

# Use of Steroid to Prevent Extubation Failure due to Stridor in Surgical Intensive Care Patients

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## Abstract

Extubation failure increases morbidity and mortality in intensive care. Laryngeal edema which develops post extubation is one of the major risk factor for extubation failure. Post extubation laryngeal edema occurs in up to 37% of the extubations. Various steroids regiments have been commonly used pre extubation to prevent development of laryngeal edema. Aim of this study was to find type of patients to have frequent extubation failure and whether steroids can prevent post extubation laryngeal edema.

**Patients and methods:** It was a prospective observational study conducted in a tertiary hospital Surgical Intensive Care Unit (SICU). All patients included in study received either one of the steroid regimes or no steroid. Patients with tracheostomy, pediatric age group, pregnant patients, and patients who were already on steroid therapy were excluded from the study. Data entered in SPSS program, chi-square test was used to compare the variables and a p value of <0.05 was considered as significant.

**Results:** A total of 489 patients were enrolled in the study, 63 were excluded. Methylprednisolone was the most frequently (49.3%) used steroid. Majority of patients (80.1%) were male. Those patients who did not receive a steroid before extubation had a higher percentage of both post extubation stridor and reintubation ( $p < 0.05$ ). Reintubation was more common in male, young patients, severe brain injury patients and patients with higher severity of the disease.

**Conclusion:** Steroids can prevent post extubation laryngeal edema and subsequently prevent extubation failure. Extubation failure was more commonly occurred in male, young, severely ill and severe brain injury patients.

Extubation is the final stage in liberating patient from invasive mechanical ventilation. Reintubation due to post extubation stridor increases the duration of mechanical ventilation, and contributes to morbidity and mortality in the critically ill patients [1]. Post extubation stridor secondary to the laryngeal edema occurs in up to 37% of extubations and 15% of all reintubations are performed because of post extubation severe laryngeal edema [2]. Post extubation stridor is an accepted marker of laryngeal edema, it is a high pitched sound produced by airflow through the narrowed airway tract [2].

Recent literature has demonstrated that use of steroids in planned extubations is beneficial in preventing laryngeal edema and reintubations [3]. Various doses, type and regimes of steroids are used with variable frequencies for prevention of post extubation laryngeal edema. The aim of our study was to know whether steroids can prevent post extubation laryngeal edema and types of patients who frequently have extubation failure in surgical intensive care unit.

## Patients and Methods

This study was conducted over a period of 4 year (January 2010 to December 2014) in the Surgical Intensive Care Unit (SICU) of a tertiary referral hospital. Our SICU is 12 bed unit providing critical care services to general, neuro, orthopedic, urology and hepatobiliary surgical patients.

Our institutional review board (IRB) and Ethics committee had given permission for the study. Patient inclusion criteria for prospective enrollment were planned extubation after meeting weaning criteria, whether received steroids or not steroids. Patients were not randomized and the extubation was planned in the morning during consultant rounds. Patients already on steroids, pediatric patients, pregnant patients, and tracheostomised patients were excluded. Male patients were intubated with size 8 endotracheal tube whereas females had size 7. All patients included were intubated and mechanically ventilated for more than 36 hours. Extubation was planned accordingly when weaning criteria was achieved. Cuff leak test was performed after suctioning endotracheal and oral secretions.

Ventilator was set in the assist control mode with the patient receiving volume-cycled ventilation with the cuff inflated, displayed inspiratory and expiratory tidal volumes

**Keywords:** Extubation; Laryngeal edema; Reintubation; Steroid; Stridor

## Introduction

Endotracheal intubation is a common intervention in critically ill patients for various reasons and etiologies.

were recorded cuff was deflated and the expiratory tidal volume was recorded over the six breathing cycles as the expiratory tidal volume will reach a plateau value after a few cycles average the three lowest values. The difference between the inspiratory tidal volume (measured before the cuff was deflated) and the averaged expiratory tidal volume (after cuff deflation) is the cuff leak volume. If leak volume is less than 110 mL or 10% of tidal volume as the cut-off value and leak test was considered as negative. These patients received one of the following steroid therapies as per the decision of morning consultant, who was blinded about the study.

Methylprednisolone 20 mg IV (intravenous) starting 12 hours before planned extubation (methylprednisolone), total of four doses. Methylprednisolone 40 mg IV single dose 4 hours before extubation (Methylprednisolone 40 mg). Dexamethasone 4 mg IV every 8 hourly for 24 hours (Dexamethasone). Hydrocortisone 100 mg IV single dose 4 hours before extubation (Hydrocortisone).

