

# Heart disease in old age

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**SYNOPSIS** In a post-mortem analysis of 1,500 patients, aged 70 years or more, heart disease and malignancy were the two major causes of death. Coronary disease was exceedingly prevalent, almost one in five being subject to this form of heart disease, and 13% dying from its effects. The levelling of the sex ratio in coronary disease in the aged was a striking feature. The clinical manifestations of coronary thrombosis were often atypical. The incidence of demonstrable coronary thrombosis was as high as in younger age groups. The pathological findings and the incidence of local complications in coronary disease were similar to those in other age groups. Other causes of heart failure were relatively infrequent. Certain features of these conditions in old age are discussed. Cardiac amyloidosis, in the form associated with senility, occurred in a very few cases but did not contribute to heart failure.

The pathology of old age is a subject of ever increasing importance, and a review of the literature reveals that there are few comprehensive studies in this field. Analysis of post-mortem findings, though perhaps not statistically of any great value, may nevertheless reflect to some extent the relative incidence of certain diseases in the elderly. The present study was therefore undertaken to investigate the frequency of different types of heart disease and their importance as a cause of death in a series of 1,500 necropsies on patients aged 70 years or more. The two major causes of death were found to be heart disease and malignancy, each accounting for 21% of fatalities, and outnumbering disorders of the nervous system by a considerable margin. The various causes of heart failure are indicated in Table I, and it is apparent that coronary disease is by far the most outstanding in this age period.

TABLE I  
INCIDENCE OF HEART DISEASE IN OLD AGE  
C.O.D. 311 = 21%

|                           | <i>No. of Cases</i> |
|---------------------------|---------------------|
| Coronary disease          | 200                 |
| Hypertensive failure      | 30                  |
| Calcific aortic stenosis  | 12                  |
| Rheumatic heart disease   | 10                  |
| Bacterial endocarditis    | 8                   |
| Syphilitic valvulitis     | 3                   |
| Right ventricular failure | 34                  |
| Miscellaneous             | 14                  |
| Total                     | 311                 |

## CORONARY DISEASE

There are certain features of coronary disease in these elderly patients which should be emphasized. The most obvious is its great frequency in the group as a whole. In 13% it was the direct cause of death, and in a further 6% the scars of healed infarcts were noted, so that almost one in five patients was found to be subject to this form of heart disease. Although the greatest number of cases of coronary occlusion occur in the 50 to 60 age group, this high incidence in the aged is consistent with the observation of Master, Dack, and Jaffe (1939) that the number of attacks of coronary occlusion per unit of the population rises progressively in each age group until the age of 74 years, after which there is believed to be a decline in incidence.

Another striking feature is the levelling of the sex incidence, in this series males being affected only slightly more frequently than females (15% M:11% F). In earlier decades males outnumber females by 3 or 4 to 1, but after the age of 70 there is more or less equality of the sex ratio. This has been attributed to the influence of the female sex hormones which appear to exert a protective effect until the menopause.

It has frequently been stressed that the clinical presentation of coronary occlusion is often atypical in the aged, and this was confirmed by analysis of the clinical histories in the present series. Pain, though still a prominent feature, was often less severe and less often accompanied by shock. A

sudden onset of dyspnoea was a common manifestation, or of congestive heart failure in a patient with no antecedent history of chest pain. Sudden death occurred in 25%. There seemed to be a greater tendency for coronary occlusion to develop following shock however induced, but particularly in relation to major surgery, trauma, or haemorrhage. In a considerable number of patients the diagnosis was not suspected during life, presumably because of the atypical presentation.

There were no significant differences in the pathological findings in coronary disease in the older age groups. Fifty per cent of the fatal cases showed the scars of healed myocardial infarcts, a finding which is consistent with the natural history of the disease. The sites of occlusion were the anterior descending, the right coronary, and the left circumflex vessels in that order of frequency. The incidence of demonstrable thrombosis is believed to decline with age but in this series it was 66%, which is higher than that recorded in most series which are inclusive of all age groups. From a study of the literature it is frequently inferred that actual coronary thrombosis is not often seen in advanced age, and that the mechanism of heart failure is based on an acute coronary insufficiency. To the pathologist this implies infarction without thrombosis, and a sub-endocardial distribution of necrosis in the region of the posterior wall of the left ventricle, the interventricular septum, and the papillary muscles. Such a distribution of necrosis was infrequently seen in this series, and when present was more often associated with extracardiac causes of coronary insufficiency such as haemorrhage or shock.

