

# INTENSIVE CARE SOCIETY NATIONAL GUIDELINES - WHEN AND HOW TO WEAN

## Introduction

Weaning is defined as the gradual reduction of ventilatory support and its replacement with spontaneous ventilation. In some cases this process is rapid and uneventful; however, for some patients the process may be prolonged for days or weeks. This guideline is aimed to assist with the prolonged weaning cases.

Prolonged weaning from mechanical ventilation is a problem in every Intensive Care Unit. It is associated not only with an increased mortality and morbidity, but also has implications for the use of resources and the costs of health care.

Weaning is a term that is used in two separate ways. Firstly, it implies the termination of mechanical ventilation and secondly the removal of any artificial airway. These definitions are not as clear cut as they might seem.

## Principles of weaning

1. Mechanical ventilation can only be discontinued when the capacity of the respiratory pump exceeds the load on it. A variety of formulae for predicting when the balance will swing in favour of the respiratory pump have been used, but none of them have been completely satisfactory.
2. The factors that may prevent weaning should be treated as soon as possible to minimise any delay in weaning.
3. The patient will not wean from ventilation until he or she is capable of breathing independently. The most important aim is to improve the patient's condition. The mode of ventilatory support during the weaning process is usually a secondary issue.
4. There is probably little difference between the modes of ventilation though there is increasing evidence from clinical trials suggesting that PSV or intermittent T-piece is superior to SIMV.
5. Weaning often comprises a succession of stages rather than a single transition from full ventilatory support to independent breathing. The implication of this is that the patient has only to be fit enough to achieve each step in the weaning process for progress to be made.

## Factors predicting weaning success

There are many parameters that have been used to predict weaning success. The most reliable is probably frequency over tidal volume ratio on trial disconnection of  $<100\text{s}^{-1}\text{l}^{-1}$ ,  $\text{PaO}_2/\text{FiO}_2 > 27.5\text{kPa}$  with  $\text{PEEP} < 5\text{cmH}_2\text{O}$ .

## Factors preventing weaning

Weaning has to take place while other aspects of the patient's care are proceeding and there may be a conflict between the treatment priorities which has to be taken into account in managing the patient.

1. Drugs/sedation - can these be reduced/stopped/changed to non-sedating drugs? Beware of those with long half lives or active metabolites, which may impair respiration for several days after cessation of the drug.
2. Ensure that muscle relaxant drugs have worn off completely.
3. Are there any signs of respiratory muscle weakness? Diaphragm weakness is likely when there is peripheral muscle weakness.
4. Is there abdominal distension with upward displacement of the diaphragm limiting ventilation or diaphragmatic paralysis?
5. Can the oxygen delivery to the tissues be improved? Are there any signs of cardiac failure especially when mechanical support is withdrawn?
6. Is the patient systemically unwell e.g. fever or infection particularly pulmonary?
7. Is there a pleural effusion or pneumothorax to drain?
8. Is the patient motivated to wean? Are there any signs of depression that could be treated? Has a normal sleep wake cycle been established?
9. Is the patient malnourished or metabolically disturbed (hypokalaemia, hypophosphataemia or low blood levels of trace elements and vitamins)?
10. Are the lungs hyperinflated, which reduces the effectiveness of contraction of the inspiratory muscles? PEEP should have been reduced and bronchospasm treated.
11. Is the  $\text{FiO}_2$  too high resulting in lack of hypoxic drive to breathe? Is the  $\text{CO}_2$  high enough to provide adequate respiratory drive? Is the pH normal?

12. Is the patient positioned to allow adequate inflation and comfort? Sitting the patient out of bed will assist with this.
13. Is the patient's upper airway function, cough and swallow adequate?
14. Is pain adequately controlled?

#### How to wean

1. Reduction in level of ventilatory support. Pressure support ventilation (PSV) and synchronised intermittent mandatory ventilation (SIMV) are the most commonly used ventilatory modes when weaning is being attempted, although assist-control ventilation (ACV) may also be useful. All these techniques are forms of partial ventilatory support. The degree of ventilatory support should be gradually weaned so that the patient contributes increasingly to the work of breathing.
2. Introduction of ventilator independence.  
This can be
  - sudden e.g. T-piece trial (ideally 30 minutes up to a maximum of 2 hours) - if successful the patient can be extubated. If not a repeat trial can be performed on a daily basis.
  - gradual e.g. initial 1 to 5 minutes of ventilatory independence with close observation and monitoring of the patient. As the patient's condition improves the duration and frequency of these trials increases. It may take a few hours to several weeks before total ventilatory independence is achieved.
3. Management of artificial airway. Weaning may be facilitated by the use of a tracheostomy tube. This has the advantage over an endotracheal tube of reducing the dead space and allowing sedation to be discontinued, but it impairs swallowing and prevents adequate coughing.

