Ultra-Fast Track Cardiac Anesthesia: Risks, Benefits, and Predictors of Outcome

HODA SAAD, M.D.*; MAGED SALAH, M.D.*; HISHAM HOSNY, M.D.* and MOATAZ SALAH, M.Sc.**
The Department of Anesthesiology, Faculty of Medicine* and Students Hospital**, Cairo University

Abstract

Background: Ultra-fast track anesthesia (UFTA) aims at immediate extubation of cardiac surgical patients at the end of the operation. It has not been found to increase postoperative cardiorespiratory morbidity, sympathoadrenal stress, or mortality. On the other hand, it significantly reduces costs and improves resource utilization.

Methods: Fifty two consecutive patients underwent open heart surgeries and were managed by the same anesthesiologist. All adult patients undergoing elective cardiac operations were included in the study. They were divided into 2 groups, 26 patients each, UFTA group and conventional group. Patients were given intravenous midazolam, before surgery as a premedication. Induction was achieved using midazolam, fentanyl, and propofol. Tracheal intubation was facilitated by atracurium. Maintenance of anesthesia was achieved using sevoflurane, and a continuous intravenous infusion of morphine. Postoperatively, patients received intravenous morphine infusion, intravenous morphine on demand, and intravenous paracetamol every 6 hours. Pain was assessed with Visual Analogue Scale (VAS), every 6 hours for the first 24 hours of their ICU stay.

Results: There was a significant reduction in mean length of ICU stay between the UFTA and the conventional groups, 57.42 hours and 95.04 hours respectively. There was no significant difference in postoperative pain perception between the 2 groups. But there was a significant difference in ICU morphine usage between the 2 groups.

Conclusion: The implementation of UFTA protocol led to a significant reduction in the length of ICU stay of adult patients undergoing elective cardiac surgical operations, without increasing postoperative complications.

Key Words: Ultra-fast track anesthesia – Cardiac surgery – ICU – Mechanical ventilation.

Introduction

SINCE open heart surgery became established in the 1950s, the sedation and prolonged ventilatory support of this patient population has been the standard practice. Prolonged ventilatory support was maintained at least until the morning of the first postoperative day until the hemodynamic, respiratory and coagulation physiological systems had stabilized completely [1,2].

Particularly the first few hours after cardiac surgical interventions are regarded as a critical period for the occurrence of myocardial ischemia [3], which are frequently triggered by the hypothermic and hemodilution as a consequence of the extracorporeal circulation and the consecutive activation of the sympathetic nervous system [4]. Moreover, the extracorporeal circulation itself caused transient functional and metabolic damage to the myocardium, which consequently became even more susceptible to new onset ischemia [5].

More importantly, it was anesthesiological management with high-dose opioid anesthetics which made prolonged ventilatory support of heart surgery patients necessary per se, and the time of extubation was already established intraoperatively [2].

The care of the cardiac surgical patient has undergone extensive changes in the past decade. Previously, postoperative ventilation was routine because of the relatively high incidence of pulmonary insufficiency and low cardiac output states, as well as the popularity of high-dose narcotic anesthetic techniques. Recent advances in cardiac anesthesia and surgery have reduced the necessity for postoperative ventilation [6].

Fast track cardiac anesthesia (FTCA) aims at tracheal extubation within 1 to 6 hours after arrival in the cardiac surgery recovery unit. It has not been found to increase postoperative cardiorespiratory morbidity, sympathoadrenal stress, or mortality. On the other hand, it significantly reduces costs and improves resource utilization [7]. Improvement in diastolic compliance and overall cardiac performance were also described as potential benefits of early extubation [8].
Ultra-fast track anesthesia (UFTA) aims at immediate extubation of cardiac surgical patients at the end of the operation. There are few contraindications to the adoption of early extubation protocols. Generally most cardiac surgical patients, presenting for either elective or emergent surgery, have adequate ventilatory function. If patients were not intubated and ventilated preoperatively, they are not likely to require prolonged mechanical ventilation [6].

