Original Research

Orthotopic Heart Transplantation: Ten Years' Clinical Experience

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Key words:
Transplantation, heart failure, ventricular assist devices.

Introduction: Heart transplantation is the "gold standard" in the treatment of patients with end-stage heart failure who satisfy strict selection criteria.
Methods: We reviewed ten years' clinical experience (1996-2006) from 53 orthotopic transplants in our centre.
Results: Low perioperative (3.7%) and long-term (7.5%) mortality rates yielded a 95% survival rate in the first year, 92% at five years, and 70% at ten years—significantly better than the corresponding rates worldwide. In addition, excellent functional recovery was achieved in all transplant recipients.
Conclusions: The strict application of international criteria in the selection of both candidates and donors, together with uninterrupted, multidisciplinary follow up, have made it feasible to perform heart transplantation with excellent results, despite the curiously low number of potential recipients and the shortage of acceptable donor hearts.

Manuscript received:
November 13, 2007;
Accepted:
May 5, 2008.

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Heart transplantation is the most effective method of treatment for patients with end-stage heart failure and has been proven worldwide to offer full restoration of their functional capacity.[1] Absolute requirements for placement on the waiting list for transplantation are the exhaustion of all conventional medical and surgical therapies[2,3] and the documentation of both, a low functional class[4] (ACC/AHA stages C and D, previously NYHA classes III and IV), and a poor life expectancy according to internationally accepted criteria.[5] In recent years, the use of ventricular assist devices (VAD) has altered the transplant horizon considerably,[6] with temporary clinical stabilisation serving as a "bridge" therapy in selected patients, until a suitable donor heart can be found.[7,8]

The initial results from 22 patients who underwent heart transplantation in our centre during the first five years of the programme have already been published.[9] Here we describe the results from 53 patients who underwent transplantation for end-stage heart failure during a ten-year period (1996-2006).

Methods

Patient selection

Our hospital's heart transplantation team follows the guidelines of the American Cardiology Societies (ACC/AHA)[10] and of the International Society for Heart and Lung Transplantation (ISHLT).[11] Briefly, suitable candidates for transplantation should

be under 65 years old, in end-stage heart failure, without severe disease of other organs or recent infection. Absolute requirements are that conventional methods of treatment have been exhausted, the patient is compliant, free of drug, alcohol, or nicotine dependence, and has a supportive family and social environment.[12] Among the selection criteria special attention is paid to the evaluation of pulmonary circulation, which is compromised early in the patient's course with the appearance of pulmonary hypertension.[13-15] The preoperative evaluation of pulmonary circulation and the measurement of pulmonary resistances—trans-pulmonary gradient (TPG) and pulmonary vascular resistance (PVR)—is performed via right heart catheterisation under baseline conditions and after administration of vasoactive drugs (sodium nitroprusside, dobutamine, milrinone, nitric oxide).[16-18] The determination of non-reversible hypertension (>4 Wood units or TPG >15 mmHg) is an absolute contraindication for orthotopic heart transplantation, being associated with a high probability of immediate graft right ventricular dysfunction.[19,20]

Preoperative support

In 19 patients (35.8%) there was a need for preoperative support using intravenous inotropes/vasodilators with continuous, low-dose dobutamine or milrinone administration via a permanent Hickman catheter and a portable infusion pump.[21] This inotropic support had the additional benefit of reducing resistances in the case of persistent pulmonary hypertension, and we have previously reported our experience from 20 patients who were accepted on the waiting list when their TPG returned to reasonable levels.[22] A total of 19 patients were on home administration of inotropes before transplantation. A further 6 (11.3%) received inotropic medication combined with mechanical support, employing an intra-aortic balloon pump in the intensive care unit prior to surgery. Implantation of a VAD (left or biventricular) was performed in 23 patients, 8 of whom underwent heart transplantation with success. Finally, 25 patients (47.1%) underwent preoperative defibrillator implantation for treatment of malignant tachyarrhythmias.

