April 2018

Factors affecting reintubations after cardiac and thoracic surgeries in cardiac intensive care unit of a tertiary care hospital

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Original Article

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ABSTRACT

Background: Reintubation and readmission after cardiothoracic surgeries are not uncommon, and its reasons are multifactorial. The study goal was to identify the factors that contribute reintubation after cardiac and thoracic surgery in tertiary care hospital and to compare the outcome with international benchmark.

Methodology: A prospective, observational study was planned in Cardiac Intensive Care Unit (CICU). The study included all those patients who required readmission in CICU due to endotracheal intubation following cardiac and thoracic surgeries. The study was conducted from January to December 2016. The primary focus was to identify the reasons for reintubation within 72 h of extubation after CICU discharge and its association with outcome.

Results: Out of 750 patients who shifted out from CICU following successful extubation, only 32 were readmitted and among them in 25 patients (3.33%) were reintubated and their reasons reintubation were noted. Patients underwent a coronary artery bypass grafting (CABG) with valve replacement had a higher incidence of reintubation 3/39 (7.69%) when compared with CABG 13/517 (2.51%) and 4/135 (2.96%) valve procedure alone. Single cause of endotracheal reintubation was observed in 7 patients (28%), in which 5 patients (20%) had respiratory and 2 patients had (8%) cardiac reason while 18 patients (72%) were observed with multisystem involvement, in which 7 patients (28%) had both respiratory and cardiovascular causes, and 2 (8%) had both respiratory and neurological causes. More than 70% cause of endotracheal reintubation was both respiratory and cardiovascular. The CICU stay after reintubations was 12.88 ± 16.88 days and the hospital stay prolonged to 23.84 ± 21.61 days.

Conclusion: Reasons of reintubation were mainly respiratory and cardiac. The rate of reintubations is high when multisystem involvement is there. CICU, hospital stay, and mortality are increases after reintubation.

Key words: Cardiac Intensive Care Unit; cardiothoracic surgery; readmission; reintubation

Introduction

Reintubation after mechanical ventilation is always considered as worst event despite having standard criteria for weaning. Endotracheal reintubation is not unusual for critically ill patients after open heart surgery.[1] The overall incidence for reintubation in a general surgical intensive care unit is 4% but varies intensely between 1%–13%, depending on the underlying disease course.[2]

Access this article online	
Website: www.saudija.org	Quick Response Code
DOI: 10.4103/sja.SJA_631_17	

How to cite this article: Siddiqui KM, Samad K, Jonejo F, Khan MF, Ahsan K. Factors affecting reintubations after cardiac and thoracic surgeries in cardiac intensive care unit of a tertiary care hospital. Saudi J Anaesth 2018;12:256-60.

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In literature, the incidence of reintubation in patients who were reweaned from mechanical ventilation after cardiac surgery is 6.6%.[3]

Reintubation is not only associated with increased duration of mechanical ventilation but also increases the length of ICU and hospital stay.[4] Reintubation is known to be an independent cause, which increases mortality. Patients who require reintubation have poor prognosis with a mortality rate exceeding 30%–40%, irrespective of the cause for reintubation.[5]

We performed a prospective study among those patients who have meet the determine criteria for extubation on mechanical ventilation and discharge from Cardiac Intensive Care Unit (CICU) after cardiac and thoracic surgery. We also and assess the number of patients requiring readmission to the CICU, and the factors causing reintubation, with their outcome.

Methodology

The study was conducted in CICU of Aga Khan University Hospital which is a JCIA accredited over 500-bedded hospital. The CICU has capacity of 8 beds and it is run by the joint team effort of surgeons and cardiac anesthesiologist who has specialist training in cardiac anesthesia and ICU. The team provide 24/7 coverage.

All adult patients who successfully extubated in CICU after open-heart surgeries including coronary bypass grafting (CABG), valve replacement/repair, combined procedures, adult atrial septal/ventricle septal defects, and planned thoracotomies were included in the study. The study was exempted from Hospital Ethical Review Committee and completed over a period of 1 year from January to December 2016.

American Society of Anesthesiologists status at the time of surgery and their comorbids were also being noted for all included patients. Patients died in the operating room or CICU were excluded from the study. A total of 750 patients fulfilling inclusion criteria, admitted in CICU during this period, were enrolled in the study. All components of management have been part of the standard care policy at our institution. Patients were targeted qualifying discharge from the CICU on the second or third postoperative day, on their arrival in the CICU.