Feasibility of ultra-fast track anesthesia has been studied for different cardiac operations and with different anesthetic techniques. Nevertheless, questions remain regarding the significance of various perioperative anesthetic techniques on fast-track management of earlier tracheal extubation [9].

**Patients and Methods**

From February, 2011, through October, 2013, 52 consecutive patients underwent open heart surgeries and were managed by the same anesthetologist. All adult patients (>18yrs) undergoing elective cardiac operations were included in the study.

Excluded from the study were patients undergoing emergency/redo operations, patients who were already intubated preoperatively, patients with preoperative uncontrolled diabetes, patients in cardiogenic shock, patients with poor left ventricular function: Ejection fraction (EF) <45%, patients with severe pulmonary hypertension: Pulmonary artery systolic pressure (PASP) >55mmHg, patients on regular dialysis, or in severe renal impairment: Creatinine clearance (CC) <50ml. min⁻¹, and patients deliberately kept intubated for hemodynamic instability, and/or concerns of postoperative bleeding.

Patients were divided into 2 groups, 26 patients each, UFTA group and conventional group. After approval of the institutional ethical committee and obtaining written informed consent from all participants, the patients were randomly allocated to either the UFTA group or conventional group, using closed envelope method.

Standard median sternotomy incision was performed for all but one patient, who had mitral valve replacement through lateral thoracotomy. One patient had off-pump coronary artery bypass grafting using Medtronic Octopus III System, (Medtronic, Inc., Minneapolis, MN) to access and stabilize the target coronary vessels.

All patients underwent the same preoperative examination. All routine preoperative investigations were done including complete blood picture, bleeding profile, liver function tests, renal function tests, fasting blood glucose level, chest X-ray, electrocardiogram (ECG), echocardiography and coronary angiography. Logistic EuroSCORE II (European System for Cardiac Operative Risk Evaluation) was calculated for all participants.

Patients in both groups received their usual medications, excluding oral hypoglycemics, up to the time of surgery. Premedication with intravenous midazolam, 1-3mg was given to patients upon arrival to the anesthesia bay 20-30min before surgery.

Routine standard monitoring was applied to all patients, including standard 5 lead system ECG, invasive arterial blood pressure, pulse oximeter, central venous pressure monitoring, response to neuromuscular blockade (using TOF guard peripheral nerve stimulator) applied to the ulnar nerve, and nasopharyngeal temperature probe.

Both groups were induced with midazolam 0.03-0.05 mg.kg⁻¹, fentanyl 1-2 mcg.kg⁻¹, and propofol 1-2 mg.kg⁻¹. Orotracheal intubation was facilitated by atracurium 0.5 mg.kg⁻¹. Anesthesia was maintained with sevoflurane titrated to an expired MAC between 1-1.5, and a continuous infusion of morphine at 10 to 20 mcg.kg⁻¹.h⁻¹. Additional doses of fentanyl and atracurium were given as needed.

Post bypass fluid balance was maintained with warmed lactated/acetated Ringer’s (Animec AM-2S infusion warmer, Elitco Co Ltd, Japan) to maintain patient’s nasopharyngeal temperature above 35.5°C. Hemodynamic instability (defined as systolic blood pressure less than 90 mmHg and/or mean arterial pressure less than 60 mmHg), if encountered, was corrected with intravenous bolus doses of fluids, table positioning, and/or norepinephrine boluses 4-8 mcg per dose. While closing the subcutaneous tissue, patients received intravenous paracetamol 15 mg.kg⁻¹.

At the completion of surgery, for UFTA group, the inhalational anesthetic was reduced gradually to 0.4 expired MAC (MAC awake). If patients met the preset extubation criteria (SpO₂ >95% with FiO₂ <0.6, ETCO₂ <50 mmHg, spontaneous respiratory rate <24/min), and train of four (TOF) ratio >90%, residual muscle relaxation was antagonized with neostigmine and atropine 0.05 mg.kg⁻¹ and 0.02 mg.kg⁻¹ respectively. The trachea then was extubated and oxygen delivered via open face mask 10 L/min during the transfer from the operating theatre to the ICU. Between 12 and 24 hours after surgery, patients were questioned about recall of intraoperative events.
For patients in the conventional group, patients were transferred to the ICU intubated and sedated with propofol infusion 50 - 70 mcg.kg⁻¹.min⁻¹ and morphine 10-20 mcg.kg⁻¹.hr⁻¹. Mechanical ventilation was continued postoperatively.

