

**Marginal donors and organ shortness: Coronary artery revascularization during heart transplantation.**

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## **ABSTRACT**

Heart transplantation is the gold standard treatment for patients with end-stage heart failure. The limited availability of organs has led to the expansion of the donor criteria by introducing the use of marginal donors. Although the use of marginal donors has reduced waiting lists, the results are worse than with standard donors. For this reason, the use of marginal donors in clinical practice is still controversial.

We describe two cases of heart transplantation from marginal donors with pre-transplant angiography evidence of coronary stenosis and normal ventricular function.

**ABBREVIATIONS:**

**BiVAD:** Biventricular Assist Device

**BTT:** Bridge to transplantation

**CABG:** Coronary Artery Bypass Grafting

**HT:** Heart Transplantation

**LAD:** Left Anterior Descending Artery

**LIMA:** Left Anterior Mammary Artery

**LVAD:** Left Ventricul Assist Device

**MD:** Marginal Donor

**PGD:** Primary Graft Dysfunction

**SVG:** Saphenous vein graft.

**Ethical Statement**

It is declared that every reasonable effort was made to obtain informed consent to participate in this study. However it is noted that there is already mention of the use of data for scientific and research purposes in the current informed consent in use at our Center. We also guaranteed the respect of anonymity and professional secrecy and used the collected data just for the scientific purposes granted in accordance with the law in force (GDPR).

## **Introduction**

Heart transplantation (HT) is the best treatment for patients affected by end-stage heart failure (1). However, due to the high and growing number of patients on the waiting list, donor supply remains the major limiting step in heart transplantation. To overcome the discrepancy between supply and demand for organs, the donor criteria have been expanded, accepting, in some selected cases, the so-called marginal donors (MD). The use of these MDs is still controversial and the match between the right donor and the right recipient still poses a great challenge for modern medicine.

## **Case reports**

### **Patient 1**

A 62 years old female previously treated with mechanical mitral valve prosthesis and affected by end stage biventricular heart failure with severe tricuspid regurgitation and immune-sensitized had a rapid deterioration of her clinical condition. Due to the biventricular dysfunction the only two options were biventricular assist device (BiVAD) or HT. A donor was suddenly available and pre-operative angiography of donor's heart showed focal stenosis (50%) on left anterior descending (LAD) coronary artery. Since the patient was critical, we decided to accept the heart and to perform HT and concomitant coronary artery bypass graft (CABG) by using left anterior mammary artery. The patient regularly followed up in our centre. She is in good clinical condition and CABG is still patent 7 years after the procedure. (Figure 1).

### **Patient 2**

The second patient is a 65 years old male, affected by end stage heart failure and assisted with left ventricular assist device (LVAD) (Jarvik 2000) since 2016 complicated by bowel ischemia which required resection and several episodes of left thoracotomy dehiscence, resulted in fistulization with the thoracic wall (Figure 2). He was listed on 2018 and a compatible donor was never found. Facing with these considerations, we suddenly opted to use a MD. He underwent HT in 2020 with MD's heart which had critical focal stenosis involving the bifurcation between LAD and first diagonal branch. Since the patient had thoracic fistulization, we decided to perform CABG by using two saphenous vein grafts to preserve the left thoracic vascularization (Figure 3).

## **Discussion**

The less restrictive criteria adopted to expand the supply of organs suitable for transplantation have identified a new donor profile called MD, who would not otherwise be used for transplantation.

MDs have shown to be associated with high incidence of primary graft dysfunction (PGD) and worse survival (2). Thus, there is still some hesitation in accepting this practice.

By contrast, the profile of recipients has also changed in recent decades, as they are increasingly at higher risk, older, and arrive at transplantation in conditions of high priority.

This situation has allowed the wide use of LVAD as bridge to transplantation (BTT), significantly reducing waiting list mortality (5) and saving time for a better allocation of optimal donors. However, the use of LVAD, when not contraindicated, could expose patients to thrombo-embolic, hemorrhagic and septic risks, sometimes requiring a transplantation in critical conditions (6).

Trivedi et al (7) show how the recipient's conditions have a more significant impact on HT mortality than those of the donor. In particular, it should be noted that better survival is independent of the donor characteristics, therefore matching high-risk organs to low-risk recipients is associated with better survival than matching low-risk organs to high-risk recipients.

The final goal is to maintain a “transplant benefit” concept, balancing the safety to use a “non-inferior heart” with the necessity of avoiding long waiting lists, to prevent the patient's condition from becoming critical.

In this context, the hypothesis of optimizing the conditions of MDs by performing myocardial revascularization procedures at the time of HT, in presence of critical coronary stenosis can be considered.

The literature only reports a few cases of patients treated with CABG during HT.

Thompson et al. in 1988(8), Laks et al. in 1993 (9) and Carlos et al. in 2013 (10) report some experiences with short follow ups (maximum 3 years). Only Abid et al. in 2002 (11) reports a series of 4 cases with a long follow up (10 years).

However, these are small and anecdotal patient series. Precise guidelines, based on the clinical characteristics of each case, are still not well defined. Our experience can be added to these cases, helping to strengthen the literature on the topic.

As pointed out by Russo et al (12), despite the use of MD has worse results than standard donors, it guarantees longer survival (5.2 years) than without transplantation (1 year).

For this reason, we believe that in selected cases, and only after performing a coronary angiography, the use of MDs with concomitant revascularization procedures might be a reasonable option, with acceptable results.

Further studies are needed to confirm data and define precise guidelines.

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## Figure legends

Figure 1:

**Title: Patient 1. Angiographic control 7 years after transplantation and cabg.**

Legends: **A:** coronary artery angiography control; **B:** Patency of the bypass. LAD: left anterior descending coronary artery; LIMA: left anterior mammary artery. The circles show the site of the anastomosis.

Figure 2:

**Title: Patient 2. Fistulization of Jarvik 2000 through the thoracic wall**

Legends: **A:** Direct view of fistula during surgery; **B:** The CT scan shows the close proximity between the device and the thoracic wall; **C:** Final result of surgical closure of the fistula, direct vision in the surgical field.

Figure 3:

**Title: Patient 2.**

Legends: **A:** Pre-operative coronary artery angiography of donor shows the stenosis involving LAD and Diagonal branch (the arrows); **B and C:** Coronary artery angiography control shows the patency of the 2 Cabg.

The circles show the anastomoses; **D:** Surgical field at the time of transplantation and cabg.

LAD: left anterior descending coronary artery; SVG: Saphenous vein graft.