EDITORIAL

The Ross Operation

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The search for an ideal valvular replacement started with the dawn of modern cardiac surgery fifty years ago and has not been found yet. In this way we find the replacement of aortic valve with a pulmonary autograft, what we know as "Ross procedure". The origin of the idea that led to the use of this surgery can be found in the experimental essays carried out by Hochrein in 1927, and followed by the group of Standford: Lower in 1960 and 1961 and Pillsbury and Shunway in 1996. The first successful clinical implementation was the one performed by Donald Ross, who in 1967 published his experience with 14 patients, 2 in mitral position and 12 in aortic position, taking into account the experience of the aortic autografts implantation. Mechanical prostheses were improved, their implantation was simpler and so the alternative of homografts and autografts was restricted to a minimum. Ending the 80 decade, Stelzer published a technique much simpler than the subcoronary, miniroot or inclusion, which was being used for the implantation of autograft in aortic position. This new option, known as implantation like root, consisted in the sinus removal, the preservation of both coronary ostium and the implantation of the autograft as if it was a cylinder, with a proximal suture at the level of the ring and a distal one with the ascending aorta and the reimplantation of the coronary ostium in the neoaorta. This technique was easily accepted by other surgeons and the interest for this surgery increased. At the same time a voluntary register containing the operated patients was created, but long-term results were missing. One of the most important points was the demonstration that the autograft goes with the patient growth, (1) which was considered the pillar of this surgery indication in paediatrics.

In 2000, Toronto's group noted that autograft dilatation preceded the progressive development of the aortic neovalve failure, especially when implantation was in the form of root. It was a median follow-up of 44 months, short for the life of a neovalve/aortic prosthesis, but enough to demonstrate that it was not so good and not an ideal alternative, at least in that group of patients. This was not confirmed by other groups which continued with the same technique, although a controversial point was declared. Other works demonstrated the direct relation between aortic failure as a preoperative pathology and the late appearance of autograft failure. Other alternative techniques to counteract this negative point were described, but there is still no data to demonstrate its effectiveness. On the contrary, everything indicates that native valve failure may be a relative indication for a Ross procedure due to its higher incidence of reoperation. All this information led to a new loss of interest for this surgery and nowadays a few of us doctors continue carrying it out with much stricter criteria for its indication.

Roura et al. work which is published in this issue of the Journal includes a very important group of patients, a total of 198, although the follow-up only involves the 83.3% of them (165 patients). Although a mortality of 2.5% during the first 30 days is low, it should be taken into account. Hospital mortality for this kind of surgery should be less than 1% to be considered an option, taking into account that it is indicated to young, very active patients, with few risk factors. Davis et al., (3) communicated that on 212 patients operated between 1990 and 2004, mortality was of 0.47% for the first 30 days. In a recent meta-analysis made by Takkenberg et al., (4) in 12 considered publications, early mortality oscillated between 0.3% and 6.8%. We did not have hospital mortality over 50 consecutive patients operated in different centers from 1995 to today. Certainly, these differences are closely related with the patients' clinical characteristics. We do not reject those with reoperations, simple congenital defects and endocarditis with little general repercussion, but we exclude those cases with aortic pathology combined with coronary artery disease and other valve diseases, unless this could be treated without lasting the pump time. This is not only a complex surgery in its technical aspect, but very long and with long extracorporeal circulation times, which can negatively impact on a haemostasis and an adequate myocardial protection. Besides, the fact that in most institutions there is only one surgeon who performs this kind of surgeries represents a difficulty to carry out those experiences with good results.

Although Roura et al. did not find statistical importance and do not mention the size of the aortic rings, the higher incidence of reoperations in those patients with native aortic valve failure called their attention. This relation was demonstrated by other authors, together with the importance of disparity between the pulmonary and aortic ring diameter as relevant points for remote results. Different groups created resources to adapt the autograft ring to the dilated aortic ring. This undoubtedly, increased the range of operated patients who were benefited in the short term, but there are many doubts about the maintenance in time. A dilated aortic ring would probably be a marker of connective tissue disorder which leads to an early deterioration of the

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pulmonary autograft valves. In a recent analysis, Davis et al. (3) described that 9 of 10 patients reoperated due to autograft failure had the valves seriously damaged and all of them showed a preoperative aortic ring ≥ 27mm. They also concluded that the mismatch of the rings, an aortic ring ≥ 27 mm, preoperative aortic failure and male sex are significantly associated with a higher incidence of reoperation due to autograft dysfunction and late postoperative aortic failure. The best results would be obtained in patients with aortic stenosis or normal or little rings and women (although the cause of sex is, for now, a mystery).

Root implant technique, used by the authors is the most used by the majority of us who perform this surgery. Although, against "inclusion" or "mini-root" techniques, this kind of autograft implantation was criticized considering it directly related to a higher incidence of neoarta failure, this has not been demonstrated in the medium term and remains an alternative of choice.

Survival at 10 years of the 165 patients monitored by the authors was near 95%, though some of them were lost of the follow-up and it is not clear in this essay if mortality of the first 30 days is included. The 212 patients analyzed by David et al. (3) had a survival of 97.7% at 10 years absolutely similar to an apparently healthy population and comparable, in term of sex and age, to one in the city of Ontario. In 464 patients operated by Bohm et al. (5) 94% of them had a survival of 94.4% at ten years, taking into account that 143 patients over 50 years were included who had a lately mortality significantly higher than the younger.

Reoperations incidence is influenced not only by autograft failure, but also by pulmonary homograft failure, which is a major concern for patients and for us who have to indicate this surgery. Due to an unknown reason, the evolution of pulmonary homografts is better in those used for a Ross procedure than for the outflow tract of the right ventricle of a congenital heart disease, (6) as for example a pulmonary atresia or a truncus. Freedom of operation due to dysfunction, both of autograft and homograft (combined), is about 85% (3) at 15 years, although freedom of dysfunction of homograft is close to 71% in the same period. There is enough anatomicophatological information which explains the abnormality of the autograft wall and its tendency to a dilatation with microlesions in the wall, which may lead to a valve dysfunction or dissection. (7, 8) In Roura et al. work, (2) freedom of reoperation is of 95% at 10 years, not different from the one reported by David et al. at 15 years. If we take into account that in Roura et al. study many patients have not been monitored, that percentage may be overvalued, as authors admit in the limitations of their work.

Significant homograft dysfunction, apart from being well tolerated for long time, today may be treated with the implantation of a new prosthesis by endovascular via. This option, widely used in the rest of the world, is not available in our country due to ANMAT (The National Administration of Drugs, Foodstuffs and Medical Technology) regulatory facts, but in a near future, these patients, should seen reduced the need of a reoperation in a conventional way. Maybe in the future, the use of decellularized homografts would become a better perspective.

I would add three points to Roura et al. conclusions. First, there is enough information that Ross procedure is, today, the best option for the replacement of aortic valve in growth-age patients and high risk sportsmen. Second, it is necessary to monitor and compare the long-term results of latest generation bioprostheses, as bovine pericardium, especially for patients with life expectancies of 20 to 30 years and a medium to low level of physical activity. Finally, we should limit Ross procedure to very special cases, in patients with predominant aortic failure and root dilatation, where new bioprostheses may, in a near future, show in a medium and long term results which may compete favourably with Ross procedure.

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