

Intra OP Predictors of Prolonged Invasive Mechanical Ventilation and Hospital Stay after Off Pump Coronary Artery Bypass Grafting

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BACKGROUND

The last decade has seen significant advances in the treatment of coronary artery disease (CAD). Drug eluting stent and off pump CABG (OPCAB) are emerged as the alternative methods of coronary revascularization that avoids the use of cardiopulmonary bypass (CPB). The avoidance of CPB during OPCAB has made the operation equivalent to any other major non cardiac surgical procedure. This has led the cardiac anaesthesiologist to believe elective post operative ventilation may not always be necessary in these patients.

Prolonged mechanical ventilation (PMV), also known as delayed extubation, is an important complication following cardiovascular surgeries. Although occurs in only 3 to 9.9% of patients, it may be associated with considerable morbidity and mortality(1-3). A significant number of these patients will undergo tracheostomy(4). Patients who experience delayed extubation will have longer intensive care unit (ICU) and hospital stay, higher treatment cost and lower quality of life(5-8). Furthermore, it may lead to undue occupation of ICU beds leading to a lengthening of waiting list and cancellation of other elective cardiac operations.

PMV is most commonly defined as ventilation ≥ 24 hrs (Society of Thoracic Surgeons (STS) score), but has been variously defined as a cumulative duration of mechanical ventilation for ≥ 6 hrs, ≥ 8 hrs, ≥ 24 hrs,

≥ 72 hrs, or as long as ≥ 14 days (9-11). Majority of patients in the intensive care unit (ICU) are ventilated for few hours, this study mainly concentrates on a group of patients who need ventilation for more than 24 hours.

We defined PIMV as cumulative ventilation time of more than 24 hours believing that 24 hours is a sufficiently long time for hemodynamic stabilization and to off-set the deleterious effects of surgery. Moreover 24-hours cut-off limit for prolonged ventilation is also used in the STS database. Previous data have shown that mortality increases significantly in patients staying for ≥ 7 days in the ICU after cardiac surgery(12).

There are many complications associated with PMV, including vocal cord granulomas and ulcerations (13), oxygen toxicity, and local inflammation(14). Patients with prolonged mechanical ventilation experience worse physiological outcome due to atelectasis and intrapulmonary shunting(15). Respiratory failure and pneumonia have been traditionally the leading causes of postoperative complications(16).

The clinical advantages of early extubation are mainly that it reduces the possibility of adverse effects of positive pressure ventilation and minimizes associated patient discomfort, potentially decreases the incidence of infection and facilitates early ambulation. The early extubation itself helps to reduce ICU stay and hospitalization cost(1).

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Recent advances in anaesthesia, surgical techniques, myocardial protection, extracorporeal perfusion techniques, critical care protocols and improved perioperative management all had contributed to the success of early extubation and shorter hospitalization in the cardiac surgical population(17). In the last years cardiac anaesthesia has fundamentally changed from high-dose opiate based technique to a more balanced approach using moderate dose narcotics, inhalational agents, and shorter acting narcotics(18).

Thus, mainly due to financial constraints, the focus of cardiac anaesthesia started shifting in the early 1990's to lower dose opioids, earlier extubation and decreased ICU stay. This came to be labeled as 'Fast Track Cardiac Anaesthesia' (FTCA)(19).

The aim of this study was to analyze intraoperative characteristics risk factors that associated with prolonged mechanical ventilation and hence intensive care unit and hospital stay after off pump coronary artery bypass grafting. The risk factors included duration of surgery, number of grafts, and transfusion requirement during surgery.

MATERIALS & METHODS

Study Area

Tertiary Care teaching hospital in India.

Study Population

Present study was conducted on 140 patients aged more than 18 years, of either sex, who were scheduled for elective isolated off pump coronary artery bypass grafting.

Study Design

A Prospective, cross sectional, observational study.

