RUPTURED VENTRICLE

INCIDENCE IN POPULATION OF LONDON, 1957-8

BY

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Spontaneous rupture of the ventricle has been recognized as a cause of sudden death at least since the time of Harvey, who described a case (Willis, 1847). Many papers have been written in modern times concerning its incidence and pathogenesis. Krumbhaar and Crowell (1925) published a series of 35 cases (with an analysis of over 600 from the literature), and this series was supplemented by Davenport (1928), bringing its number to 92. The whole series had more male than female cases and the majority were elderly. The authors found that rupture occurred most often on the anterior surface of the left ventricle, and they demonstrated that severe coronary artery disease with occlusion was almost invariably the underlying cause.

In subsequent papers there is no agreement on the relative incidence in the two sexes, but in most there is an increase of numbers with age. Beresford and Earl (1930), describing 46 cases from the records of Tooting Bec Hospital, a large mental institution with many senile inmates, found an excess of females; they believed there was a specially high incidence among mental patients. Jetter and White (1944) also reported a high incidence of ruptured heart in a series of sudden deaths in mental patients, but they found more cases in men than in women. Friedman and White (1944) published details of 10 cases from the post-mortem records of the Massachusetts General Hospital: 7 were male and 3 female; the average age was 66 years. However, Oblath *et al.* (1952), in a series of 80 cases, gathered from the records of the Los Angeles County Hospital over a period of 10 years, found a preponderance of female cases, especially in very old age. Wessler *et al.* (1952) reported 11 male and 9 female cases and exhaustively reviewed the literature; they list many other surveys, some from large general hospitals, some from mental institutions, and some from coroners' material; they conclude that the sex incidence is equal in spite of the higher rates of classical myocardial infarction in men. Recently there have been further publications mainly connected with anticoagulant therapy (Maher *et al.*, 1956; Aarseth and Lange, 1958; Capecci and Levy, 1959). There is disagreement about the effects of anticoagulants, but it is generally accepted that the number of cases is increasing, probably owing to such therapy (Kohn, 1959; Sigler, 1960).

Present Study

The wide differences in the literature on the age and sex distribution of spontaneous rupture of the ventricle and in the estimates of its frequency are due to "selection" in the material, to the varying chances of post-mortem examination being made in cases of sudden death, and to bias in the type of hospital studied. The discrepancies must be further aggravated by the use of simple *hospital numbers* as basis for estimates of *population frequency rates*; it is these that are involved

in statements that a disease has a different incidence in the two sexes or at different ages.

In the course of a study of the historical trends of coronary disease (Morris, 1951) data on the incidence of ruptured ventricle were collected. Those for London have now been brought up to date, giving an estimate of the actual incidence of the condition based on a defined population. The figures illustrate how the epidemiological method may clarify the natural history of disease and help to "complete the clinical picture" (Morris, 1957).

Information about deaths from spontaneous rupture of the ventricle in 1957 and 1958 has been obtained for the London (London County Council) area with its population of about 3½ million. First, the post-mortem records of over 95% of the hospitals in the area, including the 13 main teaching hospitals, were examined. Secondly, records were obtained of the cases occurring among all the necropsies carried out by several coroners' pathologists; these amounted to a 65% sample of all necropsies in the coroners' mortuaries. In London close on 100% of cases of unexplained death from apparently natural causes are examined *post mortem*, mostly in the coroners' mortuaries.

Anticoagulant treatment was noted but no attempt made to obtain details: the information is probably complete for the hospital data, and in the coroners' cases it can be assumed that anticoagulants were not in use, as the deaths were unexpected and usually in persons not under medical care.

Results

Tables I and II show the distribution of cases by sex, age, and place of necropsy. (A few necropsies were made for the coroner in various hospitals; these

TABLE I.—*Number of Cases of Spontaneous Rupture of Cardiac Ventricle Found in London Hospitals, 1957-8*

Age	13 Main Teaching Hospitals*		Other Hospitals (>95% Sample)	
	Male	Female	Male	Female
45-54	—	—	1	—
55-64	10	3	5	2
65-69	5	1	6	2
70-74	3	2	2	6
75-79	1	8	3	7
80-84	—	3	4	3
85+	—	—	1	2

"London" throughout refers to the London County Council area and population.

* Twelve undergraduate hospitals and Hammersmith Hospital.

