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Perioperative Anesthetic Management of a Patient with Severe Pulmonary Hypertension Undergoing Bilateral Inguinal Hernia under Neuraxial Anesthesia and Milrinone Infusion

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Abstract

Pulmonary hypertension is defined as a mean pulmonary artery pressure ≥25 mmHg measured by right heart catheterization at rest. Anesthetic management in patients with pulmonary hypertension can be challenging because changes such as tachycardia, systemic hypotension, fluid shifts, and sympathetic nervous system activation can occur and an increase in pulmonary vascular resistance can lead to acute right ventricular decompensation and cardiac arrest. In this article, we present a case report of a 76 years old male with a mean pulmonary artery pressure of 85-90 mmHg undergoing bilateral hernia operation under neuraxial anesthesia and milrinone infusion to lower pulmonary vascular resistance and increase cardiac contractility. We recommend multidisciplinary team collaboration and meticulous anesthetic management to optimize the procedure and prevent further fatal complications.

Keywords: Anesthesia, inguinal hernia, milrinone infusion, pulmonary hypertension

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INTRODUCTION

Pulmonary hypertension (PH) is a disorder defined as a mean pulmonary artery pressure (mPAP) ≥25 mmHg measured by right heart catheterization at rest (1).

In patients with PH physiologic changes such as tachycardia, systemic hypotension, fluid overload, increased sympathetic tone (pain, airway instrumentation, surgical manipulation), hypoxia, positive pressure ventilation, acidosis, left ventricle failure, an increase in pulmonary vascular resistance (PVR) also called PH crisis can lead to acute right ventricular (RV) decompensation and cardiac arrest (2). The estimated perioperative mortality in patients with PH undergoing surgery is 2-18%. Some of the variables used to predict mortality in PH are clinical like the presence of RV failure, arrhythmia, syncope, or patients with high American Society of Anesthetists physical status (III-IV), diagnostical like the presence of pericardial effusion in echocardiography, reduced RV ejection fraction ≤54 % in magnetic resonance, right atrial pressure ≥8 mmHg and cardiac index ≤2.4 L min-1 m-2 in right heart catheterization, as well as lowering of exercise capacity (6 minutes walking distance ≤440m) and also increase levels of biomarkers like BNP(Brain Natriuretic peptide) >50 ng L-1 and NT-pro BNP (N terminal-pro-BNP) >300 ng L-1 (1). Treatment for PH must be planned according to the progression and the etiology of the disease. Treatment must include drugs like anticoagulant medications and diuretics which slow the progression of PH. Endothelin receptor antagonists (bosentan, ambrisentan), phosphodiesterase-5 inhibitors (sildenafil, tadalafil), prostaglandins (epoprostenol, iloprost), soluble guanylate stimulator (rociguate), and calcium channel blockers (nifedipine) are some of the choices for treatment of high PAP. These pulmonary vasodilator therapies should routinely be continued through the perioperative period. On the other side, angiotensin-converting enzyme inhibitors, angiotensin receptor antagonists, and β-blockers are not recommended because they may cause bronchoconstriction and an increase in PAP.

CASE PRESENTATION

In this article, we present a case report of a 76 years old male with an mPAP of 85-90 mmHg undergoing bilateral hernia operation under neuraxial anesthesia with a continuous milrinone infusion given intraoperatively and postoperatively to lower PVR and to increase cardiac contractility (Figure 1,2,3,4). He weighed 67 kg and was 165 cm tall (body mass index 24.6 kg/m2). His underlying diseases were heart failure, a chronic obstructive lung disease with everyday long-term oxygen therapy usage for 5 hours, and a history of pulmonary thrombosis. He also had a history of smoking. He was initially treated with rociguate, formoterol fumarate, glycopyrronium bromide, and rivaroxaban. A transthoracic echocardiogram showed an ejection fraction of 55%, mPAP of 85-90 mmHg, 2-3/4 degree tricuspid regurgitation, and left ventricular

diastolic dysfunction. A chest computer tomography showed cardiomegaly, right heart chambers dilatation, and pericardial and pleural effusions. The forced expiratory volume(FEV1)/forced vital capacity(FVC) rate was 53 %. His complete blood count and coagulation parameters were within the normal rate. His basal creatine was 1,47 since contrast-related acute renal failure happened in 2017. Electrocardiography showed normal beats per minute. He was evaluated with a mallampaty score (MPS)I and ASA IV.

