Balloon Dilatation of Coarctation of Abdominal Aorta: A Case Report

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The technique of balloon dilatation of stenotic lesions was described by Rubio and Limon-Lason in 1954 (1) and Dotter and Judkin in 1964 (2). It, however, became popular after Gruentzig and associates applied similar techniques for dilatating the coronary artery stenosis in mid 1970's (3,4).

More recently similar techniques have been used in infants, and children to relieve congenital and post-operative stenotic lesions of the pulmonary valve, peripheral or main pulmonary artery, pulmonary vein, aortic valve, native and restenosed surgically resected coarctation of the aorta, (5,7), interatrial baffle stenosis after Mustard's operation for transposition of great arteries and superior vena caval stenosis.

We report the first case of percutaneous transluminal angioplasty for coarctation of aorta performed at the National Institute of Cardiovascular Diseases.

Case History:

A 6 – year old girl was admitted in the hospital for the third time with complaints of shortness of breath, diffuse headache and history of low grade intermittent fever since one year. A clinical diagnosis of congestive heart failure and coarctation of aorta was made. On physical examination her weight and height were 15kg and 110cm respectively, she looked sick and had moderate respiratory distress. Her pulse rate was 96/minute. Femoral pulses were not palpable and blood pressure was 140/90mm Hg in the upper extremities, and 80mm Hg in the lower extremities (flush method). Thus a pressure gradient of 60mm Hg was present at the coarctation site. Jugular venous pressure was elevated. On precordial examination heart was enlarged with cardiac apex 2cm outside the mid-clavicular line. S_3 was audible at the apex. S_2 was closely split with accentuated P_2 indicating pulmonary artery hypertension. Fine basal crepitations were audible at both lung bases. Liver was palpable about 2cm firm and slightly tender. Electrocardiogram showed generalized inversion of T waves in all precordial leads and left ventricular hypertrophy. X-ray chest film, P.A view, showed gross cardiomegaly with cardiothoracic ratio of 0.7. Barium swallow showed displacement of the middle part of oesaphagus due to left atrial enlargement. Her laboratory work-up showed blood glucose of 82 mg%, blood urea of 26mg%, serum sodium of 140 mEq/L, serum potassium of 3.9 mEq/L, Chloride of 101 mEq/L. Haemoglobin was 10G per cent and total white cell count was 13,700. Erythrocyte sedimentation rate was 50mm in Ist hour (Wester-Gren). Rheumatoid factor was negative, and lupus erythematosus cells were not seen. Blood cultures produced growth of psendomonas-aeroginosa and supported the diagnosis of bacterial endocartidis.

Echocardiography:

An echocardiogram antero-posterior diameter of aortic root was 25mm and left atrial dimension was 35mm. The main pulmonary artery diameter was 27mm and left ventricular end diastolic dimension was 60mm while end systolic dimension was 50mm. These measurements were compatible with depressed left ventricular function.

