Original Article

Outcome of Anesthesia and Open Heart Surgery in Pregnant Patients

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Abstract

Background: Cardiovascular disease is an important non-obstetric cause of maternal and fetal /neonatal morbidity and mortality during pregnancy. For a pregnant woman with cardiac disease, the potential inability of the maternal cardiovascular system to contend with normal pregnancy-induced physiologic changes may produce deleterious effects on both mother and fetus. To determine the most frequent surgical indications of maternal and fetal mortality, we studied 15 cases of severe cardiac disease in pregnant women who required cardiac surgical procedures.

Methods: In this descriptive study, fifteen pregnant women who underwent cardiac surgery were studied. Maternal age ranged from 27 to 36 years, and gestational age varied from 4 to 22 weeks. Most of the patients were in New York Heart Association Classes II and III. Opioid- based anesthesia with fentanyl citrate (50µ/kg) or sufentanil (5µ/kg) plus low dose of thiopental were used for the induction of anesthesia. During non-pulsatile cardio-pulmonary bypass, core temperature was between 28-36 °C, average CBP time was 61.2±22 min, average aortic cross-clamp time was 34.13±14 min, and mean pump pressure was maintained between 65-80 mmHg.

Results: Ten patients had severe mitral valve disease (66.6%), three had aortic valve disease (20%), one had subvalvular aortic stenosis (6.7%), and the remaining one had left atrial myxoma (6.7%). There were five fetal deaths (33.3%) and one maternal death (6.7%).

Conclusion: It seems that open heart surgery in the first trimester is very hazardous for the fetus and may lead to fetal death. If possible, surgery should be carried out in the second trimester of pregnancy. The recommendations are simply guidelines because research data and clinical experience in this area are limited.

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Introduction

The presence of significant cardiac disease has been one of the great contraindications to pregnancy. For the pregnant woman with cardiac disease, whether or not previously diagnosed, the potential inability of the maternal cardiovascular system to contend with normal pregnancy-induced physiologic changes may produce harmful effects on both mother and fetus. Maternal functional status may deteriorate during pregnancy, as evidenced by the fact that 44% of women with cardiac disease first develop pulmonary edema (or class IV status) in the third trimester of pregnancy.[1] Open heart surgery during pregnancy is usually well-tolerated by the mother, but the fetal outcome is variable.[2-4]

The first reported case of cardiac surgery during pregnancy was performed in 1956 and published in 1957. Pulmonary commissurotomy without cardio-pulmonary bypass (CPB) was performed in a pregnant woman (at 3 months of gestation), who then delivered a normal baby at term.[5]

Pregnant patients who require cardiac surgery and CPB present conflicting issues for perioperative management, and creative compromise is required to meet the best interests of mother and fetus. In some studies, high-pressure- high-flow CPB is recommended for pregnant cardiac surgical candidates;[6] and successful fetal outcome has been reported using mean pump pressures above 60 mmHg and flows above 2.0 L/min/ m².

There is no evidence for preferring any particular anesthetic strategy or drug regimen for surgery during pregnancy, and nor is there adequate information on anesthetic management in the case reports and series that comprise the clinical literature on cardiac surgery during pregnancy. The choice of anesthetic technique and drug should be based mostly on the usual criteria of patient pathophysiology and hemodynamics and surgical plan.[7]

For appropriate management, the well-being of both mother and fetus must be considered. The best interests of mother and fetus may not coincide, and optimal therapy for one may be inappropriate for the other.

To determine the most frequent surgical indications of maternal and fetal mortality, we studied 15 cases of severe cardiac disease in pregnant women who required surgical intervention.

Methods

In this descriptive study, fifteen pregnant women who underwent cardiac surgery in Shahid Rajaei Cardiovascular Center between September 2003 and March 2005 were studied. Maternal age ranged from 27 to 36 years, and gestational age varied from 4 to 22 weeks. Most of the patients were in New York Heart Association Classes II and III. The most frequent pathology was valve disease. Mitral valve disease was the most prevalent; the other cases being aortic valve disease and myxoma.

