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original article

The results of treatment in renal artery stenosis due to Takayasu disease: comparison between surgery, angioplasty, and stenting. A monocentrique retrospective study

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SUMMARY: **The results of treatment in renal artery stenosis due to Takayasu disease: comparison between surgery, angioplasty, and stenting. A monocentrique retrospective study.**

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Purpose. *To evaluate retrospectively and compare the long-term patency and the antihypertensive effect of open surgery, angioplasty, and stent insertion of the renal artery stenosis due to Takayasu's arteritis.*

Patients and methods. *We retrospectively analyzed and compared the effects on blood pressure and permeability of the renal artery over 23 patients (age ranging from 16 to 60 years, mean 33.9 years); with renovascular hypertension caused by Takayasu's arteritis. those patients underwent surgical treatment (11 arteries) or endovascular (19) including angioplasty (11) and stenting (8) for 30 stenotic renal arteries.*

Results. *Technical success was 96.7% (29/30) without major complications (but longer period of hospitalization among patients who had surgery). In the last follow-up CT angiography (mean 60 ± 36 months), restenosis was 18.2% (2/11) in the surgery, 9% (1/11) in the angioplasty, and 62.5% (5/8) in the stenting. Rate of the permeability of the surgery was 100%, 90.9% , 81.8%, the permeability of the angioplasty was 100%, 90.9%, 90.9%, primary patency rate stenting was 62.5%, 37.5%, 37.5%, assists permeability was 87.5%, 75%, 50% at 1, 3 and 5 years, respectively.*

In the clinical follow-up (mean 60 ± 37.8 months, range 48-96 months) beneficial effects on blood pressure were achieved into 91.3% of patients (21/23), and there was no significant difference between patients who have been treated by surgery and angioplasty alone and the patients who received a stent in at least one renal artery.

Conclusion. *Angioplasty has shown better long-term patency and a similar clinical benefit of renovascular hypertension in renal artery stenosis caused by Takayasu's arteritis compared with the surgery and the stenting. We suggest that stenting should be reserved in case of clear failure of the angioplasty. The surgery is our choice for patients who do not meet the indication of endovascular treatment or failure of this treatment.*

KEY WORDS: Angioplasty - Hypertension - Stenosis - Renal artery stents - Takayasu arteritis.

Introduction

Takayasu's disease is a nonspecific inflammatory arteritis of large and medium caliber arteries (the aorta and its main branches, pulmonary arteries). Nonspecific inflammatory signs precede signs of ischemia reflecting the development of stenosis, thrombosis and sometimes aneurysms. This is a disease in young patients occurring during the 2nd or 3nd decade, and it lasts a lifetime with recurrence and progression of symptoms and complications.

Renovascular hypertension result from the affection of the renal artery, which can be refractory to medical treatment and it is known as a major prognostic factor and a cause of premature death (1, 2). Although surgical revascularization of the renal artery shows good long-term patency (3-5), the endovascular treatment is preferred as the initial treatment. Percutaneous transluminal renal angioplasty is established as the most widely used treatment (6-8) but the establishment of a stent has specific indications as a bailout procedure especially for residual stenosis hemodynamically significant or when there is dissection limiting the flow (9). Although there had been numerous studies showing the results of endovascular treatment of renal artery stenosis in Takayasu arteritis, there are a few comparing data on the long-term results of open surgery, angioplasty, and the introduction of a stent. In this study, we described and compared the long-term follow-up results of the surgery, renal angioplasty and the introduction of a stent with a focus

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on the permeability of the renal artery and clinical effects of hypertension.

Patients and methods

Patients

Between September 2004 and August 2011, 23 patients (19 women and 4 men, age ranging from 16 to 60 years, mean 33.9 years) with renovascular hypertension due to Takayasu's arteritis underwent surgical treatment (11 arteries) or endovascular treatment (for 19) for renal artery stenosis.

The diagnostic Takayasu arteritis was based on criteria modified by Sharma et al. (10).

Hypertension was defined as systolic blood pressure ≥ 140 mmHg, diastolic ≥ 90 mm Hg, or use of antihypertensive drugs (11). All patients had renal hypertension and an upper renal artery stenosis less than or equal to 50%.

