Queensland Trauma Education

CHEST TRAUMA

Invasive Ventilation Strategies

Procedural skill

Facilitator resource kit

Clinical Excellence Queensland
JAMIESON TRAUMA INSTITUTE
CSDS Clinical Skills Development Service
Queensland Government

Queensland Trauma Education

The resources developed for Queensland Trauma Education are designed for use in any Queensland Health facility that cares for patients who have been injured as a result of trauma. Each resource can be modified by the facilitator and scaled to the learners needs as well as the environment in which the education is being delivered, from tertiary to rural and remote facilities.

Developed by
Dr Fran Williamson, Senior Staff Specialist - MNHHS

Reviewed by
Angelka Opie, Nurse Educator – CSDS, MNHHS

Tracey McLean, Simulation Educator – CSDS, MNHHS

Queensland Trauma Education
Chest Trauma – Invasive Ventilation Strategies: Procedural skill – Facilitator resource kit
Version 1.0

Published by the State of Queensland (Clinical Skills Development Service), 2024

An electronic version of this document is available via csds.qld.edu.au/qte

About this training resource kit

This resource kit provides the learner with the opportunity to explore ventilation strategies for different trauma presentations.

National Safety and Quality Health Service (NSQHS) Standards

Target audience

Emergency department medical and nursing clinicians.

Duration

30 minutes.

Group size

Suited to small group participation.

Learning objectives

By the end of this session the participant will be able to:

- Identify the knobology in basic invasive ventilation.
- Understand the parameters to deliver appropriate ventilation strategy.
- Recognise clinical states necessitating ventilation strategies.

Facilitation guide

1. Identify knobology on ventilator.
2. Discuss manipulation of variables.
3. Use case studies to highlight target endpoints for ventilation strategy.
4. Encourage process of regular review, rather than ‘set and forget’.

Supporting resources (in Printable Resources)

- ABG template
- CG4 template

Procedural skill

Resources required

Equipment	• Oxylog 3000+ ventilator / Hamilton T1 ventilator • Oxygen supply • Lung model • Case studies • Example blood gas results
Delivery tool	Case study cards

Case 1

37 yr old male, 100kg. Intubated and ventilated for severe traumatic brain injury, no other injuries.

Vital signs: GCS 3, HR 100, BP 130/80, sats 99% FiO2 1.0.

Ventilator settings: Vt 350mL, RR 12, PEEP 5.

ABG: pH 7.22 CO2 60 O2 180 HCO3 20.

Case 2

26 yr old female, 70kg. High speed RTC, severe chest injury- R rib fractures 3-10 (5-10 flail segment), L rib fractures 2-6, bilateral pulmonary contusions and ICCs to manage bilateral haemopneumothoraces.

Intubated for respiratory fatigue and transfer via road ambulance to tertiary hospital.

Vital signs: GCS 3, HR 100, BP 120/70, sats 89% FiO2 0.5.

Ventilator settings: Vt 450mL, RR 16, PEEP 5.

ABG: pH 7.30 CO2 36 O2 85 HCO2 19.

Case 3

86yr old man, 65kg. Crushed by metal gate, sustaining injuries to all limbs. R closed humeral fracture, L compound olecranon and midshaft radius/ulnar fractures, R closed NOF, L midshaft femoral fracture with complex L foot injury. He has no chest, head or abdominal injury.

Despite significant IV analgesia he remains distressed in pain. He is intubated to facilitate transfer to a trauma centre.

Vital signs: GCS 3, HR 120, 150/90, sats 100% FiO2 1.0.

Ventilator settings: Vt 700mL, RR 16, PEEP 15.

ABG: pH 7.48, CO2 20, O2 200, HCO3 26.

Case 4

56yo male, 80kg, self-immolation with petrol. 50% TBSA PT/FT burns to legs and lower abdomen. No inhalational injury- was outside and flame extinguished rapidly by bystanders. First aid completed prehospital. Intubated prehospital for safe transfer to hospital given highly agitated state, to allow fluid resuscitation to commence.

Vital signs: GCS 3, HR 140, BP 155/85, sats 100% FiO2 1.0, ETCO2 35.

Ventilator settings: Vt 500mL, RR 12, PEEP 5.

There is not yet an ABG result.