Patient demographic data, admission diagnosis, severity of disease, duration of intubation, steroids use for extubation,

occurrence of post extubation stridor and requirement of re-intubation was recorded daily prospectively. During the steroid therapy if any adverse effect such as polyuria, glycosuria or hyperglycemia occurred were recorded.

Data was entered in the SPSS program. Data is presented in the form of mean, percentage; range and standard deviation (SD) as appropriate and statistical analysis were conducted using T-square test, for continuous variables and Pearson Chi-square test or Fisher exact test for categorical variable, P value of less than 0.05 was considered as statistically significant.

## Results

A total of 489 patients were enrolled in the study, 63 patients were excluded: these were the patients who were already on steroid therapy, pediatric, pregnant and tracheostomised patients. Majority of patients were male n= 345 (80.9%) Versus female n=81 (19.0%) (Figure1).

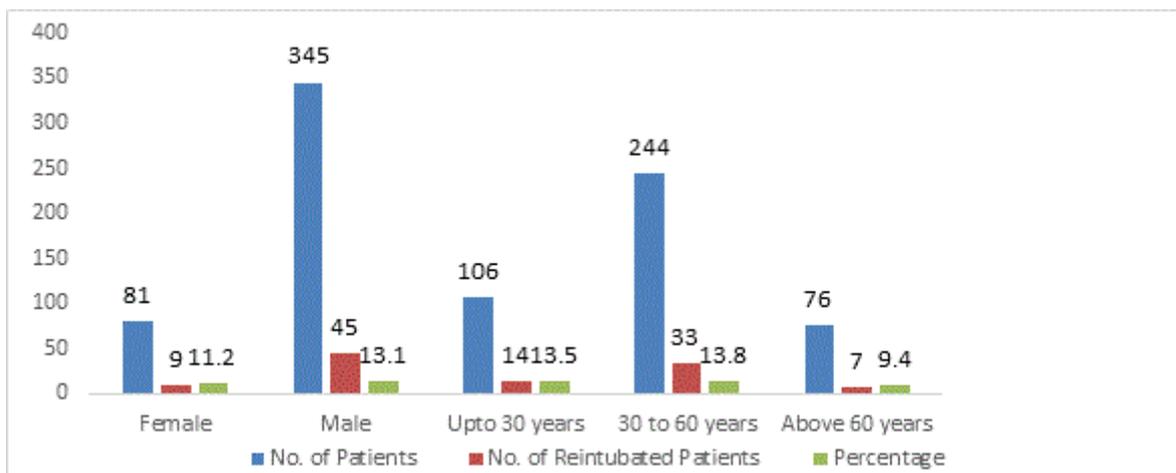


Figure 1: Gender, Age Group and Reintubations.

Steroid used for extubation were methylprednisolone 20 mg Q 4 hourly 4 doses till extubation in n=210 (49.29%) patients, single dose hydrocortisone 100 mg in n=88 (20.65%) patients, n=53 (12.44%) patient received dexamethasone 4 mg Q8 hourly, methylprednisolone 40 mg IV stat single dose in n=42 (9.85%) and n=33 (7.74%) patients did not receive any steroids (Table 1).

Table 1: Reintubation and steroid used (P<0.05).

Steroid	Reintubations (Number)	Reintubations Percentage	Total Patients	Total Patient Percentage
Dexamethasone	9	16.99	53	12.44

Hydrocortisone	8	9.10	88	20.65
Methylprednisolone	18	8.58	210	49.29
Methylprednisolone 40	3	7.15	42	9.85
No Steroid	16	48.49*	33	7.74
Total	54	12.68	426	100

Fifty-four patients (12.68%) patients were reintubated, and 42 (9.86%) had stridor. Twelve patients required reintubation due to excessive secretion and deteriorated level of consciousness (Tables 1 and 2). Those patient who did not receive any steroid for extubation had significantly higher stridor n=42 (33.4%) and reintubation n=54 (48.48%), (P<005)