Sample Size

The percentage of patients undergoing off pump CABG in prolonged ventilation is 6%(3 to 9%), assuming the absolute precision is 4% and 95% confidence interval the minimum required sample size is 135

Time Frame of the Study

Study was done from Jan 1st 2017 to Dec 31st 2017.

METHODOLOGY

- As a standard policy of the unit all patients were explained the details of surgery and informed consent was taken.

- Anaesthesia and analgesia were standardized for all patients as per our institutional practice.
- All patients included in the study were pre-medicated with tablet Alprazolam 0.25mg and pantoprazole 40mg orally at night before surgery and they were kept nil oral 8 hrs. before surgery.
- Next day on arrival of patients in the operating room preoperative risk factors were noted, patients were induced with midazolam 0.1 mg/kg, fentanyl 5µg/kg, etomidate 0.1mg/kg and pancuronium 0.1mg/kg and patients were intubated with appropriate size cuffed endotracheal tube under direct laryngoscopy and patients were ventilated with volume control ventilation. Ventilator settings were managed according to EtCO₂ and ABG status which is done every hour and whenever necessary.
- Anesthesia was maintained with inhalational anesthetic isoflurane (1-2%). Analgesia and muscle relaxation was maintained with fentanyl 1mg/kg bolus and pancuronium 0.02mg/kg bolus respectively every hour and whenever required.
- ECG, ST segment, SpO₂, EtCO₂, invasive BP, CVP, FiO₂, anesthetic gases, nasopharyngeal temperature and urine output were monitored continuously.
- Norepinephrine (40µg/ml dilution) and nitroglycerin (NTG) (1mg/ml dilution) infusion were used depending up on blood pressure. Epinephrine (40µg/ml dilution) and dobutamine (5mg/ml) also were used whenever necessary. Sudden drop in blood pressure was managed with 50 to 100 µg bolus of phenylephrine.
- Anticoagulation while grafting was done with unfractionated heparin 2mg/kg bolus and 1mg/kg top up doses every hour. ACT while grafting maintained above 250. At the end of grafting anticoagulation was reversed with protamine 1:1 ratio.
- Blood transfusion was done when patient was hemodynamically unstable due to blood loss and /or hematocrit was less than 25 in ABG. Preoperative blood transfusion was not included in the analysis.

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SURGICAL TECHNIQUE

All of our study patient's CABG had been performed by the same groups of surgeons. The standard approach was median sternotomy. Left internal mammary artery (LIMA) and Reversed Saphenous Vein Graft (RSVG) were harvested. Our usual grafting was LIMA to LAD and RSVG to OM, RCA, PDA and others.

After completing surgery patients were shifted to ICU continued ventilation with VCV and monitoring was continued with ECG, ST segment, SpO2, EtCO2, invasive BP, CVP, nasopharyngeal temperature, urine output and chest tube drainage. Analgesia was maintained with fentanyl infusion 0.5 to 1 µg/kg/hour.

Once the patient is warm (temp > 35.50C), awake, conscious and cooperative, haemodynamically stable with minimal or no inotrope support and achieved good clinical neuromuscular recovery and chest tube draining is less than 50ml/hr, ventilator weaning was started with synchronized intermittent mandatory ventilation. Then patients were put on CPAP mode after slowly reducing the rate up to 8breath/minute in SIMV. Patients were extubated if arterial oxygen tension was > 70 mm Hg, arterial carbon dioxide tension was < 45 mm Hg and pH between 7.35 to 7.45 on CPAP with fractional inspired oxygen concentration less 0.5, for half an hour. And patients were extubated once they achieve extubation criteria. Those patients who could not be extubated in more than 96 hours and were expected to need PMV underwent surgical tracheostomy.