Choice of donor

Donor hearts were accepted from brain-dead victims of traffic accidents or spontaneous cerebral haemorrhage, preferably from subjects younger than 35 years, in order to avoid as far as possible the presence of coronary artery disease. Meticulous recording of the donor's history to rule out diabetes mellitus, hypertension and coronary artery disease was of vital importance.[23] Desirable, though not essential, was the absence of a history of cardiac arrest after the accident, of prolonged hypotension (<90 mmHg), and of excessive doses of sympathomimetic drugs to maintain the donor's blood pressure.[24] Preservation of the graft was carried out *in situ* with cold (4°C) HTK cardioplegia (Histidine/Tryptophane/Ketoglutarate, "Custodiol", Dr. F. Köhler Chemie GmbH, Germany).[25,26] The mean age of the 53 donors was 27.1 ± 9.6 years (Table 1) and the mean duration of graft ischaemia was 208.6 ± 50.4 minutes. In all cases detection of class I and II human leukocyte antigen (HLA) antibodies was performed and donor and recipient were cross-matched using flow cytometry.

Surgical technique

Despite the introduction of the bicaval graft anastomosis in the 1990s,[27,28] heart transplantation technique has not deviated much from the brilliantly simple method of Lower and Shumway, which consists of suturing two atria (right and left) and two large vessels (aorta and pulmonary artery).[29] This method was used in the majority (51) of our patients.

Postoperative medications

Postoperative immunosuppression included a few days' induction therapy with anti-thymocyte globulin (ATG),[30] and maintenance therapy with cyclosporine, low-dose steroids[31] and the lymphocyte antimetabolite mycophenolate mofetil[32] instead of azathioprine. The remaining medication consisted of antihypertensive drugs, statins, aspirin, and prevention against opportunistic infections, as well as agents to avoid osteoporosis from long-term steroid administration.

Table 1. Age of recipients and donors.

Age	Recipients	Donors
10-19	6	10
20-29	8	25
30-39	9	13
40-49	17	3
50-59	10	2
60-69	3	0
Mean	38.1 ± 13.3	27.1 ± 9.6

A week after successful transplantation, the patients followed a strict protocol of myocardial biopsies for prompt diagnosis of acute graft rejection.[33,34] The degree of rejection was determined using the internationally accepted ISHLT system[35] and rejection was treated with intravenous administration of methylprednizolone, 1 g for 3 days, for grades 1B, 2, 3A/B.[36] Biopsy was repeated 5-7 days after completion of steroid treatment in order to confirm that rejection had been resolved. In the case of steroid-resistant rejection ATG was administered again for 7-10 days,[37] after which time cyclosporine was replaced by the newer immunosuppressant tacrolimus, which has proved effective for this purpose.[38]

The hospitalisation time for the 51 patients discharged alive was 31.1 ± 18.9 days, with a range of 15-105 days (11.3 ± 12.9 days in the intensive care unit, 20.1 ± 11.3 days in the ward).

Results

Over a ten-year period (1996-2006), 348 patients with advanced heart failure and no apparent clinical contraindications for heart transplantation underwent the thorough pre-transplant evaluation described above. Subsequently, 175 patients were referred to the Selection Committee, which in addition to the regular transplant staff also includes specialised consultant physicians and transplant coordinators who form the backbone of the programme. After a detailed data discussion, 114 patients were found to satisfy the criteria for inclusion. However, 29 declined to proceed, so finally only 85 patients were registered with the National Transplant Organisation. As expected, a number of candidates (32 patients) died before a suitable graft could be found (on-list mortality 37.6%), after waiting 123.3 ± 252.8 days (range 3-1387 days). However, mortality on the waiting list was not the same at the beginning of the programme compared to that in recent years. The reason was the introduction of VADs as a "bridge" to transplantation in the year 2003. The waiting time until transplantation or death in 55 patients who entered the programme before the introduction of VADs was 143.2 ± 216.1 days, and 26 patients died without receiving a transplant (on-list mortality 47.2%). In contrast, for the 41 transplantation candidates enrolled after the introduction of VADs, although the waiting time did not differ significantly (131.8 ± 162.9 days), deaths were few, as only 6 patients died without transplantation (on-list mortality 14.6%) and only one of them was on mechanical support.