#### When to consider a tracheostomy

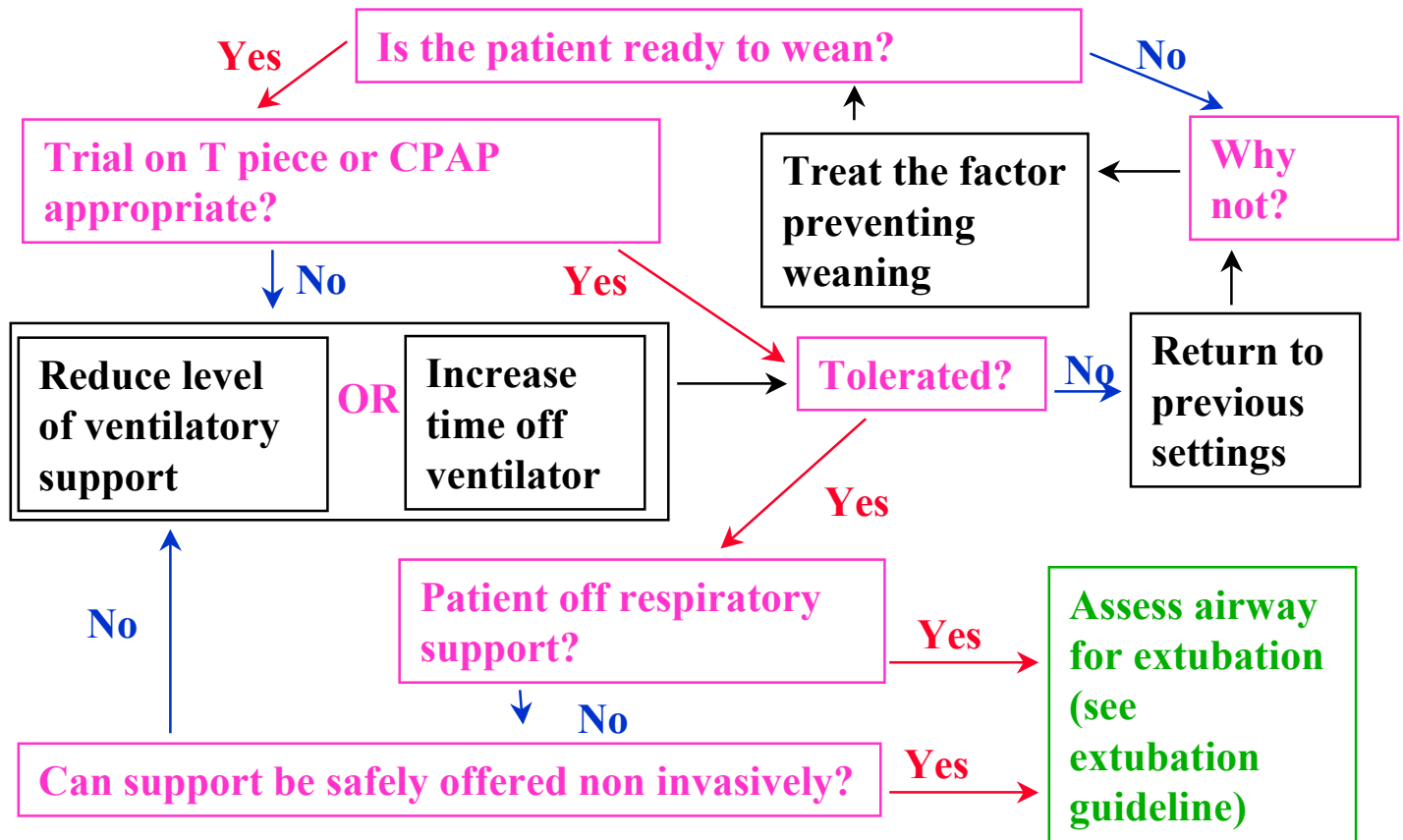
1. A tracheostomy should be considered in patients who are failing to wean rapidly (+/- 5 to 21 days depending on speed of recovery and how they are tolerating the endotracheal tube). The method of choice for performing tracheostomy is percutaneous.
2. Those who will be unable to protect their airway for a prolonged period (neurological problems).
3. Those with severe problems with oropharyngeal trauma.