Concomitant participation Takayasu was present at the time of surgery or developed during all patients follow-up period (abdominal aorta in 12, 10 in the carotid artery, thoracic aorta in 9, subclavian artery in 8, branches of the abdominal aorta in 7, the right iliac artery in 7, and the left iliac artery 3).

For the assessment of the clinical course, patients were divided into three groups (Table 1).

- Group I: 9 patients have been treated surgically for unilateral (n=7) or bilateral (n= 2) renal artery stenosis.
- Group II: 8 patients have received angioplasty treatment, unilateral (n = 5) or bilateral (n = 3).
- Group III: 6 patients have got a stent in one renal artery at least, regardless of whether the angioplasty was performed in the other renal artery or not. 4 patients have received a unilateral stent, 1 patient received a stent and contralateral angioplasty, and 1 patient have received bilateral stents.

At the time of surgery, most patients had been diagnosed with renovascular hypertension for the first time, they have not received antihypertensive drugs, only seven patients (2 in group I, 3 in group II, and 2 in group III) had received antihypertensive treatment.

Patients were treated with anti-inflammatory agents such as prednisolone, during the active phase or the progression of the symptoms before and / or after surgery. Immunosuppressive agent such as methotrexate, has also been used for prolonged control of the disease progression.

Patient demographics, sedimentation rate (ESR), systolic and diastolic blood pressure (BP), the number of antihypertensive drugs, serum creatinine, and data from CT angiography (CT) findings before and after intervention were collected through patient records and review of imaging studies.

The main criteria were followed:

- Comparison of preoperative PA and medication requirements with those at the last follow-up.
- The permeability of the renal revascularization.
- Patient survival.

Blood pressure was measured in each of the four members, if possible, using conventional methods.

Hypertension cure was defined as the restoration of PA below 140/90 mmHg and requiring no antihypertensive drug.

Clinical improvement was defined as a systolic pressure less than 140 mmHg or diastolic less than 90 mmHg with the same number of anti-hypertensive drugs or a diastolic blood pressure reduction of at least 15 mmHg with the same number of anti-hypertensive drugs or less. Unchanged PA with a reduction in the number of antihypertensive drugs has also been considered a clinical improvement.

The response was considered a failure if the healing or improvement criteria are not met.

Clinical outcome was assessed using patient groups at the last clinical follow-up.

The approval of the Institutional Review Board was obtained for a retrospective review of patient medical records and radiological images, however, informed consent was not required. The written consent of the proceedings was obtained from all patients.

Surgical treatment

The surgical treatment was used in 9 patients including:

- 3 patients underwent occlusion of the abdominal aorta with severe stenosis in one and/or two artery/s kidney/s.
- 4 patients underwent surgery for abdominal aortic stenosis associated with stenosis in one and/or two artery/s kidney/s.
- 2 patients were operated on for isolated stenosis of the renal artery with a bilateral.

The surgical technique includes:

- replacement of the abdominal aorta by a dacron graft (aorta-bi-iliac) and re-location of the renal arteries to the prosthesis in 3 cases;
- replacement of abdominal aorta by a dacron graft (aorta-bi-iliac or aorta-aortic) and grafting a renal artery by a PTFE bypass in 5 cases;
- performing an aorta-renal bypass by a PTFE graft in 3 cases.

Technical success was 100%, the permeability was 100%, 90.9%, 81.8%.

The average length of hospital stay was 12 days (including the ICU stay).

TABLE 1 - SUMMARY OF PATIENTS TREATED WITH SURGERY, ANGIOPLASTY AND STENTING FOR RENAL ARTERY STENOSIS CAUSED BY TAKAYASU'S ARTERITIS.