After gynecological consultations, the patients' invasive arterial blood pressure, central venous pressure, and O_2 saturation were monitored via intra-arterial cannula, central venous cannula, and pulsoximetry. In patients with gestational age above 16 weeks,[8] fetal heart rate (FHR) monitoring was performed externally by surface ultrasound. Urine output was recorded. Because there is little scientific or clinical evidence for selecting one agent over another; and on the other hand, all opioids appear to be safe for use in anesthesia and postoperative analgesia during pregnancy,[7] we used opioid-based anesthesia. Fentanyl citrate (50μ/kg) or sufentanil (5μ/kg) plus low dose of thiopental were used for the induction of anesthesia, according to the patients' condition. Muscle relaxation for tracheal intubation was achieved with cisatracurium (0.15 mg/kg), and additional muscle relaxant was given during surgery. A continuous infusion of fentanyl and midazolam was used for maintenance of anesthesia.

For the prevention of coagulation during CPB, heparin (3-4 mg/kg) was used and ACT (activated clotting time) was maintained higher than 480 seconds. During non-pulsatile CPB, core temperature was between 28-36 °C, average CBP time was 61.2±22 min, average aortic cross-clamp time was 34.13±14 min, and mean pump pressure was maintained between 65-80 mmHg. Periods of hypertension and hypotension were treated with an infusion of nitroglycerin and administration of ephedrine, respectively. During CPB, the arterial blood gas and electrolytes were measured every 30 minutes and hematocrit concentrations were maintained between 25 to 30%.

Loss of fetus beat to beat variability and bradycardia responded to an increase in the pump flow, temperature, and mean arterial pressure. The patients were transported to the Intensive Care Unit (ICU) and assessed for tracheal extubation 6-12 h after operation.

Except one of the patients with a history of the central nervous system (CNS) embolic event 7 days before surgery, the postoperative recovery was uneventful and all the cases were discharged on the 6-12th postoperative day. Postoperative bleeding developed in only one patient, which led to reoperation.

Results

As it can be seen in figure 1, ten patients had severe mitral valve disease (66.6%), three had aortic valve disease (20%), one had subvalvular aortic stenosis (6.7%), and the remaining one had left atrial myxoma (6.7%).
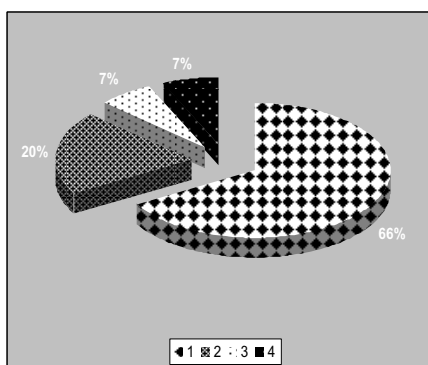
Figure 1. Pathologic conditions leading to cardiac surgery (1. mitral valve disease, 2. aortic valve disease, 3. subvalvular aortic stenosis, 4. left atrial myxoma)

Indications for surgical treatment were related to cardiac complications associated with increased demands that pregnancy placed on the heart, life-threatening condition, and need to prevent further CNS embolic injury associated with the malfunction of valves.

After ICU arrival, fetal heart rate monitoring and consultation with a gynecologist were provided again. Postoperative premature labor developed in one patient at 32 weeks of gestation, and the baby died after delivery. In one patient, stillbirth occurred at 26 weeks of gestation. At 9 to 12 weeks of gestational age, three patients had abortion at 7 to 30 days after operation. The other children did not have growth problems. In one patient who had a prosthetic mitral valve, CNS emboli occurred seven days before surgery; and several days after mitral valve debridment, the patient and her fetus died at 5 weeks of gestation.

Data for patients with maternal or fetal death are summarized in Table 1.

