Factors associated with long-term survival following cardiac transplantation

Kalp nakli sonrası uzun dönem sağkalımı etkileyen faktörler

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ABSTRACT

Objective: By improving short and long-term survivals, cardiac transplantation would be a more realistic curative treatment modality. The aim of this study was to evaluate factors associated with the long-term survival following cardiac transplantations in our center.

Methods: Forty-four patients were operated on cardiac transplantation between 1989 and November 2006. The study was designed in a retrospective manner and all data were collected from hospital records. Our study population consisted of 16 patients (Group A) who survived >1 month, but died <2 years after cardiac transplantation and 17 patients (Group B) who survived more than 2 years. All patients had triple immunosuppressive therapy (cyclosporine, azathioprine, corticosteroid). Statistical analyses were performed using Fischer's exact and Mann Whitney U tests, and multivariate regression analysis. Survival was analyzed using Cox proportional hazard regression analysis.

Results: Group B patients had lower pre-transplant creatinine levels (0.93±0.28 mg/dl vs. 1.16±0.21 mg/dl, p=0.033) younger donor age (24.5±6.3 years vs. 30.1±8.1 years, p=0.017) and more male donors (82.3% vs. 50%, p=0.05) as compared with Group A patients. The perioperative and follow-up analysis showed that patients with long-term survival had shorter ischemic time (141.5±33.2 min vs. 182.5±49.2 min, p=0.007), aortic cross clamp time (65.9±10.2 min vs. 83.6±7.9 min, p<0.001), less amount of blood transfusion (3.4±1.6 units vs. 5.0±1.5 units, p=0.01), better NYHA status after operation (1±0 vs. 1.63±0.72, p=0.014) and less frequent acute rejection episodes (11.8% vs. 68.8%, p<0.001) than those with short-term survival after operation. Cox proportional hazard regression analysis showed higher preoperative creatinine level (HR=42.6, 95% CI 4.67-388.21, p=0.001), acute rejection (HR=4.45, 95% 1.44-13.77, p=0.01), early postoperative functional status (HR=4.84, 95% CI 1.9-12.27, p=0.001) and unsatisfactory rejection surveillance protocol in the first 6 months after transplantation (HR=0.2, 95% CI 0.07-0.67, p=0.008) were prominent factors associated with the long-term survival.

Conclusion: The availability of the donor hearts from younger male donors with the shortest ischemic times is identified as the most significant factor improving long-term survival. The main strategy in cardiac transplantation should be shortening ischemic times and applying strict postoperative follow-up. *(Anadolu Kardiyol Derg 2008; 8: 360-6)*

Key words: Cardiac transplantation, rejection, ischemic time, survival analysis

ÖZET

Amaç: Günümüzde kısa ve uzun dönem sağ kalımda elde edilen gelişmeler sonrasında kalp nakli daha tercih edilebilir küratif bir tedavi yöntemi olmuştur. Bu çalışmanın amacı, kliniğimizin gerçekleştirdiği kalp nakli girişimlerinin uzun dönem sonuçlarını irdelemektir.

Yöntemler: Kırk dört hasta 1989 ile Kasım 2006 arasında kalp nakli ameliyatına alındı. Bu çalışma retrospektif olarak dizayn edilmiş olup, hastalara ait veriler hastane kayıtlarından toplanmıştır. Bu çalışmaya ameliyat tarihi üzerinden en az 2 yıl geçen 33 hasta dâhil edildi. Hastalar 2 gruba ayrıldı: Grup A'da kalp naklinden sonra en az 1 ay yaşamış, fakat 2 sene içinde kaybedilmiş 16 hasta yer almaktayken, Grup B'de 2 seneden fazla yaşayan 17 hasta yer almaktaydı. Tüm hastalar üçlü immünospressif (siklosporin, azatioprin, kortikosteroid) tedavi gördü. İstatistiksel analiz Fischer ve Mann Whitney U testleri, ve çoklu regresyon analizleri ile yapıldı. Sağkalım Cox oransal hazard regresyon analiz ile incelendi.

