

Submission ID #: 70146

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Title: Inspiratory Muscle Training as an Adjunct to the Treatment of Weaning Failure in Critically Ill Patients: A Practical Guide

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Author Questionnaire

1. We have marked your project as author-provided footage, meaning you film the video yourself and provide JoVE with the footage to edit. JoVE will not send the videographer. Please confirm that this is correct.

✓ Correct

2. Interview statements: Which interview statement filming option is the most appropriate for your group? **Please select one.**



Interview Statements are read by JoVE's voiceover talent.

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Current Protocol Length

Number of Steps: 07

Number of Shots: 21

Introduction

NOTE TO VO: Please record this section

INTRODUCTION:

~~REQUIRED: Summarize your research focus and the main questions it aims to answer.~~

- 1.1. The research proposes an evidence-informed practical guide to help clinicians implement inspiratory muscle training in mechanically ventilated patients experiencing weaning difficulties.

1.1.1. *Suggested B.roll: 2.2.2*

~~Describe the research contexts or systems in which this protocol can be applied.~~

- 1.2. The protocol applies to fully cooperative, mechanically ventilated patients with weaning difficulties, and especially in tracheostomized patients with prolonged weaning.

1.2.1. *Suggested B.roll: 2.2.3*

CONCLUSION:

~~What does this protocol allow researchers to study or measure?~~

- 1.3. The protocol provides a reproducible inspiratory muscle training approach to improve inspiratory muscle strength and potentially weaning outcomes during prolonged weaning.

1.3.1. *Suggested B.roll: 3.1*

~~Describe the most important consideration or challenge when performing this protocol.~~

- 1.4. This protocol can only be used in patients who are awake and sufficiently cooperative to follow instructions during training and assessments.

1.4.1. *Suggested B.roll: 2.6.1*

~~How can future studies build on this work? Describe the questions or research directions that can be investigated next.~~

- 1.5. Supporting evidence has come exclusively from single-specialized centers studies. Larger multicenter studies are needed to confirm its effectiveness and generalizability.

1.5.1. *Suggested B.roll: 3.2*

Ethics Title Card

This research has been approved by the Ethics Committee at the Research of the University Hospitals Leuven

Protocol

NOTE: Scripted from Footage

2. Assessment and Training of Inspiratory Muscle Strength and Forced Vital Capacity in Mechanically Ventilated Patients

Demonstrator: Marine Van Hollebeke

2.1. To begin assessment of Forced Vital Capacity, disconnect the patient from the ventilator [1-TXT]. Connect the spirometer to the airway opening [2].

2.1.1. LAB MEDIA: FVC.mp4 00:06 - 00:09

TXT: Temporarily mute the ventilator alarm

2.1.2. LAB MEDIA: FVC.mp4 00:10-00:14

2.2. Instruct the patient to breathe normally first [1], then perform a forceful deep inspiration followed immediately by a complete and forceful exhalation to residual volume [2]. Repeat this three times and record the best value [3].

2.2.1. LAB MEDIA: FVC.mp4 01:23-01:31

2.2.2. LAB MEDIA: FVC.mp4 00:20-00:27 + 01:00 – 01:10

2.2.3. LAB MEDIA: FVC.mp4 02:00-02:07 *Video editor: Highlight the column labeled “N°2”*

2.3. To assess maximal inspiratory pressure, explain to the patient that during the measurements, expiration will be possible but inspiration will be occluded [1-TXT]. Reassure the patient that the procedure is closely monitored [2].

2.3.1. LAB MEDIA: PImax.mp4 00:00-00:25

TXT: Reassure the patient that the procedure will be closely monitored

2.4. Next, disconnect the patient from the ventilator [1]. Connect the T-piece [2], and ask the patient to exhale completely [3]. Instruct the patient to perform repeated forceful inspiratory efforts against the occlusion for 20 to 25 seconds [4].

2.4.1. LAB MEDIA: PImax.mp4 00:35 – 00:38

2.4.2. LAB MEDIA: PImax.mp4 00:39-00:41

2.4.3. LAB MEDIA: PImax.mp4 00:42-00:45

2.4.4. LAB MEDIA: PImax.mp4 00:46-00:57 + 01:39-01:48

TXT: Encourage the patient to sustain each inspiratory effort for at least 1 - 2 s

2.5. Record the plateau PImax (*P-I-Max*) sustained for at least 1 second. Repeat at least three times, with a 2-minute rest between attempts and retain the best plateau PImax [1].

2.5.1. LAB MEDIA: PImax.mp4 01:50-01:56 *Video editor: Highlight the row labeled "PImax"*

2.6. To perform inspiratory muscle training in patients, disconnect the patient from the ventilator [1]. Connect the external device to the airway opening [2]. Instruct the patient to exhale completely through the device before performing the first inspiration of the set [3].

2.6.1. LAB MEDIA: IMT intervention.mp4 01:04 - 01:09

2.6.2. LAB MEDIA: IMT intervention.mp4 01:10-01:12

2.6.3. LAB MEDIA: IMT intervention.mp4 01:13-01:15

2.7. Instruct patients to perform 4 to 10 deep and fast inspirations before restoring the support of the ventilator [1]. Restore the support of the ventilator to let the patient rest for approximately 2 minutes [2].