Table 1. Mechanical Ventilation, Icu Stay, and Hospital Stay

PARAMETER	GROUP A(n=113)	GROUP B(n=27)	P
Duration of MV(hours)	12±3.34	33±8.13	0.0001(S)
Duration of ICU stay(hours)	24±5.8	48±12.9	0.0001(S)
Duration of Hospital (days)	5±0.99	7±1.75	0.0001(S)

Table 2. Duration of Surgery

GROUP A		GROUP B		P
MEAN	SD	MEAN	SD	0.83
4.59	0.89	4.55	0.86	

Table 3. Number of Vessels Grafted

GROUP A		GROUP B		P
MEAN	SD	MEAN	SD	0.32
2.58	0.86	2.81	1.66	

STATISTICAL METHODS

Patients were divided two groups GROUP A and GROUP B depending up on duration of mechanical ventilation.

GROUP A: Post-operative mechanical ventilation ≤ 24 hours.

GROUP B: Post-operative mechanical ventilation > 24 hours (PMV group)

Student's t-test or Mann Whitney test was used for to find the significance difference between the number of vessels grafted & duration of surgery and its expressed as mean and standard deviation.

Chi square or fisher exact test was used for to find the association between transfusion and duration of ventilation and its expressed as frequency and percentage.

p < 0.05 considered as statistically significance.

RESULT

There were 121(86.43%) male patients and 19(13.57%) female patients. Among all 27(19.28%) patients were associated with post-operative mechanical ventilation > 24 hours (GROUP B, PMV group). Remaining 113 patients were extubated ≤ 24 hours (GROUP A). Out of 27 patients in prolonged mechanical ventilation group, 3(11.11%) patients underwent tracheostomy. The results of the study are presented as Tables 1-4.

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Table 4. *Transfusion*

TRANSFUSION	GROUP A	GROUP B	P
INTRA-OP	10(8.84%)	4(14.81%)	0.354
POST-OP	16(14.15%)	6(22.22%)	0.327

DISCUSSION

The use of off-pump coronary artery bypass surgery (OPCAB) for surgical candidates deemed to be at high risk has become increasingly popular as a result of evolving evidence showing outcome and cost benefits (18–25). High-risk patients, such as the elderly and women, appear to benefit, with lower rates of mortality and other adverse events with OPCAB, compared with conventional on-pump coronary artery bypass surgery (ONCAB) (26–27). In fact, the female sex has disappeared as a risk factor from studies of OPCAB, which demonstrate reduced mortality, respiratory complications and lengths of hospital stay for women (11,12). It also appears that high-risk patients may have lower rates of adverse outcomes with the use of OPCAB.

In this study, we have studied the intra-op factors affecting the duration of stay and prolonged mechanical ventilation in patients undergoing an OPCAB. There are limited studies done on the OPCAB, in respect to the factors studied in this research, in comparison to ONCAB. Several randomized controlled trials (RCTs) have been conducted that have either favored on-pump CABG or have failed to show a significant difference in outcomes between the two techniques. However, these RCTs have been fraught with claims that they do not represent the majority of patients undergoing CABG in real world practice. Therefore, assessment of the benefits and drawbacks of each technique through observational and registry studies would be more representative of patients encountered in daily practice. The present review examined and established that the duration of surgery, number of grafts, and transfusion requirement during surgery were not strong predictors of prolonged medical stay and care, and thus other factors in pre-op and post-op need to be considered. Strategies to delineate the patients at risk and to modify those risk factors by prophylactic measures should probably lead to a lower incidence of prolonged mechanical ventilation in patients undergoing isolated off pump CABG surgery.

However there were a few limitations in the study:

The observational nature of the study, the relatively small patients' sample which may affect the power of the study by increasing the chance of type II error (false negatives) and that it is a single centre study.

Most of the previous studies which we have used for reference were on "ON PUMP CABG" and only few studies were on off pump CABG. Our study tried to find risk factors for PMV in "OFF PUMP CABG" in the same way of previous studies.

We included only elective isolated off pump CABG cases but as per previous studies urgent surgery, was one of the reason for PMV. We failed to evaluate the same.

CONFLICTS OF INTEREST

The authors have none to declare.

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