10%)
Coexisting Disease	449 (47%)	67 (51%)	55 (70%)
LOP, hour	≤1: 497 (52%) 1-2: 438 (46%) >2: 24 (3%)	≤1: 83 (63%) 1-2: 41 (31%) >2: 8 (6%)	≤1: 11 (14%) 1-2: 43 (54%) >2: 25 (32%)
LOHS, day	<5: 922 (96%) 5-7: 21 (4%) >7: 14(2%)	<5: 120 (91%) 5-7: 8 (6%) >7: 4 (3%)	<5: 49 (62%) 5-7: 24 (30%) >7: 6 (8%)
Systemic POC	Pul+Cardiac: 16 (2%) Urinary retention: 26(3%)	Pul+Cardiac: 3 (2%) Ileus: 3 (2%)	Pul+Cardiac: 4 (3%) Ileus: 4 (5%)
Local POC	Infection: 26 (3%) Hematoma: 10 (10%)	Infection: 6 (5%) Hematoma: 1 (1%)	Infection: 8 (10%) Hematoma: 2 (3%)

LOP: Length of procedure, LOHS: Length of hospital stay, POC: Postoperative complication, Pul: Pulmonary

**Table 2.** Results of univariate analysis

Variable	Inguinal hernia		Primary ventral hernia		Incisional ventral hernia	
	p value	n (%)	p value	n (%)	p value	n (%)
Age, 60y	<0.001	322 (34%)	NS	34 (26%)	NS	28 (35)
Female Gender	NS	867 (90%)	NS	59(45%)	0.008	21 (27%)
Recurrent	0.004	89 (9%)	0.019	10 (8%)	NS	30 (38%)
Emergency	<0.001	92 (10%)	NS	19 (14%)	NS	8 (10%)
Incarceration	<0.001	113 (12%)	NS	103 (78%)	NS	61 (77%)
Strangulation	<0.001	22 (2%)	NS	9 (7%)	NS	5 (6%)
Coexisting Disease	<0.001	449 (47%)	0.006	67 (51%)	NS	55 (70%)
ASA III-IV Class	<0.001	105 (11%)	0.015	18 (14%)	0.043	15 (19%)
Repair Procedure	NS		<0.001		0.012	
Anesthesia	NS		NS		0.044	
LOP	<0.001		<0.001		<0.001	
Systemic POC	<0.001		0.021		0.014	
Local POC	<0.001		NS		0.024	

LOP: Length of procedure, POC: Postoperative complication, NS: Non significant

**Table 3.** The significant predictive factors for length of hospital stay in logistic regression test

Independent Variable	Inguinal hernia	Primary ventral hernia	Incisional ventral hernia
	p value	p value	p value
Strangulation	0.021	NS	NS
ASA III-IV Class	<0.001	NS	0.027
Repair Procedure	NS	0.028	NS
LOP	<0.001	<0.001	NS
Systemic POC	<0.001	0.006	NS
Local POC	<0.001	NS	0.003

LOP: Length of procedure, POC: Postoperative complication, NS: Non significant

## Discussion

Hernia repairs are the most common of all of the operative procedures and the most common elective procedures performed by surgeons. The inguinal hernias are the most, ventral hernias are the second common abdominal hernias (3). Further ventral hernias of the abdominal wall can be classified into incisional and non-incisional (primary) ventral hernias (5). Primary ventral hernias can be further classified depending on their location on the anterior abdominal wall as umbilical, epigastric, and spigelian hernias. Even though elective hernia repairs have favorable outcomes except incisional type, altogether they significantly cost to health care and society. Each hernia type (inguinal, primary ventral or insicional) is a specific entity with different predictors for longer hospital stay and health care costs. Knowing the predictors of longer LOHS can be very helpful for managing the hospital beds. Hernia type specific analysis for factors predicting longer hospital stay such as in the current study provides good targets to be lowered by the surgeons and the health care consultants.

