Original Article

"A RETROSPECTIVE COMPARISON OF ARTERIAL BLOOD GAS PARAMETERS IN PATIENTS UNDERGOING OFF PUMP CORONARY ARTERY BYPASS GRAFTING SURGERY USING FASTTRACK EXTUBATION PROTOCOL VERSUS CONVENTIONAL EXTUBATION PROTOCOL"

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Abstract

Background: Fast-track anaesthesia which includes early extubation after cardiac surgery is frequently done as a way to facilitate speedy recovery and early discharge from intensive care unit (ICU), thereby, reducing costs and avoiding other complications

Method: The study was designed as a 6 month retrospective study with two groups. Hundred patients undergoing elective off pump coronary bypass grafting(CABG) were divided into two groups . The first fastrack group following the new early extubation protocol, while the other group was extubated according to the old conventional extubation protocol after CABG. The arterial blood gas(ABG) analysis were performed at two different interval post extubation (20 minutes and 4 hours) to compare the effect of new fastrack extubation protocol on the ABG parameters.

Results: At both 20 minutes and 4 hours interval, the partial pressure of oxygen, PaO2 / FiO2 ratio in the fast track group was better as compared to the patients undergoing extubation via conventional method. PCO2 four hours post-extubation were lower in the fast track group and the results were statistically significant.

Conclusion: The early extubation protocol improved respiratory parameters like oxygenation profile as well as lower pco2 levels postextubation.

Keywords: Off pump CABG, Fast track

INTRODUCTION

Coronary artery bypass grafting (CABG) is a commonly performed cardiac surgical procedure for myocardial revascularisation in patients with coronary artery disease. The aims of CABG are to alleviate symptoms, decrease the risk of MI and thus, improving survival by restoring coronary perfusion. Fast-track anaesthesia which includes early extubation after cardiac surgery is frequently done as a way to facilitate speedy recovery and early discharge from intensive care unit (ICU), thereby, reducing costs and avoiding other complications .(1)

It is evident from literature that fast-track management of cardiac patients with early extubation and anaesthesia care is efficacious, cost beneficial and safe in both valvular and coronary patients. As this cannot be denied that the cardiac surgery is still evolving to incorporate less invasive procedures and shorter cardiopulmonary bypass times, the number of suitable patients for a fast track recovery model will increase. For fast track program of cardiac recovery to provide good results, the pivotal element is to provide intraoperative fast-track extubation protocol anaesthesia along with good post-operative anaesthesia care to smoothen the process. (2)

Arterial blood gas (ABG) analysis provides anaesthesiologist with detailed information regarding cardiopulmonary andmetabolic homeostasis in the emergency as well as elective patients. Upon integration with history and physical examination, the rapidly available ABG analysis is helpful in resuscitation of the acutely ill patients and while extubating a post-operative patient. (3) And in case if arterial blood gas shows worsening hypercapnia, respiratory acidosis or hypoxemia, this would help in reinforcing the decision to continue mechanical ventilation and defer extubation.

We started the fast-track cardiac anaesthesia protocol in our center (HIMS Hospital) in 2016. We retrospectively analyzed the data for the patients during last 3 years in this study; the data were analyzed to assess the impact of ABG analysis andsuccess of fast-track protocol on patient outcome.

MATERIAL AND METHODS

Study was conducted in the Department of Cardio Vascular Surgery and Department of Anesthesiology and Pain Medicine, Himalayan Institute of MedicalSciences (HIMS), Swami Ram Nagar, Dehradun. 100 patients who had undergone elective off pump coronary arterybypass surgery from December 2016 to December 2019 were retrospectively recruited in the study. 50 of these patientswere extubated using a fast track protocol (Group A) and the remaining 50underwent conventional extubation protocol (Group B).

Selection of Subject:

Inclusion Criteria: We included Patients undergoing off pump CABG Aged 18-60 years of either sex.

The exclusion Criteria comprised of any known history of any respiratory disease , asthma, COPD , smoking ,emergency procedures ,pregnancy and lactating mothers ,history of any mental or psychiatric illness, neuromuscular disorder, hepatic, renal abnormality, any coagulopathy, patient with stroke or transient ischemic attack within 6 month,left ventricular ejection fraction < 40% ,Uncontrolled diabetes ,alcoholic and patient on long-term analgesic therapy

Study Protocol:

All eligible patients were kept nil orally 6 hours for solid food and 2 hours for clear fluid before surgeryand premedicated with tablet lorazepam 0.05mg/kg night before and tablet pantoprazole 40 mg 2 hours prior to surgery. On preoperative visit, the patients were explained regarding the procedure and the postoperative extubation protocol and methodology. After establishing intravenous cannulationin the operating theatre standard monitoring- electrocardiograph (ECG), invasive blood pressure (systolic, diastolic, and mean), and pulse oximetry (SpO_2) was established and baseline monitoring was recorded. Arterial cannula was inserted in left radial artery and cvp line inserted in right IJV. Invasive blood pressure monitoring established and baseline ABG recorded at room air.

