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HYPERCAPNIA AND SEDATION IN PATIENTS UNDERGOING SURGERY IN SPONTANEOUS BREATHING

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Abstrct: Intraoperatively hypercapnia develops during intravenous sedation of patients in the ICU or during surgery, while the patient is breathing spontaneously. In this review we looked at the correlation between hypercapnia and delayed awakening while the patient is on spontaneous breathing. In this study we looked into patient response to sedation while on spontaneous breathing, in relation to development of hypercapnia. During the literature review there were evidence that shows that hypercapnia is not adequately monitored and that there is no direct correlation between the oxygen saturation and the level of carbon dioxide (CO2) in arterial blood in patients under sedation in spontaneous briefing. In this article, 2 cases is presented.

Keywords: hypercapnia, postoperative awakening, arterial blood gas analysis, dexmedetomidine, propofol, sedation.

Introduction

Oxygen and carbon dioxide are product of oxidative phosphorylation is organisms. They also serve substrate in the same process of oxidation. They maintain a physiological level, in the incidence any deviation either higher or lower than the normal level poses severe treat in the respiratory chains of events and electrolyte and gaseous imbalance to the whole body. This imbalance affects all levels from cells, tissues and the whole body. It is important to note that at normal level homeostasis is maintained which allow for adequate body functions. In event of low values of CO2, is called hypercapnia, while a higher value exceeding upper limit is called hypercapnia. In the condition of increase of low value, there will be pathological changes in cellular acid base balance with various consequences. (1). In hypercapnia the major events are reduction in tidal volumes and an increase in death space, this adversely affects the respiratory center and the cardiovascular systems. (2). In prolonged uncontrolled hypercapnia there will be the suppression of the respiratory motor function, this is an indicator of patient in long tern intravenous sedation.

Aim

To study the impact of hypercapnia in patients with prolonged intravenous sedation breathing spontaneously. Also examine how hypercapnia develop during sedation in a patient and the right method of performing blood gas analysis in sedated patients during surgery.

Reviews

The partial pressure of PaCO2 will change when there a change in breathing, when there is respiratory depression, this is often seen when patient is sedation but breathing spontaneously. The change is directly

proportional to the depth of sedation. FIG 1. This illustrates that how vital signs changes with depth of anaesthesia on patient breathing spontaneously.

It is important to note that the deeper the level of sedation, the more respiratory function of the patient changes, there will be accumulation of CO2, as its elimination from the body is hampered. As a result, patient develops delayed post-operative recovery and delays time of waking from anaesthesia, this will extend period of stay in the ICU. There will be post-operative delirium. The extended stay in the ICU has cost implication and more work over on the few ICU staff.

Most patients receiving treatment on account trauma resulting from RTA, explosion and others require sedation, especially when surgical procedures are being done, combined regional anaesthesia and sedation is often used while the patients' breath spontaneously. To achieve sedation of this patient, drugs like propofol, or dexmedetomidine is ready available, patient maintains spontaneous breathing. In carrying out this procedures, opioids' like fentanyl is given, to achieve proper analgesia.

In 2013, in a research work to study development of postoperative delirium, and prolonged hospital stay, after intraoperative sedation, with propofol, and dexmedetomidine. They resolved that propofol more often causes post-operative delirium and extended length of stay in the hospital (4).

In that study patients were divided in two groups, dexmedetomidine-remifentanil and propofol-remifentanil, all the group arterial blood gases were measured, it was seen that patients with propofol developed hypercapnia more often than patients that was sedated with dexmedetomidine. (5).

Despite the recommendation, using capnography is not accurate when patient is breathing spontaneously while being sedated. There is mixing of room air since the patient is not intubated. It is also important to note most hospitals especially in the developing nations capnography is rarely used, routine pulse oximetry is more commonly used to measure oxygen saturation. In a research it was found out that pulse oximetry is used in 99.2% of cases, whereas capnography is used in only 12.9% of cases [7}.

In accessing blood gases of analysis arterial blood gases is the gold standard (8) A study conducted in patients who are undergoing procedure the time for the procedure was within 80 minutes and in few patient's time was up to 122 – 290 minutes. In these patients' sedation and analgesia was done in a spontaneous breathing. All through the procedure patient had no apnoea. (8). In this study they recorded that all patient was recovered promptly, in blood gas analysis it was discovered that there was a rise in the CO2, this hypercapnia resulted from prolonged sedation. They recorded that this normalised 30minutes after discontinuation of propofol. In this study it was clear that under sedation there is a build-up of CO2 which will lead to hypercapnia and its outcomes especially respiratory acidosis. Monitoring hypercapnia or increase in CO2 in blood can be done with the transcutaneous capnography, but is not possible in countries with low income, but due some factors it may not be sufficiently informative. The oxygen saturation monitor pulse oximetry is more often used to monitors gases in the blood. But most at times there is no accurate correlation to blood pO2 and blood pCO2, this in turn complicates and delay early detection of hypercapnia.

