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Carbon dioxide and Anaesthesia

Essay

Submitted for partial fulfillment of Master Degree in Anaesthesia.

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Carbon dioxide is colorless gas with physical properties that provide continuous gas exchange between inspired air and the blood in the pulmonary circulation, supplying oxygen and removing carbon dioxide which is then cleared from the lungs by subsequent expiration.

Breathing control in healthy people is by CO2 concentrations in the brain and arterial blood. The breathing centre regulates our breathing movements through special chemoreceptors to measure CO2 concentrations in the brain and arterial blood. The central chemoreceptors detect changes in the pH of the cerebro-spinal fluid and they are responsible for long term or slow changes in breathing. Since CO2 dissolves in the blood and can penetrate through the blood-brain barrier, the main reason for pH variations in the brain are changes in CO2 concentrations.

Peripheral chemoreceptors including the carotid and aortic bodies monitor immediate changes in CO2, O2 and pH concentrations of the blood and control our breathing in the short run.

carbon dioxide used in insufflation into fallopian tubes and abdominal cavities and in laparoscopic surgery.

Laparoscopy results in intra-operative cardio-respiratory changes during pneumoperitoneum. PaCO2 increases due to CO2 absorption form peritoneal cavity. Therefore pathophysiologic changes and complication of laparoscopy are first reviewed in compromised patients, cardio respiratory disturbance aggravate this increase in PaCO2. Hemodynamic changes are accentuated in high risk cardiac patient.

Monitoring devices potentially increase the specificity and precision of clinical judgments. Our understanding of the physiologic effects of anesthesia and its inherent risks can be enhanced by the appropriate use of intra-operative physiologic monitoring. Capnometry is the measurement and numeric representation of the CO_2 concentration during inspiration and expiration. Carbon dioxide monitoring the partial pressure of expiratory CO_2 has evolved as an important physiologic and safety monitor. CO_2 is usually sampled near the endotracheal–gas delivery interface. Alterations in ventilation, cardiac output (CO), distribution of pulmonary blood flow and metabolic activity influence end tidal CO_2 concentration and the capnograph display obtained during quantitative expired gas analysis.

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	demand. Prolonged or severe hypocapnia induces severe cerebral vasoconstriction, resulting in brain ischemia, particularly in poorly perfused areas of the brain such as watershed areas (right-hand side of figure). This ischemia may initiate white-matter destruction in the brain of premature infants. In addition, antioxidant depletion (caused by excitatory amino acids), lipopolysaccharide (LPS), and cytokines produced in response to sepsis, such as interleukin-1*b* and tumor necrosisfactor *a*(TNF*a*), potentiate the process. Finally, restoration of the normal partial pressure of arterial carbon dioxide can result in cerebral vasodilation, which may precipitate or contribute to intraventricular hemorrhage	
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List of Abbreviations

Co2	Carbone di oxide
(-NH2)	amino
NH.COO–	(carbamino)
O_2	oxygen
mm Hg	Millimeter mercry
PaCO2	The partial pressure of carbon dioxide in the arterial blood
(MAC)	monitored anaesthesia care
TcCO2	Transcutaneous measurement of carbon dioxide
H2O	water
H2CO3	Carbonic acid

Content

Introduction:

Carbon dioxide Co2 is an odorless and colorless gas

CO2 is resulting from oxidation of carbon and formed in tissues and eliminated by the lungs Co2 is used in some pump oxygenators to maintain blood carbon dioxide (Co2) tension.

The solid form of Co2 is carbon dioxide snow **(BOCMedical,June ,1994)**

There are many uses of Co2 the most common practice is abdominal insufflations in laparoscopic surgery.

The hallmark of laparoscopy is the creation of apneumo peritoneum with pressurized co2.the resulting increase in intra-abdominal pressure displaces the diaphragm cephalad, causing a decrease in lung compliance and increase in peak inspiratory pressure. Atelectasis, diminished FRC, ventilation/perfusion mismatch, and pulmonary shunting contribute to a decrease in arterial oxygenation. These changes should be exaggerated in this obese patient with a long history of tobacco use. **(Lumb A et.al.,Nunn JF et.al.,2000)**. **(Evers AS et.al., Maze M et.al.Churchill Livingstone, 2004).**

Side effect of Co2 insuffilation

1. CO2 is not an inert gas. It causes direct peritoneal irritation and pain by forming carbonic acid. Post operatively it remains intraperitoneal and causes referred shoulder pain.
2. It causes hypercarbia and respiratory acidosis.
3. It causes sympathetic stimulation which leads to tachycardia, hypertension, and arrhythmias.

(Malley Cet.al., Cunningham AJ et.al., 2001), (Joshi Gp et.al., 2001)

Co2 disorders

Hypocapnia

Produced by passive hyperventilation

Hypocapnia may cause a decrease in Twave by three separate mechanism

- First, if it is present, an increase in intrathoracic pressure will decrease cardiac output.
- Second, hypocapnia is associated with withdrawal of sympathetic nervous system activity, and such withdrawal can decrease the inotropic state of the heart
- . Third, hypocapnia can increase pH, and the increased pH can decrease ionized calcium, which may in turn decrease the inotropic state of the heart**.(Wang T et.al, El Kebir D et.al., Blaise G et.al., 2003)**

Hypercapnia

is generally defined as a blood gas carbon dioxide level over 45 mmHg.

Causes

- Increased CO2 production, as Increased temperature including malignant hyperthermia
- Decreased CO2 excretion, as inadequate ventilator settings
- Increased CO2 delivery to the lungs, as Increased cardiac output, R to L shunt

Management

Ensure adequate oxygenation,adequate ventilation, Check FiO2,sample Blood gases to confirm capnography, Consider secondary causes, Treat complications of hypercapnia

(Rowan Thomas et.al.,2009)

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Chapter 1

ANATOMY AND PHYSIOLOGY OF THE RESPIRATORY SYSTEM