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REVIEW

Valve replacement in children: A challenge for a whole life

Remplacement valvulaire chez l'enfant : les défis pour toute une vie

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Summary Valvular pathology in infants and children poses numerous challenges to the paediatric cardiac surgeon. Without question, valvular repair is the goal of intervention because restoration of valvular anatomy and physiology using native tissue allows for growth and a potentially better long-term outcome. When reconstruction fails or is not feasible, valve replacement becomes inevitable. Which valve for which position is controversial. Homograft and bioprosthetic valves achieve superior haemodynamic results initially but at the cost of accelerated degeneration. Small patient size and the risk of thromboembolism limit the usefulness of mechanical valves, and somatic outgrowth is an universal problem with all available prostheses. The goal of this article is to address valve replacement options for all four valve positions within the paediatric population. We review current literature and our practice to support our preferences. To summarize, a multitude of opinions and surgical experiences exist. Today, the valve choices that seem without controversy are bioprosthetic replacement of the tricuspid valve and Ross or Ross-Konno procedures when necessary for the aortic valve. On the other hand, bioprostheses may be implanted when annular pulmonary diameter is adequate; if not or in case of right ventricular outflow tract discontinuity, it is better to use a pulmonary homograft with the Ross procedure. Otherwise, a valved conduit. Mitral valve replacement remains the most problematic; the mechanical prosthesis must be placed in the annular position,

Abbreviations: AV, auriculoventricular; AVR, aortic valve replacement; LVOT, left ventricular outflow tract; MV, mechanical valve; MVR, mitral valve replacement; PA, pulmonary autograft; PH, pulmonary homograft; PVR, pulmonary valve replacement; RVOT, right ventricular outflow tract; TV, tricuspid valve; TVR, tricuspid valve replacement; VR, valve replacement.

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avoiding oversizing. Future advances with tissue-engineered heart valves for all positions and new anticoagulants may change the landscape for valve replacement in the paediatric population.

MOTS CLÉS
Pédiatrique ;
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Remplacement valvulaire

Résumé Les valvulopathies chez l'enfant constitue des nombreux défis au chirurgien cardiaque pédiatrique. Il va sans dire que la réparation valvulaire est la technique de choix pour la restauration de l'anatomie valvulaire et la physiologie utilisant les tissus originaires permettant d'aboutir à un bon développement et à un résultat potentiellement meilleur à long terme. Quand la reconstruction échoue ou n'est pas faisable, le remplacement valvulaire devient inévitable. Quelle valve pour quelle position reste une question assez controversée. L'homogreffe et les bioprothèses aboutissent à des résultats initialement supérieurs de point de vue hémodynamique, mais toujours aux dépens d'une détérioration accélérée. La petite taille des patients et le risque thromboembolique limite l'utilité des valves mécaniques et la croissance de l'enfant constitue un problème universel avec toutes les prothèses disponibles. Le but de cet article est d'adresser des options de remplacement valvulaire pour les quatre valves chez l'enfant. À la lumière de la littérature actuelle et notre pratique, nous essaierons de justifier nos préférences. En résumé, une multitude d'avis et d'expériences chirurgicales existent. Aujourd'hui, les choix de valves sans controverse sont le remplacement biologique de la valve tricuspide et le Ross ou Ross-Konno si nécessaire pour la valve aortique. En outre, la bioprothèse pulmonaire peut être implantée si la taille de l'anneau le permet ; sinon ou en cas de discontinuité entre le ventricule droit et l'artère pulmonaire, il est recommandé d'utiliser l'homogreffe pulmonaire en cas d'intervention de Ross, ou un tube valvé en dehors du Ross. Le remplacement valvulaire mitrale chez les enfants reste la plus grande problématique ; la prothèse mécanique en position annulaire doit être réalisée en évitant de surdimensionner la prothèse. Des avancées futures avec de nouveaux substituts valvulaires ou d'anticoagulants sont susceptibles de changer les données du remplacement valvulaire dans la population pédiatrique.

Background

Valvular pathology in infants and children poses numerous challenges to the paediatric cardiac surgeon. Without question, valvular repair is the goal of intervention because restoration of valvular anatomy and physiology using native tissue allows for growth and a potentially better long-term outcome. When reconstruction fails or is not feasible, valve replacement (VR) becomes inevitable. Which valve for which position is controversial. Homograft and bioprosthetic valves achieve superior haemodynamic results initially but at the cost of accelerated degeneration. Small patient size and the risk of thromboembolism limit the usefulness of mechanical valves (MVs), and somatic outgrowth is a universal problem with all available prostheses. The goal of this article is to address VR options for all four valve positions within the paediatric population. We review current literature to support our preferences.

Aortic valve replacement

Aortic valve disease is one of the most common congenital cardiac defects, occurring in 5% of all children with heart disease. The bicuspid aortic valve is the second most common pathological valve entity in the paediatric patient population that requires VR in a high percentage of patients over their lifetimes [1].

Ross procedure

Controversy over prosthetic type for aortic valve replacement (AVR) has dropped dramatically in the past 15 years because of the growth in popularity and excellent results obtained with the Ross procedure (Fig. 1A and B). Pulmonary autograft (PA) has become the first choice of AVR in children and adolescents in some institutes [2,3]. PA shows excellent haemodynamic performance, superior longevity (Fig. 2) [4], freedom from anticoagulation and haemolysis and decreased susceptibility to endocarditis. PA is also known to have the potential for growth. However, the Ross procedure is a technically demanding procedure and reoperation for bleeding and postoperative conduction abnormality is not as rare as early complications. Freedom from autograft dysfunction, including severe autograft insufficiency, ranges from 75% to 100% depending upon the duration of follow-up [5]. Elkins et al. [6] reported freedom from autograft replacement of 93% and freedom from severe autograft insufficiency or valve-related death of 90% at their 12-year follow-up. Autograft insufficiency is one of the leading causes of reoperation with the Ross procedure and several factors are implicated as risk factors, such as preoperative diagnosis of aortic insufficiency, presence of dilated aortic annulus, bicuspid aortic valve, rheumatic heart disease, technical imprecision, the type of insertion and inherent disease of the pulmonary valve. Elkins et al. reported a freedom from right ventricular outflow tract