Preoxygenation with 100 % oxygen was done for 3 minutes. Inj fentanyl 5mcg/kg iv given slowly and for induction injetomidate 0.3mg/kg iv.

After check ventilation inj succynylchloine 2mg/kg iv was given and airway was secured by cuffed endotracheal tube, after checking bilateral air entry endotracheal tube was fixed. Maintenance of anaesthesia was done with oxygen and air in 1 : 1 ratio, isoflurane was used as inhalational agent, and vecuronium 0.1mg/kg iv for maintainance of muscular relaxation .Just before sternotomy inj. Fentanyl 2mcg/kg i.v and vecuronium 0.01mg/kg i.v was given. Inj. fentanyl 1mcg/kg and inj. vecuronium 0.01mg/kg was repeated after every 30 minutes during procedure. At the time of sternum steel wire suturing after completion of surgery inj. fentanyl (2mcg/kg) and vecuronium (0.01mg/kg) were repeated.Inj. Paracetamol 15mg/kg iv along with inj. ondansetron 0.1 mg/kg i.v given and patient was shifted to CVTS ICU, and standard monitoring (ECG,SPO2,IBP,ETCO2,Temp), were connected. Patient was shifted on SIMV mode of mechanical ventilaton (Vt 8ml/kg, Fio2 50%,PS 12 mmhg, PEEP 5 mmhg, R.R 14/min.) once patient started following verbral command like eye opening and had adequate muscle power 5/5 in both upper and lower limbs , inj. Neostigmine 0.05mg/kg and inj. Glycopyrolate 0.01mg/kg was given.

Assessment for tracheal extubation was done after 1 hour of mechanical ventilation, and ABG was recorded, (if Vt> or equal to 8ml/kg, R.R 12-20 per minute and regular, $PaCo_2$ < 50 mmhg, PaO_2 > 90mmHg) , then patient was put on CPAP mode (PS 10 mmhg,PEEP 5 mmhg, FiO_2 0.5) After 20 min. of CPAP mode another ABG was done and recorded.

The criteria followed for tracheal extubation:-

1. Patient awake and following commands
2. Body temperature > 36.0 degree C
3. Haemodynamically stable (H.R < 100 bpm, MAP >70mmhg,stable cardiac rhythm)
4. Adequate oxygenation and ventilation.(PaO_2 > 80mmhg,FiO_2 < 0.5, R.R > 10 /min. but not > 30/min., $PaCo_2$ < 50mmhg
6. No excessive bleeding or collection in drains.
7. Urine output > 1ml/kg/hr.
8. Good muscle tone(hand grip present).
9. Good bilateral chest movement.

These patients were included in fast track group (group A) if extubated within 6hrs of admission to CTVS group.

ABG was recorded 20 minutes and 4 hours after extubation. Any complication in the next 24 hours of extubation was recorded.For postoperative pain management inj. Tramadol 100mg iv 8 hourly and inj. Paracetamol 1 gm iv 8 hourly were continued for the next 2 days.

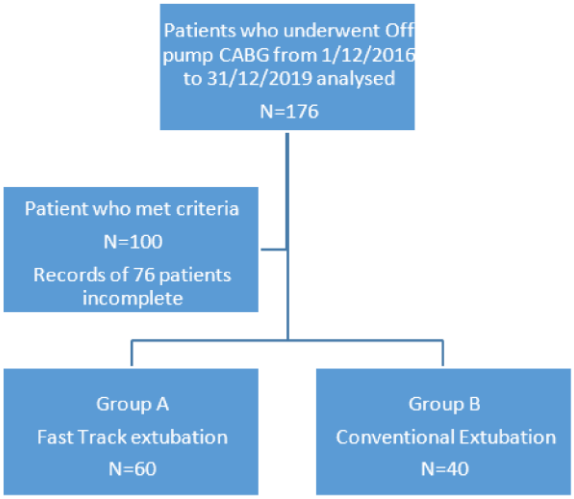
Patients who were not extubated within 6 hrs of CTVS ICU admission criteria were sedated with inj morphine 0.1mg/kg iv slowly then repeated every 5 hourly in CTVS ICU on SIMV mode and conventional extubation protocol (Group B)was followed .Patient was kept on SIMV mode ((Vt 8ml/kg, Fio2 50%,PS 12 mmhg, PEEP 5 mmhg, R.R 14/min). Assessment for tracheal extubation done after 12 hour of mechanical ventilation, and ABG was recorded. On the next morning at 4 am last dose of inj. morphine was repeated in the above mentioned dosage. Once patient started following verbral command like eye opening and had adequate muscle power 5/5 in both upper and lower limbs, assessment for tracheal extubation done and ABG was recorded (if Vt> or equal to 8ml/kg, R.R 12-20 per minute and regular, PaCo2 < 50 mmhg, PaO2 > 90 mmHg) , then patient was put on CPAP mode (PS 10 mmhg, PEEP 5 mmhg, FiO2 0.5). After 20 minutes of CPAP , ABG was done and recorded. Patient extubated after following extubation criteria as mentioned above and ABG was recorded after 20 minutes and 4 hours of extubation. Post operative pain management was same as done in fast rack protocol group.

