

SAFETY AND EFFICACY OF LUNG RECRUITMENT MANEUVERS IN POST-OPERATIVE PEDIATRIC CARDIAC SURGICAL PATIENTS

Tiffany Morandi, MS4¹, Harjot Bassi, MD², Courtney Howell, PNP, MSN², Jillian Bybee, MD², Chengcheng Hu, Ph.D.^{1,2}, Brigham C. Willis, MD^{1,2}
¹University of Arizona College of Medicine, Phoenix; ²Phoenix Children's Hospital

ABSTRACT

Lung recruitment maneuvers improve oxygenation and lung function, and reduce atelectasis in ventilator-dependent patients. **Hypothesis:** Lung recruitment maneuvers are safe for post-operative pediatric cardiac surgical patients. **Methods:** Retrospective review of 62 post-operative pediatric patients receiving lung recruitment maneuvers. **Results:** Statistically significant improvement in lung compliance and renal non-invasive regional oximetry immediately after recruitment. No statistically significant change in blood pressure, heart rate or inotrope requirement throughout recruitment. **Conclusions:** Lung recruitment maneuvers are safe and effective at improving lung compliance and oxygenation in this patient population.

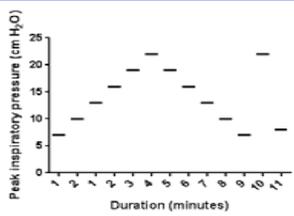
INTRODUCTION

Mechanical ventilation is often required in the post-operative period for children undergoing open heart surgery. Sound ventilator management is imperative as these patients have an already compromised physiologic status. It is thought that much of ventilator-induced lung injury arises from repetitive collapse (atelectasis) and re-expansion of the alveoli. Ventilator recruitment maneuvers help maintain the alveoli in an opened state, allowing better ventilation and oxygenation and potentially decreasing ventilator-associated morbidities.

METHODS

Retrospective chart review of 62 patients who underwent open heart surgery after implementation of a lung recruitment protocol. Exclusion criteria: patients >18 years and patients with tracheostomies. Physiologic data before, during and after maneuvers and demographic data were collected.

RECRUITMENT PROTOCOL



Recruitment protocol: On pressure control mode PEEP is increased every minute in 1-2cm H₂O increments, up to 5-10cm H₂O above baseline PEEP. PEEP is increased until tidal volume stops increasing. PEEP is then decreased every minute in 1-2cm H₂O increments until derecruitment of the alveoli (recognized as a significant decrease in dynamic compliance) is noted. The alveoli are opened (recruited) again by temporarily increasing PEEP to pre-lung derecruitment level plus 5-10cm H₂O. PEEP is brought down to 2-4cm H₂O above derecruitment level and this is recorded as the new, optimal PEEP.

RESULTS

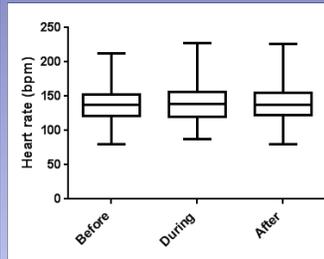


Figure 1. Heart rate before, during and after recruitment. No significant change in heart rate (P = .18, 95% CI)

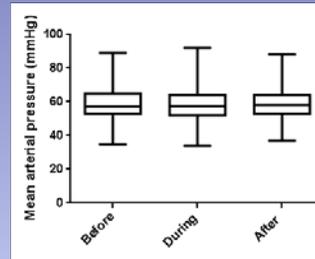


Figure 2. Mean arterial pressure (MAP) before, during and after recruitment. No significant change in MAP (P = .65, 95% CI)

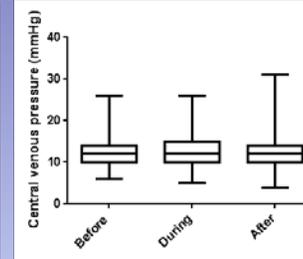


Figure 3. Central venous pressure (CVP) before, during and after recruitment. Transient increase in CVP during maneuver. Mean CVP before, during and after 12, 13, 12mmHg, respectively (P < .0001, 95% CI)

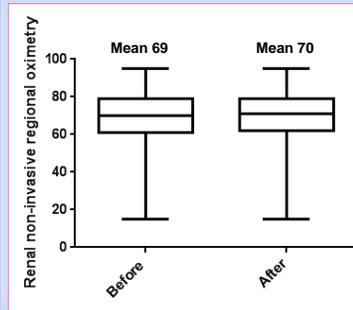


Figure 4. Renal non-invasive regional oximetry before and immediately after recruitment. Statistically significant increase after maneuver (P = .015; 95% CI).

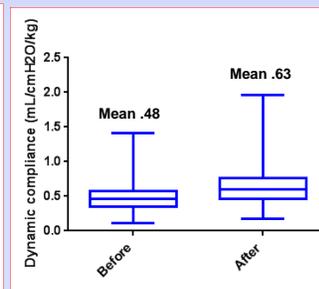


Figure 5. Dynamic compliance of the lungs before and immediately after recruitment. Statistically significant increase in compliance after maneuver (P < .0001; 95% CI).

Median Age	4 weeks
Average # of maneuvers per patient	8
Development of pneumonia	7 patients
Development of pneumothorax	5 patients
Average length of intubation	4 days
Prolonged intubation > 7 days	9 patients
Average length of hospital admission	20 days
Evidence of bronchopulmonary dysplasia on CXR	0 patients
Death	2 patients

CONCLUSIONS

Lung recruitment is safe in post-operative pediatric cardiac surgical patients as evidenced by preserved cardiovascular dynamics throughout the procedure. Improved oxygenation, as indicated by improved renal non-invasive regional oximetry, could potentially decrease the work of the heart. Improved lung compliance is likely the result of decreased atelectatic areas which could improve oxygenation, further decrease the work of the heart and possibly reduce ventilator morbidities and dependence.

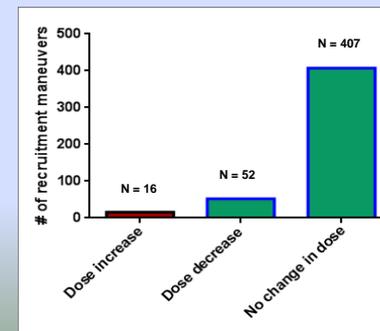


Figure 6. Intotropic support: Data for milrinone, dopamine, epinephrine, vasopressin and calcium gluconate dosage before, during and after maneuver. Of the 475 recruitment maneuvers analyzed, there were 16 dose increases, 52 dose decreases and 407 maneuvers without dose adjustment.