**ENHANCING CEREBRAL PROTECTION: A CLOSED-LOOP VENTILATION APPROACH FOR TARGETED CARBON DIOXIDE REGULATION IN TRAUMATIC BRAIN INJURY**

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Introduction:

Cerebral protection aims to prevent secondary brain injury and by maintaining stable levels of carbon dioxide (CO2), oxygen, temperature, blood sugar, and blood pressure. CO2 significantly affects cerebral blood flow (CBF): high levels cause vasodilation, increasing blood volume and intracranial pressure, while low levels cause vasoconstriction, reducing cerebral perfusion. A closed-loop ventilator (CLV) is an advanced system that automatically adjusts its settings based on continuous feedback from the patient. Using real-time CO2 levels, the CLV makes precise ventilation adjustments. Here, we demonstrate a case utilizing CLV to control CO2 levels and regulate CBF.

Case Description:

A 19-year-old male presented with motor-vehicle-accident, sustaining severe traumatic brain injury. CT Brain revealed interhemispheric bleeding and subarachnoid haemorrhage. Initial Glasgow Coma Scale (GCS) was Eye 1, Verbal 1, and Motor 3. Intubation for cerebral and airway protection included connection to INTELLIVENT – Adaptive Support Ventilation, a fully automated CLV using the “Brain Injury” mode, clinician just need to enter the target End Tidal CO2 (EtCO2) range and the ventilator is left on automated mode till it reaches the targeted EtCO2 level. His serial partial carbon dioxide (pCO2 - mmHg) levels, taken hourly for 4 hours, are as follows: 39.9, 32.2, 35.1, 37.4, 35.5. He was subsequently admitted to the intensive care unit (ICU), and an intracranial pressure (ICP) probe was inserted by the Neurosurgical team for 48 hours, resulting in full GCS recovery. He was discharged home with intact neurological function and periodic assessments by the neurosurgical rehabilitation follow-up team.

Discussion:

Ventilation strategy is crucial for CO2 control. CLV adapts and automates ventilator settings in TBI patients based on continuous feedback, adjusting parameters which includes the tidal volume, respiratory rate and inspiratory/expiratory ratio for desired CO2 levels using capnography. This is not only efficient in achieving the target but also user-friendly, requiring fewer manual adjustments.

Conclusion:

In the hectic ED environment, frequent ventilator adjustments for CO2 maintenance are challenging. CLV offers a solution, utilizing breath-to-breath analysis, adapting to the patient's CO2 level, and automating ventilator parameters to achieve the desired CO2 level. Clinician’s role now shifts from “presetting” parameters to “deciding” the target CO2 level, permitting CLV handle the adjustments.

Keywords:

Closed-loop ventilation, Cerebral protection, Automated ventilation.