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# Clinical profile of patients undergoing laparotomy at a tertiary care hospital

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**Abstract**
Postoperative fever, wound infection, nausea and vomiting are the most commonly encountered complications but postoperative pulmonary complications (PPC'c) contribute significantly to overall perioperative mortality and morbidity. Post-operative pulmonary complications (PPC's) are commonly understood as failure to wean from mechanical ventilation within 48 hours of surgery or unplanned intubation / re-intubation postoperatively. Detailed clinical history about co-morbid factors like diabetes, Hypertension, Coronary artery disease, cerebrovascular accident, pulmonary disease, and Kidney disease is taken. Clinical examination include recording of vitals, Respiratory system, cardiovascular system, Central nervous system and GIT. Pulmonary complications seen in 44 patients of which 4 patients was found to have hemo/pneumothorax, Cardiac co-morbidities was found in 47 patients, signs of acute abdomen found in 90 patients and features of abdominal mass in 67 patients. Of the 47 patients with cardiac comorbidities 33 patients were NYHA grade II and 4 patients with NYHA grade III.

**Keywords:** Laparotomy, postoperative fever, wound infection

## Introduction
Laparotomy is a commonly performed procedure in any surgical unit. Postoperative complications directly affect the outcome of the disease. Postoperative fever, wound infection, nausea and vomiting are the most commonly encountered complications but postoperative pulmonary complications (PPC'c) contribute significantly to overall perioperative mortality and morbidity [1].

Post-operative pulmonary complications (PPC's) are commonly understood as failure to wean from mechanical ventilation within 48 hours of surgery or unplanned intubation / re-intubation postoperatively [2].

In a study of patients undergoing elective abdominal surgery, as an example, pulmonary complications occurred more than cardiac complications and were associated with significantly longer hospital stays. In another study involving 15,059 cases 329 cases required postoperative critical care admission and mechanical ventilation, of these 75% was due to respiratory aetiology. It has been reported that 5 to 10% of all surgical patients and 9 to 40% of those undergoing abdominal surgery developed at least one PPC's. Hypoxemia complicates the recovery of 30 to 50% of patients after abdominal surgery; endotracheal intubation and mechanical ventilation may be required in 8 to 10% of cases, prolonging intensive care and hospital stay and increasing mortality. These data suggest that PPC's occur at the same rate as cardiac complications in non-cardiac surgery. Most importantly, in-hospital death rate for patients with PPC's is 40% to 42% where as it is 6% for those without PPC's [3].

Other factors which mandates post-operative ventilation / prolong post- operative ventilation are cardiac (e.g. Pulmonary oedema, hypotension, myocardial ischemia), central causes (e.g., reduced respiratory drive, cerebral / brainstem ischemia), musculoskeletal (e.g., neuromuscular disease, thoracic restriction, abdominal pain after laparotomy), systemic (e.g., acidosis, septic shock, electrolyte abnormality) [4].

Although there are many complications associated with laparotomy, this study includes only those complications which are associated with post-operative invasive mechanical ventilation requirement, as they are associated with longer hospital stay and increased mortality and morbidity.

## Methodology

### Study population
All patients undergoing laparotomy under the department of general surgery.

### Inclusion criteria
All patients undergoing laparotomy under the department of general surgery.

### Exclusion criteria
- Patient already on ventilator support.
- Terminal malignancy; palliative procedures.

### Study design
A prospective observational study

### Sample size and technique
All patients undergoing laparotomy under the department of general surgery, for a period of two years and fulfilling the inclusion criteria were enrolled for the study. Informed written consent was taken from patients or close relatives. For this study census method also called complete enumeration survey method of data collection is used. In census method each and every person fulfilling inclusion criteria is taken and selected for data collection.

### Methodology
Whenever a patient is posted for laparotomy, a detailed clinical history followed by clinical examination and routine lab investigations will be done. If needed special investigations also will be done. Patient is categorised according to ASA classification and NYHA classification whenever applicable. After laparotomy details, of surgery were also collected.