Overall, during the decade 53 patients received a heart graft after a mean wait of 146 ± 158.4 days (range 0-744 days). The aetiology was dilated cardiomyopathy in 36, ischaemic in 13, and valvular in 4 patients (Table 2). It should be noted that during the period prior to transplantation periodic clinical and haemodynamic examinations were performed in all candidates, including those on mechanical support. Although the latter achieved rapid clinical stabilisation, none of them showed cardiac functional recovery while on VAD support, based on haemodynamic and echocardiographic criteria. The clinical data from the 53 transplant patients are shown in Tables 2-6.

Two patients died in hospital (3.7%), the first from diffuse intraoperative haemorrhage after three previous operations for valvular disease, and the other from a fulminant pneumonia due to multiresistant pseudomonas, on the third postoperative day.

Complications are common after transplantation, but the great majority can be treated successfully. In

Table 2. Clinical characteristics of 53 heart transplant patients.

Age (years)	38.1 ± 13.3
Sex (M/F)	41/12
Cause of heart failure:	
Ischaemic cardiomyopathy	13 (24.5%)
Dilated cardiomyopathy	36 (68.0%)
Valvular cardiomyopathy	4 (7.5%)
Functional class (ACC/AHA):	
Stage C	35 (66%)
Stage D	18 (34%)
Peak oxygen consumption (ml/kg/min)	14.3 ± 7.4
Left ventricular ejection fraction (%)	19.8 ± 5.8

Table 3. Preoperative haemodynamic parameters.

Mean pulmonary artery pressure (mmHg)	31.1 ± 9.9
Pulmonary capillary wedge pressure (mmHg)	24.0 ± 9.8
Trans-pulmonary gradient (mmHg)	7.2 ± 3.2
Pulmonary resistance (Wood units)	1.85 ± 0.92

Table 4. Preoperative medication.

Diuretics	53 (100%)
Angiotensin-converting enzyme inhibitors	38 (71.6%)
Angiotensin II receptor blockers	10 (18.8%)
Digoxin	34 (64.1%)
Beta-blockers	27 (50.9%)
Amiodarone	27 (50.9%)

Table 5. Preoperative support.

Implantable defibrillator	25 (47.1%)
Preoperative use of intra-aortic balloon pump	6 (11.3%)
Ventricular assist device	8 (13.2%)
Home administration of inodilators	19 (3.8%)

the immediate postoperative period all transplant patients required inotropic support with dobutamine and/or adrenaline, from 24 hours to 7 days, while in 12 cases an intra-aortic balloon pump was required because of transient but severe graft dysfunction. Administration of inhaled prostaglandins and nitric oxide also helped in treating patients with pulmonary hypertension.

Coagulation problems were diagnosed and treated promptly by the Coagulation-Haemostasis Division with administration of the appropriate blood products.

During scheduled myocardial biopsies, 24 patients (45.3%) showed graft rejection, which was treated successfully with optimisation (further steroids, ATG) of the immunosuppressive regimen. In 4 patients, it was judged necessary to replace cyclosporine with tacrolimus for control of persistent cellular rejection.

Five patients (9.4%) exhibited acute renal failure after transplantation and were placed temporarily on dialysis. Another 11 (7 men and 4 women) showed renal dysfunction with elevated serum creatinine (upper normal limit 1.6 mg/dL in men and 1.4 mg/dL in women). Diabetes mellitus due to steroids was observed in 9 patients, whose blood glucose levels returned to normal after steroids were discontinued. Finally, another 2 patients developed hirsutism due to cyclosporine, which gradually disappeared when its dosage was reduced or it was switched to tacrolimus (Table 6).

