

The effect of a mechanical insufflator-exsufflator on wall shear stress by functional respiratory imaging

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Rationale

The linear velocity of gas flow of a mechanical insufflator-exsufflator (MI-E) is of importance in applying sufficient wall shear stress to clear mucus. This study tries to determine the effect inspiratory and expiratory velocity of a MI-E (Cough Assist E70, Phillips Respironics) on wall shear stress in central airways in two clinical conditions: tracheostomy and facemask.

Methods

Functional respiratory imaging is used to create a patient-specific model of the airways and to simulate airflow. Inspiratory flow setting: average flow of 5.2L/s with three rise time profiles as comfort function: slow, medium and fast. Expiratory flow setting: average flow of 4.23L/s as minimum.

Results

Flow simulation with mask reveals that wall shear stress of the inspiratory flow was less or equal to the expiratory flow during all rise time profiles. For tracheostomy, this only occurs with a slow rise time, while wall shear stress of the inspiratory flow with medium and fast rise time exceeds those of the expiratory flow.

[figure1]

Conclusion

When wall shear stress of inspiratory flow exceeds those of the expiratory flow, mucus in central airways can be transported to peripheral airways which make the simulated cough with a MI-E less efficient. Therefore, a slow rise time as comfort function in MI-E should theoretically be favored in tracheostomized patients.

Figure

