TRICUSPID STENOSIS AND TRICUSPID VALVOTOMY

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Tricuspid stenosis as an isolated heart lesion is rare and is usually of congenital origin. Up to 1960 only 18 cases of congenital triscuspid stenosis were described in the world literature.[1] On the other hand, rheumatic tricuspid stenosis is usually associated with mitral or aortic stenosis. The incidence of involvement of the individual heart valves in rheumatic fever was given by Wood[2] as: mitral 80%, aortic 48%, tricuspid 12% and pulmonary 5%. The post-mortem studies of Cooke and White[3] and of Smith and Levine[4] showed that 10 - 20% of patients with chronic rheumatic heart disease have a degree of tricuspid stenosis.

The presence of significant mitral stenosis tends to mask the signs of tricuspid stenosis. Bailey and Bolton[5] explored the tricuspid valve in 98 cases of mitral stenosis. They found stenosis of this valve in 15 of these patients, and in only 3 had this lesion been diagnosed before operation. The degree of tricuspid stenosis is often insignificant when compared with the degree of mitral stenosis, and although the condition may not be overlooked, it is not always necessary to do a tricuspid valvotomy in association with a mitral valvotomy. Occasional papers on the operation of tricuspid valvotomy have been published since 1953, and at the end of 1956 only 19 patients who had undergone this operation had been reported on.[6] Since then a few more reports have been added to the literature.

It is the purpose of this paper to report on a patient who had both tricuspid and mitral stenosis, and to describe the technique of combined mitral and tricuspid valvotomy with a transventricular dilator.

DIAGNOSIS OF TRICUSPID STENOSIS

In tricuspid stenosis cardiac filling is impaired; it may resemble constrictive pericarditis in its symptoms and signs. Fatigue is a prominent symptom and is probably due to the diminished cardiac output. When tricuspid stenosis is extremely severe, symptoms from an associated mitral lesion, e.g. orthopnoea and haemoptysis, may be absent, since the lungs are protected against congestion by the low fixed output of the right ventricle. If stenosis of the tricuspid valve is less severe, the mitral stenosis will dominate the clinical picture and symptoms of tricuspid stenosis may only appear after a successful mitral valvotomy has been performed. The presence of oedema and ascites in mitral stenosis (which are common but late signs) should point to a stenotic tricuspid valve.

Pre-systolic venous and hepatic pulsations may be present because of the raised pressure on the right side of the heart, but the pre-systolic hepatic pulsation must be distinguished from the systolic hepatic pulsation of tricuspid incompetence. Hepatomegaly is invariably present. In advanced cases cardiac cirrhosis of the liver and bronzed discoloration of the skin of the head and neck may be present.

The murmur of tricuspid stenosis is best heard in the left parasternal area between the 3rd and 5th spaces. It is loud and coarse and of a higher pitch than the diastolic rumble of mitral stenosis. A pre-systolic accentuation will occur if the heart is in sinus rhythm. An important diagnostic point is the increased intensity of this murmur on inspiration, whereas the mitral stenotic murmur becomes louder on expiration. An opening snap may be present and a diastolic thrill may also be felt.

When tricuspid stenosis is suspected, confirmatory evidence may be obtained from fluoroscopy, electrocardiography and cardiac catheterization. Fluoroscopy will show enlargement of the right atrium. If there is associated mitral stenosis the left atrium and right ventricle may also be enlarged, but severe tricuspid stenosis may prevent these changes, even in the presence of significant mitral stenosis. The electrocardiogram shows, in patients in sinus rhythm, the peaked waves of right atrial enlargement. On cardiac catheterization the most important finding is a raised right atrial mean pressure of more than 5 mm.Hg. In addition there is usually a giant a-wave, caused by the powerful contraction of the hypertrophied right atrium. There is a gradient between the right atrial pressure and the right ventricular end-diastolic pressure. A gradient of more than 1·9 mm.Hg at rest, or more than 2·6 mm.Hg on exercise, is significant, and this gradient increases on inspiration.[7]

CASE REPORT

A Coloured male, aged 23 years, was admitted to the Karl Bremer Hospital on 13 October 1961. He was quite well until one month before admission when he developed fatigue, dyspnoea and pain in the lower anterior chest with moderate exercise. There was no orthopnoea or paroxysmal nocturnal dyspnoea. For three years he had experienced bronchitis in the winter and two weeks before admission he developed a cough, productive of yellow purulent sputum.