Standard postoperative care consisted of mechanical ventilation with synchronized intermittent mandatory ventilation with pressure support (PS) and cardioactive drugs where indicated. The use of warm air heaters to maintain normothermia, and analgesia with intravenous narcotics boluses (fentanyl) were also prescribed by either anesthesiologist or primary surgeon as required to patients. Criteria for weaning from the ventilator included hemodynamic stability (no or decreasing use of cardioactive drugs), absence of significant bleeding (<100 mL/h), absence of significant arrhythmias, adequate urine output (>1 mL/kg/h), and oxygen saturation more than 95% with fractional concentration of inspired oxygen less than 0.50; the patient also needed to be sufficiently awake to follow commands.

Patients fulfilling these criteria were placed on PS ventilation for 20–30 min, and in the absence of respiratory or cardiac distress, extubation was performed immediately thereafter. During this period, any increasing requirement for cardioactive drugs or significant decrease in oxygen saturation (90% despite oxygen mask), urine output, or level of consciousness was considered a contraindication for discharge. After second or third postoperative day, the patient is routinely discharged from CICU with set above criteria. Whenever any bounce back or reintubation in the CICU were observed and identified the reasons of readmission and reintubation were recorded.

All data were collected by CICU nurse on predesigned data collection form. The principal reasons for reintubation, length of stay in the CICU as well as hospital following reintubation, the occurrence of postoperative complications and outcome in terms of mortality was also be determined in all patients.

All statistical analysis was performed using Statistical Packages for Social Science version 19 (SPSS Inc., Chicago, IL, USA). The cause of reintubation was the primary study variable. Mean and standard deviation were estimated for quantitative variables such as age, ICU, and hospital stay. Frequency and percentage were computed for qualitative variables and analyzed by Chi-square test. $P \leq 0.05$ was considered statistically significant.

Results

We received 750 patients fulfilling inclusion criteria after adult open heart surgeries and planned thoracotomies in CICU over a period of 1 year. A total of 32 patients were readmitted during study, and among them, number of reintubations were documented 25 (3.33%) [Table 1]. Patients underwent a CABG together with a valve replacement had a higher incidence of endotracheal reintubation 3/39 (7.69%) when comparison to CABG 13/517 (2.51%) and valve procedure 4/135 (2.96%) alone.

Demographic data showed a mean age of 55.8 ± 19.9 years. The number of male patients was almost two times compared with the females. Patients who underwent a CABG were 517 (68.93%). Most of the cases were male (80%) and 80% were open heart surgeries, and 20% were thoracic surgeries [Table 2]. Majority of the patients were readmitted during the first 24 h after initial discharge from CICU. The single cause of endotracheal reintubation was observed in 7 patients (28%), in which 5 patients (20%) had respiratory, and 2 patients had (8%) cardiovascular. While 18 patients (72%) patients were observed with multisystem involvement, in which 7 patients (28%) had both respiratory and cardiovascular causes, and 2 (8%) had both respiratory and neurological causes. Moreover, there were 7 (28%) patients who had more than 2 causes with respiratory, cardiovascular, and neurological. The breakup of each cause of reintubation is also mentioned in Table 3.

More than 70% cause of reintubation was both respiratory and cardiovascular as shown in [Figure 1]. The CICU stay after reintubations was 12.88 ± 16.88 days and the hospital stay prolonged to 23.84 ± 21.61 days. The mortality after intubation was 44% of patients. We also evaluated survival and death ratio with each cause of reintubation and found that dysrhythmias with hemodynamic instability are the major confounding factor toward patients mortality which is statistically significant [Tables 3 and 4].

Discussion

In general, the need for reinstitution of ventilatory support or reintubation within 24–72 h of planned endotracheal tube removal occurs in 2%–25% of extubated patients with multiple pathophysiologic causes such as hemodynamic instability, pulmonary edema, imbalance between respiratory muscle capacity and work of breathing, upper airway obstruction, excess respiratory secretions, inadequate cough, and encephalopathy.

