Heart failure, metabolic acidosis, and postoperative multiple organ failure after anesthesia for cesarean section in a patient with Takayasu arteritis: a case report

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Summary

The incidence of Takayasu arteritis (TA) is approximately one in 200,000. The prevalence of this disease is higher among Asian women under the age of 30. Most pregnant women with mild TA receive spinal anesthesia for cesarean sections. Despite difficulties in measuring blood pressure, the entire surgical process, including the administering of anesthesia, is generally stable. Studies in this area are rare. The authors report a case of a pregnant woman with TA who received anesthesia for a cesarean section and then suffered for heart failure, metabolic acidosis, and postoperative multiple organ failure. The authors hope to contribute to the clinical studies on the subject of anesthesia for pregnant women with TA.

Key words: Pregnant; Takayasu arteritis; Patients anesthesia; Cesarean section.

Introduction

Takayasu arteritis (TA) is a chronic, progressive, non-specific inflammatory disease of the aorta and its main branches, particularly the aortic arch and its branches [1]. This disease majorly affects not just the blood supply, but also the head, the upper and lower limbs, as well as other bodily organs. Patients suffer from a weakened arterial pulse in the upper or lower extremity, which in turn causes difficulties in measuring blood pressure. Variations in blood pressure are therefore common in patients with TA [2]. The incidence of TA is approximately one in 200,000, and it is more prevalent in Asian women under the age of 30. Most pregnant women with mild TA receive spinal anesthesia for cesarean sections [3-5]. Despite the variations in the blood pressure of patients, the entire surgical process, including the administering of anesthesia, is generally stable. Nonetheless, studies on pregnant women with severe TA receiving anesthesia during a cesarean section and postoperative treatment are rare.

Late pregnancy in women with TA often leads to heart failure and multiple organ dysfunction syndromes after a cesarean section, resulting in a high mortality rate. The authors report a case of a pregnant woman with TA who received anesthesia during a cesarean section and then suffered from and was treated for heart failure, metabolic acidosis, and postoperative multiple organ failure.

Case Report

The patient was a 20-year-old female weighing 62 kg and was 35 weeks pregnant at the time of the study. The patient was reported to have been suffering from cough and chest tightness for 13 days as well as from abdominal pain for 12 hours. This study was conducted in accordance with the declaration of Helsinki and with the approval of the Ethics Committee of Liaocheng People's Hospital. A written informed consent was obtained from the participant who met the criterion set for the study: an individual suffering from pulmonary TA that has been left systematically untreated for the past three years. The following observations were made: stiff seated position, mild jaundice of the skin and sclera, shortness of breath, moist rales in the lower left lung, a heart rate of 135 beats/min without murmur, mild edema in the lower extremity, weak pulsatility index in the bilateral radial artery. and a blood pressure of 80/60 mmHg measured from the right upper limb. Results of the laboratory tests were as follows: HB: 79 g/l, ALT: 32 IU/l, AST: 42 IU/l, TBIL: 59 umol/l, DBIL: 40 umol/l, GLU: 2.2 mol/l, ECG: ST-T changes; echocardiography: LA: 37 mm, LV: 54 mm, RA: 53 mm, MPA: 29 mmHg, PASP: 53 mmHg, EF: 20%, diffuse left ventricular mobility: low, mitral valve: mild regurgitation, tricuspid valve: mild to moderate regurgitation, pericardial: a small amount of fluid.

The patient intended to undergo an emergency cesarean section. In the operating room, the patient underwent right radial artery pressure tests (blood pressure: 80/45 mmHg), right internal jugular catheterisation (CVP: 12 cm H_2O), selection of general anesthesia and inhalation of pure oxygen for five minutes before the anesthesia. The anesthesia was made up of the following: 14 mg etomidate (0.05 ug/kg/min trace pumped remifentanil) and 80 mg succinylcholine chloride. The anesthesia was administered via intravenous injection 60 seconds after intubation. After three minutes, a baby girl was delivered with an Apgar score of 8, which was taken one minute after delivery. The patient was then administered with 0.1 mg fentanyl and five mg midazolam via intravenous injection. In addition, the patient was given a subcutaneous injection of ten mg morphine. After

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Table 1. — *Blood gas analysis and monitoring results in patient at each time point.*

