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Stochastic Modelling of Respiratory System Elastance for Mechanically Ventilated Respiratory Failure Patients
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Abstract
While lung protective mechanical ventilation (MV) guidelines have been developed to avoid ventilator-induced lung injury (VILI), a one-size-fits-all approach cannot benefit every individual patient. Hence, there is significant need for the ability to provide patient-specific MV settings to ensure safety, and optimise patient care. Model-based approaches enable patient-specific care by identifying time-varying patient-specific parameters, such as respiratory elastance, Ers, to capture inter- and intra-patient variability. However, patient-specific parameters evolve with time, as a function of disease progression and patient condition, making predicting their future values crucial for recommending patient-specific MV settings. This study employs stochastic modelling to predict future Ers values using retrospective patient data to develop and validate a model indicating future intra-patient variability of Ers. Cross validation results show stochastic modelling can predict future elastance ranges with 92.59 and 68.56% of predicted values within the 5–95% and the 25–75% range, respectively. This range can be used to ensure patients receive adequate minute ventilation should elastance rise and minimise the risk of VILI should elastance fall. The results show the potential for model-based protocols using stochastic model prediction of future Ers values to provide safe and patient-specific MV. These results warrant further investigation to validate its clinical utility. © 2021, Biomedical Engineering Society.

Author Keywords
Critical care; Elastance; Mechanical ventilation; Patient-specific ventilation; Respiratory mechanics; Stochastic modelling

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