MEDICAL SCIENCE

To Cite:
Mishra D, Chakole V. Anaesthetic challenges in a case of polytrauma with hypovolemic shock, pneumothorax and anticipated difficult airway. *Medical Science* 2023; 27: e133ms2862.
doi: https://doi.org/10.54905/disssi/v27i133/e133ms2862

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Peer-Review History
Received: 24 January 2023
Reviewed & Revised: 28/January/2023 to 23/February/2023
Accepted: 27 February 2023
Published: 05 March 2023

Peer-review Method
External peer-review was done through double-blind method.

Medical Science
pISSN 2321–7359; eISSN 2321–7367

Anaesthetic challenges in a case of polytrauma with hypovolemic shock, pneumothorax and anticipated difficult airway

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ABSTRACT

Beginning at the site of the injury, the continuum of resuscitation extends through the operating room and onto the intensive care unit (ICU). The key to high success rates understands the importance of early resuscitation and trauma management in the resuscitation continuum. Securing the airway, careful fluid management, anaesthesia and anaesthetic drug selection are essential for achieving the best results. In our case report, we discuss the management of a 39-year-old man who was involved in a road accident that resulted in a crush injury to his right leg and massive subdural haemorrhage in the left frontal and temporal lobes. We also analyse how careful selection of drugs and resuscitation was used to maintain hemodynamic stability along with facing and managing a "can't intubate, can't ventilate" situation.

Keywords: Difficult airway, percutaneous tracheostomy, craniotomy, hypovolemic shock

1. INTRODUCTION

When providing care for a patient who has endured extensive trauma, the trauma anesthesiologist must prioritise proper resuscitation in order to expedite surgical hemostasis despite of having several competing concerns. To address the various pathophysiological processes seen in trauma, one must have a thorough understanding of airway management, resuscitation, physiology, pharmacology and critical care that is backed by evidence-based research (Asai, 2006). To ensure optimal results, meticulous fluid, anaesthesia and anaesthetic agent selection are crucial. A previously unreducible 1-28% of all anesthesia-related fatalities are caused by the "cannot ventilate, cannot intubate" emergency condition. Both the American Society of Anesthesiologists (ASA) and the Difficult Airway Society advocate surgical cricothyrotomy or needle cricothyrotomy as the final life-saving interventions in CVCI emergencies (Krafft and Frass, 2000). In our case report, we outline methods for inducing and maintaining a patient under general anaesthesia who has sustained major trauma.

2. CASE REPORT

We present the case of a 39year old male who was brought to our casualty with the history of a road traffic accident where the patient was run over by a truck resulting in head injury, loss of consciousness and crush injury of his right leg (Figure 1).

Figure 1 Depicts the crush injury of the right leg

Urgent neurosurgery, general surgery, orthopedics and anaesthesia call was noted for the patient. Upon our arrival, the presenting GCS of the patient was E2V3M3 which was worsening with time hence we decided on intubating the patient right then. The patient had a pulse rate of 120/minute, blood pressure of 80/50mmhg and an oxygen saturation of 93%. Two large bore intravenous cannula were secured in both the arms and fluid resuscitation was commenced. Ringer Lactate, being the most physiological fluid, was chosen as we were not aware of the patient's existing comorbidities. We decided to go with rapid sequence induction to avoid any chances of aspiration, being unaware of the patient's nil by mouth status. We avoided the use of any anaesthetic agent that would cause the blood pressure to drop further and hence we were left with two choices considering the availability in our hospital: Injection ketamine and injection etomidate. Ketamine was avoided as with the history of loss of consciousness, there were high chances of intracranial bleed or cerebral oedema and we did not want to cause any further increase in the intra-cranial pressure. Hence, we preferred to induce the patient on injection etomidate which provided us with an additional advantage of it being cardio-stable and using injection succinylcholine as the muscle relaxant; which was preferred due to its short duration of action as it was an anticipated difficult intubation, the patient being heavily built. Upon laryngoscopy, neither glottis nor epiglottis was visible, corresponding to Cormack lehane grade four. After three failed attempts at intubation, we inserted an LMA, but could not succeed in ventilating the patient adequately. Hence, we had to go with an emergency bedside percutaneous tracheostomy, owing to the unavailability of fiber-optic bronchoscope at that moment. Under all aseptic precautions, the patient was tracheostomised and connected to the ventilator set to SIMV mode with appropriate settings (Figure 2).

After placing a 7 French triple lumen central venous catheter in the left subclavian vein, the patient was started on injectable Noradrenaline at 2ml/hour due to continuously plummeting blood pressure (Figure 3).

An E-FAST (Extended Focused Assessment with sonography in Trauma) was performed to rule out any peritoneal/ pericardial fluid; pneumothorax or hemothorax. On E-FAST, pneumothorax was detected on the right side (Figure 4) and intercostal drain insertion (ICD) was planned and executed. After ruling out any other associated possibilities, the patient was sent for a CT scan on which it was found that the patient had a massive subdural hemorrhage in the left frontal and temporal lobes. An emergency decompressive craniotomy and external fixation of the crush injury of the right leg were planned for the patient.

