Original Article

Comparison of Immediate Extubation Versus Ultrafast Tracking Strategy in the Management of Off-Pump Coronary Artery Bypass Surgery

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Abstract

Introduction: Ultrafast tracking of anesthesia (UFTA) is practiced routinely, whereas immediate on-table extubation after off-pump coronary artery bypass (OPCAB) grafting surgery has many concerns. The purpose of our study was to evaluate the safety and feasibility of immediate extubation (IE) versus UFTA. **Methods:** Sixty patients were enrolled who underwent OPCAB surgery. The two groups IE and UFTA had thirty patients each. Inclusion criteria were patients for OPCAB surgery including left main stenosis. Exclusion criteria were patients with Ejection Fraction(EF) <30%, with unstable hemodynamics, on intra-aortic balloon pump (IABP), with renal dysfunction, with associated valvular heart diseases, on inotropes, on temporary pacemaker, with intraoperative conversion to on-pump coronary artery bypass grafting (CABG), who are chronic smokers, and with chronic obstructive pulmonary disease. Statistical analysis was done with Minitab 15 software. Descriptive statistics were summarized as mean, standard deviation, and percentage. Student's *t*-test was used to determine the significance of normally distributed parametric values. *Z*-test was used for proportion. Statistical significance was accepted at $P < 0.05$. **Results:** OT extubation was found to be safe as no patient had reintubation or respiratory insufficiency. None of the patients in either group had postoperative myocardial infarction, stroke, low cardiac output, mediastinitis, and renal failure. Hypothermia, blood transfusion, atrial fibrillation, and re-exploration did not occur. Intensive Care Unit length of stay was similar in the two groups. Discharge day is statistically significant ($P = 0.001$), with 5.66 days in the IE group and 6.36 days in the UFTA group. Time spent in the operating room at the end of surgery is statistically significant, with 14.03 min in UFTA group and 33.9 min in IE group. **Conclusion:** IE appears to be safe and effective in OPCAB patients without any major complications. It can be achieved after fulfilling traditional extubation criteria but is confined to highly selective group of patients.

Keywords: *Cardiac anesthesia, Intensive Care Unit, immediate extubation, off-pump coronary artery bypass, postoperative ventilation, ultrafast track*

Introduction

Fast tracking in cardiac surgery is an accepted technique due to improvement in resource utilization.[1] Anesthesia management tailored to facilitate fast tracking in cardiac surgery is routinely practiced now. Ultrafast tracking algorithm in cardiac anesthesia has still fastened the postoperative recovery. Interest in immediate extubation (IE) in the operating room (OR) has been rekindled taking into account the expensive resources in the health system. Not to forget is the patient safety and quality of health care during the practice of IE. Furthermore, the factors that preclude IE are bleeding, hypothermia, and cardiovascular instability, leading to reintubation and increase in morbidity. This study was undertaken to evaluate the same and the impact of IE versus ultrafast tracking of anesthesia (UFTA) on postoperative complications, length of stay (LOS) in Intensive Care Unit (ICU), patient recovery, and hospital LOS in off-pump coronary artery bypass grafting surgery (OPCAB) patients.

Methods

After obtaining the ethical committee approval and written informed consent, sixty patients between the age group of 35 and 60 years of New York Heart Association Functional Class II were enrolled in the study who underwent OPCAB surgery. The two groups were IE and UFTA, with 30 patients in each group. IE group had patients immediately extubated on table and then shifted out of OR, whereas UFTA group had patients extubated within 2 h of shifting out of OR. Inclusion criteria were

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all patients posted for OPCAB surgery including left main stenosis. Exclusion criteria were patients with EF <30%, with unstable hemodynamics, on intra-aortic balloon pump (IABP), with renal dysfunction, with associated valvular heart diseases, on inotropes, on temporary pacemaker, with intraoperative conversion to on-pump coronary artery bypass grafting (CABG), who are chronic smokers, and with chronic obstructive pulmonary diseases. Inclusion and exclusion criteria were strictly followed.

