

Anesthesia for a Patient with Severe Pulmonary Hypertension Undergoing Laparoscopic Cholecystectomy: A Case Report

Yilu Zhou, Hongfei Chen, Hao Zhang, Mingxing Li, Jiayu Guo and Qingxiu Wang*

Department of Anesthesiology, Shanghai East Hospital, Tongji University School of Medicine, China

Abstract

Pulmonary hypertension (PH) is a haemodynamic and pathophysiological condition defined as an increase in mean pulmonary arterial pressure (PAP) ≥ 25 mmHg at rest as assessed by right heart catheterization. We report a patient with severe pulmonary hypertension after repair of ventricular septal defect. The patient underwent laparoscopic cholecystectomy. The purpose of this case was to discuss the perioperative management of a patient with severe pulmonary hypertension who underwent laparoscopic cholecystectomy which could provide a reference for the management of these patients in the perioperative period.

Keywords: Severe pulmonary hypertension; Ventricular septal defect; TUSPLC; Laryngeal mask; TAP

Introduction

Pulmonary hypertension (PH) is a haemodynamic and pathophysiological condition defined as an increase in mean pulmonary arterial pressure (PAP) ≥ 25 mmHg at rest as assessed by right heart catheterization that can lead to right heart failure [1]. It can be an independent disease, complications or syndrome. The most common symptoms in the early stage were dyspnoea and with the aggravation of the disease, heart valve damage could occur. Pulmonary hypertension symptoms include shortness of breath, fatigue, chest pain, syncope, leg and ankle swelling. Those with moderate and severe pulmonary hypertension leads to acute pulmonary edema and right heart failure. Here is a case report of a patient with severe pulmonary hypertension undergoing laparoscopic cholecystectomy.

Case Presentation

A 36-year-old female patient with congenital ventricular septal defect and pulmonary hypertension has undergone repair of ventricular septal defect at the age of 16 years. The pulmonary hypertension has improved in a short term after the operation and use sildenafil 25 mg TID treatment for a long-term, she felt the chest tightness controlled good. The patient underwent cesarean section 2 years ago and discontinuation of sildenafil at the period of pregnancy, she terminated the pregnancy because of the chest tightness, shortness of breath at thirty-four weeks of gestation, the cardiac ultrasound suggested that pulmonary artery pressure was about 60 mmHg at that time. The cardiac ultrasound points out the pulmonary artery pressure was about 80 mmHg without symptoms progress 6 months ago. She went to the hospital for treatment because of the symptom of chest tightness and polypnea increased, decreased exercise tolerance with amaurosis two months ago. After a period of treatment, now the patient would undergo laparoscopic cholecystectomy for gallstones.

The electrocardiogram displays sinus rhythm, complete right bundle branch block (CRBB). The chest film showed postoperative changes and pulmonary hypertension. Echocardiography showed a large amount of tricuspid regurgitation, PH approximately 139 mmHg, pulmonary regurgitation while the left ventricular systolic function is normal. Right cardiac catheterization and pulmonary angiography showed that the PH is 101 mmHg. The patient was treated with bosentan, furosemide, spironolactone, digoxin, vasorel after admission. The patient had a long history of right upper abdominal pain with abdominal ultrasonography showed gallstones. Her families required

surgery strongly with fully aware of the possible risk of anaesthesia, so the patient would undergo laparoscopic cholecystectomy some days later.

The patient told us she felt chest tightness, shortness of breath as she climbed one stair, so as she got up immediately after bend down. The patient was classified as Grade III in the WHO pulmonary hypertension. During the preoperative discussion, in order to reduce the influence of hemodynamic changes during operation, the operation mode was determined as trans umbilical single-pore laparoscopic cholecystectomy (Figures 1 and 2). In the anaesthesia aspect, we need to maintain adequate oxygen supply and demand, avoid carbon dioxide accumulation, keep the stability of haemodynamics and release the postoperative analgesia, reduce the stress response.

She is 158 cm and the weight is 44 kg. She was sent into the operation room with routinely fasting for 8 hours, we monitoring her ECG, blood oxygen saturation, arterial blood pressure and BIS. Preoperative heart rate was 82 times per minute, ABP was 121/78 mmHg, SpO₂ was 92% and BIS was 95. Arterial blood gas showed: PH 7.427, PO₂ 55.8 mmHg, PCO₂ 32.9 mmHg. Preoxygenation, we gave the patient midazolam 1 mg, sufentanil 10 μ g, propofol 50 mg and cisatracurium 6 mg into the intravenous. Three minutes later, a four degree laryngeal mask were put into her trachea and then adjust the respiratory parameters: Tidal volume 350 ml, Frequency 12 times per minute, inspiratory-to-expiratory ratio of 1:2. At that time the patient's airway pressure was 22 cm H₂O, PetCO₂ was 31 mmHg, heart rate 58 times per minute and oxygen saturation:100%, blood pressure was 88/60 mmHg, injection phenylephrine 40 μ g intravenous, then the blood pressure return to normal. Intraoperative propofol 120 mg/h and remifentanyl 0.4 mg/h intravenously maintenance during the operation. Since the surgery start, the airway pressure was about 22 cm H₂O. The signs were stability during the operation: the blood pressure remained at about 105/65 mmHg, the heart rate remained at about 55 times per minute, the

