Prolonged Hospital Stay is Associated with Increase Surgical Site Infection, Gastrointestinal and Hepatobiliary Surgery. – A propensity Matched Analysis

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Key words: Surgical Site Infections (SSI), Hospital stay, morbidity, mortality, HPB surgery.

Abstract:

Aims :

Primary AIM of the study was to evaluate effect of prolonged hospital stay on Surgical site infections

We also evaluated effect of prolonged hospital stay on overall morbidity in Gastrointestinal and Hepatobiliary Surgery as secondary outcome.

Methods:

We retrospectively analysed all the patients who underwent gastrointestinal and hepatobiliary surgery between April 2017 to March 2020. On our analysis we found mean hospital stay in patient who did not develop SSI and/or morbidity was 4 days (Total hospital stay) vs 6 days who developed morbidity (hospital stay before

diagnosis of SSI or diagnosis or morbid event). Based on this to avoid selection bias, we did 1:1 propensity score analysis between patients who had 4 or less than hospital stay vs patients who had 5 or more hospital stay before diagnosis of surgical site infection and/or morbid event. We took all the preoperative and intraoperative factors like Age, sex, malignant disease, ASA score, CDC grade of surgery, open or laparoscopic surgery, HPB surgeries, colorectal surgeries, Upper Gastrointestinal surgeries and small intestinal surgeries as covariates. We used nearest neighbor matching protocol with a calipher of 0.2. Cases were not reusable after matching. Statistical analysis was done using SPSS version 23.

Results:

We included 348 patients operated between April 2017 and March 2020 in our analysis. After 1:1 propensity score matching 58 patients included in study arm (prevent hospital stay more than 4 days) and 56 patients in control arm. Both groups were comparable with regard to Age, Sex, Surgery for malignant disease, ASA score, CDC grade of surgery, HPB surgeries, Small intestinal surgeries, Colorectal surgeries, upper gastrointestinal surgeries, intraoperative blood product requirement, intraoperative hypotension or any other event, operative time. Prolonged hospital stay (> 4 days) was significantly associated with surgical site infections (p<0.0001), morbidity (p=0.001). Open surgeries were associated with prolonged hospital stay. (p=0.032).

Conclusion:

Prolonged Hospital stay is associated with increase surgical site infection and morbidity in Gastrointestinal and Hepatobiliary Surgery.

Introduction:

Global estimates suggest that at least 7 million people suffer complications

following surgery each year, including at least 1 million deaths, a magnitude that exceeds both maternal and AIDS-related mortality. As many as 50 percent of these deaths and complications are preventable. [1] These estimated deaths are more than projected global deaths due to HIV/AIDS by 2030 which is estimated to about 6.5 million.[2]

Prolong hospital stay is associated with increased morbidity and mortality in many diseases. [3] However very few studies examined effect of prolonged hospital stay on actual morbidity and mortality. Postoperative hospital stay also found to be associated with surgical site infections. [4]. However, there is very limited data of association of length of hospital stay before diagnosis of morbid event/surgical site infection or occurrence of mortality.

Aim of Study:

Primary aim of the study was to evaluate effect of prolonged hospital stay on Surgical site infections

We also evaluated effect of prolonged hospital stay morbidity and mortality in Gastrointestinal and Hepatobiliary Surgery as secondary outcome.

Material and Methods:

Study Design:

All gastrointestinal and hepatobiliary procedures performed in last 3 years have been evaluated retrospectively. It is very well known and logical that after complications or wound infection has happened subsequent hospital stay increases for managing those complications. To know cause effect relationship, we considered hospital stay as hospital stay before diagnosis of complications, surgical

site infections or any morbidity or in case of sudden deaths hospital stay before mortality in the study group. For control group consisting of patients with uneventful recovery total hospital stay was considered as hospital stay. To evaluate cutoff for hospital stay we evaluated ROC curves for 90 days morbidity and surgical site infections.

Surgical site infections were defined as any culture positive discharge from the wound either superficial or deep within 30 days post operatively. [5]

Statistical analysis:

We used ROC curve analysis with coordinates for each factor to select optimal hospital stay beyond which it was associated with SSI, morbidity and mortality and we found that hospital stay beyond 4 days was associated with SSI, morbidity and 30 days mortality with highest sensitivity and specificity.

To avoid selection bias in attempt to evaluate effect of prolonged hospital stay less than or greater than 4 days on surgical Site infections we did 1:1 propensity score matching analysis with surgical site infections as dependent factor. Propensity scores were calculated using logistic regression.

