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Donor Nephrectomy

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1. Introduction

Donor selection for allografting of a non-paired vital organ, such as the heart, is necessarily limited to cadaveric or possibly xenogeneic sources. In contrast, because of the presence in most normal persons of two kidneys – each with a physiological reserve capable of providing four times the minimal required function – renal transplantation has become an accepted medical procedure using cadaveric and living related or unrelated volunteers as organ sources.

Each of these donor categories presents unique ethical, legal and social implications (Spital, 1991; Woo, 1992).

That must be addressed carefully to protect not only the health and rights of the recipient but also those of the donor.

Of equal importance are the medical aspects of donor evaluation and the technical features of the nephrectomy procedure.

The initial functional capacity of the transplanted kidney is largely independent of immunological factors; however, it is highly dependent on the efficacy of donor preparation and procurement techniques in preventing ischemic injury.

It has been necessary to adapt the surgical procedures to develop combination procurement techniques that provide equal protection for the extra renal organs as well as the kidneys.

2. Living kidney donor

The first successful renal transplant was performed in 1954. With the development of effective immunosuppressive regimens, this observation was extended to less compatible intrafamilial donors and eventually to unrelated donors.

Until the early 1980s, many dialysis patients had doubt to heed cadaver donor transplantation because its morbidity and mortality rates were manifold.

With the introduction of calcineurin inhibitors, monoclonal and polyclonal antibody immunosuppression and other new immunosuppressive agents into clinical regimens, the gap in graft survival between living related and cadaveric renal transplantation narrowed considerably.

Living related donor grafts still have a 10 to 12 % better survival rate at 1 year and a significantly higher probability of function thereafter, however (Cecka and Terasaki, 1998).

Family members as suitable organ donors were recommended. (Delmonico et al., 1990).

The experience of using living unrelated kidneys in transplantation has shown that these organs have a graft survival profile that, in fact approaches that of related donors (Terasaki et al., 1995).

Even with the current widespread application of calcineurin inhibitors and monoclonal and polyclonal antibody immunosuppression, there is a persisting biological advantage of living donor kidneys (living related donor or living unrelated donor) over cadaver donor allograft.

Although short – term graft survival after transplantation from both donor sources is excellent, the 5 year success rate of greater than 80 % that can be attained using living donor kidneys exceeds by 10 to15% of any reported cadaver donor results.

Another justification for using living donors is that the operation can be specifically planned, limiting waiting time on dialysis.

Of greater importance is the ability to perform the transplant when the recipient is in optimal medical condition. This ability is particularly pertinent for diabetic patients, whose condition may deteriorate rapidly on dialysis. Finally, there is the risk that the patient may develop antibody to HLA antigens during prolonged dialysis, especially if intermittent blood transfusions are required.

The final reason for the continued expansion of living donor transplantation is the insufficient supply of cadaver donor organs required to fulfill the needs of renal failure victims awaiting transplantation (Cohen et al., 1998).

For each 1 million of the population, approximately 75 to 80 renal transplants would have to be performed annually to keep pace with the more than 100 new patients diagnosed with end – stage renal disease and previous transplant recipients whose allograft eventually fail.

Even in areas with outstanding cadaver donor retrieval rates or with less strict criteria for donor selection (Kauffman et al., 1997), the number of potential recipients greatly exceeds the supply of donor's kidneys. A steadily growing population of patients is being maintained on dialysis in most areas of the world.

With the extension of minimally invasive techniques to living kidney donation the potential adverse impact of the operation has become less significant.

Although, it was thought that laparoscopic nephrectomy for renal transplantation might have some adverse effects to the donor organ because of prolonged warm ischemic interval, it is known that laparoscopic donor nephrectomy leads to decreases analgesic dose, decreased length of hospitalization, early return to normal daily activity and less surgical morbidity.

Nowadays, new devices are used in laparoscopic nephrectomy, have led to shorten ischemic time. So that its results are now comparable to those achieved after classic open nephrectomy. (Ratner et, al., 1997).

Laparosopic donor nephrectomy (LDN) has become the preferred technique for live donor nephrectomy at most transplant centers in the United States (Ratner et al, 1999; Jacobs et al, 2004).

Survival studies indicate that the 5 year life expectancy of a unilaterally nephrectomized 35 year – old male donors is 99 % compared with 99.3 % normal expectation (Merrill, 1964).