All the patients underwent OPCAB surgery done by a single experienced lead surgeon. Left anterior descending artery was grafted with left internal mammary artery, and other coronaries were grafted with reversed saphenous vein conduits. Octopus was used as a retracting device during grafting. Patients were observed carefully for their intraoperative behavior in terms of hemodynamics, urine output, requirement of inotropes, and body temperature and then selected for IE. Primary outcome measure was safety and efficacy of OT extubation in terms of respiratory insufficiency and reintubation and ICU LOS. Secondary outcome measures were as follows: (1) complications such as postoperative myocardial infarction (MI), postoperative low cardiac output syndrome, bleeding requiring re-exploration, prolonged ventilation, postoperative renal failure, and stroke and (2) hospital LOS.

Anesthesia protocol was standardized. Tablet lorazepam 2 mg previous night and tablet betaloc 12.5 mg in the morning were given orally. In the OR, patients were monitored by five-lead electrocardiogram with ST analysis, central venous pressure monitoring, invasive arterial pressure monitoring, pulse oximetry, end-tidal carbon dioxide monitoring, urine output, and nasopharyngeal temperature monitoring. Central venous cannulation in the right internal jugular vein and femoral arterial line insertion was done under local anesthesia infiltration with injection xylocaine 2%. Anesthesia induction was done with intravenous (IV) injection fentanyl 4 mcg/kg, injection midazolam 0.04 mg/kg, injection propofol 0.5–1 mg/kg, and injection rocuronium 0.6 mg/kg. Maintenance of anesthesia was done with intermittent injection fentanyl 25 mcg IV bolus, injection propofol 20 mg IV bolus, injection atracurium 10 mg IV, and sevoflurane. Local anesthetic infiltration was given at skin closure with injection bupivacaine 0.25%. Injection tramadol 100 mg IV was given during closure. Blood gas analysis was done before deciding on IE. Reversal of muscle relaxants was done with injection neostigmine and injection glycopyrrolate. Inhalation agent sevoflurane was stopped after sternal wiring. Blood loss was minimal in all the patients, and none demanded blood transfusion. In both the groups, patients were extubated and guided by clinical judgment after fulfilling extubation criteria. Injection paracetamol 15 mg/kg IV was given postoperatively every 6 hourly. Injection diclofenac 75 mg IV was given if patient demanded more analgesic.

Utmost care was taken to maintain the patient's body temperature within normal limits. Therefore, the ambient temperature inside the OR was maintained between 20°C and 22°C. Furthermore, temperature monitoring was done vigilantly so as to facilitate conditions to allow IE. Active temperature control was done with circulatory water mattress, forced-air warmer, and minimum room temperature around 22°C. Patients covered properly, heated water mattress beneath the patient, warm IV fluids, and OT temperature not allowed to drift down excessively were the measures exercised. Furthermore, all the measures to avoid hypothermia were exercised postoperatively in the ICU.

Extubation criteria were as follows: a conscious alert patient with spontaneous eye opening and obeying commands, sustained head lift for 5 s or more, SpO_2 >98% with FiO_2 <60%, $EtCO_2$ <45 mmHg, stable hemodynamics with minimal inotropes, no arrhythmias, no hypothermia, and normal arterial blood gas (ABG) analysis report.

"Fitness for ICU discharge" criteria were inotropes weaned off, hemodynamic stability, adequate urine output, no arrhythmias, no pacemaker dependency, removal of all invasive lines, and adequate pain control.

"Fitness for hospital discharge" criteria were fully mobilized patients who can tolerate full diet.

Results

The demographic data were comparable in both the groups. The mean age in the UFTA group was 55.17 ± 6.82 years and in the IE group was 52.73 ± 4.34 years (P = 0.106 is not significant). Majority of patients were male 76.67% versus 23.33% females. Ejection fraction of patients in the UFTA group was 50.3 ± 10.5% and in the IE group was 50.97 ± 6.63% (P = 0.770 is not significant). UFTA had preoperative MI in 26.66% and IE had preoperative MI in 13.33% (P = 0.1970 is not significant). Hypertension was similar in both the groups. Z-test was used for finding the proportion between the two. The total surgical time in hours was comparable –2.720 ± 0.501 in UFTA and 2.737 ± 0.478 in IE (P = 0.891 is not significant) – and the number of grafts were also similar –3.194 ± 0.601 in UFTA and 3.000 ± 0.587 in IE [Table 1]. Ward shift day in the IE group was 4.333 ± 0.711 days and in the UFTA group was 3.967 ± 0.718 days (P = 0.052 is not significant) [Table 2]. Hospital discharge day was statistically significant (P = 0.001), with 5.66 days in the IE group and 6.36 days in the UFTA group [Table 3]. Time spent in OR after the end of surgery was 14.03 ± 2.21 min in the UFTA group, while it was 33.90 ± 5.41 min in the IE group (P = 0.000 is significant) [Table 4].