The risks of the procedure from the anesthesia point of view were explained to the patient and a written consensus was obtained for both general and regional anesthesia. We preoperatively performed a right heart catheterization and a radial artery cannulization for invasive blood pressure measurement. An arterial blood gas within normal values was obtained at the beginning of the operation showing a pH:7.43, partial pressure of carbon dioxide of 44 mmHg, and oxygenation pressure of 86 mmHg. Oxygen was given at 5 L/minute via nasal cannula. Because the saturation measured by the pulse oximeter showed a value of 85%, the nasal cannula was immediately replaced with a mask. An epidural anesthesia was performed and an anesthetic level was achieved to the 9th thoracic dermatome (T9). 80 mg of bupivacaine (0.05%) was given from the epidural catheter to ensure adequate pain control. Midazolam 2 mg was given because the patient was extremely anxious. Fentanyl 100 mcg iv was added in terms of limiting tachycardia and decreasing systemic vascular resistance. Cefazoline 2 gr was infused intravenously for antibiotic prophylaxis. To reduce the PVR, Milrinone infusion was initially given at 0.375 mcg/kg/min dose. Milrinone was discontinued on postoperative day 3. Remifentanil 0.1 mcg/kg/min was infused continuously during the perioperative period for both pain control and pulmonary vasodilatation due to histamine release (1). Even though the operation lasted 2 hours and 30 minutes, we infused only 1000 mL of fluid. His systolic blood pressure ranged from 125-100 mmHg and diastolic blood pressure ranged from 82-60 mmHg. Air warming blankets and warm fluids were used to maintain normothermia. He was discharged to the postoperative care unit in good condition and with normal vital signs.

Figure 1. Patient during perioperative period.

Figure 2. Continuous milrinone infusion given intraoperatively and postoperatively to lower PVR and to increase cardiac contractility.

Figure 3. Surgical field during operation.

Figure 4. Bilateral inguial hernia.

DISCUSSION

PH is a hemodynamic state with clinical features of right heart failure such as shortness of breath, edema, arrhythmias, embolism, and pericardial effusion. Anesthesia poses a risk to patients with PH so the decision whether to choose general or regional anesthesia should be made according to the patient's preoperative status since both can have an impact on RV failure. Regardless of the chosen anesthetic technique, there is a significant risk of peri and postoperative morbidity and mortality in these patients (3).

In our case, we did not choose the method of general anesthesia because of the hemodynamic instability it could cause. Propofol decreases RV contractility, ketamine increases PVR. The best agent for general anesthesia in patients with severe PH would be etomidate but unfortunately, it is not available in Turkey. Nitric oxide is not recommended because it increases PVR. Fentanyl and sufentanil have minimal effects on pulmonary hemodynamics while volatile anesthetics have a dose-dependent effect in reducing right ventricular contractility and negative effects on right ventricle afterload (4). Remifentanil infusion was preferred as an analgesic and sedative because it also has a pulmonary vasodilatation effect by histamine release. We also applied epidural anesthesia because it allows hemodynamic stability to be maintained.

Laura C. Price et al. stated that spinal or epidural anesthesia and other neuraxial blocks could be beneficial to avoid general anesthesia-related

hemodynamic instability although the right ventricle contractility would remain neutral or would decrease in regional anesthesia because of the inhibited homeometric regulation caused by the blockage of the cardiac sympathetic fibers in the upper thoracic region. In our case report, we did not perform spinal anesthesia to prevent systemic hypotension and did not choose general anesthesia to avoid hypotension caused by positive end-expiratory pressure (PEEP) as well as an increase in RV afterload and precipitate a pulmonary hypertensive crisis (2,5,6).

