STENTING OF STENOSIS OF THE ABDOMINAL AORTA

M C L Lim, M Choo, H C Tan

ABSTRACT

Isolated abdominal aortic stenosis resulting in bilateral lower limb claudication is uncommon in Asians. We report a 75-year-old Oriental man with isolated abdominal aortic stenosis who underwent intraluminal stenting, resulting in the abolishment of a 76 mmHg gradient. As the stenotic segment was local, only the mid-segment of the Palmaz stent was apposed to the aortic wall. Follow-up ultrasound scans showed that the partially apposed stent was patent, with no thrombosis in the free space between the stent and the wall. Hence, although aortic stenting in this patient resulted in partial apposition of the stent to the aortic wall, there was no thrombosis or migration of the stent. The patient remained symptom-free one year post-stenting. Stenting in this patient with failed balloon angioplasty was a safe and efficacious method of treating significant isolated abdominal aortic stenosis.

Keywords: *angioplasty, Palmaz stent, abdominal aorta, stenosis, claudication*

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INTRODUCTION

Isolated stenosis of the abdominal aorta resulting in significant bilateral lower limb claudication is an uncommon cause of lower limb claudication in Asians. Conventionally, significant distal abdominal aortic disease has been treated with endarterectomy and bypass grafting. The evolution of percutaneous catheter-based methods such as percutaneous transluminal balloon angioplasty (PTA) has made these techniques a viable first choice option in the treatment of disease of the distal abdominal aorta[1-12]. There have been several reports on the use of PTA in the management of significant isolated stenosis of the abdominal aorta[1-12]. The reported experience in the literature shows that it is a safe and efficacious method of treatment with infrequent complications[13]. Long-term follow-up data is limited but follow-up data up to 9 years has been reported[6]. In patients where PTA has failed, surgery used to be the only option. However, the development of intraluminal stents, provided an alternative option. Such stents have been used with considerable success in the coronary and iliac arterial circulation. There are a few reports on the use of stents in patients with failed PTA of the abdominal aorta[14-17].

Although we have had significant experience with the use of balloon-expandable stents in the coronary and peripheral circulation in our department, this is our first reported experience with the balloon expandable Palmaz stent for the treatment of a localised significant atherosclerotic abdominal aortic stenosis. To the best of our knowledge, this is the first reported successful use of the balloon expandable Palmaz stent for a localised abdominal aortic stenosis with follow-up results in Asia.

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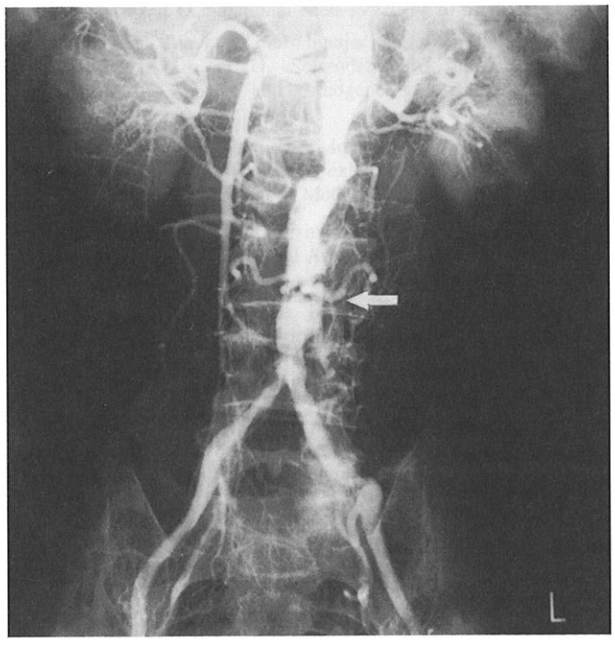
CASE REPORT

