

Anesthesia management of a patient with left ventricular assist device for emergency open appendectomy: a case report

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Abstract. – OBJECTIVE: The objective of this case report is to describe the management of anesthesia of a patient with an LVAD that underwent an emergency open appendectomy. Literature regarding emergency anesthesia management of such patients is still limited. A search in the PubMed engine with the keywords “LVAD appendectomy anesthesia management” revealed no results.

CASE REPORT: The case regards a 54 years old male patient that received an LVAD implant 2 months before the current incident. Close monitoring was applied including invasive arterial pressure measurement. Etomidate was selected for induction thanks to its’ insignificant hemodynamic effects. Careful titrated drug and liquids administration was applied to avoid hemodynamic destabilization. Anticoagulation treatment cannot be stopped in these patients, and there was no time for anticoagulation treatment changes. Two units of fresh frozen plasma were issued as preventive bleeding measures.

RESULTS: No hemodynamic destabilization (targeted MAP: 65-90 mmHg) and bleeding were registered. The patient was extubated without any complications.

CONCLUSIONS: Anesthesia management of similar cases should be focused around bleeding and hemodynamic destabilization and is harder in emergency surgery due to narrow time limits. Drug and liquids titration and use of drugs with minimum hemodynamic effects are advised, as well as close cardiovascular monitoring.

Key Words:

LVAD, Anesthesia management, Appendectomy.

Introduction

Heart failure is described as a major global public health problem as it is defined by significant mortality and morbidity in spite of maximal medical therapy. The left ventricular assist device (LVAD) is used as therapy for patients with advanced or end-stage heart failure, partially or

completely replacing heart function. With the progress of technology, the LVADs have improved survival rates and quality of life among recipients significantly^{1,2}.

Consequently, an increasing number of patients present themselves for evaluation and treatment of a non-cardiac disease (NCD). However, the literature regarding the management of anesthesia of such patients is still limited^{1,2}.

More specifically, a search in the PubMed database with the keywords “Anesthesia management of patients with LVAD for NCDs” resulted to only three studies regarding the management of such cases, while only two case reports emerged. Another search in the PubMed search engine with the keywords “LVAD appendectomy anesthesia management” revealed no results. After the patients verbal consent in the presence of the operating medical staff (anesthesiologists and surgeons), it was decided to report the following case³⁻⁷.

The objective of this case report is to describe the anesthesia management of a patient with an LVAD that underwent an emergency open appendectomy, to highlight which facts anesthesiologists should consider perioperatively, to point out the characteristics of those patients, and to mark the key points that might hinder the successful outcome of the patient. It also has to be noted that there is a great difference between the approach of a patient that is going to receive anesthesia for a regular surgical procedure and that of a patient undergoing an emergency procedure due to different preoperative patient preparation as well as action time limits.

Case Report

A 54-years old male patient arrived at the Emergency Department, referring acute abdomi-

nal pain. His heart was functionally supported by a third generation LVAD with continuous flow and axial rotor and connected in parallel to the native circulation. The specific LVAD was manually controlled, and the parameters were set to 10,000 rpm with a flow of 5 l/min. The LVAD was positioned 2 months before the present incident due to end-stage heart failure. This condition resulted by chronic dilated cardiomyopathy with mild tricuspid valve insufficiency and severe aortic valve insufficiency while there was no coronary obstruction (ejection fraction 20%, Cardiac Output 3 l/min). The LVAD was implanted as a bridge therapy until a proper organ donor was available.

The condition of the patient was evaluated as NYHA IV due to severe limitation of physical activity even while at rest, presenting fatigue, palpitation, or dyspnea caused by much less than ordinary activity. Furthermore, the patient suffered from arterial hypertension, chronic obstructive pulmonary disease (COPD), and hyperuricemia.

His medication consisted to Furosemide 40 mg, Allopurinol 100 mg, Amlodipine 5 mg + Valsartan 160 mg, Amiodarone 200 mg, Eplerenone 25 mg, Acetylsalicylic acid 325 mg and Acenocoumarol 4 mg.

Clinically, Mc Burney and Rousing tests were positive while the patient also had fever (38.8 Co). Despite COPD, no pathological lung sounds were noted and the patient presented no pathological lung symptomatology. The patient confirmed that had not eaten or drank anything for at least 8 hours due to severe abdominal pain.

The blood tests results, described an elevated white blood cell count (17.58 K/l), with neutrophilia (80.7%), while the red blood cell count was slightly low (3.79 K/l), presenting an hemoglobin gradient of 12.2 g/dL and a normal platelet count (206 K/l). The lactate dehydrogenase (640 U/l), gamma glutamyl transpeptidase (90 U/l) and C-reactive protein (3.32 mg/dl) levels were high.

The blood coagulation analysis presented prolonged prothrombin time (32.4 sec), and partial thromboplastin time (58.4 sec) as well as a high International Normalized Ratio (2.71). Urine analysis revealed leukocytosis.

The electrocardiogram (ECG) confirmed the presence of atrial fibrillation. Ultrasound examination pointed out a dilated appendix and presence of liquid. The x-ray of the chest pointed out an increased cardiothoracic index, incom-

plete insufflation of the left lung, and presence of liquid at the left pleuro-diaphragmatic angle. Finally, abdomen x-ray revealed full intestines and absence of any pathological liquid-air levels.

