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Improvement on Crackle Severity in a Patient with Lung Edema after Hemodialysis

血液透析改善肺水腫病人肺部濕囉音之觀察

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INTRODUCTION

Crackle is explosive discontinuous respiratory sound that could be heard over the lungs in various diseases, including pneumonia, congestive heart failure, lung edema, lung fibrosis, chronic bronchitis, etc. Some studies have used quantitative measures of crackle to evaluate the outcome of airway clearance, treatment of pneumonia and treatment of bronchiolitis. However, the relation between these crackle measures and hemodialysis (HD) in patients with pulmonary edema is rarely reported.

CASE REPORT

A 48 y/o female was admitted to hospital with fever, diarrhea and nausea. Her past disease history included type 2 diabetes mellitus, end-stage renal disease and hypertension. Admission chest X-ray film indicated edema in both lungs. She accepted HD for the first time in her life during the admission. A digital stethoscope (Littmann 3200, 3M, Minnesota, US) was used to record her lung sound at 8 different locations (2nd and 5th intercostal spaces in the bilateral midclavicular lines and 4th and 10th intercostal spaces in the midaxillary lines) before and after the HD. The duration of each recording was 15 seconds containing at least 4 full breathing cycles, and the sampling rate was 4,000 Hz. Short-time Fourier transform was used to render the spectrogram of the sound signal. One experienced expert labeled the start time and end time of the heard crackles when viewing the spectrogram derived from the corresponding signals at the same time. Crackle can be heard at 7 auscultation locations before the first HD, and it only presented at 1 location after the treatment.

DISCUSSION and CONCLUSION

The results displayed significant improvements in Δ occupation rate (-0.396±3.92, P = 0.016), Δ number of crackle segments (-2.75±2.12, P = 0.016) and Δ presences/breathing cycles (-0.344±0.314, P = 0.016) based on Wilcoxon Sign-Rank tests. The image of chest X-ray after the HD displayed normal opacity in the lung fields, which matched the findings of crackle quantification. In summary, the aforementioned quantitative measures could be useful indicators for evaluating the severity of lung edema. A more comprehensive study is warranted in the future.

ACKNOWLEDGMENTS

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Figure 1. Patient's Chest X-ray film before hemodialysis.

Figure 2. Patient's Chest X-ray film after hemodialysis.

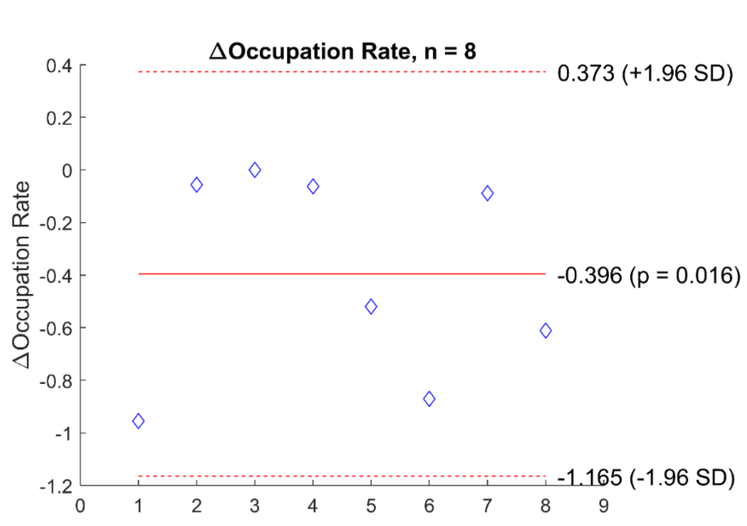

Figure 3. Bland-Altman plot of crackle occupation rate before and after hemodialysis treatment.

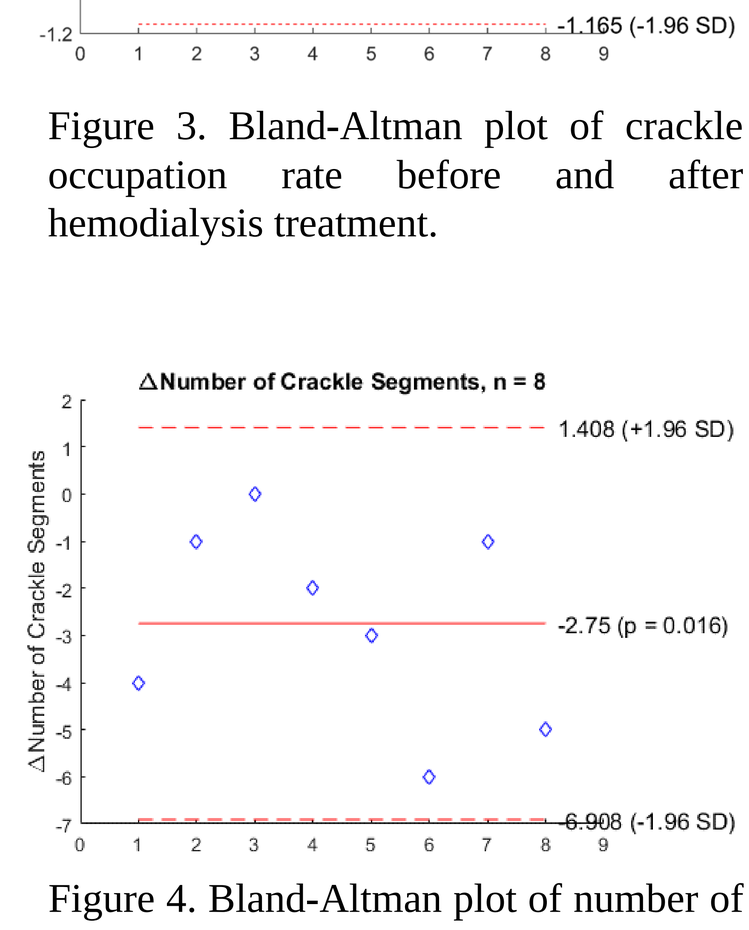

Figure 4. Bland-Altman plot of number of crackle segments before and after hemodialysis treatment.