Blood gas analysis	Preoperative	Intraoperative	Postoperative	First day in ICU	4th day in ICU	Away from ventilator	Re-intubate	Death
pH	7.27	7.09	7.13	7.31	7.34	7.36	7.09	7.18
PO_2 (mmHg)	111	248	245	160	168	126	19	30
PCO_2 (mmHg)	14	27	39	23	25	27	42	46
GLU (mmol/l)	1.2	0.8	3.4	4.7	4.9	4.7	1.2	11.0
Lac (mmol/l)	11.7	11.8	11.2	10.3	9.6	9.2	11.8	10.3
HCO^-_3(mmol/l)	6.4	8.2	13.0	27.9	28.1	28.3	10.2	13.4
BEecf (mmol/l)	-20.5	-21.6	-16.2	-14.7	-13.6	-12.7	-16.2	-10.5
Na^+ (mmol/l)	133	132	135	131	138	136	129	127
K^+(mmol/l)	4.3	4.7	4.4	4.6	4.7	4.6	6.3	7.3
BP (mmHg)	80/60	80/50	84/52	90/58	94/60	96/60	undetectable	0
HR (beat/min)	135	132	126	130	112	96	110	0
CVP (cm H_2O)	12	16	12	14	12	9	unscanned	unscanned
S_pO_2 (%)	70	80	83	91	98	100	78	0

fetal expulsion, blood pressure dropped to 70/40 mmHg, CVP: seven cm H_2O. Upon laying the patient on the operating table, blood pressure gradually rose to 85/50 mmHg. After five minutes, CVP also increased to 16 cm H_2O upon adjustment of the operating table head to30°. To control the infusion rate, the patient was slowly injected with 0.3 mg cedilanid.

Intraoperative blood gas analysis showed metabolic acidosis, pH: 7.09, Lac: 11.8 mmol/l and Glu: 0.8 mmol/l; HCO_3^-: 8.2 mmol/l and BEecf: -21.6 mmol/l (Table 1). After an intravenous injection of ten g glucose, blood sugar rose to 3.4 mmol/l. The blood gas analysis revealed the following after an intravenous infusion of 5% $NaHCO_3$ (150 ml): pH: 7.13, Lac: 11.2 mmol/l, HCO_3^-: 13.0 mmol/l, and BEecf: -16.2 mmol/l and 300 ml bleeding was also observed. A compound solution of 200 ml sodium chloride and 200 ml erythrocyte suspension was also given during operation. The following were noted after the operation: blood pressure: 84/52 mmHg, CVP: 12 cm H_2O and heart rate: 126 beats/min. A portable ventilator was used to control breathing. The patient was subsequently delivered to the ICU to continue treatment.

The following observations were made during the first day of treatment in the ICU: ventilator-assisted breathing, APACHE II score: 24 points, liver and kidney damage: further aggravated, jaundice: aggravated, ALT: 372 IU/l, AST: 1,603 IU/l, TBIL: 120.1 umol/l, DBIL: 63.7 umol/l, ALB: 22g/l, BUN: 10.2 mmol/l, CREA: 129 umol/l. Several blood gas analyses showed metabolic acidosis and ten mmol/l blood lactate. The patient then went into coma, with a heart rate measured at 130 beats/min and wet rales at the bottom lung. Ventilator support was given for four days, along with cardiac, diuretic, and hepatoprotective medications to correct metabolic acidosis and hypoglycemia as well as to prevent infection. When the patient gained consciousness, the following observations were noted: heart rate: 100 beats/min, blood pressure: 96/60 mmHg and CVP: seven to ten cm H_2O. Ventilator support was also necessary, In addition, wet rales in the lower end of the lungs as well as bloodier and frothy sputum in the endotracheal tube were observed.

After four days of continued treatment, heart condition gradually improved from the ventilator. The endotracheal tube was also removed, but the patient still received continuous oxygen at four l/min, with spontaneous breathing of 20 times/min and an SpO_2 level of 97%. Blood gas analysis revealed metabolic acidosis and nine mmol/l of blood lactate. During the second day off the ventilator, the patient experienced sudden difficulty in breathing and chest tightness. The following observations were recorded: breathing: 35 times/min, oxygen: seven l/min, SpO_2: 80% and heart rate: 150 beats/min. Blood pressure could not be determined, and scattered moist rales were noted at the bottom of the lungs. Endotracheal intubation was immediately performed. The patient was placed on ventilator-assisted breathing as well as on cardiac and diuretic therapy. Further deterioration was observed, with the patient having a high fever of 41.3 °C, decreased urine output, severe respiratory and circulatory failure, as well as other internal disorders. Blood profusion within the endotracheal tube was also noted. After two hours, heart rate decreased rapidly to zero, resulting in the death of the patient.

Discussion

In patients with TA, lesions are common in the aortic arch and its branches, followed by the descending aorta, abdominal aorta, and the renal artery. Lesions are also observed in the secondary branches of the aorta, such as the pulmonary and coronary arteries [1].

The lesions can be grouped into four types: brachiocephalic artery type (aortic arch syndrome), chest-abdominal aortic type, extensive type, and pulmonary type [1]. The brachiocephalic artery type and other types of mild lesions are generally less worrisome, as the arterial pulse pressure of the upper and lower limbs are greater despite the undetectable upper limb blood pressure [6]. Generally, lesions of the said type can be tolerated during pregnancy and childbirth, but blood vessels and cardiac function must be closely monitored, especially during pregnancy [3]. Patients with TA of the said type undergoing a cesarean section may choose to have either an epidural or spinal anesthesia [2-6]. For the extensive type and the pulmonary type of lesions, conditions are often serious, as characterised by ventricular dysfunction, as well as liver and kidney dysfunction. In particular, during late pregnancy, patients with cardiopulmonary diseases are prone to multiple organ failure, resulting in a high mortality rate. In severe cases, patients are generally recommended to take contraceptive measures to avoid pregnancy [7].