Figure 2 Post-tracheostomy picture of our patient

Figure 3 Showing cannulation of left subclavian vein

The patient was scheduled to have an emergency craniotomy first and then have the right leg externally fixed. Following completion of all emergency lab examinations, it was discovered that the the serum concentrations of urea and creatinine were deranged with serum urea 111mg/dl and serum creatinine 2.4mg/dl. The patient's total leucocyte count and platelet count were both within normal ranges and his haemoglobin level was 9.5 mg/dl.

The patient was shifted to the operation theatre and was administered injection glycopyrrolate 0.2mg, injection fentanyl 100mcg; then induced on injection etomidate and injection atracurium. We chose atracurium as the patient had deranged kidney function tests, any other choice of muscle relaxant would have been difficult to eliminate from the body. Atracurium undergoes Hoffman elimination which means it is degraded in the plasma at body temperature and pH and hence has a short elimination half life. As the flap was raised and the hematoma drained (Figure 5) there was a sudden drop in blood pressure which was managed with increasing the noradrenaline infusion to 4ml/hour (double strength).

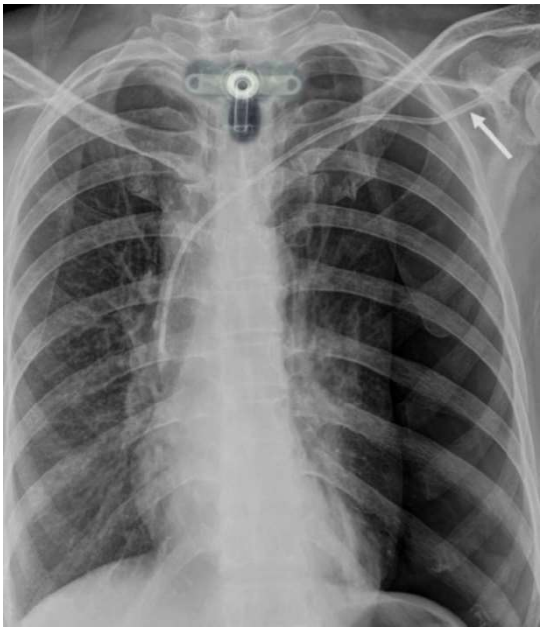

Figure 4 Chest X-ray showing left sided pneumothorax, we can also see the central venous catheter & tracheostomy tube

Figure 5 Showing the intra-operative image during craniotomy

Intraoperative the vitals were maintained with timely top-ups of muscle relaxant and judicious use of fluids. The blood loss was compensated with appropriate use of crystalloids, colloids and whole blood transfusions. After the craniotomy was over (Figure 6) the patient was handed over to the orthopedic surgeons and the external fixator applied to the right leg.

Figure 6 Showing the removed bone flap

The patient was shifted to postoperative ICU, put on volume control mode on the ventilator and continued on injection atracurium and injection midazolam via an infusion pump.

The infusions of atracurium and midazolam were stopped the next day in the morning and the patient was followed up for any signs of spontaneous breathing. Meanwhile, infusion of injection noradrenaline was also being tapered by 0.5ml/ hour owing to the hemodynamic stability of our patient. When the patient became fully aware and was spontaneously breathing, he was shifted to CPAP mode on the ventilator. An ABG was sent after an hour of this. The report did not show any derangement and hence we decided to shift the patient to T-piece, with oxygen at 6litres/minute.

Subsequent trials were given in the next three days to see if the patient was maintaining the saturation of peripheral oxygen (SPO2) off Oxygen on T-piece but all went in vain. On the fourth day, after the patient began maintaining his SPO2 above 95% off oxygen and after ABG was normal, he was planned for tracheostomy closure.

4. DISCUSSION

In critically ill patients, percutaneous dilatational tracheostomy (PDT) is a routine intervention. Intensivists can safely execute it at the patient's bedside. The requirement for prolonged ventilation is the most frequent indication of a tracheostomy in an ICU (Mehta and Mehta, 2017). Tracheostomy, however, can also be carried out as an emergency procedure in circumstances where it is impossible to intubate or ventilate, as it was in our case. Daily assessments should be made to determine whether the tracheostomy tube is still warranted. Decannulation should be performed as soon as possible and should be taken into consideration if the patient is coughing effectively, is able to protect their upper airway, has a reasonable low demand for fio2 and suctioning and has not required mechanical ventilation in the past 24 to 36 hours. If the patient is agitated or delirious, it should be postponed to prevent airway compromise.

The management of patients with hypovolemic shock should follow the principles of immediate resuscitation with electrolyte solutions, correction of metabolic acidosis, early induction of anaesthesia to allow control of bleeding as soon as feasible. Preoxygenation, intravenous anaesthesia, muscle relaxation and ventilation with only pure oxygen are all components of the anaesthetic approach.

