Original Research Article

Study of preoperative and intra operative factors associated with post operative mechanical ventilation following elective abdominal surgery

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Abstract

Background: Most severe form of post operative pulmonary complications is acute respiratory failure, a condition in which respiratory system fails in gas exchange function. Unscheduled admission to the ICU is also a problem due to the non availability of the ventilated ICU bed. Endotracheal intubation and mechanical ventilation is not without serious risks as it can lead to nosocomial infections, multi organ failure and even death at times. **Aim** The aim of the study is to identify the preoperative and intra operative factors associated with post operative mechanical ventilation following elective abdominal surgery. **Materials and methods:** This prospective observational study was performed on 86 consecutive patients undergoing elective abdominal surgery **Results:** There is association between the need for post operative mechanical ventilation and duration of hospital stay prior to surgery, serum albumin, loss of weight >10% preoperatively, more than 2units blood transfusion during surgery, upper abdominal incision site, duration of surgery, and open abdominal surgical procedure. Multiple regression analysis further identified only two of the seven variables to be significant ie preoperative duration of hospitalization and loss of weight more than 10% in last 6 months. **Conclusion:** Identifying risk factors for post operative mechanical ventilation pre operatively is a crucial step in the peri operative management of the patients undergoing abdominal surgery under general anaesthesia. Instead of emergency admission to the ICU at the cost of tremendous increase in the anxiety both for the patient and as well as relatives and also the surgeon too

Key Word: Mechanical ventilation, Preoperative, Intra operative

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INTRODUCTION

Despite advances in anesthesia and surgical care, post - operative pulmonary complications are still a major problem in modern perioperative practice. The incidence of post-operative pulmonary complications depends on presence of predictable risk factors and the criteria used to define them. Pulmonary complications include hypoxemia, hypoventilation, bronchospasm, tracheal edema, atelectasis, pleural effusion, pulmonary edema, pneumonia and ARDS. The most severe form of post operative pulmonary complications is acute respiratory failure, a condition in which respiratory system fails in

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gas exchange function. However the need for post operative mechanical ventilatory support would arise in patients undergoing elective abdominal surgeries due to factors other than gas exchange failure. In the present day scenario, admission to the ICU for postoperative mechanical ventilation will result in tremendous increase in the cost of care and psychological stress to the patient and relatives. Unscheduled admission to the ICU is also a problem due to the non availability of the ventilated ICU bed. Endotracheal intubation and mechanical ventilation is not without serious risks as it can lead to nosocomial infections, multi organ failure and even death at times. Hence, prior identification of the risk factors associated with the need for mechanical ventilatory support postoperatively is very much essential in the management of patients undergoing elective abdominal surgeries. Identification of such risk factors peri operatively can reduce the conflict with the surgical team too. Hence, we undertook this study to identify the risk factors predicting the need for mechanical ventilatory support in patients undergoing elective abdominal surgeries at our institute.

AIM OF THE STUDY

The aim of the present study is to identify the preoperative and intra operative factors associated with post operative mechanical ventilation following elective abdominal surgery.

MATERIALS AND METHODS

This prospective observational study was performed on 86 consecutive patients scheduled for elective abdominal surgery. Informed consent was obtained from each patient. Demographic data-age, sex, weight and height of the patients was recorded. The study was approved by the Institutional ethical committee. On the day prior to surgery; a clinical evaluation was done to obtain the medical history, with a particular focus on history of cardiovascular (hypertension, ischemic heart disease, congestive heart failure) or pulmonary disease, history of cerebro vascular accident, history of chronic smoking (more than 10 pack years), chronic obstructive pulmonary disease (COPD), history suggestive of bronchial asthma, sputum production more than 30 ml, history suggestive of Obstructive sleep apnea, history of loss of weight of more than 10% within 6 months. The surgery was postponed in patients who had pre operative respiratory infection. Use of steroids, history of diabetes and alcohol consumption was noted. Renal status was measured by serum creatinine levels. Presence of any other co-morbidity was noted and patients are classified into different risk categories based on ASA classification. Duration of hospital stay preoperatively was noted. Chest x-ray PA-view was obtained. On the day of surgery, bedside peak expiratory flow rate (best of three attempts) and an arterial blood gas determination while the patient was breathing room air were done. Laboratory data including albumin levels were noted. Intra operative variables like surgical incision site, duration of surgery, open or laparoscopic surgery, number of units of blood transfused, were recorded. Type of anaesthesia, general anaesthesia or regional technique (central neuraxial blockade- Spinal/epidural anaesthesia) used were recorded. The anesthetic technique was determined by the attending anesthesiologist. As per the institutional protocol general anesthesia was provided with nitrous oxide, oxygen, volatile agents, opioids, and neuromuscular blocking agents. Epidurals were placed in those patients undergoing general anaesthesia for upper abdominal surgeries provided coagulation parameters were within normal limits. All patients were scheduled for extubation at the end of surgery. But patients who did not meet the criteria for extubation (spontaneous eye opening, hand grip, sustained head lift for 5 seconds) were shifted to ICU for postoperative mechanical ventilatory support. Postoperative analgesia was provided with fentanyl administered intravenously or epidurally. Postoperatively, peak expiratory flow rates were measured in those extubated within 24 hrs after surgery. The development of postoperative respiratory tract infection as defined by appearance of new pulmonary infiltrations on the chest x-ray taken 24 hrs after surgery along with at least two of the following signs: purulent tracheobronchial secretion, elevation of body temperature (above 38.3ºC) , and increase of blood leukocyte count (over 25% above the base count) was noted. The investigators in the study were not involved in postoperative clinical management of the patients and did not influence the decision to extubate or continue ventilation postoperatively. Need for mechanical ventilation postoperatively was reviewed. The duration of the ICU stay was noted. The outcome in terms of survival or in-hospital mortality was estimated. The final outcome measure in this study was need for postoperative mechanical ventilation.