There were one maternal death (6.7%) and five fetal deaths (33.3%). It seems that the open heart surgery in the first trimester is very hazardous for the fetus and may lead to fetal death.

Discussion

Cardiac surgery during pregnancy has many potential side effects for mother and fetus. If such surgery is required, it is best undertaken in the second trimester of pregnancy. Usual indications are severe mitral or aortic valve diseases. Most studies of open heart surgery during pregnancy are in the form of case reports.[9-11]

In a multi-central review of CPB during cardiac operations, Zitnic et al. found maternal mortality and associated fetal mortality to be 5% and 33%, respectively.[12] Another multi-centric study from Sao Paulo documented a fetal mortality of 33% and a maternal mortality of 15% among 30 patients with rheumatic heart disease operated on during pregnancy in the time period between 1981 and 1992.[13]

In the present study, there were one maternal death (6.5%) and five fetal deaths (33%).

There is no choice anesthetic technique or drug for the management of anesthesia during pregnancy. It was previously suggested that the use of benzodiazepines during the first trimester was associated with an increased incidence of cleft palate, but this association has recently been questioned.[7]

Heart surgery with CPB involves certain pathophysiologic effects, such as hypothermia, hemodilution, inhibition of coagulation, hemolysis, complement activation, and non-pulsatile flow, as well as acid-base changes that affect the uteroplacental circulation and fetus. Nevertheless, multiple reports have demonstrated the relative safety of performing heart surgery with CPB during pregnancy.[14]

Because of the pregnancy-induced increase in cardiac output and oxygen consumption, however, alterations of routine CPB may be necessary to provide adequate perfusion and oxygenation to both mother and fetus. Non-pulsatile flow, hypotension, and hypothermia can adversely affect the outcome by altering the uteroplacental perfusion.[15] In our study, core temperature was between 28-36℃, average CBP time was 61.2±22 min, average aortic cross-clamp time was

Table 1. Characters of patients with Maternal or Fetal Death

maternal age (year)	GA (week)	surgical procedure	CPB time (minute)	lowest temperature	outcome
36	9	MVR	105	30	Abortion
23	10	Debridment of Aortic valve	45	36	Abortion
25	12	Debridment of Mitral valve	66	30	Abortion
23	22	MVR	62	36	Stillborn
27*	5	Debridment of Mitral valve	112	30	Maternal Death
40**	32	AVR	55	34	Prematurity and RDS

*This patient had CNS embolic accident 7 days before surgery

**The baby died after delivery

GA, Gestational Age; CPB, Cardio-Pulmonary Bypass; MVR, Mitral Valve Replacement; AVR, Aortic Valve Replacement; RDS, Respiratory Distress Syndrome

34.13±14 min, and mean pump pressure was maintained between 65-80 mmHg. Because ephedrine is a choice for treatment of hypotension during pregnancy,[7] we used it as a first-line drug for the treatment of hypotension.

Some investigators have found a direct correlation between pump flow and FHR pattern, suggesting that high flow with high maternal mean arterial pressure might improve placental flow and oxygen delivery to the fetus.[16,17] Maternal alkalosis during CPB can Shift the maternal oxygen-hemoglobin dissociation curve to the left, resulting in reduced fetal partial arterial oxygen pressure and oxygen content.

Many authors[18] suggest that the late second trimester or early third trimester (before the 30th week of gestation) is optimal. This timing avoids fetal drug exposure during organogenesis and allows surgery to be performed before the increased cardiovascular demands that occur later in the third trimester.

Open heart surgery during pregnancy is best avoided. If surgery is imminent and pregnancy is known, however, a short duration normothermic high-flow and if possible pulsatile CPB with expeditious surgery is recommended.

We believe that open heart surgery in the first trimester is very hazardous for the fetus and may lead to fetal death; if possible, surgery should be carried out in the second trimester of pregnancy. The recommendations are simply guidelines because research data and clinical experience in this area are limited.

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