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Transplant renal artery stenosis: experience and comparative results between surgery and angioplasty

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Abstract. One hundred thirty-eight patients with transplant renal artery stenosis (TRAS) were identified among 1200 patients undergoing renal transplantation in our university hospital. Severe systemic hypertension was the main symptom leading to a diagnosis of TRAS. Only 88 TRAS patients were given interventional treatment consisting of percutaneous angioplasty (PTA; $n = 49$) or surgical repair (SR; $n = 39$). The immediate success rate was 92.1% for SR and 69% for PTA. The long-term success rate was 81.5% for SR and 40.8% for PTA, with a follow-up period of 56.7 ± 22.4 months (SR group) and 32 ± 28.1 months (PTA group). PTA morbidity reached 28%, compared to 7.6% in the SR group. In spite of these results, we still favor PTA as a first line interventional treatment when TRAS is recent, linear, and distal and primary SR in cases of kinking and proximal TRAS.

Key words: Renal artery stenosis – Stenosis, renal artery – Angioplasty for renal artery stenosis – Hypertension, renal artery stenosis

Transplant renal artery stenosis (TRAS) is a serious complication following kidney transplantation. Hypertension remains the main symptom leading one to suspect TRAS, especially when it is resistant to multidrug treatment. We used to turn to digitalized intravenous angiograms (DIVA) in every case of hypertension [4, 10]. However, our attitude has changed, and standard arteriograms are now used when indicated by severe resistant hypertension or in unexplained renal function alteration, especially when aggravated by hypotensive drugs (converting enzyme inhibitors) [31]. We have already published previous data concerning TRAS [2] in which we concluded that percutaneous transluminal angioplasty (PTA) should be the first line treatment. The aim of this study is to show long-term follow-up according to two different therapeutic options.

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Materials and methods

From January 1976 to June 1989, 1200 renal transplantations were performed in our hospital. These included 774 men and 426 women. Of these, 1150 cases were cadaveric transplants and 50 were from living related donors. A single renal artery was found in 73% of these cases and 27% had two or three arteries; a Carrel patch was left in 48% of the cases. Renal artery anastomosis was performed either end-to-end (41%) on the hypogastric artery or end-to-side (59%) on the external iliac artery, which is now our favored technique. Renal vein extension was performed in 24 cases of right kidneys. Some 44% of the recipients had systemic hypertension before transplantation. All patients were given corticosteroids and 50% received cyclosporin. An acute rejection was diagnosed in 77.3% of the cases and a chronic rejection was found in 17.7%. Recipient atheromatous lesions were identified in 19.1% of the cases. Donor renal artery atheromatous lesions were found in ten cases (7%). In seven other cases (5%), an intimal flap was observed and had to be repaired. Arterial kinking was evident in 27% of the cases and was noticed in 42% of the surgical repair (SR) patients and in 14% of the PTA group. We had four cases of end-to-end anastomotic discrepancy, one case of arterial twisting, and eight kidneys from pediatric donors less than 10 years old (5.9%). One hundred seventeen patients (out of 138) had at least one of the abovementioned risk factors.

Location of TRAS in the 88 patients was defined as proximal (near the anastomosis; $n = 50$) or distal ($n = 21$), including renal arterial division branches. In the remaining 17 cases, we were unable to locate TRAS because of missing documents in the patients' charts.

The date of the TRAS diagnosis averaged 13.1 ± 16.5 months after the date of transplantation for the SR group and 16.5 ± 24.8 months for the PTA group. Follow-up averaged 56.7 ± 22.4 months for the SR group and 32 ± 28 months for the PTA group. The diagnosis of TRAS was based on arteriograms revealing more than 50% narrowing of the renal artery diameter. Neither a captopril test nor renin levels were used.

