

Is coronary artery transfer still the jugular for the arterial switch operation?

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Abstract

The outcomes of the arterial switch operation have improved over a period of time with the elimination of coronary artery anatomy as a risk factor for operative mortality in some series. However, cumulatively, when all the series published so far are analyzed, two coronary variations, namely the single sinus coronary artery origin and intramural type, persist as risk factors for an adverse operative outcome.

Title: Is coronary artery transfer still the jugular for the arterial switch operation?

Running Head : Transposition of the great arteries and arterial switch operation

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Since its first successful application by Jatene [1], the arterial switch operation has become the procedure of choice for transposition of the great arteries over the atrial switch operation when both operations are applicable. The shift in momentum towards the arterial switch was due to increased experience with safe coronary transfer techniques and an early application of the operation before regression of the morphological left ventricle, leading to improved outcomes [2]. While some single institution series have reported no operative mortality directly attributable to coronary artery variation and transfer technique [3], Chowdhury and colleagues, in their expert review, have synthesized a cumulative impact of coronary artery variation on the short and long-term outcomes of the arterial switch operation from previously published studies [4].

Fundamental to a successful coronary artery reimplantation is an understanding of distorting forces acting on the coronary button and specific variations in the coronary artery pattern limiting the application of conventional techniques of coronary artery transfer. The goal is to have a coronary implant without tension, kinking, or torsion.

The coronary button can be subject to distortion in three principal directions:

1. *Rotation* along its long axis. Excessive rotation can lead to torsional obstruction of the implanted coronary artery. In order to minimize this, the button is implanted with a slight oblique medial tilt to the long axis of the great vessel.
2. An *upward or downward pitch* perpendicular to its longitudinal axis. Implantation low in the sinus will lead to a downward pitch, and kinking and high in the sinus can lead to an upward pitch and create tension in the implant.
3. A *medial or lateral movement* along its short axis. Usually, the button is subject to an excessive medial movement which is minimized by using a medially based trapdoor incision in the implanting sinus.

Certain coronary variations such as a looping coronary course, single sinus origin of the coronary arteries, and an intramural course of the coronary are considered high risk for a coronary artery transfer as they can further exacerbate the distorting forces. Several modifications have been developed to address these coronary patterns, such as an easier siting of the coronary button reimplantation site by constructing the neo-aortic root first as proposed initially by Jatene [3], using the “medial trap door” technique, and siting the button high at or above the neo-aortic suture line. With the adoption of these techniques, a looping course, unless associated with a single sinus origin of the coronary arteries, is no longer considered a risk factor for a safe coronary artery transfer, at least in the short term [5]. However, despite these techniques, the single sinus origin of the coronary arteries and an intramural course are still considered high-risk variants and deserve further attention during coronary reimplantation.

Single sinus origin coronary artery type can have a single orifice or multiple orifices for each major coronary artery in close proximity. They are invariably associated with a looping course of one of the coronary arteries. Alternatively, the arteries can have an interarterial course with a possibility of an intramural and a juxta commissural course. The coronary button is usually harvested as a single button, or the button can be split into two buttons if there is enough separation between the left and right coronary arteries orifices (> 2 mm)[5]. The harvested single button may be reimplanted with a conventional technique but minimizing medial rotation using a medially based trapdoor with or without augmentation by patch material or by a “bay window” technique as described by Yamagishi [5]. However, sometimes it is impossible to rotate a single button without kinking one of the arteries. In such a case, if the button is not harvested yet, the coronary artery is rerouted to the neo-aorta using an aortopulmonary window somewhat akin to a Takeuchi repair [5]. However, with this technique there is risk for neopulmonary valve obstruction particularly if the coronary ostium is deep within the sinus. If the button has been harvested, a variation of the inverted button technique as described by Yacoub is used [6]. Alternatively, conventional implantation techniques may be used if the single button can be safely split. As the authors have pointed out in the review, a single sinus origin, particularly with a looping arterial course, remains a risk factor for a safe coronary artery transfer leading to a 3-fold increase in early mortality and continues to have a long-term mortality risk, albeit at a much lower rate.

A coronary artery with an intramural course is another risk factor for a safe transfer and, as detailed in the review, carries a 28% risk for an early mortality. The coronary artery is at risk for injury during transection of the aortic root and during harvesting of the coronary button if the intramural nature of the course is not appreciated. An intramural course may be associated with a juxtacommissural course and will require the takedown of the commissure to facilitate a harvest of the coronary button. The intramural segment may be stenotic and require an additional unroofing procedure. An intramural course can be associated with a single sinus origin of the coronary arteries, further compounding the risk. As pointed out by the authors in the review, there is also a risk for long-term stenosis due to intimal fibrosis.

In conclusion, outcomes of the arterial switch operation have improved over a period of time with the elimination of coronary artery anatomy as a risk factor for operative mortality in some series. However, cumulatively, when all the published series so far are analyzed, two coronary variations, namely the single sinus coronary artery origin and intramural type, persist as risk factors for an adverse operative outcome.

References:

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