



Implementation of Heart Transplantation Program to Advanced Heart Failure Patients in Brazil

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Abstract

Purpose Heart transplantation is the gold standard treatment for advanced heart failure. Left ventricular assist devices (LVADs), despite being a good option for these patients, are not quite available in developing countries. Time spent in heart transplant waiting list has increased lately even in regions where the number of transplants has also risen showing that a new strategy should be sought.

Recent Findings Transplant process organization combined with multidisciplinary work are linked to better outcomes while improvement in donor's care and in pre-transplant evaluation might be opportunities to change the long waiting list scenario.

Summary For the first time in Brazil, a survey with the most expressive heart transplant centers has been made, which allows an overview of treatment of advanced heart failure in a developing country. We also described a model of heart transplant team, which has proved to be a success when compared to the largest heart transplant centers in Latin America.

Keywords Advanced heart failure · Heart transplantation · Ventricular assist devices · Multidisciplinary team

Introduction

Heart transplant is the gold standard treatment for advanced heart failure, which can improve both survival and quality of life for these patients [1].

In the past decades, the number of heart transplants has increased as well as the survival rate. Data from the *International Society for Heart and Lung Transplantation* (ISHLT) show a total number of 5074 transplants in 2015 in 285 different centers. North America was the region with the

most substantial rise, while in Europe, numbers have been stable for several years [1–3].

Despite that, the number of patients waiting for a heart transplant has had a big increase in the USA lately, suggesting that maybe the number of heart transplants has not risen enough to meet their needs [1].

Also, the US data show that from 2015 to 2016, time spent in the waiting list was 9.4 months, which means 4.2 months more than the previous analysis (2005–2006). Depending on patient's blood type, body mass index, gender, and priority status, it can take even longer. Between 2013 and 2014, patients with no need for ventricular assist devices (VADs) or inotropes had to wait months for heart transplantation [1].

Mechanical circulatory assistance, used as bridge to transplant, allows patients to reach heart transplantation in better condition, which results in mortality reduction in waiting list. Between 2015 and 2016, mortality declined in patients with VADs at listing, from 43.2 to 8.0 deaths per 100 waitlist years, while patients without VADs had 10.4 deaths per 100 waitlist years waiting. Groups had similar survival rate after transplant, with the exception of patients previously in ECMO (probably because they had more severe disease) [1, 3].

With the increasing availability of VADs, data from ISHLT show that, at least, half of adults who undergo heart

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transplantation were in ventricular assistance. It raises an issue about priority criteria in organ allocation [1, 3].

In developing countries, VADs are not quite available and, especially in public health programs, their use as bridge to transplant is not usually possible. In Brazil, the rate of heart transplant increased by 129% from 2010 to 2017, followed by a rise in the number of transplant centers as well. This increase may be explained by a substantial growth in the number of effective donors. Figure 1 shows the curves of heart transplant and effective donors per millions of people from 2010 to 2017.

In this review, we describe the structure of the main centers of advanced HF treatment in developing countries, where the use of ventricular assist devices is not yet accessible to the entire population. To achieve this goal, we will describe the main transplantation centers in Brazil. For an overview of the reality of advanced heart failure treatment in Brazil, the main centers have answered a survey about their structure and characteristics. All data were analyzed, and the results are described below. We have also described, in details, the characteristics of the major center in Brazil as a model of an advanced heart failure successful center in developing countries.

Heart Transplantation Centers in Brazil

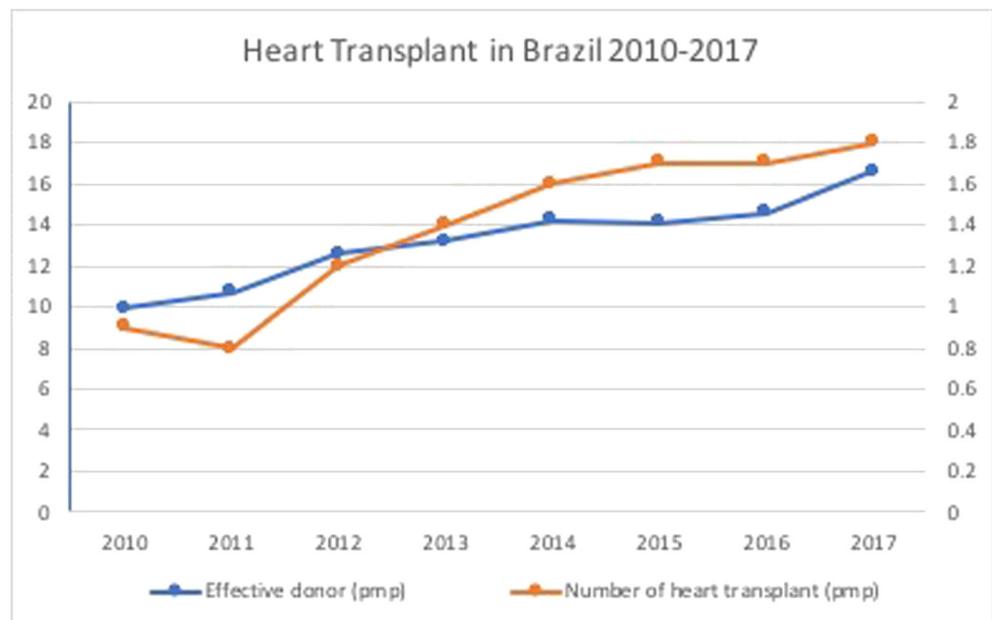
Brazil currently has 36 active heart transplantation centers which are responsible for more than 350 heart transplants a year (380 performed in 2017). More than 15 transplants a year are carried out in 9 of these centers and account for 67% of the

