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Dynamics of Voluntary Cough Maneuvers SHAILESH NAIRE, School of Computing and Mathematics, Keele University, United Kingdom — Voluntary cough maneuvers are characterized by transient peak expiratory flows (PEF) exceeding the maximum expiratory flow-volume (MEFV) curve. In some cases, these flows can be well in excess of the MEFV, generally referred to as supramaximal flows. Understanding the flow-structure interaction involved in these maneuvers is the main goal of this work. We present a simple theoretical model for investigating the dynamics of voluntary cough and forced expiratory maneuvers. The core modeling idea is based on a 1-D model of high Reynolds number flow through flexible-walled tubes. The model incorporates key ingredients involved in these maneuvers: the expiratory effort generated by the abdominal and expiratory muscles, the glottis and the flexibility and compliance of the lung airways. Variations in these allow investigation of the expiratory flows generated by a variety of single cough maneuvers. The model successfully reproduces PEF which is shown to depend on the cough generation protocol, the glottis reopening time and the compliance of the airways. The particular highlight is in simulating supramaximal PEF for very compliant tubes. The flow-structure interaction mechanisms behind these are discussed. The wave speed theory of flow limitation is used to characterize the PEF. Existing hypotheses of the origin of PEF, from cough and forced expiration experiments, are also tested using this model.

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