Statistical Analysis

The data was entered in Microsoft excel spread sheet 2000. Statistical analysis was performed using SPSS® (version 13). The continuous data was expressed as mean, standard deviation, median, and range. The categorical data was expressed as actual numbers and proportions. The comparison of variables in patients with and without the need for immediate postoperative mechanical ventilation was performed. chi square test was used for categorical variables and independent sample ‘t’ test for continuous variables. Out of the total 30 variables noted the variables which were significantly associated with

postoperative mechanical ventilation were identified. The variables were subjected to Spearman correlation and the risk factors associated with the need for mechanical ventilation were identified. A p value <0.05 was considered to be significant. The variables significant from the Spearman correlation were subjected to multiple logistic regression analysis.

RESULTS

Table 1: Demographic Variables

Parameters	Age Years	Weight Kg	Height Cm	BSA Kg/m2
Minimum	18	40	150	17.6
Median	45	58.5	160	23
Maximum	70	86	169	33.2
Mean	44.79	58.88	158.5	23.4
Standard Deviation	12.89	8.096	4.784	3.05

The median age of the patients was 45 years (range 18-70)

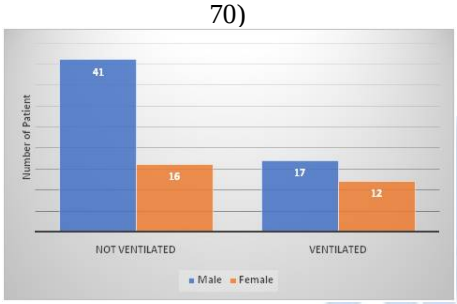

Table 2: Sex distribution in ventilated and non ventilated patients

Male: female ratio was 2.07:1.0.

Table 2: General variables in study

Variable	Total	Not ventilated	Ventilated
ASA class	86	57 (66.3%)	29 (33.7%)
Obesity	8	3 (50.0%)	3 (50.0%)
Low albumin*	14	1 (7.1%)	13 (92.9%)
LOW*	11	4 (36.4%)	7 (63.6%)

Among the general health status and nutritional variables, low albumin levels and loss of weight (LOW) (92.9% and 63% incidence of requirement of post operative mechanical ventilation respectively) were found significant variables.

Table 3: Systemic Variables in study

	Total	Not ventilated	Ventilated
Cardiovascular Variables			
Hypertension	25	14 (56.0%)	11 (44.0%)
Ischemic Heart Disease	6	6 (100.0%)	0 (0.0%)
Respiratory Variable			
RTI	2	1 (50.0%)	1 (50.0%)
COPD, Asthma	4	3 (75.0%)	1 (25.0%)
Smoking	42	26 (61.9%)	16 (38.1%)
Sputum production	42	26 (61.9%)	16 (38.1%)
OSA	23	13 (56.5%)	10 (43.5%)
Neurological Variables			
Cerebro Vascular Accident	2	1 (50.0%)	1 (50.0%)
Immune Variables			
Steroids	2	1 (50.0%)	1 (50.0%)
Alcohol	48	32 (66.7%)	16 (33.3%)
Diabetes	22	13 (59.1%)	9 (40.9%)

Cardio vascular variables were not found to be significantly correlating with the need of postoperative mechanical ventilation. Pre-operative respiratory tract infection (RTI), history of chronic obstructive pulmonary disease (COPD), Bronchial Asthma and Obstructive Sleep Apnea (OSA) were not found as significant variables because of small sample size. History of chronic smoking and pre operative sputum production of more than 30 ml were not found as significant variables. Patients with Cerebro Vascular Accident were not found to be significantly correlatingwith the need of postoperative mechanical ventilation. Steroids, Alcohol, Diabetes were not found to be significantly correlating with the need for postoperative mechanical ventilation.