DATA MANAGEMENT AND STATISTICAL ANALYSIS:

Statistical testing was conducted with the statistical package for the social science system version SPSS 17.0. Various arterial blood gas variables at 20 minutes and 4 hours post extubation between 2 groups were compared using Chi-Square Test. For all statistical tests, a p value less than 0.05 was taken to indicate a significant difference.

RESULTS

60 patients were extubated in fast track protocol and 40 patients required the conventional extubation protocol.86.6%were male and13.3%were female in fast track extubation group. 80 % were male and 20 % were female in conventional extubation group and majority of the patients were aged 51-60 years in both groups. There was no significant differencebetween two groups with regards to age and gender distribution. There was no difference in type of grafts used betweenthe groups.



Age wise distribution of cases

Age Group	Group A	Group B
40-50	6 (10%)	7 (17.5%)
51-60	25 (41.6%)	18 (45%)
61-70	21 (35%)	13 (32.5%)
>70	8 (13.3%)	2 (5%)

Gender wise distribution of cases

Gender	Group A	Group B
Male	52 (86.6%)	32 (80%)
Female	8 (13.3%)	8 (20%)

Off Pump CABG type of Grafts

Type Of Grafts	Group A	Group B
LIMA + Venous Graft	40(66.6%)	26(65%)
Only Venous graft	20 (33.3%)	14(35%)

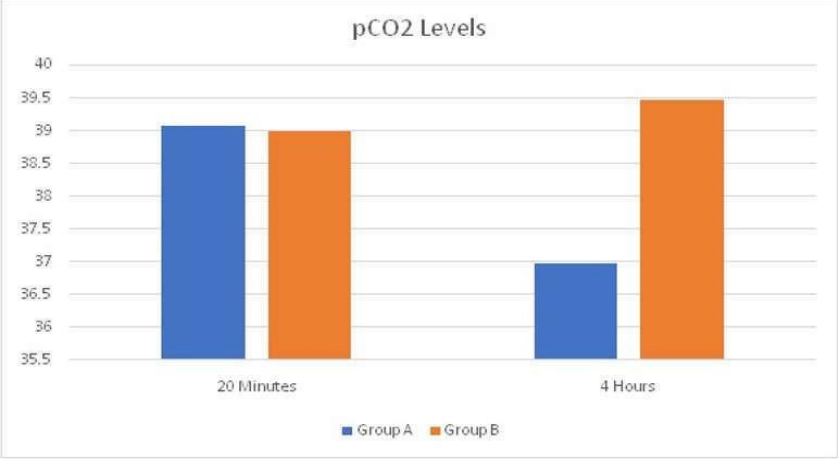
ABG at 20 minutes

Variables	Group A	Group B	p value
pH	7.41±0.05	7.39±0.04	0.314
Po2	253.64±84.19	233.11±87.12	0.234
Pco2	39.07±3.78	38.98±6.15	0.307
Bicarb	24.51±2.05	24.00±1.74	0.287
BE	-0.84±2.20	-1.14±2.51	0.302
Lactate	2.06±0.80	1.87±0.53	0.302
PO2/FiO2	422.73±140.31	388.52±145.21	0.234

ABG at 4th hour

Variables	Group A	Group B	p value
pH	7.39±0.04	7.40±0.02	0.316
Po2	188.18±40.30	177.68±42.70	0.207
Pco2	36.97±2.48	39.47±1.60	<0.001

Bicarb	24.32±1.38	24.64±0.87	0.172
BE	-0.72±1.52	-0.29±1.31	0.133
Lactate	1.73±0.81	1.68±0.50	0.713
PO2/FiO2	313.63±67.17	296.14±71.17	0.074



Arterial blood gas immediately within 20 minutes of extubation demonstrated no statistically significant difference in PH, PCO2, Bicarbonate levels between fast track and conventional extubation group. However, average p02 levels and Po2/Fio2 ratio was higher in fast track group (422.73+-140.31) even though it was not statistically significant.