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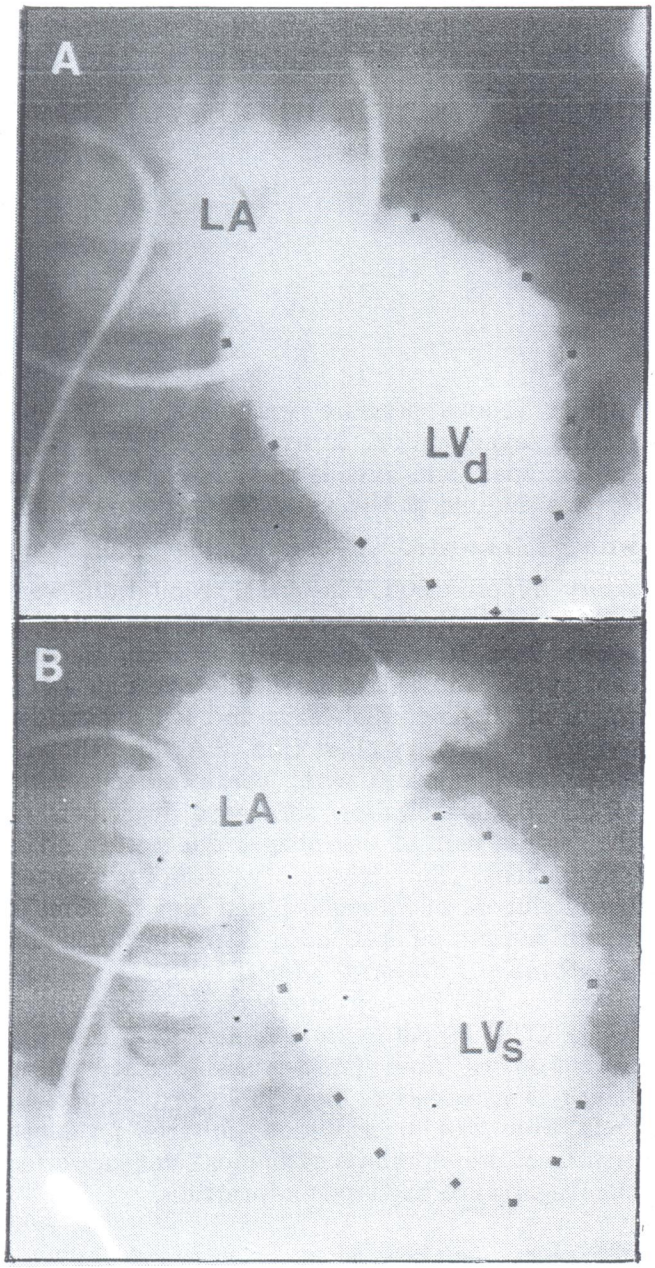


Fig. 1. A& B Pulmonary artery angiogram showing opacification of the left ventricle (LV) on levophase, in diastole (LVd) in pannel A, and systole in pannel B (LVs). Markedly reduced left ventricular contractions are present.

Cardiac Catheterization:

Cardiac catheterization was performed in order to determine the degree of left ventricular dysfunction and to document the area and site of coarctation. The peak systolic pressure in left ventricle was found to be 140mm Hg and end diastolic pressure was elevated to 16mm Hg. Ventriculogram showed a large left ventricle with severely reduced contractions, (Fig 1. A,B). On quantitation left ventricular ejection fraction was 42 per cent (Dodge Biplane Method) and cardiac index was 3.4 LU/M^2. Ascending aorta pressure was 180/100mm Hg. The pressure in abdominal aorta below the level of diaphragm was 80/60mm Hg so that a gradient of 78mm Hg was located at the level of diaphragm, (Fig 2). Aortogram showed gradual narrowing of aorta starting just after origin of left subclavian artery and extending upto level of twelfth dorsal vertebra with the narrowest discrete point of coarctation at the level of middle of body of eleventh dorsal vertebra, (Fig 2. A,B).

Angiographic:

Aortic diameter was measured in antro-posterior angiogram. Ascending aorta at root was 27mm and the total length of coarcted segment was 25mm with narrowest point of 3mm in diameter at the middle of eleventh dorsal vertebra.

The surgical coarctectomy was considered to be of high risk because of left ventricle failure so that balloon dilatation was planned.

Dilatation Procedure:

Percutaneous femoral artery catheterization was performed with a number 5F superflow big tail catheter. Five thousand units of heparin was administered immediately after introduction of arterial catheter left ventricular and angiogram were obtained. Angiographic catheter was taken out and 0.038, guide wire was left well above the level of coarctation. Gruentzig balloon dilatation catheters the balloon diameter of 4mm and 3cm length was introduced over the guide wire and balloon dilatation was performed three times with varying pressure of 5, 10 atmosphere; inflation lasted 45 second at each time. Interval between inflation was 5 minutes. The position of the balloon was confirmed by fluoroscopy which showed an hour glass shape during initial phases of inflation and the waiste due to coarctation segment, (Fig. 3. A,B). The waiste was completely eliminated at the last inflation. Aortic angiogram was obtained after the procedure and pull back pressure were also recorded