The quality of life after kidney donation has been reported in 979 patients who had donated a kidney for transplantation (Johnson et al., 1997). Most of the responders had an excellent quality of life.

Multivariate analysis of those who did not respond favorably identified the following two factors for negative psychosocial outcome; relatives other than first degree and recipients who died within 1 year of transplantation.

Concern has been raised that healthy human donors might develop hypertension and renal dysfunction years after unilateral nephrectomy. Follow – up studies of hundreds of living donors for 20 years have been unable, however, to identify any convincing evidence of long – term functional abnormalities associated with unilateral nephrectomy (Najarian et. al., 1992).

Regarding to these considerations, living donors continue to be the significant proportion of that donor pool. The proportion varies from less than 5% in some areas to 100% in areas where cadaver donor transplantation is unavailable. At present in U.S. about 27% of transplanted kidneys are obtained from living donors.

3. Medical evaluation and selection of the living donor

Advantages of transplant should be reasonable in comparison with its limited risks and both patient and donor should be justified for accepting it.

All potential donors are first screened for emotional stability and motivation as well as blood group ABO typing.

Incompatibility of ABO blood group between donor and recipient has resulted in irreversible rejection. Because of the extreme shortage of donor kidneys, especially for blood group O recipients, this requirement has been constantly reassessed. Several groups have reported successful results after transplantation of blood group A_2 kidneys into group O recipients (Nelson et.al., 1998). Approximately 20% of blood group A persons are subtyped as A_2. The highly successful transplantation of A_2 kidneys into group O recipients has been explained by the low expression of A determinants in A_2 kidneys compared with A_1 kidneys.

Potential donors remaining after initial screening process are evaluated to confirm excellent general health and bilateral renal function (kasiske et. al., 1996).The basic criteria for a renal donor are an absence of renal disease, an absence of transmissible malignancy, and an absence of active infection.

Many of the studies are directed toward detection of exterarenal pathology. This medical evaluation may reveal significant but treatable problems of which the donor was unaware. (Table 1) (Ko, et al. 2001)

Family conference with transplant-dialysis team ABO blood group, tissue typing, leukocyte cross match, ± mixed lymphocyte culture
History, physical examinations, serial blood pressure determinations
Cell blood count, coagulation profile, BUN, serum creatinine, FBS, cytomegalovirus antibody, human immunodeficiency virus antibody, hepatitis B and C testing, cholesterol, triglycerides, calcium, phosphorus, urine analysis, urine culture, 24-hour urine protein
Chest radiograph, intravenous pyelogram or ultrasound electrocardiogram
Aortogram or digital subtraction angiography and/or three-dimensional computed tomography

Table 1. Evaluation of living donors.

The remaining studies are concerned with the quality of renal function and the clarification of any anatomical abnormalities in either kidney. It must be determined that the non-donated kidney is normal.

Final selection of the donor, if several medically suitable relatives are available is made on the basis of histocompatibility testing. Selection also may be determined on the basis of age (avoiding elderly volunteers) or on less objective factors, such as the special social obligations of particular family member.

It is now clear that living unrelated donor kidneys provide significant physiological and long term survival advantages and are being accepted with increasing frequency. In most centers donation for monetary compensation is not allowed (Childress, 1996; Quinibi 1997).

The imaging of kidneys prior to nephrectomy performs by several methods, including: ultrasound (US); conventional angiography (CA); digital subtraction angiography (DSA); computed tomography (CT) and magnetic resonance imaging (MRI), each of which has innate problems. A single modality to assess vasculature, renal parenchyma and urinary drainage is preferred. The pre-nephrectomy anatomy which most anticipates complications during the transplant procedure is the presence or absence of variant arteries (Stephen Munn, 2010).

For the living donor who has been identified by these criteria, the classic gold standard aortogram has been the final diagnostic study scheduled. The ability to visualize data obtained with CT or MRI in a three-dimensional method carefully reconstructing the images, isolating arteries, veins or parenchymal structures has assisted surgical planning. Surgical goals are to minimize warm ischemia time, to preserve renal vessels, and to preserve ureteral blood supply.

Magnetic resonance imaging and angiography provide suboptimal information on renal vascular anatomy (Kok NF, et al., 2008).

