

Monitorization of Fetal and Placental Perfusion During Surgical Management of Aortic Coarctation in a Pregnant Woman

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Introduction

Aortic coarctation (AC) is an unusual cause of hypertension in pregnancy. The disorder is often unrecognized by obstetricians (1). Coarctation is poorly tolerated during pregnancy and is associated with the risk of aortic rupture, aortic dissection, rupture of cerebral aneurysm, cardiac failure, bacterial endocarditis, and eclampsia (2).

We describe a case of surgically treated AC in a pregnant patient with monitorization of fetoplacental perfusion during the operation. This is the first reported case of our country for successful treatment of AC in a pregnant patient with peroperative fetoplacental perfusion monitorization was used.

Case Report

A 19-year-old woman was referred to our hospital due to hypertension, heart murmur, absent lower extremity pulses, diminished effort capacity, headache and epistaxis. She was in the 16th week of gestation. Her arterial blood pressure was 160 / 110 mm Hg. Physical examination demonstrated a loud ejection murmur at the left side of the chest and absence of lower extremity pulses.

Electrocardiogram showed left ventricular hypertrophy and strain. Echocardiography revealed bicuspid aortic valve, hypertrophy of left ventricular posterior wall and interventricular septum, and severe AC just distal to the left subclavian artery with 65 mm Hg systolic pressure gradient. Thoracic magnetic resonance angiography (MRA) confirmed severe coarctation and demonstrated the anatomy in detail. Cerebral MRA excluded cerebral aneurysm. Fetal echocardiography, ultrasonography and amniocentesis were done to determine the status of the fetus. No pathologic finding was observed related to the fetus.

Surgical treatment was recommended because of known fetal and maternal risks. Risks of the present condition and surgical procedure were explained to the family. The parent decided to continue gestation, informed consent was taken for surgery. Operation and fetoplacental monitorization were planned with obstetricians.

Technique

Patient was taken into operating room without premedication. Surgical procedure was performed under general anesthesia. Anaesthesia was induced with fentanyl 10 mcg/kg and propofol 2 mg/kg, a propofol and fentanyl perfusion were administered at a rate of 6 mg/kg/h and 10 mcg/kg/h respectively until the end of the operation. Vecuronium 0.1 mg/kg was given to facilitate orotracheal intubation with a cuffed tube. Throughout the operation vecuronium (0.01 mg/kg) administration was repeated according to the patient need.

Following left posterolateral thoracotomy incision aorta was prepared and patient was cooled down to 33°C by using topical saline. After aortic cross clamping, diseased segment of the aorta was resected and an 18 mm Dacron graft interposition was performed. Total aortic cross clamping time was 30 minutes.

During the operation, simultaneous radial and femoral artery blood pressures and nasopharyngeal temperature were monitored continuously. Nitroglycerin perfusion at a rate of 3 mg/h was administered to control hypertension. Gastric tonometer catheter (TRIP NGS catheter 2002-48-16, Tonometrics Division, Instrumentarium Corp., Helsinki, Finland) was used to monitor splanchnic perfusion. Submucosal pH of stomach was measured in every 20 minutes (3). Also placental and fetal perfusion was monitored with continuous Doppler ultrasonography (Toshi-

ba SSA 270A, 5 MHz, convex abdominal probe). For this purpose, fetal heart rate (FHR), maternal uterine artery pulsatility index (MUA-PI) to show resistance to perfusion of the placenta by maternal uterine arteries, umbilical artery pulsatility index (UA-PI) to show resistance to flow in the umbilical artery and fetal middle cerebral artery pulsatility index (MCA-PI) to show fetal cerebral perfusion were monitored. When the resistance of the vascular bed is low, PI rises. When hypoxia occurs in tissue, PI rises because of vasospasm. On the other hand, when the fetus is hypoxic the MCA-PI falls (perfusion increases) because of "brain sparing effect mechanism". When hypoxia is continuous and severe, the MCA-PI rises as brain edema develops.

