# Nonsurgical procedure related postoperative Complications predicts 30 days perioperative mortality, in abdominal surgeries. A Propensity score matched analysis.

Dr. Bhavin B. Vasavada,

Consultant Hepatobiliary and Liver Transplant Surgeon,

Shalby Hospitals,

Ahmedabad- 380054.

Email: drbhavin.liversurgeon@gmail.com

Dr. Hardik Patel

Consultant Hepatobiliary and Liver Transplant Surgeon,

Shalby Hospitals,

Ahmedabad- 380054.

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**Key words:** Mortality; Hepatobiliary: Surgery; Surgical critical care; Complications.

**Abbreviations:** ASA (American society of Anesthesiologists), HPB (Hepato pancreatico Biliary), ARDS (Acute Respiratory Distress Syndrome)

**Abstract:**

**Aims and Objectives:**

Our primary aim was to study association between nonsurgical techniques related complications and mortality and our secondary aim was to determine factors responsible for non surgical technique related complications.

**Material and Methods:**

All gastrointestinal and hepatobiliary procedures performed in last 3 years have

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been evaluated retrospectively. Nonsurgical procedure related postoperative complications were defined as perioperative complications nonrelated to surgical procedures or techniques and related to patients' physiological health or comorbidities. To avoid selection bias in attempt to evaluate effect of non-surgical procedural related complication on mortality, we did 1:1 propensity score matching analysis with nonsurgical technique related complications 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 calipher of 0.2. Cases were not reusable after matching. Statistical analysis was done using SPSS version 23.

**Results:**

Total 348 patients underwent various abdominal surgeries (gastrointestinal and hepatobiliary) in our department from April 2017 to March 2020. Total 24 patients developed nonsurgical technique related complications. Before Propensity score matching nonsurgical technique related complications were significantly higher in Upper Gastrointestinal surgeries (gastric and esophageal), emergency surgeries, Open surgeries, in patients who developed intraoperative hypotension, patients operated for malignancies, patients with higher ASA grades, patients in whom more blood products were used and patient who had more operative time. ASA scores independently predicted nonsurgical technique related complications. [P=0.001. Odds Ratio 3.955 (95% C.I.) 1.774-8.813)]. After Matching 24 patients patients were included in nonsurgical complication related complication group and

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they were compared with 23 matched controls. After matching also nonsurgical procedural related complications were significantly associated with mortality. ($p < 0.0001$). No intraoperative factors like intraoperative hypotension, blood product requirement, operative time predicted non-surgical technique related complication. Surgery related complications were not associated with mortality after matching.

**Conclusion:**

Nonsurgical technique related complications are associated with significant increase risk of mortality.

**Introduction:**

Surgical Complications are major cause of mortality and morbidity. [1] Surgical complications can be as high as 30% in some group of patients. [2,3]. Surgical complications generally consist of two types of complications as per our knowledge. One is technique or surgical procedure related e.g. bleeding, anastomotic leaks. The other is non surgical technique related complications or complications due to change in physiology due to surgical stress, for example ARDS, Acute kidney Injury, Post operative Acute left ventricular failure or Post operative acute delirium.[4] We assumed that nonsurgical technique related complications are much more dangerous but neglected than surgical technique related or surgical complications.

**Aims and Objectives:**

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Our primary aim was to study association between nonsurgical techniques related complications and mortality and our secondary aim was to determine factors responsible for non surgical technique related complications.

**Material and Methods:**

All gastrointestinal and hepatobiliary procedures performed in last 3 years have been evaluated retrospectively.

Nonsurgical procedure related postoperative complications were defined as perioperative complications nonrelated to surgical procedures or techniques and related to patients' physiological health or comorbidities (e.g acute kidney injury, ARDS, acute respiratory failure, cardiac complications etc.).

Surgical related complications were defined as perioperative complications related to surgical procedures or techniques (e.g., bleeding, leaks, sepsis, etc.).

**Study Design:**

Retrospective analysis of prospectively collected data of all the patients who underwent gastrointestinal and hepatobiliary surgery was done at our center from April 2017 to March 2020. Complications divided between surgical technique related or nonsurgical technique related or patient related complications based on definitions mentioned above.

**Nonsurgical technique complications individual definition:**

Acute kidney injury has been defined according to acute kidney injury network definition. [5] Acute respiratory distress syndrome has been defined according to berlin definition. [6]. Acute myocardial infarction and postoperative left ventricular dysfunction was diagnosed as per cardiologists' opinion based on cardiac markers, electrocardiogram and echocardiography. Pulmonary embolism was confirmed by contrast enhanced CT scan chest.