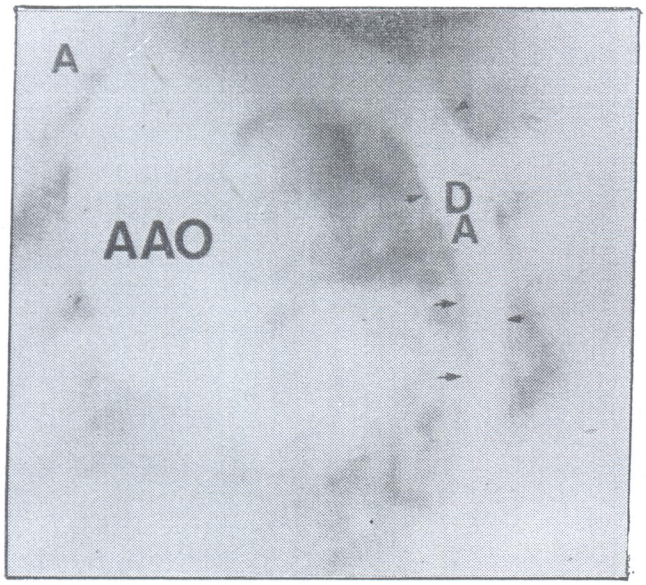


Fig. 2 – A. Aortogram, lateral view, showing narrowed descending aorta due to generalized aortitis indicated by irregular vessel walls (arrows).

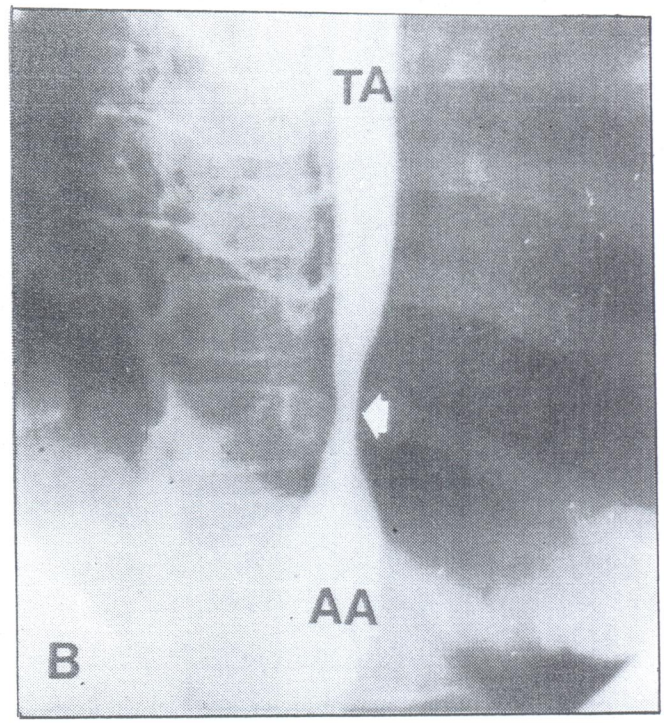


Fig. 2 – B. Aortogram, antero-posterior view. A discrete area of coarction is present within the markedly narrowed thoracie aorta (TA) just above the level of diaphragm (arrow). The post stenotic dilatation of abdominal aorta is well seen.

which showed that the pressure gradient had been reduced to 10mm Hg. Femoral pulses were examined and blood pressure measured after the procedure. The ascending aortic pressure before dilatation was 125/80mm Hg, and below the coarctation it was 80/60mm Hg. After dilatation remained at 125/80 above coarctation but increased up to 115/70mm Hg below the coarctation. The aortogram showed that discrete coarctation had been effectively dilated (Fig 3, C). There was no significant complications during or after the procedure. Patient stayed in the hospital for one week after dilatation. During this period blood pressure fell to 120/80mm from predilatation of 140/90mm Hg in upper extremities. In the lower extremities blood pressure went up from 80mm Hg to 110/70mm Hg. Thus a gradient of 10mm Hg was left. The signs of congestive heart failure improved and patient required few anticongestive medications.