In our case patient had also developed pneumothorax due to the trauma inflicted on the chest. The use of positive pressure ventilation during general anaesthesia is the primary factor that contributes to the development of pneumothorax (Steier et al., 1974). It is well knowledge that elevating the positive end-expiratory pressure, abbreviated as "PEEP" raises the risk of barotrauma. This is particularly true in the context of respiratory distress syndrome, abbreviated as ARDS. When positive pressure ventilation is used on a patient who has emphysematous bullae or smaller blebs, it is a well-known scenario that pneumothorax will occur as a result of the bullae or blebs rupturing, leading to the formation of pneumothorax. Patients, who are known to have emphysematous lung disease, including bullae and pleural blebs, should not be subjected to positive pressure while they are being ventilated, since this is the current advice (Bansal et al., 2014). Previous examples described the occurrence of pneumothorax in patients who were receiving mechanical ventilation while under the influence of general anaesthesia. In these situations, the presence of bullae was the primary factor that contributed to the occurrence of pneumothorax.

For freshly admitted trauma patients, rapid sequence induction and intubation is used with induction drugs and neuromuscular blockers. The neuromuscular blockers succinylcholine, rocuronium and vecuronium are utilised for RSII in trauma patients. The depolarizing medication succinylcholine, at a dose of 1-2mg/kg intravenously (3-4mg/kg intramuscularly), is often the neuromuscular blocker of choice due to its rapid onset (30 seconds) and brief duration (5-10 minutes). The non-depolarizing neuromuscular blocker rocuronium (1mg/kg) may be utilised in situations when succinylcholine is contraindicated or unavailable (Magorian et al., 1993).

It has been demonstrated that rocuronium is just as useful as succinylcholine for enabling laryngoscopy during RSII. Because of its quick start of action and neutral hemodynamic profile, etomidate has been used widely in the trauma population. Etomidate is a sedative hypnotic produced from imidazole that activates GABA receptors to inhibit neuroexcitation and cause amnesia. It lowers the cerebral oxygen metabolism rate, cerebral blood flow and intracranial pressure and is widely used to induce anaesthesia in patients undergoing neurosurgery and those who have suffered traumatic brain damage.

Another concern with out patient was the comminuted fracture of his right tibia. After intramedullary nailing, patients with long-bone fractures may experience fat embolism, in which huge fat droplets are discharged into the venous system, are deposited in the capillary beds in the pulmonary system and then move to the brain via arteriovenous shunts. Local ischemia and inflammation are caused by the droplets lodging in the microvasculature, which also causes localised vasoactive amine and inflammatory mediator release as well as platelet aggregation. The condition is mostly asymptomatic, but a small percentage of patients will show signs and symptoms of multi organ dysfunction, especially when it involves the triad of the lungs, brain and skin. Overzealous reaming or nailing of the medullary cavity and increase in the gap between the nail and cortical bone are factors that enhance the risk of FES after intramedullary nailing (Shaikh, 2009).

In 75% of patients, pulmonary dysfunction is the first to present; in 10% of instances, it progresses to respiratory failure. Tachypnea, dyspnea and cyanosis are some of the symptoms; hypoxemia may be found hours before respiratory issues appear. The majority of people experience a petechial rash which isn't palpable on their chest, axilla, conjunctiva and neck that appears within 24 to 36 hours and disappears within a week as the skin dysfunction.

The precise distribution of the rash is connected to the way that fat droplets float in the aortic arch like water containing oil and embolize to the areas of the body which are not dependant. Numerous other symptoms, such as tachycardia and pyrexia, are non-specific. Hepatic damage may appear as jaundice and renal alterations such as lipuria, oliguria or anuria may occur. Exudates, edoema, haemorrhage or intravascular fat globules can all be seen in the retina. An assortment of tests can aid in the diagnosis of the syndrome, including transesophageal echocardiography, transcranial Doppler sonography, CT and MRI scans.

The goal of treating FES is to maintain adequate arterial oxygenation. To keep the arterial oxygen tension within the normal range, high flow rates of oxygen are administered. Maintaining intravascular volume is also crucial since shock can exacerbate the lung damage brought on by FES. To keep arterial oxygenation at a constant level, mechanical ventilation and PEEP may be necessary.

5. CONCLUSION

When providing care for a patient who has suffered substantial trauma, the trauma anaesthesiologist must juggle many competing concerns, but the most crucial thing is to ensure that the patient has a secured airway and receives adequate resuscitation to permit surgical hemostasis. The physiology of the critically damaged trauma patient must be supported, which necessitates careful selection of anaesthetic drugs. When managing the patient, it's important to keep in mind the potential consequences that could arise from the specific trauma the patient has experienced and act swiftly if anything untoward develops.

Informed consent

Written & Oral informed consent was obtained.

Authors' contributions

Deeksha Mishra has collected information and prepared the manuscript which has been thoroughly reviewed by Vivek Chakole. Both the authors have read and agreed to the final manuscript.

Funding

This study has not received any external funding.

Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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