Ultra fast-tracking versus a conventional strategy in valve replacement surgery

INTRODUCTION

Fast tracking following cardiac surgery is commonly employed as a means to facilitate rapid recovery and discharge from intensive care unit (ICU), thereby, reducing costs of expensive resources.[1] Its use, however, raised various issues in terms of, the type of surgery (there are limited studies on the valve replacement group) and the timing of extubation. This study was undertaken (i) to analyse the factors associated with ultra-fast-tracking in valve replacement surgery, and (ii) to assess its impact on patient recovery, ICU and overall hospital stay when compared to conventional methods.

METHODS

Data were extracted from a group of 119 consecutive patients who underwent cardiac valve replacement surgery from January 2010 to September 2011. The patients were divided into two groups: Group A (ultra fast-track), those extubated within 3 hours of completion of surgery (n=49); Group B (conventional), those extubated beyond 3 hours (n=70). Patients with hemodynamic instability, severe pulmonary arterial hypertension (tricuspid regurgitation (TR) peak pressure gradient >60 mmHg), prolonged aortic cross clamp (ACC) (>120 minutes) time and excessive bleeding were excluded from early extubation. Both groups were analysed on the following variables: Severity of disease, ACC and cardiopulmonary bypass (CPB) time, intraoperative requirement of hemofiltration (CAVH), inotropes, pacing, intra aortic balloon pumping (IABP), transfusion, duration of ventilation, ICU and hospital stay and postoperative events. Ethical committee approval was obtained and patients gave written informed consent after preoperative counselling.

A standard premedication protocol was applied with oral diazepam, pantoprazole and intramuscular morphine.After securing invasive monitoring access under local anaesthesia, induction was performed with fentanyl 5 micrograms/kg, midazolam 0.04 mg/kg and thiopentone 2 mg/kg and was maintained with fentanyl 2 μgrams/kg/hr and midazolam 0.02 mg/kg/hr infusions along with 0.4-0.8% Isoflurane. Vecuronium was used for muscle relaxation.

Amiodarone 150 mg i.v. was administered over 45 minutes in patients with atrial fibrillation (AF) with ventricular rate more than 100/minute. Nitroglycerin (NTG) infusion was titrated to optimise the perfusion (Mean arterial pressure of 50-70 mmHg) and the filling pressures (central venous pressure of 6-8 mmHg) throughout surgery. Furosemide 20 mg and Magnesium 3-4 grams were administered on bypass. CAVH was performed during CPB in patients with fluid overload. Anaesthetic agents were stopped during skin closure.

Apart from warm i.v fluids and under body blanket, operating room temperature was kept at 24°C to ensure normothemia after coming off bypass. All patients received i.v paracetamol 20 mg/kg during sternal closure. After shifting to ICU, all patients were given tramadol 1 mg/kg i.v along with reversal agents, neostigmine and glycopyrrolate.

Extubation was performed when the patient had awakened sufficiently, was able to respond to commands, and has regained sufficient strength to protect his/her airway. A core temperature of 36-37°C and an optimal blood gas (pH 7.35-7.45, pCO_2 35-45 mmHg and pO_2 > 90 mmHg) was ensured prior to extubation.

The Visual Analog Scale (VAS) score was used to quantify pain and fentanyl or morphine (in young, muscular adults) infusion was used in patients with VAS score >4. Oral feeds were resumed in a stepwise manner. Patients were mobilized on the second postoperative day after removal of all invasive lines.

All the data were retrospectively collected and entered into a computerised database. Statistical comparisons were done by the Independent 't' test/Mann Whitney test, Chi Square test with a probability of <0.05 considered significant.

RESULTS

There was no significant difference between the groups in age, gender or comorbidity [Table 1]. All

the patients with severe PAH were in group B ($n=15$), whereas Group A had none, which was statistically significant ($P=0.001$).

Intraoperative and procedural details are listed in Table 2. ACC time ($P=0.01$) and CPB time (0.01) were significantly lower in Group A. The need for cardiac pacing during weaning from CPB was significantly higher in Group B (2 versus 12; $P=0.03$). Blood product usage was more in Group B which also was statistically significant ($P=0.01$). CAVH ($n=5$) and IABP ($n=1$) were used only in Group B.