Bulgular: Grup B hastaları Grup A'ya göre daha düşük pre-transplant kreatinin seviyesine (0.93±0.28 mg/dl karşın 1.16±0.21 mg/dl, p=0.033), daha genç yaşta vericiye (24.5±6.3 yıl karşın 30.1±8.1 yıl, p=0.017) ve daha fazla erkek donöre (%82.3 karşın %50, p=0.05) sahipti. Perioperatif ve takip analizlerine göre uzun sağkalıma sahip hastalar daha kısa sürede kaybedilen gruba nazaran daha kısa iskemik (141.5±33.2 dak karşın 182.5±49.2 dak, p=0.007) ve aortik kros klemp (65.9±10.2 dak karşın 83.6±7.9 dak, p<0.001) sürelerine, daha az kan ürünü kullanımına (3.4±1.6 üniteye karşın

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5.0±1.5 ünite, p=0.01), transplantasyondan sonra daha iyi fonksiyonel kapasiteye (NYHA 1±0 karşın 1.63±0.72, p=0.014) ve daha az akut rejesiyon ataklarına (%11.8 karşın %68.8, p<0.001) sahipti. Cox oransal hazard regresyon analizi yüksek preoperatif kreatinin seviyesini (HR=42.6, %95 GA 4.67-388.21, p=0.001), akut rejeksiyonu (HR=4.45, %95GA 1.44-13.77, p=0.01), erken postoperatif fonksiyonel kapasiteyi (HR=4.84, %95GA 1.9-12.27, p=0.001;) ve postoperatif ilk 6 aydaki yetersiz rejeksiyon takibini (HR=0.2, %95 GA 0.07-0.67, p=0.008) uzun dönem sağ kalımı olumsuz etkileyen faktörler olarak ortaya koydu.

Sonuç: Uzun dönem sağ kalımı etkileyen en önemli faktör, genç erkek donörlerden alınan kalbin ek kısa iskemik sürede nakledilmesidir. Kalp nakli programlarında uygulanması gereken en önemli strateji iskemik sürenin en aza indirilmesi ve sıkı postoperatif takibin uygulanmasıdır.

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Anahtar kelimeler: Kalp nakli, rejeksiyon, iskemik süre, sağ kalım analizi

Introduction

Cardiac transplantation is a proven treatment modality for end stage heart failure in experienced centers with comparable clinical outcomes (1). The success of cardiac transplantation is evaluated by the early-mid-long term surveillance results and quality of life. Improvements gained over 35 years of cardiac transplantation have decreased early mortality (three months) because of graft failure, infection or rejection dramatically. However, the success of cardiac transplantation is determined by long-term survival. In some detailed studies, it has been shown that long-term survival following cardiac transplantation is correlated with preoperative and postoperative factors in both the donor and recipient (2, 3). Recent trends show increasing time on waiting lists, more frequent emergency transplantations, more usage of donor hearts with longer ischemic times and those with increasing inotropic support (4-6). Although these risky procedures for cardiac transplantation are widely accepted, more detailed studies are needed to evaluate factors influencing early and late mortality following cardiac transplantation. Given these circumstances, we aimed to investigate factors affecting long-term survival in a single center experience.

Methods

Between 1989 and November 2006, forty-four patients underwent cardiac transplantation at our center. The study was designed in a retrospective manner and all data were collected from hospital records. Investigating risk factors associated with long-term survival, we grouped patients who survived more than 24 months or died earlier. The first reason was the first longest survivor-recipient in Turkey died at the end of his second year. The second, we used Shumway technique for orthotopic cardiac transplantation until 1989 (7), but after 2002 we have preferred the bicaval technique and the longest survivor with this method was in his third year during this study. The third, most recipients died in their second postoperative year. Our study population consisted of 16 patients (Group A) who survived >1 month, but died < two years after cardiac transplantation and 17 patients (Group B) who survived more than two years. Remaining 11 patients were excluded from the study since 8 of them are still alive but have not filled the 24 months period. Two patients died in their first month, possibly due to early graft failure and the last one underwent heterotopic cardiac transplantation.