The complications of coronary disease were of the same nature and frequency as in younger age groups. Apart from mural thrombosis and pericarditis, the commonest local acute complication was rupture of the heart. It has been described in 6 to 9% of acute infarcts, compared with 7% (8F:4M) in the present series. It is one complication which is commoner in the female sex, perhaps attributable to the greater frequency of hypertension, which if it persists after the onset of infarction is believed to increase the chance of rupture. Seven of the eight female patients in whom this complication occurred had hearts weighing more than 400 g. The incidence of hypertension in the coronary group as a whole was assessed at 36%. Cardiac aneurysm occurred in only eight cases, and this low incidence suggests that there is no particular predisposition to the development of this complication in old age. An example of an aneurysm of exceptional size, in a male aged 72, is shown in Figure 1. It ruptured terminally into the pleural cavity. Rupture of the interventricular septum is a rare complication of myocardial infarction, and

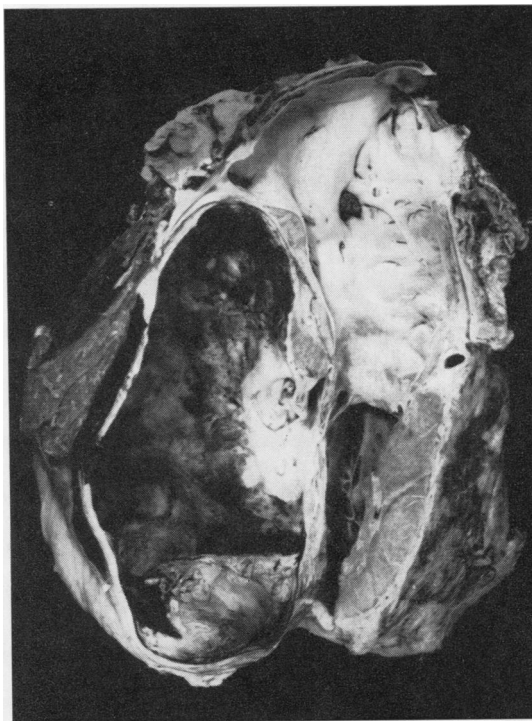


FIG. 1. Heart, showing very large ventricular aneurysm. Male aged 72 years.

was observed in only six cases (4F:2M). In the older age groups, especially with no antecedent history of chest pain, the diagnosis is frequently difficult, and for this reason the condition was suspected in only two of the present series (Fig. 2). Rupture of a papillary muscle is an exceedingly rare complication of infarction at any age, and it was of interest that two examples of this condition were found in the over-70 age group (Fig. 3). It is remarkable that it is not encountered more frequently, since the prerequisite for its development is myocardial necrosis involving the base of a papillary muscle at its attachment to the ventricular wall.

In summary, the main features of coronary disease in the aged, as revealed by this study were: Its great frequency, the levelling of the sex incidence, the atypical presentation, the high incidence of demonstrable thrombosis, and the similarity with other age groups in the incidence of complications.

#### HYPERTENSIVE HEART FAILURE

There were only 30 examples of hypertensive heart failure in the present group, 26 of which were due to essential hypertension and four to chronic pyelone-

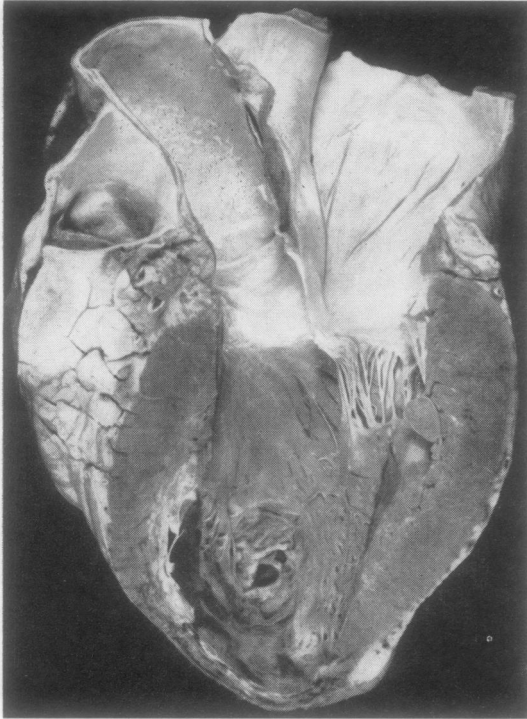


FIG. 2. Heart, showing healing infarct, with perforation of interventricular septum. Female aged 74 years.

