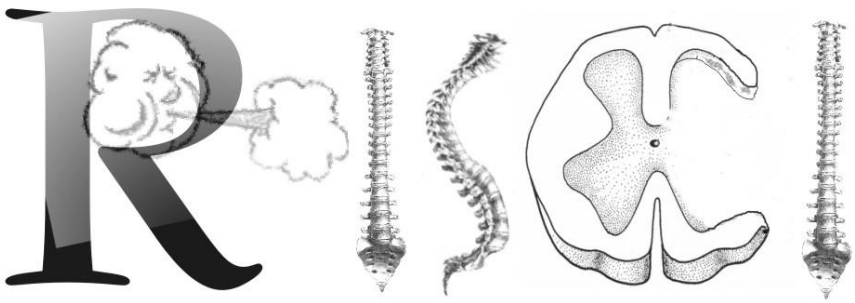
# RISCI
# Respiratory Information for Spinal Cord Injury
# UK & Ireland



# Weaning Guidelines for Adult Spinal Cord Injured Patients in Critical Care Units

*RISCI is a multi-disciplinary group concerned with the management of spinal cord injured patients requiring respiratory support.*

**This document has been developed alongside the 'RISCI Ventilation Strategies in Tetraplegia' document.**

## Contents

## 1. Introduction

i. Patients with Spinal Cord Injury (SCI) have specific needs with regards to weaning from mechanical ventilation [1,2,3].

ii. The weaning technique advocated by Spinal Cord Injury Centres (SCIC) is simple but needs to be followed rigorously by the Intensive Care Multi-Disciplinary Team (MDT) to achieve ventilator independence efficiently [4].

iii. A number of patients will remain ventilator dependent [5] and require careful management to optimise their quality of life in liaison with the linked SCIC.

## 2. Background Pathophysiology

i. Respiratory dysfunction immediately following SCI is due to flaccid paralysis of the respiratory muscles, both inspiratory and expiratory. The degree of dysfunction is directly related to the level of cord injury.

ii. High cervical injuries may lose diaphragmatic and accessory muscle activity. They will lose all intercostal and abdominal activity: ventilatory failure is rapid in these circumstances.

iii. Early tracheostomy is recommended, as successful early extubation is rare. Tracheostomy simplifies weaning, abolishes the need for sedation, improves communication and enables efficient secretion clearance [6,7].

iv. Low cervical cord injuries may have lost all intercostal and abdominal activity but will have activation of their diaphragm and accessory muscles of breathing.

v. Thoracic cord injuries will lose some degree of intercostal and abdominal activity and can be complicated by rib fractures and pulmonary contusions. Haemothoraces may be present secondary to the thoracic spine fractures.

vi. Respiratory failure results from ineffective ventilation due to compromised respiratory muscles acting on a flaccid rib cage. This is exacerbated by intrapulmonary compliance changes and an inability to spontaneously clear secretions.

vii. Some respiratory afferent information is lost; patients may not feel dyspnoeic or become tachypnoeic when failing.

viii. Autonomic disruption as a result of SCI causes excessive bronchial secretions and a tendency to bronchoconstriction [8,9].

## 3. Weaning Principle

i. Based on the patient's initial Forced Vital Capacity (FVC) measurement, all ventilatory support is removed for a specified time period, after which the SCI patient is returned to ventilatory support at the same pressures[10] for a rest period of two hours. The common term for this is Ventilator Free Breathing (VFB).

ii. Evidence has shown that ventilating patients with higher tidal volumes is safe[11] and reduces the time taken to wean patients from ventilation[12]. It is suggested that ventilation of around 10-15mls/kg is used. There is some evidence that during 'rest' ventilation periods, high tidal volume ventilation whilst maintaining normocarbia accelerates weaning as it may reduce atelectasis[12].

## 4. On-Ventilation Tracheostomy Cuff Deflation

i. For all SCI patients the ability to communicate is paramount to rehabilitation and reintegration. Being in a critical care unit for considerable amounts of time without easy communication is, at best, frustrating and can contribute to psychological morbidity [13].

ii. Ventilator settings should be adjusted to allow for the resultant leak, through either increases in inspiratory pressure or inspiratory time. Many ventilators will alarm continuously with this degree of leak so a change to a simpler, domiciliary type device can be considered.

iii. On-ventilator cuff deflation is advised prior to commencing VFB. Initially the aim is for cuff deflation during the daytime, up to 12 hours, before progressing to full-time cuff deflation. Cuff deflation reduces micro-aspiration, and restores laryngeal and pharyngeal reflexes, which will optimise conditions for the resumption of safe swallowing [14].

**5. Swallowing**

Swallowing with the cuff inflated is not always advocated in SCI. Assessment by a Speech and Language Therapist (SLT) is vital to reduce the risk of aspiration and pulmonary complications, which could impact on weaning. SLTs can provide upper airway & swallow assessment via the use of Fibreoptic Endoscopic Evaluation of Swallowing (FEES). The use of FEES allows teams to assess secretion management, oedema, potential laryngeal pathology and risk of silent aspiration. The use of FEES can expedite return to safe oral intake and allows for targeted treatment approaches to be instigated [15,16,17].