All patients had triple immunosuppressive therapy (cyclosporine, azathioprine, corticosteroid). Endomyocardial biopsy (7), cytoimmunologic monitoring (8), echocardiography (9) and pace electrocardiography (10) are the techniques that we have used for follow-up and rejection surveillance. Endomyocardial biopsy and echocardiography were used to identify acute rejection, and we performed coronary angiography and, echocardiography when a recipient was hospitalized because of heart failure and chronic rejection. The standardized grading system for the pathologic diagnosis of rejection in cardiac biopsies and its revision were used to address a uniform description and grading scheme for acute cardiac rejection (11).

Pre-transplant clinical and demographic variables, peroperative and follow-up data including long-term complications are collected prospectively and recorded in our center's computer based data bank. We have investigated our study groups by evaluating this data bank retrospectively.

Statistical Analyses

All data were analyzed by using SPSS for Windows version13.0 software (Chicago, IL, USA). Data are shown as mean ± standard deviation (min-max) values. Univariate and multivariate analyses were used to assess risk factors as independent predictors of late mortality. Cox proportional hazard regression analysis was used to assess risk factors as independent predictors of patient survival. Categorical data between groups were compared with Fischer's exact test, while continuous and discrete data were analyzed with Mann Whitney U-test. All variables significant at the $p<0.1$ level in the univariate analysis were included into Cox proportional hazard regression test. Statistical significance was determined with $p<0.05$ values.

Results

Preoperative Findings

Demographic variables and follow-up periods for both groups are shown in Table 1. More patients in Group A needed more inotropic support. In Group B patients, younger age and male gender were more prominent. Preoperative creatinine levels were lower in Group B (p=0.033). Although patients in Group B had poorer NYHA preoperative status, they had better long-term survival. Comparison for preoperative risk factors and echocardiographic data are shown in Table 2. When groups were compared according to the echocardiographic data, no significant difference was determined except mitral insufficiency (p=0.041).

Per- and Postoperative Findings

Comparisons of peroperative and postoperative findings for both groups are shown in Table 3. When ischemic times between groups were compared, we observed significant differences. Cold ischemic and aortic cross clamp (ACC) times were longer in Group A than in Group B (p=0.007 and p<0.001, respectively). The

need for inotropic support and prostaglandin I2 after operation were more prominent in Group A as compared with Group B (p=0.014 and p=0.031, respectively). We also observed more sinus node dysfunction in Group A (p=0.004). In the intensive care unit, less blood products were transfused to Group B patients (p=0.01).

Late Period Complications

Late Mortality

One patient in Group A died because of the right ventricular rupture and acute tamponade following cardiac biopsy for rejection surveillance. Four patients died because of infections. Six patients in Group A died in their first year because of acute cellular rejection. Four patients in Group B died following rehospitalization with the diagnosis of chronic rejection, supported by echocardiographic evidence of segmental wall movement impairment and decreasing in ejection fraction. Mortality causes in groups are given in Table 4.

Chronic Rejection

Eleven patients in Group A and two patients in Group B had severe rejection in their first year. Six patients in Group A died from acute rejection and 3 patients died from chronic rejection. In Group B, mortality was observed in 7 patients due to chronic rejection. Late mortality due to ventricular fibrillation was thought to be a cause for chronic rejection. In Group B, 12 patients had new

Table 1. Comparison of groups for preoperative demographic data

Parameters	Group A (n = 16)	Group B (n = 17)	*p
Congestive symptoms, months	15.0±10.8 (1-36)	24.3±12.6 (6-58)	0.028
Mean follow-up, months	9.1±8.9 (1-24)	49.6±26.4 (25-98)	<0.001
Time in waiting list, months	7.3±8.7 (1-36)	12.8±14.8 (1-58)	0.23
Demographic variables			
Recipient gender, male, n (%)	15 (93.8)	13 (76.5)	0.17
Recipient age, years	31.6±13.1 (16-58)	29.5±10.9 (16-51)	0.85
Donor age, years	30.1±8.1 (14-48)	24.5±6.3 (16-40)	0.017
Recipient weight, kg	63.5±7.9 (46-76)	66.3±12.9 (45-98)	0.56
Male Donor, n (%)	8 (50)	14 (82.3)	0.05
Etiologic factors			
Ischemic cardiomyopathy, n (%)	12 (75)	12 (70.6)	0.95
Dilated cardiomyopathy, n (%)	4 (25)	5 (29.4)	0.78