heart transplants performed in the country. We have selected data about the structure of the five largest heart transplant centers in Brazil and their characteristics are described below. The average number of transplants per center per year was 37, ranging from 27 to 49 in these five centers.

Organ Harvesting

- In 60% of centers, a nursing team receiving the offer is responsible for checking all information with the team responsible for taking care of donors and providing all data to the medical team to evaluate the organ's acceptance or refusal;
- The nursing team is composed of 4–6 nurses who have exclusive dedication to the transplant team and works 24 h a day, 7 days a week in 67% of centers;
- The medical team consists of 1–5 cardiologists and/or cardiac surgeons;
- In all five main centers, air transport is available, which increases the possibilities of long-distance organ harvesting and is a hope to improve the number of effective donors;
- Echocardiogram is not available in all organ harvesting, just 60% of effective donors have echocardiogram done before heart transplantation. This fact limits the increase in heart transplant numbers;
- In these five centers, a heart transplantation specialist nurse is able to help in the management of donors before organ is withdrawn in about 80% of time. Two physicians (2 surgeons or 1 surgeon and 1 trainee) and one more

Fig. 1 Number of heart transplant and number of effective donors per millions of people. Adapted from *Registro Brasileiro de Transplantes. Rev Brasil Transpl 2017; Ano XXIII Num. 4. 2017: 1–100* [3]



health professional usually participate in the process of organ harvesting.

Heart Transplant Team

- On average, the medical team consists of 5 cardiologists, 6 cardiac surgeons, cardiology and/or cardiac surgery trainees
- In all the centers, there is a multidisciplinary team with nurses (ranging from 1 to 7), psychologists, and social workers exclusively dedicated to heart transplantation process. Physiotherapists are part of the team in 80% of centers.

Medical Care

- The postoperative management is performed in a specialized transplant intensive care unit 80% of time.
- Medical visits are performed daily in heart transplant waiting list or transplanted patients by heart transplantation team. In one of the centers, visits are held twice a day.
- In the five centers mentioned, all clinical cases are presented in a weekly meeting and in the post-transplant period, multidisciplinary care is also offered.

Physical Structure and Funding

- A specific Heart Transplantation Unit exists in three of the five centers.
- Funding, in general, is mixed. All centers have federal resources, 40% have state incentives, and 20% have also non-profit foundation resources.

Successful Heart Transplantation Center

Considering Heart Institute (InCor) of University of Sao Paulo is the largest heart transplantation center in Latin America, with the highest number of post-transplanted patients being followed and with good results, we will describe its structure in details below.

The organization of a transplantation center is complex. It involves at least an appropriate structure to take care of recipients in pre-transplant period; organ harvesting logistics and a multidisciplinary team in pre- and post-transplant period. Not only should the logistics of receiving offers be appropriate, but also the evaluation and management of donor's condition. At Heart Institute (InCor), there is a 24-h nursing team dedicated to organ harvesting. This team receives offers from the Transplant Center and has the

support of surgeons and cardiologists to discuss case-by-case the possibility of accepting an organ. In case of acceptance, a nurse goes to the donor's location and gives instructions to local team aiming to improve donor's condition as much as possible. An echocardiographic image technician goes with surgeons to the hospital, where the donor is allocated, to perform echocardiography. The images obtained are sent to a specialist who evaluates the donor's heart function. This helps organ acceptance decision-making.