Postoperative infections occurred in 50 patients (94.3%), with 81.1% of the episodes occurring during the first 6 months. Twenty-one cases of pneumonia (39.6%), 20 urinary tract infections, 2 of gastroenteritis, 5 of herpes zoster, and 2 infections of the internal jugular vein were documented. Primary bacteraemia was found and treated successfully in 17 patients. In addition, laboratory tests in 28 patients showed cytomegalovirus infection, which was treated with ganciclovir. One patient developed rhabdomyolysis and 2 others polyneuropathy, from which they all recovered. Five patients suffered transient strokes, one due to an *Aspergillus* abscess (diagnosed by paracentesis) that responded to intensive antifungal treatment. Four patients underwent permanent pacemaker implantation later in the follow up because of symptomatic bradyarrhythmias, while another 4 showed early (within 30 days) moderate tricuspid regurgitation. In a fifth patient the same valvulopathy appeared after the first year. So far, none of these patients has required valve repair or replacement.

All patients underwent coronary angiography one month after transplantation, and annually thereafter. In recent years this examination was supplemented by intravascular ultrasound (IVUS). Despite the administration of statins and aspirin, the study showed the presence of cardiac allograft vasculopathy (chronic rejection) in 14 patients (27.4%), usually several years after the operation. In 2 patients vasculopathy was already present on the first coronary arteriogram and was attributed to coronary artery disease in the donors, who were aged 50 and 53 years. In 2 patients angioplasty with stenting was performed successfully.

Table 6. Clinical events in 53 transplant patients in relation to the time from operation.

	0-30 days	1-6 months	6-12 months	>1 year
No. of patients	53	51	51	51
Deaths	2	0	0	4
Rejection	22	19	10	15
Infections	28	15	1	6
Tricuspid regurgitation	4	0	0	1
Allograft vasculopathy	0	0	3	11
Acute renal failure (temporary dialysis)	5	0	0	0
Renal dysfunction	0	3	4	4
Bradyarrhythmia	0	1	0	3
Diabetes mellitus (*de novo*)	9	0	0	0
Neoplasm	0	0	0	2
Hirsutism	0	2	0	0

Of the 51 patients discharged, 4 died during follow up, 2 from lymphoma (15 and 8 months after transplantation), one from alcoholism (after 6.5 years), and the fourth from chronic graft rejection (after 8 years). Thus the overall mortality, including the immediate postoperative deaths, was 11.2% (6 patients) over a mean follow up of 49.1 ± 38.6 months (range 1-127 months).

Discussion

This paper describes the results from 53 patients with end-stage heart failure who were treated with orthotopic heart transplantation during a ten-year period. Survival was 95% in the first year, 92% at 5 years and 70% at 10 years, significantly superior to the rates reported by the ISHLT (Figure 1). From June 1998 there were no perioperative deaths and all patients (42) were discharged. The 47 transplant survivors were free of failure and enjoyed an excellent quality of life. As reported above, the perioperative mortality (30 days) was 3.7% (2 patients), the long-term mortality 7.5% (4 patients) and the overall mortality 11.2%, comparable to rates reported from established transplantation programmes in other countries.[39]

In spite of the well known poor supply of donor hearts in Greece,[40] which indirectly discourages prospective candidate referral and limits the number of transplants performed by our centre, thorough preoperative selection and preparation, together with aggressive treatment of postoperative complications, contributed to the satisfactory survival and functional

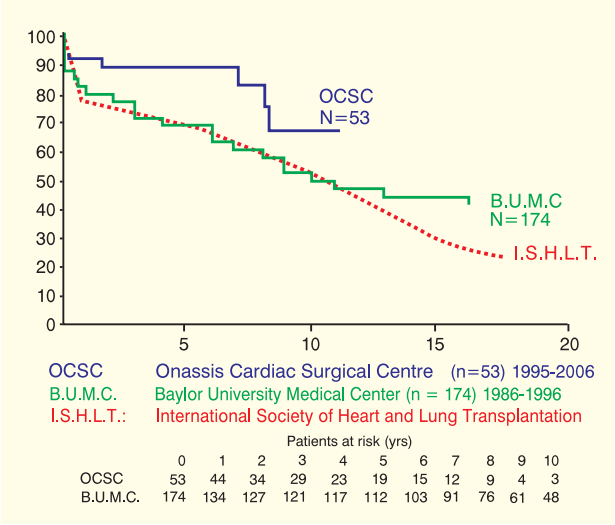

Figure 1. Survival curve of transplant patients (n=53) in comparison with the International Society for Heart and Lung Transplantation and the heart programme of the Baylor University Medical Centre (Dallas, Texas).

