EX-VIVO SURGERY FOR TREATMENT OF INTRARENAL A-V MALFORMATION

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ABSTRACT

Two patients, a 33-year-old female and 28-year-old male, were presented with sudden onset of total gross hematuria leading to non visualization of the involved kidney on excretory urogram. Diagnosis was made of multiple intrarenal arteriovenous malformation having cirrroid appearance in the selective renal arteriogram. The multiplicity and gross hematuria caused by eroding renal tissue were considered to be unquestioned indication for surgical intervention. Several modes of therapy aiming at the conservation of the kidney have been considered, such as partial nephrectomy, transcatheter embolization and vascular ligation. Vascular ligation can be accomplished with the minimal loss of renal tissue, but because of its technical difficulty, its indication is strictly limited. The modern technology of ex vivo renal surgery, however, can expand the realm of vascular ligation even to the intrarenal arteriovenous fistula.

The patients were treated successfully by ligation and division of each feeding artery by ex vivo technique and autotransplantation. Selective arteriography of the grafted kidney taken at the 18th month after operation demonstrated no evidence of recurrence of A-V malformation.

Review of English literatures revealed that present two cases are the first publication of multiple intrarenal A-V malformation in which kidney conserving vascular surgery was carried out by utilizing ex vivo technique.

It dates back to 1923 when Varela reported the first case of intrarenal arteriovenous fistula, subsequently increasing number of cases are being detected with the widespread use of arteriography. Until recently nephrectomy had been the primary surgical treatment. The first concern of modern urologists, however, is how to conserve a functioning kidney.

Several modes of therapy aiming at the conservation of the kidney have
been considered, such as partial nephrectomy, transcatheter embolization and vascular ligation. Vascular ligation can be accomplished with the minimal loss of renal tissue, but because of its technical difficulty, it has been considered that the indication is strictly limited. We believe, however, the modern technology of ex vivo renal surgery can expand the realm of vascular ligation even to the intrarenal arteriovenous fistula.

Herein reported are two cases of intrarenal arteriovenous fistula of cirrhotic type with multiple vascular ramifications. They were treated by ligation of each feeding artery under vision by ex vivo technique, and then autotransplanted to the ipsilateral iliac fossa.

The indication for ex vivo surgery in the management of renal arteriovenous malformation are discussed from the viewpoint of our experience and the review of literatures.

**OPERATIVE TECHNIQUES**

Ligation and division of each feeding artery by utilizing ex vivo technique was performed in two patients with cirrhotic variety of multiple intrarenal A-V malformations.

A longitudinal right para-median incision was extended from the rib cage to the pubic tubercle, through which the dissection was carried out down to the posterior sheath. The cleavage layer between the peritoneum and posterior sheath was identified; it was extended wide enough by utilizing blunt and sharp dissection, so that the right extra peritoneal space was opened until the kidney was exposed under vision. Renal artery and vein were isolated for each other. The ureter was freed with ease down to the level of crossing the common iliac artery.

Then the preparation of recipient vessels included the isolation of internal iliac artery and external iliac vein. Following the preparation of pelvic vessels, the renal artery and vein were ligated and divided. The ureter was not divided and the kidney was brought out within the reach of the ureter. The kidney was perfused with lactated Ringer’s solution containing albumin, heparin and procaine, and placed in an ice slush bath. Then the renal artery was isolated, dorsal and ventral branches individually, and this procedure was advanced toward periphery by use of hilar dissection technique. Since intrarenal blood flow was washed out with clear perfusate, an attempt to identify the small lesion of A-V malformation by feeling its thrill or configuration was of no use. The only possibility was to trace the arterial tree, guided by the documentation of preoperative arteriography.

Each of a feeding artery of the A-V malformation was ligated with 6-0
nylon and divided between two ties. After the vascular treatment, the kidney was autotransplanted to the ipsilateral iliac fossa which was turned upside-down in the process so as to keep the ureter on the vessels. An end to side anastomosis from the renal vein to the external iliac vein, as well as an end to end anastomosis from the renal artery to the internal iliac artery was performed. Upon release of the clamps, excellent perfusion was obtained to the kidney in both cases.