As per the local ICU protocol, and after discontinuation of sedation, the patients were judged eligible for extubation if they were awake and able to respond comprehensively to simple verbal commands, provided that they were hemodynamically stable, with minimal chest tube drainage, and had normal ventilatory mechanics, acid-base status, PaO₂, and PaCO₂ at an inspired FiO₂ of 0.4.

Postoperative pain management was multimodal. Each patient received a combination of the following treatments: Continuous intravenous morphine 10-20 mcg.kg⁻¹.hr⁻¹, intravenous morphine on demand 0.05 mg.kg⁻¹ (if pain scored more than 4), with an interval of at least 10 min between boluses, and intravenous paracetamol 15 mg.kg⁻¹ every 6 hours. Pain was assessed with Visual Analogue Scale (VAS), every 6 hours for the first 24 hours of their ICU stay, by the intensivist in charge.

Preoperative data collected included (1) Demographic data, including age, sex and body weight, (2) Preoperative diagnosis and comorbidities, including diabetes, hypertension, chronic renal disease and chronic lung disease, (3) Preoperative investigations, including complete blood picture, bleeding profile, liver function tests, renal function tests, random blood glucose, chest X-ray, ECG, echocardiography and coronary angiography, and (4) Logistic Euro SCORE II.

Intraoperative data collected included hemodynamic parameters, including invasive arterial blood pressure, heart rate and central venous pressure, urine output, arterial oxygen saturation (SpO₂), arterial blood gas analysis (ABG), standard 5 lead ECG analysis, total operative time, cardiopulmonary bypass time, aortic cross clamp time, and total opioid consumption (fentanyl & morphine).

Postoperative data collected included (1) Time to extubation (in hours), (2) The total length of ICU stay (in hours), (3) Pain score (assessed every 6 hours), (4) Total opioid requirements.

Based on two-tailed α error probability of 0.05 and β error probability of 0.2 (power of 80%), a total sample size of 52 patients equally allocated into two groups was required to detect a presumed minimum clinically significant effect size d of 0.8 in length of ICU stay. Statistical power calculations was performed using computer program G*Power 3 for Windows. (Franz Faul, Universitit Kiel, Germany).

### Statistical analysis:

Obtained data was presented as mean ± SD, ranges, numbers and percentages as appropriate. Nominal variables were analyzed using Chi-squared (χ²) test or Fischer exact test as appropriate. Continuous variables were analyzed using unpaired Student’s t-test or univariate two-group repeated measures analysis of variance (ANOVA) with post hoc Dunnett’s test as appropriate. Nominal and non-normally distributed variables were analyzed using Mann-Whitney U test. Statistical calculations were performed using Microsoft® Office Excel 2010 and SPSS 16.0 for windows. p-value <0.05 was considered statistically significant.