2.7.1. LAB MEDIA: IMT intervention.mp4 01:16 – 02:04

2.7.2. LAB MEDIA: IMT intervention.mp4 02:05 - 02:10

Results

3. Results

3.1. During calibration using a tapered flow resistive load, the first breaths were performed maximally from residual volume [1], and the inspiratory volumes recorded during these breaths were used to estimate forced vital capacity [2]. These volumes were then compared to those recorded during subsequent breaths against the set external training load to assess whether the patient could inhale approximately 70 percent of the estimated forced vital capacity [3].

2.7.3. LAB MEDIA: Figure 3. *Video editor: Highlight the text "First calibration breaths against the lowest imposable external load"*

2.7.4. LAB MEDIA: Figure 3. *Video editor: Highlight the text "Inhaled volumes ~ FVC=0.89L "*

2.7.5. LAB MEDIA: Figure 3. *Video editor: Highlight the text "Average inhaled volumes against the set training external load ~ 70% FVC = 0.6L "*

3.2. These patients often have a P_{Imax} of 30 to 40 centimeters of water at baseline [1]. After 2 to 4 weeks of IMT executed with fast and deep inspirations performed at least 5 days per week, P_{Imax} typically increases to the order of 10 to 15 centimeters of water [2].

3.2.1. LAB MEDIA: Figure 2A. *Video editor: Highlight the box labeled "P_{Imax} plateau: 32 cmH₂O"*

3.2.2. LAB MEDIA: Figure 2B. *Video editor: Highlight the box labeled "P_{Imax} plateau: 48 cmH₂O"*

Pronunciation Guide:

Inspiratory

Pronunciation link: <https://www.merriam-webster.com/dictionary/inspiratory>

IPA: /ɪnˈspɪrəˌtɔːri/

Phonetic Spelling: in·spih·ruh·tohr·ee

Tracheostomized

Pronunciation link: <https://www.howtopronounce.com/tracheostomized>

IPA: /ˈtreɪ.ki.ʊʊˌstɑː.məɪzd/

Phonetic Spelling: tray·kee·oh·stah·mized

Weaning

Pronunciation link: <https://www.merriam-webster.com/dictionary/weaning>

IPA: /ˈwiːnɪŋ/

Phonetic Spelling: wee·ning

Spirometer

Pronunciation link: <https://www.merriam-webster.com/dictionary/spirometer>

IPA: /spaɪˈrɑː.mɪ.tə/

Phonetic Spelling: spy·rah·mih·ter

Residual

Pronunciation link: <https://www.merriam-webster.com/dictionary/residual>

IPA: /rɪˈzɪdʒ.u.əl/

Phonetic Spelling: rih·zih·joo·uhl

Plateau

Pronunciation link: <https://www.merriam-webster.com/dictionary/plateau>

IPA: /plæˈtoʊ/

Phonetic Spelling: pla·toh

Tapered

Pronunciation link: <https://www.merriam-webster.com/dictionary/tapered>

IPA: /ˈteɪ.pəd/

Phonetic Spelling: tay·perd

Resistive

Pronunciation link: <https://www.merriam-webster.com/dictionary/resistive>

IPA: /rɪˈzɪs.tɪv/

Phonetic Spelling: rih·zihs·tiv

Calibration

Pronunciation link: <https://www.merriam-webster.com/dictionary/calibration>

IPA: /ˌkæ.ləˈbreɪ.ʃən/

Phonetic Spelling: ka·luh·bray·shun

Centimeters of water

Pronunciation link: No confirmed link found

IPA: /ˈsen.tə.mi.təz əv ˈwɔː.tə/

Phonetic Spelling: sen·tuh·mee·terz uhv waw·ter

Multicenter

Pronunciation link: <https://www.merriam-webster.com/dictionary/multicenter>

IPA: /ˈmʌl.ti.sən.tə/

Phonetic Spelling: mul·tee·sen·ter

Generalizability

Pronunciation link: <https://www.merriam-webster.com/dictionary/generalizability>

IPA: /ˌdʒen.ə.ə.lɪ.zəˈbɪ.lə.ti/

Phonetic Spelling: jen·ur·uh·liz·uh·bil·uh·tee

Cooperative

Pronunciation link: <https://www.merriam-webster.com/dictionary/cooperative>

IPA: /koʊˈɑː.pə.ə.tɪv/

Phonetic Spelling: koh·ah·puh·ruh·tiv

Occluded

Pronunciation link: <https://www.merriam-webster.com/dictionary/occluded>

IPA: /əˈkluː.dɪd/

Phonetic Spelling: uh·kloo·did

Ventilator

Pronunciation link: <https://www.merriam-webster.com/dictionary/ventilator>

IPA: /ˈven.tɪ.leɪ.tə/

Phonetic Spelling: ven·tuh·lay·ter

Mechanically

Pronunciation link: <https://www.merriam-webster.com/dictionary/mechanically>

IPA: /mə'kæn.ɪ.kli/

Phonetic Spelling: muh·kan·ik·lee

Prolonged

Pronunciation link: <https://www.merriam-webster.com/dictionary/prolonged>

IPA: /prə'lo:ŋd/

Phonetic Spelling: pruh·lawn·d

Ethics

Pronunciation link: <https://www.merriam-webster.com/dictionary/ethics>

IPA: /'εθ.ɪks/

Phonetic Spelling: eh·thiks

Reproducible

Pronunciation link: <https://www.merriam-webster.com/dictionary/reproducible>

IPA: /,ri:.prə'du:.sə.bəl/

Phonetic Spelling: ree·pruh·doo·suh·buhl

Clinicians

Pronunciation link: <https://www.merriam-webster.com/dictionary/clinician>

IPA: /kli'nɪʃ.ənz/

Phonetic Spelling: kli·nih·shunz

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