Patients in Group A required lesser number of hours of ventilation (2.27±0.9) when compared to Group B (10.44±12.7), which was statistically significant ($P=0.00$). Group A patients also had statistically significant shorter ICU length of stay (2.24±0.4 versus 3.04±0.9 days; $P=0.00$) and shorter overall hospital stay (6.12±0.9 versus 7.13±1.6 days; $P=0.00$).

There was higher incidence of uncontrolled AF in Group B, but statistically found to be insignificant. There was no significant difference in re-intubation, re-exploration, morbidity and mortality between the groups [Table 3].

DISCUSSION

This study demonstrates 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. The core principles of ultra-fast-tracking programme include choice and the titration of short-acting anaesthetic drugs, sustained postoperative normothermia, multimodal analgesia, early extubation, ambulation, alimentation and discharge.

Multimodal analgesia with tramadol and paracetamol seems to be the best option for treating postoperative pain in the specific setting of early extubation after cardiac surgery.[2] The principle of this is to gain additive analgesic effects from different modalities of pain control while minimizing side-effects.

Hypothermia (≤35°C) on arrival to the ICU is associated with delayed extubation,[3] shivering and increased peripheral O_2 consumption,

Table 1: Patient demographics and clinical data			
Variables	**Group A (Ultra fast-track)**	**Group B (Conventional)**	***P* value**
Age (years)	33.8±1.6	34.9±11	NS
BSA (m²)	1.33±0.1	1.35±0.1	NS
HTN	0	0	NS
DM	0	2	NS
Renal	0	1	NS
Severe PAH	0	15	0.001

BSA – Body surface area; HTN – Hypertension; DM – Diabetes mellitus; PAH – Pulmonary artery hypertension; NS – Not significant

Table 2: Intraoperative data			
Variables	**Group A (Ultra fast-track)**	**Group B (Conventional)**	***P* value**
ACC time (minutes)	57.2±8.1	80±33	0.01
CPB time (minutes)	81.2±11.1	111.7±44.7	0.01
Pacing	2	12	0.03
IABP	0	1	NS
CAVH	0	5	NS
Blood transfusion	1	18	0.01
Inotropes>1	0	8	NS

ACC – Aortic cross clamp; CPB – Cardiopulmonary bypass; IABP – Intra aortic balloon pumping; CAVH – Continuous arterio-venous haemofiltration; NS – Not significant

Table 3: Postoperative data			
Variables	**Group A (Ultra fast-track)**	**Group B (Conventional)**	***P* value**
AF with RVR	10	25	NS
Re-exploration	0	3	NS
Re-intubation	0	1	NS
Morbidity	0	1	NS
Mortality	0	2	NS

AF – Atrial fibrillation; RVR – Rapid ventricular rate; NS – Not significant

haemodynamic instability, atrial and ventricular arrhythmias, and increased systemic vascular resistance and coagulopathy. Active temperature control is an integral part of ultra-fast-tracking and measures like operating room temperature at 24°C, warming blankets, warm i.v. fluids and humidified gases should be used.

Rapid AF significantly affects the timing of extubation, and to some extent, the length of ICU and hospital stay.[4] Preoperative amiodarone in rapid AF has been found to be beneficial for rate control.[5] Prophylactic magnesium therapy in this subset of patients has been shown to reduce the incidence of postoperative AF.[6]

Shorter ACC and CPB times, uncontrolled arrhythmias, absence of severe PAH were the factors found to be associated with early extubation and were statistically significant.

CONCLUSION

Early extubation in valve surgery is feasible and offers a substantial advantage in terms of accelerated recovery, shorter ICU and hospital stay with no significant difference in postoperative patient outcomes. Various perioperative factors (shorter ACC and CPB times, absence of arrhythmias, absence of severe PAH) can be used as guidelines to improve safety in ultra-fast-track cardiac anaesthesia.

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