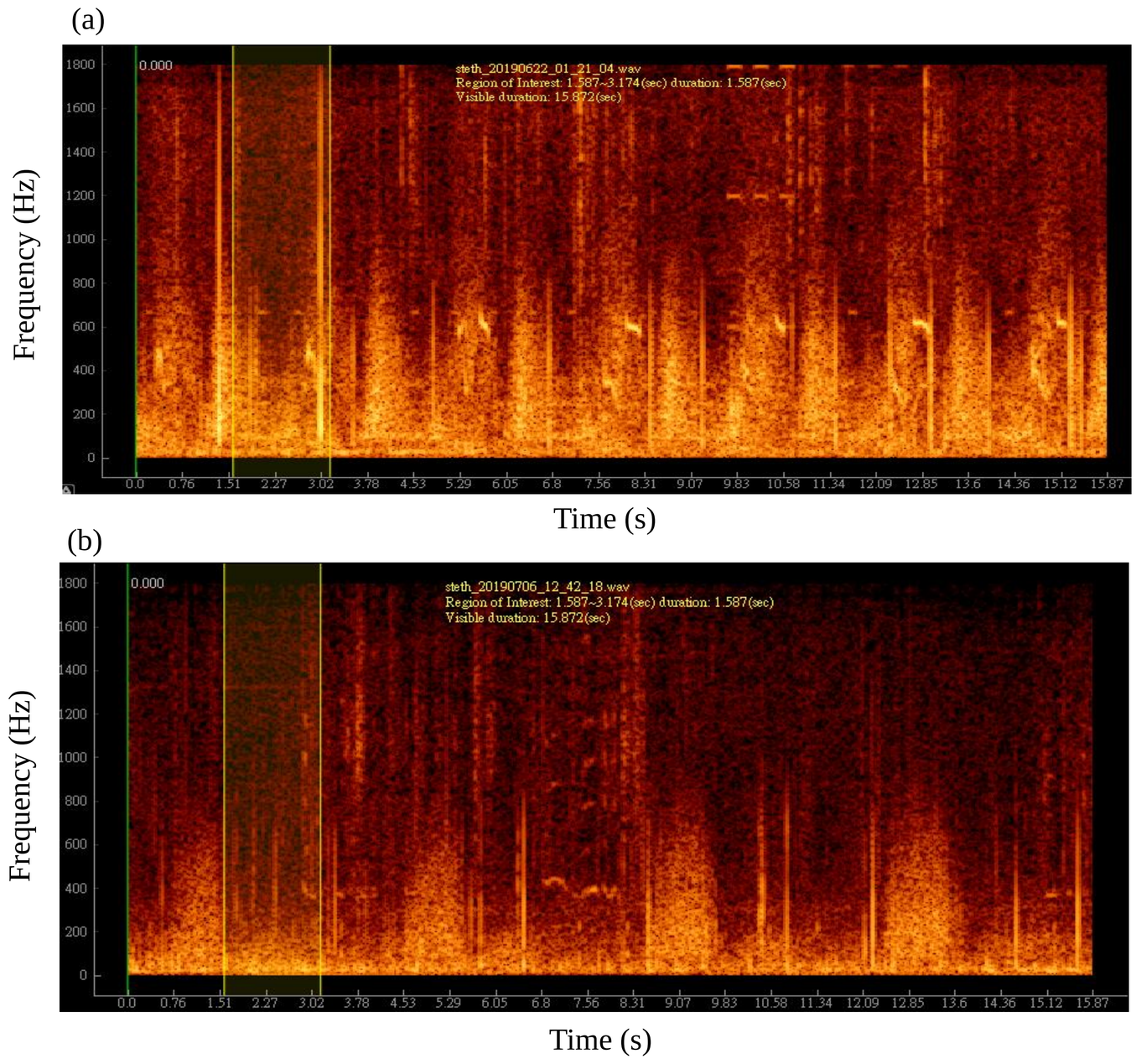

Figure 6. Spectrograms of lung sounds (a) before, and (b) after hemodialysis treatment. The sounds were obtained at the right 10th intercostal space in the midaxillary line.

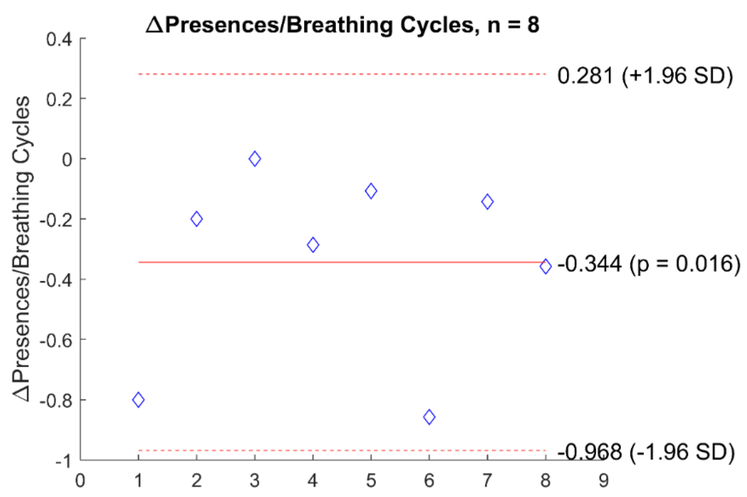

Figure 5. Bland-Altman plot of crackle presences/breathing cycles before and after hemodialysis treatment.