OT extubation was found to be safe as none of the patients had reintubation or respiratory insufficiency. None of the patients in either group had postoperative MI, stroke, low cardiac output, mediastinitis, and renal failure. Hypothermia, blood transfusion, inotrope score, atrial fibrillation, re-exploration,

Table 1: Comparison of Number of grafts

Groups	Number of grafts (mean±SD)	*t*	*P*
Group UFTA	3.194±0.601	1.27	0.208 (NS)
Group IE	3.000±0.587		

UFTA: Ultrafast tracking of anesthesia, IE: Immediate extubation, NS: Not significant, SD: Standard deviation

Table 2: Comparison of Ward shift day

Groups	Ward shift day (mean±SD)	*t*	*P*
Group UFTA	3.967±0.718	−1.99	0.052 (NS)
Group IE	4.333±0.711		

UFTA: Ultrafast tracking of anesthesia, IE: Immediate extubation, NS: Not significant, SD: Standard deviation

Table 3: Comparison of Hospital discharge day

Groups	Hospital discharge day (mean±SD)	*t*	*P*
Group UFTA	6.367±0.850	3.46	0.001 (S)
Group IE	5.667±0.711		

UFTA: Ultrafast tracking of anesthesia, IE: Immediate extubation, S: Significant, SD: Standard deviation

Table 4: Comparison of Time in OR after the end of surgery

Groups	Patient in OR after end of surgery (min), mean±SD	*t*	*P*
Group UFTA	14.03±2.21	−18.66	0.000 (S)
Group IE	33.90±5.41		

OR: Operating room, UFTA: Ultrafast tracking of anesthesia, IE: Immediate extubation, S: Significant, SD: Standard deviation

and re-intubation were monitored. Patient recovery was rapid in the OT extubation group. LOS in ICU was similar in the two groups. The study was powered to show the difference in LOS in ICU but failed to do so. OT extubation was cost-effective as ICU ventilation costs and disposables were saved. Besides this, high level of satisfaction was noted among ICU staff and patient's relatives.

Power of study was calculated by considering the average ICU LOS and decrease of one day was considered as an important goal. These data suggested that a power of 90% for detecting a difference in ICU LOS at a level of 0.05 would be obtained with 27 patients in each group. Statistical analysis was done with Minitab 15 software (Minitab Inc., US). Descriptive statistics were summarized as mean, standard deviation, and percentage, and Student's *t*-test was used to determine the significance of normally distributed parametric values. *Z*-test was used for proportion. Statistical significance was accepted at $P < 0.05$.

Discussion

Ultrafast tracking anesthesia is now an accepted technique.[2] The term ultrafast tracking includes shortening of prolonged ventilatory support, reducing ICU stay, and early discharge. The core principles of UFTA and IE are choice and titration of short-acting anesthetic drugs and opioid-based anesthesia, postoperative normothermia, multimodal analgesia, early extubation, ambulation, and early discharge.[3] Inhalation-based anesthesia is also an important factor in UFTA as much as low-dose opioid technique.[4] Hence, authors have made judicious use of both the techniques.

The resource expenditure of CABG surgery is higher than any other single procedure in cardiovascular medicine.[5] Cost containment has forced to revise the management strategy for cardiac surgery.[6] Perhaps, IE can be a beneficial proposition in terms of economic grounds. It helps resource utilization in a better manner and is cost-effective from the standpoint of decreased ICU and hospital stay.[7-9] In the authors' experience also, the ventilator costs are totally negated, and the cost savings of associated disposables are achieved.[7] Sedative drugs are not needed. Patients can be transferred to lower-dependency ward earlier. By this, cost saving can be achieved. It also saves cost through decreasing the usage of ventilator, oxygen, sampling for ABG analysis, suction catheters, gloves, power consumption, and manpower consumption. IE lowers the overall surgical costs, prevents airway and lung trauma, decreases stress due to suctioning and weaning from ventilation, improves cardiac output by spontaneous breathing, reduces nurse dependency, and lowers ICU dependency.[5] Apart from this, the potential benefits of IE after cardiac surgery are improved cardiac output and renal perfusion with spontaneous respiration. Furthermore, Gangopadhyay *et al.* have stated that reduced atrial fibrillation in IE group was noticed by Egdgerton.[2] IE has no increase in perioperative morbidity.[10] It also has less chest infection compared to the ventilated group.[2]