### Results

Fifty two adult patients underwent cardiac operations, and were divided into 2 groups (26 patients each): UFTA group and conventional group.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Group A (UFTA)</th>
<th>Group B (Conventional)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis, N (%):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHD</td>
<td>3 (11.5%)</td>
<td>1 (3.8%)</td>
<td>0.125</td>
</tr>
<tr>
<td>IHD</td>
<td>13 (50%)</td>
<td>20 (76.9%)</td>
<td></td>
</tr>
<tr>
<td>RHD</td>
<td>10 (38.5%)</td>
<td>5 (19.2%)</td>
<td></td>
</tr>
<tr>
<td>Operation, N (%):</td>
<td></td>
<td></td>
<td>0.060</td>
</tr>
<tr>
<td>ASD closure</td>
<td>2 (%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>AVR</td>
<td>0 (0%)</td>
<td>3 (11.5%)</td>
<td></td>
</tr>
<tr>
<td>CABG</td>
<td>13 (50%)</td>
<td>20 (76.9%)</td>
<td></td>
</tr>
<tr>
<td>Mitral repair</td>
<td>2 (7.7%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>MVR</td>
<td>7 (26.9%)</td>
<td>3 (11.5%)</td>
<td></td>
</tr>
<tr>
<td>TVR</td>
<td>1 (3.8%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>VSD closure</td>
<td>1 (3.8%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>Gender, N (%):</td>
<td></td>
<td></td>
<td>0.064</td>
</tr>
<tr>
<td>Female</td>
<td>11 (42.3%)</td>
<td>4 (15.4%)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>15 (57.7%)</td>
<td>22 (84.6%)</td>
<td></td>
</tr>
<tr>
<td>Age (years) mean (SD)</td>
<td>43.81 (13.12)</td>
<td>48.69 (12.53)</td>
<td>0.176</td>
</tr>
<tr>
<td>BMI (kg/m²) mean (SD)</td>
<td>27.44 (1.9)</td>
<td>27.76 (1.76)</td>
<td>0.538</td>
</tr>
<tr>
<td>EF, mean (SD)</td>
<td>62.08 (6.05)</td>
<td>57.85 (7.67)</td>
<td>0.032</td>
</tr>
<tr>
<td>Labs, mean (SD):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hb (g/dl)</td>
<td>13.5 (1.3)</td>
<td>13.83 (1.27)</td>
<td>0.365</td>
</tr>
<tr>
<td>Creatinine (mg/dl)</td>
<td>1.05 (0.3)</td>
<td>1.16 (0.24)</td>
<td>0.355</td>
</tr>
<tr>
<td>Euroscore, mean (SD)</td>
<td>0.81 (0.23)</td>
<td>0.87 (0.09)</td>
<td>0.234</td>
</tr>
</tbody>
</table>

UFTA : Ultra-fast track anesthesia.

CHD : Congenital heart disease.

IHD : Ischémic heart disease.

RHD : Rheumatic heart disease.

ASD : Atrial septal defect.

AVR : Aortic valve replacement.

CABG : Coronary artery bypass graft.

MVR : Mitral valve replacement.

TVR : Tricuspid valve replacement.

VSD : Ventricular septal defect.

BMI : Body mass index.

SD : Standard deviation.

HTN : Hypertension.

DM : Diabetes mellitus.

COPD : Chronic obstructive pulmonary disease.

PHT : Pulmonary hypertension.

EF : Ejection fraction.

Hb : Hemoglobin.

Euroscore: European System for Cardiac Operative Risk Evaluation.
Preoperative data of the 2 groups are summarized in Table (1).

The spectrum of preoperative diagnosis included CHD (congenital heart disease), IHD (ischemic heart disease), and RHD (rheumatic heart disease). There was increased number of patients suffering from IHD in the conventional group, 20 patients versus 13 patients in the UFTA group, though it was statistically insignificant.

There was no significant difference regarding preoperative diagnosis, type of operation performed, male to female ratio, age, BMI, preoperative laboratory findings, and EuroSCORE.

There was a significant difference in the mean (SD) ejection fraction between the UFTA and conventional groups, 62.08 (6.05) and 57.85 (7.67) respectively.

Intraoperative data are summarized in Table (2).