One hundred thirty-eight cases of TRAS were identified. The male/female ratio was 1:4. Mean age was 38.5 ± 10.4 years with a range of 17–62 years. In 42 cases (31.1%), arterial hypertension was medically treated and no other treatment was suggested. Five cases could not be operated because of morbid obesity ($n = 2$), TRAS occlusion before surgery ($n = 2$), and death due to a cerebrovascular accident before surgery ($n = 1$). In three cases (2.1%) there was a spontaneous regression of TRAS. In the remaining 88 cases, systemic hypertension was resistant to medical treatment. These were all treated either surgically or using angioplasty. When reviewing the

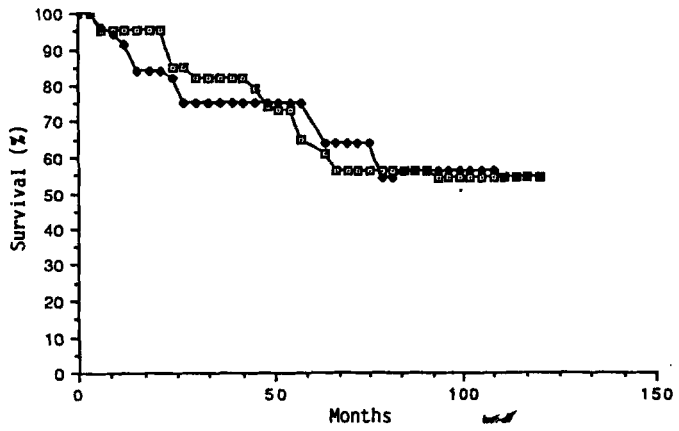

Fig. 1. Comparative actuarial graft survival between surgical repair (SR) and percutaneous transluminal angioplasty (PTA). □, Surgical repair: ◆, percutaneous transluminal angioplasty

patients' charts, we were unable to ascertain any pattern regarding the choice of therapy, SR or PTA. SR was done using a transperitoneal approach, first with dissection of the stenotic area and control of both distal and proximal segments and then either transection of the artery distal to the stenosis and reimplantation end-to-side to the iliac artery ($n = 10$) or use of interposition venous ($n = 28$: 27 autologous and 1 homologous saphenous grafts) or arterial grafts ($n = 1$) between the iliac artery and the distal segment of the renal graft artery. Recently, we have begun to favor arterial grafts over the saphenous venous ones, using bench surgery when needed and especially when the stenotic area involves the first division branches of the renal artery. The arterial graft is usually the autologous hypogastric artery with its first division branches. SR was performed on 39 patients; PTA was performed by radiologists on 49 patients. The dilating balloon was passed across the stenosis and dilation was done by inflating the balloon two to four times for 30–60 s with a pressure of around 4 atmospheres. In all cases, immediate post-PTA angiograms were obtained.

Results were evaluated according to blood pressure values and graft function when it was previously abnormal. The patient was considered as having a good result when blood pressure was normal without hypotensive medication or with a decrease in the number of medications; failure or poor results were reported if hypertension persisted as before treatment and/or when there was loss of a transplant secondary to the procedure.

Angiograms were performed post-treatment, and good results were reported when all arterial stenoses and all persistent lesions with diameters larger than 50% were cured.

Results

No TRAS was found in cases of living related donors. All TRAS cases were from cadaveric donors, the incidence being 11.5% (138/1200 cases).

Results in the PTA group (49 patients)

A total of 15 out of 49 patients (30.6%) had immediate failure. Ten of these patients received no other treatment. One patient was redilated with success, while four were submitted to SR. Of these, there were three successes and one cardiogenic death during an emergent graft salvage operation for a freshly occluded TRAS after dilation.

Thirty-four of 49 patients (69.4%) had immediate success, 14 of whom had recurrent TRAS 4.2 ± 2.9 months later (range 1–30 months). Of these 14 patients, 5 received no other treatment, 5 were successfully redilated, 3 were redilated with, again, a complete failure, and 1 had SR with failure and was then redilated with no success because of a long stenosis associated with chronic rejection.

One or more PTA complications were found: eight instances of arterial thrombosis (four partial and four complete with graft loss), five intimal flaps without thrombosis, two intimal flaps on the external iliac artery with thrombosis and limb ischemia, one groin false aneurysm ruptured and surgically repaired, and one arteriovenous fistula that was surgically managed.