Table 4: Preoperative duration of hospitalization (DOH), arterial blood gas analysis(ABG) and peak expiratory flow rates (PEFR).

All patients	Pre OP DOH Days	Pre PH	Pre pco2	Pre Po2	Pre PEFR	Post pH	Post pco2	Post po2	Post PEFR
Minimum	2	7.33	28.8	73.5	220	7.31	26.3	57.8	150
Median	4	7.4	36.85	89.25	345	7.39	36.7	76.1	240
Maximum	7	7.5	334.9	114.6	470	7.46	47.4	186.8	380
Mean	4.02	7.395	43.94	89.26	346.7	7.397	36.77	78.68	248.8
Standard Deviation	1.2	0.03	45.33	9.287	65.66	0.032	3.35	17.45	45.7

DOH (Duration of Hospitalization) The intra operative variables that were found to be significant are – blood transfusion of more than 2 units, open surgical procedures, upper abdominal incision and duration of surgery more than 3 hrs.

Table 5: Intraoperatively Variable

Variable	Total	Not ventilated	Ventilated
Blood transfusion*	39	10 (25.6%)	29(74.4%)
Upper abdominal* Incision	76	47 (61.8%)	29(38.2%)
Open surgery*	71	42 (59.2%)	29(40.8%)
Duration of surgery >3hrs*	37	8 (21.6%)	29(78.4%)
General Anaesthesia	46	39 (84.8%)	7 (15.2%)

Spearman Correlation analysis of Risk Factors such as Duration of surgery, low albumin levels, requirement of intra op blood transfusion, Duration of hospitalization prior to surgery, open or laparoscopic surgery, incision site, loss of weight, age, sex, and weight for predicting post operative mechanical ventilation were calculated and the correlation coefficients were shown in the following table.

Table 6: Factors correlating with requirement of postoperative ventilatory support

Need for Ventilation Versus	Spearman Correlation R Value	P value	P value summary
Age	-0.09	0.4	ns
Sex	-0.13	0.21	ns
Pre operative duration of Hospitalization	0.22	0.03	*
Albumin	0.55	<0.0001	***
Loss of weight more than 10% Within last 6 months	0.24	0.02	*
Blood Transfusion	0.78	<0.0001	***
Upper abdominal incision Site	0.25	0.01	*
Open Surgical procedure	0.32	0.002	**
Duration of surgery	0.82	<0.0001	***
Weight	-0.14	0.019	ns

Seven variables were found to be significantly correlating with requirement of postoperative ventilatory support pre operative duration of hospitalization, low albumin, loss of weight (more than 10% within last 6 months), blood transfusion of more than 2 units, upper abdominal incision site, open surgical procedures, duration of surgery greater than 3 hrs. The parameters that were significant with spearman correlation were analyzed with multiple logistic regressions. Finally, duration of pre operative hospitalization (DOH) (Coefficient -1.3755, SE -0.5166)and loss of weight (low) (Coefficient- 1.4620, SE-0.7085)were found to be independent predictors of requirement of post operative mechanical ventilation.

DISCUSSION

The main objective of this prospective study was to determine the predictors for the need of postoperative mechanical ventilation following elective abdominal surgery. The overall incidence of post operative ventilatory requirement following abdominal surgery was 33%. Review of literature revealed a wide variation in the incidence (20 to 69%).[1,2] This variability is primarily due to the type of post operative pulmonary complications studied, clinical criteria used in the definition, and differing surgical populations. Other studies have used less quantitative endpoints, such as radiologic or clinical criteria.[1] In retrospective and prospective studies[1,3]of risk factors and post operative pulmonary complications in abdominal surgical patients, several variables have been identified consistently. We identified that only 7 of the 30 previously reported preoperative variables to be associated with requirement of postoperative mechanical ventilation which include pre operative duration of hospitalization, low serum albumin, loss of weight preoperatively, blood transfusion, upper abdominal incision site, open abdominal procedure and duration of surgery. However, only two of these variables were independently associated with increased risk after multiple regression analysis: preoperative duration of hospitalization and loss of weight (10% within last 6 months). The duration of hospitalization prior to surgery was significantly correlated with the risk of pneumonia postoperatively in a study by Hall, *et al*[1] who identified that a preoperative stay of > 4 days as significant independent risk factor. Low albumin levels significantly correlated with requirement of post-operative ventilation.