Table (2): Intraoperative hemodynamics, ABG findings, intraoperative findings, and opioid usage. Data are presented as ( ... ).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Group A (UFTA)</th>
<th>Group B (Conventional)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemodynamics, mean (SD):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAP (mmHg)</td>
<td>85.74 (5.26)</td>
<td>93.36 (2.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>HR (beats/min)</td>
<td>88.69 (1.21)</td>
<td>89.31 (1.41)</td>
<td>0.099</td>
</tr>
<tr>
<td>CVP (cmH2O)</td>
<td>4.62 (0.49)</td>
<td>4.56 (0.11)</td>
<td>0.011</td>
</tr>
<tr>
<td>Urine (ml)</td>
<td>2330 (342)</td>
<td>2700 (280)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SpO2, mean (SD)</td>
<td>99.18 (0.18)</td>
<td>99.16 (0.18)</td>
<td>0.789</td>
</tr>
<tr>
<td>OP time (hours), mean (SD)</td>
<td>4.96 (0.82)</td>
<td>5.48 (0.49)</td>
<td>0.008</td>
</tr>
<tr>
<td>CPB time (min), mean (SD)</td>
<td>70.15 (23.05)</td>
<td>86.35 (12.13)</td>
<td>0.003</td>
</tr>
<tr>
<td>AXC time (min), mean (SD)</td>
<td>49.81 (19.31)</td>
<td>61.92 (11.58)</td>
<td>0.008</td>
</tr>
<tr>
<td>Opioid usage, mean (SD):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fentanyl(µg)</td>
<td>559.62 (227.6)</td>
<td>696.15 (137.06)</td>
<td>0.012</td>
</tr>
<tr>
<td>Morphine(mg)</td>
<td>9.65 (3.2)</td>
<td>13.38 (2.23)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>


Postoperatively, there was a significant difference in the mean (SD) bypass time between the UFTA and conventional groups, 70.15 (23.05) min and 86.35 (12.13) min respectively. Also, there was a significant difference in the mean (SD) aortic cross clamp time between the UFTA and conventional groups, 49.81 (19.31) min and 61.92 (11.58) min respectively.

Regarding intraoperative hemodynamics, there was a significant difference in the mean (SD) arterial blood pressure between the UFTA and conventional groups, 85.74 (5.26) and 93.36 (2.1) respectively. Also, there was a significant difference in the mean (SD) volume of urine output between the UFTA and conventional groups, 2330 (342) ml and 2700 (280) ml respectively.

Concerning intraoperative use of opioids, there was a significant difference in the mean (SD) amount of fentanyl used between the UFTA and conventional groups, 559.62 (227.6) µg and 696.15 (137.06) µg respectively. Also, there was a significant difference in the mean (SD) amount of morphine used between the UFTA and conventional groups, 9.65 (3.2) mg and 13.38 (2.23) mg respectively.

Postoperative data are summarized in Table (3).

Table (3): Postoperative ICU course, pain score, and postoperative complications. Data are presented as ( ... ).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Group A (UFTA)</th>
<th>Group B (Conventional)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exubation time (hours), mean (SD)</td>
<td>0.23 (1.18)</td>
<td>12.94 (5.03)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>ICU stay (hours), mean (SD)</td>
<td>57.42 (18.62)</td>
<td>95.04 (33.58)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>VAS, mean (SD)</td>
<td>3.86 (0.67)</td>
<td>3.83 (0.37)</td>
<td>0.832</td>
</tr>
<tr>
<td>ICU morphine (mg), mean (SD)</td>
<td>4.19 (1.94)</td>
<td>5.08 (0.74)</td>
<td>0.035</td>
</tr>
</tbody>
</table>


Postoperatively, there was a significant reduction in mean (SD) length of ICU stay between the UFTA and the conventional groups, 57.42 (18.62) and 95.04 (33.58) respectively (p-value <0.001).

Regarding postoperative pain perception detected by VAS score between the 2 groups. But there was a significant difference in ICU morphine usage between the 2 groups. Patients in the UFTA group required a mean (SD) morphine dose of 4.19 (1.94) mg, while the patients in the conventional group required a mean (SD) morphine dose of 5.08 (0.74) mg (p-value = 0.035).
In the UFTA group, only one patient didn’t meet the extubation criteria, and was kept intubated because of lack of spontaneous ventilation at the end of surgery. He was extubated safely six hours postoperatively. Two patients in the UFTA group were reintubated and continued being sedated because of agitation and restlessness. They received additional bolus doses of propofol 0.5 mg.kg\(^{-1}\), and concerns of their capability to maintain their airway patent was the cause for the decision of reintubation. In comparison, no patients in the conventional group required reintubation, though this difference is not statistically significant.

