Oxygenation during one-lung ventilation

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Two patients in our hospital experienced arterial hypoxaemia during one-lung ventilation (OLV) whenever their cardiac outputs decreased. Arterial oxygenation during OLV is determined not only by the magnitude of the intrapulmonary shunt, but also by cardiac output, hemoglobin concentration [Hb], and oxygen consumption. Theoretically, the relationships between these variables can be understood by regarding the shunt equation, as well as the Fick equation for oxygen consumption. Solving the shunt equation for arterial oxygen content (CaO₂) gives:

\[ \text{CaO}_2 = \text{C}_c\text{O}_2 (1 - \frac{\text{Qs}}{\text{Qt}}) + (\frac{\text{Qs}}{\text{Qt}}) \times \text{C}_v\text{O}_2 \]  

Equation-1

Mixed venous content (C′O₂) is given by solving the Fick equation:

\[ \text{C}_v\text{O}_2 = \text{CaO}_2 - \frac{\text{V}_0\text{O}_2}{\text{Qt}} \]  

Equation-2

Where: CcO₂ = oxygen content of capillary blood
Qs = intrapulmonary shunt
Qt = cardiac output

These equations may be combined into a single equation.¹

\[ \frac{\text{Qs}}{\text{Qt}} \times \text{CaO}_2 = \text{C}_c\text{O}_2 - \left( \frac{\text{V}_0\text{O}_2}{\text{Qt}} \right) \times \frac{10(1 - \frac{\text{Qs}}{\text{Qt}})}{1} \]  

Equation-4

Equation-4 may be used to construct plots to illustrate the relationship between arterial oxygen content and cardiac output. In addition, it is possible to illustrate by means of these plots how varying Qs/Qt, [Hb] and VO₂, influences CaO₂.

All the variables contained in Equation 4 should be controlled by the anaesthesiologist to maintain adequate arterial oxygenation during OLV. Note that the most important determinant of CcO₂ is the haemoglobin concentration. An important determinant of CaO₂ in Equation 4 is the ratio VO₂/Qt. This ratio is in turn governed by C′O₂ (Equation 2). C′O₂ should therefore be assiduously monitored and optimized during OLV.

Reference:

**BOOK REVIEW**

Handbook of pain Management


Medical practice from a patient’s perspective often revolves around the pain that he or she will experience through out and beyond the management period. A patient’s perception of how good or bad a doctor is, is often defined in terms of the amount of pain experienced after the treatment. In this book Melzack and Wall firstly define clinical pain states. This is followed by therapeutic options and lastly they comment on certain problem areas in pain assessment and management. This book is easy to read with a reasonable print size. The illustrations are clear and easy to understand. The frequent use of tables are relevant and most appreciated. The bibliography is reasonable and up to date.

As a clinician focused on chronic pain it is imperative for me to have a book that describes a wide variety of pain states with a fair amount of detail. I then look at the therapeutic approaches such a book has. This has to be comprehensive including reference to the team approach, which would include the pain practitioner, physiotherapist, occupational therapist and psychologist. The pain practitioner has two arms to manage patients with. One being his pharmacological arm and the other being his interventional arm. Lastly, comments on the current evidence based medicine are always appreciated.

The section on clinical pain states is divided into five sections. Each section represents a fairly homogeneous area of pathology or of anatomy. These sections I found very thorough and also very broad based. The chapter on obstetric pain I found quite refreshing although some reference to the American Society of Anesthesiologists annual refresher course would have been nice.

The next section deals with therapeutic approaches. The chapters on pharmacology are excellent. Even drugs like Pregabalin which has recently been launched is already mentioned as possible pharmacological agents. Physical and Psychological therapies are well described with good reference to evidence based medicine. The last sections deal with special problems. Age and sex differences play a very important part of daily practice. The tables on opioids and local anaesthetics I find particularly useful. The chapters on cancer pain are also very comprehensive. There are several highlighted areas that summarize certain aspects such as adverse effects. These are particularly helpful as a quick reference.

What I find disturbing is the mere brief reference to in particular pulsed radio-frequency, epidural neurolysis and spinal cord stimulators. I feel that the authors should have dedicated a section on these types of procedures. These procedures form the basis of interventional pain management.

The Handbook of Pain Management is a good introduction to the world of pain practice. It describes a variety of pain states as well as their basic management. I find this book most helpful in my daily practice. I feel that this is an essential practical tool that I cannot do without.

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