ORIGINAL ARTICLE

Endotracheal reintubation in post-operative cardiac surgical patients

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ABSTRACT

Background: The reported incidence of reintubation in patients who were weaned from mechanical ventilation after cardiac surgery is 6.6%4 in a retrospective study, but little work has been done prospectively to find out the incidence and causes for reintubation in a cardiac surgical ICU. We conducted this study to find out incidence and the causes of endotracheal reintubation in patients who were electively ventilated after open heart surgery and were extubated after fulfilling preset criteria for extubation.

Methodology: A total of 1229 consecutive patients were included in the study. On arrival to ICU after cardiac surgery, all patients were electively ventilated with standardized ventilatory parameters. Routine monitoring of all patients was done and patients were extubated once they met the criteria for extubation. The patients, who met the reintubation criteria, were reintubated and the reason(s) noted. Once they stabilized and fulfilled the extubation criteria, they were extubated.

Results: A total of 47(3.82%) patients required reintubation after weaning from the ventilation during the study period, and in 5(10.63%) patients out of these, reintubation was needed more than once. We found a higher incidence of reintubation, 11.84 % and 10.63%, in patients after single and double valve replacement surgery respectively. The incidence was much lower (2.14%) among coronary artery bypass grafting (CABG) patients.

Conclusion: The patients undergoing valve replacement surgery are more prone to reintubation in postoperative period as compared to CABG patients. Impending respiratory failure, cardiovascular (hemodynamic) instability and impaired conscious level are the common indications for reintubation.

Key Words: Extubation failure; coronary artery bypass grafting; reintubation; cardiac surgery intensive care unit; open heart surgery; valve replacement.

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INTRODUCTION

Endotracheal reintubation is not uncommon among critically ill patients after open heart surgery[1]. The overall incidence for reintubation in a general surgical intensive care unit is generally considered 4%, but varies dramatically between 1-13%, depending on the underlying disease process [2]. Similarly a 10% incidence has been re ported in 745 consecutive admissions in medical ICU patients that were mechanically ventilated for a minimum of 6 hours[3]. The reported incidence of reintubation in patients who were weaned from mechanical ventilation after cardiac surgery

is 6.6%[4] in a retrospective study but little work has been done to find out the incidence and causes for reintubation in a cardiac surgical ICU prospectively.

Reintubation is not only associated with increased duration of mechanical ventilation but also the ICU and hospital length of stay[5]. Reintubation is known to be an independent cause, which adds to the mortality; patients who required reintubation have poor prognosis with a mor tality rate exceeding 30-40% [6], ir respective of the cause for reintubation. The major causes of reintubation are usually related to respiratory or cardiovascular system but could be multi-factorial6 and may possibly be prevented, to some extent, by improving the care[7].

We studied the incidence and the causes of endotracheal reintubation in patients who were electively ventilated after open heart surgery and were extubated after fulfilling the preset criteria for extubation.

METHODOLOGY

After approval by the institutional review board of our hospital, all adult patients , who underw ent open hear t surgery and were electively ventilated after the surgery in the post-cardiac surgery intensive care unit (CICU), were included in the study. It was a descriptive study. The data was prospectively collected for a period of seven months, from January to July 2008. A total of 1229 patients, admitted during this period, were enrolled in the study.

Routine monitoring of all patients w as done including ECG, arterial oxygen saturation (SaO2), end tidal carbon dioxide (EtCO2), central v enous pressure and in vasive arterial blood pressure . Pulmonar y ar tery pressure , pulmonary capillary wedge pressure or left atrial pressure were monitored where indicated (Table 3).

Arterial blood gases were checked hourly for the first four hours and were subsequently repeated after every change in the ventilatory parameters. Urine output and surgical bleed through the chest drains was measured on an hourly basis. Hematocrit was aimed to be kept at 30 % or above and appropriate transfusion w as given when indicated.

All patients, on arrival to ICU, were put on standardized ventilatory parameters unless indicated otherwise. They were initially put on volume controlled or pressure controlled mode (Table 3). A positive end expiratory pressure (PEEP) of 5 cmH2O or more w as added where indicated. An inspired oxygen fraction (FiO2) of ³50% and a tidal volume of 10ml/kg body w eight was set to all patients.

The ventilatory parameters were adjusted according to the results of arterial blood gases (ABG's).

An early extubation was aimed in all patients but no time schedule was fixed like a fast trac k. All patients w ere extubated without any dela y, when they met the preset criteria for extubation (Table 1).

