Focal Myocarditis in a Pilot Involved in a Fatal Aircraft Accident

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Introduction

THE entity of focal myocarditis is recognised by Forensic pathologists as a cause of sudden death in asymptomatic ambulatory persons. Some investigators have, however, found it to be an incidental autopsy finding in at least 5% of population. Significance of this lesion, therefore, becomes obvious in cases of fatal aircraft accidents where several simultaneously occuring human as well as mechanical factors are involved in a very short period of time. We report here a case of focal myocarditis detected in a deceased pilot involved in an air crash, along with a brief review of relevant literature.

Case Report

VKD, a 28 year old fighter pilot had been in perfectly good health throughout his flying career. Repeated routine medical examinations including assessment of cardiovascular system with skiagram of the chest and electrocardiogram had been normal. He was asymptomatic on 28 May 76 and preflight medical check up was normal. He took off in a Sea Hawk aircraft on the afternoon of 28 May 76 during a combined Army and Navy Wing exercise. While performing pull-up 15° attacks on a ground target, the officer executed a very tight circuit, pulled up earlier than normal and climbed to a height which was much more than stipulated. Being too high and too close to the target, the aircraft entered into a much steeper dive for the attack and crashed on the ground. Body of the pilot got separated from ejection seat, caught fire and fell nearby. Autopsy was performed next day.

Body showed gross mutilation. Internal examination revealed multiple fractures of the skull bones and cervical vertebrae with protrusion of brain tissue. The chest wall showed multiple fractures of ribs with distorted lung tissue, blood and some of the abdominal viscera lying in the thoracic cavity. Diaphgram was torn. Heart was crushed and only a single piece 10 cm × 10 cm × 3 cm was found attached to the root of aorta. Arch of aorta was torn to pieces. Abdomen showed crushed and fragmented pieces of liver, spleen, kidneys and intestines which were protruding out through various gaping wounds.

The piece of heart found during autopsy was subjected to histopathological examination at Institute of Aviation Medicine. Small pieces of brain, liver, kidneys, spleen and lungs were also studied histopathologically. Cerebral cortex showed mild congestion. Cerebellum was normal. Kidneys and spleen were normal. Lungs showed fragmentation of alveolar wall with haemorrhages. No embolic phenomenon was seen. Aorta showed very mild atheromatous changes. Lumen of the coronary artery available was patent. Histopathology of the heart studied in multiple sections showed in two areas aggregation of mononuclear cells (fig. 1, 2,), number of cells being more than 100 in each. There was no infiltration of cells between muscle fibres and no necrosis of the fibres was seen. These histopathological features detected in myocardium were diagnostic of isolated focal myocarditis.

Discussion

The concept of myocarditis was introduced to medical literature by Sobernhein in 1837. Fiedler in 1890 recognised the primary acute interstitial

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myocarditis involving the heart only. Since then the term myocarditis was so commonly used as to fall into disrepute. Since Clawson (1928) demonstrated the microscopic appearances, many terms like isolated, Fiedlers, Idiopathic, interstitial, focal and diffuse have been applied in describing the disease. Saphir (1942) classified myocarditis into four major groups: (1) myocarditis following infection with or without endocarditis (2) specific myocarditis eg....rheumatic, tuberculous etc. (3) myocarditis due to chemical poisons, physical agents or hypersensitive states and (4) isolated myocarditis.

The incidence of myocarditis has been reported to be 4.3% (Saphir 1942) to 6.8% (Saphir et al 1944), though Gore and Saphir (1947) have recorded 25% incidence in various infective diseases.

Isolated myocarditis as the name implies is not associated with generalised systemic lesions, hence it more often remains undetected clinically and may be encountered as an incidental autopsy finding.

Isolated 'focal' myocarditis would mean localised lesions in the myocardium. The criteria for diagnosis have been discussed in details by Stevens and Underwood Ground (1970). Findings of a focal inflammatory infiltrate with or without necrosis of myocardial fibres and unassociated with pathology elsewhere, was taken as a feature of focal myocarditis. The quantum of inflammatory cells was fixed as approximately 100 cells or more if only a single focus was found. If there were more than one focus, the lesions of about half the size as above were accepted as the diagnostic criterion.

Studies on autopsies in sudden deaths and medico-legal fatalities have shown that incidence of isolated focal myocarditis varies from 0.35% to 1.2% (Gormsen 1955, Corby 1960), whereas Schwartz and Mitchell (1962) as well as Stevens and Underwood Ground (1970) reported the incidence to be as high as 5%. Analysis of post mortem findings of the pilots killed in aircraft accidents has shown infrequent incidence of focal myocarditis; six out of 263 autopsies in Sopher's (1974) series showing the lesions.

The cause of sudden cardiovascular incapacitation in a case of focal myocarditis is believed to be due to ventricular arrhythmias arising from a focus in the area of the myocarditis, which may lead either to ventricular fibrillation or acute left ventricular failure. However, many authors felt that focal myocarditis could be an incidental finding in the post mortem, and may not be directly responsible for the fatal aircraft accident (Mason 1962, Stevens 1970, Stevens and Underwood Ground 1970).

The diagnosis of focal myocarditis in our case was based on findings of mononuclear cell infiltration in the myocardium numbering more than 100 in two sites. The cardiac tissue available was, however, a very small piece and was not identifiable as to which part of the heart it belonged to. It is possible that more areas of localised cellular infiltration could have been present in the entire myocardium before the accident. The conduction tissue of the heart if involved by this process could have influenced the occurrence of A-V blocks and cardiac arrhythmias prior to the accident, but since the heart had been completely damaged and disintegrated by the air crash, no confirmatory study could be done.

