PERIOPERATIVE NON-INVASIVE VENTILATION TO AVERT INTUBATION IN SEPSIS-INDUCED MULTI-ORGAN FAILURE PATIENT UNDERGOING EMERGENCY LOWER-LIMB SURGERY

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CASE REPORT

Doi: 10.33695/rojes.v3i2.29
Accepted: 20.11.2021

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Abstract

Non-invasive ventilation (NIV) has proven benefits in critically ill patients over invasive ventilation in indicated patients. The use of NIV is, however, mostly confined to the critical care unit, although it is being used in many patient care set-ups. The use of intraoperative NIV is emerging and relatively less reported. We present a case of a 60-year-old woman, with a history of type-II diabetes mellitus inadequately controlled by oral hypoglycemics, and chronic kidney disease, that presented with a diabetic gangrenous foot. She was in sepsis-induced acute hypoxemic respiratory failure and was successfully managed with NIV and spinal anesthesia, and the need for endotracheal intubation and possible consequences were averted. The case highlights the usefulness of NIV in indicated patients requiring surgery, which can be managed by neuraxial anesthesia. The case also highlights the need for dedicated NIV modes in the anesthesia workstation.

Keywords: noninvasive ventilation, spinal anesthesia, sepsis, acute respiratory failure, surgery, acute care

Introduction

Spinal anesthesia is the time-tested, most common, and probably the gold standard for surgeries below the level of the umbilicus [1]. It is also beneficial for short-duration procedures. The technique preserves the patients' respiration, airway patency and the involvement of functional residual capacity; the ventilation-perfusion mismatch is limited as compared to general anesthesia (GA) [2]. GA also impairs respiratory drive, immune function, and coughing.

Moreover, the drugs used for GA usually require well-functioning organ systems. However, we often come across patients with multiple organ dysfunctions like respiratory distress, sepsis, renal failure, electrolyte imbalance, cardiac issues with a hemodynamic imbalance in the emergency. As sepsis affects the pharmacokinetics and pharmacodynamics of drugs, the response to the general anesthetic agents is often unpredictable and exaggerated in such patients [3]. The need for multiple organ support, invasive hemodynamic monitoring during and after GA is also frequent in sepsis patients [3]. Non-invasive ventilation (NIV) allows us to avoid and reduce many complications associated with invasive ventilation, including ventilator-associated pneumonia [4]. In such complicated cases, we can combine the

benefits of neuraxial anesthesia and NIV for the benefit of the patient.

Case report

A 60-year-old lady, with a history of type-II diabetes mellitus inadequately controlled by oral hypoglycemics and chronic kidney disease, presented with a diabetic gangrenous foot. She complains of fever and productive cough for two days. In the ED, she was conscious, oriented, but with toxic appearance, pallor, shortness of breath, tachypnea, and bilateral pedal pitting edema. Her blood pressure and heart rate were 110/65 mmHg and 105 beats per minute, respectively.

We noted bilateral chest crepitations with preoperative SpO_2 < 90% without oxygen supplementation. Laboratory test showed:

- anemia (Hb=8 mg/dl)
- infection (TLC=25.900 cells/mm^3)
- hyperglycemia=180 mg/dl
- acute kidney injury (blood urea=116 mg/dl and serum creatinine=2.6 mg/dl)
- dyselectrolytemia (Na^+=130 mEq/L, K^+=5.6 mEq/L)
- metabolic acidosis with
    - pH=7.3
    - pCO_2=25 mmHg
    - paO_2=65 mmHg
    - lactate=2 mmol/L

Bedside chest x-ray was suggestive of bilateral mild pleural effusion. We provided NIV support in the ED, along with other supportive measures and decided for an emergency amputation. Before the surgery, the patient had an ASA PS 4E and signed a high-risk informed consent.

In the operating room, a NIV mask was attached with the closed circuit of Mindray A7 anesthesia workstation.

The patient was ventilated with pressure support ventilation with support of 5 cm H_2O, without positive end expiratory pressure, and minimum rate 10 /min with FiO_2 of 100% with fresh has flow of 5L/min; SpO_2 improved to 100% (Figure 1).