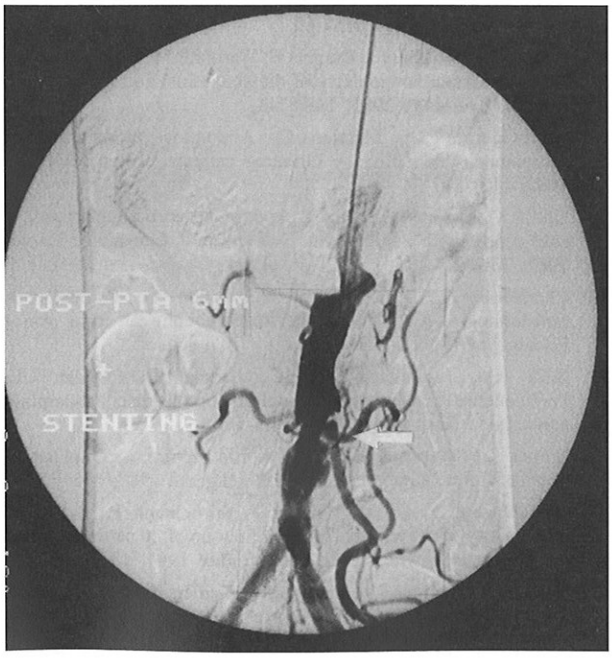
A 75-year-old man, with a history of chronic smoking and hypercholesterolaemia, was referred for bilateral lower limb claudication which had become progressively more severe over the past 6 years. The claudication distance was less than 100 metres. On examination, both his femoral pulses were weakly palpable and the distal lower limb pulses were not palpable. A vascular ultrasound and Doppler scan of the lower limb arteries was performed with Hewlett-Packard Sonos 1000 peripheral vascular 7.5 and 4.5 MHz transducers. The external iliac and lower limb arteries were widely patent with damped monophasic Doppler signals consistent with a significant proximal stenosis. An aortogram was performed via the left axillary approach. This showed an 85% diameter stenosis of the abdominal aorta at the level of the L3 vertebra, 3 cm proximal to the aortic bifurcation with good opacification of the distal abdominal aorta both via antegrade flow and collateral flow from lumbar arteris. The abdominal aorta was only 2 mm in diameter at the narrowest site (Fig 1). The common, external and internal iliac arteries were patent with only minor atherosclerotic plaques.

Fig 1 – Significant discrete stenosis of the abdominal aorta



The patient was scheduled for percutaneous balloon angioplasty with a view to stent the aorta if the result of balloon angioplasty was unsatisfactory. Pre-procedurally, the patient was started on intravenous low molecular weight dextran at the rate of 100 ml/hr and dipyridamole 75 mg tid. Aspirin was not given as the patient had frequent epigastric pain. Arterial access was obtained via the right femoral and left axillary routes. A bolus of 10,000 units heparin was given intraarterially. Using two catheters placed proximal and distal to the stenotic site in the abdominal aorta, simultaneous pressure recording was obtained. The peak systolic pressure proximal to the stenosis was 186 mmHg and the peak systolic pressure distal to the stenosis was 110 mmHg, with a pressure gradient across the stenosis of 76 mmHg. Using a 0.035 inch Terumo hyrophillic straight guidewire, the stenosis was crossed via the femoral route. A 5 French USCI 6mm x 2cm PTA balloon catheter was placed across the stenosis and inflated. A smaller size balloon catheter was used with a view to proceed with a larger balloon catheter if the response was satisfactory or to stent the aorta if there was significant recoil. Post-deflation, there was no significant change in the severity of the stenosis as a result of significant recoil of the aorta. Via a 9 French Terumo sheath at the right femoral artery, a 7 French 3 cm Palmaz stent mounted on an 8 mm balloon catheter was placed across the stenosis and inflated. The stent was further expanded by inflating a 5 French 10mm x 4cm Penta MediTech balloon angioplasty catheter across the stent. Post-stenting, both the peak systolic pressure proximal and distal to the stent was 152 mmHg. The proximal end of the stent was mildly wider than the waist of the stent where it was apposed against the aortic wall. The proximal and distal ends of the aortic stent were not apposed to the aortic wall as the diameters of the aorta at these sites were wider than the stenotic site (Fig 2). The visceral and lumbar branches at the site of stenting remained patent. Having achieved good haemodynamic results, it was decided not to dilate the aortic stent further. Clinically, the patient had good lower limb arterial pulses. Post-procedurally, the patient was put on intravenous heparin for 24 hours and continued on dipyridamole 75 mg tid.

