

Registry of the International Society for Heart and Lung Transplantation: Twenty-fourth Official Adult Heart Transplant Report—2007

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In this, the Twenty-fourth Official Report of the Registry of the International Society for Heart and Lung Transplantation (ISHLT), we present information on >76,000 heart transplants performed worldwide. As in last year's report,¹ we focus our principal analysis on recently transplanted patients rather than the entire cohort of heart recipients in order to provide a contemporary rather than historic analysis of the state of heart transplantation.

STATISTICAL METHODS

Survival rates were calculated using the Kaplan-Meier method² and compared using the log-rank test. Multivariate analyses were performed using Cox proportional hazard regression analysis.³ Results of the multivariate analyses are reported as relative risks (RRs), with either corresponding *p*-value and/or 95% confidence limits. Factors with a RR significantly >1 indicate that the factor is associated with an increased likelihood of the event (e.g., mortality, development of coronary allograft vasculopathy) occurring. Conversely, RR <1 indicates that the event is less likely to occur when that factor is present. Based on the RRs and baseline survivals obtained by the Cox proportional hazards models, predicted survival rates were computed for specified patient/donor/transplant profiles.

HEART TRANSPLANT DEMOGRAPHICS

The number of procedures reported to the Registry of the ISHLT each year peaked in 1994 at 4,428 (Figure 1). The slow but steady fall in reporting over the last 13 years has slowed and, for the first time since the peak, more procedures were reported during 2006 than

during the preceding year. In last year's report¹ we demonstrated that this overall decrease since 1994 was due to both decreased reporting of transplant procedures as well as to decreasing transplant procedure volumes in many countries. In 2004, based on an analysis of a variety of worldwide transplant registries, we estimated that >2,000 heart transplants were being performed annually at centers not reporting to the Registry.⁴ If accurate, this would put the annual worldwide number of heart transplants at >5,000.

Transplant activity continues to vary widely between the Registry centers. From January 1, 2002 through June 30, 2006, 42% of the reporting transplant centers averaged <10 procedures per year, and these centers account for approximately 13% of all heart transplant procedures. Furthermore, 18% of active centers averaged only ≤4 procedures per year. Higher-volume centers (those averaging >30 per year, representing approximately 11% of centers) account for 36% of the total number of procedures. These percentages are essentially the same as those from 10 years prior (1992 to 1996) (figure available at www.isHLT.org/registries).

The characteristics of the most recent cohort transplanted between January 1, 2004 and June 30, 2006 are shown in Table 1. The primary indication for adult heart transplantation during the last 3 years has remained relatively balanced between coronary heart failure and non-coronary cardiomyopathy (41% and 45%, respectively); however, the incidence of coronary heart failure cited as the primary indication has slowly decreased over the last 10 years. Valvular heart disease (3%), adult congenital heart disease (3%) and re-transplantation (3%) accounted for the remaining transplants. Over the last 20 years, the percentage of recipients over the age of 60 years has steadily increased, now accounting for almost 25% of recipients, whereas the percentage of recipients 40 to 49 years of age has continued to decline.

Forty percent of recent recipients were receiving intravenous inotropic support and almost 27% were on some type of mechanical circulatory support modality (22% on left ventricular assist device [LVAD] support). This is a significant increase compared with the time period of January 1, 1999 to June 30, 2001, when 34%

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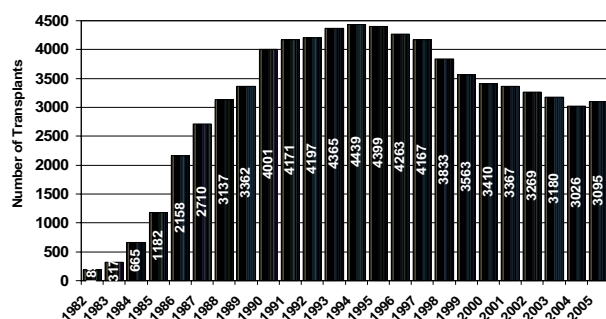


Figure 1. Number of heart transplant procedures reported to the Registry of the ISHLT by year.