recovery. It is clear that strict selection ensured the optimal clinical course during the waiting period of candidates accepted for the small number of suitable grafts. It must be emphasised that recipient acceptance is the most crucial step towards a successful transplantation,[41,42] with major factors being the careful selection of patients with reversible pulmonary hypertension[43,44] and the employment of inotropic and/or mechanical support in the case of sudden haemodynamic deterioration.[45] Despite the voluminous literature, there is no agreement regarding either the level of pulmonary hypertension that prohibits transplantation, or the acceptance of a specific parameter expressing it.[14,19] Our personal experience suggests that TPG is the most sensitive index and that a reduction of TPG <15 mmHg in response to pharmacological manipulation should be documented before a candidate is accepted for transplantation.[13,46]

Our care of candidates prior to transplantation (medical, haemodynamic and arrhythmiologic) was intensive and constant, as evidenced by the high rate of intravenous inodilators, biventricular pacing,[47] defibrillators and VADs used. The mortality on the waiting list decreased after VADs came into use, a fact that supports the usefulness of mechanical support as a "bridge" to transplantation,[48] including the proven reduction of pulmonary hypertension.[49,50] To date we have implanted 23 VADs in 22 patients, 8 of whom underwent transplantation with complete success (8/8). It must be stressed, however, that VADs did not reduce patients' time on the waiting list; they simply enabled survival until a suitable graft could be found.[51]

Concerning the choice of donor, important factors influencing acceptance (apart from the blood group) are the donor/recipient body dimensions and the distance from the donor hospital, which determines the ischaemia time.[52] The relations between age, sex, dimensions, predicted ischaemia time and the presence of pulmonary hypertension are crucial for the immediate outcome. They are the product of experience acquired after the performance of a large number of transplants.[53] For example, grafts from middle-aged donors are a relative risk factor,[54,55] although that does not mean that grafts from younger individuals are always suitable.[56] Almost catastrophic graft dysfunction was experienced in 3 of our patients who received grafts from young donors (19-22 years) after administration of unusually high dosages of vasoconstrictive drugs.[57] The grafts recovered after 3, 7, and 9 hours on extracorporeal circulation.[58] At this point mention should be made of the so-called "ex-

panded" acceptance criteria and by extension, of the "high-risk" donors which result from a steady (or even diminishing) supply of grafts in the face of the continuously increasing demand.[59] There is a relative abundance of conflicting references in the literature concerning the use of suboptimal grafts.[24,60] Through careful selection, mature transplantation teams may achieve acceptable early results,[61,62] but not long-term ones.[63] In this regard, it is our belief, based on previous unfavourable experience,[46] that grafts from donors aged >50 years (especially without coronary angiography), from smokers, hypertensives or diabetics, from those with left ventricular hypertrophy or from donors who have had excessive noradrenalin administration, are at a high risk for early failure.[39,46,60] Even if the recipient survives, the probability of future allograft vasculopathy is high, thus influencing survival.[64] It is worth recalling that 2 patients in our programme received grafts with atheromatous lesions from donors over 50 years old.

