# Surgical management of type A aortic dissection during the second trimester: a case report

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# Abstract

**Background** Acute aortic dissection during pregnancy is a relatively rare but often life-threatening conditio. A previous study showed that the overall incidence of the disease was about 4 in 1 million women aged 15–45 years. Hormonal and Hemodynamics changes during pregnancy are a major cause of aortic dissection, and these changes may begin in the first and second trimesters, but are most pronounced in the third trimesters(about 50% and 33%, respectively).In addition, some genetic disorder such as Marfan syndrome may be associated with AD during pregnancy.

**Case presentation** A 29-year-old pregnant woman at 21 weeks of gestation presented with acute, non-radiating retrosternal tearing pain lasting 15 h, unrelieved and accompanied by three episodes of vomiting. Ultrasonography identified aortic root dilatation with aortic regurgitation, and contrast-enhanced aortic computed tomography (CT) confirmed type A aortic dissection (AD). Emergency surgery was performed, including ascending aortic replacement, total arch replacement with prosthetic graft placement, stented elephant trunk implantation (Sun's procedure), and aortic valvuloplasty under cardiopulmonary bypass (CPB). The patient was discharged on postoperative day (POD) 9, and the fetus remained viable. At 26 weeks of gestation, the family expressed concerns regarding maternal safety, prompting an early request for cesarean delivery due to cervical insufficiency and preeclampsia, resulting in the delivery of a healthy infant with no adverse events.

**Conclusion** Although AD during pregnancy is uncommon, clinicians must maintain a high index of suspicion for pregnant women presenting with severe chest pain. CTA is essential for diagnosing the condition and determining surgical options. After 28 weeks of pregnancy, cesarean section should be prioritized [17–18]. In the early second trimester, ensuring fetal safety involves appropriately increasing mean arterial pressure, minimizing circulatory arrest time, and closely monitoring the fetus post-surgery.

Keywords Aortic dissection, Pregnancy, Surgery

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#### Introduction

Acute aortic dissection (AD) in pregnancy is rare, with an incidence of approximately 4 per million women aged 15-45 years [1]. It predominantly occurs in the third trimester and postpartum period (50% and 33%, respectively) [2]. Hormonal fluctuations, gestational hypertension, connective tissue diseases, hemodynamic and blood volume changes are recognized pathogenic factors contributing to aortic dissection, usually a multifactorial condition [3-5]. This report described a pregnant woman who developed acute type A AD during the second trimester, underwent successful surgical intervention, and delivered a viable fetus. At 26 weeks of gestation, the family expressed concerns regarding maternal safety, prompting an early request for cesarean delivery due to cervical insufficiency and preeclampsia, with the neonate surviving without complications.

### **Case presentation**

A 29-year-old pregnant woman (gravida 1, para 0) at 21 weeks of gestation was transferred to our center with a 15-hour history of sudden-onset retrosternal tearing pain, non-radiating, and paroxysmally worsening, accompanied by three episodes of vomiting without relief. Ultrasonography at the referring hospital demonstrated aortic root dilatation with aortic regurgitation, and contrast-enhanced aortic CT confirmed type A AD. On admission, blood pressure was 122/48 mmHg in the right upper extremity and 120/56 mmHg in the left. Bilateral breath sounds were clear, without dry or moist rales. Cardiac examination revealed a regular rhythm at 73 bpm, with no pathological murmurs. Obstetric evaluation showed no uterine contractions, vaginal bleeding, or amniotic fluid leakage, and bedside ultrasonography confirmed fetal viability with a heart rate of 154 bpm. Laboratory investigations revealed a red blood cell count of  $3.3 \times 10^{12}$ /L, hematocrit of 30.4%, white blood cell count of  $14.96 \times 10^{9}$ /L, and neutrophil percentage of 83.3%. Blood gas analysis showed serum sodium at 176 mmol/L, chloride 110 mmol/L, free calcium 1.376 mmol/L, oxygen saturation of 85%, partial pressure of oxygen at 45.9 mmHg, and a base excess of -4.46. High-sensitivity cardiac troponin measured 15.8 pg/mL, and B-type natriuretic peptide was 241 pg/L. Coagulation parameters (PT, APTT, TT, and FIB) were within normal limits, and renal function tests were unremarkable. Electrocardiography confirmed sinus rhythm (Fig. 1).

