

Electrical Impedance Tomography Vs Whole Thoracic Impedance for Monitoring Lung Fluid Content in Congestive Heart Failure Patients

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Abstract

Detection of pulmonary edema is possible with the bio-impedance technique. In the present study two approaches, the whole-thoracic impedance and the Electrical Impedance Tomography, for monitoring pulmonary congestion level were compared. A good correlation ratio of $R=0.75$ ($p\text{-value} < 0.01$) was found between the two data sets. The results suggest that the EIT method with 8 electrodes has the potential to be used for monitoring patients with congestive heart failure.

1. Introduction

Acute decompensate heart failure is accompanied with pulmonary congestion resulting from elevated left ventricular filling pressures. Since pulmonary edema causes changes in lung conductivity, an approach such as bio-impedance is appropriate for monitoring the level of fluids accumulated in the lungs. A new scheme called parametric electrical impedance tomography (pEIT), which uses reduced number of electrodes and is more suitable for the clinical setting, was recently developed for several clinical applications [1-5]. A significant difference of mean left and right lung resistivity values between chronic heart failure patients and healthy subjects using a pEIT system was demonstrated [1,2]. The purpose of this study is to compare two approaches, the whole-thoracic impedance and the Electrical Impedance Tomography, for monitoring pulmonary congestion level.

2. Methods

The preliminary study was conducted on a group of 14 subjects (all males, aged 50 ± 19 years). All subjects signed an informed consent. To ensure minimal inter-subject variance, all EIT measurements were taken in similar postures on a seated subject during tidal

respiration, with 8 electrode belt attached to the patients' thorax on the plane of the fifth intercostal space in the midclavicular line using conventional ECG Ag/AgCl disposable electrodes (figure 1). Eight specially designed elongation mechanisms on the electrode belt were used for adapting the electrode belt length to the thoracic perimeter of the subject, ensuring a fixed angular distance between the electrodes. In addition to the bio-impedance measurements, the whole thoracic impedance for each subject was measured..

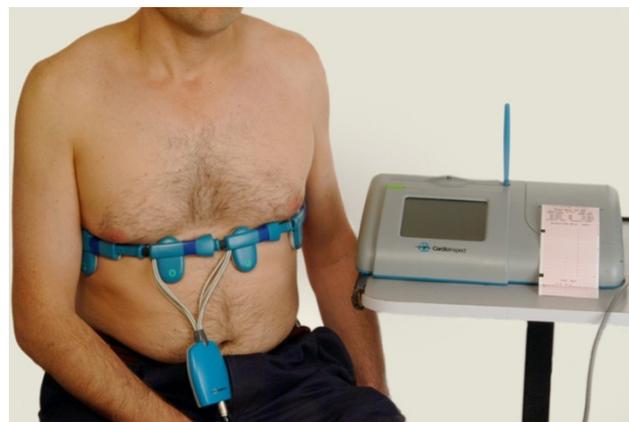


Figure 1: Standalone Device for Hospitals and Clinics

3. Results

Figure 2 shows the relationship between the EIT ($\Omega \cdot \text{cm}$) and the whole thoracic impedance ($1/\text{K}\Omega$). A good correlation ratio of $R=0.75$ ($p\text{-value} < 0.01$) was found between the two data sets. The results suggest that the EIT method with 8 electrodes has the potential to be used for monitoring patients with congestive heart failure.

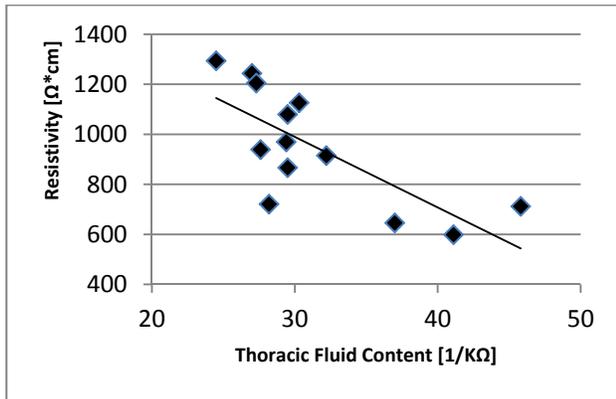


Figure 2: The relationship between the EIT ($\Omega \cdot \text{cm}$) and the whole thoracic impedance ($1/k\Omega$). A good correlation ratio of $R=0.75$ ($p\text{-value} < 0.01$) was found between the two data sets.

4. Conclusions

Lung edema levels can be achieved with our novel EIT reconstruction scheme with 8 electrodes, making the proposed technique feasible in reliable monitoring of lung fluid status in CHF patients.

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