The benefits must outweigh the risks of;

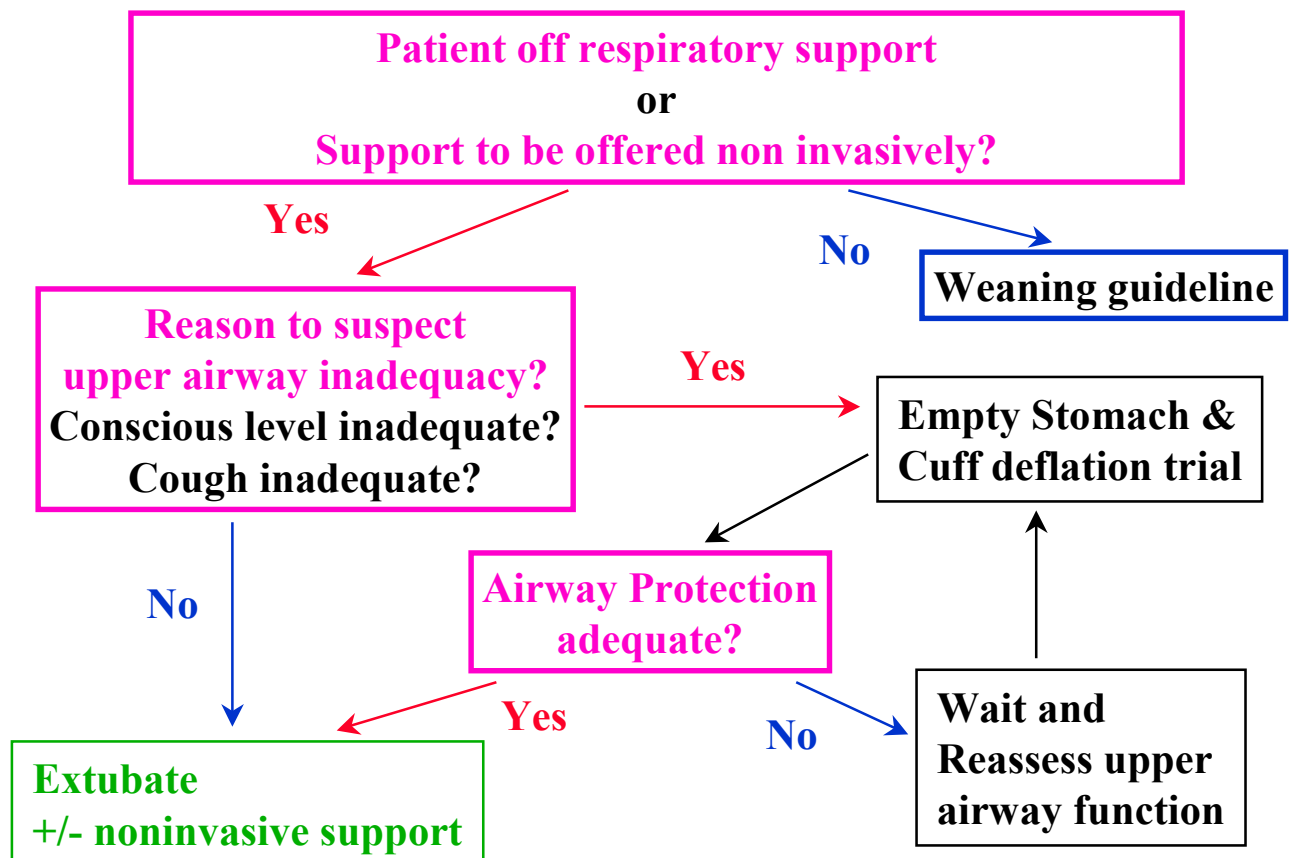
- Malplacement (especially those with a difficult airway).
- Bleeding, infection (local surgery).
- Tracheal stenosis and scarring.
- The risk of anaesthesia.

Removal of the tube may not be possible until the patient is able to protect their airway. This can be hastened by cuff deflation encouraging speech and improved laryngeal co-ordination, as long as aspiration into the tracheobronchial tree is not a problem. Removal of the tube may then be possible, but if ventilatory support is still required a non-invasive system such as a nasal or face mask with positive pressure ventilation may be needed during the weaning phase and occasionally in the long-term if there is a chronic underlying respiratory disorder.

## WHEN AND HOW TO WEAN



## EXTUBATION GUIDELINE



## FAILURE TO WEAN GUIDELINES

### LOAD

Bronchospasm  
Left ventricular failure  
Sepsis  
Fever  
Seizures  
Other causes of increased basal metabolic rate

#### Is there evidence of:

Excessive secretions  
Hyperinflation

### DRIVE

Sedation  
CNS disease  
Hypercapnia  
Motivation  
Self-esteem  
Control

#### Consider:

Hb  
Anxiety  
Fear  
Sensory overload/deprivation  
Communication  
Depression  
Pleural effusion/pneumothorax

### CAPACITY OF RESPIRATORY PUMP

Treat pain and discomfort  
Treat abdominal discomfort  
Optimise positioning  
Look for diaphragmatic paralysis  
Have muscle relaxants worn off?

#### Optimise strength:

Muscle weakness  
Neuropathy  
Disuse atrophy  
Nutrition  
Rest/sleep  
Electrolytes

These factors should not be seen as mutually exclusive but inextricably linked.

## WHEN TO WEAN

- Normalised I:E ratio
- Reducing FiO<sub>2</sub> (usually <0.5)
- No requirement for high PEEP
- Appropriate underlying respiratory rate
- Appropriate tidal volume with moderate airway pressures