*Corresponding author: Qingxiu Wang, Department of Anesthesiology, Shanghai East Hospital, Tongji University School of Medicine, China, Tel: +86-21-61569776; Fax: +86-21-58798999; E-mail: qxw1123@126.com

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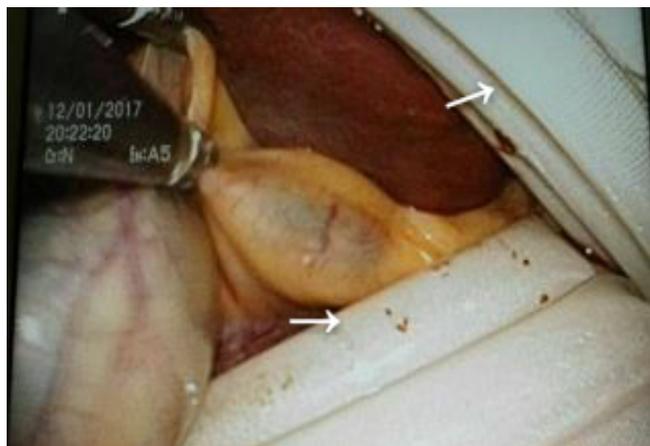


Figure 1: Pneumoperitoneum for three channel leak device.

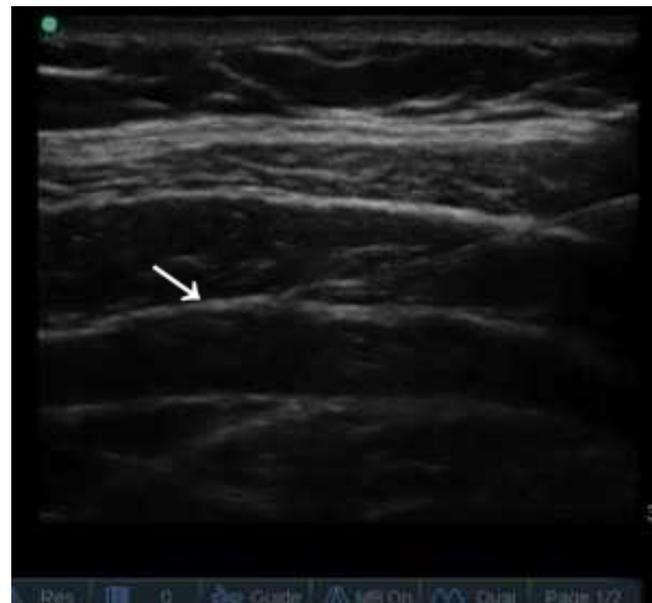


Figure 3: Ultrasound transversus abdominis plane.

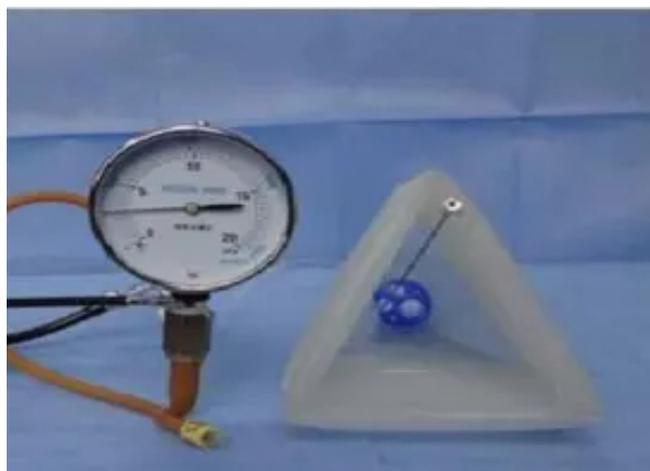


Figure 2: The three channel leak device.



