

Predictors and Outcome of Early Extubation in Infants Postcardiac Surgery: A Single-center Observational Study

With the studies proving the benefit of fast tracking in adults by reducing the postoperative morbidities, intensive care unit (ICU) stay and cost, many practitioners found it attractive to apply in pediatric congenital cardiac surgery.^[1] The authors evaluated the feasibility of early extubation, its effect on outcome and looked for predictors of prolonged ventilation in children's aged <1 year that underwent a wide variety of cardiac surgical procedures with or without cardiopulmonary bypass (CPB). They could achieve early extubation within 6 h of surgery in 33.8% of children's with comparable mortality and reintubation rate. Those extubated early had a significant lower incidence of sepsis and duration of ICU stay. Age <6 months, RACHS category ≥ 3 , duration of CPB ≥ 80 min, duration of aortic cross-clamp (AXC) ≥ 60 min, and vasoactive-inotropic score (VIS) >10 were independently associated with prolonged ventilation. This report differs from other previous similar reports by the fact that the author did not use any fixed anesthesia protocol, particular type and dosage of anesthetic drugs, or fixed CPB management and transfusion protocol. Rather they choose to reverse opioid and muscle relaxant effect following completion of surgery after ensuring satisfactory transesophageal echocardiography finding and hemodynamic stability. The author did not report the duration of hospital stay and reduction cost of treatment, which is the ultimate goal of fast tracking. This commentary discusses the effects of the use of fixed anesthesia protocol, regional anesthesia, normothermic CPB, ultrafiltration, and restrictive transfusion protocol on fast tracking in children's undergoing repair for congenital heart disease.

The concept of fast tracking essentially involves early extubation, mobilization, and hospital discharge with ultimate goal of reduction in postoperative morbidity and cost of treatment. It requires multidisciplinary management strategies including proper patient selection, modification in anesthesia and surgical techniques, and modifications in CPB management and postoperative care. Since early extubation is an essential component of fast tracking, most anesthesiologists use modern inhalational anesthetics such as sevoflurane and low-or-moderate doses of short-acting opioids.^[2] Although high-dose opioid techniques are mostly avoided, the ultrashort-acting remifentanyl has made the high-dose opioid technique also possible for fast tracking. Dexmedetomidine is another very useful drug for fast tracking. Apart from its sedative property, it has opioid-sparing effect by activating α -2 receptors in spinal cord and reduces the release of substance *P* from dorsal horn, thereby reducing the transmission of nociceptive signals.^[3] Although its use in children is not recommended

by the Food and Drug Administration, its minimal or no respiratory depressant effect in addition to the above beneficial effects makes its very useful drug for achieving early extubation.^[3] The use of neuraxial techniques such as caudal, spinal, or epidural opioid with or without local anesthetics has also shown to be beneficial in reducing the intravenous opioid requirement and helps in achieving early extubation. In addition to providing superior analgesia, neuraxial opioid has shown to blunt the stress response to surgery, improve postoperative pulmonary function, and decrease duration of mechanical ventilation and cost associated with it.^[4] Author reversed the opioid and muscle relaxant effects using antagonist to achieve early extubation, rather than using short-acting drugs or neuraxial technique. Although author did not report any untoward effects, this approach may be associated with side effects for the use of naloxone and neuromuscular reversal agents. The nonavailability of short-acting opioids or its cost may be a reason for its not use; however, neuraxial technique may be used easily in this situation. In fact, this commentator and team use caudal morphine with or without local anesthetic agent in conjunction with low doses of fentanyl and sevoflurane in all cases planned for fast tracking.

Fluid balance forms an important role in the lung mechanics, particularly in children, where the blood volume is low. There is increased chance of fluid overload during cardiac surgery involving bypass, thereby affecting extubation. The CPB management strategies like the use of normothermic CPB, miniaturized circuit, anti-inflammatory agents, and ultrafiltration techniques are useful in reducing the inflammatory response and minimizing net fluid balance.^[5,6] The beneficial effect of normothermic CPB in early extubation after adult cardiac surgery is proven, but there is not much evidence in pediatric cardiac surgery due to the frequent use of some degree of hypothermia in congenital corrective cardiac surgeries. At least in relatively simple congenital heart surgeries where normothermic bypass is feasible, its use is expected to be beneficial in achieving early extubation by avoiding the complications associated with hypothermic bypass such as the increased release of catecholamines, activation of complements, neutrophils, active rewarming, and associated after drop in the postoperative period. Various studies have shown the beneficial effect of ultrafiltration strategies in achieving early extubation in children after cardiac surgery by removing the pro-inflammatory cytokines, maintaining better fluid balance with higher level of hematocrit, thereby reducing blood transfusion and improved pulmonary function.^[6]

Aside from anesthesia management, essential components for the safe execution of fast tracking would be good surgical correction preferably using minimally invasive approaches and reduced postoperative bleeding.

The author demonstrated younger age, prolonged CPB and AXC time, higher VIS, and increased complexity of surgery as predictors for prolonged ventilation requirement. Besides these, other factors shown to affect the duration of mechanical ventilation that includes intraoperative transfusion, net fluid balance, pulmonary hypertension, congestive cardiac failure, prematurity, syndromic child, and preoperative mechanical ventilation.^[7]

Similar to adults, fast tracking has been associated with significant reduction in the ICU stay and cost of hospital treatment in children undergoing cardiac surgery.^[8] The author demonstrated reduction in the ICU stay and sepsis in children who were extubated early; however, they did not evaluate its effect on the duration of hospital stay and cost of treatment. Largely the process of postoperative care in addition to early extubation determines the hospital length of stay. Hence, for the optimal success of fast or ultra-fast track model in cardiac surgery, the most important element is to facilitate the process of postoperative care coupled with intraoperative early extubation anesthesia.

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