Pre-operative confounding factors like age, sex, American society of Anesthesia score (ASA), emergency surgery, type of surgeries like HPB surgeries, Upper gastrointestinal surgeries, small bowel surgeries, colorectal surgeries, hernia surgeries, open or laparoscopic surgeries were entered in model as covariates. We used nearest neighbor matching protocol with a caliper of 0.2. Cases were not reusable after matching. [Austin et al. 2009]

Categorical variables were analyzed using chi square test or fisher exact test as per the requirement. Continuous variables were analyzed using Mann Whitney U test for nonparametric data and student t test for parametric data, after checking for

skewness and standard error of skewness and also kurtosis and standard error of kurtosis. Medians were used for nonparametric data. Two-sided p value less than 0.05 was considered as significant. Statistical analysis was done using SPSS version 23.

RESULTS:

We included 348 patients operated between April 2017 and March 2020 in our analysis. After 1:1 propensity score matching 58 patients included in study arm (prevent hospital stay more than 4 days) and 56 patients in control arm.

Both groups were comparable with regard to Age, Sex, Surgery for malignant disease, ASA score, CDC grade of surgery, HPB surgeries, Small intestinal surgeries, Colorectal surgeries, upper gastrointestinal surgeries, intraoperative blood product requirement, intraoperative hypotension or any other event, operative time. [Table 1]

Prolonged hospital stays (> 4 days) was significantly associated with surgical site infections (p<0.0001), morbidity (p=0.001). Mortality was more common in patient who had hospital stay less than 4 day Open surgeries were associated with prolonged hospital stay. (p=0.032). [Table 1]

Kaplan Meier Analysis:

We also performed Kaplan Meier survival analysis of surgical site infections (SSI) 90 days morbidity free survival, and mortality.

Surgical site infection free survival was significantly higher in patient with hospital stay less than or equal to 4 days. (p=0.001).

90 days morbidity was significantly higher in prolonged hospital stay group. (p=0.012).

90 days mortality was higher in hospital stay less than 4. This finding was due to

majority of immediate postoperative deaths suggested by median hospital stay in patient who died was 2 days vs 5 days in group with no post-operative mortality. [Figure 1]

Discussion:

Prolonged Hospital stay has been shown to be associated with perioperative morbidity and mortality in various surgical disciplines. [6,7]. However very few studies evaluated increase hospital stay before diagnosis of surgical site infection, morbidity or occurrence of mortality as a causative factor for increase surgical site infection or morbidity.

Surgical science has progressed to a great extent in last century. Despite such a great progress Surgical site infection remains a major challenge and its incidence rates still remains high due to prevalence of wide range of protocols and practices. [8].

Causes of Surgical site infection can be multifactorial and include variety of patient related, hospital related and procedural related factors and it includes use of variety of protocols and procedures to prevent them. [9]

Mortality and morbidity are also related to various perioperative factors like ASA score, intraoperative blood product use, intra operative hypotension and pre-operative patients' physiology also contribute to morbidity and mortality.

So, to avoid selection bias and various confounding factors we did propensity score matching analysis with various pre-operative and intraoperative factors as mentioned in study design as cofactors.

After 1:1 propensity score matching we found that increase post-operative hospital stay was associated with increase rate of surgical site infections and 90-day morbidities.

We decided 4th day as a cutoff based on ROC curve analysis for each factor like

SSI, Morbidity and Mortality. [Figure 3]. All showed cutoff of 3.5-4.5 days showing maximum sensitivity and specificity based on that we decided to take 4 days as optimum cutoff.

In our analysis mortality was significantly higher in patients whose hospital stay was lesser than 4 days. This was due to most of the mortalities were in emergency and sicker patients who died in immediate post-operative period. Williams et al. also did not find any association between hospital stay and mortality. [11]

There are studies about effect of night times and weekend admission on morbidity and mortality. [12,13]. However, we could not find effect of prolonged hospital stay on over all morbidity and mortality.

Mujagic et al [14] showed that increase hospital stay was associated with increase rate of surgical site infections, similar to our findings.

Our studies have certain limitation like low numbers of patients, also SSI, morbidity and mortalities depend on many factors which might have been missed in our analysis.

In conclusion, prolonged hospital stay is associated with increased 90 day morbidity and surgical site infection rates. However, further studies are needed to confirm these findings.

