

General Anesthesia for Cesarean Section in a Pregnant Woman with Truncus Arteriosus Intraoperatively Monitored by Transesophageal Echocardiography

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Received 11 June 2020 • Revised 3 November 2020 • Accepted 11 November 2020 • Published online 7 April 2021

Abstract:

Truncus arteriosus (TA) is defined as a congenital cardiovascular malformation in which one great artery arises from the base of the heart and gives origin to the pulmonary and systemic arteries. TA patients who become pregnant have high morbidity and mortality rates because physiologic changes during pregnancy can worsen the cardiopulmonary balance causing cardiopulmonary decompensation. In this case report we report a successful general anesthesia in a truncus arteriosus patient with severe pulmonary hypertension (Eisenmenger syndrome) who underwent a full-term pregnancy delivery monitored by intraoperative transesophageal echocardiography, a new technique to assist physicians in dealing with patients with hemodynamic instability during both cardiac and noncardiac surgery.

Keywords: cesarean section, general anesthesia, pregnancy, transesophageal echocardiogram, truncus Arteriosus

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J Health Sci Med Res 2021;39(6):503-508
doi: 10.31584/jhsmr.2021799
www.jhsmr.org

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Introduction

Truncus arteriosus (TA) is defined as a congenital cardiovascular malformation in which one great artery arises from the base of the heart and gives origin to the pulmonary and systemic arteries.¹ The abnormalities begin in the embryogenic period from atresia of the subpulmonary infundibulum with partial or complete absence of the pulmonary valve, and an aortopulmonary septal defect.² Collett and Edwards categorized four types of TA; type 1 is characterized by “aorta and main pulmonary artery share a common arterial trunk”, type 2 as “the right and left pulmonary arteries separately from the posterior part of truncus”, type 3 as “separate origins of the pulmonary arteries from the lateral aspect of the truncus” and type 4 as “neither pulmonary arterial branch arising from the common trunk with the lungs supplied by collaterals (pseudotruncus)”.³ The prognosis for people with this disease, especially when accompanied by severe pulmonary hypertension or Eisenmenger syndrome, is poor, even in cases where the defect has been repaired.⁴

TA women who become pregnant have high morbidity and mortality.⁵ The optimization of pre-delivery, intra-delivery and post-delivery care is very important when taking care of these patients to decrease the risk of cardiac complications.⁶ A multidisciplinary team of cardiologists, obstetricians, perinatologists, neonatologists and anesthesiologists must work together to manage the complex problems of these women when they become pregnant. However, to date there are few reports of TA woman during pregnancy.⁷⁻⁹ We report our success in performing general anesthesia in a full term pregnant woman with TA who underwent a cesarean section assisted by intraoperative transesophageal echocardiography (TEE) monitoring.

Case Report

A 20-year-old pregnant woman with truncus arteriosus came for antenatal care (ANC) at Songklanagarind Hospital, Prince of Songkla University beginning at 15 weeks

of pregnancy by ultrasound. She had been diagnosed with cyanotic heart disease at 4 months of age, but she had never received treatment. She could tolerate her routine daily activities, and lie down comfortably with one pillow, but she had occasional palpitations and dyspnea on exertion, and had been classified as NYHA function class 3. She did not come for further ANC after this first visit until just prior to delivery in May 2020.

Her pre-delivery physical examination revealed a full-term pregnancy (38 weeks), body weight 49 kilograms (kg), body height 151 centimeters and body mass index 21 kg/meter.² She had normal blood pressure, with tachycardia and oxygen saturation (SpO₂) 85.0–90.0% in room air. There was notable engorgement of her neck vein. Heart auscultation found a systolic ejection murmur grade III at the apex. Electrocardiography showed sinus tachycardia 116/minute with left ventricular hypertrophy. A chest radiograph showed marked cardiomegaly but no pulmonary edema. The obstetrician planned to deliver by cesarean section. Her hematocrit was 41.0% and electrolytes were in normal ranges. Ranitidine 50 milligram (mg) and Metoclopramide 10 mg were given intravenously preoperatively for aspiration prophylaxis.

Preoperative transthoracic echocardiography showed normal ejection fraction, good right ventricular function, right ventricular systolic pressure 140 millimeters of mercury (mmHg), pulmonary artery connected to the ascending aorta, and a ventricular septal defect (VSD) of 17 millimeters (mm) (bidirectional flow) with mild tricuspid regurgitation.

In the operating room, she was placed in the supine position with left uterine displacement and monitored with continual electrocardiography, non-invasive blood pressure and SpO₂. An arterial line was inserted into the left radial artery followed by central venous pressure (CVP) monitoring at the right internal jugular vein. Her baseline blood pressure was 130/80 mmHg with a heart rate of 100 beats per minute (bpm) and CVP was 13 mmHg. The patient was pre-oxygenated with 100% O₂ before the induction of anesthesia.

