DETAILED OPERATIVE TECHNIQUES OF RENAL TRANSPLANTATION

Essay

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INTRODUCTION & HISTORICAL REVIEW

INTRODUCTION AND HISTORICAL REVIEW

Until the mid-1950s the course of chronic progressive renal failure was inevitable whatever the cause. The advent of two new therapeutic procedures, chronic intermittent hemodialysis and renal homotransplantation, has radically changed this prognosis, *(Konnak and Turcotte, 1976)*. The technical feasibility of renal transplantation was demonstrated in animals by *Carrel and Ullmann* in the early *1900s*. Other workers were performing work of this type between 1900 and 1930. In almost all these experiments, kidneys were used because of their simple vascular supply, the presence of the ureter which gives index of function within minutes, and the fact that it was a paired organ. *(Moore, 1988)*.

Emile Holman in the mid *1920s* grafted the skin of a mother onto a badly burned child which was unsuccessful. *(Moore, 1988)*.

Early human transplantation which was done sporadically includes Voronoy's unsuccessful kidney transplant into the groin of a patient in 1936. *(Chatterjee, 1979)*.

Peter Medawar's classic studies in *1944* first defined the events which occur in rejection of a skin allograft. These observations were extended to renal allografts by *Dempster.*

With this evidence suggesting an immunologic mechanism for allograft failure, a great effort has been put forth to modify the immunological capability of the recipient, and it was shown that skin grafts between identical twins are not rejected, *(Straffon, 1977)*.

In *1952 Hume and his co-workers* systematically studied renal transplantation in man in a series of cadaver kidney transplants in uraemic patients. *Hume* demonstrated that the transplanted kidneys could function for short periods of time, *(Starffon, 1977).*

The analogy between skin and renal homografts in identical twins was demonstrated in 1954 when the first successful renal transplant in human identical twins was done by Murray, Harrison and Merrill at the Peter Bent Brigham Hospital, but it was the genetic identity of tissue which precluded rejection, *(Konnak and Turcotte, 1976).*

It was not until several years later that the first successful kidney transplant between non-HLA-identical sibling was performed.

The initial attempts at protecting renal homografts in nonidentical individual were through the use of total body irradiation, but the side effects of irradiation were usually disastrous, *(Konnak and Turcotte, 1976).*

Schwartz and Dameshek in 1959 demonstrated immunosuppression effects of 6-mercaptopurine in animals exposed to foreign protein. It was later demonstrated that this drug would also prolong the survival of an allograft, *(Straffon, 1977).*

Soon *Calne and Murray* had struck on a derivative of 6-mercaptopurine, substituted at the sulfer atom. This was originally called "BW-322" then "Azothioprine" and later "Imuran". The results in dogs were clearly better than those with 6-mercaptopurine, the toxicity was less marked, and prolonged kidney graft acceptance in the dog became the rule, *(Moore, 1988).*

Since April 1962, all transplantation of tissues between unrelated individuals have been done with the patient under the influence of a chemical agent to suppress the immune response of the patient to the graft. *(Moore, 1988).*

The use of other immunosuppressive agents with Imuran was explored immediately. These included low-dose whole-body irradiation, irradiation of the grafted kidney either before or after it was placed, the use of ACTH, and cortisone.

The role of massive doses of prednisone in prevention of the graft rejection crisis was recognized by Goodwin in 1963, *(Martin, 1979).*

In the late 1960s, starzl employed antilymphocyte globulin from the horse for recipients of renal grafts as an adjunct to the immunosuppressive regimen, *(Martin, 1979).*

Improvements in the results of disparate recipient-donor combinants in living related donor transplantation evolved slowly through the 1970s. Most of the advancements were about better selection of combinant pairs, thereby improving results, they also resulted in narrowing of the scope of living related donor transplantation, *(Robert Mendez et al., 1985).*

In *1978, Salvatierra and associates* began to use donor-specific blood transfusions even though earlier reports predicted ominous results due to amnestic immunological antibody responses, *(Robert Mendez et al., 1985).*