Discussion

In the current study, there was a significant reduction in mean (SD) length of ICU stay between the UFTA and the conventional groups, 57.42 (18.62) hours and 95.04 (33.58) hours respectively (\(p\)-value <0.001).

The question whether early extubation leads to shorter post-operative length of ICU stay has rapidly gained importance over the past decade, considering the correlation between length of hospital stay and costs. Although some investigations \([10,11]\) did not find a difference between in post-operative length of stay in early and late extubated patients. Most observational studies and small randomized clinical trials \([12-14]\) showed significant benefits for early extubation.

A study by Chamchad et al. \([15]\) showed that immediate extubation was associated with a shorter ICU stay by 23 hours (\(p\)-value <0.001) after cardiac surgery and with similar reductions, a 26-hour shorter ICU stay after CABG-only surgery. The authors concluded that extubation in the operating room of patients undergoing cardiac surgery, as guided by clinician judgment, provided adequate safety to guarantee clinical practice, with a reintubation rate comfortably below 1%.

Another study by Amirghofran et al. \([16]\) stated that there was a statistically significant reduction in length of ICU stay between the immediate (or early) extubation group and the late extubation group, which was 2.79 and 3.42 days respectively (\(p\)-value = 0.006). Also, there was a statistically significant decrease in mortality rates between the immediate (or early) extubation group and the late extubation group, which was 2% and 4.7% respectively (\(p\)-value <0.05).

A recent meta-analysis \([7]\) combining the results of 10 randomized controlled trials provided evidence that post-operative length of stay is shorter in cardiac surgery patients who underwent early extubation. Previous studies have shown that prolonged intubation after bypass is associated with increased mortality, the development of multi organ failure, and sepsis. Another study showed that reintubation is a predictor of midterm mortality.

The authors of the meta-analysis \([7]\) stated cautiously that no definitive conclusion could be drawn regarding the potential benefit or harm of early extubation. Moreover, many previous studies included a selection of younger low risk patients and were performed at highly specialized university centers, clearly limiting the generalization of their findings.

In the study done by Kandasamy et al. \([17]\) it was reported that there was a statistically significant reduction in the length of ICU stay between the UFTA and conventional groups, which was 2.24 ± 0.4 and 3.04±0.9 days respectively (\(p\)-value <0.05). Also, there was a statistically significant reduction in the overall length of hospital stay between the UFTA and conventional groups, which was 6.12 ± 0.9 and 7.13±1.6 days respectively (\(p\)-value <0.05). They demonstrated that extubation following cardiac valve replacement surgery can be achieved successfully within 3 hours, and that it very likely leads to reduced length of ICU and hospital stay.

Edgerton et al. \([18]\) observed that patients immediately extubated after off pump coronary artery bypass grafting had a reduced incidence of atrial fibrillation, shorter length of stay and also reduced mortality \([19]\). However, few authors argued against the early extubation, immediately after cardiac surgery. Their views are that immediate extubation activates the sympathetic nervous system, thereby causing hemodynamic instability and myocardial ischemia.

Another study by Borracci et al. \([20]\) suggested that immediate extubation after on pump and off pump cardiac surgery should be avoided in patients with heart failure, left ventricular dysfunction, cross-clamping time, pacemaker usage, hemodynamic compromise and difficult cardiopulmonary bypass weaning. The chances of requiring reintubation are increased if the patients are hemodynamically unstable, cold, hypovolemic or had considerable opioid medication \([21]\).

A comparative study was done by Reis et al. \([22]\), analyzing the complication rates after on pump coronary artery bypass graft surgery. In their study, the authors compared 76 patients sequentially submitted to anesthesia with a fast track extubation protocol and 188 patients submitted to anesthesia.
using a conventional anesthetic protocol. The mean ventilation and intubation times were significantly shorter in the fast track extubation group than in the non-fast track extubation patients (30min vs. 7h and 50min vs. 8h, respectively). However, the ICU LOS (length of stay) and pain evaluation were not assessed in their study.

