## **Original Research Article**

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# Risk factors for 30-day unplanned readmission among patients undergoing laparotomy for perforation peritonitis

Sanjay Marwah\*, Priyanka Singla, Mahavir Singh, Himanshu Sharma

Department of General Surgery, Pt. B.D. Sharma PGIMS Rohtak, Haryana, India

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# \*Correspondence:

Dr. Sanjay Marwah,

E-mail: drsanjay.marwah@gmail.com

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## **ABSTRACT**

**Background:** Unforeseen re-admissions are a consequence of natural course of patient's disease or results from sub-optimal care during first admission. Apart from causing increased expenditure, readmission immensely adds to the distress of the patient as well as his relatives. The aim of the study was to assess the incidence and risk factors for 30-day unplanned readmission following emergency laparotomy for perforation peritonitis.

**Methods:** This prospective observational study was conducted on 145 patients undergoing laparotomy for perforation peritonitis in over a period of two years. Various pre-operative, intra-operative and post-operative parameters were studied to identify the risk factors for readmission.

**Results:** Overall readmission rate was 8.96% and in majority of the cases it was due to post-surgical complications. Various factors found significant for readmission were American Society of Anaesthesiology (ASA) grade (p = 0.014) hypoproteinemia (p < 0.001), diabetes mellitus (p = 0.001), immuno compromised status (p < 0.001), stoma creation (p < 0.001), blood transfusion (p = 0.022), renal complications and UTI (p = 0.027 each). On multivariate analysis, hypoproteinemia and stoma creation were found to be significant.

**Conclusions:** Risk factors for readmission among surgical patients are multi-factorial. Taking appropriate steps can reduce the burden of readmission. Moreover decreasing the rate of surgical readmission represents an opportunity to improve patient care.

Keywords: Perforation peritonitis, Readmissio rate, Unplanned

## **INTRODUCTION**

As indicated by Dietrich and Anderson, readmission is a state in which an individual who is discharged from an applicable hospital to a non-acute setting (e.g., home) and admitted to the same or another hospital within a specified time period (such as 30 days) from the date of discharge. Unforeseen re-admissions may be consequence of a natural course of the patient's disease or may result from sub-optimal care during the first admission. There is a paucity of information on readmission rates among surgical patients. Also the problem of readmission is different among surgical

patients where apart from medical co-morbidities, surgical procedures and their post-operative sequelae are the added risks for readmission.

In addition to the financial implications, a patient's unplanned return to the hospital not only limits hospital resources but also deprives another patient who needs care. It also negatively impacts the patient's quality of life so reducing the number of 30-day readmissions following surgery is important not only for institutions, but also for patients. Decreasing the rate of surgical readmission represents an opportunity to improve patient care.<sup>3</sup>

The current interest in re-admission rates is related to their use as indicators of clinical performance. Poor quality of care has been found to be significantly associated with a higher risk of re-admission in a major meta-analysis which involved a review of 29 appropriate studies. Many studies have found that a significant proportion of re-admissions occur at a cut-off point of about a month (28, 30 or 31 days). Almost all the studies on readmissions till date are retrospective and based on hospital coded database. As pointed out by Adeyemo and Radley in a recent retrospective audit, this kind of record may not be accurate enough for unplanned re-admission data analysis.

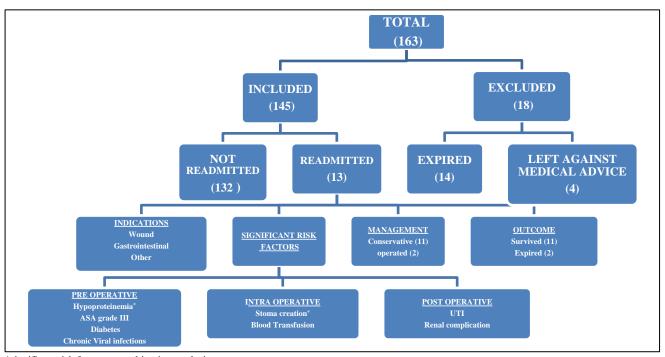
#### **METHODS**

This prospective observational study was conducted on the patients undergoing laparotomy for perforation peritonitis in a tertiary care centre in India over a period of two years (October 2013 to September 2015) after clearance from the institutional ethical committee. Exclusion criteria included patients admitted >30 days planned after surgery, readmissions (e.g. chemotherapy, stoma closure), postoperative requiring complications not hospitalization and postoperative death during index admission.