In patients operated for disease of digestive tract, Jones and Eaton[4] found that postoperative edema was associated with low concentrations of serum albumin and serum protein, which they attributed to preoperative and postoperative under nutrition. Rich *et al*[5] found that patients undergoing cardiac surgery, who had lower serum albumin levels, showed a trend toward having higher postoperative mortality rates, and had significantly higher rates of several complications than did patients with higher serum albumin levels, while controlling for other risk factors. Albumin also has been found to predict post operative mortality and some types of morbidity, particularly sepsis and major infections in patients undergoing elective surgery and postoperative morbidity for those undergoing gastrointestinal surgery[6] in other previous studies. Serum albumin concentration is a better predictor of surgical outcomes than many other preoperative patient characteristics. It is relatively low-cost test that should be used more frequently as a prognostic tool to detect malnutrition and risk of adverse surgical outcomes, particularly in populations in whom co morbid conditions are relatively frequent. Obesity, though is an important variable for post operative complications was found to have no correlation with the need for post operative mechanical ventilation. Chronic pulmonary disease is one of the most common risk factors found in the literature to be associated with postoperative complication contrary to our study.[7,8,9,10] Even in the prior literature once chronic pulmonary disease has been taken into account, the presence of respiratory symptoms and smoking habits ceased to be strongly associated with a high incidence of post operative pulmonary complications. Although some of the variables are clinically related to each other (smoking, history of respiratory tract infection, abnormal results of pulmonary examination, abnormal chest radiography), none were sufficiently collinear by spearmen correlation coefficients. The duration of surgery of more than 3 hours was found to be significantly correlating with requirement of post operative ventilatory support. This finding contrasts with data on postoperative cardiac complications, where duration of surgery is not an independent predictor and does not appear in any commonly used cardiac risk index.[11.] Duration of surgery >3 h is an important risk factor for post operative pulmonary complications because only severe surgical procedures require prolonged duration and the patients scheduled for simpler surgical procedures had duration of surgery <3 h. The duration of surgery (and anesthesia) probably depends on the underlying surgical disease, which could be a true risk factor for post operative pulmonary complications. Unfortunately, avoiding general anesthesia with tracheal intubation, shortening the duration of surgery (and anesthesia), and avoiding abdominal incision may not always be possible. Requirement of more than 2 units of blood transfusion intra operatively was found to be significantly correlating with the requirement of post operative mechanical ventilation. It was a common opinion of the anaesthesiologists consent to maintain the haematocrit more than 25 to 30 % to optimize the tissue oxygenation. However, the literature revealed controversial statements with regard to the need for perioperative transfusion. Our study was similar to that of Christian Jyar etal[12] who identified intraoperative blood loss and transfusion was significantly associated with the need for prolonged mechanical ventilation.

The value of preoperative testing to estimate pulmonary risk is perhaps the most controversial area in the field of preoperative pulmonary evaluation. While some reports have suggested that certain tests, such as spirometry, identify a subset of high-risk patients, few studies have systematically compared the incremental risk attributable to abnormal preoperative testing with that obtained by history and physical examination. Lawrence *et al*[13] assessed the predictive value of preoperative spirometry through a systematic literature search and critical appraisal of the published literature and concluded that it is not clear that spirometry adds much predictive value beyond that of a clinical examination alone, and that the full potential of spirometry for precise, accurate risk assessment may not yet have been realized. Our data suggests that when general preoperative evaluation does not reveal any classic history of lung disease, pulmonary function testing as assessed by preoperative PEFR may assist in making a specific pulmonary diagnosis and assessing the degree of impairment before operating. The need for postoperative mechanical ventilation appeared to be similar in patients who had abnormal postoperative chest X-rays and patients who did not. Mendelson[14] reported that a preoperative chest radiograph was useful for comparison in 51% of patients having postoperative chest radiographs.[1] However; the clinical benefits of such a comparison were not reported. The usefulness of comparing an upright posterior-anterior and lateral preoperative CXR to a supine, anterior-posterior post operative CXR has been questioned.[15] However we found no abnormality in the preoperative chest x- rays in most of the patients. Though plenty of literature is available correlating the peri operative variables with post operative pulmonary complications, there are only a few available correlating the need for mechanical ventilation per se[7].we consider this as a preliminary study.

LIMITATION OF STUDY

The main limitation of the study is small sample size. Hence we could not perform analysis for patients requiring ventilatory support for more than 24 hours. There are plenty of articles in the literature correlating the variables with a number of postoperative pulmonary complications. Only very few evaluated the need for postoperative mechanical ventilatory support. Hence we consider this study as crucial though a preliminary one with small sample size to identify the predictable risk factors for the need of mechanical ventilatory support postoperatively in patients undergoing elective abdominal surgery in this era of cost containment and increased ICU cost of care.

CONCLUSION

Identifying risk factors for post operative mechanical ventilation pre operatively is a crucial step in the perioperative management of the patients undergoing abdominal surgery under general anaesthesia. This helps the attending anesthesiologist to plan elective postoperative ventilation in patients with the predictive risk factors and scheduling the surgeries according to the availability of ICU bed and ventilator. Instead of emergency admission to the ICU at the cost of tremendous increase in the anxiety both for the patient and as well as relatives and also the surgeon too

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