Operative procedure resulted in the blood loss of 1250 ml and 1160 ml, respectively. Total ischemic time were 125 min and 133 min, respectively.

CASE PRESENTATION

Case 1. a 33-year-old Japanese housewife was presented with total gross hematuria on November 3, 1977, that caused almost urinary retention due to bladder clots. Next day she was admitted in emergency.

The excretory urogram on admission showed no visualization of the right kidney. The blood pressure was 156 systolic and 114 diastolic. On November 11, a selective renal arteriography was performed. The arterial phase of this study revealed the malformation of right renal vasculature with early venous drainage supplied with three and two ramifications arising from the dorsal and ventral branches respectively (Fig. 1).

The diagnosis was confirmed. On November 24, ligation and division of each feeding artery were performed by ex vivo technique under general endotracheal anesthesia, which was followed by the autotransplantation into the ipsilateral iliac fossa (Fig. 2).

An infusion urography made on the 11th day after operation showed that the grafted kidney was well functioning (Fig. 3A). A selective renal arteriography performed three weeks after operation demonstrated no abnormalities on the vascular architecture (Fig. 3B). The patient has been followed regularly at our outpatient department. No blood cells have been elicited by urinalysis during the observation of two and half years. She has been normotensive after operation. Follow-up study of renal arteriography at the 18th months postoperatively revealed absolutely normal vascular architecture.

Case 2. a 28-year-old Japanese male experienced sudden onset of painless hematuria on February 2, 1978, and was brought to a nearby hospital.

Although he was completely relieved from the symptoms by IV infusion therapy, he was referred to us for the additional examination on March 1, 1978. An excretory urography revealed no visualization of the left kidney. The blood pressure was 148 systolic and 96 diastolic. On March 20, 1978, a selective renal arteriography was performed. In the initial plates, there were two arteries on
Fig. 1  A, superselective renal arteriography of right ventral branch demonstrates two feeding arteries of cirrroid type A-V malformation as illustrated in sketch.

B, right selective renal arteriography. Sketch illustrates dorsal branch providing three feeding arteries.
Fig. 2 Dissection of ventral (A) and dorsal (B) branches by ex vivo technique. Each feeding artery was ligated and divided.

Fig. 3 A, infusion urography at the 11th day after operation shows right grafted kidney functioning well. B, selective renal arteriography performed three weeks after operation shows normal vascular architecture.
the left side kidney, the superior and inferior, and they provided two and one feeders respectively that formed a cirsoild type of arteriovenous malformation with early venous drainage (Fig. 4). These feeding arteries were not tapered by epinephrine treatment. Ligation and division of each feeding artery by ex

Fig. 4 A, superior branch of left renal artery shows cirsoild type A-V malformation supplied with two ramification as illustrated in sketch.

B, arteriography of inferior branch treated with epinephrin. Inferior branch provides a small tributary supplying A-V malformation that is not tapered by epinephrin treatment.
vivo technique were chosen as the means of operation to salvage the kidney. On May 11, 1978, the operation was accomplished in the same manner as in Case 1. By way of exception, two arteries were united in the figure “8”, prior to end to end anastomosis to the ipsilateral internal iliac artery.

Excellent function of the grafted kidney was confirmed by excretory urogram on the 9th day after operation, and complete disappearance of abnormal vasculature was also confirmed by the selective renal arteriography done three weeks after operation. During the 19-month-follow-up, no blood cells have been seen in his urine.

