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Assessing mechanical ventilation asynchrony through iterative airway pressure reconstruction (Article)

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Abstract

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Background and objective: Respiratory mechanics estimation can be used to guide mechanical ventilation (MV) but is severely compromised when asynchronous breathing occurs. In addition, asynchrony during MV is often not monitored and little is known about the impact or magnitude of asynchronous breathing towards recovery. Thus, it is important to monitor and quantify asynchronous breathing over every breath in an automated fashion, enabling the ability to overcome the limitations of model-based respiratory mechanics estimation during asynchronous breathing ventilation . Methods: An iterative airway pressure reconstruction (IPR) method is used to reconstruct asynchronous airway pressure waveforms to better match passive breathing airway waveforms using a single compartment model. The reconstructed pressure enables estimation of respiratory mechanics of airway pressure waveform essentially free from asynchrony . Reconstruction enables real-time breath-to-breath monitoring and quantification of the magnitude of the asynchrony (M_{Asyn}). Results and discussion: Over 100,000 breathing cycles from MV patients with known asynchronous breathing were analyzed. The IPR was able to reconstruct different types of asynchronous breathing. The resulting respiratory mechanics estimated using pressure reconstruction were more consistent with smaller interquartile range (IQR) compared to respiratory mechanics estimated using asynchronous pressure . Comparing reconstructed pressure with asynchronous pressure waveforms quantifies the magnitude of asynchronous breathing, which has a median value M_{Asyn} for the entire dataset of 3.8%. Conclusion: The iterative pressure reconstruction method is capable of identifying asynchronous breaths and improving respiratory mechanics estimation consistency compared to conventional model-based methods. It provides an opportunity to automate real-time quantification of asynchronous breathing frequency and magnitude that was previously limited to invasively method only. © 2018 Elsevier B.V.

Author keywords

Asynchronous magnitude | Asynchrony | Mechanical ventilation | Respiratory mechanics

Indexed keywords

Engineering controlled terms: Iterative methods | Mechanics | Respiratory mechanics | Ventilation

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	Ministry of Higher Education, Malaysia	MOHE	
	Health Research Council of New Zealand	HRC	See opportunities by HRC ↗
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