Focal myocarditis in this case was considered an incidental post mortem finding. Opinion of court of inquiry held to investigate the accident was that the officer was flying the aircraft in a very tight circuit, much lesser than the circuit planned before flight and hence had to dive steeply to reach the target. He was unable to recover from this steep dive, and hit the ground. The execution of the tight circuit was probably an attempt on the part of the pilot to devise a new plan of attack. The court of inquiry was conclusive of the fact that there was no distress signal given by the pilot either for his own incapacitation or of any defect in the aircraft.

Recommendations

Nevertheless, the post mortem finding of focal myocarditis in this case, and in any case of aircraft accident, is felt to be significant and cannot be overlooked. In retrospect, by the available current cardiac diagnostic techniques, it is difficult to diagnose focal myocarditis in an asymptomatic healthy pilot, especially when the electrocardiogram is absolutely normal. It is felt, therefore, that any electrocardiographic abnormality short of specific features for positive diagnosis of cardiac disease, should be further evaluated under various stresses like maximal Treadmill exercise, hypoxia, positive Gz stress and tilt table studies. It is also recommended that in case

of fatal aircraft accidents, the histopathological studies of the heart should not be confined to routine one or two sections, but efforts must be made to scan the myocardium with multi section tissue sampling to exclude such possible cardiac lesions. Potential significance of this condition should not be underestimated and must be taken into account while investigating a fatal aircraft accident.

REFERENCES :

1. CLAWSON, BJ — Myocarditis: Amer Heart J. 4, 1, 1928.

2. CORBY, C — Isolated myocarditis as a cause of sudden obscure death: Med. Sci. Law. 1, 23, 1960.

3. GORE, J and SAPHIR, O — Myocarditis — A classification of 1042 cases: Amer. Heart J. 34, 827, 1947.

4. GORMSEN, H — Sudden unexplained death due to myocarditis. Acta. Path. Microbiol. Scand. Suppl. 105, 50, 1955.

5. MASON, JK — Pre-existing disease in aircrew. Aviation Accident Pathology, P. 192, 1 Edition, 1962.

6. SAPHIR, O — Myocarditis. General review with analysis of 240 cases: Arch. Path. 33, 88, 1942.

7. SAPHIR,O, WILE, SA and REINGOLD, JM — Am. J. Dis. Child. 67, 291, 1944.

8. SCHWARTZ, CJ and MITCHELL, JR — The relation between Myocardial lesion and coronary disease. An unselected necropsy study. Brit. Heart J. 24, 871, 1962.

9. SOBERNHEIN, JF (1937) — Quoted in Myocarditis and Myocardial disease of obscure origin. Diseases of the heart (Charles K Friedberg) P. 984, 3rd Edition, 1966.

10. SOPHER, IM — Myocarditis and the aircraft accident. Aerospace Medicine, 45, 968, 1976.

11. STEVENS, PJ — Natural disease in the operating crew. Fatal Civil Aircraft Accidents, P. 15, I Ed., 1970.

12. STEVENS, PJ and UNDERWOOD GROUND, KE — Occurrence and significance of Myocarditis in Trauma. Aerospace Medicine 41, 776, 1970.

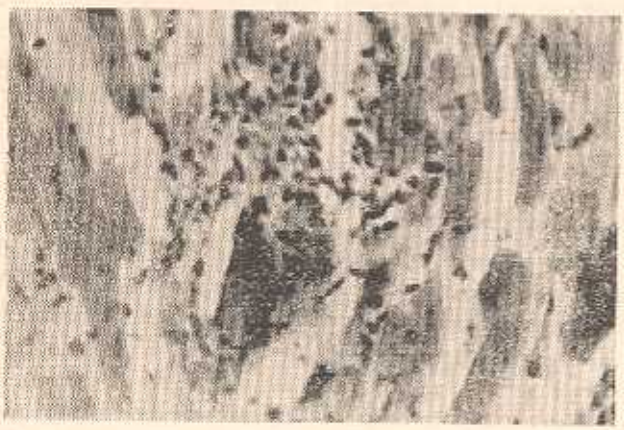

Fig. 1
A view of a focus of Myocardial Inflammation (H&E x 270)

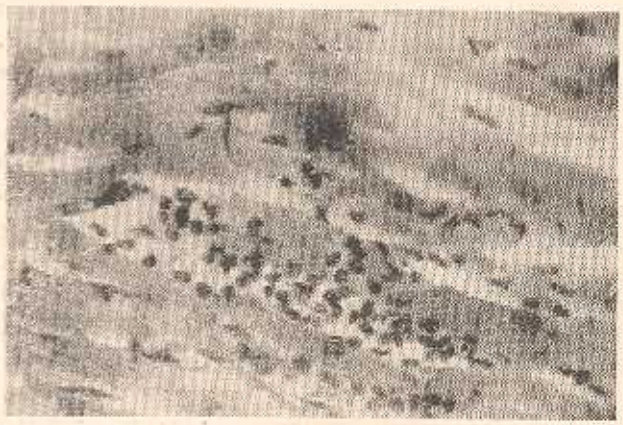

Fig. 2
Photomicrograph of another inflammatory focus in the Myocardium (H&E x 270)