Should we introduce permissive hypoxaemia into the critical care unit?

Hypoxaemia is a common finding among critically ill patients. A series of ventilatory and non-ventilatory strategies to restore arterial oxygenation have been proposed, advocated or rejected over the years. The harm associated with these interventions is evident, yet the benefit remains unclear. From this, the concept of permissive hypoxaemia was proposed (Abdelsalam, 2006) as the latest in a series of 'permissive' strategies, where values outside the physiological range are tolerated in order to minimize the adverse effects of therapeutic interventions to correct them. This approach has the potential to radically change the management of hypoxaemic patients in the critical care unit.

Permissive hypoxaemia should be used in the critical care unit

High inspired concentrations of oxygen are associated with pulmonary toxicity, indistinguishable from the effects of acute respiratory distress syndrome, through the production of reactive oxygen species. Similarly, hyperoxia is associated with adverse clinical outcomes following acute myocardial infarction, ischaemic stroke and adult cardiac arrest. Tolerating hypoxaemia may enable a significant reduction in inspired oxygen concentrations thus preventing iatrogenic lung injury compounding an existing pathological process (MacIntyre, 2013).

Without exception, every intervention to treat hypoxaemia is associated with harmful effects. Ventilator-induced lung injury is common and often causes comparable morbidity to the underlying disease. Proning patients can be hazardous and high frequency oscillatory ventilation has been associated with increased sedative and vasopressor use. Permissive hypoxaemia could avoid these complications while the underlying disease process is treated appropriately. Although conventional teaching has suggested an association between hypoxaemia and mortality this has not been reflected in clinical practice, given that most patients with acute respiratory distress syndrome die from multiorgan failure rather than hypoxaemia itself. In addition, several therapeutic interventions have been shown to improve arterial oxygenation yet fail to reduce mortality in critical illness, such as inhaled nitric oxide, a conservative fluid strategy and high positive end-expiratory pressure.

Further evidence supporting the safety of this intervention arises from the study of hypoxaemia at high altitude. A landmark study conducted on Mount Everest demonstrated the ability of the human body to tolerate extreme hypoxaemia while maintaining normal homeostatic mechanisms (Grocott et al, 2009). More research is needed to understand how this translates to the critical care unit cohort, but it appears that permissive hypoxaemia could be both safe and effective.

Permissive hypoxaemia should not be used in the critical care unit

The current model of permissive hypoxaemia produces more questions than answers. How low can we go? How long should we apply it? Which patients are suitable? And what do we measure? It is simply impractical to implement a therapy with so many uncertainties. There is a complete absence of clinical evidence to support the use of permissive hypoxaemia in the critical care unit.

A recent systematic review (Gilbert-Kawai et al 2014) failed to identify any studies assessing the efficacy or safety of a strategy accepting hypoxaemia against conventional treatment. While a causal link between arterial hypoxaemia and death has not been established, it may contribute to significant organ dysfunction. This morbidity may not be overt but nonetheless should not be discounted. Without robust methods of identifying the imbalance between regional oxygen supply and demand, the deleterious effects of arterial hypoxaemia on various organ systems may pass undetected. Safe thresholds must be established to avoid significant iatrogenic harm before implementation of this strategy.

Conclusions

While permissive hypoxaemia remains an unproved and untested concept, it is apparent that blindly restoring oxygenation to normal levels may cause more harm than benefit. The key question that needs answering is 'how much oxygen is enough in the critically ill patient?' Until evidence emerges regarding the safety of permissive hypoxaemia, novel strategies such as targeted oxygen therapy and precise control of arterial oxygenation suggested by Martin and Grocott (2013) offer a pragmatic approach for the future. BJHM

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