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FACTOR	Hospital stay more than 4 days (N=58)	Hospital stay less than 4 days (N=56)	P VALUE
Age (median/range)	55(28-79)	54 (13-79)	0.630
SEX (FEMALE/MALE)	(28/30)	(27/28)	0.994
ASA (N)	ASA 1=0 ASA 2= 8 ASA 3= 34 ASA 4= 35	ASA1= 0 ASA2= 20 ASA 3= 17 ASA 4= 19	0.353
Intraoperative hypotension (N)	11	10	1.0
Open Surgery (N)	**56**	**49**	**0.032**
90 days Mortality	**9**	**19**	**0.029**
COLORECTAL SURGERY (N)	9	3	0.123
SMALL BOWEL SURGERY (N)	16	19	0.544
UPPER GI SURGERY	10	12	0.639

(STOMACH/ESOPHAGUS)(N)			
EMMERGENCY SURGERY(N)	18	25	1.0
MALIGNANT DISEASE(N)	22	13	0.106
HPB SURGERY(N)	23	22	1
BLOOD PRODUCT (MEDIAN/RANGE)	2(0-40)	2 (0-40)	793
OPERATIVE TIME (MINTUTES)(MEDIAN/RANGE)	180(60-800)	180 (60-800)	0.552
CDC grade of surgery	3 (2-4)	3 (2-4)	0.951
90 days morbidity	**21**	**5**	**0.001**
Surgical Site Infection (SSI)	**16**	**0**	**0.001**

Table 1: Comparisons between hospital stay less than 4 vs more than 4.

Overall Comparisons

	Chi-Square	df	Sig.
Log Rank (Mantel-Cox)	11.605	1	.001

Test of equality of survival distributions for the different levels of hospitaleven.
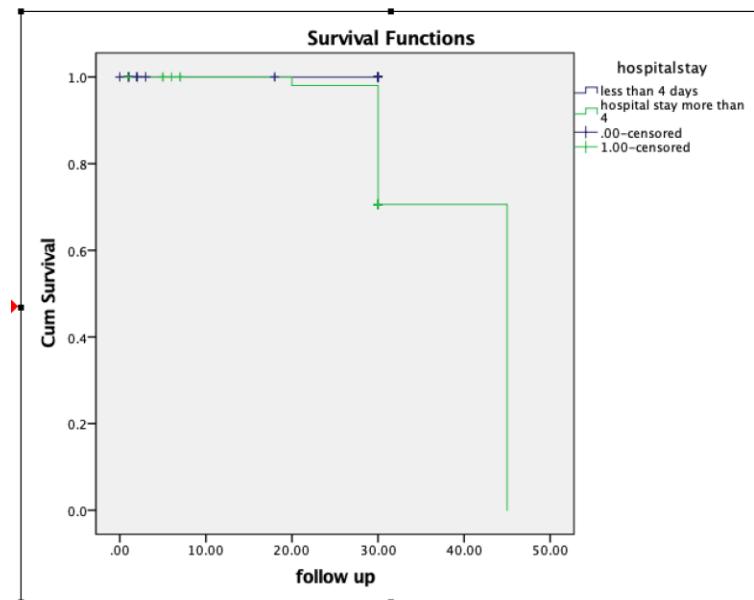
Figure 1. SSI free survival was significantly higher in patient with hospital stay less than or equal to 4 days. (p=0.001)

Overall Comparisons

	Chi–Square	df	Sig.
Log Rank (Mantel–Cox)	6.290	1	.012

Test of equality of survival distributions for the different levels of hospitaleven.
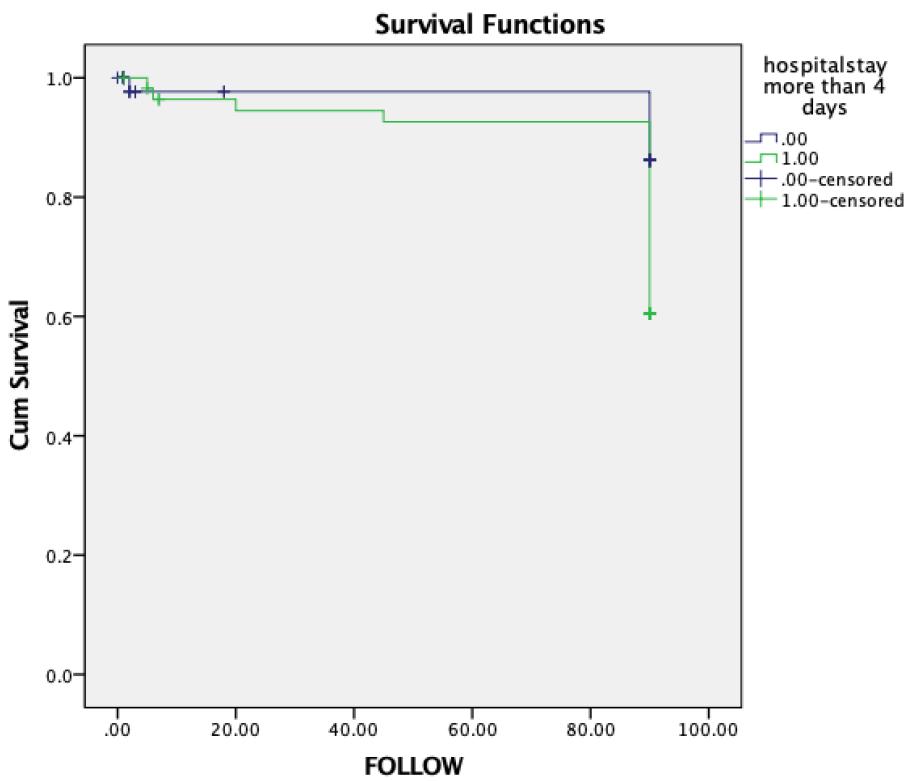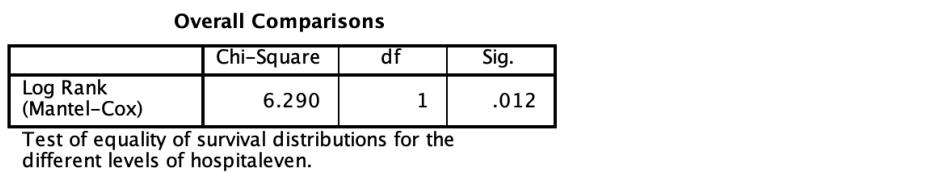
Figure 2: 90 days morbidity analysis between normal vs prolonged hospital stay. (p=0.012).

