

Abdominal electrical stimulation with respiratory muscle training to improve cough in acute spinal cord injury

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INTRODUCTION

- From 2010 to 2017, respiratory diseases were the leading cause of mortality in spinal cord injury (SCI).¹
- The ability to produce an effective cough is severely impaired in cervical and high thoracic SCI and leads to increased pulmonary complications.²⁻⁴

OBJECTIVE: Examine if co-treatment with abdominal functional electrical stimulation (AFES) + respiratory muscle training (RMT) improves unaided cough in an individual with acute SCI.

METHODS

- **Study design:** Case-report.
- **Subject:** 68-year-old female presenting with T2 AIS A SCI after falling while hiking.
- **Intervention:** AFES and RMT co-treatment (**Figure 1**).
 - **Dose:** 45-minute sessions of RMT 5 days/week with AFES 3 days/week for a total of 2 weeks.
 - **RMT:** Inspiratory (IMST) and expiratory muscle strength training (EMST) with calibrated pressure threshold resistance (**Figure 2**), diaphragmatic and stack breath, huff cough, and loud voice projection.
 - **AFES:** Electrodes applied to bilateral rectus abdominis and external obliques (**Figure 3**), timed to stimulate concurrently with expiratory phase of RMT.
 - **Positions:** Supine, prone, supported and unsupported short sitting, and quadruped positions used to allow for increased or decreased load during training.
- **Outcomes:** Cough effectiveness, peak expiratory flow (PEF), and the function in sitting test-SCI (FIST-SCI).



Figure 1. Supported sitting during an abdominal functional electrical stimulation + respiratory muscle training session with a person with T2 AIS A SCI.



Figure 2. Expiratory muscle strength training device utilized during co-treatment sessions.



Figure 3. Electrodes applied to bilateral rectus abdominis and external oblique muscles.

RESULTS

- Cough effectiveness, measured using a 5-point Likert scale, baseline of 2/5 was maintained after week 1 and increased to 3/5 after week 2 (50 % increase) (**Figure 4**).
- PEF increased from 260 L/min to 300 L/min after week 1 and was maintained in week 2 (15% increase) (**Figure 4**).
- FIST-SCI increased from 30 to 42 after week 1 and was maintained in week 2 (40% increase) (**Figure 4**).

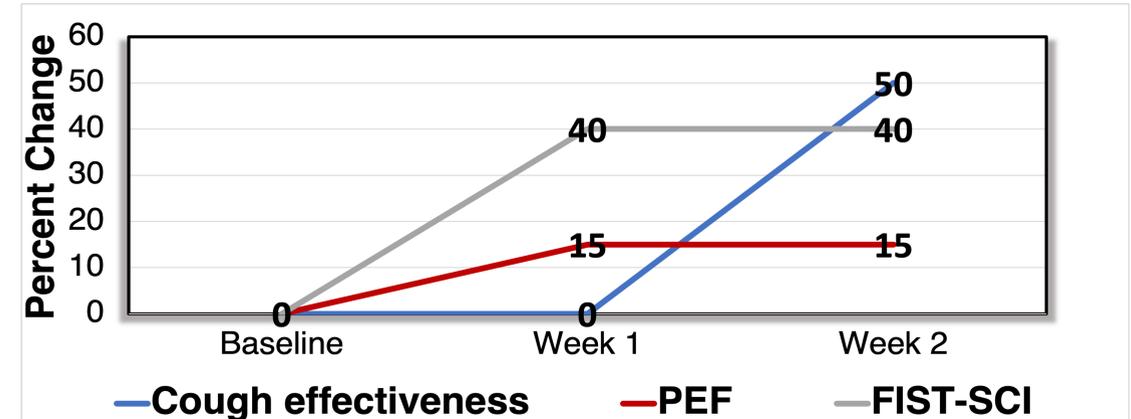


Figure 4. Percent change of outcome measures as measured during baseline, week 1, and week 2. PEF, peak expiratory flow; FIST-SCI, function in sitting test-SCI.

CONCLUSION

- Co-treatment with AFES + RMT showed improvements in subjective rating of cough, PEF and the FIST-SCI in an individual with acute SCI, potentially through the increase of intra-abdominal pressure.

SIGNIFICANCE: Because respiratory issues are a leading complication after SCI, consideration must be given to strengthening respiratory function during rehabilitation.

References: 1. DeVivo M et al., *Arch Phys Med Rehabil*, 2021. 2. Berlowitz D, Tamplin J., *Cochrane Database Syst Rev.*, 2013. 3. Raab A et al., *Spinal Cord*. 2019. 4. Raab A et al., *Spinal Cord Ser Cases*. 2018.