General anesthesia was induced by etomidate 8 mg and ketamine 40 mg, with succinylcholine 75 mg as a muscle relaxant for rapid sequence induction with cricoid pressure. A No.7 tube was inserted to a depth of 19 cm then she was maintained with 50.0% O₂, 2.0–3.0% sevoflurane, fentanyl and cisatracurium. Baseline arterial blood gas was pH 7.48, PCO₂ 30, PO₂ 55, HCO₃ 24, BE 0.4. Syntocinon 10 units was added in Lactated Ringer Solution 1,000 ml after the surgeon clamped the umbilical cord. Her delivery went well, and a male newborn was delivered with Apgar scores of 3 and 9, SpO₂ 95.0%, heart rate 130 bpm and body weight 2,047 grams. Her estimated blood loss was 200 mL.

After induction of anesthesia, a TEE probe was inserted. A midesophageal ascending aortic short axis view from the TEE showed the ascending aorta (AscAo) connected to the main pulmonary artery (MPA) and a long

axis view showed a perimembranous VSD (Figure 1), size 17 mm, left to right shunt with good left ventricular and right ventricular function. Figure 2 shows the peak continuous wave doppler tricuspid regurgitation jet velocity, with right ventricular systolic pressure 100 mmHg.

After induction her blood pressure decreased to 90–100/50–60 mmHg but the TEE profile did not change so then dobutamine 3–5 microgram/kg/min was started to maintain her blood pressure during the operation. Her blood pressure then remained stable, with a good heart rate and urine output intraoperatively. When the delivery was successfully completed, neostigmine and glycopyrrolate were used for muscle relaxant reversal agents and when she regained full consciousness and muscle strength and could breathe spontaneously, she was extubated and transferred to the Intensive Care Unit (ICU).

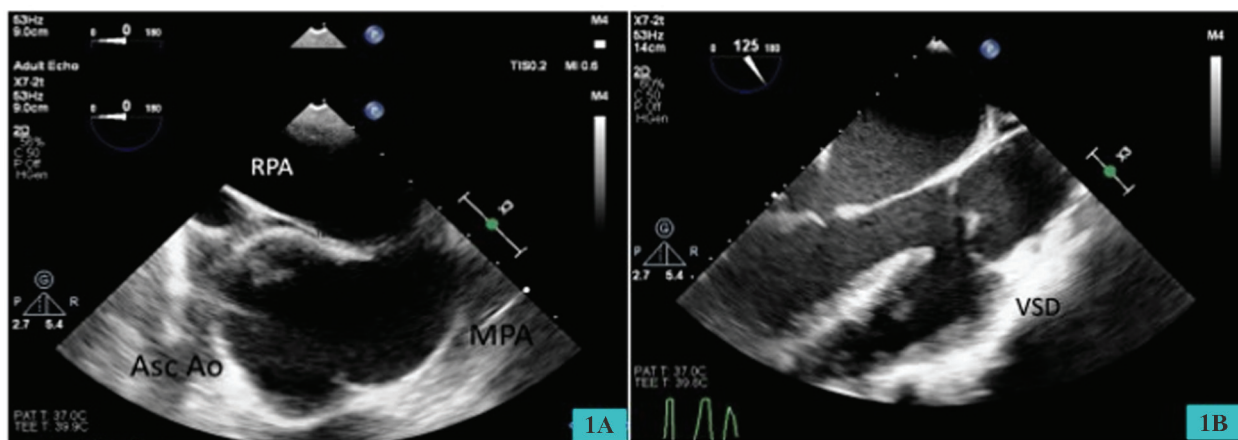


Figure 1 A midesophageal ascending aortic short axis view showing the ascending aorta connected to the main pulmonary artery (1A), and a midesophageal long axis view showing a perimembranous ventricular septal defect (1B)

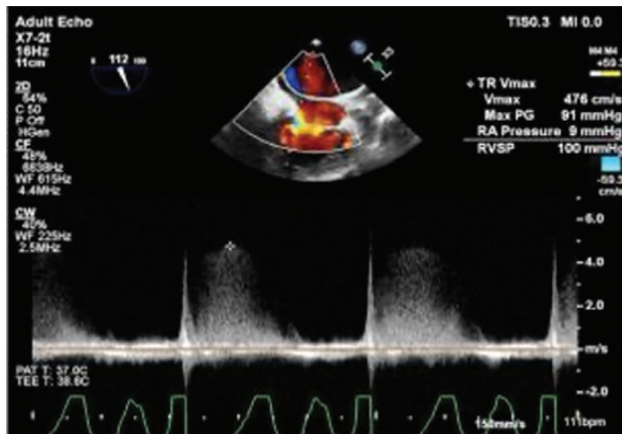


Figure 2 Peak continuous wave doppler tricuspid regurgitation jet velocity, showing right ventricular systolic pressure 100 millimeters of mercury