TABLE II.—*Number of Cases of Ruptured Ventricle Found in London Coroners' Mortuaries, 1957-8*

Age	Male	Female
45-54	7	1
55-64	21	20
65-69	28	18
70-74	30	45
75-79	29	43
80-84	18	36
85+	17	32

These cases were found in a 65% sample.

have been included with the rest of the hospital cases.) Table III scales up the figures to give estimates of the total cases recognized in London during the two years. It will be seen from the tables that this is a cause of death in old rather than middle age. The sex ratio varies with age: under 70 years (Table III) men predominate with a ratio that may be estimated at 114 males:68 females (1:0.6), but over 70 years the position is reversed and the estimated ratio is 160 males:272 females (1:1.7).

TABLE III.—*Number of Cases of Ruptured Ventricle Found in London, 1957-8: Estimated Total*

Age	Male			Female			Total		
	Hos- pitals	Coroners' Mortuaries	Total	Hos- pitals	Coroners' Mortuaries	Total	Hos- pitals	Coroners' Mortuaries	Grand
Under 70	28	86	114	8	60	68	36	146	182
70+	15	145	160	32	240	272	47	385	432
Total	43	231	274	40	300	340	83	531	614

The hospital and the coroners' figures have been scaled up to 100%. It was not considered worth attempting any adjustment for London cases examined outside the area, and non-London cases examined inside it.

Table III, with its approximate totals, also shows that only a small minority of cases were seen in hospital—rather less than 15%—and, with Table I, that the hospital experience, in particular the teaching hospital experience, differs from the total in both sex and age distribution. There is no overall preponderance of female cases in hospital, as is seen in the coroners' and total data. This is mainly due to the excess in number of males under 70 among teaching-hospital cases; and this excess also produces a biased age distribution particularly in these hospitals, with too many in middle age. Of the 13 cases that were known to have had anticoagulant therapy (11 men, 2 women), 7 were men in the middle-aged hospital group.

Finally, estimates of annual sex and age incidence rates that are probably accurate enough for epidemiological purposes are given in Table IV. The present

TABLE IV.—*Ruptured Ventricle in London. Estimated Average Annual Incidence per 1,000 Population, 1957-8*

Age	Male	Female
45-54	0.03	(0.004)
55-64	0.2	0.1
65-69	0.5	0.2
70-74	0.6	0.6
75-79	0.9	0.8
80-84	1.2	1.1
85+	2.4	1.8

Cases from Table III. Population estimates were kindly provided by Mr. C. W. Shaddick.

data, scaled up to 100%, have been related to 1957-8 population estimates for the L.C.C. area. Incidence in men is higher than in women during middle age (though there are so few deaths in women from this cause at 45-54 that the rate is "unreliable"), but there is little difference after 70 years. This finding is factual support from pathological and epidemiological evidence for the clinical impression that the excess of coronary heart disease in males over females is reduced after the menopause and tends to disappear in old age. There are so many more old women than old men in the population (Registrar-General, 1960a) that a greater number of female cases in old age merely produces near equal rates.

Clinical Histories

Ruptured ventricle is thus a relatively frequent cause of death in the aged, and a study of the clinical histories gives some indication why these cases are commoner in coroners' post-mortem material than in hospital. In most cases death seems to have occurred with few prodromal symptoms, and these were not very specific. Here are typical stories:

1. Woman 78 years. Complained of "indigestion pain" two weeks before death but otherwise seemed well. Found dead on the floor.

2. Man 68 years. Pain in left shoulder five days before death. This was thought to be rheumatic. On day he died he felt sick in the morning, but this passed off. Died about noon.

3. Woman 74 years. Some "indigestion pains" for one week; otherwise well. Dropped dead while out shopping.

4. Woman 75 years. Neighbours noticed milk bottles not taken in for several days. Found dead in bed.

5. Woman 84 years. Complained of tiredness for a few days, but up and about. Died suddenly.

With such clinical histories, it is possible that the number of cases recognized underestimates the real total.

The seasonal trend shown in the Chart is characteristic of mortality as age advances. It was noted in both the years studied that there were twice as many ruptured hearts in December and January as in the summer months.

Pathological Findings.—At necropsy, pathological evidence of hypertension was very commonly noted and a history of diabetes frequently mentioned, but because of the nature of these deaths there are no reliable data on blood-pressure

Average monthly deaths from ruptured ventricle, London, 1957-8. Frequencies have been adjusted to number of days in month.

and associated conditions during life (likewise, retrospective social analysis proved impracticable). In more than half the cases the rupture had taken place through the anterior wall of the left ventricle and in about a quarter through the posterior wall; in the rest the site of rupture was lateral, antero-lateral, postero-lateral, apical, or undefined. In seven cases the rupture was in the right ventricle. Very severe coronary atheroma, and coronary occlusion, were usually reported.