### History and clinical examination
Detailed clinical history about co-morbid factors like diabetes, Hypertension, Coronary artery disease, cerebrovascular accident, pulmonary disease, and Kidney disease is taken. Clinical examination include recording of vitals, Respiratory system, cardiovascular system, Central nervous system and GIT. For the purpose of analysis patients are grouped into below 60 yrs. and above or equal to 60yrs and odds ratio of each group is calculated. Frequency of comorbidity in the study population is calculated and odds ratio for post-operative invasive ventilation is calculated. From temperature, heart rate, respiratory rate, total leukocyte count a composite SIRS score is calculated. A score of two or more, if present, then the patient is considered to have SIRS. Number of patients with SIRS and odds ratio for SIRS patients to have post- operative ventilation is calculated.

## Results
On admission 126 patients had systolic B.P above 120mmHg, 61 patients had systolic. B.P between 90 and 120mmHg and 4 patients had systolic B.P less than 90mmHg.

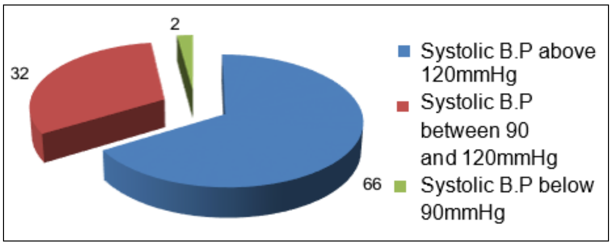


**Fig 1:** Systolic BP of patients on admission.

An SIRS composite score is made from temperature, TLC, respiratory rate and heart rate. Each of the components is given a score of 1 if an aggregate score of two or more is present then that patient is considered to have SIRS. 56 patients came under the category of SIRS.

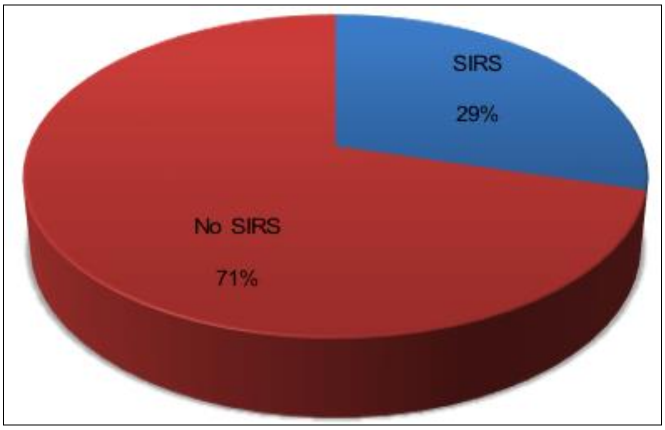


**Fig 2:** Percentage of patients with SIRS on admission.

Of the total 191 patients 65 (34%) patients had diabetes, 72 (37%) patients had systemic hypertension, coronary artery disease in 43 (22%), cerebrovascular accident in 12, Chronic obstructive airway disease in 41, and chronic kidney disease in 9 (4.7%) patients.

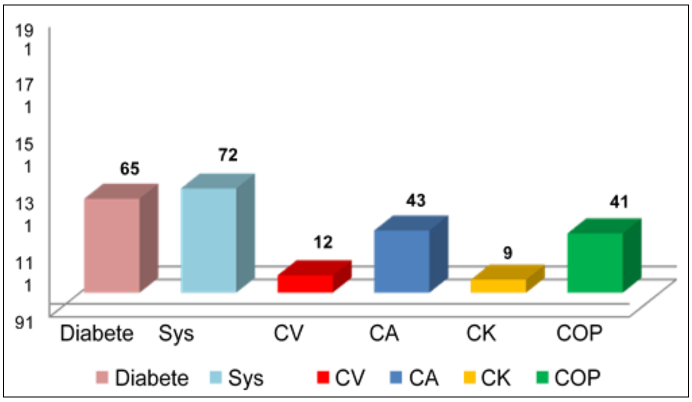


**Fig 3:** Different comorbidities present in the study population

Pulmonary complications seen in 44 patients of which 4 patients was found to have hemo/pneumothorax, Cardiac co-morbidities was found in 47 patients, signs of acute abdomen found in 90 patients and features of abdominal mass in 67 patients. Of the 47 patients with cardiac comorbidities 33 patients were NYHA grade II and 4 patients with NYHA grade III.