Discussion:

This report describes the first balloon dilatation attempt of acquired coarctation of aorta at the National Institute of Cardiovascular Diseases. This patient had generalized aortitis involving much of the thoracic aorta and was associated with a discrete segment of coarctation. Left ventricular failure dominated the clinical picture and required multiple hospital admissions of 3-4 month duration. She had marked degree of upper limb hypertension which required multiple drug therapy. The surgical relief of coarctation was considered a prohibitive risk. Balloon dilatation, by relieving the discrete coarctation, lead to dramatic improvement of left ventricular failure and amelioration of upper limb hypertension so that patient could be discharged home at reduced medication.

Successful dilatation of congenital native coarctation has been reported with increasing frequency both in infants and children. Surgical repair of older children with coarctation is a very satisfactory procedure with a much smaller recurrence rate of recoarctation. However in infants, who are often in gross cardiac failure at the time of presentation surgical, repair of coarctation carries a significant mortality and recurrent coarctation rate is high. Balloon dilatation has been successfully done in this group of infants.

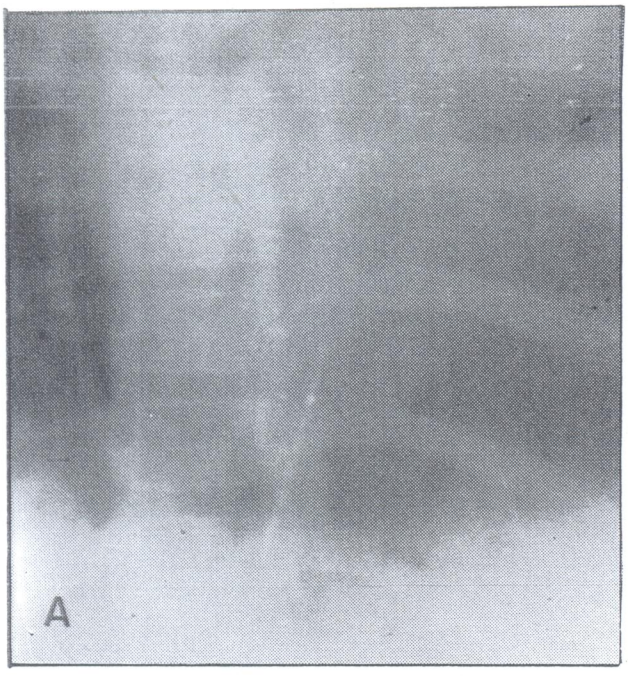
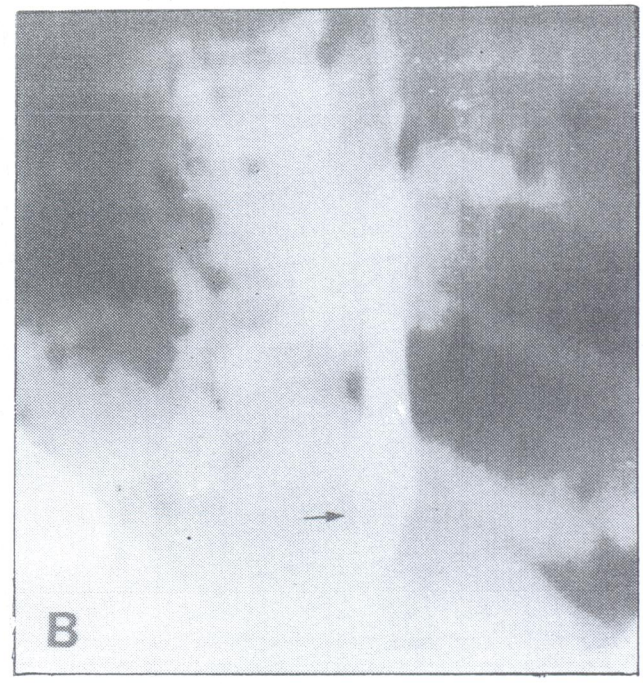


Fig. 3 – A. A 6mm balloon is passed over the guide wire and is positioned across the coarcted segment.