"Select" group of patients is another important criteria. The patients chosen for IE were strictly adhered to the inclusion criteria mentioned earlier. Independent predictors of IE are renal failure, cardiac reoperation, preoperative IABP,[11] diabetes mellitus, long surgical time[7] previous MI, and vasoactive drugs.[4]

Adequate analgesia is a must in IE and UFTA. Thoracic epidural analgesia (TEA) with general anesthesia (GA) can provide high-quality analgesia and quick rehabilitation when IE was done with TEA along with GA.[2] It also ensures hemodynamic stability and allows early extubation.[12] Nonetheless, it is not essential to obtain optimal results in UFTA,[11] and the less invasive cardiac anesthesia is promising as well.[13]

The success rate of IE largely depends on maintaining normothermia.[14] With normothermia, mental status, respiratory efforts, acid–base balance, and drug metabolism remain normal postoperatively. Besides hypothermia, pacemaker dependent, blood transfusion, high inotropes, atrial fibrillation with Fast ventricular rate (FVR), and re-exploration were also closely watched. Any of the

complications stated under secondary outcomes did not occur. Tracheal extubation criteria, ICU discharge criteria, and hospital discharge criteria were fixed.

Other concerns of IE are increase in cardiac and respiratory workload causing myocardial ischemia and infarction.[10] Ultrafast tracking or IE can lead to hemodynamic instability and adrenaline discharge,[5] which can lead to sympathetic stimulation to ensue myocardial ischemia.[2] Therefore, strict hemodynamic monitoring and management are needed for every patient intraoperatively as well as postoperatively.

A secured airway is always desired in the case of mediastinal bleeding requiring re-exploration,[15] and the most common cause of reintubation is re-exploration for bleeding,[5] with other causes being ischemia, reperfusion, arrhythmias, and reduced graft flow. Although IE rarely resulted in reintubation,[8] Rodriguez Blanco *et al*. state that the risk of reintubation actually decreases with early extubation.[9]

As stated by Rodriguez Blanco *et al*. in our patients too the decision of IE was left to the discretion of attending anesthesiologist who managed the case,[9] and extubation was guided by clinical judgment.[7] The depth of anesthesia was not monitored, which forms the cornerstone in IE and UFTA cases. Although the benefits and risks are talked about, still IE is challenging for the anesthesiologist. The postoperative ICU management was done by the intensivist along with the attending anesthesiologist who was well versed with the patient's intraoperative behavior in terms of hemodynamics and ABGs.

Delay in shifting the patient out of OR is another concern. Patient's eligibility for IE can be promptly judged, and the time taken for extubation can be curtailed by having a standard anesthesia protocol for induction as well as intraoperative anesthesia management. Although it is not very significant, IE did not add substantially to the OR time.[9] Therefore, focus on interventions designed for immediate or early extubation such as low-dose opioid-based anesthesia and use of time-directed extubation protocol is necessary. IE causes delay in shift from OR, but the time is not statistically significant, a similar finding by Montes *et al*.[10]

Karen Singh has emphasized on psychological benefits of IE.[7] Good postoperative morale of patients has also been emphasized.[16] Many patients fear remaining intubated postoperatively. As few as 4 h of postoperative ventilation causes more mental depression on postoperative day 3. If IE is safe, at a minimum, patient is saved of psychological trauma.[17] Patients and also their relatives have such psychological benefits.

Limitation of our study is that the patients included were less morbid, and hence, it was feasible for IE. Bispectral index monitoring was not done to exclude intraoperative awareness.

Conclusion

IE is feasible with an awake, warm, pain-free, and hemodynamically stable patient, and therefore, we emphasize the importance of normothermia, hemodynamic stability, analgesia, no bleeding, and meeting standard extubation criteria to be advocated stringently to perform IE in OPCAB patients. Furthermore, strict adherence to the "select" group of patients is necessary for the success of IE without increase in morbidity and mortality. With this, IE can be safe and effective in OPCAB patients without any major complications; however, more clinical trials are necessary.

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Conflicts of interest

There are no conflicts of interest.

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