When arterial blood gas between the 2 groups was repeated after 4 hours, it was observed that Po2 was higher in fast track group (188.18+-40.30) as compared to the conventional group (177.68+-42.70). Po2/FiO2 ratio was also higher in fast track group. It was noted that Pco2 levels were lower in fast track group (36.97+-2.48) versus 39.47+-1.60 in conventional group. This was statistically significant ($p<0.001$). Fast track patients had slightly higher base excess and lactate levels but they were not statistically significant.

There were no incidence of re intubation in either group.

DISCUSSION

In the late 90s, fast-track cardiac anesthesia (FTCA) technique was developed, consisting of propofol infusion and low- dose fentanyl . It has been regarded safe for early extubation, mobilization and faster recovery of CABG patients. Fast track protocols include extubating the patient off mechanical ventilation within 6 hours of surgery as compared to conventional cardiac anaesthesia where extubation is done within 12–24 hours. With FTCA, there has been considerable reduction in stay in ICU, hospital stay, cost and resource utilization without any adverse effect on morbidity and mortality. (4)

The cornerstone of fast track anaesthesia is the early extubation following cardiac surgery. The prerequisites for early extubation are patients to be relatively young and healthy with good pre-operative cardiac, respiratory and renal functions, rapid recovery from anaesthesia and operation to be quick and uncomplicated with short bypass time. (5)

All the attention is mainly given to the intubation , very little importance is given to the extubation. Vital signs along with oxyhemoglobin saturation percentage should be monitored during the process of extubation(6,7), It is imperative for the medical personnel to be alert in the immediate post-extubation period as it is the most crucial and vulnerable time for the occurrence of complications like respiratory disturbances leading to hypercapnia and hypoxia.(8) The respiratory effects of systemic inflammatory reaction after cardiac surgery are decreased lung compliance, increased intrapulmonary shunt fraction, pulmonary edema, and decreased functional residual capacity, ultimately landing into hypoxemia. Literature shows that approximately 40% of cardiac surgery patients undergo readmission to the ICU owing to respiratory failure and acute respiratory distress syndrome. (6)

Morbidity post CABG surgery is frequently seen (90% patients) mainly due to respiratory disturbances.(9) Respiratory morbidity can occur due to many reasons like shallow breathing, increased airway resistance, decrease in functional residual capacity, phrenic nerve neuropraxia, alterations in rib cage mechanics, postoperative pain, or changes in sternalblood flow poststernotomy. (10)

The ABG values demonstrate a combination of many events, including cell metabolism, muscular activity, oxygen consumption and production of carbon dioxide, cardiac function, tissue perfusion and ventilation. These values give an idea to the intensivist about the response of the patient after extubation. ABG parameters are also used to identify patient's readiness for weaning off ventilator. As long as the patient has an adequate PaO2 and PaCO2 levels and pH > 7.35, without mechanical ventilatory support, the patient can be extubated. Moreover, hypercapnia and respiratory acidosis isseen in patients who cannot be extubated.

Failed extubations are also common in most post operative ICUs, with failure rate being 2 to 20%.Failed extubation is associated with greater morbidity and mortality and longer length of stay in hospital (11). Thus, it is essential to identify screening techniques which can help in minimizing the number of failed extubations. (12) Several previous studies have shown various factors for prediction of extubation failure like rapid shallow breathing index, positive fluid balance in last 24 hours, pneumonia as the cause for initiation of mechanical ventilation, amount of endotracheal secretions, mental status and hypercapnia.(3) Hence, ABG is considered to be one of the powerful indicators for successful extubation.

The PaO2/FiO2 ratio at 4 hours between group A and group B , though statistically not significant but a difference canbe observed in the new early extubationfast track method compared to the old conventional method and while no difference at 20minutes. This somehow attributes to the compensatory mechanism indicating better oxygenation profile in the fastrack group leading to fewer complications due to hypoxemia, establishing the need of new fastrack model of cardiac anaesthesia care perioperatively. Badenes et al decribed the pulmonary dysfunction due to mechanical ventilation in cardiac surgery patients, as prolonged mechanical ventilation can cause changes in the lung structure and function mainly the compensatory responses (13).

CONCLUSION

After observing the different parameters and findings in this study, we conclude that the new early extubation protocol could have better pulmonary outcomes and fewer complications and better oxygenation profile after fast-track anaesthesia. However, further studies may affirm our outcomes and furthermore enhance the use of new early extubationmethod.

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