

Immediate extubation after heart transplantation in a child by remifentanil-based ultra-fast anesthesia

A case report

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Abstract

Rationale: Ventilator-associated complications comprise important fatal aetiologies during heart transplantation. Ultra-fast anesthesia might provide the most effective measure to prevent this type of complication. Immediate extubation after heart transplantation (IEAHT) has recently been reported in adult patients. However, IEAHT in children is much more challenging due to limitations in anesthesia protocols. Recently, we managed to perform an ultra-fast anesthesia protocol combined with IEAHT during a heart transplant operation in a child, who had an excellent postoperative outcome.

Patient concerns: A 13-year-old girl had been diagnosed with dilated cardiomyopathy 5 years before this case, due to intractable dyspnoea and cough. She received multiple medical treatments after diagnosis, with minimal effects. Physical examination findings included a bulge in her left chest and pitting edema over both legs. Moist rales could be heard in the lung. Echocardiography revealed very large heart chambers, with an ejection fraction of 17%.

Diagnosis: The patient was diagnosed with dilated cardiomyopathy and scheduled to undergo an emergent operation for heart transplantation.

Interventions: The patient underwent an ultra-fast anesthesia protocol and ultra-fast reversal during heart transplantation. General anesthesia was induced with etomidate, fentanyl, and vecuronium; it was then maintained with remifentanil-based total intravenous anesthesia.

Outcomes: Immediately after the end of the operation, the patient was brought to consciousness with stable breathing and haemodynamics. The patient was successfully extubated on the operating table and transferred to the intensive care unit with spontaneous breathing, without postoperative mechanical ventilation. The recovery period was uneventful and the patient was discharged 1 month later without complications.

Lessons: Our experience, in this case, revealed that IEAHT in children is achievable if the ultra-fast protocol is performed properly and carefully, in order to prevent ventilator-associated complications.

Abbreviations: IEAHT = immediate extubation after heart transplantation.

Keywords: heart transplantation, immediate extubation, total intravenous anesthesia

1. Introduction

Ventilator-associated complications comprise important fatal aetiologies during heart transplantation, with overall morbidity near 60%.^[1–3] Ultra-fast anesthesia might provide the most effective measure to reduce or even prevent this type of

complication.^[4] Immediate extubation after heart transplantation (IEAHT) has recently been reported in adult patients.^[5] However, IEAHT in children is much more challenging due to limitations in anesthesia protocols. Recently, we managed to perform an ultra-fast anesthesia protocol combined with IEAHT during a heart transplant operation in a child, who had an excellent postoperative outcome.

2. Case presentation

This case was reviewed by the Ethical Committee Board of First Affiliated Hospital, Zhejiang University School of Medicine (No: 2018–186) and informed written consent was obtained from the patient's family for publication of this case report. A 13-year-old girl (body weight: 29.5 kg, height: 146.5 cm, American Society of Anesthesiologists' status III) was diagnosed with dilated cardiomyopathy 5 years prior due to intractable dyspnoea and cough. Her parents were healthy. She received multiple medical treatments after diagnosis, but these were largely ineffective. Physical examination findings were a bulge in her left chest and pitting edema over both legs. Moist rales could be heard in the lung. Echocardiography revealed very large heart chambers (aorta: 23 mm, interventricular septal end diastole: 6 mm, left

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ventricular diameter diastole: 73 mm, left ventricular posterior wall dimension: 8 mm, left ventricular diameter systole: 67 mm, right ventricle: 41 mm, fractional shortening: 8%, left atrium: 6.7 × 7.9 cm, right atrium: 4.5 × 5.3 cm, heart rate: 100 beats/min (bpm) and extremely low contractile ability, with an ejection fraction of 17%. The patient could not endure minimal physical activity and had been bedridden for 6 months. She was transferred to the heart transplant department and waited for a suitable heart until a 40-year-old donor became available. She was scheduled to undergo an emergent operation for heart transplantation.