**Table 1:** Pulmonary system examination findings

| Pulmonary findings on systemic examination | | Number of patients |
|---|---|---|
| 1 | Obstructive airway disease | 40 |
| 2 | Restrictive disease /Hemopneumo thorax | 4 |
| 3 | Pneumonia/Consolidation | 0 |

**Table 2:** Patients with cardiac comorbidities

| Patients with cardiac co-morbidites | 47 |
|---|---|
| NYHA class I | 0 |
| NYHA class II | 43 |
| NYHA class III | 4 |
| NYHA class IV | 0 |

**Table 3:** Abdominal examination findings

| Patients with abdominal findings | No of patients |
|---|---|
| Acute abdomen | 90 |
| Abdominal mass | 67 |
| Total | 157 |

After examination by anaesthetist, the patients are classified according to their ASA class. The number of patients in each ASA class is mentioned below.

**Table 4:** ASA class of patients

| ASA class | No of patients |
|---|---|
| Class I | 55 |
| Class II | 91 |
| Class III | 42 |
| Class IV | 0 |
| Class V | 3 |
| Class VI | 0 |

All the patients who required post-operative invasive ventilatory support were class III patients. Serum electrolytes were checked in all 191 patients. 146 patients had normal serum sodium, in 42 patients it was found to be low and in 3 patients it was high. In case of potassium, 143 had normal potassium, 44 patients with low potassium and 4 patients with high potassium.

**Table 5:** Serum electrolyte of patients

| Serum electrolyte | Low | Normal | High |
|---|---|---|---|
| Se sodium | 42 | 146 | 3 |
| Se potassium | 44 | 143 | 4 |

## Discussion

An SIRS composite score is made from temperature, TLC, respiratory rate and heart rate. Each of the components is give a score of 1 if an aggregate score of two or more is present then that patient is considered to have SIRS. 56 (29%) patients came under the category of SIRS. According to my study SIRS on admission is found to be an important risk factor for postoperative invasive ventilation. Patients with SIRS have 3.58 times more chance for going in for postoperative invasive ventilation than patients without SIRS. Odds ratio of 3.58 and P value of 0.029.

Systemic inflammatory response syndrome (SIRS) is a pathologic reaction triggered by a variety of insults, including infection, trauma, burns, and acute pancreatitis.

In a study by MárcioSoares *et al*., they found all patients fulfilled the criteria for SIRS on presentation to the ICU and had at least three distinct organ dysfunction required ventilator support conventional mechanical ventilation was used in four patients, while non-invasive ventilation was used in one patient [5]. Prevalence of SIRS was found to be 35% among acutely hospitalized medical patients [6]. In another study by Ting PC, *et al*. they found that patients with preoperative COPD, pneumonia, ascites and systemic inflammatory response syndrome (SIRS) were more likely to be subjected to reintubation after planned extubation [7].

Of the total 191 patients 65 (34%) patients had diabetes, 72 (37%) patients had systemic hypertension, coronary artery disease in 43 (22%), cerebrovascular accident in 12, Chronic obstructive airway disease in 41, and chronic kidney disease in 9 (4.7%) patients. Chronic obstructive airway disease is found to have increased risk for postoperative invasive ventilation. Odds ratio of 4.36 and P value of 0.01.All the other co-morbidities like CVA, diabetes, hypertension, CAD were absent in those who required ventilator support. So odds ratio was not calculated for them.

