

A497

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Cuirass Negative Pressure Ventilation Augments Cardiac Output After the Fontan Operation

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Introduction: In the majority of patients with Fontan circulation, antegrade diastolic pulmonary arterial flow, and hence cardiac output, increases during spontaneous inspiration but is significantly lowered during positive pressure ventilation. Thus early postoperative extubation including the extubation in an operating room (OR) is preferred in many institutes after the Fontan operation. However early extubation in OR is not always possible because of the patient conditions including the influence of residual anesthesia or opioids, hypothermia, etc. after the surgery, and they may need positive pressure ventilation. Hence we hypothesized that cuirass negative pressure ventilation may augment the cardiac output even in combination with positive pressure ventilation in the patients with Fontan circulation. We hereby examined the effect of continuous cuirass negative pressure ventilation (CNPV) on cardiac output after the Fontan operation.

Methods: With approval of institutional review board and informed consent, patients who underwent the Fontan operation between January 2009 and December 2010 were included in the study. All patients were transferred to the ICU with intubation and received positive pressure support (PS; 5 cmH₂O) with positive end-expiratory pressure (5 cmH₂O) under spontaneous breathing postoperatively. Intermittent mandatory ventilation was provided if necessary. Continuous cuirass negative pressure ventilation (-10-15 cmH₂O) was started three hours after the initiation of positive pressure ventilation. CNPV was continued for 12-24 hours after the extubation. Cardiac output and ScvO₂ were monitored by FloTrac sensor and PreSep oximetry catheter (Edwards Lifesciences) continuously. Percent increase in cardiac index (CI) calculated by following formula was analyzed: $(100 \times (CI \text{ after CNPV} - CI \text{ before CNPV}) / CI \text{ before CNPV})$. Data were analyzed with Kruskal-Wallis H-test followed by Mann-Whitney U-test with Bonferroni correction where applicable. $P < 0.05$ or less were considered significant.

Results: Five patients were included in the study. They were extubated on the first day after the surgery. Cardiac index increased after the initiation of CNPV by 68% comparing (range: 26% - 115%). ScvO₂ increased after the initiation of CNPV significantly, which indicated improved oxygen delivery.

Conclusion: CNPV augmented cardiac output even in combination with positive pressure ventilation and improved oxygen delivery. Cuirass negative pressure ventilation is effective to increase cardiac output and to improve oxygen delivery in patients with the Fontan circulation.