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**Statistical analysis:**

To avoid selection bias in attempt to evaluate effect of non-surgical procedural related complication on mortality and who did 1:1 propensity score matching analysis with nonsurgical technique related complications 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 calipher of 0.2. Cases were not reusable after matching. [5]

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. We also analyzed 90 days postoperative mortality between patients who developed non-surgical techniques related complications and control with Kaplan Meier analysis with log rank test. Statistical analysis was done using SPSS version 23.

**Results:**

Total 348 patients underwent various abdominal surgeries (gastrointestinal and hepatobiliary) in our department from April 2017 to March 2020. Total 24 patients

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developed nonsurgical technique related complications. Individual complications have been listed in table 2.

**Groups' comparison before matching:**

Comparisons of both the groups, nonsurgical techniques related complications and controls before propensity score matching has been shown in table 2.

Before Propensity score matching nonsurgical technique related complications were significantly higher in Upper Gastrointestinal surgeries (gastric and esophageal), emergency surgeries, Open surgeries, in patients who developed intraoperative hypotension, patients operated for malignancies, patients with higher ASA grades, patients in whom more blood products were used and patient who had more operative time. [Table 2]

On multivariate logistic regression analysis of preoperative factors only Higher ASA scores independently predicted nonsurgical technique related complications. [P=0.001. Odds Ratio 3.955 (95% C.I.) 1.774-8.813)]

Mortality and hospital stay was significantly higher in patients who developed non-surgical technique related complications. Surgery related complication did not predicted mortality ($p = 0.06$).

**Post Matching analysis:**

To avoid selection bias on factors affecting mortality we did 1:1 propensity score matching as described in statistical analysis. We used all the preoperative 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.

After matching 24 patients patients were included in nonsurgical complication related complication group and they were compared with 23 matched controls.

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After matching also nonsurgical procedural related complications were significantly associated with mortality. ($p< 0.0001$). No intraoperative factors like intraoperative hypotension, blood product requirement, operative time predicted non-surgical technique related complication. [Table 3]. (Intraoperative factors were not matched)

Surgery related complications were not associated with mortality after matching also.

**Post matching Kaplan Meier analysis with log rank test.**

Patients who developed nonsurgical procedure related complication has significantly higher 90 days mortality compared to control. ($p< 0.0001$). [Figure 1].

## DISCUSSION:

Perioperative mortality is the one the most important problem surgical community is facing. Perioperative mortality range from 0.1% to as high as 27%-30% according to various types of surgeries. [7]. Gastro intestinal and hepatobiliary surgeries are technically demanding procedures and has one of the highest perioperative mortality rates. [8,9,10].

Surgeons are always worried about surgical techniques and surgical techniques related mortalities, how ever a very few studies are done to look at the impact of such complications on perioperative mortality. There are various perioperative complications, which are not actually related to surgical techniques, but depend on many factors like patients' pre operative conditions as well as perioperative anesthetic course and complications due to that. These complications can include but not limited to acute kidney injury, adult respiratory distress syndrome, post

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operative delirium, Myocardial infarction. Postoperative acute left ventricular dysfunction. These complications can contribute to mortality significantly. [11,12].

Aim of our study to look for effect of nonsurgical technique related complications and surgical technique related complications on mortality. For gastrointestinal and hepatobiliary surgeries we defined anastomotic leaks, sepsis due to leaks, intraoperative bleeding, iatrogenic injuries to surrounding structure as surgical technique related complications and other complications like acute kidney injury, ards (acute respiratory distress syndrome), as non surgery related complications, we have discussed this in materials and methods section.

Mortality can be affected by preoperative status of the patient as well as type of surgery, to avoid these confounding factors and selection bias we performed 1:1 propensity score matching analysis.

Secondary aim of our study was to study factors responsible for developing nonsurgical technique related complications. We evaluated this by doing univariate and multivariate analysis in unmatched samples as well as after matching.

In unmatched univariate analysis Upper Gastrointestinal surgeries (gastric and esophageal), emergency surgeries, Open surgeries, in patients who developed intraoperative hypotension, patients operated for malignancies, patients with higher ASA grades, patients in whom more blood products were used and patient who had more operative time were at higher risk for developing non surgical technique related complications. On multivariate analysis only higher ASA grade predicted nonsurgical technique related complications.

After 1:1 propensity score matching there was no significant difference in any

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preoperative factors, which were matched between the two groups, suggesting adequate matching. After matching also nonsurgical technique related complications significantly associated with mortality. Matching of all the preoperative surgery related or patients' physiology related parameter confirmed that nonsurgical techniques related complications were themselves associated with postoperative mortality. However they were not associated with increased hospital stay post matching unlike pre matching analysis.

