contributory factor to late deaths: 7.5% of cases with fibrillation as against 7.2% of those in sinus rhythm.

Influence of Valvotomy upon the Mitral Diastolic Murmur.—From the clinical data available it was possible to ascertain in 162 cases whether the final size of the valve bore any relation to the abolition of the pre-operative diastolic murmur. It was found that when the final size of the valve was 4 cm. or more the diastolic murmur disappeared in 67.2% of cases (Table VIII). In those with a final valve size of less than 4 cm. the diastolic murmur disappeared in 10.9%.

TABLE VIII.—Final Valve Size Related to Presence of Diastolic Murmur (Assessed at Six Months to Nine Years)

Valve Diameter at End of Operation	Diastolic Murmur	
	Present	Absent
2.0 cm.	4	—
2.5 "	33	2
3.0 "	29	2
3.5 "	24	7
4.0 "	10	16
4.5 "	10	25
Total	110	52

Reoperation.—Repeat valvotomy was required in 21 cases (10%). In the light of recent work (Belcher, 1958, 1960) most of these must be regarded as instances of "false" restenosis. The transventricular route using the dilator was found to be satisfactory in all cases and a good valvotomy was accomplished. The need for reoperation became apparent in most cases between three and five years. Doubtless a number of the earlier cases will yet require further surgery.

Summary

The case records of 221 mitral valvotomies have been reviewed. All cases except two have been traced, seen, and assessed.

Two different operative techniques provided two series of cases—the finger or finger/knife technique for the first 150 cases, the dilator by the transventricular route for the remaining 71.

The final valve size was 3.5 cm. or more in 98.6% of cases where the dilator had been employed. Where the finger or finger/knife technique had been used only 16.6% had a final valve size of 3.5 cm. or more.

The operative mortality was lower in the dilator series. Death due to embolus was three times more common in the finger/knife series. The lowered incidence of embolus is due to the dilator entering the valve orifice from below and thus causing less disturbance of the calcification, which, when present, is normally found on the superior aspect of the valve leaflets or fused commissures.

Early results are compared with late results in the first 100 patients. Results are reviewed for the series as a whole. Although it is perhaps early to be certain of the late results in cases where the dilator has been used, it is encouraging that, so far, all survivors from this operation are in the "good" to "excellent" category. The influence of auricular fibrillation on the operative mortality and prognosis is discussed.

We wish to acknowledge the secretarial assistance given by Miss E. McLean.

REFERENCES

- Bailey, C. P. (1949). *Dis. Chest*, 15, 377.
 — (1959). *Ibid.*, 35, 435.
 — Zimmerman, J., and Likoff, W. (1960). *Ibid.*, 37, 543.

- Baker, C., Brock, R. C., and Campbell, M. (1950). *Brit. med. J.*, 1, 1283.
 — (1955). *Ibid.*, 2, 983.
 Belcher, J. R. (1958). *Brit. Heart J.*, 20, 76.
 — (1960). *Lancet*, 1, 181.
 Diveley, W. L., Daniel, R. A., Scott, H. W., and Foster, J. H. (1958). *Ann. Surg.*, 147, 614.
 Dubost, C. (1954). *Presse méd.*, 62, 253.
 Goodwin, J. F., Hunter, J. D., Clelland, W. P., Davies, L. G., and Steiner, R. E. (1955). *Brit. med. J.*, 2, 573.
 Harken, D. E., Ellis, L. B., Ware, P. F., and Norman, L. R. (1948). *New Engl. J. Med.*, 239, 801.
 Logan, A., and Turner, R. (1959). *Lancet*, 2, 874.
 Mason, G. A. (1960). *Acta chir. scand.*, Suppl. 253, p. 15.
 Neptune, W. B., and Bailey, C. P. (1954). *J. thorac. Surg.*, 28, 15.
 Sellors, T. H., Bedford D. E., and Somerville, W. (1953). *Brit. med. J.*, 2, 1059.

RHEUMATIC MITRAL VALVE DISEASE IN THE ELDERLY

INCIDENCE FOUND AT NECROPSY

BY

T. HARGREAVES,* M.B., B.S., B.Sc.

From the Department of Morbid Anatomy, King's College Hospital and Medical School, London

The incidence of mitral valve disease in elderly patients is much higher than is commonly realized. Some clinical studies—for example, those of Baker and Musgrave (1947), Cookson (1949), Kaufman and Poliakoff (1950), Appel and Kossmann (1951), and Hebbert and Rankin (1954)—have emphasized the relatively large number of cases of mitral valve disease in elderly patients. Hammond and Platts (1960) have drawn attention to the numbers of patients over the age of 60 who were found at necropsy to have mitral valve disease. Varying figures have been recorded concerning the incidence of rheumatic mitral valve disease found in patients over the age of 50, based on post-mortem studies: Cabot (1926) gives a figure of 33%, Boas and Fineberg (1926) 34%, and Coombs (1924) only 9%. In the clinical series of Brenner (1934) and Coombs (1924) the percentage of patients with mitral valve disease over the age of 50 varied from 6 to 10%. The suggestion, therefore, is that the diagnosis of mitral valve disease is missed in elderly patients.

