Chapter 5

OVERVIEW AND CURRENT SURGICAL APPROACHES FOR ATRIAL SEPTAL DEFECT

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Introduction

The first successful surgical atrial septal defect (ASD) closure was performed using a pump oxygenator by John Gibbon on May 6, 1953. Initially, ASD used to be close by performing a highly risky technique in which the defect is sewn with sutures placed from the outside of hearth under deep hypothermic circulatory arrest. As the surgical experience increases, the surgical closure of ASD has been performed successfully (1).

Incidence and Etiology

ASD is the third most common congenital heart disease. It is encountered in 56 of 100000 live births (2). 30% out of adult congenital heart defects is ASD (3). The most common type is ostium secundum septal defect and it is seen the rate of 65-70%. Many ASDs are sporadic and the cause of it is not certain. Autosomal dominant inheritance has been reported in familial type (4,5). The mutation in the 14q12 gene, which plays a major role in cardiac septation, is considered to be responsible for the pathogenesis (6). The mutation in NKX2-5 gene is also the responsible factor for the pathogenesis of ASD with atrioventricular block (7,8,9). Besides, the risk of ASD is higher in the family group, particularly in the twins (10). There is a relationship between ASD and genetic disorders such as the syndromes of Holt-Oram, Ellis van Creveld, Noonan, Down, Budd-Chiari and Jarcho-Levine (11-18). Holt-Oram syndrome in which there is a NKX2-5 mutation presents in 66% out of ASD patients. ASD is also encountered in patients with trisomy 21 syndrome (19). In pregnancy, various factors such as the exposure of some chemical substances, fetal alcohol syndrome (20), the smoking in the first trimester (21,22) and the usage of some antidepressant drugs (23-25) increase the risk of ASD. Furthermore, it is reported that there is an increased ASD risk in women without diabetes who eat foods with high glycemic index (26,27) and in women with pregnancy over the age of 35 (28,29).

Embryologic and Anatomic Features

The atrial septum originates from the fossa ovalis which consists of two anatomical structures as the part of muscular and valvular. The muscular part of fossa ovalis

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ASD closure with the help of 3D printing technology

When the echocardiography and computed tomography which are conventional imaging methods are inadequate in some conditions, 3D printing technology may be useful in the preoperative evaluation (97). In this method, the heart rate of patients being in the procedure is decreased by beta blocker and the images of patients are obtained by multi-slice computed tomography. The simulation of cardiac structures and ASD is achieved by 3D printer and 3D model is printed. This method is feasible in both surgical and transcatheter closure for ASD.

ASD Closure Surgery in the Pregnancy

In generally pregnancy, during cardiac surgery with cardiopulmonary bypass, while there is no an increase in maternal mortality rate, fetus death due to hypotension and non-pulsatile blood flow is 10-15% (98,99).

The pulmonary and systemic vascular resistances of patient with pregnancy and ASD decrease in the first trimester (100). In patient with pregnancy and ASD, although the pregnancy is well tolerated, there is a high risk of mortality, especially one month after giving birth, in pregnant patients with pulmonary hypertension (101). There are different treatment opinions in this patient group. The percutaneous ASD closure has been applied in the past, however, this procedure is not appropriate method in ASD with large defect (102). The second option is the therapeutic termination of pregnancy which is not accepted by most of patients, and then the surgical closure for ASD. The other option is that the pulmonary hypertension is kept under control by medical approaches until the birth and then the surgical closure for ASD is performed.

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