A short comment on the surgical technique: the introduction in 1990 of bicaval anastomosis and its variations,[27,65,66] which allow better orientation, more complete emptying of the atria, and avoid distortion of the tricuspid annulus (causing insufficiency of the valve), along with a lower rate of conduction disturbances, has not met with universal acceptance. A significant percentage of transplant centres still use the classical technique (Lower), either exclusively or in combination with the bicaval method,[67] while there are reports that even the newer technique does not preclude complications.[28] Its presumed main advantage, the prevention of tricuspid insufficiency, early on depends on the presence of significant pulmonary hypertension, while later it is associated with the frequency of myocardial biopsies, which may injure the subvalvular mechanism.[68-70] Our experience up to this point has not revealed enough shortcomings to force abandonment of the classical method (Table 6). Briefly, selection of the right donor heart and acceptance of a suitable recipient are of equal importance, while the technical part is the simplest. Heart transplantation really starts after surgery.[71]

Acute rejection was not a cause of death in this series of transplants, probably because of the aggressive immunosuppression, even for low grades (ISHLT 1B or 2). We share the conviction that long-lasting, low-grade cellular rejection, left untreated, gradually leads to allograft vasculopathy.[72,73] Furthermore, rejection rates decrease with time, which is why 41 of 66 instances (62.1%) were observed in the first 6 months.[34] This policy may have led to a higher incidence of infections but without paying a price, as will be discussed below. It should also be noted that the low incidence of lymphoma (2 cases) does not support the possibility of over-immunosuppression.[74,75]

The introduction of cyclosporine in the 1980s dramatically altered the horizon of transplantation, with reduction of acute rejection and infection.[76,77] The initially proposed "double" regimen of cyclosporine/azathioprine or cyclosporine/steroids[31,78] did not live up to expectations[46,79] and was soon replaced by the "triple" regimen of cyclosporine/azathioprine/steroids, which achieved better survival.[80,81] Subsequently, in 1993, the replacement of azathioprine by mycophenolate mofetil further reduced acute rejection, again increasing survival.[82,84] More recent data suggest a probable beneficial effect of mycophenolate mofetil in preventing allograft vasculopathy and in reducing malignancies.[85,86]

Concerning the perioperative administration of ATG, it has so far been invaluable in our experience. It delayed the administration of nephrotoxic cyclosporine until haemodynamic stabilisation and restoration of renal function had been achieved (1-7 days), without running the risk of acute rejection.[87,88] The newer monoclonal antibodies (basiliximab, daclizumab) are not superior in terms of immunosuppressive action, although they are probably associated with fewer infections.[89-91]

Finally tacrolimus, a newer immunosuppressant than cyclosporine with a similar mechanism of action (calcineurin inhibition), is superior when rejection does not respond to bolus steroid administration. Then, it substitutes for cyclosporine as "rescue therapy".[92] That is why it is kept in reserve rather than being a first choice drug in our programme. Newer data show tacrolimus to be more effective in the prevention of severe (>3A) rejection,[93] while it is known to be superior in the control of hyperlipidaemia and hypertension.[94]

Postoperative infections were common, but apart from one in a patient with cardiac cachexia, all were treated successfully with appropriate antibiotics and antiviral agents.[95] Infection diagnosis was the product of continuous patient monitoring, while treatment was aggressive and in many cases long-term. The loss of only one of the 21 patients with postoperative pneumonia, a complication associated with a mortality rate of 15%,[96] is a testimony to the alertness of the Infectious Disease team. Particularly intensive was the treatment of cytomegalovirus, in view of its catastrophic effect on target organs and its implication in early allograft vasculopathy.[97]

The occurrence of vasculopathy (chronic rejec-

tion) is the main cause of reduced life expectancy in heart transplant patients.[98] In our series its incidence (27.4%) was lower than that reported in the international literature, where 50% of the transplant recipients show coronary lesions of varying degree within the first 5 years.[99] This caused the loss of our first patient, 8 years after transplantation. In this regard, all transplant recipients were taking the indicated antihypertensive medications (converting enzyme inhibitors, angiotensin II inhibitors, calcium blockers),[100] all but 3 were taking statins for control of high cholesterol and triglycerides,[101,102] and all were on aspirin.[103,104] It should be stressed that our consistent policy of gradual steroid reduction with complete cessation after the first year must have contributed decisively, if not to the prevention of vasculopathy,[105] at least to controlling the metabolic disturbances, such as obesity, diabetes mellitus, hypertension and dyslipidaemia, usually seen after transplantation.[106,107] Also, steroid discontinuation is associated with a reduction of infection and probably of neoplasms.[108,109] Osteoporosis with vertebral fractures occurred in one female patient at the start of the programme. Since then, all transplant patients have been given calcium, vitamin D, and calcitonin as required.[110,111]