Besides organ harvesting, it is essential that patients are well attended both in the pre- and post-transplantation periods. At Heart Institute (InCor), most patients transplant in a priority condition (by inotropic or intra-aortic balloon). Clinical interferences are common in these patients. In this way, the identification and prompt treatment of these situations are fundamental to guarantee the success of the program. With that in mind, medical bedside visits are performed twice a day. In addition, the group has weekly meetings to discuss clinical cases. Cardiologists specializing in heart transplantation, cardiac surgeons, infectologists, trainees, and multidisciplinary team participate in these meetings.

The multidisciplinary team plays a fundamental role in the evaluation and follow-up of recipients. Patients receive nursing, psychological, nutritional, and social assessment. Each procedure, from any area, is adapted to the needs of each patient.

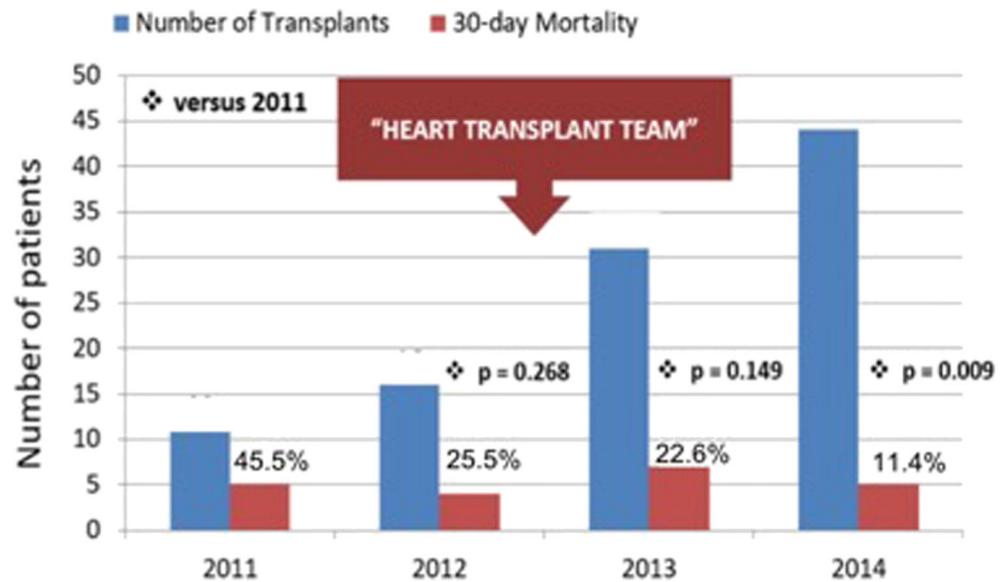
We believe that all these aspects contribute to building a quality heart transplantation center model that may work as an example for implementation of new transplant centers.

The creation of a specialized team in 2013 has played an important role in heart transplantation results at the Heart Institute (InCor), University of Sao Paulo. Since its first years, it is responsible for improving the rate of utilized organs, the survival in both waiting list and after heart transplant, and, specially, the total number of heart transplants.

When compared to the historical control period in the same institution, data previously presented at the ISHLT meeting in 2015, the rate of transplant surgeries in a year has increased from 14.3 to 36.2 with organ utilization rate going from 10.7 to 14.2% (Fig. 1). In the same comparison, mortality in waiting list decreased from 61.4 to 33.4% while 30-day mortality after heart transplant had a significant reduction to 11.4% (Fig. 2). There was also a reduction in 1-year mortality, reaching 20.5% in 2014. Figure 3 depicts the 1-year survival curves in the two different periods (pre- and post-heart transplant team creation) [4].

It is important to state that, even when compared to the early years of the heart transplant team creation, Heart Institute transplant numbers have been improving. In 2017, the number of heart transplants reached 49, an institution's record.

Fig. 2 Number of heart transplants and 30-day mortality from 2011 to 2014. Presented in the 35th Annual Meeting and Scientific Sessions ISHLT 2015. Heart Transplant Team and Its Impact in the Results of Heart Transplant in a Brazilian Center [4]