Data are represented as Mean±SD (Min-Max) values and proprotion/percentage
* Fischer's exact test for categorical data comparison and Mann Whitney U-test for comparison of continuous variables

Table 2. Comparison of groups by means of preoperative risk factors

Variables	Group A (n = 16)	Group B (n = 17)	*p
Preoperative NYHA class	3.75±0.45 (3-4)	3.71±0.47 (3-4)	0.85
Patients in inotropic support, n (%)	7 (43.8)	6 (35.3)	0.63
Family history, n (%)	1 (6.3)	1 (5.9)	0.96
Urea, mg/dl	54.8±10.4 (38-78)	51.2±16.7 (27-94)	0.11
Creatinine, mg/dl	1.16±0.21 (0.8-1.6)	0.93±0.28 (0.5-1.5)	0.033
Lung failure, n (%)	1 (6.3)	1 (5.9)	0.96
Liver failure, n (%)	2 (12.5)	2 (11.7)	0.95
Renal failure, n (%)	3 (18.8)	2 (11.7)	0.59
Cardiothoracic index, %	0.59±0.04 (0.5-0.7)	0.59±0.02 (0.6-0.7)	0.74
LVESD, cm	6.63±0.52 (5.6-7.8)	6.59±0.89 (5.1-8.9)	0.85
LVEDD, cm	6.99 ± 0.65 (5.4-8.2)	6.6±0.78 (5.4-8.4)	0.13
Mitral regurgitation, degree	2.94±0.57 (2-4)	2.41±0.71 (1-4)	0.041
Tricuspid regurgitation, degree	0.19±0.4 (0-1)	0.06±0.2 (0-1)	0.53
Ejection fraction, %	21.7±5.9 (10-35)	24.2±9.9 (10-45)	0.53
Pulmonary artery pressure, mmHg	46.1±6.2 (40-60)	47.7±11.1 (30-70)	0.79

Data are represented as Mean±SD (Min-Max) values and proprotion/percentage
* - Fischer's exact test for comparison of categorical data and Mann Whitney U-test for comparison of continuous variables
LVEDD - left ventricle end diastolic diameter, LVESD - left ventricle end systolic diameter, NYHA - functional capacity

onset segmental wall motion abnormality on echocardiography in the first year after the transplantation.

Infection

Ten patients in Group A and 3 patients in Group B had severe infection. Four patients in Group A died because of infection due to *Enterobacter* sepsis, gram-negative sepsis, *Neisseria* pneumonia and *Klebsiella* pneumonia. The remaining patients were cured following appropriate antibiotic treatment and were discharged.

Risk Factors Associated with Long-term Survival

Survival curves of all patients are shown in Figure 1. The longest follow-up time was 98 months and 66% of our patients (n=22) had survived more then one year, 33% (n=11) had completed their third years following the transplantation.

Univariate analysis showed that advanced donor age and female donor, higher preoperative creatinine level, prolonged ischemic and aortic cross-clamp time, postoperative blood products transfusion, early postoperative NYHA status, rejection