Arm-leg pressure gradient disappeared after operation (Fig. 1). Fetal heart rate decreased to 80 / minute during hypothermic period (Fig. 2). Gastric tonometer catheter measurements demonstrated no critical ischemia in the submucosa of the stomach (pH < 7,35) during the procedure. UA-PI and MCA-PI (Fig. 3,4) were within normal ranges preoperatively and were not adversely affected from the operation (preoperative and postoperative values were 2.09

and 2.5 for UA-PI, 1.53 and 1.5 for MCA-PI, respectively; normal ranges for this gestation week for UA-PI and MCA-PI are 1-2 and 1.08-2.33, respectively). Whereas preoperative MUA-PI was lower for this gestation week (1.05 normal range for this gestation week is 1.5-2.6) it was relatively nonpulsatile due to collateral circulation. It increased to the normal range (2.18) and became more pulsatile after the operation (Fig. 5).

Her postoperative course was uneventful and serial fetal ultrasounds confirmed fetal health. Postoperatively the patient was initially treated with propranolol, which was subsequently discontinued. The remaining period of her pregnancy course was uncomplicated and she underwent a cesarian section delivery at 39 weeks gestation. A 3.5 kg healthy female infant was delivered with 10/10 Apgar score.

Discussion

Aortic coarctation is a rare disorder accounting for approximately 2 % of congenital heart diseases. Although 80 % of cases are diagnosed in infancy or childho-

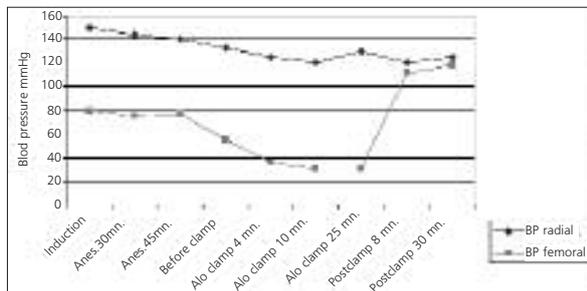


Figure 1. Right radial and femoral artery mean blood pressures during the operation. (Ao: Aorta; Anes: Anesthesia)

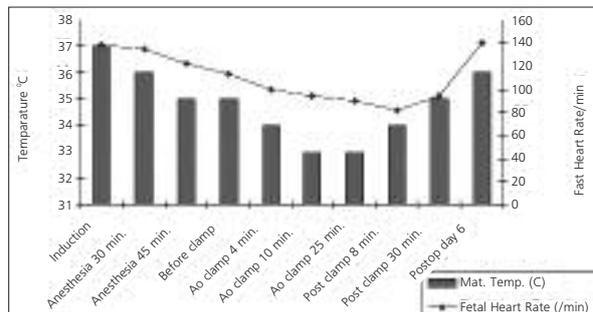


Figure 2. Course of fetal heart rate and maternal temperatures. (Ao: Aorta; postop: postoperative)

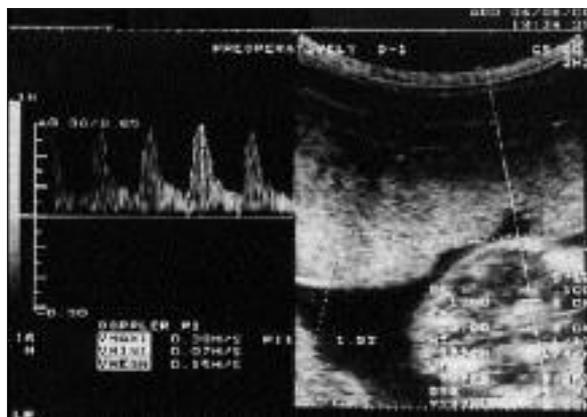


Figure 3. Doppler ultrasonographic image of preoperative MCA-PI.