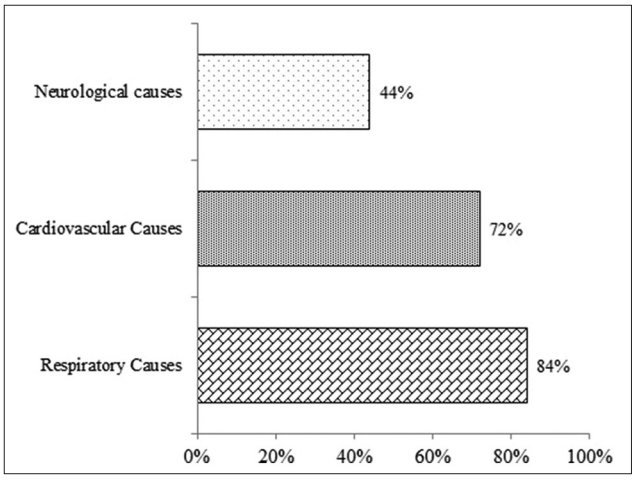

Figure 1: Contribution of causes of reintubation (*n* = 25)

In the previous cohort study of cardiac intensive care setup of tertiary care hospital over a 42 months period found an incidence of reintubation (6.6%) after cardiac surgery.[3] This difference is compared with the current study possibly due to the change in the policy of fast-track protocol followed in other tertiary care centers, in an attempt to reduce the CICU stay and cost which have shown in numerous studies in literature.[6,7]

Table 1: Rate of reintubation with respect to gender and procedures (*n*=750)

Variables	Total number of patients	Re-intubation, *n* (%)
Gender	750	25 (3.33)
Male	480 (64)	20 (4.16)
Female	270 (36)	5 (1.85)
Procedures		
CABG	517 (68.93)	13 (2.51)
CABG + valve	39 (5.2)	3 (7.69)
Valve only	135 (18)	4 (2.96)
Thoracic procedure	59 (7.87)	5 (8.47)

CABG: Coronary artery bypass grafting

Table 2: Characteristics of patients (*n*=25)

Variables	Point estimates (%)
Age (years)	55.8±19.90
Gender	
Male	20 (80)
Female	5 (20)
ASA status at the time of surgery	
ASA I	0
ASA II	0
ASA III	4 (16)
ASA IV	21 (84)
Surgical procedure	
Open cardiac procedure	20 (80)
CABG	13
CABG + valve	3
Valve procedure only	4
Thoracic procedure	5 (20)
Causes of reintubation	
Respiratory	5 (20)
Cardiovascular	2 (8)
Respiratory + cardiovascular	7 (28)
Respiratory + neurological	2 (8)
Cardiovascular + neurological	2 (8)
Respiratory + cardiovascular + neurological	7 (28)
CICU stay (days)	12.88±16.88
Hospital stay (days)	23.84±21.61
Mortality	11 (44)

Results are presented as mean±SD and *n* (%). SD: Standard deviation; CICU: Cardiac Intensive Care Unit; ASA: American Society of Anesthesiologists; CABG: Coronary artery bypass grafting

A prospective study of 1229 patients after cardiac surgeries found 11.8% and 10.6% reintubation in double and single valve replacement, respectively, whereas reintubation incidence in CABG alone was found 3.82%, and overall reintubation incidence was 2.14% which is very much comparable to our study.[8]

The higher incidence of reintubation among the CABG together with valve replacement surgery indicates some correlation between extubation failure and a combined procedure. The exact mechanism is unclear; however, it is known that respiratory functions might deteriorate in the immediate postoperative period and might take time to return to preoperative values. It may be due to poor compliance of the lungs to accommodate the corrected cardiac output after combined CABG and valvular surgery. The incidence of persistent pleural effusion for weeks after combined CABG and valve replacement surgery is reported to be 45% and that could have been the contributing factor to pulmonary malfunction and subsequent need for reintubation in our combined procedure patients.[9]

Table 3: Subtype of causes of re-intubation (*n*=25)

Causes of reintubation	*n* (%)
Respiratory causes (*n*=21/25=84%)	
Impending respiratory failure	13 (52)
Increase work breathing	14 (56)
Excessive pulmonary secretion	6 (24)
Pulmonary edema	4 (16)
Upper respiratory obstruction	1 (4)
Cardiovascular causes (*n*=18/25=72%)	
Decreases arterial pressure (60 mmHg) (for 1 h)	10 (40)
Dysrhythmias with hemodynamic instability	9 (36)
Cardiopulmonary arrest	5 (20)
Neurological causes (*n*=11/25=44%)	
Drop in GCS	11 (44)
Stroke	2 (8)
Continuous sedation drug	1 (4)

GCS: Glasgow Coma Score

Table 4: Comparison of causes of reintubation in patients with survived and death