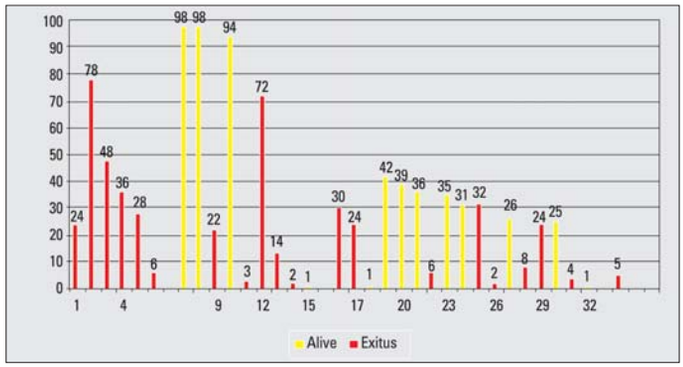

Figure 1. Survival of recipients after heart transplantation

Table 3. Comparison of groups for peroperative data and postoperative follow-up

Variables	Group A (n = 16)	Group B (n = 17)	p•
*Anastomoses technique, n (%)	13 (81.3)	15 (88.2)	0.59
Ischemic time, min	182.5±49.2 (120-270)	141.5±33.2 (110-200)	0.007
Cross-clamp time, min	83.6±7.9 (65-98)	65.9±10.2 (48-92)	<0.001
**Total ischemic time, min	265.6±51.8 (200-345)	208.7±33.4 (174-280)	0.001
Inotropic support, day	6.75±2.9 (3-14)	4.5±2 (2-10)	0.011
Prostavazine usage, n (%)	14 (87.5)	9 (52.9)	0.031
Sinus rhythm, n (%)	10 (62.5)	17 (100)	0.004
Permanent pacing need, n (%)	6 (37.5)	5 (29.4)	0.6
Post-operative PAP, mmHg	39.2±7.6 (25-50)	35.5±12.4 (25-80)	0.31
Intubations time, hour	27.5±7.6 (15-48)	31.4±27.2 (10-129)	0.12
***Drainage , mLs	1759.4±1740.2 (450-7000)	1003.5±545.1 (110-2750)	0.13
Chest tube removal, day	8.1±7.6 (2-28)	3.1±0.7 (2-5)	0.006
Transfusion, blood units	5.0±1.5 (1-8)	3.4±1.6 (2-7)	0.01
Mobilization, day	4.75±1.1 (2-7)	5.1±2.1 (2-12)	0.98
Intensive care unit stay, day	30.5±22.3 (12-100)	27.1±16.2 (14-80)	0.76
Hospital stay, day	87.1±57.9 (20-193)	68.1±35.6 (30-180)	0.68
Renal function impairment, n (%)	6 (37.5)	2 (11.7)	0.09
Infection, n (%)	10 (62.5)	3 (17.6)	0.007
Rejection, n (%)	13 (81.3)	5 (29.4)	0.002
Endomyocardial biopsy, n (%)	3 (18.8)	5 (29.4)	0.49
Anti-rejection therapy, n (%)	12 (75)	6 (35.2)	0.064
Rejection monitorization, n (%)	9 (56.3)	14 (82.3)	0.1
Acute rejection, n (%)	11 (68.8)	2 (11.8)	<0.001
Chronic rejection, n (%)	1 (6.3)	12 (70.6)	<0.001
Early NYHA functional capacity	1.63±0.72 (1-3)	1±0 (1)	0.014
Hospital mortality, n (%)	9 (56.3)	0	<0.001
Late mortality, n (%)	7 (43.8)	7 (41.2)	0.63

Data are represented as Mean±SD (Min-Max) values and proprotion/percentage
•- Fischer's exact test for comparison of categorical data and Mann Whitney U-test for comparison of continuous variables
NYHA - New York Heart Association, PAP - pulmonary artery pressure
* Orthotopic, bicaval orthotopic
** Total time from cross-clamping the donor's aorta to releasing cross-clamp from recipient's aorta
*** Total drainage including postoperative hemorrhage and serous fluid

episode type and frequency were found to be significant factors associated with long-term survival (Table 5). Cox proportional hazard regression analysis showed higher preoperative creatinine level, acute rejection, early postoperative functional status and unsatisfactory rejection surveillance protocol in the first 6 months after transplantation were prominent factors associated with the long-term survival (Table 6, Fig. 2).