Groupe	Patient/sex/age	Site	Stenosis (%)	Treatment	Final permeability	Follow-up	Clinical results
I	1/W/28	R	15%	-	Permeable	88 month	recovery
		L	85%	SUR	Permeable		
I	2/W/37	R	10%	-	Permeable	68 month	improved
		L	90%	SUR	Permeable		
I	3/M/40	R	80%	SUR	Permeable	48 month	improved
		L	75%	SUR	Permeable		
I	4/W/42	R	95%	SUR	Permeable	78 month	recovery
		L	0%	-	Permeable		
I	5/W/34	R	90%	SUR	Permeable	54 month	recovery
		L	10%	-	Permeable		
I	6/W/38	R	80%	SUR	Permeable	68 month	improved
		L	20%	-	Permeable		
I	7/W/26	R	0%	-	Permeable	72 month	improved
		L	95%	SUR	Permeable		
I	8/M/35	R	90%	SUR	Permeable	36 month	recovery
		L	70%	SUR	Permeable		
I	9/W/55	R	80%	SUR	Occl	96 month	improved
		L	75%	SUR	Permeable		
II	10/W/18	R	0%	-	Permeable	48 month	recovery
		L	95%	AP	Permeable		
II	11/W/27	R	15%	-	Permeable	60 month	improved
		L	90%	AP	Permeable		
II	12/W/33	R	85%	AP	Permeable	56 month	recovery
		L	0%	-	Permeable		
II	13/W/22	R	90%	AP	Permeable	24 month	improved
		L	10%	-	Permeable		
II	14/M/36	R	75%	AP	Permeable	78 month	improved
		L	30%	-	Permeable		
II	15/W/28	R	90%	AP	Perméable	36 month	improved
		L	80%	AP	Permeable		
II	16/W/29	R	80%	AP	Permeable	90 month	failure
		L	100%	AP	Occl		
II	17/W/37	R	75%	AP	Permeable	40 month	improved
		L	80%	AP	Permeable		
III	18/M/42	R	90%	ST	Occl	28 month	guérison
		L	10%	-	Permeable		
III	19/W/60	R	0%	-	Permeable	76 month	improved
		L	80%	ST	Occl		
III	20/W/30	R	25%	-	Permeable	55 month	improved
		L	75%	ST	Occl		
III	21/W/16	R	80%	ST	Permeable	37 month	improved
		L	0%	-	Permeable		
III	22/W/41	R	100%	ST	Occl	66 month	failure
		L	85%	ST	Permeable		
III	23/W/26	R	90%	ST	Permeable	44 month	improved
		L	100%	ST	Occl		

Note: *L (left renal artery), R (right renal artery), AP (angioplasty), ST (stent), SUR (surgery).*

There were no major postoperative complications.

Restenosis rate was 18.18% (2/11 renal arteries treated by surgery).

Endovascular treatment

The femoral approach was used as a standard, except for patients with caudal angle of severe renal arteries or aortoiliac occlusion, so the brachial approach was used. After obtaining aortography, catheter angiography Fr 4 or 5 was inserted into a renal artery and advanced through the stenosis after crossing with a 0.035-inch guidewire hydrophilic coating. There was no significant difference ($p = 0.4207$) in the degree of stenosis between arteries treated by angioplasty alone (80.1 ± 16.6%) and the stent (75.4 ± 12 5%), before the treatment. Angiographic catheter was then replaced by a balloon catheter, with or without using exchange wire guide. The balloon diameter is equal to the estimated initial diameter of the artery or the diameter of the normal contralateral artery. The balloon was inflated with a pressure gauge until the size has disappeared or the pain has developed. If there is a significant equivocal dissection distal stenosis, or residual stenosis of more than 30% diameter on angiography control post angioplasty, installation of a stent is shown. A preformed guiding catheter has been positioned at the renal ostium on the exchange wire, the stent is positioned across the lesion and released by balloon inflation. A diameter of the stent was equal to (or more) 1 mm larger than the balloon used in angioplasty.

Angioplasty was performed in 11 renal arteries in 8 patients and stenting in 7 renal arteries in 6 patients. In one patient among them angioplasty was performed on one side and on the other we used a stent.

Stent indications were:

- Residual stenosis of more than 30% of the diameter (n = 4).
- Significant dissection following angioplasty (n = 1).
- Distal lesions (n = 2).

Endovascular treatment was considered technically successful if the arterial lumen after treatment was less than 30% residual stenosis.

There was no major complications: death, permanent sequelae, necessity of surgery and prolonged hospitalization for more than 48 h.

Imaging

Permeability of the renal arteries was assessed by CT angiography for individual arteries.

CT examinations were performed in all patients.

A total of 120 ml of non-ionic contrast medium was injected with an automatic injector at a rate of 3-4 ml/sec. An analysis of the arterial phase was started automatically 18s after an arrival time just above the level of the celiac trunk and transport into the external iliac arteries. The angiography source of CT images were reformatted on the 3D software capture both the renal arteries.

Stenosis was determined by measuring the ratio between the narrowest section of the diameter and the diameter of a segment of normal ipsilateral or contralateral renal artery.