Overall Comparisons

	Chi–Square	df	Sig.
Log Rank (Mantel–Cox)	7.662	1	.006

Test of equality of survival distributions for the different levels of hospitaleven.
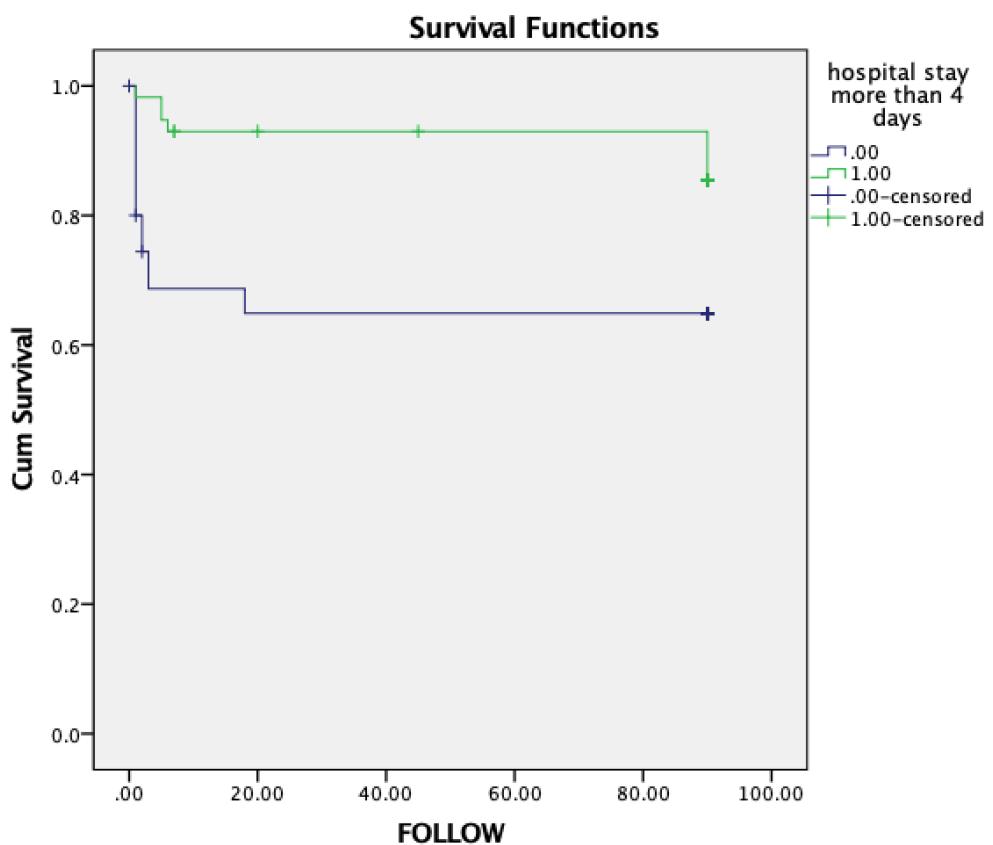

Figure 3: Mortality rates were higher in patients with less hospital stay. (p=0.006)