In the course of the whole study 10 cases of *septal* rupture were collected. They have been excluded from the tables as they usually present with a different history (Sager, 1934; Armanious, 1960), death being delayed often for two or three weeks. Of the 10, 5 were in men and 5 in women.

Discussion

This paper is concerned with the frequency and distribution of this manifestation of ischaemic heart disease. It illustrates in gross degree the selection which may be present in hospital material and, in particular, it indicates how unrepresentative the post-mortem material of teaching hospitals, the source of most statements on morbid anatomy, may be. The main teaching hospitals each had, on average, between one and two cases a year of this condition during the two years studied; six of them, in fact, had only one case during the two years or none at all. The total hospital data show "selection" with regard to age, sex, and anticoagulant therapy. Such selection, together with the real variation of the sex ratio with age—and sheer inadequacy of numbers—presumably explains the conflicting statements in previous series. The high incidence in mental patients may also have been due to selection, more necropsies being done on mental patients, particularly in America; moreover, such series

would inevitably deal with an undue number of the very aged (Registrar-General, 1960b). No excess incidence in mental patients was found in the present study, and although special data from the large mental hospitals in the Surrey area were obtained (not reported) there still appeared to be no excess. However, no attempt has been made to prove this.

Four points about ruptured ventricle have been brought out by the use of a *population study* rather than the *collection of clinical cases*: (1) Spontaneous rupture of the ventricle is a common post-mortem finding. The estimates given here are for cases recognized at necropsy and therefore minimal. (2) In London it is a problem of the coroners' mortuaries rather than the hospitals. Once again the disadvantage of studying ischaemic heart disease in hospitals alone is illustrated (Morris, 1951). (3) The incidence rises with age in both sexes; it is rare in middle age but a frequent cause of death in old age. (4) The largest number of cases occur in old women, but the true incidence during old age in the two sexes is similar.

Interest nowadays is focused on the post-mortem finding of ruptured heart in relation to anticoagulant therapy. The evidence is that, whether increasing or not, these cases form a tiny fraction of the total. The figures presented—13 cases in the two years—provide a baseline, and it should be possible in a few years to estimate whether a real increase is occurring in London in relation to the increasing use of anticoagulants, which is likely.

Summary

The incidence of ruptured ventricle due to ischaemic heart disease among the $3\frac{1}{4}$ million population of London has been studied. It may be estimated that about 600 cases were recognized in London during 1957 and 1958. If the London figures are typical of the country as a whole there may be about 5,000 cases a year in Great Britain or about 100 cases per million of population. The condition is thus by no means rare; it probably causes about 1% of deaths in old people. Because of the nature of the clinical history in old people these figures are likely to be an underestimate.

The incidence of ruptured ventricle rises with age in both sexes. In *middle age* there are more cases in men than in women, and the incidence rate, per 1,000 of the population, is more than double that in women. In *old age* there are more cases in women than in men, but the incidence is probably about equal in the two sexes.

The great majority of the cases in London are seen in the coroners' mortuaries. Hospitals deal with less than 15% of the total, and the sex and age distribution of their cases is atypical: in particular there is a disproportionate number in middle-aged men. Cases associated with anticoagulant therapy form a small minority, about 2% of the total; they are grossly over-represented in the hospital data.

In more than half the cases rupture occurred through the anterior wall of the left ventricle; in about a quarter through its posterior wall.

The analysis illustrates how the epidemiological method can help to correct and complete the clinical picture of a disease and its natural history.

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RUPTURE OF THE HEART

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Rupture of the heart is a dramatic complication of myocardial infarction, and the knowledge that it may occur has undoubtedly influenced the management of other cases of myocardial infarction with regard to the degree and duration of rest, the length of stay in hospital, and the activities permitted during convalescence.

To try to define the factors which may cause an infarcted heart to rupture we have studied 215 cases of ventricular rupture occurring in two teaching hospital groups and in a series of sudden deaths investigated by the coroner of a large industrial city.

Methods

The records of two groups of patients were examined

Hospital Series.—Patients who were found at necropsy to have died from rupture of the heart in the years 1939-59 at the Radcliffe Infirmary, Oxford, and the Queen Elizabeth and General Hospitals, Birmingham.

Coroner's Necropsy Series.—From the records of all the post-mortem examinations carried out on the instructions of H.M. Coroner for the City of Birmingham in the years 1951-60, information was obtained on two groups of patients. (a) All patients