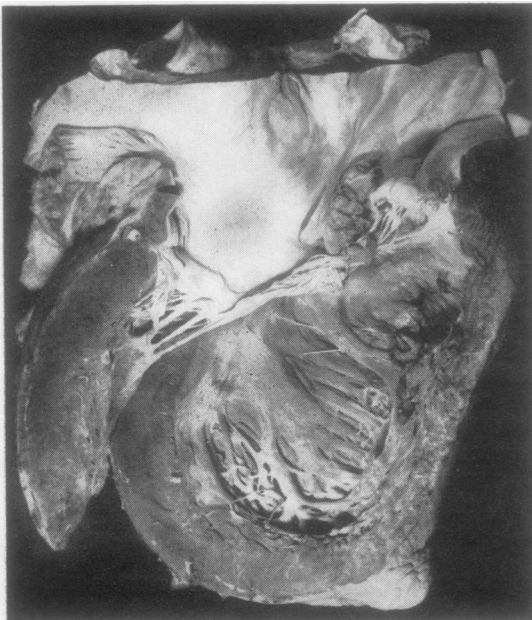


FIG. 3. Heart, showing recent infarct, obtuse margin of left ventricle, and ruptured papillary muscle. Male aged 78 years.

phritis. It is naturally difficult to separate into two categories those patients dying from hypertensive heart failure, or from coronary disease in which hypertension is a complicating factor, but in these 30 cases evidence of ischaemic myocardial disease was carefully excluded. Severe essential hypertension is rare in old age, and malignant hypertension is seldom encountered. The great majority of hypertensive deaths occur between the ages of 50 and 70, and only about 5% thereafter, hence the infrequency of essential hypertension as a sole cause of heart failure in the aged. There is a tendency to over-diagnose hypertension both clinically and pathologically in old age. According to the standards of normal blood pressure which have been recommended by Master, Dublin, and Marks (1950) in elderly patients a reading of 170/100 mm. Hg falls within normal limits. This degree of systolic hypertension is attributed to loss of elasticity of the aorta and its main branches with advancing age, and is therefore believed to have a physiological basis, but atherosclerosis is probably an important additional factor.

The post-mortem diagnosis of essential hypertension is difficult in the aged, for all other causes of left ventricular hypertrophy must be excluded, including the mild enlargement of the left ventricle which accompanies the so-called arteriosclerotic hypertension. Furthermore, a heart of normal weight is not inconsistent with severe hypertension, as was exemplified in one of the present cases, a woman aged 75 with a blood pressure of 280/120 mm. Hg, and a heart weight of 250 g. Nor does the presence of renal arteriolosclerosis carry the same significance as in younger age groups, for it is a normal age change and is present in some degree in many elderly patients. It is evident, therefore, that the morphological criteria on which the diagnosis of essential hypertension is based are less clearly defined in the aged. Nevertheless, as a cause of heart failure at this period of life it would seem to play a subsidiary role.

#### CALCIFIC AORTIC STENOSIS

There were 12 fatal cases of calcific aortic stenosis, and in an additional 60 patients it was an incidental finding, thus resulting in an incidence of almost 5%. Minor degrees of calcification of the aortic valve are very common in old age, but do not necessarily give rise to stenosis. This form of valvular disease is relatively well tolerated and consistent with long survival, the average age at death in some series being recorded as 66 years or more. There are two main theories regarding its aetiology: 1 That it is degenerative, and 2 that it is a sequel to rheumatic



FIG. 4. *Calcific aortic stenosis in male aged 70 years.*

fever. Mönckeberg (1904) expressed the view that it resulted from a degenerative process akin to arteriosclerosis but Karsner and Koletsky (1947) favoured a rheumatic origin, finding stigmata of rheumatic heart disease in the vast majority of their cases. In the present series evidence of previous rheumatic carditis was discovered in 33%. It is probable that in the younger age groups rheumatic disease accounts for most cases, but in the over-70 age group a larger proportion may be of a degenerative nature (Fig. 4). It is claimed that in the degenerative form the calcium is first laid down in the sinus pockets and base of the cusps, with progression to the free margin, whereas in the rheumatic variety the calcification begins and is most extensive in the distal third of the cusps. However, in the advanced form in which it is frequently seen in the aged the whole valve may be converted into a stony mass, at which late stage it may be impossible to decide from the appearance of the valve alone to which group the condition belongs. Another possible aetiological factor is bacterial endocarditis, especially with *Brucella abortus* as the infecting agent. This form of endocarditis primarily affects the aortic valve and heals by calcification (Peery, 1958). The cause of death in calcific aortic stenosis is frequently not cardiac, and this was confirmed in the present series, with only 12 out of 72 cases proving fatal. Sudden death is not uncommon, and has been

attributed to changes in coronary flow or to conduction disturbances.