Examination showed a young Coloured man who did not appear acutely ill. There was no cyanosis or anaemia. On examination of the respiratory system a few crepitations were found at both lung bases. The liver was enlarged one finger below the costal margin but not tender. Pulsations were felt in the epigastrium, synchronous with a prominent a-wave in the neck. The pulse was regular, not collapsing and of good volume, and the blood pressure was 125/85 mm.Hg. The heart was clinically not enlarged, and the apex beat was in the nipple line and of a right ventricular type. A diastolic thrill was palpable over the lower end of the sternum, and over the mitral area a soft mid-diastolic rumbling murmur was heard. At the tricuspid area there was a coarse, hard, pre-systolic crescendo murmur which increased in intensity with inspiration and radiated towards the mitral and aortic areas. There was also a musical systolic murmur, which became louder with inspiration. At the aortic area an ejection systolic murmur which radiated to the neck, and an early blowing diastolic murmur were heard. The electrocardiogram showed bi-atrial hypertrophy, a grade 1 A-V block and an incomplete right bundle-branch block. Fluoroscopy showed normal uncongested lungs. There appeared to be a generalized enlargement of the heart with a prominent right atrium. Both ventricles appeared enlarged in the two oblique views. A barium swallow showed a moderate enlargement of the left atrium. Cardiac catheterization showed the following pressures:

Femoral artery	135/75	mm.Hg
Right ventricle	30/0	mm.Hg
Right atrium (mean)	11	mm.Hg
Left atrium (mean)	8	mm.Hg
Left ventricle	140/0	mm.Hg

The diastolic gradient at rest between the right atrium and the right ventricle was 3·5 mm.Hg.

Clinically, the patient appeared to be suffering from tricuspid stenosis, slight tricuspid incompetence, aortic incompetence of a mild degree, and mitral stenosis. The diagnosis of tricuspid stenosis was confirmed by cardiac catheterization, which also indicated mitral stenosis. It was then decided to perform a tricuspid and mitral valvotomy.

Operation

Under general anaesthesia the patient was placed on his right side, rotated backwards to 45°. The skin was cleaned and draped from the spine to the right anterior axillary line. The skin incision stretched from the left erector spinae muscle to three inches to the right of the sternum. It crossed the sternum at the level of the fifth costal cartilage. The left thorax was opened through the bed of the left fifth rib, without removing the rib. After ligation of the internal mammary arteries on both sides, the sternum was transected at the level of the attachment of the fifth costal cartilage and the right chest was opened along the bed of the fifth rib, again without resection of the rib. This exposure gave an excellent view of the anterior and left surfaces of the heart. The pericardium was opened vertically on the left side, anterior to the phrenic nerve, and then transversely towards the right side.