All the patients undergoing laparotomy for perforation peritonitis were promptly resuscitated after admission. All baseline hematological investigations were performed at the time of admission as shown in Figure 2 along with relevant radiological imaging. After stabilization, all patients underwent emergency laparotomy and the operative procedures were performed as indicated. The duration of surgery, difficulties during operation, requirement of blood transfusion and ionotropic support, if required, were recorded. The post-operative complications, if any, were recorded and were managed on standard guidelines with operative/non-operative means. Duration of hospital stay and outcomes at the time of discharge was recorded. The details of the cases requiring readmission within 30 days of discharge were recorded with specific mention of reasons for readmission. At the end of the study the data was compiled and subjected to statistical analysis. The qualitative data was analyzed using chi-square test and quantitative data by student t-test. A p value of <0.05 was considered as significant. The significant variables were combined in a logistic regression model to predict the significant risk factors for readmission.

#### **RESULTS**

The study included 163 patients presenting in emergency department with a diagnosis of perforation peritonitis. Eighteen of these 163 cases were excluded from the study as per exclusion criteria. Out of remaining 145 patients, 13 (8.96%) cases required readmission within 30 days of their discharge out of which one patient had two readmissions within 30 days. The distribution and outcome of readmitted patients is shown in consort chart (Figure 1).



\*significant risk factors on multivariate analysis.

Figure 1: Consort chart.

Patient demographics like age, gender, body mass index (BMI) had no effect on readmission rate. However, American Society of Anaesthesiology (ASA) grade III or more and patients requiring blood transfusion were found to be at higher risk for readmission (Table 1).

Table 1: Various parameters assessed for readmission.

Parameter

Number (%)

	<b>Parameter</b>	Number (%)	P value	
SS	Age <40 years	86/145 (59.3)	0.674	
ohide	Sex (male)	118/145 (81.3)	0.054	
ıt graj	BMI >24.9	75/145 (51.7)	0.054	
Patient demograph	ASA grade >III	8/145 (5.5)	0.014	
	Hemoglobin <10 gm%	13/145 (8.9)	0.253	
	Blood urea >45 mg/dl	57/145 (39.3)	0.715	
ters	Hyponatremia <135 meq/l	26/145 (17.9)	0.738	
iochemical parameters	Hypokalemia <3 meq/l	23/145 (15.8)	0.769	
1 pg	TLC >11000/cmr	70/145 (48.2)	0.839	
emica	Serum protein <6 gm/dl	18/145 (12.4)	< 0.001	
Bioch	Blood sugar >200 mg/dl	1/145 (0.7)	0.080	
	Chronic lung disease	45/145 (31)	0.983	
	Chronic alcoholic	36/145 (24.8)	0.409	
	Cardiovascular disease	9/145 (6.2)	0.151	
	Pre-existing renal failure	13/145 (8.96)	0.396	
SS	Chronic drug use	4/145 (2.75)	0.524	
biditie	Diabetes mellitus	1/145 (0.68)	0.001	
noi	Malignancy	4/145 (2.75)	0.524	
Pre-op co-morbidities	Chronic viral infections (hiv/hepatitis b/hepatitis c)	3/145 (2.06)	<0.001	
ve	Blood transfusion (yes)	48/145(33.1)	0.022	
Intra operative	Peritonitis (generalized)	114/145 (78.6)	0.581	
Intra (	Operation (stoma creation)	26/145 (17.9)	<0.001	
ive	Pulmonary complications	39/145 (26.9)	0.101	
Post-operative complications	Wound complications	62/145 (43.1)	0.158	
Post-comp	Urinary tract infection(UTI)	11/145 (7.6)	0.027	

	Gastrointestinal complications	24/145 (16.6)	0.507
	Renal complications	11/145 (7.6)	0.027
	Los >7 days	76/145 (52.4)	0.49
	Fever	2/13 (15.3)	
	Pain	2/13 (15.3)	
Reasons for readmission	Pulmonary complications	1/13 (7.6)	
	Wound complications	7/13 (53.8)	
	Gastrointestinal complications	9/13 (69.2)	
	Immuno- compromised status	2/13 (15.3)	

Out of all hematological investigations, only hypoproteinemia was found to be a significant risk factor for readmission (p<0.001) (Figure 2).