In view of these varying figures it was decided to determine the incidence of mitral valve disease found at necropsy in patients over the age of 50 during the 13-year period 1947 to 1959 in a general hospital.

Methods of Survey

A total of 2,086 necropsies in patients over the age of 50 were carried out in this period. The diagnosis was based on thickening or deformity of the valve cusps and shortening of the chordae tendineae. In all the cases stenosis of the valve was found, and in nearly all there was calcification of the valve. For the sake of completeness the number of cases of mitral valve disease in subjects under the age of 50 was also determined.

King's College Hospital is a general teaching hospital with no special geriatric facilities. A limited amount of cardiac surgery is performed, but there is no special tendency for patients to be referred specifically for this treatment.

*Now at the Department of Chemical Pathology, the School of Medicine, Leeds.

Results

A total of 2,686 necropsies were performed on patients over the age of 1 year during the 13-year period 1947 to 1959. These included the 2,086 on patients over the age of 50, of whom 64 (3.1%) had mitral valve disease. The distribution of the disease in the different age-and-sex-groups is shown in Table I. In the older age-groups mitral valve disease was found in 4.4% of women and 2.2% of men over 50. The incidence in each

TABLE I.—Incidence of Rheumatic Mitral Valve Disease Found at Necropsy from 1947 to 1959

Age of Patient	All Cases				Male				Female			
	No. of Necropsies	Mitral Disease			No. of Necropsies	Mitral Disease			No. of Necropsies	Mitral Disease		
		No.	%			No.	%			No.	%	
1-9	54	0			34	0			20	0		
10-19	40	3	7.5		26	1	3.8		14	2	14.2	
20-29	66	5	7.6		41	3	7.3		25	2	8.0	
30-39	163	19	11.7		98	7	7.1		65	12	18.3	
40-49	277	24	8.6		165	9	5.5		112	15	13.4	
50-59	531	30	5.6		344	14	4.1		185	16	8.9	
60-69	791	23	2.9		481	10	2.1		311	13	4.2	
70-79	581	10	1.7		344	3	0.9		237	7	2.9	
80+	183	1	0.5		75	0			108	1	0.9	
Total	2,686	115	4.3		1,608	47	2.9		1,077	68	6.3	

group is higher than that given by the Registrar-General (1958). For the purpose of this paper we shall consider only patients aged 50 and over at the time of death.

Cause of Death.—Death was attributed to mitral valve disease in 27 of the 37 women over the age of 50 who came to necropsy. In the other 10 cases it was due to an unrelated cause—six as a result of cerebrovascular accidents and four from myelosclerosis, carcinoma of the bladder, carcinoma of the colon, and motor neurone disease. Death was attributable in part to mitral valve disease in 20 of the 27 men. In the remaining seven it was due to haematemesis from a duodenal ulcer, uraemia, pneumococcal septicaemia, carcinoma of the stomach, carcinoma of the bronchus, aortic aneurysm, and cerebral haemorrhage. In the 47 patients dying from causes thought to be directly related to mitral valve disease, the cause of death was congestive cardiac failure (8 males, 13 females), myocardial infarction (4 males, 2 females), multiple emboli (2 males, 2 females), acute left ventricular failure (2 males, 2 females), bacterial endocarditis (2 males, 1 female), pulmonary embolus (1 male, 1 female), post-valvotomy (1 male, 1 female), pulmonary vein thrombosis (1 female), and bronchopneumonia (4 females).

Valve Lesion

In all the cases the valve lesion was due to rheumatism and was classified as mitral stenosis or mitral incompetence. The cases of mitral stenosis were divided into mild, moderate, and severe, corresponding to an orifice of 1.5 by 0.75 cm., 1 by 0.75 cm., and 0.5 by 0.3 cm. respectively. Table II shows the age-and-sex distribution of the severity of involvement of the mitral valve.