### Treatment

The patient's condition and associated risks were explained to her and her family, and consultation with the Obstetrics and Gynecology Department led to a recommendation for pregnancy termination. Despite understanding the potential complications, the patient declined. Following written informed consent, the patient underwent total arch replacement with a prosthetic graft, stented elephant trunk implantation (Sun's procedure), ascending aortic replacement, and aortic valvuloplasty. These procedures were performed under general anesthesia and emergency hypothermic cardiopulmonary bypass (CPB).

#### Outcome and follow-up

Postoperatively, the patient was admitted to the cardiac surgery intensive care unit (ICU) for routine monitoring and management. Multidisciplinary consultations, including Pharmacy and Obstetrics and Gynecology, were conducted to support diagnosis and treatment planning. On postoperative day (POD) 1, ultrasound confirmed an intrauterine pregnancy with a single viable fetus. By POD 9, the patient was discharged successfully. During follow-up, at 26 weeks of gestation, the family expressed concerns regarding maternal safety, prompting an early request for cesarean delivery due to cervical insufficiency and preeclampsia, with the neonate surviving without complications (Fig. 2).

## Discussion

AD is a rare yet life-threatening cardiovascular emergency with a high mortality rate. The challenges of diagnosing and managing AD during pregnancy are further compounded by increased risks and complexities. The majority of cases are associated with hereditary connective tissue disorders, such as Marfan syndrome, Loeys-Dietz syndrome, Turner syndrome, and Vascular Ehlers-Danlos syndrome (EDS). Additional risk factors include poorly controlled hypertension, hemodynamic fluctuations, and hormonal changes during pregnancy [3-5]. This case involved a pregnant patient initially presenting with sudden, severe chest pain, which is a common but nonspecific symptom. Differential diagnoses include acute myocardial infarction, pulmonary embolism, AD, and pneumothorax, all of which pose significant risks to both maternal and fetal survival. The clinical presentation of AD in pregnancy is often atypical, and in many cases, back pain is overlooked because it is attributed to pregnancy or urinary tract infections during pregnancy. Concerns about the safety of radiological imaging further complicate early diagnosis. In urgent scenarios, transthoracic echocardiography is the initial diagnostic modality due to its accessibility and safety. Nevertheless, CT angiography (CTA) offers superior diagnostic detail, including three-dimensional aortic reconstruction, which aids in evaluating and selecting appropriate surgical interventions. Current guidelines endorse the use of low-dose radiation CTA as a diagnostic tool for aortic diseases during pregnancy, given its acceptable safety profile [6].



Fig. 1 CTA imaging reveals aortic root dilation, with measured dimensions as follows: aortic annulus, 44 mm (a); Valsalva sinus, 55 mm (b); and sinotubular junction, 44 mm (c)

Dissections predominantly arise during the third trimester and the postpartum period. In the third trimester, cesarean section is typically preferred, while maternal safety and fetal prognosis are paramount in the second trimester. Fetal survival rates remain significantly low before 28 weeks of gestation [7]. At 21 weeks of gestation, as in this case, the risk of abnormal fetal development significantly increases, and the likelihood of fetal survival is even lower, with survival cases being exceedingly rare. Emergency surgical intervention is often considered the optimal approach for managing AD.

Surgical treatment of pregnant women with AD demands collaborations from a multidisciplinary team.

Given the physiological changes associated with pregnancy and the presence of the fetus, both maternal and fetal safety must be prioritized during the procedure. Prior to surgery, a multidisciplinary consultation should be conducted to collaboratively develop a comprehensive surgical and emergency plan, ensuring the procedure proceeded smoothly.