After matching intraoperative factors like increased operative time, more blood product requirement or intraoperative hypotension did not predict nonsurgical procedure related complication suggesting surgeons' had very little control over them and it depends in pre operative patients' physiological states as suggested by ASA grades as per our pre-match multivariate analysis.

Surgery related complication did not predict mortality in pre-match analysis as well as post match analysis.

After propensity score matching Kaplan Meier analysis also showed significant less 90 days survival in patients who developed nonsurgical related complications. [Figure 1].

We do not want to say that surgical technique related complications are not harmful but our purpose is to point out importance of nonsurgical technique related complications and their impact on surgical mortality. This study also shows importance of critical care management in reducing postoperative mortality. [13,14,15,16]

This study being retrospective analysis has some limitations associated with it. We also need larger sample size study. However strength of study is good propensity score matching to eliminate selection bias. Considering it would be too difficult to

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conduct randomized control trial on the said research questions, this study shows if by good critical care management we can reduce these non surgical technique related complications, we can significantly reduce postoperative mortality.

In conclusion nonsurgical technique related complications are associated with significant increase risk of mortality and surgeon should concentrate on preventing and managing these complications in more effective way.

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| Complications | Total number patients |
|---|---|
| Acute Kidney Injury (AKI) | 11 |
| Acute respiratory distress syndrome | 7 |
| Pulmonary embolism | 3 |
| Myocardial infarction | 2 |
| Postoperative left ventricular dusfinction | 1 |

Table 1: post operative surgical tenchique related complications.

| FACTOR | NONSURGICAL TECHNIQUE RELATED COMPLICATION (N=24) | CONTROL GROUP (N=324) | P VALUE (UNIVARIATE ANALYSIS) | MULTIVARIATE ANALYSIS FOR FACTORES PREDICTING STUDY GROUP |
|---|---|---|---|---|
| Age (median/range) | 55(34-80) | 54 (7-83) | 0.194 | |
| SEX (FEMALE/MALE) | 10/14 | 141/183 | 0.853 | |
| ASA (N) | ASA 1=0<br>ASA 2= 5<br>ASA 3= 8<br>ASA 4= 11 | ASA1= 1<br>ASA2= 223 | <0.0001 | 0.001. ODDS RATIO 3.955 (95% C.I.) 1.774-8.813) |

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| | | | | |
|---|---|---|---|---|
| | | ASA 3= 80 ASA 4= 19 | | |
| Intraoperative hypotenstion (N) | 6 | 17 | 0.003 | 0.173 |
| Open Surgery (N) | 22 | 172 | <0.0001 | 0.161 |
| 90 days Mortality | 16 | 9 | <0.0001 | |
| COLORECTAL SURGERY (N) | 5 | 47 | 0.379 | |
| SMALL BOWEL SURGERY (N) | 4 | 39 | 0.518 | |
| UPPER GI SURGERY (STOMACH/ESOPHAGUS)(N) | 4 | 12 | 0.018 | 0.194 |
| EMMERGENCY SURGERY(N) | 10 | 54 | 0.05 | 0.977 |
| MALIGNANT DISEASE(N) | 9 | 61 | 0.036 | 0.781 |
| HPB SURGERY(N) | 11 | 190 | 0.284 | |
| HERNIA(N) | 0 | 32 | 0.147 | |
| BLOOD PRODUCT (MEDIAN/RANGE) | 2(0-15) | 0 (0-40) | <0.0001 | 0.392 |
| OPERATIVE TIME (MINTUTES)(MEDIAN/ | 120 (45-600) | 90 (15-800) | 0.002 | 0.506 |

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| | | | | |
|---|---|---|---|---|
| RANGE) | | | | |
| HOSPITAL STAY (MEDIAN/RANGE) | 4 (1-25) | 2 (1-15) | 0.035 | |

Table 2: Univariate and multivariate analysis of both the study and control group before propensity score matching.

| FACTOR | NONSURGICAL TECHNIQUE RELATED COMPLICATION (N=24) | CONTROL GROUP (N=23) | P VALUE |
|---|---|---|---|
| Age (median/range) | 55(34-80) | 54 (32-68) | 0.535 |
| SEX (FEMALE/MALE) | 10/14 | 9/14 | 0.859 |
| ASA (N) | ASA 1=0<br>ASA 2= 5<br>ASA 3= 8<br>ASA 4= 11 | ASA1= 0<br>ASA2= 6<br>ASA 3= 13<br>ASA 4= 14 | 0.104 |
| Intraoperative hypotenstion (N) | 6 | 4 | 0.724 |
| Open Surgery (N) | 22 | 18 | 0.245 |
| 90 days Mortality | 16 | 0 | <0.0001 |

