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Future aspects of renal transplantation *

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Summary. New and exciting advances in renal transplantation are continuously being made, and the horizons for organ transplantation are bright and open. This article reviews only a few of the newer advances that will allow renal transplantation to become even more widespread and successful. The important and exciting implications for extrarenal organ transplantation are immediately evident.

Renal transplantation has excited both physicians and patients for more than 30 years. The role of transplantation in the treatment of renal failure was not firmly established until the early 1960s, after the introduction of the immunosuppressive agents azathioprine and prednisone [17] and, somewhat later, antilymphocyte globulin (ALG) preparations [18]. With the advent of cyclosporine in the late 1970s and early 1980s [2], renal transplantation expanded greatly. At present, 1-year patient survivals of >90% and graft survivals of 80% for cadaveric allografts are not uncommon [14]. However, even with these improved results, some patients lose their grafts to rejection. Ideally, the goal is complete patient and graft survival with a very low incidence of morbidity. Many of the concerns of the early 1960s remain: donor organ preservation, immunosuppression, rejection, sensitization, infection, and issues related to organ supply and distribution. These problems are discussed, and some of the more recent developments and their implications for the clinical renal transplant surgeon are pointed out.

Organ preservation

Donor organ preservation has recently benefited from a major new advance. Historically, cold storage with relatively high osmotic preservation fluids (i.e., modified Collin's solution) has been the generally accepted mode of preservation [4]. The ultimate renal function of organs kept in this manner was as good as that of organs preserved with pulsatile perfusion storage, without the cost or inconvenience required for the latter [4]. The incidence of delayed graft function, primary nonfunction, and graft failure increases exponentially with the duration of cold storage [21]. Belzer's group at the University of Wisconsin (UW) has achieved a quantum improvement in static cold preservation of the kidneys and, especially, of the liver and pancreas (Table 1) [1]. The addition of lactobionate and hydroxyethyl starch has been shown to control intracellular fluid and electrolyte shifts in the donor organ [1]. The solution appears to stabilize cell membranes during cold storage and at the time of reperfusion [1]. The results of these authors in canine renal transplants suggest that cold storage for up to 5 days is possible [1].

Preservation injury is thought to have two components. The first is produced by ischemia, with which cellular energy reserves decay to the point that synthetic functions required for cellular integrity are no longer adequate. The second component of preservation injury is thought to occur during reperfusion, when the blood supply to the donor organ is reestablished. Evidence suggests that this type of injury is produced by oxygen free radicals [11]. These radicals are generated by the breakdown of ATP by xanthine oxidase during the initial

Table 1. Composition of the UW cold-storage solution

Substance	Amount in 1 l
K^+-lactobionate	100 mmol
KH_2PO_4	25 mmol
$MgSO_4$	5 mmol
Raffinose	30 mmol
Adenosine	5 mmol
Glutathione	3 mmol
Insulin	100 IU
Penicillin	40 IU
Dexamethasone	8 mg
Allopurinol	1 mmol
Hydroxyethyl starch	50 g

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promptly and prior to irreversible ischemic renal damage [9]. In such cases, the kidney is removed, flushed, and preserved extracorporeally with surface hypothermia while associated abdominal injuries are repaired. Following extracorporeal renal reconstruction, when the patient's condition has stabilized, autotransplantation into the iliac fossa is then carried out in the usual fashion. Although such cases are uncommon and require early operative intervention for attempted renal salvage, it is appropriate to include them among the listed indications for renal autotransplantation.

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