According to literature a diagnosis of chronic obstructive pulmonary disease (COPD), congestive heart failure, or chronic liver disease are independent risk factors for postoperative pulmonary complication. COPD was associated with increased risk for postoperative pneumonia, respiratory failure, myocardial infarction, cardiac arrest, sepsis, return to the operating room, and renal insufficiency or failure. In a study conducted by Fields AC, *et al*., COPD was present in 12,491 patients (3.8%) undergoing the abdominal operations he surveyed. The 30-day morbidity and mortality rates and hospital duration of stay for patients undergoing all abdominal procedures reviewed was greater for patients with COPD compared with patients without COPD.

Based on the study by JaumeCanet, *et al*., history of cardiac disease in an important risk factor for postoperative respiratory failure as the NYHA class of patient increases the risk for postoperative respiratory complications also increases [8].

Study by Krolikowska M, *et al*., found diabetic patients undergoing non-cardiac surgery had a significantly higher incidence of short-term post-operative and long-term mortality compared with non-diabetic subjects [9]. The major causes of death among diabetic subjects were diseases of the cardiovascular system compared with non-diabetic patients.

Stephen Serio, *et al*. in their study “Outcomes of Diabetic and Non-diabetic Patients Undergoing General and Vascular Surgery” [10] says insulin dependent diabetic patients undergoing general surgery and vascular surgery have an increased risk for any morbidity when compared to non-diabetics.

Chronic kidney disease (CKD) is increasing in prevalence and is associated with adverse cardiovascular events and mortality in asymptomatic and post-operative populations. In a study by Currie A, *et al*., they found patients with CKD were more likely to develop cardiovascular morbidity and 30-day mortality than the non-CKD patients [11].

Limited information is available on the association between a medical history of stroke and postoperative outcomes. Using Taiwan's National Health Insurance Research Database, a nationwide cohort study was conducted of patients who underwent non-neurological surgery between 2008 and 2010 with a medical history of stroke in the 24-month period before operation. Patients with previous stroke had a higher risk of adverse postoperative outcomes; their 30-day in-hospital mortality rate was nearly twice that of patients without previous stroke [2].

In this study ASA class is found to be a significant risk factor post-operative invasive ventilatory support. Odds ratio of 1.45 for class III or above patients compared with below class II patients and a P value of 0.000.

## Conclusion

After examination, the patients were classified according to their ASA class. There were 55 class I patients, 91 class II patients, 42 class III patients and 3 class V patients.

All the 14 patients who required post-operative invasive ventilation were class III or above.

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# Risk factors of postoperative invasive ventilator support in laparotomy patients

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**DOI:** https://doi.org/10.33545/surgery.2021.v5.i3b.808

**Abstract**
A medical ventilator is a machine designed to move breathable air in and out of the lungs, to provide breathing for a patient who is physically unable to breathe, or breathing insufficiently. The early history of mechanical ventilation begins with various versions of what was eventually called the iron lung, a form of non-invasive negative pressure ventilator widely used during the polio epidemics of Copenhagen, Denmark, in 1952. Whenever a patient is posted for laparotomy, a detailed clinical history followed by clinical examination and routine lab investigations will be done. If needed special investigations also will be done. Patient is categorized according to ASA classification and NYHA classification whenever applicable. After laparotomy details, of surgery were also collected. Surgery was elective for 143 patients and emergency for 48 patients. 25% of surgeries were emergency.8 out of 48 emergency surgery patient required ventilatory support (16.6%). 8 out of 14 ventilator patients were emergency surgery patients (57%). From this emergency surgery is found to be an important risk factor for post-operative invasive ventilation with an odds ratio of 4.567 and P value of 0.008.

**Keywords:** postoperative invasive ventilator support, laparotomy, risk factors

## Introduction
The last 200 years have seen enormous improvements in the management of patients undergoing surgery. This has been due to key discoveries in anaesthesia, antibiotics, aseptic practices, understanding of human physiology, x-ray to name a few. There have also been important organizational changes including the development of postoperative recovery rooms and critical care units. Surgical mortality has fallen while range of invasive surgical procedures has expanded. Operations are undertaken on patients who would have formally been deemed unsuitable because of serious comorbidities, age or physiological derangement. A good percentage of these high risk patients surviving surgeries will require admission to a critical care unit and ventilator support [1].