Table 1: Pre-set Criteria for extubation

Respiratory:
- *Minimal respiratory support (1-2 h):* SIMV rate ² 6 breaths/min; Pressure support ²10cmH2O; PEEP ² 5cmH2O; FiO2 ² 50%.
- *Arterial blood gas:* SaO2 ³ 90% on Fio2 ² 50%, PaO2 ³ 80mmHg on Fio2 ² 50%, PaCo2 30-45mmHg
- *No frequent airway suctioning needed*

Cardiovascular:
- Mean arterial pressure 70-110mmHg.
- Stable (sinus) rhythm or a rhythm other than sinus not adversely affecting the BP.
- Heart rate 60-110/min.

Conscious level:
- Mentally alert, Obeying verbal commands, protecting airway, intact cough and gag reflex.

Vasoactive drugs:
Dopamine²10 µg/Kg/min; Dobutamine ² 10 µg/kg/min; Epinephrine ² 0.05µg/min; Norepinephrine ² 0.2 µg/kg/min; Glyceral Trinitrate (GTN) ² 5 µg/kg/min; Milrinone ² 0.5 µg/kg/min and Sodium nitroprusside (Nepride) ² 2 µg/kg/min

Miscellaneous:
- Chest drainage ³ 100 ml/hr
- Muscle power ³ grade-3

A consideration w as also gi ven to the frequency of requirement and dosag e of inotropic , chronotropic, vasodilator and/or vasoconstrictor drugs used. Extubation was delayed if a patient was on more than three drugs at that same time. Diaphoresis, confusion, stroke, renal failure or compromised renal functions and anxiety w ere also considered as causes for extubation dela y. Patients were re-intubated when indicated according to preset criteria for reintubation (Table 2).

Table 2: Pre-set criteria for re-intubation

Respiratory:
- Impending respiratory failure:
- ↑in PaCO2 ³ 10 mmHg/hr, _in the pH ³ 0.10/hr, PaO2 ² 60 mmHg or SaO2 ² 90% on FiO2 ³ 50%
- ↑work of breathing
- Upper respiratory obstruction
- Excessive pulmonary secretions

- Pulmonary edema
- Tension pneumothorax
- Severe bronchospasm

Cardiovascular:

- ↓Mean arterial pressure ² 60mmHg (for ³ 1hr)
- Cardiac temponade
- Dysrythmias with hemodynamic instability
- Cardiopulmonary arrest

Impaired conscious level:

Miscellaneous:

- Chest drainage ³ 100ml/hr
- Accidental extubation

The data for the indications for reintubation were collected under the categories of respiratory, cardiac, central nervous system and multisystem involvement. All other causes were grouped under miscellaneous , including accidental extubation and surgical bleeding.

RESULTS

Demographic data showed a mean age of 62±5.5 years. The number of male patients was almost three times more than females. Patients, who underwent a CABG, were 933(75.91%), including 5(0.4%) patients who had had a redo procedure. Nine patients (0.73%) had sev ere renal impairment and underwent off pump bypass.

A total of 47(3.82%) patients required reintubation after weaning off ventilation. Fourteen (29.78%) patients were reintubated within 5-10 hours after extubation, but 18(38.29%) patients tolerated the extubation trial well for the first 24 hours and needed reintubation afterw ards (Table-4).

Table 3: Reintubation data*

Variable		Total No. of patients	Reintubation N(%)
Patients		1229	47(3.82)
Sex	Male	864(70.30)	32(3.70)
	Female	365(29.69)	15(4.10)
Single valve replacement		152(12.36)	18(11.84)
Double valve replacement		65(5.28)	5(10.63)
CABG		933(75.91)	20(2.14)
Coronary + valve replacement		79(6.42)	4(5.06)
Special Monitoring			
Pulmonary artery pressure		43(3.49)	11(25.58)
PCWP**		35(2.84)	5(14.82)
Left atrial pressure		17(1.38)	7(41.17)
			Initial mode of ver
Volume control		971(79.00)	41(87.23)
Pressure control		258(20.99)	6(12.76)

*Data presented as number and percentage
**Pulmonary capillary wedge pressure

Table 4: Time to reintubation

Time of Reintubation	N(%)
Within 24 hours	26(55.31)
2nd day	7(14.89)
3rd day	4(8.51)
4th day	7(14.89)
5th day	1(2.12)
>5 days	2(4.25)
	0
Time since last extubation (hrs)	**N(%)**
0-1	8(17.02)
2-4	5(10.63)
5-10	14(29.78)
11-24	2(4.25)
>24	18(38.29)

Twenty six (55.31%) patients were reintubated because of impending respiratory failure due to various reasons but respiratory muscles weakness and hypoventilation were the most impor tant cause (T able 5). Only 6 (12.76%) patients had cardiovascular reason for reintubation, where hemodynamic instability and h ypotension w ere the important responsible factors. Five patients (10.6%) were re-intubated because of impaired conscious lev el that deteriorated after extubation. Only 2 (4.25%) patients were extubated accidently and w ere reintubated immediately.