#### SYPHILITIC AORTIC VALVULITIS

This is a disease of late middle life and only a very small percentage of patients survive beyond the age of 70 years. There were only three examples of heart failure due to this cause in the present series, despite the fact that histological evidence of syphilitic aortitis was noted in 5% of the group. This high incidence merely reflects the prevalence of infection at a period when treatment was unsatisfactory, and doubtless in the future syphilitic aortitis will be encountered with decreasing frequency in the older age groups.

#### ISOLATED AORTIC INCOMPETENCE

This condition arises almost exclusively in elderly patients as a result of changes in the wall of the aorta due to age which predispose to widening of the aortic valve ring, thus causing aortic incompetence. Attention has been drawn to this condition by Bedford and Caird (1960) who believe that it is by no means rare in old age. Two examples were found in the present series, but the dilatation of the valve ring appeared to be secondary to a severe degree of medial necrosis of the ascending aorta rather than to age changes alone.

#### RHEUMATIC HEART DISEASE

Only 10 patients died from heart failure due to rheumatic heart disease but the incidence of rheumatic stigmata in the whole series was 4%. There were 12 patients in whom an asymptomatic mitral stenosis was discovered, three of whom were elderly women aged 83, 85, and 87 years (Fig. 5). Acute rheumatism is exceedingly rare after 70, and in only one patient, a man aged 72, were Aschoff nodules found in the myocardium. Among the factors which are believed to influence longevity in rheumatic heart disease are:—

**THE AGE OF ONSET** In some series it has been shown that the later the onset of rheumatic fever the better the prognosis. However, Bedford and Caird (1960) in their study of rheumatic valvular disease in the elderly could find no support for the contention that longevity was related to the initial infection having occurred late in life.

**CHOREA AS A MANIFESTATION** Chorea is believed to be indicative of a mild infection and a good prognosis, but this has not been confirmed in all follow-up studies.

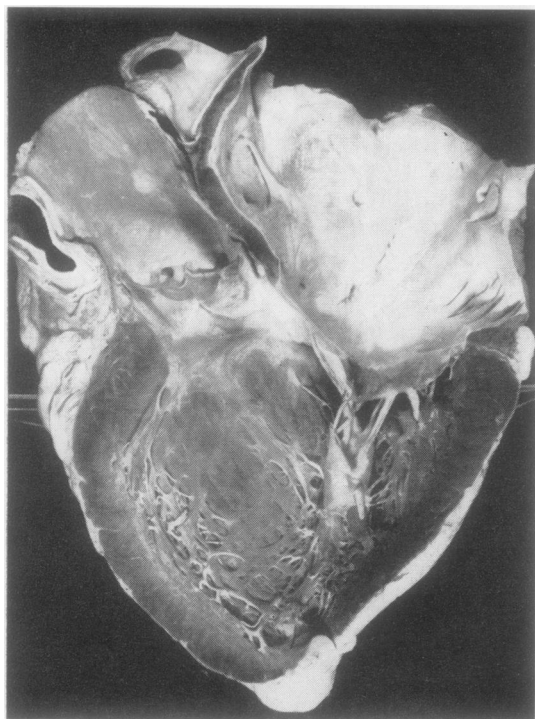


FIG. 5. *Mitral stenosis, an incidental finding in female aged 83 years.*

**DEGREE OF INVOLVEMENT OF THE HEART** On the whole those who survive longest have valvular and myocardial lesions of mild extent, but there are exceptions where severe cardiac lesions are well tolerated into old age.

**FREQUENCY OF RECRUDESCENCES** Although it is clearly established that mitral stenosis can evolve after one attack of rheumatic fever it is inevitable that the occurrence of recrudescences, often sub-clinical in nature, contribute to the rate of evolution of the cardiac damage. From biopsy studies of auricular appendages it has been demonstrated that recrudescences commonly occur even in the fifth and sixth decades, and their frequency and severity undoubtedly play a significant role in dictating the onset of heart failure in a patient with rheumatic heart disease.

**DECLINE IN CARDIAC OUTPUT** If the patient with heart disease survives to old age the decline in cardiac output which normally occurs in this period may tend to avert the onset of heart failure.

**INTEGRITY OF THE CORONARY CIRCULATION** The maintenance of cardiac compensation is largely

dependent on a healthy coronary system and therefore freedom from involvement of the coronary arteries by the rheumatic process, or by atheroma, should exert a favourable influence on the course of rheumatic heart disease.

