Heart Transplantation From Donors of Different ABO Blood Type

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ABSTRACT

Introduction. ABO blood group compatibility between donors and recipients of heart transplants is required to reduce the risk of hyperacute rejection. Ideally, ABO-identical cardiac grafts should be used but transplantating using ABO compatible types allows reduced waiting times among recipients with rarer types without a significant increase in hyperacute rejection. However, previous reports have indicated that use of donors with minor ABO mismatches may adversely influence late outcomes, although more recent studies do not confirm this suggestion. Our purpose was to analyze this practice in our center.

Methods. We analyzed 121 patients who underwent heart transplantation between November 2003 and May 2008. One hundred nine patients (90.0%) received ABO-matched grafts (population 1 [P1]) and 12 (9.9%) received ABO-compatible grafts (population 2 [P2]). P1 included 60 group A, 44 group 0, and 5 group B patients; P2 included 5 group A, 5 group B, and 2 group AB patients. The populations did not differ statistically in age, gender, urgency status, surgical technique, ischemic time, donor features, or immunosuppression. They were assessed for left ventricle ejection fraction (LVEF), rejection, and mortality.

Results. There were no significant differences in total mortality (P1, 13.7%; P2, 8.3%), rejection grade ≥2R (P1, 21.1%; P2, 33.3%), or LVEF (6 months: P1, 65%; P2, 71%; 1 year: P1, 68%; P2, 69%).

Conclusion. Minor ABO mismatches did not adversely affect 1-year outcomes of heart transplantation. This practice may facilitate organ allocation for end-stage heart failure patients, thereby reducing waiting time for heart transplantation.

CARDIAC transplantation is now a well-accepted treatment for selected end-stage heart failure patients.[1] Usually, matched ABO group donor organs are used; however, minor ABO mismatches (different but compatible) allow a reduction in waiting time to heart transplantation for recipients with rarer ABO types allowing more effective usage of the most frequent blood type donors. Morbidity and mortality after heart transplantation depend on acute and chronic rejection. Hyperacute rejection is greatly reduced if a compatible (even if not identical) donor is used, following the same rules as for blood transfusions. However, there is controversy about the medium- and long-term effects of minor mismatches. Our heart transplantation program began in November 2003. We performed transplantation for 12 patients with ABO-compatible but nonidentical grafts. The purpose of this study was to assess the 1-year performance of these grafts.

PATIENTS AND METHODS

We analyzed 121 patients who underwent heart transplantation upto May 2008. Beside ABO compatibility, donor allocation was based on recipient urgency grade, body mass index, and age. Heart transplantation with minor ABO mismatch was only performed when the waiting list included no potential recipient with the same blood group as the donor. Heart transplantation was performed by the bicaval anastomosis technique. Data on donors and recipients were obtained from our prospective computerized registry. One hundred nine patients (90.0%) received ABO-identical grafts (population 1 [P1]) and 12 (9.9%) received ABO-different but compatible grafts (population 2 [P2]). In P2, 5 group A patients

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(41.6%) received organs from group 0 donors; 5 (41.6%) group B received organs from group 0 donors; and among 2 (16.6%) of group AB, 1 received a group A and 1 received a group 0 graft (Table 1). Both populations were analyzed for age, gender, United Network for Organ Sharing (UNOS) status, previous diagnosis, hemodynamic variables, surgical technique, ischemic time, extracorporeal circulation (ECC) time, donor characteristics, and immunosuppressive therapy. Patients were compared for left ventricle ejection fraction (LVEF), incidence of rejection, and mortality. LVEF was measured echocardiographically using the Teicholz technique. Endomyocardial biopsies (an average of 12 per patient) were performed for histological diagnosis of rejection (International Society for Heart and Lung Transplantation [ISHLT] classification, 2005). Coronary angiography was carried out 1 year after heart transplantation to exclude graft vasculopathy. Ninety-eight P1 patients were evaluated at 6 months and 81 at 1 year. Eleven P2 patients were evaluated at 6 months and 10 1 year after heart transplantation.

Fisher and Student *t* tests were used for statistical analysis of categorical and continuous variables, respectively. Survival was analyzed using the Kaplan-Meier method and the log rank test. $P < .05$ defined significance.

