# Balloon Angioplasty for Aortic Coarctation in Adult Patients

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## Abstract

***Objective-*** The aim of this study was to evaluate the use of endovascular intervention in managing native and recurrent aortic coarctation in adult patients.

***Methods-*** Balloon angioplasty was undertaken transfemorally in 16 patients (mean age 18.3 ± 4 years old) with arterial hypertension in 12 native and 4 recurrent aortic coarctations. Systolic pressure gradient measurements were taken peri-interventionally and in the course of follow-up during conventional angiography and transesophageal echocardiography. The average diameters of the balloon catheters used ranged from 15 to 20 mm.

***Results-*** Immediately after aortic angioplasty, the peak systolic pressure gradient decreased from 61 mmHg ± 5.4 to 7.6 mmHg ± 2.2 across the coarctation ($P < 0.001$). One patient with recoarctation had an unsuccessful immediate result. Restenosis occurred in two patients, who subsequently underwent repeat dilation with successful results. Transesophageal echocardiography was repeated post-procedure and at 6 months post-intervention. One patient developed a small aneurysm at the site of dilation. In the course of follow-up, no other major or minor complications were observed.

***Conclusion-*** Endovascular intervention appears to be a safe and effective alternative to surgery for the treatment of native and recurrent aortic coarctation in most adult patients with a low rate of complications ***(Iranian Heart Journal 2004; 5(1,2):51-54).***


**Key words:** aortic angioplasty ■ hypertension ■ aortic coarctation

Coarctation of the aorta is among the most common heart defects and classically refers to a discrete area of stenosis in the proximal descending thoracic aorta. Surgical repair of coarctation was first described by Crafoord et al. in 1945[1] and remained standard therapy until 1982, when transcatheter treatment of aortic coarctation was first described by Singer et al.[2] A less invasive alternative to surgery over the years, trans-catheter therapy has been the subject of several studies comparing it to the potential benefits and complications of the various surgical techniques.[3]

Despite satisfactory immediate results, concerns with angioplasty have persisted regarding long-term outcome, including the risks of recurrent coarctation, aneurysm formation and aortic dissection.[4-6] Immediate gradient reduction appears to be similar following either surgery or balloon angioplasty and is variable, depending on both the anatomy and the age of the patient.[7] Balloon angioplasty still plays a role in the management of native coarctation in neonates and infants.

Controversial as it is because of a high incidence of restenosis, it is more universally accepted in children and adults,

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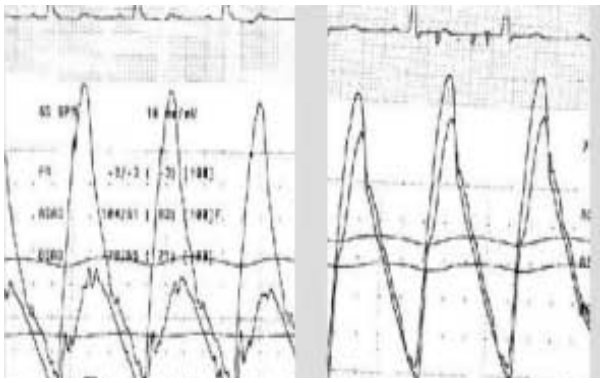
and indeed it is the recommended treatment of choice for recurrent coarctation.[8-10] Currently, aneurysm formation with angioplasty is an unusual event.[11]

## Methods

Over a period of 3 years, 16 patients underwent balloon dilatation at our department. The mean age of the patients was 18.3 ± 4 years. There were 11 males and 5 females. Indications for dilation included angiographic evidence of significant coarctation with a pressure gradient greater than 20 mmHg across the coarctation. Patients with hypoplasia of transverse aorta as well as those with long-segment coarctation were referred for surgical correction.[12-14] Twelve patients had native coarctation, and four patients had recurrent coarctation after surgical repair or balloon angioplasty.

The procedure was performed under local anesthesia in all but one patient, in whom it was done under general anesthesia. Access having been obtained to the femoral artery and vein, a complete right and left heart hemodynamic study was performed, and systolic pressure differences were measured across the area of coarctation. The coarctation site was then crossed in a retrograde fashion, and the peak and mean pressure gradients were measured by pull back or by simultaneous ascending and descending aortic pressure recordings. Aortography was performed initially in the straight anteroposterior and lateral projections, with a second angiogram in the left anterior oblique projection when the anatomy was not well profiled. The nature and diameter of the coarctation site and the descending aorta at the level of the diaphragm with reference to the size of the patient determined the choice of balloon size.

