

# Cardiac Reconstructions with Allograft Valves

R.A. Hopkins

# Cardiac Reconstructions with Allograft Valves

With Contributions by  
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With 169 Figures



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*This work is dedicated to Jenny*

# Preface

Human cadaver tissues (homografts) were used clinically for vascular reconstructions as initially reported by Gross in 1948 and based on the experimental work of Carrel and others earlier in the century. An aortic homograft allowed the first abdominal aneurysm operation by DuBost in 1951, and valved tissues were utilized during the 1950s and early 1960s prior to the general availability of mechanical or xenograft valve prostheses. However, the continued use of homograft valves (allografts) in cardiac reconstructions has subsequently been limited to a few centers. This limitation has been partly because processing homograft valves for sterility and preservation (e.g., irradiation, glutaraldehyde) resulted in poor durability, and “fresh” valves stored in nutrient media with antibiotics were logistically difficult to bank and probably not truly viable.

Now, however, use is increasing and interest greatly heightened for a number of reasons. First, human allograft valves do indeed have hydraulic performance superior to that of synthetic prostheses when harvested, sized, and implanted properly. Second, availability is increasing owing to the expanded use of multiple organ harvests. Third, cardiologists and cardiac surgeons are increasingly dissatisfied with “prosthetic valvular disease” in regard to thromboembolic and anticoagulation complications associated with mechanical prostheses and the poor durability of xenografts, especially in young patients. Lastly, improved performance and durability of allograft valves are being demonstrated with new cryopreservation techniques that result in cellular viability of valves “banked” in vapor-phase liquid nitrogen. It is clear that these allograft cardiovascular tissues have special advantages in certain anatomic situations, for many patients requiring aortic or pulmonary valve replacements, and for pediatric cardiac reconstructions requiring conduit procedures. Thus we are entering a new era of cardiac reconstructions that utilize transplanted viable human tissues—distinct from the era of nonviable homografts and mechanical/xenograft prosthetics.

Although allograft cardiovascular tissues are being used in a number of applications, the focus of this volume is on valved ventricular outflow tract reconstructions. As with all materials used in surgery, surgeons must learn the technical features specific to the new materials in order to fully exploit their potential benefits and unique characteristics. For allograft valves and conduits, this knowledge involves an amalgamation of old and new methods. Viable allograft tissue is a more forgiving and easier material with which to reconstruct outflow tracts than rigid prostheses. Allo-

grafts lend themselves to somewhat different reconstructive techniques that solve tricky anatomic problems while preserving physiological principles.

This book is primarily designed as a guide to the practicing cardiac surgeon for the use of allograft valves and conduits in cardiac reconstructions. Full descriptions are given for their use in various lesions, including indications, sizing, and specific surgical techniques for both simple implants and complex reconstructions. The cryobiology of viable human cardiovascular tissue cryopreservation is reviewed in Chapters 3, 4 and 5. An understanding of the principles and techniques is necessary for the safe participation in harvesting, thawing, preparation, and handling of these allografts.

Certain conventions are used in the book. Half-tone or carbon dust figures are used to depict surgical techniques as viewed from the surgeon's perspective. When figures are drawn from a nonsurgical view to make anatomic or other points, pen-and-ink line drawings are used. There is some repetition of steps in the depiction of various surgical techniques so readers can be spared page flipping to follow a procedure from beginning to end. The older term "homograft" is used generically, particularly when referring to information gained from the precryopreservation era (when the term was universally used), and the term "allograft" is adopted for more recent series, particularly when there is an expectation, or intention, of some element of donor cellular viability in the transplanted tissues. While not inherent in the vocabulary, this convention nicely separates the older from the current literature.

All surgeons performing valve replacements and congenital cardiac surgery should be interested in these methods. Cardiothoracic residents will hopefully benefit from the illustrations and descriptions as well. Cardiologists who time the referral of patients for valve surgery based on expected performance of various types of valve replacements will also be interested in human valve transplants.

All of the techniques depicted have been used by the author; they are based on original classic descriptions but as modified by a modest experience of 85 personally performed surgeries in neonates, children, and adults. The surgical techniques are, of course, derived from those of the pioneers in the field—Sir Brian Barratt-Boyes, Mr. Donald Ross, Dr. William W. Angell, Dr. Mark O'Brien, Mr. Magdi Yacoub, Professor Francis Fontan, Mr. Jaroslav Stark, and Dr. John Kirklin—as well as others cited in the text. One of the goals of this volume was to collate techniques into one resource. Our own variations are noted. When these techniques vary significantly from those previously promulgated, the rationale is given as well as indications for alternative methods. Allograft valve transplants involve the use of biologic tissues, which lend themselves to many creative reconstructions. Learning and mastering a flexible range of techniques is important and allows improved solutions to complex problems in ventricular outflow reconstructions. Expanding the ranks of surgeons facile with the use of cardiovascular allografts is the fundamental purpose of this book.

RICHARD A. HOPKINS

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