In inguinal hernia repairs, the assessment of LOP and LOHS in literature generally focused on the comparison of laparoscopic and open techniques. In reviews, endoscopic repair is associated with longer operation time, shorter post-operative hospital stay, return to usual activities is faster, and recurrence rates similar to those for open inguinal hernia repair (6-9). The procedure involves greater expenses for hospitals, but appears to be cost effective from a societal perspective (6). By analyzing the open techniques Cochrane Database System Review reported that although the trials showed some heterogeneity there is an indication that mesh repair is associated with faster return to normal activities when compared with other open types (10). This review also provide evidence that the use of mesh in open repair is associated with a substantial reduction in the risk of recurrence of between 50% and 75% which would also probably lower the costs in a long time period (10). In this research of inguinal hernia population tension free open anterior mesh repair was the most preferred procedure as with a ratio of 94%. Associated risk factors of longer LOHS as strangulation, ASA III-IV class, longer LOP, and systemic-local POC in inguinal hernia repairs were specific especially for this type of procedure.

Incisional hernia is a common complication of abdominal surgery and an important source of morbidity with a considerable proportion of incarceration, strangulation, and emergency abdominal surgery requirement which raises health care costs (4). Their repairs have been reported to be two-fold more frequent in female when compared with male patients and higher incidence among female patients may be due to the higher number of laparotomy incisions related to obstetric and gynecologic indications, especially hysterectomy (11-13). This matches with 73% female dominance of this study in incisional hernia repairs. Even though female gender in this study was associated significantly with longer LOHS in univariate analysis in incisional hernias, it was not associated with longer LOHS in multivariate logistic regression analysis.

Incisional hernias tend to be larger, frequently incarcerated, and more complex as compared with primary hernias and associated with greater need for adhesiolysis (14). They are also commonly seen in the elderly population as compared with primary ventral hernias (14). Comorbid diseases with high ASA class scores in this elderly population of incisional hernia and need for lysis may explain prolonged LOP and LOHS. Laparoscopic repair of both incisional and ventral hernia repair has also been reported to be superior to open mesh repair in terms of fewer complications, shorter hospital stay, and decreased recurrences (15-17). In laparoscopic trials it has also been reported that incarcerated hernia, hernia size, repair of incisional ventral hernia, older age, and complex hernia predict longer length of stay after laparoscopic ventral hernia repair (14,18-20). Well matched with this finding, our study also establishes female gender, ASA III-IV class, type of repair, anesthesia type, LOP, and systemic-local POC as variables associated with significantly longer LOHS in open repair on univariate analysis. However only ASA III-IV class and LOP were associated with longer LOHS on multivariate logistic regression analysis.

LOHS was longest in incisional hernia patients whereas type of the hernia was not an independent predictor of longer LOHS. This finding can be explained by the facts that incisional hernias need longer operation time and the patients have more coexisting diseases with more postoperative complications. Logically, incisional ventral hernias are more complex than primary ventral hernias and their hernioplasties will be more complicated. In that respect, Kurani et al.

reported that laparoscopic incisional hernia repair is more complicated and takes longer to perform than the laparoscopic repair of primary ventral hernias (21). Therefore patients stay longer in the hospital after incisional hernias repair as compared with primary ventral hernia patients (21). Consequently matching with it incisional open repairs had also longer LOP and LOHS than the primary types in this study.

As a conclusion of this study; the length of hospital stay can be predicted with different parameters in ventral, inguinal and incisional hernia patients. Strangulation, ASA III-IV class, length of procedure, systemic postoperative and local complications are independent predictors of the length of hospital stay in inguinal hernia repairs. Type of repair procedure, local and systemic postoperative complications predicts length of stay after ventral primary hernias. After incisional hernias ASA III-IV class and length of procedure were associated with longer length of hospital stay. The major shortcomings of the current study are that it is retrospective analysis of prospectively collected data and it is from a single center. Therefore, prospective researches that also analyze the effects of different surgeons and medical centers with high number of patients are needed. However, this study may have important clinical implications in health care planning such as triage of hospital beds, operating room scheduling, cost analysis, health quality evaluation and measurements of performance improvements.

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