Acute Hypoventilation affects arterial gases, especially pH and pCO2, it on note that intraoperative determination of arterial blood gas composition for the early diagnosis of hypercapnia is insufficiently studied. We are presenting 2 case reports from our experience that shows undergoing procedures with intravenous sedation, developing hypercapnia and its correlation between SpO2 and arterial blood pCO2. Arterial blood gases of this patients were monitored at 30min and 60 min. In one case propofol was used for sedation and the second case dexmedetomidine was used for sedation.

Case No1

Patient AH, a 50-year-old male 75kg was hospitalised due to trauma and fracture of the Rt femur, patient medical / general history was ok, clinically in review of organs were within normal limits. By ASA classification, ASA1, patient was booked for surgery osteosynthesis. the anaesthesia choice was spinal anaesthesia (SA), with intravenous sedation and supplemental oxygen. Spinal anaesthesia given was with 0.5% bupivacaine 10 mg. for sedation dexmedetomidine was administered at a dose of 0.7-1.0 µg/kg/hour. Patient was attached to the monitor and vital sign and necessary monitoring was done. Throughout the whole procedure patient had spontaneous breathing and no apnoea was seen. Patient was stable at all times vital signs intraoperative was blood pressure 100/60-115/65 mmHg, heart rate 60-67 bpm, SpO2 97-98%. Supplemental oxygen was given via a face mask and was humidified at 5 L/min. the duration of surgery was 112 minutes' Intraoperative blood gas analysis revealed a very slight increase in partial pressure of CO2 in the blood 50mmHg. Patient woke up in 10 minutes' post-surgery and was fully conscious.

The Dexmedetomidine infusion was stopped 15 minutes before the end of the surgical procedure. Patient was fine, no sign of delirium, excessive drowsiness, or nausea were observed. This patient was immediately transferred to the ward.

Clinical case №2

Patient VO, was admitted through the ER on account of industrial accident with open fracture of the Lt femur, he was aged 45 years, 89kg. clinically patient was ok apart from the sustained injury. Past medical history noting remarkable. ASA classification was ASA 1E, patient was booked for surgery for open reduction and internal fixation (ORIF). Method of anaesthesia was spinal anaesthesia (SA). Patient was sedated with IV sedation, using 0.5% Bupivacaine solution, 10 mg. For sedation, 1% Propofol solution was used at a dose of 3.5-5.1 mg/kg/h. during the procedure patient was breath spontaneously and no apnoea event occurred. Supplemental oxygen was given to this patient, at 5 L/min through a face mask. Patient was stable all through the period of surgery. Vital signs were monitored: BP 110/70-125/75 mmHg, HR 68-75 bpm, SpO2 96-98%. Surgical procedure last for 150 minutes, at the end patient woke up 15 minutes' post-surgery. Sedation with propofol infusion was stopped 15 minutes before the end of the procedure. In the analysis of blood gases intraoperatively it was found that the values CO2 partial pressure was 60mmhg. Patient had increased drowsiness and mild disorientation which persisted for persisted for the next 20 minutes. The patient was transferred to the HDU, where he stayed for 2hrs for monitoring. The patient was later transferred to the ward.

Discussions

In the two patients their hemodynamic stability was comparable, the dexmedetomidine protocol had superior airway security due to fewer hypercapnia and respiratory adverse events and also it shows a lower level of postoperative delirium than propofol in healthy patients as compared to one had 1% propofol infusion for moderate sedation, which experienced the development of moderate hypercapnia. While in turn led to a longer awakening period after the surgery and mild side effects. Oxygen saturation had remained at normal levels but there was a build-up CO2 in the blood.

Conclusion

In most patient undergoing surgery, it is important to monitor blood gases especially if patient is having a long term intravenous sedation with analgesia on spontaneous breathing. This patient blood gas should be monitored, there is insufficient data on this topic hence the need for more multicentre collaborations. The use of capnography is hence necessary is surgical procedures as single pulse oximeter is not enough. Normal peripheral blood oxygen saturation levels during sedation are not a reliable indicator and does not naturally signify normocapnia.

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