Introduction:
Maintaining inspiratory pleural pressure (Ppl) in an optimal range is important to prevent lung injury, respiratory muscle fatigue and ventilator-induced diaphragmatic dysfunction. While esophageal pressure (Pes) has been used as a gold standard surrogate for Ppl, the measurement of Pes has several challenges including correct positioning of an esophageal catheter. We hypothesized that Ppl in spontaneously breathing children during mechanical ventilation can be estimated by using the change in central venous pressure (ΔCVP).

Methods:
Spontaneously breathing children under mechanical ventilation with acute respiratory failure (PaO2/FIO2 <300), who has a central venous catheter and an esophageal catheter for clinical purposes, were enrolled. Correct positioning of the esophageal balloon catheter was ensured by an occlusion test (OT), in which the changes in Pes and airway pressure (ΔPes and ΔPaw, respectively) were confirmed to be close to unity. First, we obtained a ratio (k) of ΔPaw (~ΔPpl) to ΔCVP during OT. Second, assuming k was the same as the ratio of ΔPpl to ΔCVP during spontaneous breathing, ΔPpl during pressure support of 10, 5, and 0 cmH2O was calculated by using ΔCVP as follows: CVP-derived Δ Ppl = k * Δ CVP. Finally, CVP-derived ΔPpl was compared to ΔPes at each ventilator setting.

Results:
Eight patients (Median age 4.8±3.3 months; median body weight 4.7±1.3 kg) were included in the analysis. CVP-derived ΔPpl and ΔPes were correlated significantly (y=0.59x+3.6, R2=0.56, p<0.01). Bland-Altman analysis showed that bias and precision of these two methods were -0.53 and 3.5 cmH2O, respectively (Figure).

Conclusion:
In spontaneously breathing children during mechanical ventilation, CVP-derived ΔPpl correlated well with ΔPes. It could be used as a guide to estimate pleural pressure without using an esophageal balloon catheter.