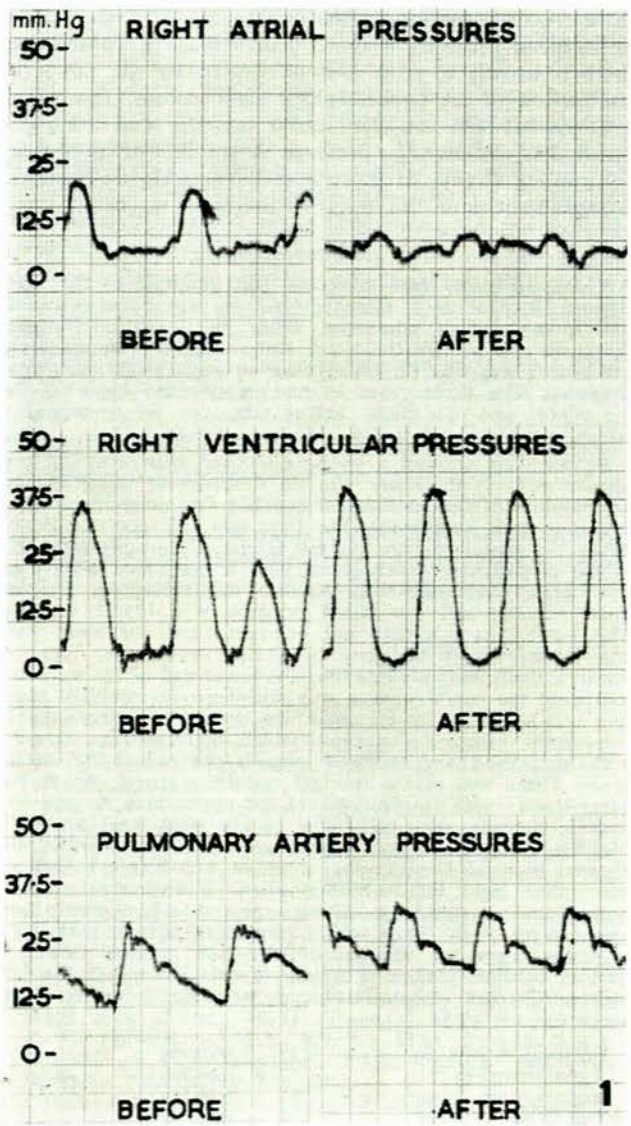

Fig. 1. Pressure tracings of the right atrium, right ventricle and main pulmonary artery before and after the tricuspid valvotomy. There is a drop in the right atrial pressure with a rise in the right ventricular and pulmonary artery pressures, indicating a successful valvotomy.

After measuring the pressures in the right and left atria, the pulmonary artery, the left ventricle, the right ventricle and the aorta, the tricuspid valve was felt with the right index finger inserted through the right atrial appendix. It was 1·5 cm. in diameter. The mitral valve was then explored and it was found to be 1·3 cm. in diameter. A mitral valvotomy with a Tubb's dilator was carried out transventricularly, and the mitral valve was opened to 4 cm. A good valvotomy was obtained without any regurgitation. The position of the patient made insertion of the finger in the left atrium difficult, but a good exposure of the left ventricle was obtained.

After closure of the left atrial and ventricular incisions a tricuspid valvotomy was performed; without changing the position of the patient on the table and without any change in the position of the operating team, the right index finger was inserted through the right atrial appendix. No calcification was present on the stenotic tricuspid valve, but the cusps appeared rather fibrous and firmly adherent. Finger fracture of the commissures was tried but was unsuccessful. The Tubb's dilator was then inserted through the right ventricle at a convenient and fairly bloodless spot on its antero-inferior surface. The dilator was opened to 4 cm. and the tricuspid valve was 3·5 cm. in diameter after the valvotomy. Slight incompetence was present. Pressures were again taken after the two valvotomies (Fig. 1). After closure of the incisions in the right atrium and ventricle and drainage of both pleural cavities, the sternal ends were approximated by two wire sutures. The rest of the wound was closed in layers.

The patient had a smooth postoperative course. The drains were removed on the second day and the patient was out of bed on the fourth day. He responded well to the operation and has become symptom-free.

DISCUSSION

Only a limited number of patients who underwent a tricuspid valvotomy in addition to a mitral valvotomy, have been reported. The first tricuspid valvotomy was done by Neptune and Bailey in 1952.[8] They used a right-sided approach. Since then this approach has often been recommended by Bailey. He explores the mitral valve through an incision in the inter-auricular septum. In a case reported by O'Neil *et al.*,[9] a mitral valvotomy was followed by a tricuspid valvotomy 4 years later. Chesterman and Whitaker[10] reported 5 cases of mitral and tricuspid stenosis: in the first 3 patients a mitral valvotomy was done first, followed by a tricuspid valvotomy at a later date. The fourth patient underwent a tricuspid valvotomy first, followed by a mitral valvotomy later. Only in the fifth patient were the mitral and tricuspid valvotomies done at the same time. In this patient a transverse sternal incision was used.