A medical ventilator is a machine designed to move breathable air in and out of the lungs, to provide breathing for a patient who is physically unable to breathe, or breathing insufficiently.

The early history of mechanical ventilation begins with various versions of what was eventually called the iron lung, a form of non-invasive negative pressure ventilator widely used during the polio epidemics of Copenhagen, Denmark, in 1952 [2].

In 1949, John Haven Emerson developed a mechanical assister for anaesthesia with the cooperation of the anaesthesia department at Harvard University. Mechanical ventilators began to be used increasingly in anaesthesia and intensive care during the 1950s. Their development was stimulated both by the need to treat polio patients and the increasing use of muscle relaxants during anaesthesia [3].

Fast forwarding to current time, modern ventilators are sophisticated computers with various programs of ventilation suited for individual patients whose respiratory needs vary considerably.

Extensive search for studies related to risk factors for postoperative invasive ventilation support in post laparotomy patients were made in PubMed, Medline and Cochrane. Several articles have mentioned the risk factors for postoperative mortality and morbidity, postoperative respiratory failure, common postoperative complications and most common type of postoperative organ support received. Several studies were conducted on post upper abdominal surgery and colon surgery patient's developing pulmonary complications. Whether these patients required invasive ventilator support or not is not clear from these studies [4].

Indications for invasive ventilation may not always be due a primary pulmonary pathology. None of these articles mentions about the risk factors in laparotomy patients that ultimately lead to post-operative invasive ventilator support.

**Methodology**

All patients undergoing laparotomy under the department of general surgery, for a period of two years and fulfilling the inclusion criteria were enrolled for the study. Informed written consent was taken from patients or close relatives. For this study census method also called complete enumeration survey method of data collection is used. In census method each and every person fulfilling inclusion criteria is taken and selected for data collection.

Whenever a patient is posted for laparotomy, a detailed clinical history followed by clinical examination and routine lab investigations will be done. If needed special investigations also will be done. Patient is categorized according to ASA classification and NYHA classification whenever applicable. After laparotomy details, of surgery were also collected.

Detailed clinical history about co-morbid factors like diabetes, Hypertension, Coronary artery disease, cerebrovascular accident, pulmonary disease, and Kidney disease is taken. Clinical examination include recording of vitals, Respiratory system, cardiovascular system, Central nervous system and GIT. For the purpose of analysis patients are grouped into below 60 yrs and above or equal to 60yrs and odds ratio of each group is calculated. Frequency of comorbidity in the study population is calculated and odds ratio for post-operative invasive ventilation is calculated. From temperature, heart rate, respiratory rate, total leukocyte count a composite SIRS score is calculated. A score of two or more, if present, then the patient is considered to have SIRS. Number of patients with SIRS and odds ratio for SIRS patients to have post- operative ventilation is calculated.

All the data collected are entered into a semi structured questionnaire after getting consent from the participant. After the completion of data collection, it will be properly coded and will be entered in Microsoft excel data sheet.

**Results**

**Table 1:** Association of socio-demographic variables to post-laparotomy ventilator support

| Variable | Ventilator support | | Odds Ratio | P value |
|---|---|---|---|---|
| | Yes | No | | |
| **Gender** | | | | |
| Male | 10 (71.4%) | 119 (67.2%) | 1.218 | 1.000 |
| Female | 4 (28.6%) | 58 (32.8%) | | |
| **Age** | | | | |
| Equal to or more than 60 yrs | 8 (57.1%) | 91 (51.4%) | 1.260 | 0.785 |
| Less than 60 yrs | 6 (42.9%) | 86 (48.6%) | | |

**Table 2:** Association of co-morbidities to post-laparotomy ventilator support

| Variable | Ventilator support | | Odds Ratio | P value |
|---|---|---|---|---|
| | Yes | No | | |
| **Chronic Obstructive Pulmonary Disease** | | | | |
| Yes | 7 (50%) | 33 (18.6%) | 4.36 | 0.01 |
| No | 7 (50%) | 144 (81.4%) | | |

All the other co-morbidities like CVA, diabetes, hypertension, CAD were absent in those who required ventilator support. So odds ratio was not calculated for them.