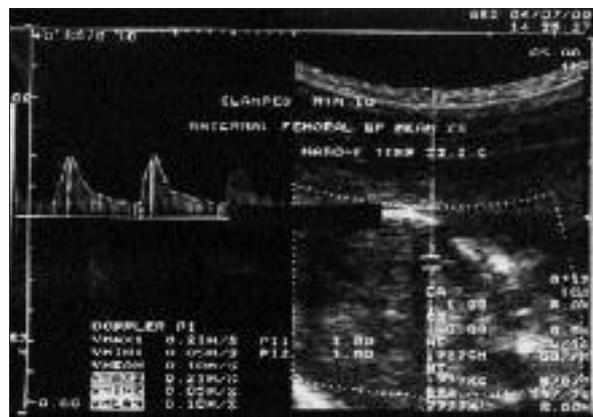


Figure 4. Doppler ultrasonographic image of MCA-PI during 10 minutes of aortic clamping.

od, occasionally disorder may first present in adulthood, and rarely in a hypertensive pregnant woman (1).

There are limited data regarding the outcome of pregnancy with AC. Recent review of the literature has shown that the maternal mortality is 9.5 % for patients whose pregnancy were complicated by coarctation (4). Cardiovascular alterations due to pregnancy may cause deterioration in patients with unrepaired congenital heart disease (5).

Surgery has greatly improved the prognosis for patients with AC, but in the past decade balloon angioplasty has become available as an alternative treatment. Lip et al (1) performed balloon angioplasty successfully during pregnancy in two cases with aortic coarctation. They showed that this technique could be chosen for selected patients. Balloon angioplasty of native coarctation is a new technique; and there is not enough experience in these patients (4).

Some authors suggest that pregnant patients with coarctation of the aorta should have surgical correction preferably in the first or second trimesters (6). Our patient was in the second trimester when she was referred to the clinic.

Some patients have resistant hypertension in spite of successful correction of coarctation, but in our case hypertension was well controlled after correction.

Many authors prefer surgical treatment especially for the patients whose pregnancies were complicated by coarctation (5-7). We suggest that possible risk for fetal loss or malperfusion of fetoplacental circulation during operation could be the major determinants in management of aortic coarctation. To prevent this risk, mild hypothermia and maintaining adequate level of perfusion pressure are mandatory (8, 9).

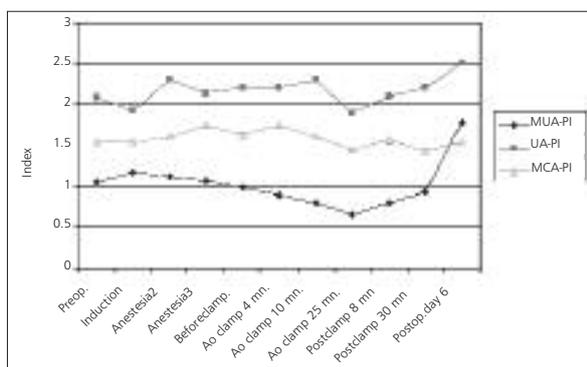


Figure 5: Course of MUA-PI, UA-PI and MCA-PI during the procedure.
(Ao: Aorta; Postop: Postoperative; MUA-PI: maternal uterine artery pulsatility index; UA-PI: umbilical artery pulsatility index; MCA-PI: middle cerebral artery pulsatility index)

Systemic hypothermia is protective against fetal hypoxia by reducing fetal oxygen demand (8) and perfusion pressure which is maintained at 60 mm Hg ensuring thus adequate blood flow to the placenta (9). In our case, arterial blood pressure was as low as 35 mm Hg during cross clamping. But no abnormality was detected in fetoplacental perfusion. We suggest that, if any abnormality of the fetoplacental perfusion exists, a shunt circuit between proximal and distal aorta may be established as some authors have described (5).

In conclusion, we demonstrated that a severe AC in a pregnant woman can be treated within pregnancy period without compromising the fetal circulation. Fetal and placental monitorization during and after the operation which requires team work of cardiac surgeons, anesthesiologist, obstetricians and cardiologist enabled surgeon to make therapeutic intervention securely and successfully.

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