Pantridge and Marshall[11] reported 3 cases of tricuspid stenosis out of 100 patients selected for mitral valvotomy. In their first patient, who was 19 years old, a trans-sternal incision was used. The mitral valve was cut with a knife and the stenotic tricuspid valve was dilated with a finger. In the second patient, a female of 35 years, a mitral valvotomy was done, followed 2½ months later by a tricuspid valvotomy by means of a right thoracotomy. Their third patient had a mitral valvotomy alone, and although tricuspid stenosis was diagnosed, a valvotomy of this valve had not been done at the date of their report.

These reports show that the operation of tricuspid valvotomy is seldom performed, although the association of tricuspid stenosis and mitral stenosis is not rare. The

approach to the tricuspid valve can be through a separate incision in the right chest after a mitral valvotomy has been done, but then the two operations cannot be carried out at the same time. The approach described by Neptune and Bailey[8] through the right chest enables the surgeon to do a valvotomy of the mitral and tricuspid valves at the same time, but the approach to the mitral valve is difficult and it is impossible to use the transventricular dilator.

A few surgeons have used a trans-sternal approach with a bilateral submammary incision. This approach, however, is not suitable if the transventricular dilator is to be used. Harken and Black[12] approached the tricuspid valve by closing the pericardium loosely after a mitral valvotomy had been done. A second incision was then made in the pericardium, anterior to the phrenic nerve. Traction on the pericardium rotated the heart to the left, bringing the right atrial appendix into the operative field. This enabled them to get a finger into the right atrium for a finger fracture of the valve.

The incision described in this paper, in which the patient lies on his right side, rotated 45° backwards, enables the surgeon to perform a mitral and tricuspid valvotomy with a dilator through the left and right ventricles, respectively. A good exposure of the surfaces of both ventricles is obtained. Both atria can be reached for finger palpation of the stenotic valves. The advantage of this approach is that the position of the patient is not changed during the operation and a second operation at a later date is also eliminated.

The use of the transventricular dilator for a valvotomy of the stenotic tricuspid valve has not previously been reported in the literature. It is well known that a better valvotomy can be performed on the stenosed mitral valve with the transventricular dilator than with the finger, although the risk of incompetence might be slightly greater. The risk of incompetence with the dilator, however, is much less than when a knife is used. Pantridge and Marshall[11] reported that instrumental splitting of the tricuspid valve is usually necessary, since it is more leathery than the mitral valve. They also pointed out that the mitral valvotomy should be done before the tricuspid valvotomy to relieve the burden on the lungs and the danger of pulmonary oedema. Bailey[13] recommended that the antero-septal commissure should not be divided, otherwise serious tricuspid incompetence will result.

Chesterman and Whitaker[10] suggested a split between the marginal cusp on the one side and the infundibular and septal cusps on the other side, to prevent regurgitation, which occurs if the latter two cusps are separated. These authors suggested the use of a finger knife. That the tricuspid valve should be cut with a knife is also stressed by O'Neil *et al.*[9] The danger of incompetence when the mitral valve is cut with a finger knife is well known. It is extremely difficult to determine the commissures of a stenotic tricuspid valve,[7] and it must be very difficult to prevent regurgitation when the finger knife is used to cut this valve. Since the stenotic tricuspid valve is tough and fibrous, the transventricular dilator is especially suitable for opening this valve. In this patient an excellent result was obtained with the dilator. The valve opened well and although slight regurgitation was present, this is the usual finding after a successful tricuspid valvotomy.[6]

The pressure in the right atrium in tricuspid stenosis is lower than in the left atrium in mitral stenosis, since there is no compensating mechanism on the right side, whereas on the left side the right ventricle overcomes the stenosis of the mitral valve by an increase in pulmonary artery pressure. Symptoms of tricuspid stenosis, therefore, appear comparatively early. When the mean pressure in the right atrium is more than 5 mm.Hg, or if the diastolic gradient between the right atrium and right ventricle is more than 1·9 mm.Hg at rest, significant tricuspid stenosis is present. There is usually a significant increase of this gradient on exercise and on inspiration. In the patient reported in this paper the mean pressure in the right atrium was 11 mm.Hg, and the diastolic gradient was 3·5 mm.Hg at rest, indicating a severe degree of tricuspid stenosis.

