

# Open Heart Surgery in Pregnant Women

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## Abstract

**Introduction**-Cardiopathy still remains a prominent cause of maternal and fetal morbidity and mortality. Pregnancy increases cardiovascular stress and can cause an asymptomatic woman with heart disease to become symptomatic. Definite data in heart surgery with extracorporeal circulation during pregnancy are limited. This report analyzes our experience in this area.

**Methods**-Thirteen women who underwent open-heart surgery during pregnancy at our center in Tehran from 1985 to 2002 were studied. The patients were in New York Heart Association functional class III to IV and were operated upon urgently.

**Results**-The mean age of the women at the time of surgery was  $25.3 \pm 5.41$  years (range: 17-36 years). Their gestational age was 4-32 weeks. Surgical procedures performed were mitral valve replacement for mitral stenosis in 4(30.76%) patients, declotting or redo valve replacement for prosthetic valve malfunction in 7 (53.83%), excision of subvalvular aortic stenosis in 1 (7.69%) and resection of atrial myxoma in 1 (7.69%) patient. Surgery was performed at normothermic cardiopulmonary bypass in 8 patients and mild hypothermia in 5 patients. There was one maternal death and as a result, fetal loss. Fetal deaths occurred in 5 of the 12 pregnancies (41.6%) in the women who survived the surgical procedure.

**Conclusion**-Cardiopulmonary bypass during pregnancy carries a high risk of fetal morbidity and mortality and should be advised only in extreme emergencies. If possible, surgery should be carried out in the second trimester of pregnancy (*Iranian Heart Journal 2004; 5(4): 34-39*).

**Key words:** pregnancy ■ cardiopulmonary bypass ■ heart surgery

One to four percent of all pregnant women suffer from some kind of cardiac pathology.

Although this incidence varies in different countries, most specialists agree that heart disease is the leading cause of death in pregnancy.<sup>1</sup> Medical therapy is not always sufficient to drive a heart with reduced functional reserve or acute complications, such as the thrombosis of a valvular prosthesis or endocarditis, which can seriously compromise the heart functions

of the pregnant woman.

Four decades ago, the regular advice to a woman with heart disease was to avoid pregnancy, but with improved cardiac care, including cardiac surgery, it is not unusual for these women to have a normal pregnancy and to deliver a healthy baby.<sup>1,2</sup>

In such cases, an open-heart operation may be necessary to save the patient's life. Cardiopulmonary bypass (CPB) during pregnancy was first performed in 1959.

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The mother survived, but the fetus was spontaneously aborted 3 months later.<sup>3,4</sup> Open-heart surgery during pregnancy has many potential side effects for the mother and the fetus. Most studies of open-heart surgery during pregnancy are in the form of case reports.<sup>2, 5-9</sup>

In this study, we evaluated the fetomaternal outcomes of 13 pregnant women who required open-heart surgery during pregnancy and also discussed the pertinent aspects of cardiopulmonary bypass that can influence the outcome of pregnancy.

### Material and Methods

#### *Patients*

Thirteen women requiring open-heart surgery during their pregnancy period between 1985 and 2002 were studied. All the patients were in functional class III to IV, preoperatively. Their gestational age was 4-32 weeks at the time of surgical intervention. Required information was taken from medical charts or by telephone calls. All of the operations were performed urgently.

#### *Open-heart surgery*

Surgery was performed at normothermic cardiopulmonary bypass or mild hypothermia. Cardiopulmonary bypass time was 37 to 112 minutes with aortic cross clamp time of 9 to 68 minutes. During surgery under general anesthesia, thiopental, diazepam or midazolam were used for induction, pancuronium or atracurium for muscle relaxation and fentanyl or sufentanyl for analgesia.

#### *Statistical Analysis*

All the above-mentioned data were filled in data sheets and analyzed with SPSS for Windows ver. 11.5.

### Results

#### *Patients*

The mean age of the women at the time of surgery was  $25.3 \pm 5.41$  years (range: 17-36 years). Three (23.1%) women were in their first pregnancy, but the others (76.9%) had two to five pregnancies. The indications for surgery were declotting or redo valve replacement for prosthetic valve malfunction in 7 (53.83%) patients, mitral valve replacement for mitral stenosis in 4 (30.76%), excision of subvalvular aortic stenosis in 1 (7.69%) and resection of atrial myxoma in 1 (7.69%) patient.

Seven (53.83%) patients had severe acute dysfunction of either a mechanical or biological mitral prosthesis.