F. 3 – B. The balloon is in full inflation and the waisteproduced by the coarctated segment is obliterated.

As our patient illustrates relief of coarctation by the balloon dilatation carries a small risk but results can be most gratifying. The great advantage of this procedure seems to be that it can be repeated should recoarctation reappear. It is clear now that balloon dilatation is indeed a procedure of choice for recurrent coarctation of aorta.

Selection of balloon size as well as positioning of balloon are essential steps in achieving effective dilatation and minimising the complications.

It is recommended that balloon diameter should not exceed 3-4 times the size of coarcted aortic segment. This can be determined from the angiogram or echogram of aorta which may be done prior to the procedure. Echocardiography allows that the selection of proper size balloon can be planned well in advance of the procedure. Angiographic measurement of coarctation orifice involves quick determination of magnification factor and stop frame capability of the recording tape.

The effectiveness of dialatation can be assessed by the ability to completely relieve the balloon waiste. The selection of the balloon size can also be made by noting the degree of waiste produced during initial phase of inflation. If the waiste is very tight then with smaller balloon should be used. After the dilatation, guide wire or catheter should not be advanced across the dilated area of the coarctation: It is therefore necessary to leave the guide-wire well above the coarctation if it is determined by post balloon angiogram that further dilatation may be necessary. Significant reduction in the systolic pressure gradient across the coarctation site combined with the disappearance of aortic ridge angiographically are reliable criteria for determining the immediate success of the balloon dilatation.

Although blood pressure measurements are useful for long term follow-up but if facility is available, pulsed Doppler echocardiography offers an even more sensitive tool for the assessment of blood flow (12, 13) and pressure gradient at the area of dilatation.

Most reported studies do not show significant complications of the procedure but some recent reports show aneurysmal dilatation in the region of previously dilated coarcted aortic

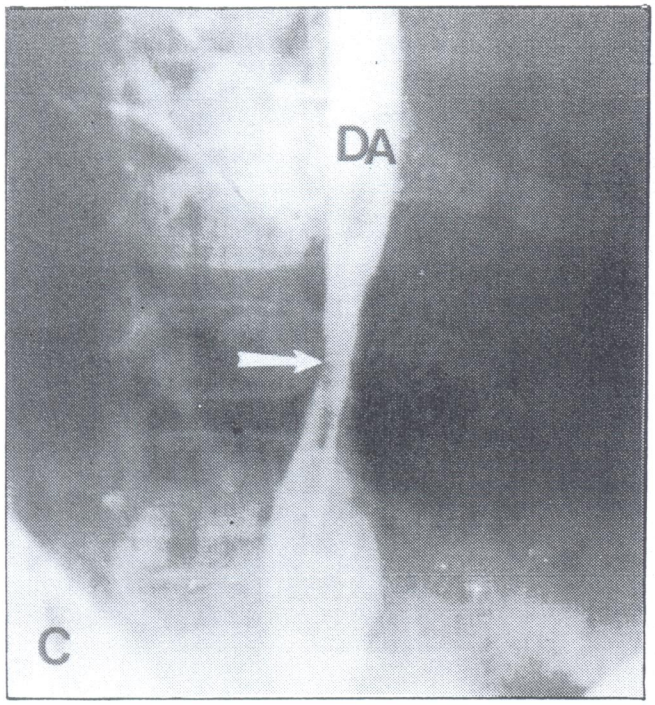


Fig. 3 – C. Descending aorta angiogram following dilatation. The discrete soarcted segment is now dilated (arrow). However, significant narrowing of this segment is still present.

segment. This is not unexpected in the view of the thinning and tear of the media which is usually the result of successful balloon dilatation. It must be kept in mind that large size catheters are introduced into the femoral artery for the procedure. Significant damage to the femoral artery is bound to result. The smaller the child greater is the risk of femoral occlusion and risk to the extremities. It is reported that infants have a high risk of femoral artery occlusion after the dilatation procedures.

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