The introduction of IVUS has increased our ability to diagnose allograft vasculopathy promptly.[112] Thickening of the endothelium >0.5 mm within the first year after transplantation is a harbinger of angiographic manifestations of vasculopathy within 5 years and affects mortality.[113] It is an indication for mycophenolate mofetil to be replaced by the newer immunosuppressive drugs sirolimus and everolimus (proliferation signal inhibitors), which appear to inhibit further vascular wall hyperplasia.[114,115] Already 14 transplant recipients in our programme are taking everolimus while awaiting results of their annual IVUS test.

This report vindicates our clinical philosophy regarding the painstaking and uncompromising selection of suitable candidates for heart transplantation, as well as the necessity for a continuous, multifaceted and organised treatment of postoperative complications. It also challenges the widely held view that performing transplants on an occasional basis is inevitably associated with unfavourable results.[116]

It might be useful in this regard to review a decade's results (1986-1996) obtained from 174 heart transplants performed at Baylor University Medical Centre (Dallas, Texas), which had the same philosophy, leadership, and evaluation algorithm described.[46] Although the first-year survival at Baylor was 82% compared to our 95%, further analysis of statistical data (personal communication) allowed the creation of a survival curve (Figure 1), which over the long haul was clearly inferior to that of our more recent patients. This divergence is attributed to the long-term care of the former group, which was transferred to family doctors and to local hospitals (other than Baylor). Their different approach to treating problems and complications became apparent, but much later. In contrast, our programme endorses a policy of 24-hours a day, 356 days a year monitoring and of readmission of our transplants whenever required, under close coordinator supervision. Based on these lessons it would be inconceivable to turn over the long-term responsibility of our transplant recipients to non-specialists, at least during the current phase of the programme.

Finally, it should be noted that the cost of hospitalisation (from the day of transplant to the day of discharge) ranged between €40-60,000, of which only €16,000 is covered by the Greek state through some form of health insurance.

Conclusions

Review of a decade's experience at the Onassis Cardiac Surgical Centre confirms that heart transplantation is the "gold standard" in treating patients with end-stage heart failure. The operation provides a second chance for survival and an incomparable quality of life. A successful programme should have priority allocation of all necessary resources, unity and discipline. Selection of the inevitably small number of candidates must be thorough and should be based on objective criteria, so as to remain above criticism. Hasty decisions have no place in a mature transplant programme, as they result in loss of both the patient and the graft. After successful transplantation the bond between the patient and the team remains perpetual and unbreakable. Ultimate success and programme recognition depend on the continuous, multifaceted and long-term follow up of its transplant patients.

Acknowledgements

The transplant team wishes to thank the "Alexander S. Onassis" charitable foundation for supplying the programme infrastructure, as well as for training the core staff abroad. Doctors, nurses, technicians, physiotherapists and other departments participating in the programme are too numerous to mention individually; we thank them all collectively for their contributions.

Appendix 1. Specialised Consultants

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Infectious Diseases:	G. Saroglou, A. Stoupi
Dental surgeon:	F. Tzerbos
Nephrology:	D. Vlachakos
Neurology:	S. Gatzonis, L. Soufleri
Neurosurgeon:	S. Tzannis, G. Vrettakos
Oncology:	Th. Karmiris
Ophthalmology:	I. Datseris
Orthopaedics:	A. Antonopoulos
Plastic surgeon:	A. Vlastou
Psychiatry:	D. Souras
Rheumatology:	M. Tektonidou
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Urology:	G. Alivizatos
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The transplant team also acknowledges the former transplant coordinators, Ch. Louri, D. Kollia, Ch. Zamanika and F. Antonoglou, whose dedication to transplant patients and unflagging follow-up played a major part in the programme's success.

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