The cause of prosthetic heart valve malfunction was discontinuation of oral anticoagulant in 2 patients, inadequate intravenous anticoagulant therapy in 3 patients and degeneration of bioprosthetic valve in one patient. Surgery was performed at normothermic cardiopulmonary bypass in 8 patients or mild hypothermia in 5 patients. Mean cardiopulmonary bypass time was  $64.66 \pm 23.2$  min with aortic cross clamp time of 9 to 68 minutes (mean  $32.66 \pm 15.13$ ).

There were 5 abortions, 6 normal vaginal deliveries and one cesarean section. The birth weights of the neonates were 2900 to 4000 gr (mean  $3228.5 \pm 394.6$  gr). There were no congenital deformities. There was only one maternal death due to heart failure in the ICU, which resulted in fetal loss.

Fetal deaths occurred in 5 (41.6%) of the 12 pregnancies in women who survived the surgical procedure.

The characteristics of the patients and fetal outcomes are shown in Table I.

**Table I: The characteristics of the patients and fetal outcomes after open-heart surgery**

| Case | Age (y) | Gestational age (week) | Diagnosis             | Surgical procedure       | C.P.B. Time | Lowest Temp@ | Delivery type    | Outcome          |
|------|---------|------------------------|-----------------------|--------------------------|-------------|--------------|------------------|------------------|
| 1    | 18      | 16                     | M.V.M <sup>1</sup>    | D.M.V <sup>2</sup>       | 80          | 28           | C/S <sup>3</sup> | N.B <sup>4</sup> |
| 2    | 22      | 4                      | M.S <sup>5</sup>      | M.V.R <sup>6</sup>       | 55          | 29           | N.D              | N.B              |
| 3    | 36      | 9                      | M.V.M                 | M.V.R                    | 105         | 30           | Ab. <sup>7</sup> | -                |
| 4    | 26      | 12                     | M.S                   | M.V.R                    | 47          | 32           | N.D              | N.B              |
| 5    | 26      | 12                     | M.V.M                 | M.V.R                    | 33          | 28           | N.D              | N.B              |
| 6    | 26      | 10                     | M.S                   | M.V.R                    | --          | --           | Ab.              | -                |
| 7    | 17      | 6                      | A.S <sup>8</sup>      | Subaortic resection      | 37          | 35           | N.D.             | N.B.             |
| 8    | 29      | 16                     | A.M <sup>9</sup>      | removal myxoma           | 25          | 35           | N.D              | N.B              |
| 9    | 23      | 8                      | A.V.M                 | aortic valve debridement | 27          | 36           | Ab.              | -                |
| 10   | 25      | 12                     | M.V.M                 | D.M.V                    | 50          | 31           | Ab.              | -                |
| 11   | 23      | 20                     | D.B.M.V <sup>10</sup> | M.V.R                    | 62          | 36           | Ab.              | -                |
| 12   | 27      | 5                      | M.V.M                 | D.O.M.V                  | 112         | 30           | --               | maternal death   |
| 13   | 34      | 20                     | M.S                   | M.V.R                    | 52          | 35           | N.D              | N.B              |

- 1- Mitral Valve Malfunction
- 2- Debridement of Mitral Valve
- 3- Cesarean Section
- 4- Normal Baby
- 5- Mitral Stenosis
- 6- Mitral Valve Replacement
- 7- Abortion
- 8- Aortic Stenosis
- 9- Atrial myxoma
- 10- Degeneration of bioprosthetic mitral valve

### Discussion

Pregnancy produces numerous physiological adaptive changes that create a greater demand on the cardiovascular system compared to the non-pregnant state.<sup>10</sup> It is estimated that 1–3 percent of pregnant women undergo a surgical procedure unrelated to their pregnancy.<sup>11</sup> Cardiovascular disease is one of the important non-obstetric causes of maternal and fetal morbidity and mortality during pregnancy.<sup>5,6,12</sup> The indications of surgery in pregnant women of our study was declotting or redo valve replacement for prosthetic valve malfunction in one half of the cases, mitral valve replacement for mitral stenosis, excision of subvalvular aortic stenosis and resection of atrial myxoma. In similar studies, the usual indications are severe mitral or aortic stenosis or regurgitation and also for management of aortic dissection during pregnancy.<sup>5</sup> In the present study, gestational age was 4-32 weeks at the time of surgical intervention. The most fetal deaths occurred during the first trimester, and the

safest trimester for fetus during cardiopulmonary bypass was the second trimester. The gestational age at the time of surgery has been sought in order to determine the influence on fetal development, morbidity and mortality. Although there is no proven relationship between the gestational age of the fetus and mortality, several reports point to the more common occurrence of congenital malformations when cardiopulmonary bypass is performed during the first trimester.<sup>4,13</sup> Surgical interventions should be avoided when possible during this time.<sup>9,13</sup> But in one report a patient underwent successful open-heart surgery in the first trimester of pregnancy and gave birth to a normal live fetus without any congenital malformations.<sup>8</sup> Cardiopulmonary bypass during the first half of the second trimester has been associated with less complications. Fetal development is completed, and the chances of fetal malformations are reduced. Also uterine excitability seems to be at its lowest levels during the second trimester of pregnancy. There are now many reports of fetal survival to term after operations