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| | | | |
|---|---|---|---|
| COLORECTAL SURGERY (N) | 5 | 4 | 1.0 |
| SMALL BOWEL SURGERY (N) | 4 | 3 | 1.0 |
| UPPER GI SURGERY (STOMACH/ESOPHAGUS)(N) | 4 | 2 | 0.666 |
| EMMERGENCY SURGERY(N) | 10 | 7 | 0.547 |
| MALIGNANT DISEASE(N) | 9 | 61 | 0.036 |
| HPB SURGERY(N) | 11 | 12 | 0.773 |
| HERNIA(N) | 0 | 1 | 1 |
| BLOOD PRODUCT (MEDIAN/RANGE) | 2(0-15) | 2 (0-40) | 707 |
| OPERATIVE TIME (MINTUTES)(MEDIAN/RANGE) | 120 (45-600) | 120 (30-800) | 0.707 |
| HOSPITAL STAY (MEDIAN/RANGE) | 4 (1-25) | 24(1-13) | 0.972 |

Table 3:Comparision after study and the control group after propensity score matching.

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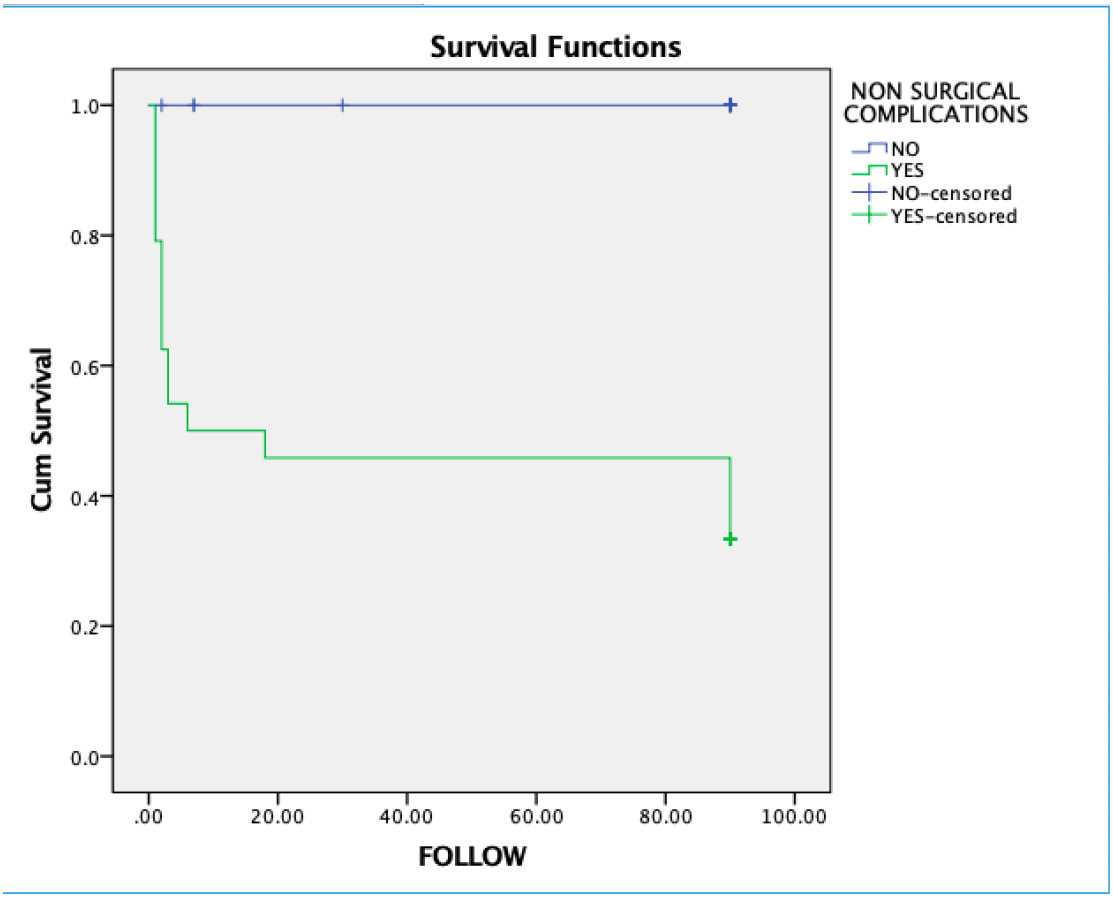


Figure: 1 Kaplan meier analysis of 90 days survival between the study and the control group after matching with lo g rank analysis. P<0.0001.