Figure 4: Comparison of preoperative and postoperative incision.

airway pressure maintained at 22 cm H₂O, and the BIS was about 49; after entering the abdominal cavity, the pulmonary artery pressure was 140 mmHg in the echocardiography. The operation time lasted 30 min and adding Ringer's Solution 300 ml. Two minutes after the surgery, the patient came to be awake; she can reply clearly, the tidal volume was about 420 ml. So we pulled out the laryngeal mask, and then gave her oxygen inhalation and observation. After send the patient to PACU, we gave her 0.2% ropivacaine 20 ml in ultrasound-guided bilateral TAP nerve block (Figures 3 and 4). Observation about one hour and then sent her back to the ward.

Discussion

Pulmonary hypertension (PH) is a haemodynamic and pathophysiological condition defined as an increase in mean pulmonary arterial pressure (PAP) rises above a certain limit [1]. It can lead to right heart failure or an independent disease, complications, syndrome. The most common symptoms in the early stage were dyspnoea and heart valve damage could occur with the aggravation of the disease. Pulmonary hypertension symptoms include shortness of breath, fatigue, chest pain, syncope, leg and ankle swelling. In addition, heart auscultation shows pulmonary second heart sounds loudly. The

criteria in WHO for the definition of pulmonary hypertension (PH) is the pulmonary systolic pressure >40 mmHg [2]. It is generally believed that pulmonary arterial pressure (PAP) \geq 25 mmHg at rest as assessed by right heart catheterization [3-5]. When the pulmonary artery pressure is between 30 and 49 mmHg, it is mildly; between 50 and 79 mmHg means moderate and \geq 80 mmHg is described as severe [6,7]. Those with moderate and severe pulmonary hypertension can lead to acute pulmonary edema and right heart failure.

The treatment of severe pulmonary hypertension (SPA) patients is oxygen therapy, cardiac, diuretic, anticoagulant, targeted therapy, improve the way of life and so on. In recent years, research of the pathogenesis of pulmonary hypertension and drug treatment shows: bosentan (endothelin receptor antagonist) and sildenafil (phosphodiesterase type 5 inhibitor) have selective vascular dilatation effect on pulmonary circulation, they can

significantly reduce the pulmonary arterial pressure without affect the blood pressure [8-10]. Prostacyclin has been shown to be effective in the control of pulmonary vascular dilatation [11], Beraprost can improve the motor function and symptoms of primary pulmonary hypertension [12].

Ventricular septal defect (VSD) is a common congenital malformation of the heart. In these patients, Blood flow from left to right at cardiac systolic, In the early stage, the pulmonary arterioles were still in the embryonic stage and there was less flow from left to right. However, with the increase of the flow rate, the interstitial fluid increased, the compliance of lung tissue was decreased and the lung function was impaired. Pulmonary vascular were reactivity changes in early time while functionality change later, to increase the resistance of the pulmonary artery and then resulting in severe pulmonary hypertension. The development of pulmonary vascular lesions can appear after the ventricular septal defect (VSD) and this patient belongs to this kind.

The patient was undergoing a repair of ventricular septal defect operation at the age of 16 with the pulmonary artery pressure was about 40 mmHg before surgery and pulmonary artery pressure was about 35 mmHg after the surgery. She took sildenafil 25 mg TID orally after operation for treatment and regular follow-up cardiac ultrasound observation of pulmonary artery pressure and corresponding treatment progress. The effect of sildenafil on pregnancy patient is not clear, although the United States Food and Drug Administration (FDA) classification of pregnancy safety of sildenafil for B, but in order to reduce the effect of sildenafil on the womb, the patient had stopped taken sildenafil for 2 years in pregnancy until the baby was born. When the pregnancy patient at 34 weeks after admission to hospital with chest tightness, shortness of breath, and the cardiac ultrasound examination showed pulmonary artery pressure was about 60 mmHg, the pregnancy patient should be stopped to use as the drug cannot control the progress of pulmonary arterial pressure. Sildenafil can also increase the heart and pulmonary consumption and the chest tightness shortness of breath symptoms gradually worsened after consultation the obstetrician. With comprehensive consideration, this patient should be with cesarean section operation. However, after the operation, the patient were regularly treated with sildenafil 25mg TID and followed up regularly.

The diagnosis of the patient was after Ventricular Septal Defect Repair, severe pulmonary hypertension. The WHO pulmonary function classification was grade III, ASA cardiac function was IV. She takes sildenafil, bosentan, furosemide, spironolactone, digoxin, Vasorel for treatment orally.

