**Prevention of Middle Ear Barotrauma (MEBT) during compression for hyperbaric oxygen therapy (HBOT)**

Please check with your local ethics service or governing body about the process requirements for auditing your own practice.

| **Background** | During the compression phase of every hyperbaric therapy session, all patients and staff must equalise the pressure in the air-filled middle ear with the rising pressure in the chamber. In normal individuals this is achieved by actively opening the eustachian tubes on each side using one or more of several techniques available. Air is introduced into the middle ear and middle ear barotrauma (MEBT) is thereby avoided. Failure to successfully equalise is the cause of the great majority of complications reported at the initial episode of hyperbaric oxygen therapy (HBOT).¹

One of the elements of the assessment of patients prior to undergoing HBOT is the ability of each patient to successfully achieve equalisation. This involves identification of factors that reduce the ability to open the eustachian tube (e.g. previous radiotherapy to the area) and investigations such as tympanometry to assess the response to attempted equalisation and familiarisation with various techniques designed to open the eustachian tubes (e.g. a modified Valsalva manoeuvre). The ultimate test is a test compression or the first episode of HBOT.² Significant MEBT can be avoided when the team is forewarned that clearing may be difficult for an individual patient.

If assessment indicates the patient is unable to equalise, there is a substantial risk of MEBT during compression. This may manifest with pain (often intolerable), and damage to the middle ear or tympanic membrane (TM). MEBT is graded for severity using the modified Teed Classification.³

Rupture of the membrane by this mechanism is a recognised complication of HBOT. Reduction in the incidence of clinically significant MEBT is universally accepted as a goal of best practice. |

| **Aim and objectives** | To reduce the incidence of unplanned insertion of tympanostomy tubes or formal grommets for patients undergoing hyperbaric oxygen therapy. This audit is therefore concerned with reducing the unexpected occurrence of MEBT requiring insertion of ventilation tubes, rather than the overall rate at which this occurs. |

| **Research evidence/best practice** | Epidemiological data suggests the incidence of MEBT resulting in termination of the treatment episode in unselected patients is about 9%.²

Despite competent assessment, there are some patients who are unable to equalise during the first compression and need to be removed from the chamber and undergo the insertion of ventilation tubes across the TM - either with tympanostomy tubes or formal grommets. This is more easily and more comfortably achieved in the absence of significant MEBT.

Some units will identify patients unable to equalise and use the first compression to confirm the need for ventilation tube placement, while others will prophylactically insert ventilation tubes in these patients. Either approach is regarded as acceptable practice. |
Patients are at higher risk of MEBT and its consequences if any of the following apply:\textsuperscript{2,4}:
- Previous surgery or infections involving the middle ear.
- Previous radiotherapy where the field includes the middle ear or Eustachian tube.
- Current upper respiratory tract infection or inflammation.
- Older age.
- Mental or physical disability that reduces the patients' ability to actively attempt to ventilate the middle ear.
- Female.
- Acuity.
- Rapid compression planned.

The development of clinically significant MEBT is usually associated with a delay to, interruption in, or cancellation of a course of HBOT and so may have important consequences for the ultimate success of treatment.

### Suggested indicators

- Proportion of patients requiring unanticipated insertion of ventilation tubes because of the inability to equalise.
- Proportion of patients withdrawn from treatment due to MEBT where ventilation tubes are not indicated or where the patient declines.

### Standards and criteria for best practice

#### Pre-treatment assessment phase
- **Key outcome:** 100% of patients should have formal assessment of their ability to equalise the pressure in their middle ear.
- 100% of patients should have had their risk of MEBT and its consequences assessed and documented pre-operatively.
- 100% of patients should have a plan in place for the avoidance of significant MEBT that would result in delays or abandonment of treatment.

#### Test compression or first treatment phase
- **Key outcome:** 100% of patients assessed as at increased risk of MEBT should have a test compression or enhanced monitoring at the first therapeutic compression.
- 100% of ‘at-risk’ patients should have active monitoring of comfort and ear-clearing at the first compression.
- 100% of ‘at-risk’ patients should have a plan in place to abandon attempts at compression before significant pain is present.
- 100% of patients with ventilation tubes in situ should be monitored in the same way as those deemed at increased risk of MEBT.
- 0% of patients should experience MEBT of grade 3 or above.\textsuperscript{3}

#### Treatment phase
- **Key outcome:** 0% of patients should experience MEBT at Teed Grade 3 or above.
- 100% of at risk patients should complete prescribed treatment course independent of the need for ventilation tubes.

### Method

Data for series of fifty (50) consecutive patients.
Suggested data collection (refer to [Prevention of MEBT Data Collection Form](#)):
- Date and time of assessment.
- Pre-operative record of history and examination with specific emphasis on identifying risk of MEBT.
- Notation of formal plan for test compression or increased monitoring during first treatment session.
- Notation of any suspicious symptoms during compression.
- Notation of method(s) used to clear ears on first compression.
- Formal assessment of tympanic membrane appearance before and after first or test compression. Assessment of modified Teed Grade if appropriate.

**References**


**Acknowledgement**

Author: Professor Michael Bennett, FANZCA. July 2019.

**Associated documents:**

- MEBT during compression HBOT Data Collection Form
- MEBT during compression HBOT Summary of results Form