Diaphragm Ultrasound As A Method To Predict Ventilation Outcome In Children: The Prospective Observational Cohort Study.

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Background and Goal of Study

Diaphragm dysfunction worsens outcomes in mechanically ventilated patients. However, the clinical impact of changes in diaphragm structure and function due to mechanical ventilation (MV) is unknown.

The hypothesis was that in children the duration of MV and the duration of stay in the intensive care unit, the frequency of complications depend on the degree of diaphragm atrophy. The aim of the study was to determine whether diaphragm atrophy developing during MV leads to prolonged ventilation.

Materials and Methods

Fig. 1. A flow chart showing criteria of patients' selection and follow up through the study.

Diaphragm thickness (Tdi) at the end of inspiration and diaphragmatic excursion were measured daily by ultrasound in children requiring invasive MV, evaluating an inspiratory effort was assessed by thickening fraction.

The primary outcome was the time to liberation from ventilation. The secondary outcomes included complications (reintubation, tracheostomy, prolonged ventilation, or death). Statistical Package for the Social Sciences was used and results were presented using adjusted hazard ratio (HR), duration ratio, and odds ratio (OR).

Results and Discussion

Thickness decreased to more than 10% in 30 patients (63%) by median day 6 (IQR 5-7).

Fig. 2. Diaphragm thickness (Tdi) at the end of inspiration

The development of decreased thickness was associated with a lower daily probability of liberation from ventilation (adjusted HR 0.47, 95%CI 0.38-0.62, per 10% decrease), prolonged ICU admission (duration ratio 1.63, 95%CI 1.25-2.44), and a higher risk of complications (OR 2.14, 95%CI 1.21-4.72). The development of increased thickness (n=8, 17%) also predicted prolonged ventilation (duration ratio 1.38, 95%CI 1.00-1.90). Decreasing thickness was related to abnormally low inspiratory effort; increasing thickness was related to excessive effort. Patients with thickening fraction between 15- 30% during the first 4 days had the shortest duration of ventilation.

Tabl. 1. Comparison of weaning parameters between patients on 4-th day of weaning (n = 44).

	Successful extubation (n=32) Median (IQR)	Failed extubation (n = 12) Median (IQR)	P-value
RSBI, breath/ml * kg	8.1 (7.3-9.2)	13.9 (12.4-18.1)	0.06
TV/body weight, ml/kg	6.9 (6.5-8.6)	4.3 (4.1-5.9)	0.08
RR, breath/min	32 (22-34)	48 (38-56)	0.001
PaO2/FiO2	210 (204-358)	182 (157-218)	0.05
Diaphragmatic excursion (mm)	9.2 (10.4-8.9)	6.5 (5.8-7.3)	0.001

Conclusion

Diaphragm atrophy developing during MV strongly impacts clinical outcomes.