Before the induction of general anesthesia, a peripheral venous catheter was established for low-dose dobutamine (2 µg/kg·min) infusion; arterial cannulation was established at the left radial artery for blood pressure measurements under local anesthesia. General anesthesia was induced with etomidate (0.25 mg/kg), fentanyl (6.8 µg/kg), and vecuronium (0.15 mg/kg); it was maintained with total intravenous anesthesia (TIVA) (propofol 150 mg/h, remifentanyl 0.35 mg/h, and cisatracurium 3 mg/h) in 80% oxygen/air. Further doses of fentanyl and rocuronium were administered as required to maintain a sedation state of bispectral index (BIS) between 40 and 50 with haemodynamic stability. Mechanical ventilation (volume-controlled, inspiration:expiration = 1:2) was adjusted to maintain end-tidal CO₂ partial pressure between 35 and 40 mm Hg.

Arterial pressure was monitored electromanometrically. After successful intubation with a 5.5-mm (inner diameter) strengthened endotracheal tube, a central venous catheter was inserted through the right internal jugular vein; central venous pressure was then monitored continuously, along with electrocardiography and saturation of pulse oxygen. Blood gas analysis was performed intermittently to maintain a stable inner milieu. The operation proceeded uneventfully with 86 minutes cardiopulmonary bypass time and 40 minutes aortic clamping time. The heart resumed sinus rhythm after the removal of aortic clamping; it exhibited satisfactory contractility with the support of infusions of low-dose dobutamine (1 µg/kg·min) and adrenalin (2 µg/min). The haemodynamic state remained stable with nitroglycerin infusion to reduce peripheral resistance. Lactated Ringer's solution (1000 mL) and fresh frozen plasma (330 mL) plus platelets (10 units) were infused during the operation. A gradual withdrawal protocol was adopted to prevent opioid-induced hyperalgesia; a bolus of fentanyl (50 µg) was administered near the end of the operation. Neostigmine (2 mg) was administered to reverse the residual muscle relaxant. Immediately after the end of operation, the patient regained consciousness and follow simple instructions well with satisfactory breathing. Her blood pressure was 130/80 mm Hg, and her heart rate was 110 bpm with dobutamine (2 µg/kg·min) infusion. After overall evaluation, immediately extubation was successfully performed on the operating table and the patient maintained a stable SpO₂ of 100% and breathing rates of approximately 20 bpm with an inspired fraction of oxygen at 30%.

Subsequently, the patient was transferred to the intensive care unit (ICU) without ventilation support. She stayed 3 days in the ICU before she was transferred to the general ward. Her recovery period was uneventful and she was discharged 1 month later without complications.

3. Discussion

In the present case, immediate extubation was performed after heart transplantation in a child. Although IEAHT in adult patients

has been reported by Kianfar et al,^[5] IEAHT in children presents a particular challenge for anesthesia management. However, the present case revealed that IEAHT in children is achievable if the ultra-fast protocol is performed properly and carefully.

We used remifentanyl-based TIVA as the ultra-fast anesthesia protocol because the sedation produced by propofol can be monitored easily and precisely with BIS,^[6] while remifentanyl infusion provides a very predictable profile of elimination.^[7] Although studies have shown that remifentanyl may inhibit cardiac performance during open-heart surgery, a suitable dosage might decrease these effects to an imperceptible level.^[8–9] Furthermore, low-dose dobutamine infusion further offsets this weakness. In the present case, remifentanyl infusion provided an ideal anti-nociceptive effect without endangering the haemodynamic state of the patient. In order to avoid the effects of remifentanyl withdrawal, we used the gradual withdrawal protocol described by Comelon et al.^[10] In our hands, low-dose remifentanyl infusion results in ideal emergence during immediate extubation after open-heart surgery.

The benefits of an ultra-fast anesthesia protocol in cardiac surgery are occasionally investigated. However, the practice of IEAHT in heart transplantation remains rare. Kianfar et al showed that ultra-fast extubation results in a short ICU stay and a lower incidence of pulmonary complications; thus, it yields better outcomes in patients above 18 years of age.^[5] Our case suggests the emergence of a new horizon in ultra-fast anesthesia administration to paediatric patients. In this case, the patient required simpler postoperative treatment and recovered faster than is typically observed when using conventional anesthesia in our institution; notably, particular attention must be given to such patients by the anesthesiologist throughout the perioperative period. The benefits and risks should be evaluated further to confirm our preliminary observations.

4. Conclusions

The present case revealed that IEAHT in children is achievable if the ultra-fast protocol is performed properly and carefully, in order to prevent ventilator-associated complications.

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