As the number of cadaveric renal grafts increased, satisfactory renal preservation became important in order to provide time for location and compatibility testing of a panel of prospective recipients. Belzer, made an important contribution with the development of a pulsatory pump employing cryoprecipitated plasma. Collins and Sacks have demonstrated the efficacy and simplicity of washout perfusion with carefully constructed solutions of electrolytes. *(Martin, 1979).*

In the last few years, kidney transplantation has reached maturity. Refinements in the use of current immunosuppressive drugs, including antilymphocyte globulin preparations, cyclosporine, and recently the use of monoclonal antibodies, have provided the transplantation specialist with a wide variety of resources. The results have considerably improved since the introduction of cyclosporine, and it is not unusual to obtain greater than 70% graft survival of first cadaver allografts, *(Toledo-Pereyra, 1988).*

In kidney transplantation, in general, we are at the point of assessing long-term survival (5 to 10 years) expectations of cadaver and living related recipients.

ANATOMICAL CONSIDERATION

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Anatomy of the Renal Vasculature

1. Renal Arteries

The renal artery arises from the aorta as a single vessel and divides into a larger and lower anterior branch that supplies more than one half of the circumference of the kidney, and a smaller but more superiorly placed posterior branch. These branches straddle the renal pelvis to enter the renal sinus, **(Fig. 1).**

The right renal artery passes behind the inferior vena cava, the right renal vein, the head of the pancreas and the second part of the duodenum. The left renal artery lies behind the left renal vein and the body of the pancreas.

Variations in the arterial supply to the kidney are not uncommon. One out of three individuals demonstrated variations (more than a single artery) and one of seven presents a variety of polar vessels whose potential existence must always be considered by the surgeon, *(Robert Lich et al., 1979).*

In addition to the larger vessels with which we are familiar, numerous small vessels pass to the superior extremity of the kidney. Such arteries usually are not solely renal in supply, but care also for part of the vascularization of the adrenal gland, *(McVay, 1984).*

Each renal artery gives off one or more inferior suprarenal arteries, and small twigs to the perinephric tissue, renal capsule, pelvis and proximal part of the ureter, *(Last, 1984).*

2. Renal Veins

The renal vein is formed by the progressive trunk formation of the cortical and pyramidal capillaries, with the final emergence of the renal vein anteriorly from the renal hilus to proceed to the vena cava.

It is helpful surgically that there is no vein on the posterior aspect of the renal pelvis. The veins draining the posterior half of the kidney cross over at the neck of the minor calyces to join the main trunks of the anterior group, *(Lich et al., 1979).*

The left vein is much longer than the right (7.5 and 2.5 cm respectively). It lies behind the splenic vein and the body of the pancreas, it receives the left suprarenal vein and the left gonadal vein and passes in front of the aorta just below the origin of the superior mesenteric artery to reach the vena cava, *(Last, 1984).*

The right vein lies behind the descending part of the duodenum and the lateral part of the head of the pancreas and opens into the inferior vena cava at a slightly lower level than the left vein, *(Last, 1984).*

The number and distribution of the renal veins correspond closely to the arteries, accessory, supernumerary or polar veins accompany similar anomalous arteries. Multiple veins on the right side drain directly into the vena cava, *(Lich et al., 1979).*

The anastomosis of the renal vein with those of the adrenal, perirenal fat, diaphragmatic, retroperitoneal (Lumbar) left gonadal and periureteral veins are sufficiently numerous to afford an abundant collateral circulation, **(Fig. 2)**, *(Lich et al., 1979).*

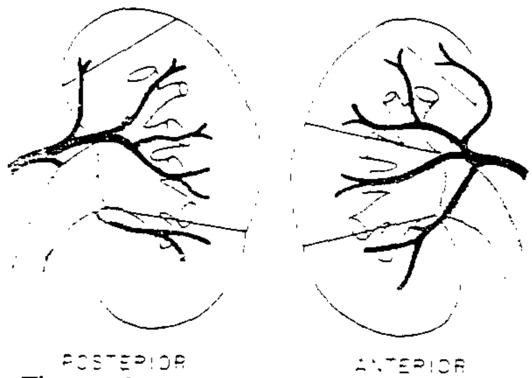

Figure 1 Segmental distribution of the renal arterial supply. Anterior and posterior branches are shown separately. After Graves