Causes of reintubation	Survive (*n*=14)	Death (*n*=11)	*P*
Respiratory causes (%)	13 (92.9)	8 (72.7)	0.28
Impending respiratory failure	8	5	0.56
Upper respiratory obstruction	0	1	0.44
Pulmonary edema	2	2	0.99
Increase work breathing	9	5	0.43
Excessive pulmonary secretion	5	1	0.18
Cardiovascular causes (%)	8 (57.1)	10 (90.9)	0.09
Decreases arterial pressure (60 mmHg) (for 1 h)	6	4	0.74
Dysrhythmias with hemodynamic instability	2	7	0.017*
Cardiac tamponade	0	0	-
Cardiopulmonary arrest	3	2	0.84
Neurological causes (%)	6 (42.8)	5 (45.5)	0.74
Stroke	1	1	0.99
Drop in GCS	6	5	0.98
Continuous sedation drug	0	1	0.44

Results are presented as *n* (%). *$P<0.05$. Percentages do not equal to 100% because each cause analyze separately. GCS: Glasgow Coma Score

In our study, around 84% causes of reintubation are respiratory with or without multisystem involvement which is very evident and has been previously shown in numerous studies in literature.[10-12] The most common respiratory cause is impending respiratory failure (52%) that manifested with increased work of breathing. In one particular study,[8] the most common cause was impending respiratory failure (55.31%) which is again comparable (52%) to our study. Interestingly, causes related to airway patency and secretions (24%) manifested only after extubation.

In our study, 72% of the patients had cardiac reason for reintubation, where hemodynamic instability (arterial pressures decreases to 60 mmHg for 1 h), dysrhythmias with hemodynamic instability as a statistically significant finding. Cardiopulmonary arrest was the common reason, while pulmonary hypertension was the important reason among the valve replacement surgery patients and combined valvular and CABG patients. As a establish fact, arrhythmias are very common complications after cardiac surgery and represent a major source of morbidity and mortality. Among all arrhythmias, atrial tachyarrhythmia is the most common postoperative heart rhythm disorder.[13]

The overall incidence of atrial fibrillation occurs in 5%–40% patients after coronary artery bypass surgery and contribute to mortality and morbidity in the postoperative period.[14] Peretto *et al*.[15] had described that age, structural heart disease, and extracardiac comorbidities, such as obesity, history of the previous stroke, and history of chronic obstructive pulmonary disease are considered the most known patient-related risk factors. Whereas, the inflammation after the surgery, hemodynamic stress during perioperative phase, ischemic myocardial injury due to hypoxia or hypercarbia, and electrolyte disbalances such as hypokalemia are considered surgical causes of arrhythmias after cardiac surgeries. To combat the postoperative arrhythmias after cardiac surgery, continuous atrial pacing is a reliable measure to follow.[16] The most recent evidence advocates that fluid and inotropes administration should be directed to maintain a cardiac index above 3l/min/m all over the perioperative phase, the use of preoperative steroids could also reduce postoperative atrial fibrillation.[17]

It has been noted that patients, who underwent myocardial revascularization and valve replacement procedures are

particularly prone to develop stroke, encephalopathy, especially in geriatric or patients with significant atherosclerotic disease. Moreover, these patients are also subject to cerebral embolization and cerebral hyperthermia after discontinuation of cardiopulmonary bypass.[18,19] In our study, impaired conscious level (drop in Glasgow Coma Scale) 11/25 (44%) was found to be the third important reason for reintubation after pulmonary and cardiovascular reasons.

In our study, the elective high-risk thoracic surgery patients in CICU were also treated and followed postoperatively. All these patients were extubated, out of them five patients required re-intubation after 24 h. The main causes that led to reintubation after thoracic surgeries were pulmonary edema, atelectasis, pneumonia, airway obstruction, arrhythmias, imp aired brain function, and aspiration pneumonia. Furthermore, compromise preoperative medical status with poor baseline pulmonary functions was thought to be the major contributory factors. In recent review related to postoperative complications after thoracic surgeries have also highlighted same issues and concludes that anticipation and recognition of the problems can preclude major impediments.[20] Similarly, another study concluded that the presence of more than two or three pulmonary risk predictors also lead to postoperative ICU requirements.[21]

This study has some limitations. First, we did not monitor and follow patients after initial CICU discharge. Second, we followed the standard protocol of weaning but occasional discretional discharge by the primary surgeon due to other lined up cases. This might contribute early discharge from CICU. Third, we did not correlate the relationship of patient's comorbids and performed surgery which could have some impact on the outcome.