The clinical, laboratory and imaging exams, conducted to acute appendicitis diagnosis and an emergency open appendectomy was decided.

Venal catheterization of the left hand (16G) was executed, as well as ultrasound-guided arterial catheterization of the right femoral artery after local infusion of 5 ml lidocaine 2% (for arterial blood pressure measurement and blood gas samples aspiration). It has to be noted that systolic and diastolic arterial pressure were not possible to be measured due to weak artery pulsation, and the mean arterial pressure (MAP) was taken into consideration instead. ECG was placed and pulse oximetry waveform – though weak – was present. Arterial and pulse oximetry waveforms were present possibly due to native aortic valve ejection. Esomeprazole 40 mg and ondansetron 8 mg were used as anti-vomit and gastroprotection measures. The monitor data at this time were SO₂: 98%, HR: 61 bpm and MAP: 85 mmHg.

Induction to anesthesia was executed with 2 mg of midazolam, 0.15 mg of fentanyl, and 20 mg of etomidate, followed by rocuronium 100 mg for muscle relaxation and the patient was intubated with an 8 mm simple endotracheal tube. A tidal volume of 570 ml and a respiratory rate of 12 breaths/minute with FiO₂ 50% oxygen-air were set to the ventilator while anesthesia was conserved with Sevoflurane 1.5% and a refimantanil 5 mg in 50 ml N/S solution at a titrated rate of 4 ml/h. Monitor data after endotracheal intubation were SO₂: 100%, HR: 65 bpm and MAP: 90 mmHg. A blood gas sample taken 5 minutes after intubation revealed a pH: 7.37, PCO₂: 42.9 mmHg, PO₂: 191.3 mmHg, HCO₃⁻: 24 mmol/l, BE: -0.6 mmol/l, Na⁺: 140, K⁺: 3.86 mmol/l, Hb: 10.5 g/dl, Hct: 31%.

Two units of fresh frozen plasma and a total of 1500 ml of Ringer's lactate were issued while the patient delivered 300 ml of urine.

Results

The procedure was completed after 60 minutes. A combination of tramadol 100 mg and Paracetamol 1 g were used for postoperative analgesia. A blood gas sample taken at the end of the operation revealed the following: pH: 7.41,

PCO₂: 33 mmHg, PO₂: 173.8 mmHg, HCO₃⁻: 24 mmol/l, BE: -0.6 mmol/l, Na⁺: 138, K⁺: 4.19 mmol/l, Hb: 10.2 g/dl, Hct: 30%.

After the operation was over, sugamadex 320 mg and flumazenil 0,5 mg were subministrated to counter the effects of rocuronium and midazolam respectively, and the patient was extubated without any complications (SO₂: 100%, HR: 63 bpm and MAP: 90 mmHg). Neither hemodynamic destabilization nor bleeding was registered during the operation.

Postoperative pain management was executed with tramadol 100 mg and paracetamol 1 g combination, four times per day for two days.

Discussion

There are two major hazards concerning the anesthesia management of a patient with an LVAD: bleeding and hemodynamic collapse. The cannula that regard inflow and outflow are respectively anastomosed to the left ventricular apex and ascending aorta. Those patients need anti-coagulation treatment (targeted INR: 1.5-2.5) as there is a high risk of thrombus formation and catastrophic thromboembolic complications in parallel to LVAD failure. This treatment could be adjusted according to the needs of the operation (e.g. low molecular weight heparin) in regular operations but there is no such luxury in emergency surgery due to time shortage⁷.

Possible bleeding requiring allogeneic blood transfusion holds the danger of a possible immunologic reaction resulting to increased difficulty in finding an appropriate matched organ donor^{3,7}.

Ultrasound guided arterial catheterization was required for arterial pressure measurement, as the specific LVAD, had a continuous flow function resulting to weakened arterial pulsation, making conventional arterial pressure measurement inadequate and unguided arterial catheterization difficult or impossible respectively. Finally, liquid management through hemodynamic monitoring is impossible, as weak or absent pulse prevents correct stroke volume variation measurement. The goal was to maintain an MAP of 65-90 mmHg through titrated fluid administration³⁻⁵.

Etomidate was selected as the induction drug thanks to its minimal hemodynamic effects while similar induction and maintenance anesthetics were used in literature. Patients with LVAD are prone to high risk of hemodynamic destabiliza-

tion as those devices cannot compensate a possible preload decrease by decreasing forward flow. Furthermore, possible afterload decrease could lead to left ventricular collapse due to suction effect, and acute right ventricular failure. The latter is linked to a rise of the central venous pressure and a decrease in MAP. Left ventricular afterload could be increased, using alpha agonists. No hemodynamic instability was present (HR range 60-68 bpm, MAP range 80-90 mmHg)^{4,5,7}.

Possible use of trans-esophageal echocardiography could be useful as the risks of sudden hemodynamic disturbances mentioned above, require immediate intervention. According to literature, interpretation of acute hemodynamic changes can easily be noted by the use of the mid-esophageal four-chamber view resulting to immediate and appropriate therapy⁷.

Conclusions

Anesthesia management of cases similar to the one presented above should be focused around the hazards that the anesthesiologist may confront and called to overcome: bleeding and hemodynamic destabilization of the patient in association to time shortage. Drug and liquid titration and use of drugs with minimum hemodynamic effects is advised, as well as close monitoring of the cardiovascular system.

Conflict of Interest

The Authors declare that there are no conflicts of interest.

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