Table 4. Comparison of groups for mortality analysis

Variables	Group A (n=16)	Group B (n=17)
Mortality, n (%)	16 (100)	7 (41)
Rejection, n	10	7
Acute	6	
Ventricular fibrillation during hospitalization	2	3
Sudden death	1	
Chronic	1	4
Infection, n	4	
Pneumonia	2	
Sepsis	2	
Acute renal failure, n	1	
Iatrogenic, n	1	

Table 5. Risk factors for late death (univariate analysis)

Risk Factor	p
Demographic variables	
Donor age	0.011
Male donor	0.024
Preoperative creatinine	0.009
Per operative variables	
Cold ischemic time	0.05
Cross-clamp time	0.002
Postoperative transfusion units	0.002
Inotropic support	0.03
Postoperative Follow-up	
Early functional capacity	<0.001
Rejection monitorization	0.045
Number of rejection periods	0.004
Acute rejection	0.002
Chronic Rejection	0.002

Table 6. Cox proportional hazard analysis for risk factors for late death

Factor	Hazard ratio (95% CI)	p
Preoperative high creatinine level	42.6 (4.67-388.21)	0.001
Acute rejection	4.45 (1.44-13.77)	0.01
Early worse functional capacity	4.84 (1.9-12.27)	0.001
Rejection monitorization	0.2 (0.07-0.67)	0.008

Discussion

Many investigators have described various risk factors affecting survival after cardiac transplantation. There are differences in risk factors between different studies. Defining risk factors help to anticipate problems in recipients after cardiac transplantation, and to provide appropriate and early treatment of complications. Defining risk factors also provide appropriate procurement and matching strategy of donor hearts. Matching donors with appropriate recipients serve to improve long-term survival, and decreases mortality and morbidity for high-risk recipient and donors. We found significant differences between two groups.

Donor age and allograft coronary artery disease

Multicenter data define advanced donor age as a prominent risk factor for poor survival (3, 12). In our study, mean donor age was found to be significantly lower in the long-term group ($p = 0.017$). Although antigenic sensitivity causes negative results in younger recipients, we have not observed a difference for age distribution in our study groups. Literature data suggest advanced age as a prominent risk factor for increased allograft coronary artery disease (13). In our study, we observed more allograft coronary artery disease in long-term survival group. Since 69% of patients in short-term survival group had died in their first year, it was not possible to compare two groups for allograft coronary artery disease.

Obesity

Obesity becomes a significant risk factor for the general population when accompanied by hypertension, dyslipidemia, diabetes and coronary artery disease. This is also observed in most of transplant patients. Many investigators have declined that obesity and hyperlipidemia may be related to allograft coronary artery disease and possibly unsatisfactory immunosuppression (14, 15). Grady et al. (16) declined that pretransplant obesity increased mortality without increasing the risk of acute rejection and allograft coronary artery disease. In contrast to the literature, we observed that the recipients in the long-term group were more obese when compared to the recipients in the short-term group. We did not observe a

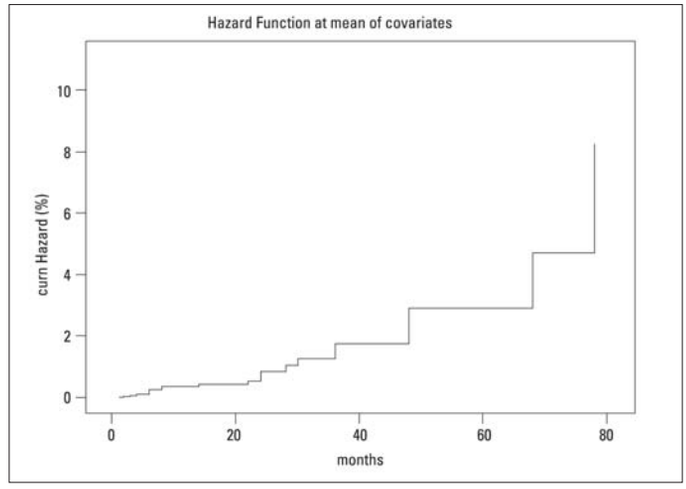

Figure 2. Cox hazard regression analyses of recipients after heart transplantation

difference in complications related to obesity between two groups. Most of the patients in our study were not morbidly obese and therefore possibly did not face significant complications from obesity. Only two patients in Group B and one patient in Group A had new onset diabetes that needed oral anti-diabetic treatment.

