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**Endovascular conduit fenestration closure after extracardiac total cava-pulmonary anastomosis operation**

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This article represents the experienceofpercutaneous closure ofextracardiac conduit fenestrationin 6 patients after Fontan operation and detailed analysis of hemodynamic changes after the procedure.

**Keywords:** Fontan operation, fenestration, early postoperational period, endovascular surgery.

Fontan operation is the final stage of surgical treatment in patients with single ventricle heart. Hemodynamic changes after surgery may have a negative impact on the immediate result in the case of high blood pressure in the pulmonary artery. There are different causes for pulmonary artery hypertension: oedema, spasm or increased vascular resistance of pulmonary capillary bed, which leadsto complications in early postoperative period. That is why creation of temporary communication between the two circles of blood circulation during the Fontan operation in high risk patients considered being a standard practice in many cardiac centers. Created fenestration reduces morbidity in early postoperative period but leads to decreasedlevelof arterial blood oxygen saturation. The first Fontan operation with fenestration was described in 1990. The main purpose of fenestration is to createright to left shunting of blood at the atrial level to increasepreload of the systemic ventricle and cardiac output. Furthermore thepresence of communication between conduit and atrium provides a regulatory function during central venous pressure rising, which occurs quite frequently in early postoperative period.

Numerous studies shows the advantages of fenestrated conduit during Fontan operation in high risk patients, such as reductionof pleural effusion incidence, a shortening of ICU and hospital stay and other [Lemler M.S. 2002, Mendoza A. 2012, Masura J. 2008]. However creating conduit fenestrations in patients with optimal indications for Fontan operation remains disputable to this day. Closure of fenestration after achievementof optimal hemodynamic parameters also remains a subject for scientific debates.

The development ofinterventional cardiology over the last decade and the invention of percutaneous transcatheterdevicesimplantation allows to close fenestration by minimally invasive method, without the need foropen surgery.

This article introduces personal experience in endovascular extracardiac conduit fenestration closure after Fontan operation in 6 patients.

Unfavorable preoperative factors inearly postoperative period after Fontan operation and also indications for the fenestration were: mean pulmonary artery pressure greater than 15 mm Hg, the presence of regurgitation in the atrioventricular valves, absence of sinus rhythm, the presence of pacemaker, Wood index more than 2 units / m2, systemic ventricle end diastolic pressure above 12 mm Hg.

All patients who undergone Fontan operation with creating fenestration after 6 - 12 months were referred to cardiac catheterization witballoon temporary closure test. Evaluation and research carried out in catheterization laboratory with intravenous anesthesia. During catheterization pressure measured in the superior vena cava (SVC), inferior vena cava (IVC) in conduit, pulmonary artery branches, atria, systolic, diastolic and end diastolic ventricular pressure and aortapressure. Calculated the ratio of systemic and pulmonary blood flow, pulmonary vascular resistance.

Nowadays there are no clear indications for fenestrationclosure in the conduit after Fontan except for desaturation of arterial blood, the risk of systemic embolism, reduced exercise tolerance due to hypoxia, high level of hemoglobin. Absence of negative hemodynamic changes during the test with balloon occlusion for 10 minutes was additional factor in favor of fenestration closure.

Fenestration closure was contraindicated if the next changes were presentduring the balloon occlusion test:

1. Increaseof pressurein Fontan anastomosesover 3-5 mm Hg.

2. Increase of arterio-venous difference of oxygen saturationlevel over 10%.

3. Reduce of systolic arterial pressure more than on 10%.

In the absence of contraindications we performed percutaneous closure of the fenestration with occluder for atrial septal defects closing. Postoperatively aspirin at a dose of 5 mg / kg once per day was administered.

**Table 1. Hemodynamic changes after the fenestrationclosure**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| № | Time from Fontan to fenestration closure (months) | Sa O2before the closing  (%) | Sa O2 after the close  (%) | CVP before the closing  (мм.рт.ст.) | CVPafter the close  (мм.рт.ст.) | Qp/Qs before closing | Hb  (G/l) |
| 1 | 0,2 | 78 | 91 | 13 | 13 | 0,82 | 174 |
| 2 | 34 | 93 | 97 | 11 | 12 | 0,87 | 189 |
| 3 | 22 | 93 | 98 | 11 | 13 | 0,9 | 178 |
| 4 | 24 | 92 | 98 | 9 | 11 | 0,8 | 210 |
| 5 | 23 | 92 | 100 | 10 | 10 | 0,79 | 192 |
| 6 | 96 | 90 | 95 | 15 | 15 | 0,82 | 188 |

One patient underwent fenestration closure on a day4after surgery due to severe hypoxemiawhich interfere the spontaneous breathing.

Immediateintervention result was successful in all cases; there was an increase of oxygen saturation in arterial blood. During the first days after proceduresaturation of arterial blood did slightly reached 97 - 100% with total occlusion of the shunt on the level of the implanted device.

**Conclusions.** 1. In 6 - 12 months after fenestrated Fontan completion thediagnostic cardiac catheterization withfenestration occlusion test isrecommended. In the absence of significant hemodynamic changes - endovascular closure offenestrationis possible.

2. Percutaneous occlusion of the fenestration is effective and safe method of closing the shunt in patients with Fontan circulation.

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