Table 1. Summary of Data and Results

	Population 1 ABO-Identical (n = 109)	Population 2 ABO-Compatible (n = 12)
Recipient ABO group		
A	60	5 (donor 0)
B	5	5 (donor 0)
AB	0	2 (donor A and 0)
0	44	0
Demographic data		
Age (mean, y)	53.0	51,5
Gender (male:female)	82:27	9:3
UNOS status 1a/1b/2	23/4/98	1/1/10
Diagnosis		
Dilated cardiomyopathy	52	4
Ischemic cardiomyopathy	31	7
Valvular	11	0
Restrictive	5	1
Hypertrophic cardiomyopathy	3	0
Hemodynamic data		
PAP (mean, mm Hg)	46,2	43,5
PVR (mean, U Wood)	3	3
TPG (mean, mm Hg)	7,8	11*
CI (mean, L/m^2)	2	2
VO_2max (mean, L/m/m^2)	12,8	11
Donor data		
Age (mean, y)	32.0	26,2
Cause of death: CT	72	8
Cause of death: CVA	35	3
Surgical data		
ECC time (min)	98	87,5
Ischemic time (min)	90,2	82
Initial immunosuppression		
Cya+MMF+Pdn	97	3
Tac+MMF+Pdn	11	1
Results		
Graft function		
6-mo LVEF	65%	71%
1-y LVEF	68%	69%
Rejection		
Hyperacute	1	0
Cellular (ISHLT grade ≥2R)	19	4
Late humoral	3	0
Graft vascular disease	1	0
Mortality Early + late	15	1

Abbreviations: CI, cardiac index; CT, cerebral trauma; CVA, cerebrovascular accident; Cya, cyclosporine; ECC, extracorporeal circulation; LVEF, left ventricle ejection fraction; MMF, mycophenolate mofetil; Pdn, Prednisone; PAP, systolic pulmonary artery pressure; PVR, pulmonary vascular resistance; Tac, tacrolimus; TPG, transpulmonary gradient.

**t* test; $P = .04$; all others, not significant.

RESULTS

The populations did not differ significantly in age, gender, UNOS status, diagnosis, hemodynamic data (except for transpulmonary gradient, which was higher in P2, $P = .04$), surgical technique, ischemic time, ECC time, donor features, and immunosuppressive regimens.

There were no significant differences in early plus late mortality; 15 patients (13.7%) in P1 and 1 patient (8.3%) in P2 died. The 1-year survival rates were identical (Fig 1). The only death in P2 occurred at 18 days after transplantation due to cerebral vascular accident. The incidences of rejection were comparable in both populations. Cellular rejection grade 2R or greater occurred in 19 P1 patients (17.4%) and 4 P2 patients (33.3%). One P1 patient and no P2 patients experienced hyperacute rejection; 3 P1 and no P2, patients displayed late humoral rejection and only 1 P1 patient experienced graft vasculopathy at the 1-year angiography. At 6 months echocardiographically measured, mean LVEF was 65% in P1 and 71% in P2. At 1 year the mean LVEF was 68% in P1 and 69% in P2. A summary of clinical data and results is shown in Table 1.

DISCUSSION

ABO blood group compatibility between donors and heart transplant recipients is required to reduce the risk of hyperacute rejection. Several reports, most of which concern kidney transplantation, suggest that the closer the donor-recipient match, the better the organ and patient survivals. Ideally, ABO-identical cardiac grafts are preferred. Minor ABO mismatches (different but compatible) allow a reduction in waiting times to heart transplantation for rarer ABO groups without significantly increasing hyperacute rejection.

Previous reports have indicated that minor ABO mismatches adversely affect long-term outcomes. Nakatani et al reported that recipients of ABO-identical cardiac donors showed better survival and fewer fatal rejections than those of compatible but not identical donors.[2] McKenzie et al reported similar results.[3] However, these studies were conducted over a decade ago. More recent reports, such as that published by Kocher et al, showed that minor ABO mismatches in heart transplantation do not adversely affect survival.[4] Nevertheless, rejection was more frequent among nonidentical ABO grafts. We did not confirm these results;

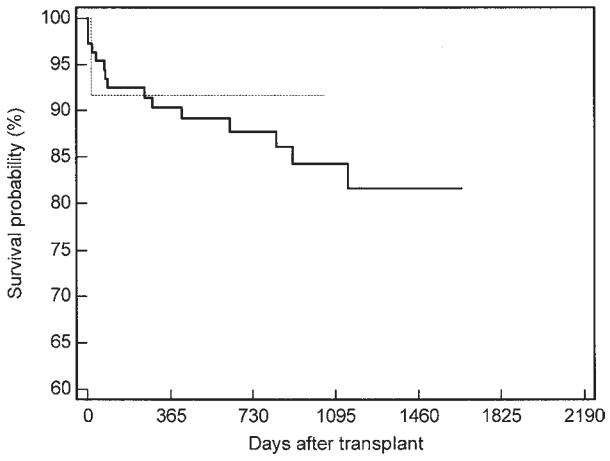

Fig 1. Actuaral survival of heart transplant recipients of ABO-identical (continuous line) and ABO-compatible (dotted line) groups.

our patients receiving nonidentical but compatible hearts displayed similar survivals, freedom from rejection, and LV function compared with those receiving ABO-matched hearts.

The main limitation of our study was the small number of patients and the short follow-up. Also, the method to assess the incidence of graft vasculopathy (coronary angiography only, without intravascular ultrasonography) was not sensitive.

In conclusion, use of ABO-compatible, nonidentical grafts may facilitate organ allocation and reduce waiting time to heart transplantation. We believe that minor ABO mismatches should be strongly considered, especially for severely ill patients with rare ABO blood groups.

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