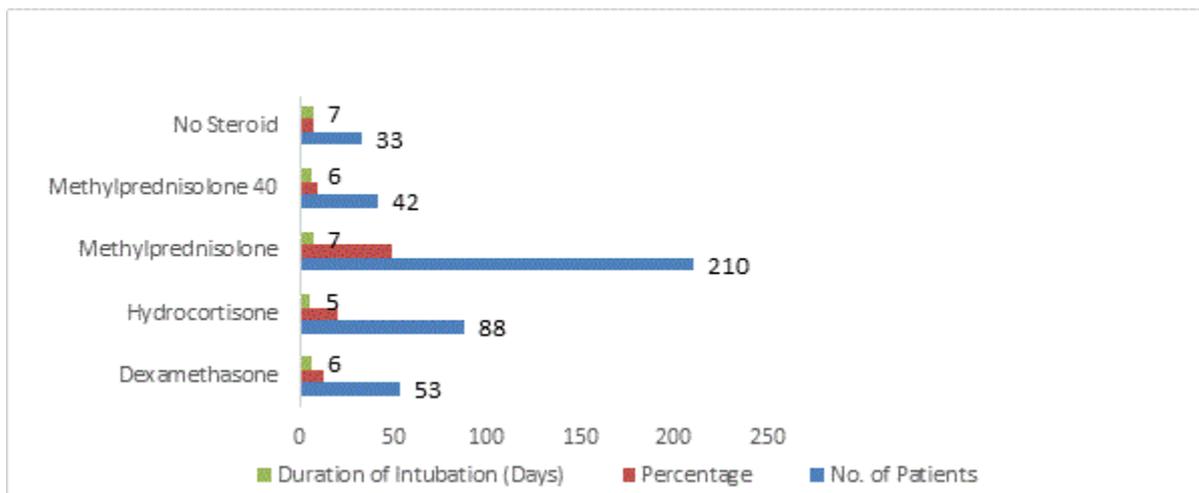
compared to the rest of patient who received steroid (Tables 1 and 2).

**Table 2:** Stridor and Steroid (P <0.05).

Steroid	Patients with stridor (Number)	Patients with stridor (Percentage)	Total Patients (Number)	Total Patient Percentage
Dexamethasone	8	15.12	53	12.44
Hydrocortisone	7	7.96	88	20.65
Methylprednisolone	16	7.62	210	49.29
Methylprednisolone 40	0	0	42	9.85
No Steroid	11	33.34*	33	7.74
Total	42	9.86	426	100

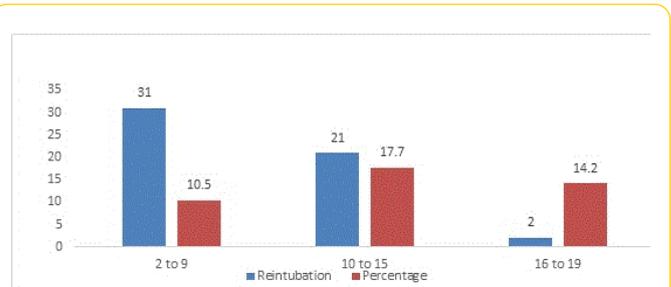
Reintubation percentage was higher in male n=45 (13.04%) compared to female patients n=9 (11.11%) There was no significant difference in reintubation according to gender (Figure 1). In our study 14 (13.5%) patient age less than 30 years, 33 (13.8%) patients in age of 30 to 60 years compared to

7 (9.4%) patients in age more than 60 years had reintubation. Reintubation rate was more in younger patients (Figure 1). Average duration of intubation was 6 days, no statistically significant difference in duration of intubation and steroid received (Figure 2).



**Figure 2:** Patients division by steroids and Duration of Intubation

Thirty-one (10.5%) patients with SOFA score 2-9, 21 (17.7%) patient in SOFA score range of 10-15, and 2 (14.2%) patients in SOFA score range of 16 to 19 were reintubated. The percentage of patients reintubated in our study had higher SOFA score (figure 3). Thirty-eight (46.4%) patients reintubated had severe brain injury, 7 (14.3%) had acute abdomen, 2 patients had necrotizing fasciitis. The higher number of reintubation 38 (46.4%) were occurred in patients with severe brain injury (Table 3).



**Figure 3:** SOFA Score and Reintubation.

**Table 3:** Reintubation & Diagnosis.

Diagnosis	Patients	Reintubation	Percentage

Acute abdomen	49	7	14.3
Acute Respiratory Distress Syndrome	5	2	40
Severe brain injury	178	38	46.4
Necrotizing fasciitis	13	2	36.2
Pancreatitis	5	1	20
Septic shock	50	4	8
Others	126	0	0
Total	426	54	12.7