In total arch replacement with a prosthetic graft, precise anastomosis of the artificial and autologous blood vessels is critical to prevent intraoperative and postoperative bleeding. Given that AD typically involves multiple vascular branches, special attention must be given to preserving these vital vessels during the procedure,



Fig. 2 CTA post-surgery

particularly the abdominal vessels, to ensure postoperative maternal and fetal organ functions are unaffected. During surgery, with nasopharyngeal temperature at 23 °C and bladder temperature at 26 °C, the three branches of the aortic arch were occluded, blood circulation of the lower body was stopped, and low-flow selective cerebral perfusion was initiated via the right axillary artery at 10 mL·kg<sup>-1</sup>·min<sup>-1</sup>. The aortic arch dissection was then opened, thrombus removed, and the rupture assessed before inserting an artificial stent into the true lumen of the descending aorta. A four-branch artificial vessel was anastomosed to the descending aorta. After completing the anastomosis, blood perfusion was restored to the lower body via the collateral branch of vascular prosthesis. Subsequently, the left common carotid artery was anastomosed to restore cerebral circulation, and rewarming was initiated. Finally, the left subclavian artery and proximal ascending aorta were anastomosed in sequence, followed by anastomosis of the brachiocephalic trunk, with CPB duration of 156 min, cross-clamp time of 122 min, and circulation arrest time of 30 min. Intraoperative CPB-induced systemic inflammatory response [8] is associated with elevated maternal and fetal mortality risks by approximately 3% and 20%, respectively ([9, 10]. Hypothermia and subsequent rewarming are linked to reduced uterine and placental perfusion, often causing fetal bradycardia and intrauterine hypoxia ([9, 11]. Unlike other vascular beds, uterine blood flow lacks autoregulatory capacity, relying primarily on mean arterial pressure and vascular resistance. Additionally, hypothermic circulatory arrest (HCA) has been implicated in fetal brain atrophy and mortality [12, 13]. Despite these risks, HCA remains an unavoidable strategy in managing type A AD with aortic arch involvement. Consequently, during CPB at our center, mean arterial pressure was maintained at 70 mmHg to ensure adequate uterine and placental blood flow during hypothermia and rewarming, and the duration of circulatory arrest was minimized to safeguard fetal safety. Medications, in addition to surgery, can negatively influence surgical outcomes. Pregnant women are advised against the perioperative use of vasoconstrictors [14], as they elevate uterine contractions, potentially leading to fetal hypoxia. Warfarin is also well-documented for its teratogenic risks [15–16]. In this case, preservation of the aortic valve eliminated the need for warfarin, mitigating this risk. Despite treatment with  $\beta$ -blockers and calcium channel blockers, no adverse effects on fetal development were observed. Close fetal monitoring is generally recommended when the mother receives these medications to prevent potential complications. Postoperatively, the patient's vital signs and fetal condition require continuous monitoring. Continuous fetal heart rate, ultrasound, fetal movement, and uterine activity monitoring, along with careful selection of anesthetics, are essential to mitigate potential complications. In this case, close postoperative monitoring and management were implemented to ensure the recovery of both the patient and the fetus.

## Conclusion

Although AD during pregnancy is uncommon, clinicians must maintain a high index of suspicion for pregnant women presenting with severe chest pain. CTA is essential for diagnosing the condition and determining surgical options. After 28 weeks of pregnancy, cesarean section should be prioritized [17–18]. In the early second trimester, ensuring fetal safety involves appropriately increasing mean arterial pressure, minimizing circulatory arrest time, and closely monitoring the fetus post-surgery.

#### Abbreviations

- AD Aortic dissection
- CPB Cardiopulmonary bypass ICU Intensive care unit
- POD Postoperative day
- CTA CT angiography
- HCA Hypothermic circulatory arrest

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#### Author contributions

Conceptualization, ZQ.Z., JQ.L. and CL.L.; methodology, ZQ.Z., TM.S. and CL.L.; software, ZQ.Z. and P.Z.; formal analysis, ZQ.Z., P.Z.; investigation, JQ.L., TM.S.; resources, J.Q.L. and CL.L.; data curation, ZQ.Z., TM.S. and P.Z.; writing—original draft preparation, ZQ.Z., TM.S. and P.Z.; writing—review and editing, All authors; supervision, JQ.L. and CL.L.; project administration, CL.L.; funding acquisition, CL.All authors have read and agreed to the published version of the manuscript.

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#### Data availability

No datasets were generated or analysed during the current study.

# Declarations

# Informed consent

Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patient(s) to publish this paper.

#### **Competing interests**

The authors declare no competing interests.

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