

Electrical impedance tomography in diagnosing pneumothorax in mechanically ventilated patients

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Abstract

Background: Pneumothorax is a common complication in ICU patients under mechanical ventilation. This study aims to evaluate the possibility of EIT in diagnosing pneumothorax in mechanically ventilated patients.

Methods: We conducted a retrospective study, which included mechanical ventilation patients had received EIT examination for respiratory therapy. Patients were divided into pneumothorax (PTX) and non-pneumothorax (Non-PTX) groups according to the presence of pneumothorax. The global ventilation map on EIT is divided into ventral (upper left quadrant and upper right quadrant) and dorsal (lower left quadrant + lower right quadrant) regions of interest (ROIs), and the defect score (DS) of each quadrant is defined as follows: 0 ($Q\% \geq 15\%$), 1 ($15\% > Q\% \geq 10\%$), 2 ($Q\% < 10\%$), and the defect score of the whole lung is equal to the sum of DS of all quadrants. The ratio of higher ventilation to lower ventilation in the two ventral quadrants is presented as $Ventral_{high}/Ventral_{low}$.

Results: A total of 203 patients were enrolled in this study, including 25 cases in the pneumothorax group and 178 cases in the non-pneumothorax group. PTX group had a higher DS of ventral quadrants (1.00(0.00, 2.00) vs, 0.00 (0.00, 0.00), $P < 0.0001$) rather than dorsal quadrants (1.00(0.00, 1.00) vs, 0.00 (0.00, 1.00), $P = 0.722$). Moreover, a higher $Ventral_{high}/Ventral_{low}$ was found in the PTX group (2.51(1.58, 3.52), vs. 1.36(1.15, 1.77), $P < 0.0001$). The area under the ROC curve of the $Ventral_{high}/Ventral_{low}$ to differentiate PTX from non-PTX was 88.0%, with the sensitivity being 70% and the specificity being 90% when the cut-off value was 2.57.

Conclusion: The ventilation defect was mainly observed in ventral region in mechanically

ventilated patients with pneumothorax. A high $Ventral_{high}/Ventral_{low}$ is highly suspicious of pneumothorax, and further determined examination should be triggered.

Table 1 ROC areas and cutoff value of parameters for identifying PTX

	AUC (95% CI)	Cut-off value	Sensitivity	Specificity	P
$Ventral_{high}/Ventral_{low}$	0.880(0.789,0.972)	2.57	0.70	0.93	0.000
Defect Score _{ventral}	0.747(0.594,0.900)	-	-	-	0.001
GI index	0.746(0.625,0.867)	0.37	0.65	0.76	0.001