Conclusion

The causes of reintubation are respiratory, and cardiac. The rate of reintubations is high when there is multisystem involvement. CICU, hospital stay, and mortality increase after reintubation with prolong ventilation. We suggest that additional studies are warranted in postcardiac and thoracic patients to identify other disease-related specific risk-factors, outcome measures, and conditions contributing to clinical deterioration. It would definitely reduce the rate of readmission in CICU and improve clinical outcome.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References

1. Boeken U, Schurr P, Kurt M, Feindt P, Lichtenberg A. Early reintubation after cardiac operations: Impact of nasal continuous positive airway pressure (nCPAP) and noninvasive positive pressure ventilation (NPPV). Thorac Cardiovasc Surg 2010;58:398-402.
2. Demling RH, Read T, Lind LJ, Flanagan HL. Incidence and morbidity of extubation failure in surgical intensive care patients. Crit Care Med 1988;16:573-7.
3. Rady MY, Ryan T. Perioperative predictors of extubation failure and the effect on clinical outcome after cardiac surgery. Crit Care Med 1999;27:340-7.
4. Gowardman JR, Huntington D, Whiting J. The effect of extubation failure on outcome in a multidisciplinary Australian Intensive Care Unit. Crit Care Resusc 2006;8:328-33.
5. Rello J, Diaz E, Roque M, Vallés J. Risk factors for developing pneumonia within 48 hours of intubation. Am J Respir Crit Care Med 1999;159:1742-6.
6. Cheng DC, Karski J, Peniston C, Asokumar B, Raveendran G, Carroll J, *et al.* Morbidity outcome in early versus conventional tracheal extubation after coronary artery bypass grafting: A prospective Randomized controlled trial. J Thorac Cardiovasc Surg 1996;112:755-64.
7. Reyes A, Vega G, Blancas R, Morató B, Moreno JL, Torrecilla C, *et al.* Early vs. conventional extubation after cardiac surgery with cardiopulmonary bypass. Chest 1997;112:193-201.
8. Zahoor A, Azlina N. Endotracheal reintubation in post-operative cardiac surgical patients. Anaesth Pain Intensive Care 2011;15:25-9.
9. Labidi M, Baillot R, Dionne B, Lacasse Y, Maltais F, Boulet LP, *et al.* Pleural effusions following cardiac surgery: Prevalence, risk factors, and clinical features. Chest 2009;136:1604-11.
10. Rosenberg AL, Watts C. Patients readmitted to ICUs. A systematic review of risk factors and outcomes. Chest 2000;118:492-502.
11. Chung DA, Sharples LD, Nashef SA. A case-control analysis of readmissions to the cardiac surgical Intensive Care Unit. Eur J Cardiothorac Surg 2002;22:282-6.
12. Cohn WE, Sellke FW, Sirois C, Lisbon A, Johnson RG. Surgical ICU recidivism after cardiac operations. Chest 1999;116:688-92.
13. Herzog L, Lynch C. Arrhythmias accompanying cardiac surgery. Clin Card Electrophysiol 1994;3:231-58.
14. Mostafa A, El-Haddad MA, Shenoy M, Tuliani T. Atrial fibrillation post cardiac bypass surgery. Avicenna J Med 2012;2:65-70.
15. Peretto G, Durante A, Limite LR, Cianflone D. Postoperative arrhythmias after cardiac surgery: Incidence, risk factors, and therapeutic management. Card Res Pract 2014;2014:615987.
16. Naghnaeian M, Samienasab M, Mirmohammadsadeghi M, Rabani M, Pourmoghaddas A, Behnemun M, *et al.* The incidence of in-hospital atrial fibrillation after coronary artery bypass grafting using ventricular and atrial pacing. Arya Atheroscler 2013;9:11-5.
17. Ball L, Costantino F, Pelosi P. Postoperative complications of patients undergoing cardiac surgery. Curr Opin Crit Care 2016;22:386-92.
18. Mora CT, Murkin JM. The central nervous system: Responses to cardiopulmonary bypass. In: Mora CT, editor. Cardiopulmonary Bypass: Principles and Techniques of Extracorporeal Circulation. New York: Springer-Verlag; 1995. p. 114-46.
19. Herskowitz A, Mangano DT. Inflammatory cascade. A final common pathway for perioperative injury? Anesthesiol 1996;85:957-60.
20. Sengupta S. Post-operative pulmonary complications after thoracotomy. Indian J Anaesth 2015;59:618-26.
21. Pinheiro L, Santoro IL, Faresin SM. Who needs to be allocated in ICU after thoracic surgery? An observational study. Can Respir J 2016;2016:3981506.