Rupture of Normal Aortic Valve after Physical Strain*

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Non-penetrating injuries or severe physical strain may result in the rupture of a valve leaflet or a chorda tendinea and rarely of a left or right ventricular papillary muscle (Glendy and White, 1936; Osborn, Jones, and Jahnke, 1964; Aleksandrow *et al.*, 1965). More often the affected valve is the seat of pre-existing disease, such as rheumatic, syphilitic (Carroll, 1951), congenital (Bushong, 1947), or atherosclerotic (Howard, 1928; Carroll, 1951), but even normal healthy valves (Howard, 1928; Kissane, Koons, and Fidler, 1936; Bushong, 1947; Kissane, Koons, and Clark, 1948) can rupture as a result of trauma.

Since the onset of open-heart surgery, a direct approach to the aortic valve for repair of the defect or insertion of a prosthetic valve has been employed. In this communication, we are reporting a case of traumatic rupture of a healthy aortic valve which has been successfully treated by insertion of a Starr-Edwards prosthetic valve.

Case Report

A man of 53 was admitted in 1967 to Mount Sinai Hospital, Medical Center, Chicago, with a history of paroxysmal nocturnal dyspnoea, exertional dyspnoea, pain in the right upper part of the praecordium, and generalized weakness which started suddenly three weeks ago. The patient was employed as a janitor, and was accustomed to climbing as many as 10 flights of stairs, with no discomfort until three weeks before admission. According to him, all his symptoms started after vigorous shovelling of snow for three days during a snow storm. There was nothing relevant in the past and family history.

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On physical examination, the patient was a muscular, heavy white man in moderate distress. The pulse was 88, regular; respiration was 23. Blood pressure was 150/35 mm. Hg in the arm and 180/65 mm. Hg in the leg. Examination of the cardiovascular system revealed a heaving apical impulse in the 6th left interspace, 2 cm. lateral to the midclavicular line. A diastolic thrill was felt over the 2nd and 3rd right interspaces parasternally and over the manubrium. There was a grade 5 high-pitched, musical diastolic murmur heard all over the praecordium, loudest over both sides of the sternum at the base.

Gross peripheral signs of aortic insufficiency were present. Crepitations were audible at both lung bases. The other systems were normal. The *clinical diagnosis* of "severe aortic insufficiency secondary to rupture of an aortic cusp" was made.

Laboratory Data. The electrocardiogram showed sinus rhythm and evidence of left ventricular hypertrophy. The chest x-ray revealed left ventricular enlargement and a small right-sided effusion. Blood reactions and several blood cultures were negative, and blood enzymes were normal. Pulmonary function tests were normal. The phonocardiogram (Fig. 1) revealed that the murmur consisted of two sets of vibrations (low frequency vibrations in the range of about 100–200 c.p.s. and high frequency vibrations in the range of 350–450 c.p.s.).

Left and right heart catheterization and selective angiocardiography revealed severe aortic insufficiency and left and right heart failure.

At open-heart surgery 16 days after he was admitted, the aortic valve was found to have a tear in the right coronary cusp and several perforations in all three cusps: a hole 0.5 cm. in diameter in the right and one of 5 mm. in the left coronary cusp, and of 4 mm. in the non-coronary cusp. There was a haematoma in the media and adventitia of the ascending aorta, caused by a 5 mm. tear in the intima of the proximal ascending aorta. On inspection, the cusps showed no evidence of endocar-

FIG. 1.—Pre-operative phonocardiogram recorded over the 4th left interspace with a 400 c.p.s. high pass filter. Loud diastolic, musical murmur.

ditis, and the ascending aorta seemed normal. A 12 Starr-Edwards prosthetic valve was sutured into place. The patient was given heparin as soon as the mediastinal

FIG. 2.—Post-operative phonocardiogram recorded over the 2nd right (above) and 4th left interspace. Minimal systolic murmur, no diastolic murmur. Ejection sound (E) and closing aortic valve click (AC).

tubes were removed, after which warfarin was started. He did well after the operation.

