Residual or Delayed Lesions from Penetrating Cardiac Wounds*

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During an eight-year period, 76 patients with penetrating wounds of the heart were treated at our institution. Among the 56 patients who survived, there were 16 instances of delayed sequelae in 14 patients, an incidence of 25 percent. Residual sequelae from penetrating cardiac wounds may not be initially evident or detected because of the urgency when tamponade or bleeding are present or because of the low cardiac output state that may exist. For this reason and because delayed sequelae such as cardiac aneurysm may occur, close observation and repeat examination is required in patients who have sustained penetrating wounds. Because of the great variability of the hemodynamic significance of the intracardiac lesions and the similarity of the clinical signs between some of them, cardiac catheterization and angiography should be performed, if at all possible, in order to define the type lesions and their hemodynamic significance before they are repaired.

With improvement in the overall management of injured patients, more and more victims of penetrating cardiac wounds survive the initial injury. This finding, coupled with the fact that more injuries with high power missiles are occurring now, suggests that more patients who sustain penetrating injury of the heart are likely to be seen with residual or delayed manifestations from their penetrating cardiac wounds.

The purpose of this study is to review the course of all surviving patients with penetrating injury of the heart treated at Grady Memorial Hospital during an eight-year interval.

CLINICAL MATERIAL

During the period July, 1964 to June, 1972, 76 patients, 32 with gunshot wounds and 44 with stab wounds of the heart, were treated. Nineteen (59 percent) of the 32 patients with gunshot wounds and 37 (84 percent) of the 44 patients with stab wounds completely recovered from their initial injury.

The subsequent course of these 56 patients (19 patients with gunshot wounds and of the 37 with stab wounds) were reviewed. The mean follow-up period for these patients from time of injury to time last seen was 19 months and all of them were followed up for at least six months. Among them, there were 16 instances of residual or delayed sequelae from the penetrating cardiac injury in 14 patients not including instances of post-traumatic or postpericardiotomy pericarditis, most of which have been previously reported.1 The time of their recognition varied from one day to seven years post-injury, though most were suspected in the immediate post-injury period.

Seven of the 19 patients with gunshot wounds had residual or delayed sequelae, an incidence of 37 percent, whereas only seven of the 37 patients with stab wounds of the heart had residual or delayed cardiac sequelae, an incidence of 19 percent.

The sequelae were divided into the following general groups: shunts (five), valvular lesions (three), ventricular aneurysms (five), and retained foreign bodies (three). The shunt group consisted of three instances of ventricular septal defect, two secondary to gunshot wounds and one to a stab wound, and of two aortico-pulmonary fistulae, both due to stab wounds. Two patients with ventricular septal defect were moderately symptomatic and had a hemodynamically significant left-to-right shunt. Both these patients had elective closure of the defect one and seven months after their injury and are presently asymptomatic. The third patient is presently asymptomatic and since only a small shunt was demonstrated at cardiac catheterization, surgical repair was not felt to be indicated. Both patients with aortico-pulmonary fistulae were initially managed with observation, were moderate to severely asymptomatic, and had elective closure of the fistula eight and 21 days postinjury. Both are presently asymptomatic, though one has evidence of mild pulmonary regurgitation.

Valvular defects consisted of two instances of mild regurgitation, both secondary to gunshot wounds, and one of pulmonary regurgitation, the latter being present in one of the patients mentioned above with an aortico-pulmonary fistula secondary to a stab wound. None of the patients in this group is symptomatic; therefore, surgery has not been necessary.

Five patients developed ventricular aneurysm (four following stab wounds and one subsequent to gunshot wound). One patient had a true aneurysm, two had a pseudoaneurysm and one had two pseudoaneurysms with a ventricular septal defect. The fifth patient refused cardiac catheterization, angiography and surgery. Thus, this aneurysm, which is unquestionably present clinically and radiographically, remains undefined.

Three patients with ventricular aneurysm were asymptomatic and two complained of mild shortness of breath, but due to the propensity of this lesion for serious complications, four had surgical repair consisting of either excision or plication and the patient with ventricular septal defect had concomitant repair of this lesion. All patients survived and are presently in good health.

There were three patients who have had firearm projectiles retained within the myocardial substance. In two of these patients, the projectile was a single bullet which resides in the interventricular septum. The third patient had multiple shotgun pellets imbedded in the ventricular myocardium. None suffered any ill effects of these retained foreign bodies over a period of one, two, and seven years. Pertinent information

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Manuscript received March 18; accepted April 24.

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of the clinical courses in two patients are summarized in the following reports.