Arvine-Berod and et al compared the sensitivity of computed tomography angiography (CTA) and magnetic resonance angiography (MRA) in preoperative renal vascularisation in living kidney donors. They determined that MRA is less sensitive than CTA in living kidney donors especially in the detection of multiple renal arteries. (Arvine-Berod A, et al., 2011)

4. Post operative care and complications

We administer a first generation cephalosporin for 24 hours, beginning 1 hour before surgery.

Most of patients are ready for discharge from the hospital in 3 to 4 days and for return to employment by 4 weeks.

Urine culture, renal function tests and a complete blood count are reassessed before discharge. The patient then has follow – up evaluations at increasing intervals.

The perioperative mortality rate for kidney donors is estimated to be 0.30 % (kasiske et al., 1996). Approximately 20 deaths have been reported after living donor allograft donation over 35 years (Jones et al., 1993). Other complications of the kidney donor procedure are generally minimal and easily remediable (Johnson et al., 1997).

The current overall complication rate is approximately 2 % (Bia et al., 1995).

Most complications occur in the perioperative period, with atelectasis, urinary infection, wound problems and prolonged bowel dysfunction accounting for the majority.

One of the most dangerous complications is thrombophlebitis with possible life-threatening pulmonary embolus.

Fatal cases of hepatitis, myocardial infarction and depression, leading to alcoholism have been reported.

Longer term morbidity should be minimal. Endogenous creatinine clearance rates rapidly approach 70 to 80 % of the preoperative level, and reports of late renal failure have been extremely rare. An important factor is the exclusion during the selection process of pathology or potential pathology in the donors.

The short and long – term morbidity of donor nephrectomy are generally considered to be low enough, and probability of successful graft outcome high enough, to make the risks acceptable for fully informed donors.

The decrease of worsening donor and noticeable successful results of transplantation from unrelated living donors caused some centres became interested to donation from strangers (Spital, 1994). According to our experience, male donors have better prognosis and survival compared with females.

5. Cadaver kidney donor

If a suitable living donor is not available, most patients with end-stage renal failure should be considered for cadaveric renal transplantation, not only because transplantation is more cost-effective but also because true rehabilitation seldom is achieved on long-term dialysis (Evans et al., 1985). Although the long-term success rates remain inferior to those achieved with interfamilial transplantation, projections indicate that cadaver donor allograft currently have a 1-year graft survival rate of greater than 85% and graft half-life (time to loss of 50% of currently surviving grafts) has improved to at least 10 years (Cecka and Terasaki, 1998).

Present methods of preservation may permit 72 hours maintenance of the cadaver donor kidney in a condition sufficiently viable to allow return of function after revascularization. Opportunities are present for evaluation of the physiological and bacteriological condition of the donor kidney and for pursuing histocompatility selection after the organ is removed from the cadaver. Because of these factors and increasingly widespread establishment of the definition of brain death guidelines that allow removal of organs that are more likely to be physiologically healthy, cadaver donor renal allograft continue to account for approximately

75% of reported transplants. The total number is limited only by the unsolved worldwide problem of persisting barriers to organ donation (Cohen et al., 1998).

6. Evaluation of the potential cadaver kidney donor

The ideal donor is a young, previously healthy individual who has sustained a fatal head injury or cerebrovascular accident.

Transplantation of kidneys from small pediatric donors is possible, although the technical aspects are more exacting. When kidneys are obtained from a pediatric donor less than 3 years of age, most groups recommend en bloc transplantation of both organs into a single adult recipient. We have reported a successful En Bloc bilateral kidney, Aorta, and Vena Cava Transplantation from a 3 years old deceased boy to an adult recipient in our center in Guilan University of Medical Sciences, Iran. (Fig. 1) (Mokhtari et al., 2010)