Two months later he was asymptomatic and was carrying out his duties as a janitor without any difficulty. Physical examination revealed no abnormal findings. The blood pressure was 140/85 mm. Hg in the right arm. Auscultation of the heart disclosed a grade 1 systolic murmur and the opening and closing clicks of the prosthetic valve. A phonocardiogram (Fig. 2) confirmed the auscultatory findings. Follow-up of the patient one year after the operation showed him to be asymptomatic and leading an active life.

Discussion

The first case of traumatic aortic insufficiency was reported by Plenderleath in 1830, and, since then, sporadic case reports have appeared. Howard (1928) in reviewing the published material from 1830 to 1928, found 112 cases of ruptured aortic valve as a result of muscular effort or trauma, and reported 1 new case. Bushong (1947) reported 2 cases, reviewed the publications from 1925 to 1946, and found a total of 119 cases, 58 of which were proved by necropsy.

Aortic regurgitation rarely results from trauma. The injury may result from an unusually strenuous muscular effort (Carroll, 1951), a blow to the chest (Leonard, Harvey, and Hufnagel, 1955; Levine, Roberts, and Morrow, 1962), or a fall from a height. Rupture of the aortic valve by contrecoup as a result of a blow to the chest had been shown experimentally by Barié in 1881 in cadavers. In the majority of cases reported, the ruptured valve was a diseased valve, and only a few documented cases had a normal aortic valve which ruptured. In 1928, when Howard reported his case, 114 cases of rupture of the aortic valve had been reported, 47 of which were due to trauma. Of the patients examined after death, only 6 had leaflets that were absolutely normal except for the tear. Since then, a few other reports of traumatic rupture of a normal aortic valve have appeared (Kissane *et al.*, 1936; Bushong, 1947; Leonard *et al.*, 1955; Levine *et al.*, 1962).

In our patient, the severe physical strain of attempting to keep snow cleared during a storm appears to be responsible for the rupture of normal aortic cusps, because he was in perfect health until the sudden onset of symptoms.

In regard to the physical findings, the patient had a "seagull" or "cooing-dove" type of diastolic murmur, which had two sets of vibrations. The murmur was so loud that it was audible over the shoulders, arms, abdomen, low back, and neck region.

Free aortic regurgitation resulting from rupture of the aortic valve, whether traumatic or infectious in origin, has a grave and usually hopeless prognosis.

Leonard *et al.* (1955) have emphasized that the sudden tearing of the aortic valve cusps with resultant free insufficiency has a strikingly different clinical course from the regurgitation caused by slowly progressing valvular incompetence due to disease. Clinically, the prognosis varies according to the degree of regurgitation caused by aortic valve rupture. The two patients reported by Kissane *et al.*, in 1936 and 1948, lived for 14 and 27 months, respectively, after the trauma, whereas the patient described by Bushong (1947) died after 69 days. Carroll (1951) stressed the poor prognosis, because 8 of his 9 patients had died within 8 months.

Leonard *et al.* (1955) reported one case of traumatic rupture of the aortic valve with successful correction by insertion of a Hufnagel valve, distal to the origin of the left subclavian artery. Since the clinical application of the pump oxygenator there have been several reported successful repairs of the aortic valve rupture produced by blunt trauma. Simple suture of the cusp has been used with success when such sutures have been appropriately buttressed with Teflon felt. The free pericardial graft has been used to repair lesions of this type.

Our patient was successfully operated on with insertion of a Starr-Edwards prosthetic valve. He is doing heavy work and has been free of symptoms for 12 months after the operation. To date, the described surgical treatment of a ruptured aortic valve seems satisfactory, and the mortality of such cases in experienced hands should be small.

Summary

A case of rupture of the normal aortic valve following severe physical strain while shovelling snow is reported. A Starr-Edwards valve was success-

fully inserted, and the patient has remained symptom-free, and been able to work as a janitor since the operation performed 12 months previously.

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