Discussion

This pregnant patient had truncus arteriosus type1, a condition in which the aorticopulmonary septum is incompletely formed, resulting in a partially separated MPA.¹ She had high preoperative right ventricular systolic pressure (140 mmHg), which is diagnosed as severe pulmonary hypertension. Women who have severe pulmonary hypertension during pregnancy have a high mortality rate, reported as 23.0–36.0%.¹⁰

Physiologic changes during a normal pregnancy may worsen cardiopulmonary balance causing cardiopulmonary decompensation leading to increased cardiac output by as much as 30.0–50.0% by the final stage of pregnancy.¹¹ This condition can be mediated by endothelium-dependent factors, including nitric oxide synthesis or upregulation by estradiol and vasodilatory prostaglandins (PGI₂). These patients can also have peripheral vasodilatation, which causes reduced systemic vascular resistance (SVR) of as much as 40.0%.¹¹ The decreased SVR of pregnant women with severe pulmonary hypertension can decrease coronary filling leading to dilation and failure of the right ventricle.⁶

Pulmonary vascular resistance (PVR) is also reduced in such cases, and the compensatory mechanisms are often insufficient to deal with pulmonary hypertension or Eisenmenger syndrome resulting in right heart failure and death.⁶

The optimal peripartum anesthetic technique for a patient with TA is still unsettled. Performing a Valsalva maneuver during parturition may cause a critical preload reduction making vaginal delivery dangerous. Cesarean section is the preferred mode of delivery for patients with pulmonary hypertension or Eisenmenger syndrome. Epidural or spinal-epidural anesthesia is the recommended anesthetic technique rather than general anesthesia.^{12,13} Single injection spinal anesthesia normally leads to a significant decrease in SVR so spinal anesthesia should be avoided. Epidural anesthesia or spinal-epidural anesthesia result in smaller SVR decreases. Local anesthetic drugs induced via epidural catheter can be titrated to achieve the desired level of anesthesia while preserving hemodynamic stability. General anesthesia can be induced rapidly to facilitate an emergency cesarean section if required but we have to be aware of the risk of difficult airway and ensure adequate respiratory care in pregnant women.¹⁴ Use of a difficult airway algorithm is recommended during cesarean section under general anesthesia.¹⁵

General anesthesia in severe pulmonary hypertension patients comes with the potential for hemodynamic instability due to reduced SVR, increased PVR caused by hypoxia, hypercapnia, acidosis, hypothermia and/or positive pressure ventilation.¹⁰ However, there is no Cochrane review evidence to show that regional anesthesia is superior to general anesthesia in terms of major maternal or neonatal outcomes except for lower estimated maternal blood loss.¹⁶ Anesthetic goals for severe pulmonary hypertension consist of maintaining adequate blood volume and venous return, minimizing PVR, avoiding myocardial depressants and maintaining afterload.⁶

We performed general anesthesia¹³ for this patient because we wanted to monitor TEE intraoperatively. Etomidate 0.16 mg/kg and ketamine 0.8 mg/kg were used for inducing sleep to minimize the decrease in SVR. We maintained the depth of anesthesia with fentanyl as the opioid and cisatracurium as the muscle relaxant to reduce histamine release. Sevoflurane mixed with oxygen and air was used as the volatile agent. There were no major complications.

From our experience, we can suggest that TEE can have a useful role in patients with hemodynamic instability during both cardiac and noncardiac surgery. If an abnormal TEE parameter is detected during the surgery, for example high RSVP or PVR, the anesthesiologist can adjust the vasopressors/inotropic drugs, or if the sonograph shows a superior vena cava less than 50.0% of normal, the anesthesiologist can correct the patient's fluid management through ICU management after the surgery is finished.¹⁷ In our patient, we decided to start intravenous dobutamine intraoperatively as an inotropic agent for her low output cardiac failure after she became hypotensive and the TEE showed a high RSVP, 100 mmHg, to increase her cardiac output by stimulating the myocardial beta 1-adrenoceptors and decrease PVR-mediated beta 2-adrenoceptors¹⁸, and also limit her fluids to avoid congestive heart failure.

Conclusion

TEE is widely used to assist the physician during noncardiac surgeries, especially in patients with hemodynamic instability. Anesthetic agents, airway management for general anesthesia and intraoperative TEE must be carefully monitored to maintain hemodynamics and provide adequate respiratory care in pregnant women with severe pulmonary hypertension or Eisenmenger syndrome.

Conflict of interest

There are no conflicts of interest.

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