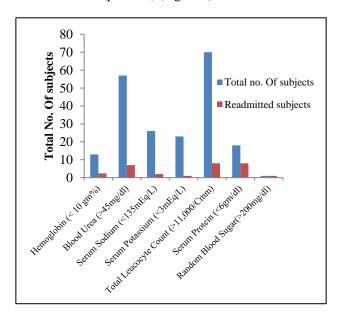


Figure 2: Deranged biochemical parameters as risk factor for readmission.

Patients were also assessed for certain co-morbidities at the time of admission as shown in Figure 3. Out of all co-morbidities, underlying diabetes mellitus and immuno-compromised status due to infections with HIV, hepatitis B or hepatitis C were found to be highly significant factors for readmission (p = 0.001 and p<0.001 respectively).

Out of 145 patients, 114 patients (78.6%) presented with generalized peritonitis out of which 68 had small bowel perforation, 31 had gastro-duodenal perforation and 15 had large bowel perforation. Bowel perforations were managed either by primary repair or resection and anastomosis or stoma formation (ileostomy/colostomy). Of these 114 patients, 11 cases (9.6%) required

readmission. The remaining 31 patients (21.4%) presented with localized peritonitis due to burst appendix that were managed with open appendicectomy with peritoneal lavage. Two out of these 31 cases (6.5%) were readmitted. None of the etiological factor for perforation peritonitis was found to be statistically significant for readmission. However, out of all operative procedures, stoma creation which was done in 26 cases (17.9%) was found to be highly significant factor for readmission (p<0.001).

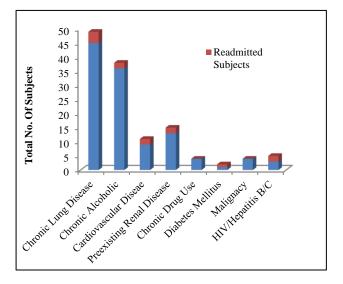


Figure 3: Pre-operative comorbidities as risk factors for readmission.

Table 2: Etiological factors of perforation peritonitis as risk factors for readmission.

Diagnosis	Number	Re- admitted	
Burst appendicitis	31 (21.4%)	2 (6.5%)	
Gastro- duodenal perforation	31 (21.4%)	0 (0.0%)	p value
Small gut perforation	68 (46.9%)	8 (11.8%)	= 0.103
Large gut perforation	15 (10.3%)	3 (20.0%)	
Total	145 (100.0%)	13 (9.0%)	

The patients were monitored for occurrence of various post-operative complications as shown in Table 3. The most common complication was wound infection but it was not found to be significant factor for readmission. Among post-operative complications, UTI and renal complications were significant factors for readmission.

The mean duration of post-operative hospital stay was more in readmitted patients (12 days) in comparison to patients not requiring readmission (10 days), but the difference was not statistically significant (p = 0.490).

Table 3: Post-operative complications as risk factor for readmission.

Post-operative Complications	Number (n = 145)	Readmitted (n = 13)	p value
Pulmonary complications	39 (26.9%)	6 (15.3%)	0.101
Wound complications	62 (43.1%)	8 (12.9%)	0.158
Urinary Tract Infection(UTI)	11 (7.6%)	3 (27.2%)	0.027
Gastrointestinal complications	24 (16.6%)	3 (12.5%)	0.507
Renal complications	11 (7.6%)	3 (27.2%)	0.027

The mean duration of post-operative hospital stay was more in readmitted patients (12 days) in comparison to patients not requiring readmission (10 days), but the difference was not statistically significant (p = 0.490).

Out of total 145 patients, 13 (8.96%) cases required readmission within 30 days of their discharge out of which one patient had two readmissions. Out of 13 readmitted cases, four had uneventful index hospital stay without any complications while nine had pre-discharge complications during index hospitalisation. Out of 13 readmitted patients, 11 (84.6%) cases were managed conservatively and two (15.3%) cases required operative intervention. Two patients out of 11 cases undergoing conservative management expired during readmission.