Of all these factors, probably those most intimately concerned with longevity in rheumatic heart disease are the degree of cardiac involvement, the frequency of recrudescences, and the integrity of the coronary blood supply.

#### BACTERIAL ENDOCARDITIS

There were 10 fatal cases of bacterial endocarditis in the series, of which eight were acute and two sub-acute. It is not a very common disorder in the aged, the greatest number of cases occurring between the third and fifth decades. However, with the aging of the population and the longer survival of patients with rheumatic heart disease as a result of modern treatment, it is possible that its frequency will increase in future. In most series recorded the acute variety is more prevalent in the elderly than the subacute. There are certain characteristic features of bacterial endocarditis in the elderly. From the clinical standpoint the diagnosis is often difficult, not so much by reason of the paucity of symptoms but by their multiplicity. Although pyrexia and a murmur are emphasized as the fundamental findings in diagnosis, Bedford and Caird (1960) calculated that on the basis of the triad—fever, systolic murmur, and a positive blood culture—an incorrect diagnosis of bacterial endocarditis could be made in no less than one-third of all elderly patients at some time during their stay in hospital. As the disease often arises as a terminal event, especially in the acute form, and as a complication of a great variety of infective conditions, it is frequently unsuspected during life. The subacute form may run a more prolonged and more characteristic course. Of the cardiac lesions which predispose to bacterial endocarditis in old age rheumatic heart disease is of somewhat lesser importance than in younger age groups. Non-bacterial thrombotic vegetations probably play a significant role in the localization of bacteria in many cases, and calcific aortic valvular disease may be responsible in a small number.

#### CARDIAC AMYLOID DISEASE

The heart may be involved by amyloid in both the primary and secondary forms of the disease, but there is a further type in which the infiltration is confined to the heart and which is almost exclusively found in old age. The condition has been termed by King (1948) 'atypical amyloid associated with senility' and

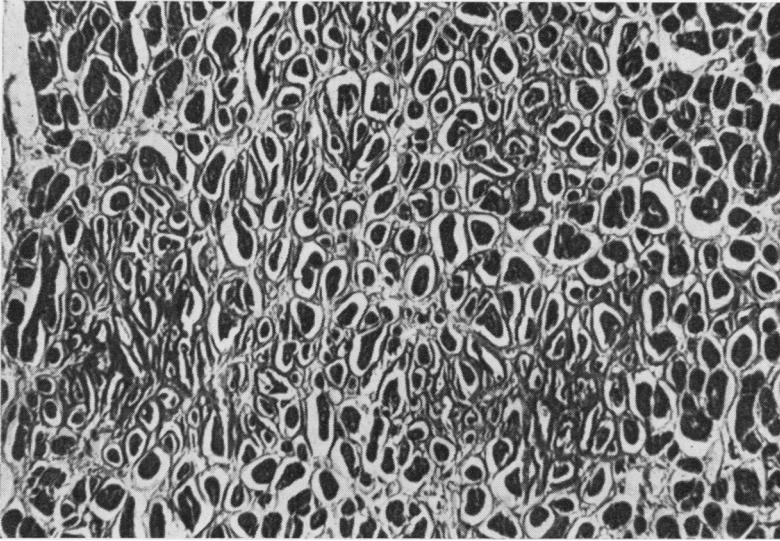


FIG. 6. Cardiac amyloidosis, showing deposition of amyloid around muscle fibres of left ventricle (methyl violet  $\times 110$ ).

he described five examples in patients all over 80 years of age. Striking features of this form of amyloid disease are the extreme age of the patients and the marked male predominance. Of 64 cases reported in the literature only five were under 70, and the great majority were over 80 years of age. This localized form of amyloid was discovered in 12 cases (11M:1F) in the present series and in all it was diagnosed only on microscopic examination and did not contribute to heart failure. However, it may be recognized grossly by cardiac enlargement, valvular thickening, and the formation of nodules in the endocardium or pericardium. Histologically the deposits may be focal or diffuse, and situated in any part of the heart, including the walls of the blood vessels. The individual muscle fibres may be invested by a layer of amyloid and subsequently undergo atrophy (Fig. 6).

Although the pathogenesis of this form of amyloid may be the same as in the primary and secondary types, in some series there has been a close association with malnutrition, cancer, and gastrointestinal

lesions. Hence it has been suggested that these conditions may contribute to a lowering of the serum albumin and to a relative or absolute increase in serum globulin, and that the amyloid infiltration possibly develops on the basis of this disturbance of plasma proteins (Mulligan, 1958).

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