ICU
MANAGEMENT & PRACTICE

Expiratory Flow Limitation During Mechanical Ventilation

Expiratory flow limitation (EFL) occurs when the expiratory flow cannot increase despite higher driving pressure at a given lung volume. In airway disease patients, this can happen during tidal expiration (tidal EFL - EFLT). The prevalence of EFLT in intubated patients varies with population, PEEP settings, and detection methods, with up to one-third of mechanically ventilated patients affected. EFLT can cause air-trapping, intrinsic PEEP, and adverse clinical outcomes like dyspnoea, asynchronies, and extubation failure. Many EFLT patients do not show significant increases in total PEEP and plateau pressure when external PEEP is applied, a behaviour termed “PEEP absorber,” which can improve ventilator triggering and reduce breathing effort. Misidentifying EFLT can harm PEEP application, causing hyperinflation and haemodynamic issues.

EFLT detection methods typically involve measuring expiratory flow during specific manoeuvres. EFLT is thought to involve dynamic airway collapse, leading to the hypothesis that real-time expiratory airway resistance (Rex) could detect EFLT without manoeuvres.

This study aimed to compare EFLT detection using the Rex method versus the PEEP reduction manoeuvre and explore Rex curve patterns in EFLT patients.

Patients aged 15 and older receiving mechanical ventilation underwent a PEEP reduction manoeuvre from 5 cmH2O to zero for EFLT detection. Waveforms were recorded and analysed offline. Rex was calculated and plotted against the volume axis, overlapped by the flow-volume loop for inspection. Data on lung mechanics, patient characteristics, and clinical outcomes were collected. The Rex method results were validated using a separate, independent dataset.

Out of 339 patients initially enrolled and undergoing a PEEP reduction, the prevalence of EFLT was 16.5%. Patients with EFLT had higher adjusted hospital mortality compared to non-EFLT cases. Using the Rex method, the prevalence of EFLT was 20%, with a 90.3% agreement with the PEEP reduction manoeuvre. In the validation dataset, the Rex method had a 91.4% agreement. Three patterns of Rex were identified: no EFLT, early EFLT (associated with airway disease), and late EFLT (associated with non-airway diseases, including obesity). In cases of early EFLT, external PEEP was less likely to eliminate EFLT.

The Rex method demonstrates excellent agreement with the PEEP reduction manoeuvre and enables real-time detection of EFLT. Rex analysis identifies two subtypes of EFLT.

A rise in Rex exceeding inspiratory resistance during mechanical ventilation indicates EFLT. Rex analysis can detect EFLT in real-time and identify two physiological subtypes of EFLT: early and late in expiration.

Source: Critical Care

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