In the case described previously, the patient experienced heart failure, liver dysfunction, and echocardiography, suggesting a thickening of the pulmonary artery that resulted in a moderately high blood pressure. Therefore, the case can be classified as belonging to the extensive and pulmonary type. Epidural or spinal anesthesia is therefore inappropriate, as both forms result in an instability of the hemodynamic parameters [8], deterioration of cardiac functions, ischemia, aggravation of metabolic acidosis, etc. General anaesthesia should be used because of the possibility of preoperative severe heart failure, hypoxia (SpO_2: 70%) and metabolic acidosis (BEecf: -21.6 mmol/l). Radial artery and jugular vein cannulation manometry must be performed before administering anesthesia. To monitor treatment, pulmonary artery pressure should be closely measured with a pulmonary artery catheter, which is limited by differing conditions and time constraints. Obtaining the data from the pulmonary artery catheter monitoring can guide treatment and explain conditional changes [9]. To shorten the time of the induction of anesthesia for fetal expulsion, anesthesia-inducing drugs may be used, as these have minimal effects on the cardiovascular drug etomidate. The micro pump Ru Ruifen (0.05 ug/kg/min) may be given to stabilise maternal cardiovascular functions, reduce stress response, and to hasten metabolism, all of which have minimal impact on fetal breathing [10].

Attention must be focused on monitoring intraoperative blood pressure and CVP changes, as well as on guiding transfusion to maintain hemodynamic stability. Abdominal pressure after the removal of the fetus is smaller because less blood flows back to the heart, which often manifests as a drop in blood pressure. A head-down tilt position may therefore be appropriate for the patient. Uterine contractions ease up after autologous blood transfusion. For patients with cardiac dysfunctions, fluid input must be controlled; otherwise, cardiac overload may occur because of the autologous blood transfusion after uterine contractions. In the case described above, the CVP decreased from 12 cm H_2O (preoperative) to 7 cm H_2O and then rose again to 16 cm H_2O after five minutes from fetal expulsion. This finding reflects the dramatic changes in the circulating blood volume after the baby is delivered. Improper handling can thus cause further deterioration of the circulatory function.

After the cesarean section, the patient was observed to have an improved heart function, but the liver and renal dysfunction, the high levels of lactate and metabolic acidosis persisted. This finding indicates that pregnant women with TA are likely to suffer from severe multi-system, multi-organ atherosclerosis, which results in the hypoperfusion of the heart, lung, liver, kidney, and other tissues. As lactate production increases, the heart, lung, liver, and kidney dysfunctions become aggravated because of the restricted metabolism of lactate discharge. This restriction further damages the liver and kidney, thereby creating a vicious cycle that eventually leads to multiple organ failure.

Faced with economic issues, the patient under study failed to receive blood dialysis, which resulted in further health deterioration. With pulmonary haemorrhage, the patient experienced collateral circulation in pulmonary arteriosclerosis, pulmonary vascular ectasia, and bleeding. As the patient's family refused an autopsy, a complete pathological report could not be obtained.

Pregnant women with severe TA, multi-organ atherosclerosis stenosis, and low perfusion are found to likely suffer from multi-organ dysfunction. Therefore, administering anesthesia and performing a cesarean section are difficult. Careful attention must be paid to the following points: 1) Comprehensive laboratory tests must be performed and effectively monitored, including invasive arterial measurement, central venous pressure measurement, pulmonary artery catheter monitoring, blood gas analysis, as well as heart, liver, and kidney function tests. In addition, respiratory and circulatory changes, as well as organ function status must be closely observed before, during, and after delivery, including follow-up treatments. 2) A reasonable interpretation of monitoring indicators, as well as the pathophysiological state of the patient must be ensured. Attention must also be placed on changes to the functions of the heart, lungs, liver, kidneys, and other vital organs. An active use of drug therapy, ventilator, haemodialysis, and artificial liver replacement therapy may result in a better therapeutic effect. This case study can serve as an important reference for the administering of anesthesia in and the postoperative treatment of pregnant women with severe TA.

As cited earlier, the patient could not undergo blood dialysis and accept an artificial liver because of economic difficulties. In pregnant women with TA lesions, damage to important organ functions are seriously common, adding burden to the patients who are already suffering from the pains of pregnancy and from the impending surgery. Even with the most comprehensive therapy, good treatment effects are difficult to achieve. The authors of this work deeply regret the death of the patient under study and hope to provide case materials that can aid in further research on the treatment and pathophysiological aspects of TA.

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