Fig 2 – Dilated Palmaz stent across the site of the abdominal aortic stenosis



A transabdominal aortic ultrasound and Doppler study was performed 3 weeks post-stenting. The Palmaz stent was widely patent and there was no significant change in the velocity across the stent. Fourteen weeks post-stenting, a repeat transabdominal vascular ultrasound and Doppler study was performed using a Hewlett-Packard Sonos 1000 peripheral vascular 4.5 MHz transducer. The pre-stent pulsed-wave Doppler velocity was 2.7 m/s and the post-stent velocity was 2.6 m/s. The antero-posterior stent diameter was 8.7 mm and the lateral diameter was 10.5 mm. There was no migration of the stent. At the areas where there was a space between the unapposed stent wall and the aortic wall, the space was not occluded by thrombi and there was flow in the space (Fig 3a and 3b). Clinically, the lower limb arterial pulses were normal and the patient had complete resolution of his claudication.

Fig 3a – Transabdominal aortic ultrasound scan showing a cross-sectional view of the Palmaz stent in the abdominal aorta

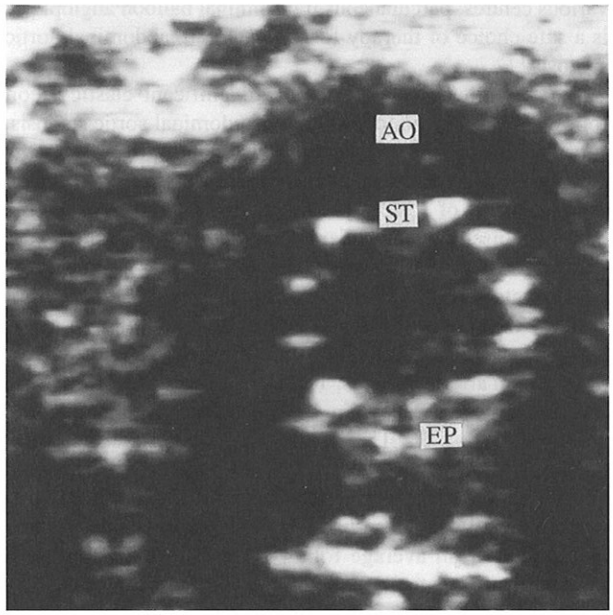
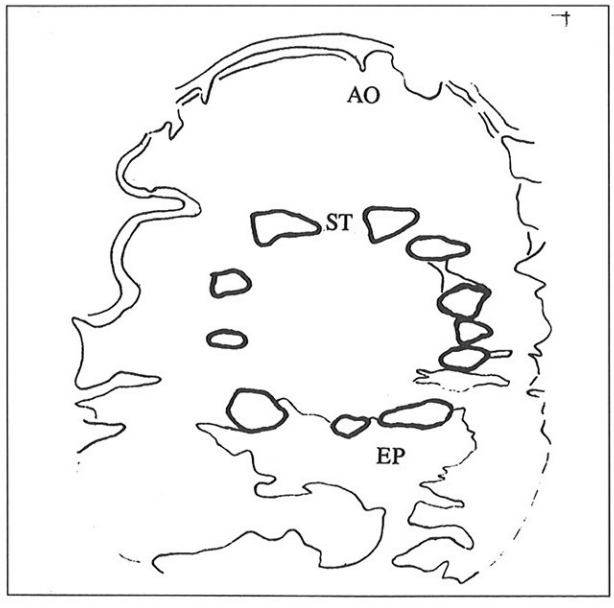


Fig 3b – Line illustration of the photograph in Fig 3a showing the stent in relation to the abdominal aorta



On follow-up, the patient remained free of claudication one year post-stenting.

