Mitral valve disruption following blunt trauma: case report and review of the literature

Abstract

We present two successfully treated cases of mitral valve rupture following blunt chest trauma. A review of the literature demonstrates the rarity of this condition and the categories of injury pattern as demonstrated by our patients.

Key words Mitral valve · Blunt trauma

Introduction

Blunt chest trauma is an only too common occurrence in the modern era of motor vehicle accidents [3]. Cardiac injury as a consequence, affecting the free walls, septae, great vessels and coronary arteries has been well recorded in the literature. That survivors of atrio-ventricular valve disruption are only rarely seen is due largely to death occurring as a result of the enormous forces acting in these circumstances. To cause this form of injury, the compressive forces should be concentrated during the short phase of isovolumetric ventricular contraction, or late diastole. At this time the aortic and mitral valves are both closed and their delicate structures are more prone to injury than the free ventricular walls. As a consequence the aortic valve is most commonly affected, followed by the mitral and finally the tricuspid valve [15, 16].

We present two cases displaying the extremes of presentation which can occur with such mitral valve disruption. The first required emergency surgery due to fulminating pulmonary oedema, while the second followed a more indolent course.

Case reports

A 38-year-old prison warden received a severe injury to his anterior chest wall at work. Increasing dyspnoea and a harsh pan-systolic murmur necessitated transfer to our unit for further investigation.

Fig. 1 Transoesophageal echocardiogram of patient 1, showing detachment of posterior papillary muscle and leaflet. LA = left atrium, LV = left ventricle, FVL = flail mitral valve leaflet
A 27-year-old male driver was involved in a motor vehicle accident, sustaining severe blunt injuries to his chest, abdomen and head. He was resuscitated at his local hospital and ventilated due to respiratory embarrassment. Bony injuries included sternal and rib fractures, while severe pulmonary contusion was seen on the chest radiograph. A soft systolic murmur was heard over the apex which was confirmed to be due to moderate mitral regurgitation by echocardiography. Due to the severity of the head and pulmonary injuries, a conservative approach was adopted. He was eventually extubated after 2 weeks and, in spite of being slightly incapacitated by dyspnoea, was discharged on diuretics and digoxin. Over the ensuing 6 months he became increasingly incapacitated by breathlessness in spite of the addition of vasodilators to his regimen. Echocardiography revealed moderate to severe mitral regurgitation with some dilatation of his atrium. He was therefore taken to theatre where a floppy mitral valve was found with rupture of the chordae to the central posterior leaflet. This was resected and plicated, together with the flail segment of the anterior leaflet. Postoperative course was uneventful and the patient was discharged on diuretics and short-term warfarin.

Discussion

The natural history of traumatic mitral regurgitation before the advent of cardiac surgery was one of gradual deterioration if death did not occur within the 1st week. The gradual deterioration was similar to chronic mitral regurgitation due to rheumatic and degenerative causes. In reporting the first successfully treated case, McLaughlin reviewed the results of conservative management of this condition in the literature [14]. Since this historical paper, only a handful of such cases have appeared in English publications. Demographically, these have been predominantly male and 75% have been the direct result of road traffic accidents.

The reported cases fall into two major categories, mirroring our two patients. The first subgroup consists of complete avulsion of an entire papillary muscle from its ventricular attachment. These patients were on the whole younger (range: 6–41, mean 27.3 years) and presented with symptoms of torrential mitral regurgitation [1, 5, 8, 13, 17]. The mean interval to operation was 16 days in this group, all but one patient being operated within 12 days. This was the scenario in our first case where early operation was warranted. Due to the nature of the damage to the muscle, valve replacement is all that can be offered to most of these patients, the haemorrhagic and devascularised muscle being difficult to repair. Repair by resection and plication, with annuloplasty has also been successfully used in this condition [18]. A subgroup of these with partial tears of the papillary muscle run a more protracted course with chronic symptoms, or their condition may have worsened due to ischaemic rupture of the muscle whose axial artery was damaged during the trauma [4, 7]. These partial ruptures may have a well fibrosed muscle tip which can be re-attached to its natural position, the ventricular attachment being more secure at this later stage [4]. Intramyocardial dissection as a direct result of the trauma or secondary to damage to the coronary arteries can also cause rupture of the papillary muscle [9]. This is an extremely rare and difficult condition, requiring repair of the defect in the ventricular wall in addition to replacement of the valve. In our first case, due to the nature of the papillary muscle remnant, repair was not contemplated and a replacement was carried out.

The other category of injury, as exemplified by our second case, is of chordal and leaflet damage. In these, part of the chordal support to the leaflets is ruptured, either at the leaflet itself or in the middle of the chordae [2, 12, 14, 19]. As this only results in partial leaflet prolapse, symptoms are more indolent and may not present until a super-added complication, such as endocarditis, affects the damaged valve [1]. Some of these cases may be completely asymptomatic, though echocardiographic follow-up is mandatory to assess the time for operation [10]. Standard techniques of valve repair have been successful in the majority of these patients, including resection and plication, chordal shortening or chordal grafting [2, 12, 14]. Only rarely is the valve unsalvageable, requiring replacement [19]. This group of patients was, on the whole, older than the preceding set, (range: 7–60, mean 40 years), perhaps indicating the shift of proportional strength from the chordae to the papillary muscle as ageing occurs. Our second case was unusual in this respect, but could be explained by the presence of pre-existing pathological weakness in the chordae allowing rupture to occur.

A single case of annular disruption was found and would be expected to be fatal due to posterior ventricular rupture if it had not been as limited as in this report [11]. The nature of this injury allowed simple repair with a good result. Diagnosis of these injuries depends on a high index of suspicion. The classical murmur may be overshadowed by the harsh ventilatory sounds often present in these circum-

Fig. 2 Pathological specimen from patient I
stances. In spite of the extent of the trauma, bony thoracic cage injury occurred in only 30% of the patients in this review. The superadded problems of fractures, subcutaneous emphysema and pneumothorax make the diagnosis extremely difficult to achieve by clinical or trans-thoracic echocardiographic means. The value of trans-oesophageal echocardiography cannot be overemphasized, as it allows exclusion of other cardiac or great vessel injuries and can be used to assist in the definitive diagnosis and repair of these damaged valves [6, 18]. Rarely, however, coexisting injuries to other parts of the heart, such as the tricuspid valve, may evade even this investigation, only becoming apparent in the operating room [20].

In conclusion, we report two cases of mitral valve rupture secondary to blunt trauma. These cases, though rare, require a high index of suspicion for diagnosis and fall into two distinct groups. The first, where the entire subvalvular apparatus to one leaflet is avulsed at the papillary muscle, require urgent surgery, while the second, involving partial ruptures of the leaflet or chordae, follows the course of degenerative valve disease, warranting operation at a later stage.

References