Some 40.8% (20/49) of PTA in patients had a good prolonged result (follow-up 32 ± 28 months). This increases to 53% (26/49) if we add successful repeat PTA ($n = 6$). Patients who had successful PTA and successful repeat PTA had a more recent TRAS (12.9 ± 15.8 months versus 10.6 ± 22.1 months, respectively) than those who had immediate failure (27.8 ± 34.4 months). If we consider PTA results according to TRAS location, we find a 45.4% failure rate in cases of proximal stenosis versus 38.4% in cases of distal stenosis. The actuarial graft survival in the PTA group was 95% at 1 year ($n = 41$), 82% at 2 years ($n = 32$), 70% at 5 years ($n = 13$), and 56% at 10 years ($n = 3$; Fig. 1).

Results in the SR group (39 patients)

One patient was quickly lost to follow-up after an initially good result. Of the other 38 patients, 3 had immediate failure with 1 case undergoing urgent thrombectomy, which was successful and resulted in salvaging of the graft. The immediate success rate reached 92.1% (35/38 cases).

Five patients had recurrence of TRAS 13 ± 11.2 months after SR; three of them were successfully retreated with SR or PTA. Thirty-one patients (81.5%) had satisfactory results with a 56.7 ± 22.4-month follow-up.

The incidence of failure was greater when patients were operated belatedly: 21.2 ± 23.1 months (failure group) versus 11.2 ± 14.1 months (success group). No failure was observed when SR was done for an arterial kinking, while we had 12.5% failure in distal TRAS and 23% failure in proximal TRAS. The actuarial graft survival in the SR group was 95% at 1 year ($n = 36$), 84% at 2 years ($n = 36$), 65% at 5 years ($n = 15$), and 56% at 10 years ($n = 1$; Fig. 1).

Patients requiring a double treatment

Ten patients in the SR and PTA groups required a double treatment (i.e., SR + PTA). Four SR patients were secondarily dilated: one success and three failures; six PTA patients had SR secondarily: four successes and two failures.

All of these results are summarized in Table 1.

Table 1. Comparative criteria between surgical repair (SR) and percutaneous transluminal angioplasty (PTA)

Treatment	SR	PTA
Number	39	49
Interval between transplantation and TRAS diagnosis (months)	13.1 ± 16.5	16.5 ± 24.8
Morbidity	7.6%	28%
Mortality	2.5%	2%
Immediate success	92.1	69%
Recurrence	15%	40%
Interval between treatment and recurrence (months)	13 ± 11.2	4.2 ± 2.9
Follow-up (months)	56.7 ± 22.4	32 ± 28.1
Long-term success	81.5%	40.8%
Actuarial graft survival at 2 years	84%	82%

Discussion

TRAS is one of many factors causing systemic hypertension in kidney graft recipients. Other factors include chronic rejection, recurrence of primary disease, renin production from native kidneys, de novo renal disease, steroids, and cyclosporin A [8, 23]. Huysmans et al. showed that the incidence of systemic hypertension was higher when native kidneys were still preserved [16]. In our hypertensive recipients, no nephrectomy was performed.

Our incidence of TRAS was 11.5%. This decreases to 7.6% if we consider only TRAS that was not controlled by medical treatment. The highest incidence of TRAS was published by Lacombe in a prospective study: 5.8% among living donor kidneys and 17.7% among cadaver kidneys [18, 19]. Our incidence (7.6%) correlates very well with that in the literature: 2%–10% [9, 20, 28, 29, 32]. We use end-to-side arterial anastomosis because it gives better hemodynamics [12, 15]; we seldom use the end-to-end type since it may cause anastomotic discrepancy. In our series, mechanical factors are frequent: kinking, discrepancy (2.8%) donor (7%) and recipient (19.1%) atheromatous lesions, and intimal flaps during harvesting and/or during artery cannulation; these intimal lesions can be easily missed [23, 25].

We have already mentioned the importance of kidney graft positioning before doing vascular anastomosis in order to prevent arterial kinking. Experimentally, kinking produces turbulence and intimal thickening almost identical to what we find in TRAS [30]. We also emphasized the importance of harvesting the right kidney with a vena caval segment for a right renal vein lengthening to avoid kinking of the renal artery [1, 3]. Yet, it seems to us that this does not prevent all TRAS since we have 24 cases of TRAS with right renal vein lengthening.