Gender

In some studies, male gender was associated with short-term survival, and this was thought to be due to ischemic cardiomyopathy (17, 18). Ischemic cardiomyopathy etiology can cause the development of allograft coronary artery disease. Young age and male gender can be prominent factors for long-term survival. In one study, male donor and female recipient combination was declared to be a cause for increased rejection in the first year and the reason for this was thought as an increased immune response in women or dimension discrepancy (19). Lietz et al. (20) pointed out higher acute rejection incidence in female recipients in the first 6 months and declared early mortality (< 6 months) caused by infection. Allograft coronary artery disease is more seldom in female patients during the first postoperative year (17). In our study, there were four females in Group B and one in Group A. Although we did not find a significant difference in gender between our recipients ($p = 0.17$), we found more female donor hearts in the short-term survival group ($p = 0.05$).

Time in Waiting List

Although we have not found waiting time as a risk factor for the long-term survival, there are relevant data for prolonged time in waiting lists which as a significant risk factor for early mortality (17,18). Improved therapies for heart failure increase the waiting time without causing secondary organ damage. In this study, we observed that the patients in the long-term survival group spent more time on waiting lists with longer symptom duration. Beyond these facts, there was no difference between groups before transplantation in terms of functional status criteria. Longer times in waiting lists did not cause significant organ dysfunction in Group B patients preoperatively. Patients in Group B had been involved to the waiting list earlier with elective criteria's for transplantation.

Rejection

We observed at least one rejection episode in 10 patients in Group A and we lost 69% of patients in their first year because of acute cellular rejection and early graft failure. In Group B, only three patients had an acute rejection episode. When considering two years period as a cut-off point for the long-term survival, rejection itself is a terminal point other than a risk factor.

Infection

We observed more infectious events in Group A ($p = 0.007$). Three of the eight patients died because of infection in the early period. Incidence of more infectious events was found as a risk factor for increased mortality itself. Infection is a serious issue in these immunosuppressed patients although proper antibiotics are used. Infection control is very important for the long time survival.

Ischemic Times

Prolonged ischemic time, which can be a cause of graft failure itself, is thought to be a prominent risk factor for survival. Ischemic times can be shortened with the success of improving organizations in donor organ transportation. Donor cold ischemic and recipient operation ischemic times were statistically different between groups. In Group B, shorter overall ischemic times were observed. In Group A, donor cold ischemic time was longer because of the difficulties in transportation of donor hearts. Prolonged ischemic times in donor hearts by causing early graft failure manifest clinically with prolonged inotropic needs and sinus node dysfunction. Both of these negative consequences were observed more in short-term survival group (69%). Cold ischemic time on an average was 4 hours in Group A and 3 hours in Group B. Better results would be accomplished if total ischemic time could be reduced to less than 3 hours. Intraregional organ sharing would be the best option other than interregional transfers of donor hearts. Cardiac recipient transfer to that region should be considered as a second best option to avoid prolonged ischemic times.

Quality Standards of Life after Transplantation

The main reason for early death after transplantation was the lower standards of home-life of our patients. The end stage cardiac failure is observed mostly in patients with lower social and economical level. After transplantation they must be followed very closely and carefully in Turkey. They have to be informed about their post-transplant life, exercise capacity, sexual behavior, infection risk and work area. We observed if the recipients were careful with health, work and medication, than they had longer high-quality life with longer survival. If we worry that recipients can not continue their high-quality life, we hold them in the hospital and give them a special room and work.

Limitations

The patient number was low, quite enough to compare both groups. May be, it would be better if we could perform angiographic evaluation in all patients including early deaths.

Conclusion

By improving short and long-term survivals, cardiac transplantation would be more beneficial treatment modality. Towards this goal, the availability of the donor hearts from younger male donors with the shortest ischemic time would be the best factor in improving long-term survival. The main strategy in cardiac transplantation should be shorten ischemic times and enforce strict postoperative surveillance and follow-up protocols

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