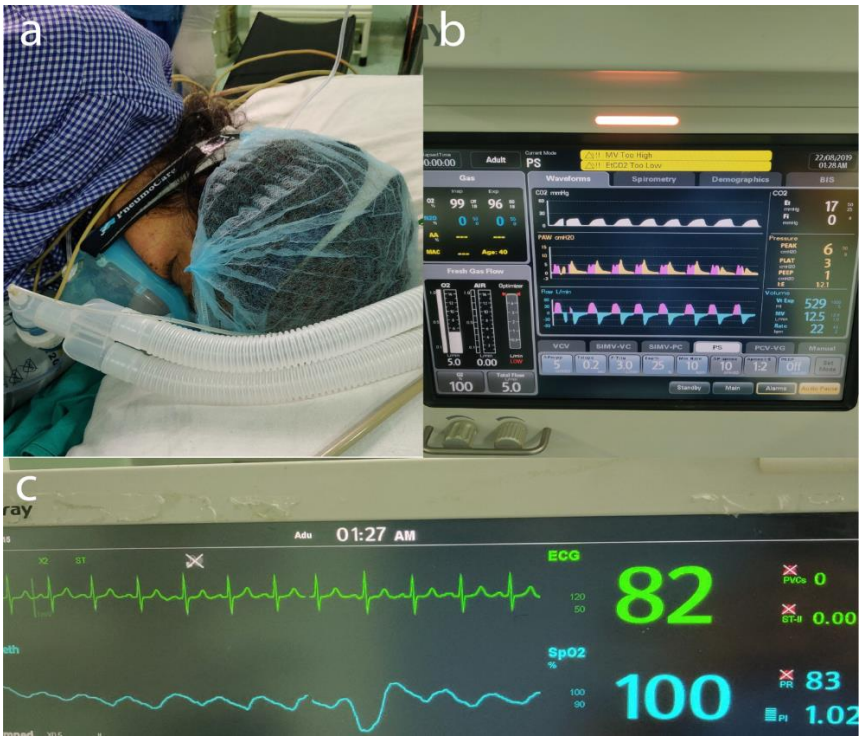

Figure 1 - Administration of non-invasive ventilatory support (1a) using pressure support (1b) and improved saturation (1c)

The spinal arachnoid block was administered in a lateral position by injecting 2.6 ml of Bupivacaine Heavy 0.5%, and the patient remained in that position for 10 minutes; we achieved block up to T10 in the left and T12 on the right side. Fifteen minutes after spinal induction, there was one episode of hypotension with a blood pressure of 80/50 mm Hg for which we administered 6 mg of intravenous Mephentermine.

Postoperatively, she was transferred to the critical care unit, and NIV continued. Another episode of hypotension was noted with a mean arterial pressure less than 60 mmHg despite 1 L of intravenous fluids. We infused 1μg/Kg/min of Noradrenaline. Other supportive measures - nebulization, calcium gluconate, insulin, etc. - were maintained as required, and the patient recovered well, weaned off Noradrenaline and NIV over the next 6 to 12 hours. The patient was kept on a facemask O_2 supplement of 5 L/min and 30-min post-liberation we had

- pH=7.415
- paO_2=82.1 mmHg
- pCO_2=36.3 mmHg
- Lactate=1.0 mmol/L

Her electrolytes and blood sugar were also normal and she was transferred to the ward the next day, where she recovered well.

Discussion

The present case reiterates the use of intraoperative NIV in patients with sepsis and multiorgan failure. The application of NIV was feasible as the patient was still cooperative, and had reasonable respiratory effort. Further, the surgery planned was of relatively short duration and the lower limb. The goal of using NIV is to improve gas exchange, improve breathing effort, and avoid endotracheal intubation and its complications. Meta-analysis has shown that NIV is effective in reducing the need for tracheal intubation and improves outcomes in chronic obstructive pulmonary disease (COPD) and cardiogenic pulmonary edema patients [5]. A systematic review indicates that patients with acute hypoxemic respiratory failure not associated with cardiogenic edema that receive early NIV associated with standard therapy benefit of a reduced rate of endotracheal intubation (ETI) [6]. Another recent systematic review shows the probable effects of regional anesthesia (RA) on the respiratory system and the probable benefit of NIV application in patients undergoing surgery under RA [7]. Our patient was not a known cause of COPD. The respiratory compromise was due to sepsis-induced inflammatory response and metabolic acidosis. In our case, the respiratory support associated with NIV improved oxygenation and gas exchange during RA, and thus we could avoid ETI.

The use of intraoperative NIV in patients with acute respiratory failure due to other causes than COPD and acute cardiogenic pulmonary edema is rarely described in the literature. Pulmonary edema due to preeclampsia has also been successfully managed using NIV [8]. Recently, NIV has been evaluated in the perioperative setting as a prophylactic and therapeutic tool [9], [10]. In patients with acute respiratory failure (ARF) or at high risk for ARF, the supine position required in most surgeries can worsen the respiratory function of the patient. Moreover, neuraxial anesthesia has the potential to interfere with intercostal muscle function. In such conditions, NIV may improve ventilation by reducing atelectasis and left ventricular afterload. The patients have an improved diaphragmatic excursion while on NIV. Furthermore, NIV also acts as a pneumatic splint to keep the airway open [9].

Most of the anesthesia machines do not have dedicated NIV modes. We managed the patient by using pressure support ventilation from the anesthesia workstations. Although this mode may not be at par with the dedicated NIV modes, these types of supports have also been used earlier for providing NIV support in

a morbidly obese patient with obstructive sleep apnea and orthopnea [11]. Considering the emerging uses and evidence of perioperative NIV, we wonder: Is now a good time to have specific noninvasive ventilatory modes in anesthesia workstations?

Conclusion

Perioperative NIV is useful in averting the endotracheal intubation and the administration of GA in surgical patients that can be managed with neuraxial anesthesia, but require artificial respirator support.

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