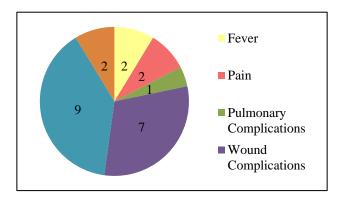


Figure 4: Reasons for readmission.

In the present study the most common reason for readmission was surgery related complications in form of gastrointestinal (69.2%) and wound complications (53.8%). Out of gastrointestinal complications majority of the patients were readmitted due to adhesive intestinal obstruction while others were readmitted due to dyselectrolytemia as a result of high stoma output, diarrhoea and vomiting. Wound complications included burst abdomen, purulent wound discharge, peristomal skin excoriation. Two patients were readmitted with persistent fever and both were immuno-compromised. Only one patient (7.6%) required readmission due to bronchopneumonia (Figure 4).

Table 4: Multivariate analysis of significant risk factors.

Parameter	Odds ratio (OR)	95% Confidence interval (CI)	P value
ASA grade III	1.235	0.116-13.134	0.861
Blood transfusion	2.171	0.316-14.91	0.431
Serum protein	0.011	0.001-0.128	< 0.0001
Procedure (stoma)	14.447	1.405-148.510	0.025
UTI	2.966	0.236-37.290	0.40
Renal complication	0.133	0.006-3.126	0.210

On multivariate analysis of the significant risk factors, preoperative hypoproteinemia (p<0.0001) and stoma creation (p = 0.025) were found to be significant factors

for readmission (Table 4). Although diabetes mellitus and immuno-compromised status due to HIV/HBV/HCV infections were significant factors on univariate analysis, but these could not be subjected to multivariate regression analysis due to small sample size.

#### **DISCUSSION**

Hospital readmissions after abdominal surgery are disruptive for the patients as well as their families and correlate with poor outcomes, including reoperation or death. Readmissions after hospitalization have been a matter of concern for acute medical ailments for many years, but it has not been well studied in the surgical specialities. This is remarkable given the frequency of surgeries being performed, the overall cost of surgical care, and the perceived association between surgical readmission and quality of care.<sup>5</sup>

Table 5: Pre-operative comorbidities as risk factor for readmission.

Type of Surgery	Study (No. of cases)	Chronic lung disease	Chronic alcoholic	Cardiovascular disease	Pre-existing renal disease	Chronic drug use	Diabetes mellitus	Malignancy	HIV/Hepatitis B/ Hepatitis C
Denomin	Grewal et al <sup>8</sup> (124)	>0.05	_	>0.05	_	>0.05	>0.05	_	_
Pancreatic	Ahmad et al <sup>9</sup> (1302)	>0.05	_	>0.05	_	>0.05	>0.05	_	_
	Kelly et al <sup>15</sup> (42609)	< 0.0001	_	< 0.0001	0.01	< 0.0001	< 0.0001	<0.0001	_
Colon	Krell et al <sup>14</sup> (5181)	_	_	_	_	_	0.23	_	_
	Damle et al <sup>16</sup> (70484)	< 0.001	_	<0.01	< 0.01	_	< 0.001	_	_
Cartin	Ahmad et al <sup>10</sup> (418)	0.908	_	0.03	_	_	_	_	_
Gastric	Zhuang et al <sup>11</sup> (376)	0.746	_	0.746	_	_	0.545	_	_
General	Kassin et al <sup>3</sup> (1442)	>0.05	_	0.036	>0.05	>0.05	>0.05	0.015	_
Perforation Peritonitis	Present study (145)	0.983	0.4	0.151	0.396	0.524	0.001	0.524	<0.001

On comparing, most of our findings were in consonance with the previous procedure specific studies. Patient demographics in terms of age, gender and BMI have not been found to affect readmission rates in most of the previous studies. Among various biochemical parameters, hypoproteinemia was found to be a significant risk factor for readmission in the present

study. Though this parameter has not been considered in majority of the studies, some authors have found it to be significant.<sup>11,18</sup> This is probably due to the fact that hypoproteinemia predisposes patients to increased risk of infections because of poor immunity. Moreover, hypoproteinemia leads to poor wound healing thus causing increased risk of anastomotic leak as well as

wound dehiscence. The impact of pre-operative comorbidities on readmission rates has been variable as depicted in the Table 5. There is abundant evidence in the literature to support that co-morbidities such as diabetes, smoking, and immunosuppresion increase the risk of surgical site infections and postoperative pulmonary complications. <sup>19,20</sup> In the present study, only underlying diabetes mellitus and immunocompromised status due to infections with HIV, hepatitis B and hepatitis C were found to be significant factors for readmission.