were on inotropic support and 15% were on mechanical support (11% on LVAD),⁶ but is essentially the same as during 2002 to 2004.⁶ Substantially fewer recipients were hospitalized immediately prior to transplant in the most recent cohort compared with 1999 to 2001 (45% vs 72.3%).⁶ This likely reflects the current practice of outpatient management of LVAD bridge-to-transplant and inotrope bridge-to-transplant patients. The percentage of recipients whose most recent pre-transplant panel-reactive antibodies (PRA) were >10% has increased from 5% to 11% during this same time period.⁶

Mean donor age increased from a low of 23 years in 1983 to 31 years by 1999, and has remained steady thereafter. Donors >50 years of age, rarely reported prior to 1986, now account for >12% of donors, and donors >60 years of age account for approximately 1% of all donors.

Perhaps not surprisingly, geographic differences in demographics are noted. Although the distribution of recipient age was quite similar between European and North American centers (37.4 years compared with 31.7 years, respectively) (Figure 2), mean donor age was significantly higher for European centers than for North American centers (Figure 3). Sixty percent of donors in North America were <35 years of age, compared with only 40% of donors in Europe. Likewise, approximately 20% of donors in Europe were ≥50 years of age, compared with only 10% of donors in North America.

POST-OPERATIVE IMMUNOSUPPRESSION

Peri-operative anti-lymphocyte antibody use increased from 42% in 1995 to 52% in 2005 (Figure 4). This is primarily due to the increased use of the interleukin-2 receptor (IL-2R) antibodies, which were used in 31% of patients transplanted in 2005, compared with 16% in 2000; these agents were not available in 1995. Anti-thymocyte globulin use has remained stable at 20% to 22% of recipients, whereas the peri-operative use of OKT3 as an induction agent has continued to decrease,

and was used in <3% of heart transplant procedures in 2005.

Figure 5 portrays maintenance immunosuppressive protocols at 1-year post-transplant for three “snapshots” in time—2000, 2003 and the first half of 2006. For the first time, tacrolimus has overtaken cyclosporine as the most common calcineurin inhibitor (CNI) used (54% vs 40%, with 6% of recipients being reported as taking neither at 1 year). Mycophenolate mofetil (MMF) has remained the predominant anti-proliferative agent, used in almost 76% of patients at 1 year. Rapamycin (sirolimus) was used by 13% of patients at 1 year after transplant during the first half of 2006, which, although

Table 1. Characteristics of Recent Adult Heart Transplant Recipients (January 1, 2004 through June 20, 2006): Data Expressed as Mean ± Standard Deviation (range)

Characteristics	
Recipient age (years)	50.7 ± 12.5 (18–77)
Donor age (years)	33.5 ± 13.0 (9–67)
Recipient/donor gender (% male)	77.1%/70.0%
Recipient weight (kg)	77.4 ± 15.1 (38–120)
Recipient body mass index	25.7 ± 4.2 (15.2–47.5)
Recipient/donor diabetes mellitus	21.0%/2.4%
Recipient amiodarone use (USA only)	29.4%
Recipient/donor cigarette history	39.0%/24.4%
Ischemic time (hours)	3.2 ± 1.1 (0.2–8.0)
Most recent panel-reactive antibodies >10%	10.8%
Pulmonary vascular resistance (Wood units)	2.6 ± 1.4 (1.0–12.0)
HLA mismatches	
0–2	4.4%
3–4	39.7%
5–6	55.9%
Diagnosis	
Coronary artery disease	41.0%
Cardiomyopathy	45.2%
Valvular	2.6%
Re-transplant	2.8%
Congenital	3.2%
Other causes	2.3%
Donor cause of death	
Head trauma	67.1%
Stroke	18.2%
Other	14.7%
Pre-operative support (multiple items may be reported)	
Hospitalized at time of transplant	44.7%
On intravenous inotropes	40.1%
Left ventricular assist device	21.9%
Intra-aortic balloon pump	4.8%
Ventilator	2.2%
Right ventricular assist device	0.6%
Total artificial heart	0.3%
Extracorporeal membrane oxygenation	0.6%

Percentages calculated based only on known responses. *N* = 6,596.

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