In that study by Reis et al. [22], there was no significant difference in the mean mediastinal drainage or hospital LOS between FTE (fast track extubation) and NFTE (non-fast extubation) groups. Only 45% of the patients in the FTE group required mechanical ventilation compared to nearly all in the NFTE group (p<0.001). Also, 42% of patients in the FTE group were successfully extubated on ICU arrival compared with only 2% among NFTE patients (p<0.001). The authors concluded that a very early extubation protocol (on average less than 1 hour) can be safely and effectively implemented in patients submitted to coronary artery bypass graft surgery with cardiopulmonary bypass. This protocol reduces intubation and ventilation times without increasing postoperative complications.

A study by Rashid et al. [23] was performed to determine which demographic and intraoperative parameters were associated with early extubation, and to assess the impact of early extubation times on ICU and overall hospital stay. They also detected the kind and occurrence of any postoperative complications. They divided the patients into two groups following intensive care unit admission: Group A (duration of intubation <4 hours) (n=34), and Group B (duration of intubation >4 hours). They observed that Group A patients had a shorter ICU length of stay (1.7±0.5 versus 2.2±0.8 days; p=0.006) and were discharged earlier than Group B patients (2.7±2.4 versus 4.01±3.96; p=0.014). They concluded that early extubation offers a substantial advantage in terms of accelerated recovery, shorter intensive care unit, and hospital stay, suggesting that efforts to reduce extubation times are cost-effective.

Usually the requirement for postoperative mechanical ventilation can be estimated in the operating room (unmet extubation criteria). UFTA usually involves short-acting opioids, volatile agents, and short-acting muscle relaxants. In concordance with previous studies [24], the use of long acting opiates and muscle relaxants did not prevent early extubation in the present study. Conversely, short-acting opiates may not guarantee early extubation [25].

In the current study, there was no significant difference in postoperative pain perception detected by VAS score between the 2 groups. But there was a significant difference in ICU morphine usage between the 2 groups. Patients in the UFTA group required a mean (SD) morphine dose of 4.19 (1.94) mg, while the patients in the conventional group required a mean (SD) morphine dose of 5.08 (0.74) mg (p-value=0.035), which indicated that the patients in this group required much higher analgesic dose to tolerate the stress of endotracheal intubation and mechanical ventilation.

This agrees with the study by Amirghofran et al. [16], which showed that there was a statistically significant difference in the dose of postoperative analgesics between the 2 groups, which was much lower in the group with immediate or early extubation than the group with late extubation. This showed that immediate extubation lessens the need for analgesia.

There was a significant difference in the mean (SD) ejection fraction between the UFTA and conventional groups, 62.08 (6.05) and 57.85 (7.67) respectively. This may be due to the fact that the prevalence of ischemic heart disease was more in the conventional group.

Intraoperatively, there was a significant difference in the mean (SD) operative time between the UFTA and conventional groups, 4.96 (0.82) hours and 5.48 (0.49) hours respectively. There was a significant difference in the mean (SD) bypass time between the UFTA and conventional groups, 70.15 (23.05) min and 86.35 (12.13) min respectively. Also, there was a significant difference in the mean (SD) aortic cross clamp time between the UFTA and conventional groups, 49.81 (19.31) min and 61.92 (11.58) min respectively. This significant difference in intraoperative timings may be due to the more lengthy nature of CABG cases which is more prevalent in the conventional group.

Regarding hemodynamics, there was a significant difference in the mean (SD) arterial blood pressure between the UFTA and conventional groups, 85.74 (5.26) and 93.36 (2.1) respectively. This may be due to more hypertensive patients in the conventional group.

