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Tissue Perfusion Monitoring in Anesthetic Conduction of Risk Patients in Limited Resource Scenarios

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Abstract

The main objective of the anesthesiologist during surgery is to ensure adequate tissue perfusion. To guide the anesthetic-surgical process, the anesthesiologist uses non-invasive or invasive monitoring techniques, according to the clinical judgment of the risk associated with the physical condition of the patient and the size of the surgery, which allow measuring and monitoring ventilation, oxygenation, cardiovascular function, temperature, metabolism, level of muscle relaxation and state of consciousness of the patient. Achieving the best hemodynamic coupling or coherence between macro and microcirculation will ultimately determine the good end result in high-risk surgical patients. To evaluate the proper functioning of the microvasculature, the comparative measurement of hemogasometric variables taken in arterial blood and central venous blood samples (called arterio-venous oxygen and carbon dioxide differences, lactate levels and venous saturation) is postulated. It is known that all of them document the interactions between systemic blood flow, tissue supply and oxygen consumption.

Keywords: *Tissue perfusion monitoring, lactate, venous-to-arterial carbon dioxide difference, central venous oxygen saturation*

Introduction

The clinical conduction of the high-risk surgical patient in the intraoperative period represents a challenge for the anesthesiologist. The main objective of the work during surgery is to ensure adequate tissue perfusion for which you must maintain careful attention in the hemodynamic and metabolic state that, together with a correct choice in ventilatory care and anesthetic method, are a guarantee of a good global homeostasis intraoperatively [1,2].

Surgical stress triggers a known neuroendocrine response is complex and has an unpredictable and individual behavior because each surgical context is unique. The anesthetic-surgical act causes the release of hormones, immunosuppression, proteolysis and oxygen consumption in the tissues and the relationship between this response to trauma and the increase in perioperative morbidity and mortality is well documented [3].

A large number of patients have chronic conditions and decreased cardiopulmonary physiological reserves that make it difficult for them to face the surgical trauma clinically, so it is important to recognize early the intraoperative warning signs of tissue hypoperfusion [2-4].

To guide the anesthetic-surgical process, the anesthesiologist uses non-invasive or invasive monitoring techniques, according to the clinical judgment of the risk associated with the physical condition of the patient and the size of the surgery, which allow measuring and monitoring ventilation, oxygenation, cardiovascular function, temperature, metabolism, level of muscle relaxation and state of consciousness of the patient [3-5].

The vertiginous progress of the specialty in the last 30 years has allowed the introduction of multiparameter monitoring equipment (called anesthesia stations) that allow to measure in real time a large number of intraoperative variables and also make calculations of variables derived from great interest in the follow-up of physiological parameters and in the decision of the treatment of the patient in this period.

However, the greater amount of intraoperative information that is recorded on a daily basis reflects the fluctuation of the physiological variables related to the macro circulation, that is, central hemodynamic variables that govern the flow of blood to the tissues, such as mean blood pressure, central venous pressure, heart rate, cardiac output, urinary debit and peripheral vascular resistance [6-8].

Material and Methods

In recent decades, research has been conducted in critical patients and in some specific surgical contexts such as cardiac surgery, which have demonstrated the existence of microvascular hypoperfusion with alterations in tissue oxygenation even in the presence of macro circulatory parameters within physiologically accepted limits [9 -14].

Evidence indicates that individualized therapy aimed at achieving specific hemodynamic goals during the intraoperative period guarantees maintaining and improving oxygenation and tissue perfusion and determines better postoperative results, given that the progressive establishment of hypoxia in the tissues is the main cause of organ dysfunction. Peri-operative and increased morbidity and mortality secondary to surgery in high-risk patients [10]. The optimization of systemic perfusion in the anesthetized patient under conditions of surgical stress is physiologically complex. Achieving the best hemodynamic coupling or coherence between macro and microcirculation will ultimately determine the good end result in high-risk surgical patients.

In order to evaluate the proper functioning of the microvasculature, the comparative measurement of hemogasometric variables taken in arterial blood and deep venous blood samples (called arteriovenous differences of oxygen D a-vO_2 and carbon dioxide D a-) is postulated. vCO_2), and venous oxygen saturation (SvcO_2) as it is known that all of them document the interactions between systemic blood flow, tissue supply and oxygen consumption [13-17].

The obtaining by the anesthesiologist of reliable and timely information of the variations of these physiological variables in the course of the surgical procedure, in parallel with the observation of the behavior of the macrovariables, allows early identification of any deterioration in the oxidative metabolism responsible for homeostatic dysregulation, what is fundamental for the taking of preventive and therapeutic decisions during the same, as well as to alert on the possible appearance of postoperative complications.

Most of the published studies have been carried out mainly in the emergency and intensive medicine scenario in samples of patients diagnosed with sepsis/ septic shock, and some others in specific high-risk surgeries such as cardiac surgery.

Results

In this article, the authors share information that can support anesthesiologists for the incorporation of variables that allow estimating the perfusion of the microcirculation, in limited resource scenarios.

Lactate

It must be evaluated in arterial blood sample.

Normal value: 0.5-2.2 mmol / L.

The increase in arterial lactate can be a marker of tissue dysoxia due to decoupling between delivery and / or oxygen consumption. Its value should not be considered strictly as a reflection of tissue hypoxia.

There are clinical situations such as increased lactate production and decreased liver clearance, in which hyperlactacidemia may exist without anaerobiosis [19]

Central Venous Oximetry

Oxygen saturation in central venous blood (SvO2) can be used as an estimate of oxygen saturation in mixed venous blood.

Normal value: ≥ 70%

It is an indicator variable of the balance between transport and oxygen consumption. Its value depends on cardiac output, oxygen consumption, hemoglobin concentration and arterial oxygen saturation. In a patient with stable oxygen demand, central venous desaturation may reflect decreased cardiac output.

In septic patients, SvO2 may be elevated due to poor distribution of blood flow and not necessarily due to global perfusion abnormalities.

In situations related to the intraoperative of complex surgeries or at-risk patients, hypothermia, anesthesia and an increase in the inspired oxygen fraction can raise the values of SvcO2, and limit its use as a prognostic marker or indicator of adequate tissue perfusion.

Difference Arterio - Central Venous Carbon Dioxide

The difference between PCO2 in central venous blood (PvCO2) and PCO2 in arterial blood (PaCO2) is defined as the venous-to-arterial CO2 tension (a-v PCO2 difference).

Normal value: ≤ 6 mmHg

The variable has shown to be a good marker of adequate microcirculation.

The increase in the values of a-v PCO2 difference can be explained by an increase in venous pCO2 secondary to a decrease in cardiac output and tissue hypoperfusion; increase in the production of CO2 secondary to the damping of hydrogen ions due to excess bicarbonate; and increase in CO2 production.

Elevation has been observed in all types of circulatory failure (cardiogenic, obstructive, hypovolemic and distributive shock) [20].

Conclusions

The anesthesiologist, even in limited resource scenarios, may have commonly used variables to estimate the functioning of the microcirculation and achieve adequate tissue perfusion, as a work goal to obtain a good final result.

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