ASA category of the patients with ASA grade III or more has been shown to be a significant risk factor for readmission in the present as well as most of the previous procedure specific studies. 3,6,11,14,15,17,21-23

This is probably because of associated co-morbidities in such cases which put them at a greater risk of developing postoperative complications and thus increased risk of readmission. Patients requiring blood transfusion during their hospital stay were found to be at a significantly higher risk of readmission in the present study. This is comparable to most of the procedure specific studies in the past. 3,6,8,9,13 It is likely to be due to decreased immunity leading to increased risk of infections following blood transfusion.

Table 6: Reasons for readmission.

Type of surgery	Study (No. of cases)	Readmission rate (%)	Wound complications	Gastrointestinal complications
Pancreatic	Reddy et al <sup>7</sup> (1600)	16	80%	
Colonic	Kariv et al <sup>28</sup> (150)	_	33%	23%
Gastric	Doumouras et al <sup>29</sup> (5007)	6.1	24.6%	_
Ventual hamis manain	Blaitnik et al <sup>30</sup> (420)	12	57%	19%
Ventral hernia repair	Bisgaard et al <sup>31</sup> (3431)	5.3	46%	_
General surgery	Kassin et al <sup>3</sup> (1442)	12.3	27.6%	22.1%
Perforation Peritonitis	Present study (145)	8.9	53.8%	69.2%

Stoma creation has consistently been found to be a risk factor for readmission. The possible reason for this in our set up was lack of proper stoma care because of illiteracy, poor socioeconomic status and non-availability of stoma care nurse. Also dehydration due to high stoma output has been found to be the primary cause of stoma related readmission in many studies, hence early detection and management of dehydration in the outpatient setting could prevent readmissions in such cases. Hanzlik et al have suggested that protocolized peri-operative teaching, such as the "Ileostomy pathway" which has been shown to reduce readmission rates in patients with new ostomies should be adopted in these cases. <sup>16,17,22,24-27</sup>

Of the post-operative complications, renal complications and urinary tract infections (7.6% each), were found to be significant risk factors for readmission and the similar findings were observed by Kassin et al as well.<sup>3</sup> Kelly et al also found that UTI was a significant factor for readmission.<sup>15</sup> Although it is difficult to directly correlate UTI with readmission, but UTI possibly remains a hidden focus of infection in the body leading to delayed activation of sepsis and its related complications requiring readmission.

The common denominator for readmission that appeared in our study as well as previous procedure specific studies was "postoperative complications". Although many causes of readmission were not clearly preventable, many of these patients could still benefit from close follow-up or additional supportive services on discharge to ensure that any developing problems are addressed before they progress to more serious conditions. Hence avoiding early discharge in cases with wound sepsis, regular follow up in outdoor and patient education regarding proper wound care, hydration and proper nutritional intake might help in decreasing readmission rates.

#### **CONCLUSION**

Unplanned 30-day readmission following surgery bears a significant clinical and financial concern and its reported incidence varies from 2.2% to 19% in various procedures specific studies. The unplanned readmission is dependent upon various non-modifiable as well as potentially modifiable factors. In the present study, we found blood hypoproteinemia as potentially transfusion and modifiable factors. Serum proteins can only be improved in elective surgeries, but it is most of the time not feasible in emergency surgeries. The transfusion of blood and blood products should be used judiciously and avoided as far as possible by adopting meticulous surgical techniques. Among various non-modifiable factors, though factors cannot be changed as such but steps can be taken to reduce the readmission related to the particular risk factor like improved stoma management, strict glycemic control in diabetic patient, etc.

The strength of present study is that it was a prospective study and included only emergency cases undergoing laparotomy for perforation peritonitis and moreover, no study of this kind has been conducted in the past. All the studies in past have been procedure specific and majority are retrospective. The major weakness of the present study is its small sample size. Hence it is suggested to conduct a similar study on a larger magnitude so that our findings can be substantiated and definite risk factors can be identified so as to draw the guidelines for decreasing the incidence of unplanned readmission.

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institutional ethics committee

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