DISCUSSION

Renal arteriovenous fistulas are congenital, idiopathic, or acquired in type. Those which having a cirrhotic appearance with multiple interconnecting fistulas probably represent true congenital abnormality. Two cases described here are considered to be congenital intrarenal arteriovenous malformation on the basis of their angiographic findings and lacking history of renal trauma or biopsy. The sine qua non for the diagnosis of renal arteriovenous fistula is arteriographic demonstration of the abnormal vascular communication with prompt visualization of the venous system in the arterial phase of the study. Once the diagnosis is made, management of renal arteriovenous fistulas becomes a question of operative versus non operative treatment. It should be obvious that not all arteriovenous fistulas of the kidney require surgery. The indication for operation in the management of renal arteriovenous fistulas is hypertension, severe hematuria, rupture or possible rupture, neoplasm, heart failure, and progressive renal failure. The arteriovenous connections due to malformation are often multiple, of small calibre and may exist for several years without producing any symptoms. Kostiner and Burnett, however, reported a case of intrarenal arteriovenous fistula that was nontraumatic and increased in fistula size during an eight-year interval. Despite the relatively small size of the arteriovenous fistulas in our two cases, their multiplicity and gross hematuria caused by eroding renal tissue are considered to be unquestioned indication for surgical intervention.

The first reported case of renal salvage by partial nephrectomy was performed by Edsman in 1957. Since that time the increasing number of cases have been handled by various modes of procedure to conserve renal function. Vascular ligation can be accomplished with the minimal loss of renal tissue. Cosgrove et al. listed nine cases surgically treated without resection of renal tissue, including the first case reported by Boijsen and Koehler in 1962, and added their own three cases of branch renal artery ligation. Ehrlich was able to find seven additional cases with complete renal preservation by utilization of
precise vascular surgical techniques and added his case of endofistulorrhaphy in 1975. In 1977 Maynard and Soderberg\(^8\) reported another case of renal arteriovenous aneurysm surgically treated with preservation of renal parenchyma and we have added the present two cases to the growing number.

In all of these 21 cases reported previously, operative procedures were accomplished in situ under an ambiothermic environment or local hypothermia. Gelin mentioned a patient with renal arteriovenous fistula that was treated by vascular technique under ex vivo surgery in the discussion for Belzer's paper.\(^9\) Since it has not been published, its details are still unknown. To our best knowledge, however, present two cases are the first reports of intrarenal arteriovenous fistula in which kidney conserving vascular surgery was carried out by utilizing ex vivo technique. Ehrlich\(^7\) predicted that recent advances in renal preservation, work bench surgery and autotransplantation will no doubt be utilized in fistula surgery with greater frequency in the future, rendering renal parenchymal salvage the rule, rather than the exception. Lawson\(^10\) indicated that selected cases of renal artery diseases can be managed most effectively by extracorporeal renal surgery. On the contrary, Gibbons et al.\(^11\) warn against the current tendency of overusing extracorporeal surgery, and point out that many technical failures have been associated with this technique, and have resulted in dialysis or transplantation. Tynes et al.\(^12\) believe that congenital or cirrhotic type fistulas with multiple vascular ramifications will continue to be treated by nephrectomy. It is besides the purpose of this paper to discuss the clear indication for ex vivo surgery of congenital arteriovenous malformation of the kidney. However, suffice it to say that their kidneys could not have been salvaged unless they had been treated by ex vivo technique.

Transcatheter embolization of the renal artery has been used in treating various kinds of renal diseases including arteriovenous fistula, and has gained popularity as a means of conserving the kidney.\(^13,14\) If, however, we had employed transcatheter embolization in Case 1, for instance, we should have occluded the branch artery at the point of A instead of B (Fig. 5). On the other hand, ex vivo technique made it possible to ligate each feeding artery at the point of B. It is apparent that far more functioning parenchyma could have been salvaged by the latter technique. Furthermore, the possibility that pulmonary emboli occur after transcatheter embolization cannot be excluded.

It must be emphasized that the precise type, location and size of the lesion should be radiographically documented before the vascular repair is chosen in selected patients to preserve the renal function completely. Under this condition, recent advances in sophisticated techniques of angiography are highly contributing.
Fig. 5 The sketch illustrates the point of embolization (A) if done, and the point of actual ligation (B) in Case 1.

REFERENCES


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