## Discussion

Critically ill patients frequently need endotracheal intubation for airway protection and invasive ventilation. The final stage in discontinuation of invasive ventilation is the successful tracheal extubation. Failed extubation increases the morbidity and mortality due to prolonged ventilation, increased ventilator associated events and the most significant etiologies of failed extubation is the development of post extubation laryngeal edema. The reported incidence of post extubation stridor varies from 3.5%-37.2%, 18% of these patients will require reintubation [1,2]. These varied incidences may be related to the different steroid use or different regimes of steroid therapy. In our study 42 patients (9.86%) required reintubation due to stridor. But overall the result of recent meta-analysis of those studies using steroid for extubation was positive in preventing postextubation stridor as well as reintubations [4]. Colice et al. in their study included mainly medical patients and able to identify that 94% of intubated patients for more than 4 days had laryngeal edema [5]. Darmon et al. reported that post extubation laryngeal edema is usually occurs immediately after extubation and frequent if patient is intubated for more than 36 hour. We also considered all patients intubated for more than 36 hours and performed the cuff leak test. The post extubation edema commonly occurs at level of vocal cord and around the cuff area in larynx [6].

Endotracheal cuff leak test is commonly used for the preextubation diagnosis of the laryngeal edema, although the direct laryngoscopy is the gold standard. After deflation of the cuff if leak is more than 10% of the inspired tidal volume, it indicates that there is no laryngeal edema. Jaber et al. in an observational study found that the cuff leak test has 85% sensitive and 95% specific, it has 69% positive prediction whereas negative prediction value of 98%. We recruited patients with a positive cuff leak test means no air leak. They also reported that the risk factor for laryngeal edema were duration of intubation, traumatic intubation, self extubation and severity of the disease [7]. Steroids are used to prevent the occurrence of post laryngeal edema, they helps in reducing edema by its anti-inflammatory action and by decreasing the infiltration of pro-inflammatory mediators in the local tissues. The reported variation in occurrence of post extubation laryngeal edema indicates that varied steroid regimes are used for prevention. In our study there was significantly higher

stridor and reintubations in patients who did not receive prophylactic steroids. As reported by François et al. that the negative reports of use of steroids for prevention of laryngeal edema was mostly due to the inappropriate use of steroids. Surprisingly those trails showing the positive results of using steroids in preventing post extubation stridor and airway obstruction had used multiple dosage of steroids and therapy was started much earlier from the day of planned extubation.

Even single dose of methylprednisolone 40 mgs given 4 hours before extubation was effective in preventing the post extubation laryngeal obstruction [8]. In our patient's methylprednisolone 40 mgs was found to be effective. Lee et al. used dexamethasone for prevention of post extubation laryngeal edema in their prospective study and reported significant increase in cuff leak, significant decrease in post extubation stridor and decrease percentage of reintubation in steroid group compared to the control group [9].

François et al. use 20 mgs methylprednisolone every 4 hour till extubation, started 12 hours before the planned extubations; a total of 4 doses and concluded that significant decrease in post extubation obstruction as well as reintubation rate in steroid group [3]. We also frequently used 4 doses methylprednisolone 20 mgs regime for prevention of post intubation laryngeal edema with a good results. McCaffrey et al. emphasized the use of multiple doses of steroid to prevention of extubation failure due to post extubation laryngeal complications [4]. Khemani et al. in their Cochrane data base review found that there is significant reduction in stridor but not the reintubation rate with the use steroid for Extubation [10]. Tao Fan et al. showed that use steroid will decrease the post extubation laryngeal complication and reintubations [11]. Jaber et al. in their meta- analysis also found that in high risk group patients the use of steroid 4 hours before extubation will prevent stridor and reintubation [7].

In our study reintubation was common in male, younger, higher severity score, and severe brain injury patients. We have higher percentage of reintubation in male whereas in the literature laryngeal edema and reintubation is more common in female patients [1-4].

Miu et al. described that the risk factors for reintubation are frequent endotracheal suctioning and higher disease severity [12]. Recently Thille et al. also concluded their study by dictating that the risk factor for reintubation are weaker cough, mechanical ventilation for more than 7 days and severe left ventricular dysfunction [13]. In our patients severe brain injury was risk factor for reintubation.

In our study, patients who received steroid had significantly less stridor and reintubation. We followed the common adverse effects of steroid and none of our patient had any of these effects of the use of steroids.

Khemani [10] and Lee [9] also report no complication with use of steroid for extubation but McCaffrey et al. [4] found glycosuria but no difference in sepsis or hyperglycemia and mortality with use of steroid for prevention of post extubation complications.

## Conclusion

Steroids can prevent the development of post extubation laryngeal edema. In our study majority of patient received methylprednisolone 20 mgs 4 doses regime. Reintubation was higher in male, severe brain injury and severely ill patients. Further randomized clinical trials are needed to confirm these associations.

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