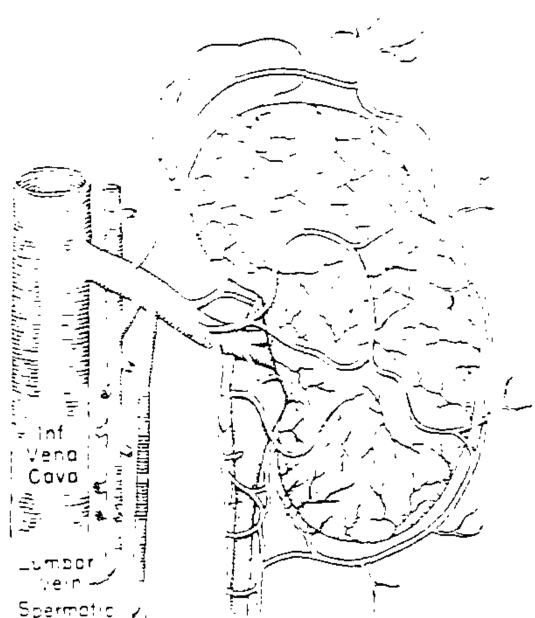

Figure 2 The venous anastomosis of the perinephric area and renal surface with the ureteral plexus, showing the lumbar vein with its many branches, an important potential source of bleeding during renal surgery.

The renal venous pattern of the right side bears little resemblance to that of the left. In its relatively short course, the right renal vein rarely receives a tributary. The longer left renal vein, on the contrary, regularly receives the following tributaries: Suprarenal and inferior phrenic, from above frequently by a common channel, spermatic (or ovarian) and second or third lumbar veins from below likewise often by a confluent vessel, *(McVay, 1984).*

In a preponderant number of specimens there is a single renal vein on the right side. Sometimes, however, there are two or even three veins. When present in duplicate or triplicate, the veins are approximately equal in caliber and parallel in course, rarely do adjacent channels anastomose, *(McVay, 1984).*

The left renal vein is complex, not only in arrangement of its tributary system, but also in its pattern of division and anastomosis. In many specimens, on the left side, in preaortic position, the veins from the kidney seem to be relatively simple in arrangement, that is, there is likely to be a single renal vein in front of the aorta. However, on the retroaortic or prevertebral level, complexity in venous pattern occurs, the retroaortic members of the plexus regularly communicate with veins draining the prevertebral connective tissue and with lumbar veins, *(McVay, 1984).*

The retroaortic set of veins is often associated with the deeper division of a circumaortic venous ring. Usually the retroaortic element of the ring is oblique, joining the left renal vein near the hilus of the kidney, but in rare instances the tributary is transverse and enters the parenchyma of the lower pole of the kidney. Here it is likely to receive iliac and lumbar veins before reaching the inferior vena cava, *(McVay, 1984).*

On the left side, the channels of the capsular network often forms a circumrenal venous network whose constituents drain directly or indirectly into the renal veins. The cranial set of capsular veins often receive muscular tributaries as well as lower suprarenal and phrenic tributaries before emptying by multiple veins into the renal, the inferior set may receive one or more lumbar veins, a caudal portion of the capsular system frequently joins the genital vein before entering the renal.

The left renal vein is then very complex in its scheme of tributary reception and its pattern of venous communication. It receives the suprarenal and phrenic (separately or as a conjoined trunk), the internal spermatic or the ovarian vein. Additionally, it often receives capsular tributaries and communicates with lumbar veins. When subdivided to send divisions in annular fashion around the aorta, the left renal veins receive lumbar and other tributaries of azygos and related drainaged. When a persistant left inferior vena cava is present, renal communications are established therewith, *(McVay, 1984).*

The Inferior Vena Cava (Fig. 3),

From its origin in the two common iliac veins the inferior vena cava increases in size from below upward with the accession of the various tributaries. It maintains a close relationship with the abdominal aorta through the major part of its course.

It lies on the bodies of the lumbar vertebrae and the right lumbar sympathetic trunk and crosses the right renal artery. Above this level it is separated from the right crus of the diaphragm by the contiguous edges of the right suprarenal gland and the right coeliac ganglion, and the right phrenic artery, *(Last, 1984).*