CASE REPORTS

CASE 1

A 32-year-old man sustained two stab wounds in the left second intercostal space, one at the anterior axillary line and the other 4 cm to the left of the sternal border. Blood pressure on admission was 110/70 mm Hg, pulse rate 100/min and no murmur was heard. A left thoracostomy tube drained 900 ml of blood; after 24 hours of drainage it stopped and was later removed. The patient's condition appeared stable until the second hospital day when he developed a fever of 37.2-38.3°C. On the sixth hospital day a chest roentgenogram showed some cardiomegaly and residual radiodensity in the left lower lung field, but the heart sounds were reported to be normal and no friction rub or murmur could be heard (Fig 1A). On the 11th hospital day chest roentgenography showed an enlarged globular heart and a three-component pericardial friction rub was heard for the first time (Fig 1B). Central venous pressure then was 24 cm H2O, but no pulsus paradoxus was present. Pericardiocentesis was done and 270 ml bloody fluid was removed, but the central venous pressure remained 22 H2O and the repeated chest roentgenogram was unchanged. On the 12th hospital day a grade 3/4 continuous murmur was first heard over the more medial stab wound. He continued to be febrile, 37.2-38°C and eight blood cultures were negative. On the 14th hospital day, right cardiac catheterization and ascending aortogram were done which showed significant oxygen step up at the main pulmonary artery level with a pulmonary to systemic blood flow ratio of 2.0 and rapid opacification of the pulmonary artery (Fig 1C). On the 23rd hospital day the patient was operated upon and in addition to the thickened pericardium, a 9 mm diameter aorticopulmonary fistula was found 3 cm above the pulmonary valve; it was closed with interrupted sutures without difficulty. Seven years after operation the patient is doing well; no murmur is present.

CASE 2

A 29-year-old woman sustained multiple gunshot wounds, two of them to the left anterior chest. Left hemothorax was evacuated with a thoracostomy tube and she did very well except for low grade fever. On the eighth postinjury day a systolic murmur was first heard and the chest x-ray film showed cardiomegaly. She continued doing well except for low grade fever and on the 15th postinjury day, a grade 2/6 continuous murmur was heard at the left sternal border at the second and third intercostal spaces and chest roentgenography again revealed an enlarged cardiac silhouette. Cardiac catheterization showed a high interventricular left-to-right shunt and left ventriculography demonstrated an aneurysm of the left ventricle. At operation, two and one-half months after her injury, a 3 x 8 cm intrapericardial bilobular false aneurysm was found (Fig 2). Upon opening the aneurysm, a well-formed thrombus partially filling it was encountered, as well as two openings, one communicating with the right ventricular outflow tract and the other with the left ventricular cavity (Fig 3). Both openings were joined by a small fistulous tract across the most anterior portion of the interventricular septum. Both openings, as well as the ventricular septal defect, were closed, the patient had an uneventful postoperative course and now, two years after surgery, is doing well with no problems referable to the cardiovascular system.

DISCUSSION

Delayed or residual sequelae from penetrating cardiac wounds include, the frequently occurring nonconstrictive and the rarely seen constrictive or purulent post-traumatic or postoperative pericarditis; valvular, mitral, tricuspid, aortic, or pulmonary regurgitation; ventricular septal defect; aorta-pulmonary or aorta-cardiac chamber fistula; ventricular aneurysm, pseudo or true; projectiles of the heart, and conduction defects.

With the increase in homicide rate, the more frequent use of higher power missiles, and the increase of the successfully managed patients with penetrat-
ing wounds of the heart, the number of patients with these delayed or residual post-traumatic sequelae of the heart is expected to increase. For this reason, a high index of suspicion of the presence of such sequelae in patients who have sustained penetrating cardiac wound and close observation and frequent examination of these patients is mandatory.

The clinical manifestations of these residual or delayed post-traumatic cardiac lesions depend upon their magnitude. The patients may be completely free of symptoms or may become severely symptomatic immediately, days, months, or years after the injury.

The diagnosis of a delayed or residual sequel from a penetrating cardiac wound can be suspected from the routine patient workup, history, physical examination, chest roentgenography, and electrocardiography. Post-traumatic pericarditis, post-traumatic conduction defects and projectile of the heart will not require further workup for the diagnosis. Cardiac catheterization and angiography should be performed for other lesions. These studies are essential to establish the type and the site of the cardiac lesion and its hemodynamic significance.

When to perform these special studies depends upon the patient's clinical condition. Patients who cannot be managed with medical treatment should undergo cardiac catheterization, angiography, and repair of their lesions as soon as possible; otherwise, these studies, as well as surgical correction of the delayed or residual sequelae, should be performed when the sequelae are clinically and hemodynamically significant. We have made exception to this policy in the management of traumatic ventricular aneurysm and we feel that because of the fear of development of late complications from this lesion in patients with an otherwise normal heart and because the operative risk in these patients is and should be negligible, excision or plication of the aneurysm should be performed even in the relatively asymptomatic patients. Whether, however, this approach is justifiable or not is not clear.

REFERENCES
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