Complete relief of the stenosis of the tricuspid valve is not necessary to cure the patient symptomatically, and a valve of 4 sq. cm. surface area is adequate.[14] In this patient the diameter of the valve was 3·5 cm. after the valvotomy, indicating a surface area of more than 9 sq. cm.

CONCLUSION

It does appear that, because of the toughness of the tricuspid valve, finger fracture of the commissures cannot be effective. The valve is often only dilated, as in the patient reported by Pantridge and Marshall.[11] The use of a knife is dangerous since one cannot see what is being done and cannot palpate the commissures properly. It is possible that in future the best approach for the relief of combined mitral and tricuspid stenosis will be an open operation on both valves. This will make the valvotomy on the tricuspid valve especially safe. However, it was found in the patient reported here that the transventricular dilator worked as well on the stenotic tricuspid valve as on the stenotic mitral valve, and this technique can be recommended.

Incompetence complicates tricuspid valvotomy much more often than mitral valvotomy, according to Hollman,[6] and it was present in 7 out of 9 published cases of tricuspid valvotomy. A degree of tricuspid incompetence must result if the valve is adequately opened. Fortunately, incompetence is not as serious on the right side as on the left, although it adds a burden to the right ventricle. In this patient a slight degree of incompetence was present after the valvotomy, but this did not appear to be significant.

SUMMARY

A patient who suffered from mitral and tricuspid stenosis is reported. In this patient both a mitral and a tricuspid valvotomy with a transventricular dilator were performed at the same operation. The approach to both valves with the dilator is described. In this approach the patient lies on his right side, rotated 45° backwards, and a long transsternal incision is made. A good exposure of the heart is obtained, enabling the surgeon to use the transventricular dilator on both valves.

With the transventricular dilator the danger of serious incompetence, which often results after the use of a finger knife, is minimized, and a good result on the fibrous and leathery tricuspid valve can be obtained.

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REFERENCES

1. Calleja, H. B., Hosier, D. M. and Kissane, R. W. (1960): Amer. J. Cardiol., **6**, 871.
2. Wood, P. (1954): Brit. Med. J., **1**, 1051 and 1113.
3. Cooke, W. T and White, P. D. (1941): Brit. Heart J., **3**, 147.
4. Smith, J. A. and Levine, S. A. (1942): Amer. Heart J., **23**, 739.
5. Bailey, C. P. and Bolton, H. E. (1956): N.Y. St. J. Med., **56**, 825.
6. Hollman, A. (1956): Lancet, **1**, 535.
7. Lambrew, C. T. and Goldsmith, E. I. (1961): Surg. Clin. N. Amer., **41**, 477.
8. Neptune, W. B. and Bailey, C. P. (1954): J. Thorac. Surg., **28**, 15.
9. O'Neil, T. J. E., Janton, O. H. and Glover, R. P. (1954): Circulation, **9**, 881.
10. Chesterman, J. T and Whitaker, W. (1955): Thorax, **10**, 321.
11. Pantridge, J. F. and Marshall, R. J. (1957): Lancet, **1**, 1319.
12. Harken, D. E. and Black, H. (1955): New Engl. J. Med., **253**, 669.
13. Bailey, C. P. (1955): *Surgery of the Heart*. Philadelphia: Lee & Febiger.
14. Yu, P. N., Harken, D. E., Lovejoy, F. W., Nye, R. E. and Mahoney, E. B. (1956): Circulation, **13**, 680.