Bosentan is an antagonist that blocking ET-A and ET-B receptor, it can delay the progression of pulmonary hypertension and used for the patient above grade III [13-16]. Sildenafil is a selective inhibitor of 5-phosphodiesterase that had obviously vasodilation on normal and pathology tissue [17-21]. The application of sildenafil and bosentan are essential to control the progress of pulmonary hypertension so they should not be stop in preoperative [22]. Digoxin is a drug used in different kinds of acute and chronic heart failure, auricular fibrillation, atrial flutter, supraventricular tachycardia but with nausea, vomiting or digitalis poisoning. The patient has been seen the distention of jugular vein in the supine position. We considered she has the pulmonary hypertension and right heart failure. Therefore, it is concluded that the patient could not stop to take the digoxin so as to avoid the influence of fluctuation on the right heart function and reduce the incidence of digitalis poisoning.

The patient had a history of chronic right upper abdominal pain

for more than one year. She was treated with conservative treatment. The abdominal ultrasound examination revealed abnormal echo in the gallbladder. And her family members strongly require laparoscopic cholecystectomy.

In the implementation of laparoscopic surgery, after pneumoperitoneum, the intra-abdominal pressure was increased, diaphragm raised and tidal volume reduced, lung-thorax compliance decreased by nearly 30% -50% [23]. CO₂ is the most widely used in laparoscopic surgery. Highly PaCO₂ affects the vagus nerve and multiple source arrhythmia by affecting the circulatory system [24]. Alveolar hypoxia can cause pulmonary vasoconstriction that aggravate the symptoms of pulmonary hypertension in the perioperative period and cause severe pulmonary edema and right heart failure, so as highly PaCO₂ and acidosis.

In order to reduce the hemodynamic fluctuations during the operation, the mode was determined as trans umbilical single-pore laparoscopic cholecystectomy (TUSPLC). Nowadays, laparoscopic cholecystectomy is usually performed by CO₂ to produce pneumoperitoneum to make operation space with 3-4 channels [25,26]. However, the patient was abandoned traditional laparoscopic surgery because of her heart and lung function is difficult to tolerate the influence of the pneumoperitoneum. TUSPLC is a type that patients were under intravenous anaesthesia (head side elevated 20-30°, leaning to left 15°), the laparoscopic operation channel was established and pneumoperitoneum was maintained. A 1.5 cm arc incision was made on lower umbilicus edge, and the rectus sheath was exposed, presenting triangle shape. A 5 mm trocar was directly inserted through the central incision to establish pneumoperitoneum and to observe the abdominal cavity. Other two 5 mm trocars were inserted at upper left and right side of first trocar, respectively. The subcutaneous three channels were not mutually connected, and rectus abdominis and rectus sheath were used to prevent gas leakage. Two single-port laparoscopes were inserted through the left and right trocar, the operation was performed according to conventional laparoscopic operation. At last, the gallbladder was taken out through umbilical incision, followed by closing fascia and skin incision.

Compared with classic laparoscopic cholecystectomy, TUSPLC is proved to be feasible in treatment of gallbladder diseases [27-29], it can improve the cosmetic effect, reduce postoperative pain, shortened postoperative hospitalization time, and improve postoperative life quality. However, it has highly requirement for the doctor. Our patient was used this with no postoperative analgesia and fastly recovery. She was discharged two days later.

Those severe pulmonary hypertension patients can lead to acute pulmonary edema and right heart failure which oblige us to maintain a stable circulation and reduce the stimulation of stress response. So we used laryngeal mask intubation, on the one hand it can reduce the stimulation of tracheal intubation reaction; on the other hand, the patient can be more resistant to the tube when extubation. TUSPLC was used to minimize the skin damage. Although LC has the advantages of small trauma [27], but the incisional pain, visceral pain and shoulder pain caused by pneumoperitoneum can appear, Transversus abdominis plane block (TAP) as an analgesia auxiliary means, it has a good analgesic effect. We gave the patient bilateral TAP block to reduce pain and the oxygen consumption. The postoperative 2 h, 4 h, 6 h, 24 h VAS score were all zero that suggesting postoperative analgesia is good.

Conclusion

For severe pulmonary hypertension patients undergoing

laparoscopic cholecystectomy, the pulmonary artery dilatation and cardiac glycosides drugs should not be stopped during the perioperative that can reduce circulatory fluctuation. The pulmonary artery dilatation drugs (such as bosentan, sildenafil) routine reserve that to prevent the occurrence of right heart failure during the operation. Trans umbilical single-pore laparoscopic cholecystectomy should be considered in these patients. Laryngeal mask is suitable as it can reduce the stimulation of tracheal intubation and extubation. Arterial blood pressure and blood gas analysis were monitored, bilateral TAP with ultrasound-guided is useful to reduce the damage of pain stimulation. Our patient's treatment can be referenced to severe pulmonary hypertension patients who underwent laparoscopic cholecystectomy.

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