Following diagnostic cardiac catheterization, the balloon catheter was advanced to the site of the coarctation over a guide wire. Next, the balloon diameter was selected to be 1 mm less than the diameter of the aorta at the level of the diaphragm. The length of the balloon was 3-4 cm. The balloon was inflated 1 to 3 times for 10 seconds to the pressure recommended by the manufacturer until the relief of the waist was noted. In order to assess the result of angioplasty following each balloon inflation, aortography was performed (Fig. 1).



**Pre 1** **Post 2**

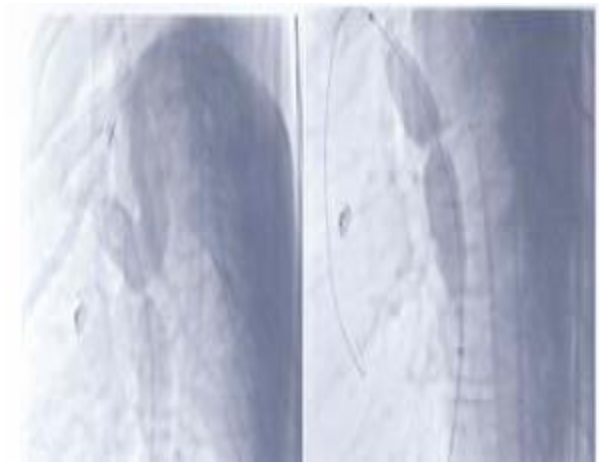


**Fig.1.** Pre procedure

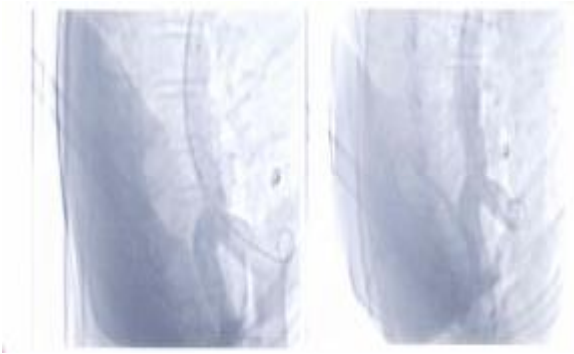


**Fig. 2**. Post procedure

Finally, the estimation of the post-dilation pressure gradient was measured across the coarctation site. A successful result was defined as a peak systolic residual gradient less than 20 mmHg after balloon angioplasty (Fig. 2). Values are expressed as mean ± one SD. The student paired T-test was used to compare pre- and post-angioplasty pressure gradients. P-value < 0.05 was considered statistically significant. Before being discharged, all the patients underwent complete clinical evaluation, including arm and leg pressure measurement, echocardiography and chest films. The patients were asked to visit their primary cardiologist within 1 month after discharge from the hospital and then regularly afterwards. A good late result was defined as the absence of restenosis and significant aortic aneurysm, as well as a residual pressure gradient less than 20 mmHg measured by cuff sphygmomanometry or repeat cardiac catheterization or echocardiography.

## Result

Balloon angioplasty led to a significant change in gradient and stenosis. Immediately after the procedure, the systolic pressure gradient between the ascending and descending aorta decreased from 61 mmHg ± 5.4 to 7.6 mmHg ± 2.2.
In 15 patients, treatment was considered to be successful. One patient with recoarctation had an unsuccessful immediate result, which led him to undergo surgical repair after one month. Recoarctation developed during follow-up in two patients; they were dilated again successfully several months later.
One patient developed a small aneurysm at the site of dilation. Magnetic resonance imaging follow-up revealed no new aneurysm or appreciable changes in the size of pre-existing aneurysms, and no coarctation was observed. The blood pressure had normalized without medication in 68% of the patients.

## Discussion

Most untreated patients with coarctation of the aorta will die before 50 years of age.[15] Unfortunately, coarctation may not be diagnosed and the patient may present in adult age with hypertension. Although the first balloon angioplasty of aortic coarctation was described in 1982,[2] its use was not popularized until the 1990s. The early limitations were related to the technique used and the devices available. The basic mechanism of balloon angioplasty is the expansion of the constricted lumen, which produces tears and cracks in the intima and various degrees of splits in the media.[16] The use of balloon angioplasty in adult patients remains controversial, and there is no consensus view. Previous studies showed an improvement in the coarctation gradient; however, the magnitude of the residual gradient was quite variable. Our results support the few previously published reports suggesting an improvement in the coarctation gradient. Previous studies reported a residual mean gradient ranging from 8 mmHg to 18 mmHg, and residual gradients of > 20 mmHg were found in 7-18% of patients undergoing balloon angioplasty alone.[17,18] Our results were similar, and we observed a significant decrease in coarctation

gradient. At follow-up, clinical hypertension or the continued use of anti-hypertensive drugs has been reported in 26-68% of patients.[19] In our study, 28% of the patients were still taking anti-hypertensive drugs after the procedure, but the number of drugs was reduced significantly.

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