Question and answer guide

1. **What are the indications for intubation and ventilation in the trauma patient?**

- Respiratory failure- inability to oxygenate or ventilate due to primary lung pathology
- Protect the airway- low GCS and risk of aspiration
- Neuroprotective management- control of O2/CO2 for control of ICP
- Humanitarian- significant injury burden
- Behavioural management- to facilitate safe assessment, management or transfer

2. **What parameters can be controlled when the patient is intubated and ventilated?**

- FiO2
- Tidal volume (Vt)
- Respiratory rate (RR)
- PEEP

3. **In severe traumatic brain injury, what is the role of intubation and ventilation for neuroprotection?**

- Aims to control O2 and CO2 to manage ICP
- Not definitive care, bridge to neurosurgical intervention

4. **In severe TBI, what are ventilation target end points?**

- Aim sats > 95%. Hyperoxia is thought to be harmful in TBI.
- PaCO2 30-35cmH2O. Lower levels of CO2 cause vasoconstriction and can worsen ischaemic brain injury in TBI. Reducing the CO2 <30 can be used for very short periods (<1hr) as a bridge to operative intervention. After this time the brain haemostasis will negate the effect.

5. **What is PEEP?**

PEEP is positive end expiratory pressure. It helps ‘splint open’ the alveoli, thereby increasing the ability to oxygenate the blood. The addition of PEEP to the ventilator settings (4-5cmH2O) when the patient is intubated will help overcome end expiratory alveolar collapse.

6. Can PEEP be used in patients with thoracic trauma?

Yes. PEEP is thought to help prevent VALI (ventilator associated lung injury) by reducing repeated alveolar collapse and expansion (RACE). By opening the alveoli, and keeping them open, the rate of VALI is reduced. The use of PEEP to maintain oxygenation will also reduce large tidal volumes thereby additionally reducing lung volutrauma.

In patients with pulmonary contusions, the injured lung is filled with blood affecting alveoli opening and shunt fraction. A PEEP of 10-15cmH2O has been demonstrated to be beneficial in this population over mechanical ventilation alone by reducing shunt fraction and improving lung compliance [1,2].

7. What invasive ventilation strategy is utilised with thoracic and pulmonary trauma?

- Lung protective ventilation- as with ARDS, is used to minimise the 'second hit' from invasive mechanical ventilation in the setting of pulmonary injury [3].
- This includes:
- Tidal volume: low. 6mL/kg of ideal body weight
- PEEP optimisation
- Permissive hypercapnia (in the setting of no traumatic brain injury)
- Avoidance of hyperoxia

Other notes

- Facilitator to demonstrate features on Oxylog/Hamilton
- Participants provided the time to alter ventilation modes and functions

Acronyms and abbreviations

Term	Definition
TBI	Traumatic brain injury
Vt	Tidal volume
RR	Respiratory rate
PEEP	Positive end expiratory pressure
ABG	Arterial blood gas
RTC	Road traffic crash
TBSA	Total body surface area
PT/FT	Partial thickness/Full thickness
ICP	Intracranial pressure
ARDS	Acute respiratory distress syndrome

References

1. Cohn, S.M. & DuBose, J.J. (2010). Pulmonary contusion: An update on recent advances in clinical management. *World Journal of Surgery. 34*(8), 1959-1970. https://doi.org/10.1007/s00268-010-0599-9
2. Gunduz, M., Unlugenc, H., Ozalevli, M., et al. (2005). A comparative study of continuous positive airway pressure (CPAP) and intermittent positive pressure ventilation (IPPV) in patients with flail chest. *Emerg Med J. 22,* 325-9.
3. Prunet, B., Bourenne, J., David, J-S., et al. (2019). Patterns of invasive mechanical ventilation in patients with severe blunt chest trauma and lung contusion: A French multicentric evaluation of practices. *Journal of the Intensive Care Society, 20*(1), 46-52. https//:doi/10.1177/1751143718767060

Share your feedback

Please complete our survey to help make Queensland Trauma Education better

The survey should take no more than 5 minutes to complete.

Scan the QR code or visit:
Evaluation Form - Clinical Skills Development Service (csds.qld.edu.au)

Queensland Trauma Education

Queensland Trauma Education
Chest Trauma – Invasive Ventilation Strategies: Procedural skill – Facilitator resource kit

Published by the State of Queensland (Clinical Skills Development Service), 2024

Visit csds.qld.edu.au/qte
Email CSDS-Admin@health.qld.gov.au
Phone +61 7 3646 6500

Queensland Government