**Table 3:** Association of SIRS, Hemo/Pneumothorax and ASA category with Post-laparotomy Ventilatory Support.

| Variable | Ventilator support | | Odds Ratio | P value |
|---|---|---|---|---|
| | Yes | No | | |
| **SIRS** | | | | |
| Yes | 8(57.1%) | 48 (27.1%) | 3.58 | 0.029 |
| No | 6 (42.9%) | 129(72.9%) | | |
| **Hemo/pneumo thorax** | | | | |
| Yes | 4(28.6%) | 0 | 18.7 | 0.00 |
| No | 10(71.4%) | 177 (100%) | | |
| **ASA classification** | | | | |
| Greater than class III Class I and II | 14(100%)0 | 31(71.5%) 146(82.5%) | 1.45 | 0.000 |

**Table 4:** Association of type of surgery with post laparotomy ventilator support.

| Variable | Ventilator support | | Odds Ratio | P value |
|---|---|---|---|---|
| | Yes | No | | |
| **Time from onset of symptoms to surgery** | | | | |
| **Less than 30 days** | 8(57.1%) | 134(75.7%) | 0.42 | 0.199 |
| **More than 30 days** | 6(42.9%) | 43(24.3%) | | |
| **Emergency /Elective surgery** | | | | |
| **Emergency** | 8(57.1%) | 40 (22.6%) | 4.567 | 0.008 |
| **Elective** | 6 (42.9%) | 137(77.4%) | | |
| **Damage control/ definitive surgery** | | | | |
| **Damage control** | 8(57.1%) | 27(15.32%) | 7.407 | 0.001 |
| **Definitive** | 6(42.9%) | 150 (84.72%) | | |
| **Duration of surgery** | | | | |
| More than 2.5 hrs<br>Less than 2.5 hrs | 6(42.9%)<br>8(57.1%) | 69(39%)<br>108(61%) | 1.17 | 0.78 |

**Table 5:** Association between operative findings and post laparotomy ventilator support.

| Variable | Ventilator support | | Odds Ratio | P value |
|---|---|---|---|---|
| | Yes | No | | |
| **Operative finding: Tumor** | | | | |
| Present | 6(42.9%) | 95(53.7%) | 0.608 | 0.580 |
| Absent | 8(57.1%) | 82(46.3%) | | |
| **Operative finding: Intra-abdominal sepsis** | | | | |
| Present | 4(28.6%) | 33(18.6%) | 0.746 | 0.479 |
| Absent | 10 (71.4%) | 144(81.4%) | | |
| **Operative finding: Hemoperitoneum** | | | | |
| Present | 4(28.6%) | 10(5.6%) | 6.944 | 0.012 |
| Absent | 10(71.4%) | 167 (94.4%) | | |

## Discussion

Surgery was elective for 143 patients and emergency for 48 patients. 25% of surgeries were emergency. 8 out of 48 emergency surgery patient required ventilatory support (16.6%). 8 out of 14 ventilator patients were emergency surgery patients (57%). From this emergency surgery is found to be an important risk factor for post-operative invasive ventilation with an odds ratio of 4.567 and P value of 0.008.

Definitive surgery was performed for 156 patients and damage control surgery for 35 patients. 8 out of 35 damage control surgery patients required post- operative ventilatory support (22.8%). 57% of ventilatory patients were damage control surgery patients. Damage control surgery is also found to be an important risk factor for postoperative invasive ventilation, probably because both the emergency and damage control surgery patients were the same ones. Odds ratio was 7.407 and P value 0.001.