Restenosis was defined as the recurrence of hypertension and renal artery stenosis in more than 50% of the diameter.

The average number of CT angiography was 4.4 ± 2.34 times during the monitoring period.

Statistical analysis

Statistical analysis was performed with SPSS software. Pre-procedural data, postoperative data or data obtained in the last followed were compared using the Mann-Whitney test. Statistical significance was considered a P value less than 0.05.

Cumulative patency rates of renal arteries were estimated using the Kaplan-Meier with log-rank test and restenosis (obstruction) were assessed by Cox regression analysis.

Results

Overall technical success rate was 96.7% (29/30 renal arteries) without major complications.

The mean duration of hospitalization for surgery was 12 days (including the ICU stay) for the endovascular technique was 2 days.

The average blood pressure in patients overall decreased 172/97 mmHg to 127/75 mmHg and the mean serum creatinine of 0.94 mg/dL to 0.83 mg/dl, 24-48 h after surgical or endovascular treatment. According to the study group, the serum creatinine (median) was 0.90 mg/dl in group I, 0.85 mg/dl in group II and 1.1 mg/dl in the group III preoperatively and 0.81 mg/dl in group I and 0.75 mg/dl in group II, and 0.96 mg/dl in group III at the last follow-up. There was no difference between the three groups before the intervention ($p = 0.704$) and final follow-up ($p = 1.000$). There was no significant change preoperatively and at final follow-up in group I ($p = 0.476$), Group II ($p = 0.398$) and group III ($p = 0.625$) (Table 2).

Repeat angioplasty was performed in three renal arteries stented three patients due to the recurrence of restenosis and hypertension, and the average interval between the first and second response was 12.3 months (range 7,6 to 22 months). Two renal arteries of them were blocked to 28 months and 49 months after the second operation.

TABLE 2 - THE RATE OF SERUM CREATININE BEFORE AND AFTER INTERVENTION.

Rate serum creatinine	Group I	Group II	Group III	Means
Before surgery	0.9	0.85	1.1	0.94
Final follow-up	0.81	0.75	0.96	0.83

In the last follow-up CT angiography (mean 60 ± 36 months, range 24-96 months), the overall restenosis rate was 26.7% and there was a significant difference (p = 0.032) of the restenosis rate between arteries treated by surgery (2/11, 18.2%) or by angioplasty (1/11, 9%) with the treated arteries stent (5/8, 62.5%)

In two patients with equivocal or minimal residual stenosis and in two patients with dissection after angioplasty, we did not place a stent and renal arteries were permeable to the last follow-up CT angiography. In one of them, there was also a reduction in the stenosis without additional endovascular treatment.

Rate of the permeability of the surgery was 100%, 90.9% and 81.8%, the permeability of the angioplasty were 100%, 90.9%, 90.9% and primary patency rate stenting were 62.5%, 37.5%, 37.5% and permeability assisted 87.5%, 75%, 50% at 1, 3 and 5 years, respectively (Table 3).

All patients survived the follow up period. Clinical results at the end of follow-up (mean 60 ± 36 months, range 24-96 months) did not show any statistical difference between the three groups (p = 0.3426). Among the group I, hypertension was cured in 4 patients and improved in 5 patients. Among the group II, hypertension was cured in 3 patients, improved in 4 patients and clinical failure occurred in 1 patient. Among the group III, hypertension was improved in 7 patients and clinical failure occurred in 1 patient.

One patient in group II (1/11, 9%) and another in Group III (1/8, 13%) developed chronic renal failure during the period followed. In both patients, contralateral renal arteries were occluded at the time of surgery and chronic renal failure developed in 16 months and 25 months after the occlusion of treated arteries.

Discussion

Several studies have shown excellent results of angioplasty in renovascular hypertension caused by Takayasu's arteritis. Tyagi et al. (6) reported a 44.2% cure rate and the improvement rate of 48.4% with a 13.5% restenosis. Sharma et al. (7) reported that angioplasty was beneficial in 89% of patients and that the restenosis rate was 16%. Their studies were the series with a follow-up period of about two years. In our study the longest follow-up period was of 5 years on average, and includes three treatment options (surgery, angioplasty, and the establishment of a stent). The technical success and beneficial effects on blood pressure (28/30, 93.3%) were similar to other studies. Rates of restenosis (26.7%) was higher than that of their studies. This is caused by the fact that the follow-up period of our study is higher, and their only series angioplasty was included, while our results have been obtained at the time of surgery, angioplasty and implementation in place of a stent have been included, and that the rate of restenosis after placement of stent (62.5%) is much higher than that of angioplasty (9%) or surgery (18, 2%).

