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A4186
October 15, 2013
10:00:00 AM - 11:00:00 AM
Room Room 104-Area A

Cuirass Negative Pressure Ventilation Decreases Morbidity of Pleural Effusion After the Fontan Procedure

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Introduction: Pleural effusion after the Fontan procedure is one of the major morbidities, which prolongs ICU stay or hospitalization. Although the mechanism of pleural effusion remains somewhat obscure, one of the strategies to reduce persistent pleural effusion is to improve pulmonary circulation, and hence cardiac output. Because negative pressure ventilation with external cuirass increases cardiac output even in patients receiving positive pressure ventilation (Ann Thorac Surg 2008; 85: 1355-60), we hypothesized that cuirass negative pressure ventilation (CNPV) may augment cardiac output and reduce the chest tube drainage after the Fontan procedure. Hence we examined the effect of CNPV on the necessity of chest tube insertion in early postoperative period of the Fontan operation.

Methods: With approval of institutional review board and informed consents, patients who underwent the Fontan operation with extracardiac conduit procedure without fenestration between January 2009 and October 2012 were included in the study. All patients received general anesthesia with sevoflurane and continuous infusion of remifentanil or fentanyl during the surgery. Extubation in the operating room (OR) depended on the decision of an attending anesthesiologist. When the attending anesthesiologist decided extubation in OR should be avoided, the patients were transferred to the ICU and received positive pressure ventilation (pressure support: 5-8 cmH_2O and positive end-expiratory pressure: 3-5 cmH_2O) with minimally required intermittent mandatory ventilation if necessary. They were evaluated for extubation at every 3 hours after the ICU admission and assigned to either of two groups after extubation: patients who received CNPV (Hayek RTX: United Hayek Medical, London, UK) after extubation (CNPV group) and patients who did not (conventional group). CNPV group received continuous cuirass negative pressure ventilation (between -10 and -15 cmH_2O) for 24-48 hours after the extubation. Incidence of chest tube insertion within one week after the surgery, and the length of ICU stay were compared between the groups. Data were analyzed with Mann-Whitney U-test or Fisher's test where applicable. $P<0.05$ was considered significant.

Results: Twelve patients were included in conventional group and ten patients were included in CNPV group, respectively. The numbers of patients who underwent extubation on the day of the surgery (including in OR) were five in conventional group and three in CNPV group, respectively. Five patients in conventional group received chest tube insertion due to pleural effusion, although only one patient in CNPV group needed a chest tube ($p<0.05$). Among these patients who received chest tube insertion, three were extubated in OR. The length of ICU stay was significantly shorter in CNPV group than in conventional group (mean ± SD: 5.4 ± 3.5 days vs. 10.9 ± 5.2 days).

Conclusion: CNPV after extubation decreased pleural effusion and incidence of chest tube insertion, and also shortened ICU stay of patients who underwent the Fontan procedure. As CNPV could be acceptable in conscious patients, CNPV after extubation could improve the short term outcome of the Fontan procedure.