Ashraf M. Eskandr et el. state that milrinone which is a phosphodiesterase type III inhibitor has positive inotropic, lusitropic, and vasodilator effects. Because of this vasodilatation, it can provoke reflex tachycardia (3). In our case, tachycardia did not occur. Air-warming blankets and warm fluids were also used since hypothermia could cause pulmonary vasoconstriction.

Central venous pressure (CVP) monitoring which is considered for major surgery was not measured because no significant fluid shifts or bleeding was expected. These patients poorly tolerate both hypovolemia and hypervolemia. The reason we only infused 1000 mL of fluid for 2 and a half hours of surgery was that an excessive increase in RV preload could increase endocardial stress and ischemia and lead to severe tricuspid regurgitation and systolic RV dysfunction, pulmonary congestive edema, and even cardiac arrest. We recommend a continuous monitorization of blood pressure with arterial cannulization and in case of hypotension, a transesophageal echocardiogram should be done to make a differential diagnosis between dehydration, severe tricuspid regurgitation, and systolic right ventricle dysfunction. We wanted to share this case repost with our colleagues worldwide as the incidence of patients with PH applying for surgery is increasing together with the increasing life expectancy and we think there is a need for better anesthetic comprehension in these patients.

CONCLUSIONS

PH poses challenges for anesthetists. It must be kept in mind that the decrease in PVR and remaining stable hemodynamics is the most important key to successful anesthetic management. Risks and benefits should be carefully considered in patients with PH and the procedures should be performed in centers able to provide a multidisciplinary approach with perioperative optimization and scrupulous management of complications that may occur.

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REFERENCES

1. Pilkington SA, Taboada D, Martinez G. Pulmonary hypertension and its management in

patients undergoing non-cardiac surgery. Anesthesia 2015;70(1):56-70.

2. Price LC, Martinez G, Brame A, Pickworth T, Samaranayake C, Alexander D, Garfield B, Aw TC, McCabe C, Mukherjee B, Harries C, Kempny A, Gatzoulis M, Marino P, Kiely DG, Condliffe R, Howard L, Davies R, Coghlan G, Schreiber BE, Lordan J, Taboada D, Gaine S, Johnson M, Church C, Kemp SV, Wong D, Curry A, Levett D, Price S, Ledot S, Reed A, Dimopoulos K, Wort SJ. Perioperative management of patients with pulmonary hypertension undergoing non-cardiothoracic, non-obstetric surgery: a systematic review and expert consensus statement. Br J Anaesth 2021;126(4):774-790.

3. Eskandr AM, Metwally AA, Abu Elkassem MS, Sadik SA, Elmiligy AE, Mourad M, Hussein L. Dobutamine and Nitroglycerin Versus Milrinone for Perioperative Management of Pulmonary Hypertension in Mitral Valve Surgery. A Randomized Controlled Study. J Cardiothorac Vasc Anesth 2018;32(6):2540-2546.

4. Yang P, Gao S, Chen X, Xiong W, Hai B, Huang X. Milrinone is a better choice for controlled low central venous pressure during hepatectomy: A randomized, controlled trial comparing with nitroglycerin. Int J Surg 2021;94:106080.

5. Minai OA, Yared JP, Kaw R, Subramaniam K, Hill NS. Perioperative risk and management in patients with pulmonary hypertension. Chest 2013;144(1):329-340.

6. Lertkovit S, Nivatpumin P. Anesthetic management of cesarean delivery of parturient with systemic lupus erythematosus associated with pulmonary arterial hypertension - A case report. Anesth Pain Med (Seoul) 2022;17(3):291-297.