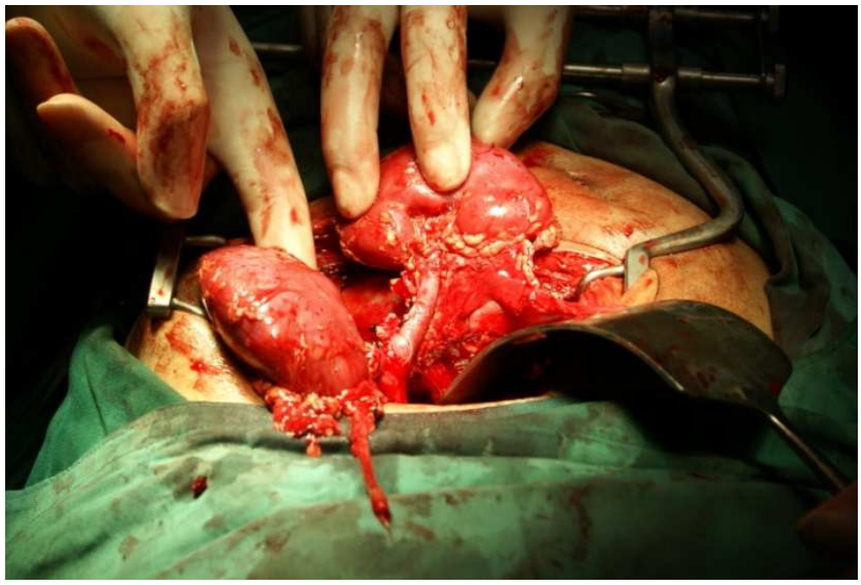

Fig. 1. En-bloc kidneys after transplantation (recipient). After irreversibility of brain damage is established, maintenance of renal blood flow and function without any complication and adequate hydration is important. Minor terminal elevations of blood urea nitrogen and creatinine levels are not unusual and do not necessarily exclude the donor.

A major concern for the donor team is the risk of transmitting infection with the allograft into an immunosuppressed recipient.

Diagnosis of irreversible coma, or brain death, which has been recognized by neurologists and neurosurgeons, has presented a set of circumstances that of great potential benefit to patients needing organ allografts. The concept and definition of brain death do not depend in any way on transplantation.

The discontinuation of respiratory support and other extraordinary therapy for patients who have been declared dead after careful assessment of brain function should be considered a humane and necessary act without regard to the possibility of such a person serving as an organ donor.

After extensive assessment of such patients, neurologists and neurosurgeons universally have agreed that once functional death of the brain stem occurs, there is no chance for partial recovery, and artificial support should be withdrawn.

7. Nonhuman kidney donor

The need for kidneys is growing steadily, whereas organ donation has leveled off or decreased in some regions. This situation has resulted in a rapidly escalating demand for medical and economic resources to support long-term peritoneal dialysis or hemodialysis programs. Because the supply of such resources is limited, constant efforts must be made to improve the efficacy and increase the number of transplants performed. The latter is determined primarily by the number of donor organs available.

Nonhuman (xenogenetic) donors represent a possible alternative source of transplantable organs. Beginning in the earlry1900$_s$, several isolated attempts were made on to transplant kidneys from various animal donors into patients with renal failure. If a successful approach to the use of such organs could be established, an unlimited pool of donors free of most of the legal and moral issues associated with the use of human organs could be made available.

The major obstacle to such an approach has been the increased intensity of the rejection response elicited by the more diverse genetic relationship between donor and recipient (Ko, et al. 2001).

For several reasons, there is renewed interest in the possibility that xenotransplantation could provide the solution for the shortage of human donor organs. The first reason for this enthusiasm is the increasingly successful use of genetic engineering to produce transgenic animals expressing recombinant molecules designed to moderate the immune response (Bhatti et al., 1999; Schmoeckel et al., 1998; Waterworth et al., 1998; Zaidi et al., 1998). Another reason for the renewed optimism regarding xenotransplantation has been the demonstration in preclinical primate models that tolerance of allograft can be produced without the need for long-term immunosuppression (Kirk et al., 1999).

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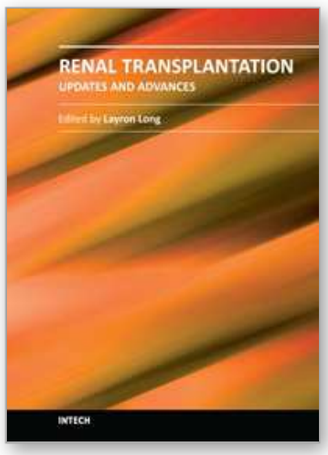

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This book presents a nice international compilation of scholarly papers and chapters which address the latest advances in renal transplant surgery. These works cover a variety of topics; the last advance and success of renal transplant science: biochemistry, immunology, molecular genetics, pharmacology - pharmacogenetics, pediatric transplant and a few rare uropathies that warrant organ replacement.

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