DISCUSSION

Percutaneous transluminal balloon angioplasty is an alternative to surgery in patients with significant stenosis of the aorta. The mechanism of angioplasty in atherosclerotic aortas consists of plaque dehiscence and fracture followed by overstretching of the plaque-free wall segments[18]. In overdilatation of the aorta with balloon catheters, the significant increase in the lumen is due to intimal and medial rupture with stretching and thinning of the adventitia. The vasa vasorum are stretched and severed resulting in adventitial haemorrhage. Subsequent healing consists of the formation of neointima, hyperplasia of the adventitia and proliferation of the vasa vasorum with no progression of the luminal dilatation[19]. The aorta is resilient to the effects of dilatation and even a severely damaged adventitia is capable of preserving the lumen from further dilatation and rupture until healing[19]. Hence, as is borne out by the experience from various centres, percutaneous transluminal balloon angioplasty is a safe choice of therapy for patients with abdominal aortic stenosis[1-12].

In the situation where there is significant elastic recoil following balloon angioplasty of an abdominal aortic stenosis, surgery was previously the only available option. With the development of percutaneous techniques of stent placement, the placement of a stent is now a viable alternative. Stents have been used with considerable success in the coronary and iliac arterial circulation where balloon angioplasty has yielded unsatisfactory results or failed because of significant recoil. It is likely that this success will be repeated with its use in the aortic circulation given the long-term success of stents in large lumen arterial vessels. There have been a few reports on successful use of stents in the management of abdominal aortic stenosis[14-16]. The largest reported series was by Diethrich et al with the use of 38 Palmaz stents in 24 symptomatic patients with distal abdominal disease[16]. Post-treatment, all patients had clinical improvement which persisted after an average follow-up period of 10.3 months. In 11 of the patients who were eligible for follow-up aortography, all aortic stents were patent without evidence of restenosis. Three access-related complications (two haematomas and one thrombus) occurred but there were no complications related to the stents. Vorwerk et al and el Ashmaoui et al reported the successful use of self-expandable stents in 2 and 3 patients with abdominal aortic stenosis disease respectively[14,15]. Long et al also reported on the successful use of arterial stents in 5 patients with tight stenosis and 2 patients with total chronic occlusions in the infrarenal aorta. Based on clinical and angiographic assessment, all the aortic stents remained patent after a mean follow-up period of 15.1 months[19].

In our patient, the use of an undersized balloon catheter allowed us to assess the response of the stenotic lesion without excessive dissection. We had planned to stent the lesion if there was no improvement in the degree of stenosis or if there was no decrease in the gradient across the stenosis. However, the length of the Palmaz stent implied that it may be much longer than stenotic lesion if it was a focal, discrete lesion as in this patient. This may result in the free edges of the stent lying unapposed to the vessel wall. Although dilatation of the stented lesion till the stent is completely apposed to the vessel wall will achieve a better angiographic appearance, it is uncertain whether it will compromise flow to the visceral and other side branches of the aorta. However, a stent which is incompletely apposed to the vessel wall may hypothetically result in 2 consequences - migration of the stent and the formation of thrombus in the space between the unapposed stent wall and the aortic wall. Migration of the stent can be prevented by overdilating the proximal end of the stent. In our patient, no further dilatation was attempted once the gradient across the stenosis was abolished. On follow-up with duplex ultrasound scans, there was good stent patency with no thrombosis or migration. The patient's claudication resolved post-stenting and he remained symptom-free at one year follow-up.

Stents have emerged as a new option in the treatment of abdominal aortic stenosis. The successful application of a balloon-expandable stent in an isolated atherosclerotic abdominal aortic stenosis which did not respond to balloon angioplasty in this patient illustrated the possibility of using the Palmaz stent in this clinical situation. Early experience with the use of stents show that the use of a stent is a promising alternative therapy in failed angioplasty of abdominal aortic stenosis[14-16,19]. However, modification of stents, such as provision of shorter stents, may help to overcome the problems of using a stent in the abdominal aorta.

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