

functional capacity, and quality of life equal to or better than heart transplantation. Individually tailored immunosuppression will help to reduce its adverse effects (such as infection and malignancy), particularly in older patients with an attenuated immune system, leading to even better long-term outcome.

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INVITED COMMENTARY

The seminal report of 20-year survivors after cardiac transplantation, by Biefer and colleagues [1] portrays a remarkable success story for this life-extending therapy. The 55% actuarial survival at 20 years defines a highly effective, although not curative, therapy for an otherwise fatal condition. The evolution of heart transplantation has been well chronicled in the annals of transplant history [2]. After Barnard's historic first successful heart transplant in

1967, survival over the next year was generally miserable, with mortality among the first 100 patients exceeding 50% by the eighth postoperative day and a median survival of only 29 days! By the end of the next decade (before the introduction of cyclosporine), survival at 1 year was barely more than 60%. Few would have predicted a subsequent experience in which nearly half the patients are still alive 20 years after transplantation, outcomes that would

impress even the most ardent skeptic. So, what lessons and paradigm shifts in the cardiac surgical landscape have emanated from this experience?

Cardiac transplantation set the paradigm for other complex cardiac surgical endeavors with its evolution from a solely surgical-driven event to a comprehensive, multidisciplinary endeavor. The recognition of the need for multiple medical subspecialties to collaborate and share in “ownership” of patient outcomes was critical to the achievement of near routine long-term survival. This paradigm, rare in cardiac surgery before 1980, became the standard for two other areas of complex cardiac surgery—infant cardiac surgery and mechanical circulatory support—in which participants from multiple disciplines are involved in the decision-making process for surgery, daily rounding, and longer-term patient care management, and often during the operation itself. This multidisciplinary commitment to successful cardiac transplantation (and later, lung transplantation) spawned an international society (International Society for Heart and Lung Transplantation) that attracted specialists from numerous disciplines nearly from the time of its inception in 1981.

During the first 25 years after the advent of successful operations with cardiopulmonary bypass [3], success for most cardiac procedures was measured by hospital mortality. Cardiac transplantation was perhaps the first instance in which success required longer-term survival metrics. Improved outcomes mandated routine long-term surveillance and proactive intervention, concepts that have expanded to the care of patients receiving circulatory support [4] and infants with complex conditions such as hypoplastic left heart syndrome that require staged surgical palliation.

Finally, the era of government regulation in cardiac surgery really began in the mid 1980s when the United Network of Organ Sharing was awarded a federal contract for data collection from all heart transplant centers [2]. A system evolved whereby government oversight of outcomes after transplantation linked Medicare reimbursements to satisfactory institutional performance in cardiac transplantation. Public reporting of cardiac

surgical outcomes is now common in many states, and more recently the Interagency Registry for Mechanically Assisted Circulatory Support (INTERMACS) was created as a partnership between the National Heart, Lung, and Blood Institute, the Centers for Medicare and Medicaid Services, and the Food and Drug Administration [5]. Federal oversight of transcatheter aortic valve replacement (TAVR) procedures is now occurring through required participation in the national TAVR registry.

So, despite the limited (by donor availability) number of patients who have received a heart transplant for end-stage heart disease, this amazing procedure and multifaceted discipline have generated far-reaching effects on the overall field of cardiac surgery.

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