Our diagnostic approach to TRAS has changed. We now only investigate cases of systemic hypertension resistant to multidrug therapy and/or graft function alteration. Doppler scanning and arterial angiograms are the only certitude for TRAS diagnosis [10]. On the other hand, our therapeutic approach has also changed. First cases were treated only with SR and then, like others, we opted for PTA with a competent radiology team [5, 6, 11, 13, 21, 34].

The evaluation of results was somewhat difficult; we considered as a success every case in which hypertension was well controlled with two or fewer hypotensive drugs and/or a decrease in serum creatinine; the renal artery had to have at least a larger than 50% diameter on the stenotic area. Grossman et al. suggest a 10% gain in diameter as a success [14].

In our pool of interventionally treated TRAS (88 patients), SR yielded a good immediate success rate: 92.1% compared to 69% for PTA-treated patients. Fifteen percent of the SR group would have recurrence after a mean interval of 13 months postsurgery, compared to 40% in the PTA group after a mean interval of 4.2 months postdilation. No difference was found between cases of direct artery reimplantation and those where interposition grafts were used.

The SR morbidity rate was 7.6% and the mortality rate was 2.5%. The hospital stay lasted around 2 weeks. Two patients (SR group) had intestinal occlusions and one patient died because of severe postoperative pneumonia. The PTA morbidity rate reached 28% and the mortality rate 2%. In one case, we tried fibrinolytic agents post-PTA without success. The hospital stay was around 1 week.

Four renal transplants were lost in the PTA group (8.1%). Curry et al. and Reisfeld et al. already mentioned this same complication [7, 27]. Weisman and colleagues showed that increasing dilating balloon pressure could result in arterial rupture [33].

PTA results in many transplant centers are now becoming inferior to results first published and tend to have a longer follow-up [6]. This is also shown by Raynaud et al.: an 81% immediate success rate, 75% at 1 month, and 57% at 1 year [26]. Repeat PTA was often needed for good results. Mollenkof and coworkers report a 56% definite success rate, and this is 40% in the Reisfeld et al. series [24, 27].

In general, and with a 1-year follow-up period, all TRAS series reports show a success rate between 32% and 57%. In our PTA population, the success rate is around 40% with a mean 21-month follow-up. These results (PTA + SR) do not seem to influence our actuarial graft survival: 95% at 1 year and 82% at 2 years for the PTA group, 95% at 1 year and 84% at 2 years for the SR group. Other authors, like de Meyer et al., have shown 85% good results in their SR patients compared to 74% in the PTA-treated TRAS, and they recommend PTA as the treatment of choice for TRAS [22].

In our previous experience with TRAS and with a relatively short follow-up period, SR showed 85% good results compared to 61% for PTA, and we also concluded that PTA should be the first-line treatment in a TRAS therapeutic strategy. With a longer follow-up period, good PTA results seem to decrease while SR shows steady success rates that are better than dilation, with less morbidity and less graft loss. In both SR and PTA groups, results are better in cases of relatively recent TRAS. The presence of arterial kinking seems to us to be a strict indication for a primary SR as we had a 60% failure rate in these cases where PTA was tried and 0% when SR was done. The

same had been shown by Laasonen et al. and Miller et al. [17, 23].

TRAS site is another criterion that seems to influence the failure rate: 12.5% for SR versus 38.4% for PTA in cases of distal TRAS and 23% for SR versus 45.4% for PTA in cases of proximal TRAS.

TRAS remains an important complication of transplantation. Its incidence reached 7.6% in our series of cadaveric kidney transplants. An interventional approach (PTA and/or SR) should be considered in cases of severe systemic hypertension and/or an increase in creatinine. Our results were better in SR-treated patients, who had an 81.5% long-term success rate, than in the PTA group (40.8%). PTA morbidity is much greater than SR morbidity: 28% versus 7.6%, but is much easier. Recurrent TRAS has been found in both groups: 15% in SR versus 40% in PTA patients. We still favor PTA as a first-line interventional treatment when TRAS is recent, linear, and relatively distal, and primary SR in cases of kinking and proximal TRAS when no chronic rejection is suspected.

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