performed in the second or third trimesters.<sup>14,15</sup> Operations with the use of CPB performed during the third trimester have been associated with a high incidence of premature labor. At this stage, the maternal hemodynamic overload is also of a greater magnitude.<sup>9,16,17</sup> It is recommended that if such surgery is required, it is best undertaken in the second trimester of pregnancy.<sup>5</sup>

In the present study, there was only one (7.7%) maternal death due to heart failure in ICU and as a result, fetal loss. Open-heart surgery during pregnancy is usually well tolerated by the mother, but the fetal outcome is variable.<sup>5,6,13</sup> In different studies, the maternal mortality has ranged between 1.5-5%.<sup>2,5,9</sup> A single-center study of 30 cases documented a maternal mortality of 13% and a fetal mortality of 33% among patients with rheumatic valvular heart disease, operated upon during pregnancy in the period of 1981-1992.<sup>18</sup> In another systemic review of outcome of 161 patients undergoing cardiac surgery during pregnancy between 1984 and 1996, the maternal morbidity and mortality were 24% and 6%, respectively.<sup>13</sup>

One half of our pregnant women had vaginal delivery. One woman underwent cesarean section. With regard to recent progress in premature infant care, few authors prefer cesarean section after heparinization and cannulation of the mother, but before commencing CPB with gestational age over 28 weeks.<sup>5,19</sup>

Mothers who get hemodynamic problems after heart operations and CPB can survive by emergent cesarean section.<sup>17</sup> In animal studies, certain anesthetic agents are known to have untoward effects on the completion of pregnancy; however, investigators have been unable to correlate human maternal or fetal mortality with any one surgical or anesthetic technique. Instead, it is believed that outcome reflects the severity of the underlying maternal

disease state.<sup>7,20,21</sup> It appears that most anesthetic agents, intravenous and inhalatory and paralyzing drugs are devoid of teratogenic effects and can be safely employed in a pregnant patient.<sup>22</sup>

In our series, fetal deaths occurred in 41.6% of pregnancies which survived the surgical procedure. In review of literature, the fetal mortality has been reported between 16-35 percent.<sup>2,5,9</sup>

In another study of 161 patients undergoing cardiac surgery during pregnancy, the fetal morbidity and mortality was reported to be between 9% and 30%.<sup>13</sup> Cardiopulmonary bypass involves several factors that can compromise the delicate biological equilibrium between the fetus and the placenta.<sup>7</sup> The effects of cardiopulmonary bypass on the fetoplacental unit are multiple and complex.<sup>14,23</sup> Potentially detrimental effects of CPB include coagulation changes, functional changes of blood cells and proteins, liberation of vasoactive substances from leukocytes, complement activation, air and particulate microembolism, linear nonpulsatile flow, hypothermia and hypotension.<sup>14,23</sup> Hypothermia can produce acid-base changes, uterine contractions and arrhythmias. Uterine contractions occur frequently during cardiopulmonary bypass and are considered to be the most important predictors of fetal death.<sup>10,24</sup> It produces insufficient perfusion of the placenta and determines the development of fetal hypoxia.<sup>13</sup> The most common fetal reaction to cardiopulmonary bypass is bradycardia.<sup>25,26</sup> Frequently during CPB the fetal heart rate decreases to 100-115 bpm, but occasionally this drop may be accentuated and heart rates of 70-80 bpm are encountered. This level of bradycardia represents a considerable degree of fetal distress. Fetal bradycardia has consistently been related to hemodynamic changes and reduced efficiency of gas exchange at the placental interface.<sup>2,9</sup> A short duration of

normothermic CPB with high flow rates and avoidance of vasoconstrictors and anesthetic drugs that cause uterine irritability may undoubtedly provide an optimal outcome. Contentious cardiocographic monitoring is a useful tool to assess the condition of the fetus when pregnancy is near term and delivery is anticipated.<sup>5</sup>

As a result, cardiopulmonary bypass during pregnancy must be conducted according to the specific physiology of pregnancy; the circulatory and respiratory functions of the placenta to maintain fetal life should be the main focus in order to decrease the detrimental effects of CPB on the fetoplacental unit.

### Conclusion

Because of high fetal risk, open cardiac surgery is recommend only in emergent or urgent situations during pregnancy. If possible the surgery should be carried out in the second trimester of pregnancy.

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