**6. Pre-requisites for VFB Weaning**

- Weaning proceeds more efficiently with a consistent MDT approach [2,4].
- Awake and co-operative
- Free from active chest infection
- $FiO_2 \leq 0.4$
- PEEP ≤ 8cm$H_20$
- Regular effective chest management including secretion clearance
- Evidence of spontaneous respiratory activity through bedside assessment (N.B. ventilator triggering does not necessarily imply useful activity)

**7. Weaning Progression**

The following table shows the pathway for patients of different levels of injury to wean from invasive ventilation via tracheostomy airway management. Flexibility with increasing or decreasing these increments is encouraged. However, this must be based on clinical judgement, the Neurological Level of Injury (NLI) and whether they have a complete or incomplete SCI. If the patient tires or develops complications, halt the weaning process. When the patient meets the pre-requisites to wean again, resume the wean at the level achieved the day prior to becoming unwell.

| **NLI** | **C3-5** | | **C6 and below** | |
|---|---|---|---|---|
| **FVC** | **Initial FVC < 1.0L** | | **Initial FVC >1.0L** | |
| Day | VFB period | Total VFB time/day (mins/hours) | VFB period | Total VFB time/day (hours) |
| 1 | 5-10 mins x 4 | 20-40 mins | 15 mins x 4 | 1 |
| 2 | 10-15 mins x 4 | 40-60 mins | 30 mins x 4 | 2 |
| 3 | 15-20 mins x 4 | 60-80 mins | 45 mins x 4 | 3 |
| 4 | 30 mins x 4 | 2 | 1 hour x 4 | 4 |
| 5 | 45 mins x 4 | 3 | 2 hours x 3 | 6 |
| 6 | 1 hour x 4 | 4 | 4 x 2 | 8 |
| 7 | 1.5 hours x 4 | 6 | 6 x 2 | 12 |
| 8 | 2 x 4 | 8 | 10 | 10 |
| 9 | 3 x 3 | 9 | 12 | 12 |
| 10 | 4 x 2 | 8 | 14 | |
| 11 | 5 x 2 | 10 | | |
| 12 | 6 x 2 | 12 | | |
| 13 | 8 | 8 | | |
| 14 | 10 | 10 | | |
| 15 | 12 | 12 | | |
| For overnight progression see Section 9 | | | | |

# RISCI Ventilator Free Breathing Guideline

## Achieve cuff deflation aiming for 12 hours/day

## Pre-requisites for VFB Wean are met

### SCI C2-C5

Measure FVC and repeat use to monitor progress and identify fatigue

↓

**Day 1**
**Step 1:** Begin VFB with trache mask and $O_2$ (speaking valve will help maintain PEEP) X 5 minutes, fully supervised

↓

**Step 2:** Return to ventilator MAINTAIN VENTILATION PARAMETERS THROUGHOUT WEANING PROCESS (10-15mls/kg) for 2 hours

↓

**Step 3:** If no signs of fatigue, Repeat VFB x 4 sessions of 5 minutes with 2 hours rest between each VFB session

↓

**Day 2**
Repeat steps 1-3 with VFB x 4 sessions of 10 minutes with 2 hours rest between each VFB session

↓

**Progression of VFB**
20 minutes, 30 minutes, 45 minutes, 1 hour, 1.5 hours, 2 hours, 3 hours, 4 hours, 5 hours, 6 hours, 8 hours, 10 hours, 12 hours
The number of VFB periods per day will reduce as the length of time VFB increases

### SCI C6 and below

Measure FVC and repeat use to monitor progress and identify fatigue

↓

**Day 1**
**Step 1:** Begin VFB with trache mask and $O_2$ (speaking valve will help maintain PEEP) X 15 minutes, fully supervised

↓

**Step 2:** Return to ventilator MAINTAIN VENTILATION PARAMETERS THROUGHOUT WEANING PROCESS (10-15mls/kg) for 2 hours

↓

**Step 3:** If no signs of fatigue, Repeat VFB x 4 sessions of 15 minutes with 2 hours rest between each VFB session

↓

**Day 2**
Repeat steps 1-3 with VFB x 4 sessions of 30 minutes with 2 hours rest between each VFB session

↓

**Progression**
1 hour, 2 hours, 4 hours, 6 hours, 10 hours, 12-14 hours
The number of VFB periods per day will reduce as the length of time VFB increases

**8. Other Factors in Ventilatory Weaning in Spinal Cord Injury**

i. Biochemistry and nutrition should be addressed. It is recommended that cervical cord-injured patients have gastrostomies inserted instead of naso-gastric tubes [14].
ii. Regular salbutamol nebulisation may improve respiratory function [18,19,20].
iii. VFB should be performed in supine or flat side lying, not sitting. There is a drop of up to 20% in VC from supine to sitting [21,22,23] associated with the mechanics of the diaphragm and the paralysed abdomen, so VFB is better tolerated in supine.
iv. Scrupulous attention should be paid to secretion clearance to reduce work of breathing. It should be undertaken prophylactically throughout the day, throughout the entire weaning process and prior to any VFB attempt [4,24].
v. Tenacious sputum may be treated with carbocysteine and/or nebulised acetylcysteine orally or via gastrostomy [25].
vi. Experience shows that ventilator weaning is expedited if the patient solely focuses on this and that plans to mobilise the patient are addressed after the ventilator weaning process has been completed.

**9. Post-Wean Checks and Maintenance**

The aim is for VFB up to 18 hours during the daytime, but with ventilation at night, as SCI patients can have significant REM sleep hypoventilation and obstructive sleep apnoea [26]. To assess safe VFB overnight requires either an early morning blood gas or transcutaneous $CO_2$ monitoring. Consideration of the use of non-invasive ventilation to assist with sleep disordered breathing and as an adjunct to augment lung volumes is advised. Use of a prophylactic cough assist device is beneficial to further assist with lung and chest wall compliance and lung volumes.

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