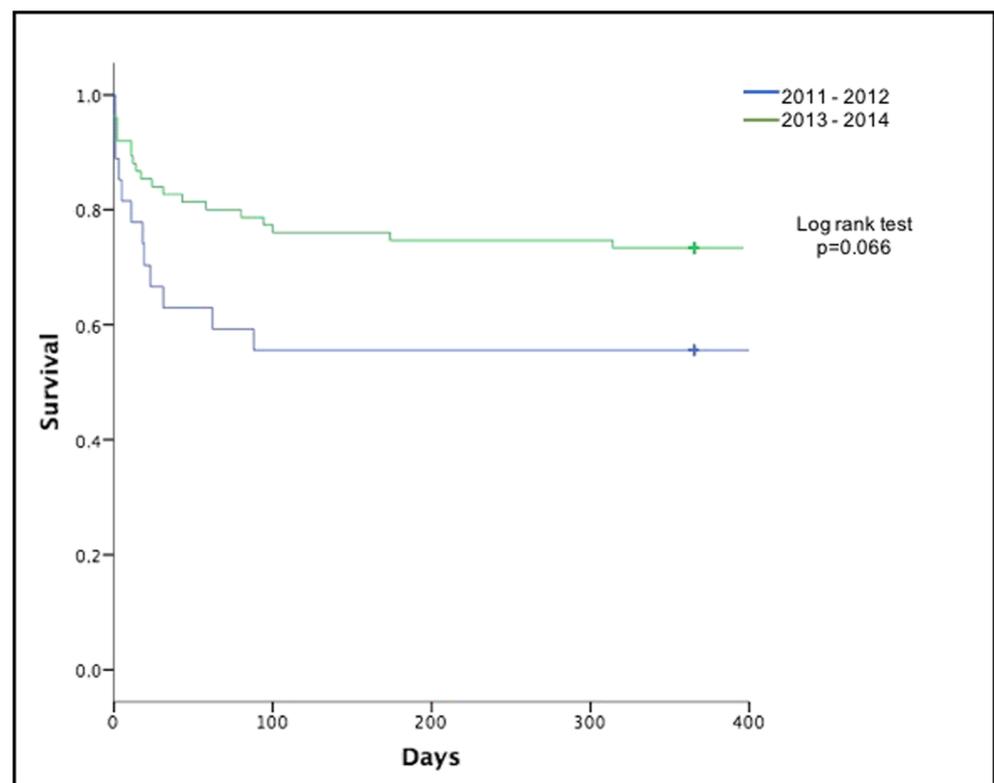
Discussion

The treatment of advanced heart failure patients has changed a lot in the past years. The emergence of the ventricular assistance devices has given new perspectives to patients that would either go to transplant in an urgency scenario or would die waiting for an organ. In developed countries, where there are not sufficient donors and costs are not a big limitation, half of patients who

undergo heart transplant have had a VAD previously implanted.

Heart transplant is still the gold standard treatment for advanced heart failure and, especially in developing countries, it is sometimes the only available treatment for many patients due to the high costs of VADs. Despite the increase in the number of heart transplants in the last years, the time in waiting list keeps rising, and some of the patients never had the chance to undergo transplant surgery.

Fig. 3 One-year survival curves pre and post heart transplant team creation. Blue curve depicts the Kaplan Meier survival curve of patients who were submitted to heart transplantation between 2011 and 2012 and green curve the survival of patients submitted to heart transplantation between 2013 and 2014



The creation of a specialized team in the Heart Institute (InCor) in Brazil has shown that organization in all the several steps of the transplant process combined with multidisciplinary work can help improve this scenario, with better numbers in both pre- and post-heart transplantation.

As future perspectives, and to keep improving these numbers, we might focus on donor's care. Currently, the Brazilian median number of heart transplants is 1.8 pmp (per millions of people), and the rate of effective donors is 11.1%, which is not enough to meet the needs of patients with heart failure in Brazil (Fig. 2). To reach this aim, it would be necessary to have a substantial increase in this rate (ideal rate = 40%). Considering this estimate, in 2017, 1374 heart transplants, instead of 380, could be done [2]. Improving quality of donor's care could end up in more successful transplants, decreasing the large number of patients in waiting-list. In this way, having echocardiogram images of the offered hearts and a transplant nurse in loco to help with specific pre-transplant care seems to be a feasible strategy.

Conclusion

In fact, in developing countries, where the resources are limited, the creation of a heart transplant specialized center is a suitable strategy to the treatment of patients with advanced heart failure, especially considering the low availability of ventricular assist devices.

As a pioneer center and leader in number of heart transplants in Brazil, the Heart Institute (InCor), University of Sao Paulo group has a lot to share in order to help improve the heart transplant scenario in Latin America.

Taking part in several research lines in heart failure and heart transplantation and exchanging experiences with international and local centers makes the Heart Institute team a leader in education and formation of new specialists.

Its medical support, ranging from donor's care in organ harvesting to long-term multidisciplinary follow-up to transplanted patients, has proved to be efficient and should be a role model for other centers.

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Compliance with Ethical Standards

Conflict of Interest Fabiana G. Marcondes-Braga, Marcely Gímenes Bonatto, Caio Ribeiro Alves Andrade, and Fernando Bacal each declares no potential conflicts of interest.

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