Study by McCoy CC, *et al.* [5] found emergency operations accounted for 14.6% of the approximately general surgery procedures. Post-operative complications included surgical site infection had the highest incidence (6.7%). The second most common complication was pneumonia (5.7%). Stroke, major bleeding, myocardial infarction, and pneumonia exhibited the strongest associations with postoperative death.

127 patients had midline incisions, 20 patients had subcostal incision, 25 patients with paramedian incisions and 19 transverse incisions. After recoding to vertical and transverse incisions 152 patients had vertical incisions and 39 patients had transverse incisions. All the patients with postoperative invasive ventilation had vertical laparotomy incisions. Odds ratio could not be calculated in this case.

According to Brown SR, *et al.* [6] both analgesia use and pulmonary compromise may be reduced with a transverse or oblique incision but this does not seem to be significant clinically as complication rates and recovery times are the same as with midline incision. The methodological and clinical diversity and the potential for bias in the included studies also mean that the results in favour of a transverse or oblique incision, particularly with regard to analgesic use, should be treated with caution. The optimal incision for abdominal surgery still remains the preference of the surgeon.

Based on the duration of surgery patients are divided into two groups, surgery for more than 2.5 hrs and surgery duration less than 2.5 hrs. 75 patients (39.2%) had surgery for more than 2.5 hrs. Based on my study, surgery for more than 2.5 hrs is not a risk factor for post-operative invasive ventilation. Odds ratio is found to be 1.17 and a P value of 0.78.

Several studies have shown that the duration of surgery is independently associated with increased infectious complications and increased length of hospital stay. Study by May Hua, *et al.* found ASA class, the presence of preoperative sepsis and total operative time were independently associated with risk of post-operative invasive ventilation [7].

Operative findings include hemoperitoneum in 14 patients, intra-abdominal sepsis in 37, tumor/mass in 101, inflammation in 32 patients. For patients who require post-operative invasive ventilation intraoperative findings include hemoperitoneum 4 patients, intra-abdominal sepsis 4 patients and tumor in 6 patients. Of the 14 patients with hemoperitoneum, 4 patients had associated hemo/pneumothorax. Finding of hemoperitoneum is associated with increased risk of post-operative invasive ventilation, odds ratio of 6.944 and P value of 0.012.

This may due to the fact that 28% of patients with hemoperitoneum had hemothorax or pneumothorax. From this study operative finding of tumor or intra-abdominal sepsis is not an important risk factor for post-operative invasive ventilation. In case of intra-abdominal tumor Odds ratio was 0.608 and P value of 0.580 for post-operative invasive ventilation. In case of intra-abdominal sepsis odds ratio was 0.746 and P value 0.479.

Colin L. Verdant, *et al.* in their study says persistence or recurrence of intra-abdominal sepsis is a serious threat in the postoperative course of acutely ill patients requiring urgent laparotomy. The prognosis of such patients is quite uncertain, with mortality rates reaching more than 50% in some series. In case of abdominal tumours, C. E. Cauley, *et al.* says patients with disseminated cancer are highly morbid and many patients die soon after surgery 8.

Mean days of hospital stay for a laparotomy patient is 10 days with a standard deviation of 4.1 days. A minimum days of hospital stay is 4 and maximum days of hospital stay is 27. In case of patients who required post-operative invasive ventilation the mean duration of hospital stay was 17 days with a SD of 3.8 days.

## Conclusion

Post-operative invasive ventilatory support requirement significantly increases the duration of hospital stay and also increases the cost of medical treatment. As these patients are critically ill their mortality and morbidity are significantly high, by identifying pre-operative risk factors for laparotomy patients requiring post-operative invasive ventilatory support we would be better able to predict and manage the post-operative period. The risk factors found during this study were presence of hemo/pneumothorax, higher ASA grade, COPD, SIRS on admission, hemoperitoneum, emergency surgery, damage control surgery. Pre- operative optimisation of these risk factors whenever possible should be done, in situations when this is not possible adequate resources for post-operative care should be available.

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