Ham SW et al. (5) reported a permeability rate of 91%, 80%, 80%, after the surgery at 1, 3, 5, and the rate of permeability after endovascular technique 73%, 49%, 49%. His study was the series with 79 patients treated for renovascular hypertension caused by non-atherosclerotic diseases including 67 patients treated surgically and 12 by endovascular techniques (angioplasty and implementation of a stent). In our study of Takayasu's arteritis alone, angioplasty had the best result regarding permeability and the restenosis rate.

In the meta-analysis of the development of a stent for angioplasty and stenosis of the renal artery atherosclerosis (12), the development of a stent showed a higher success rate (98%), and restenosis rate (17%) lower than those of angioplasty (77% and 26%, respectively) at 19 months of follow-up period of the average.

In the randomized trial of ostial stenosis of the renal artery due to atherosclerosis (13), the establishment of a stent showed better results in the technical success, primary patency, restenosis comparing with angioplasty

TABLE 3 - RATE OF RESTENOSIS AND PERMEABILITY IN THE THREE STUDY GROUPS.

	Restenosis rate	Rate of permeability		
		1 year	3 years	5 years
Group I	18,2%	100%	90,9%	81,8%
Group II	9%	100%	90.9%	90.9%
Group III	62.5%	62.5%	37.5%	37.5%
Total	26,7%	90%	76,7%	73,3%

(88% against 57%, 75% against 29% and 14% against 48%, respectively). In our study of Takayasu's arteritis, angioplasty showed better permeability and the restenosis rate versus the stenting and surgery.

There are two studies with positive results from implementation of a stent renal artery in Takayasu arteritis (20) and (21). However, their studies were with a small number of patients and follow-up in the short term. Relapse or reactivation is common and Takayasu accompanying the worsening of vascular lesions. (22)

There were reports on a further improvement in lumen diameter after angioplasty. Tyagi et al. (6) recorded improvement of 21.2% (11/52 cases) – (we recorded this improvement in two cases in our study) – and this can be caused by the rupture of the thick fibrous bands in the intima and adventitia, and by the slow retraction of these bands. Disturbed bands can continue to shrink, and the artery can heal with a fully dilated long-term condition. Whereas later remodeling after angioplasty and with our results, stenting should be considered only after the failure of the aggressive angioplasty.

Hypertension Takayasu arteritis is not a simple question. It can be due to a marked narrowing or reduced compliance of the aorta and the abnormal function of the baroreceptors of aortic sinus and the carotid, in addition to the stenosis of the renal artery (23). In extensive disease involving arch vessels with severe stenosis, it may be difficult to estimate true blood pressure. The effects of drugs, including anti-hypertensive, anti-inflammatory and immunosuppressive ones, should not be overlooked in assessing the clinical benefit of endovascular or surgical treatment (15). In our study, although there was a difference of meaning in the permeability of the renal artery between arteries treated with angioplasty or surgery and the establishment of a stent, the antihypertensive effect of treatment did not differ between the three groups.

Conclusion

We have represented a comparative long-term study of surgery, angioplasty and placement of a stent in stenosis of the renal artery caused by Takayasu's arteritis. Restenosis rate was 18.2% by surgery, 9% by angioplasty and 62.5% in the setting up of a stent. Renal artery patency rates were 100%, 90.9%, and 81.8% in the surgery, 100%, 90.9%, 90.9% in angioplasty alone; the rate of primary permeability by the introduction of a stent were 62.5%, 37.5%, 37.5%, and assisted permeability 87.5%, 75%, 50% at 1, 3 and 5 years, respectively. The clinical results in hypertension did not differ between the groups of patients. Our study suggests that angioplasty has better long-term patency than stent and surgery.

Because there was no significant difference in clinical outcomes in the three groups, the establishment of a stent should be reserved for the failure of the obvious angioplasty, although surgery remains an effective solution specially for patients with associated aortic pathologies, and in case of failure of endovascular treatment.

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