There was a significant difference in the mean (SD) volume of urine output between the UFTA and conventional groups, 2330 (342) ml and 2700 (280) ml respectively. This may be due to more lengthy operative time in the conventional group.
Concerning intraoperative opioid consumption, there was a significant difference in the mean (SD) amount of fentanyl used between the UFTA and conventional groups, 559.62 (227.6) ug and 696.15 (137.06) ug respectively. Also, there was a significant difference in the mean (SD) amount of morphine used between the UFTA and conventional groups, 9.65 (3.2) mg and 13.38 (2.23) mg respectively. This significant difference in the intraoperative opioid consumption can be explained by the more lengthy nature of operation and the more number of hypertensive patients in the conventional group.

Predictors of success of UFTA protocol:

Several studies already have reported predictors of UFTA feasibility. A study by Constantinides et al. [26], found 3 preoperative predictors for immediate extubation failure: (1) Previous renal failure, (2) Cardiac reoperation, and (3) Preoperative IABP (intra-aortic balloon pump) placement. Additionally, the authors found that diabetic patients had a higher risk for extubation failure, which is in agreement with the results reported by Cumpeeravut et al. [27] in OPCAB (off pump coronary artery bypass) patients undergoing UFTA.

Another study by Chamchad et al. [15] showed that postoperative renal failure, atrial fibrillation, and tracheal reintubation consistently predicted longer ICU duration and/or hospital length of stay. They stated that the following patient selection factors indicate the importance of clinician judgment: Patients undergoing immediate extubation compared with fast track were younger, more often male, and healthier by New York Heart Association classification. In addition, those scheduled for simpler operations and off-pump operations more frequently had tracheal extubation in the operating room.

In concert with the present results, Brucek et al. [28] previously reported the impact of total surgical time on UFTA feasibility. In that study, the authors included 547 patients who underwent coronary and/or valvular surgical procedure either with OPCAB or conventional CABG surgery. Intraoperative conversion to conventional CABG surgery is usually a marker of severe hemodynamic instability and clearly is associated with a worse clinical outcome. As expected, intraoperative conversion has been a strong predictor of immediate extubation failure [29].

Kandasamy et al. [17] concluded that shorter AXC (aortic cross clamp) and CPB (cardiopulmonary bypass) times, uncontrolled arrhythmias, absence of severe PHT were the factors found to be associated with early extubation and were statistically significant.

In a retrospective study by London et al. [30] involving 304 cardiac surgical patients on a “fast-track clinical pathway” in which early extubation was defined as extubation in ≤10h; one preoperative factor (age) and intraoperative factors (sufentanil/fentanyl dose, inotrope use, platelet transfusion, use of arterial graft) were identified as independent predictors of delayed extubation.

A recent study by Dorsa et al. [1] found that among other factors, three preoperative predictors for immediate extubation failure namely: Previous renal failure, cardiac reoperation, and preoperative IABP placement, stood as the main obstacle against UFTA. Additionally, diabetic patients had a higher risk for extubation failure, which is in agreement with the results reported by Constantinides et al. [26].

Another recent study by Rodriguez Blanco et al. [31] stated that some preoperative variables (presence of EF > 30% and hypertension) and intraoperative variables (off-pump, shorter surgical times) appeared to be associated with increased likelihood of extubation in the operating room. Even though the patients who were extubated in the operating room had statistically significant shorter CPB and AXC times, these factors were not found to be independent predictors of safe extubation in the operating room.

Wong et al. [32] reported two preoperative variables (increased age and female gender) and four postoperative variables (usage of intra-aortic balloon pump, inotropes, excessive bleeding, and atrial arrhythmia) to be associated with delayed extubation. Furthermore, it is to be stated that “every patient who is free of those predictors is a potential candidate for UFTA until proven otherwise”.

Limitations:

In the current study, the total length of stay in the hospital was not assessed due to technical issues, as it was not applicable to track accurate data about the patients after transfer from the ICU, during their stay in the zone. Late postoperative complications were not assessed in this study, as the follow-up of the patients ended with their discharge from the ICU.

Conclusion:

The implementation of UFTA protocol appears to be feasible and safe. It has led to a significant
reduction in the length of ICU stay of adult patients undergoing elective cardiac surgical operations. Development of a scoring system is the next logical step to universally implement the UFTA protocol.

References