Surgical Procedure

The decision to reintubate was made on overall condition of the patient and the cause for reintubation was assigned to the physiological system that was predominantly involved in the failure. Only 4(8.5%) patients had a significant involvement of more than one body system and the cause was assigned to m ulti-organ failure categ ory. The most

common combination of multi-organ involvement was impending respiratory failure together with impaired conscious level.

Table 5: Causes of reintubation

Causes	N(%)
Impending respiratory failure:	
Due to Pneumonia / excessive secretions, non cardiac pulmonary edema, lung collapse, aspiration, bronchospasm, respiratory muscle weakness, upper airway obstruction, hypoventilation syndrome and kinked / blocked tube.	26(55.31)
Cardiovascular: Severe myocardial ischemia or acute Infarction, severe arrhythmia with Hemodynamic instability, severe hypotension (low output syndrome), congestive heart failure and cardiac arrest.	6(12.76)
Impaired conscious level	5(10.6)
Accidental extubation	2(4.25)
Surgical bleeding	2(4.25)
Multi organ involvement	4(8.5)
Miscellaneous	2(4.25)
Total	47(100)

Eighteen patients (38.29 %) that were reintubated once or more than once eventually died. None of them had a tracheostomy because they all died for various reasons within two weeks of reintubation. The cause of death determination was beyond the scope of this study; hence, has been ignored.

Five (10.63%) patients, needed reintubation more than once (Table 3). The incidence of reintubation was not different between male and female patients and corresponded closely to their ratio. We found a higher incidence of reintubation, 18/152 (11.84 %) and 5/65 (10.63%), in single and double valve replacement surgery respectively. The incidence was much lower [20/933 (2.14%)] among CABG patients.

DISCUSSION

We admitted 1229 consecutive patients after cardiac surgery in our ICU over a period of 7 months and studied them prospectively. A total of 47(3.82%) patients failed the extubation trial. Patients undergone a single or double valve surgery had a higher incidence of reintubation in comparison to CABG surgery. The incidence of reintubation was 4/79(5.06%) in patients who had CABG together with a valve replacement.

The higher incidence of reintubation among the valve replacement surgery indicates some correlation between the extubation failure and valve surgery. The exact cause is unclear but it is known that pulmonary functions might deteriorate in the immediate postoperative period and might take time to return to the preoperative values8. The possible mechanism could be the poor compliance of the lungs to accommodate the corrected cardiac output after valve surgery. The reported incidence of persistent pleural effusion for weeks after valve replacement surgery is 45%[9] and that could have been contributed to pulmonary malfunction and subsequent need for reintubation in our valve replacement patients.

Our overall incidence (3.82%) of reintubation was almost half of the reported incidence (6.6%) after cardiac surgery[4]. The reasons of this difference may be related either to the difference in the type of surgery or to a difference in the policy of fast track protocol at some centers, in an attempt to reduce the ICU stay and cost[10].

The most common (55.31%) cause for reintubation in our study was impending respiratory failure that manifested with increased work of breathing, accessory muscle use, hypoxia and/or hypercapnea, hypoventilation and respiratory acidosis, especially for those who were reintubated within the first 24 hours. Half of our reintubated patients developed pneumonia. In a case control study, the incidence of pneumonia was significantly higher (47%vs10%) in patients needing reintubation[11]. Dries and colleagues also found an increased incidence of nosocomial pneumonia in patients who failed extubation trial[12], which confirms our findings.

Pulmonary edema and upper airway obstruction were among the important respiratory causes for reintubation, especially for those who were reintubated after the second day of extubation. Interestingly, causes related to airway patency and secretions manifested only after extubation.

The incidence of asymptomatic myocardial ischemia has been reported to be 52% after CABG[13]. In our study 6/47 (12.76%) of the patients had a cardiac reason for reintubation, where myocardial ischemia or acute infarction were the common reasons, that led to low output syndrome and heart failure among CABG patients, while pulmonary hypertension was the important reason in the valve

replacement surgical patients.

It is well known that patients, who undergo myocardial revascularization procedures, are particularly prone to stroke, encephalopathy and other neurologic dysfunction, because they are relatively old and have atherosclerotic disease. They are also subject to cerebral embolization and cerebral hyperthermia after the discontinuation of cardiopulmonary bypass[14,15]. We found impaired conscious level (10.6%) to be the third important reason for reintubation in our study. Two of those patients ultimately developed stoke and died later on.

CONCLUSION

Endotracheal reintubation is not uncommon among critically ill patients after open heart surgeries. The incidence was higher in patients undergone valve replacement surgery in comparison to CABG surgery. Impending respiratory failure, cardiovascular (hemodynamic) instability and impaired conscious level were the most important indications for reintubation.

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