Relationship between Peak Cough Expiratory Flow Rate, Inspiratory Cough Flow Rate & Pulmonary Physiologic Capacity in Individuals with Amyotrophic Lateral Sclerosis.


BACKGROUND:
• Peak expiratory flow (PEF) is an important metric directly related to an individual’s physiologic ability to defend the airway and expel tracheal aspirate (Tabor et al., 2019).
• PEF is reduced in ALS and associated with unsafe swallowing (Flowman, 2016) and global dysphagia status (Flowman, 2019).
• It is currently unclear what physiologic factors contribute to reductions in PEF in individuals with ALS.

AIM:
Examine relationships between peak expiratory flow rate generated during voluntary cough (i.e. cough strength) with inspiratory and expiratory pressure generation capacity (MIP, MEP), forced vital capacity, & cough peak inspiratory flow rate in ALS.

METHODS:

Participant Demographics:
• 101 ALS individuals (El-Escorial Criteria Revisited) participated.
• Mean age: 63 years (SD: 10.6), 54M / 47F, mean ALSFRS-R: 36 (SD: 7.6).

Assessments & Outcomes:
• Participants attended a single testing session and underwent voluntary cough spirometry testing and pulmonary function testing.

Voluntary Cough Spirometry:

Figure 1. Schematic of voluntary cough spirometry testing set up (1A); Participant completing testing (1B).

Figure 2. Example of voluntary cough airflow spirometry waveform.

Pulmonary Function Testing:
• Maximal Inspiratory Pressure (MIP, 3A)
• Maximal Expiratory Pressure (MEP, 3A)
• Forced Vital Capacity (FVC, 3B)

Statistics:
Descriptive statistics and Spearman’s Rho correlation analyses were conducted using SPSS (Version 25.0).

RESULTS:

Peak Inspiratory Flow Rate Demonstrates the Strongest Association with Peak Expiratory Flow Rate:

Figure 4. Larger (negative) peak inspiratory flow rates were associated with larger peak expiratory flow rates, \( r_s = -0.49, p < 0.001 \).

Maximal Inspiratory Pressure Demonstrates a Moderate Association with Peak Expiratory Flow Rate:

Figure 5. Greater inspiratory pressure generating ability (MIP) was associated with higher peak expiratory flow rates, \( r_s = 0.48, p < 0.001 \).

Maximal Expiratory Pressure is Associated with Peak Expiratory Flow Rate:

Figure 6. Greater expiratory pressure generating ability (MEP) was associated with higher peak expiratory flow rates, \( r_s = 0.38, p < 0.001 \).

Forced Vital Capacity is Weakly Associated with Peak Expiratory Flow Rate:

Figure 7. Higher FVC was associated with higher peak expiratory flow rates during voluntary cough, \( r_s = 0.31, p = 0.002 \).

CONCLUSIONS:
• Peak inspiratory flow and inspiratory pressure generating ability were most strongly associated with peak expiratory flow during voluntary cough in this group of individuals with ALS.
• Larger inspiratory airflow volumes during voluntary cough likely provides a mechanical advantage during the subsequent expiratory phase of cough, resulting in a stronger cough response.
• Strategies that optimize increased inspiratory pressure generating abilities and flow rates during the inspiratory phase of cough could represent therapeutic targets not previously thought to be a candidate to aide airway clearance abilities in individuals with ALS.
• We are currently continuing to assess potential predictors of cough strength in a larger dataset powered for logistic regression analyses.

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