TABLE II.—Degree of Mitral Valve Disease

Age	Mitral Stenosis						Mitral Incompetence	
	Mild		Moderate		Severe		M	F
	M	F	M	F	M	F		
50-59	1	2	5	2	4	8	4	4
60-69	3	3	3	5	2	4	2	1
70-79	2	3	0	2	1	1	0	1
80+	0	0	0	1	0	0	0	0

The aortic valve was affected by a rheumatic process in 12 out of 27 males. In three cases the valve was severely stenosed (admitting the tip of one finger). In two of these patients, aged 52 and 54, there was severe stenosis of the mitral valve also. The aortic valve was affected in 11 out of 37 women. The valve was severely stenosed (admitting the tip of one finger) in three patients aged 64, 69, and 74. The one aged 69 had severe stenosis of the mitral valve.

The tricuspid valve was dilated in four men, and in two of these it was associated with mitral incompetence. In the female series there was dilatation of the tricuspid valve in four cases and thickening or stenosis in three. The stenosis was severe in one patient aged 52.

The association of the valve lesions and their distribution in the various age-groups is shown in Table III. From these results it will be seen that extensive rheumatic valvular involvement is compatible with

TABLE III.—Age Distribution of Mitral and Other Valvular Lesions at Necropsy

Age	M.S.		M.S. A.S.		M.S. A.I.		M.S. T.S.		M.I. A.S.		M.I.		M.I. A.I.	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
50-59	5	9	5	0	0	1	0	2	2	0	1	4	1	0
60-69	7	5	1	3	0	3	0	1	1	0	1	1	0	0
70-79	1	3	2	3	0	0	0	0	1	0	0	0	0	0
80+	0	1	0	0	0	0	0	0	0	0	0	0	0	0

M.S.=Mitral stenosis. A.S.=Aortic stenosis. T.S.=Tricuspid stenosis. M.I.=Mitral incompetence. A.I.=Aortic incompetence.

survival to old age. Cabot (1926) concluded that most patients with pure mitral stenosis died between 30 and 40, and that those with combined aortic and mitral stenosis died between 50 and 60.

Of the 17 patients who died from causes unrelated to mitral stenosis, 11 had mitral stenosis alone, five had aortic and mitral stenosis, and one had mitral incompetence. Four of these cases, each one having pure mitral stenosis, were unsuspected during life. Of these four, two had mild and two had a moderate degree of mitral stenosis. All other cases in the series were diagnosed before death.

Findings in the Series

Active Rheumatism.—All hearts were routinely examined at necropsy for Aschoff nodes and scars of Aschoff nodes. Sections were taken from the mitral valve ring, the posterior wall of the left atrium, and at random from the myocardium. Aschoff nodes were found in one case, but scars of Aschoff nodes were not found. This incidence is much less than that reported in other series. De la Chapelle, Graef, and Rottino (1934) found Aschoff nodes in 33% of cases over the age of 40 with rheumatic heart disease.

Heart Weight.—In all cases, except two, the weight of the heart was above the normal limits for the patient. The exceptions were pure mitral stenosis in a man of 78 and a woman of 71. The average weight of the male hearts was 555 g., and of the female hearts 508 g.

Heart Chambers.—Gross dilatation of the left atrium was found in six women: five were in the 50-59 age-group and one was 69. Five of these patients were recorded as having had auricular fibrillation. Gross dilatation of the right atrium was found in one case, that of a man of 67 with a moderate degree of mitral stenosis. The left ventricle was hypertrophied in 44 cases. Not all of these had hypertension or multiple valvular disorganization.

Emboli.—Embolic phenomena were recorded during life in five men and eight women. Emboli were found at necropsy in these 13 cases. The emboli were situated in the cerebral vessels in eight cases, in the renal vessels in 10 cases, in the splenic vessels in two cases, and in one case each in the mesenteric and the femoral vessels. Of these 13 cases with embolic phenomena, antemortem thrombus was found in the left atrium in six; one case had subacute bacterial endocarditis. Auricular fibrillation was present in 11 of the 13 cases, including all those with cerebral emboli. Two occurred after mitral valvotomy and four patients were ambulant at the time of the embolism. In five men and nine women there was evidence of pulmonary infarction. This incidence is higher than that in a younger age-group.

Bacterial Endocarditis.—This was present in four cases. In one woman a *Staphylococcus aureus* infection developed after valvotomy. Another patient, a man of 53, first presented with signs of subacute bacterial endocarditis at the age of 48. The other two cases had involvement of the aortic valve and developed mycotic aneurysms of the sinus of Valsalva. All cases were recognized during life and were in the 50–59 age-group. Fulton and Levine (1932) found 15 patients over the age of 50 among 111 with subacute bacterial endocarditis. Zeman (1945) reported 18 cases of subacute bacterial endocarditis in patients aged 60–87; 10 of these occurred in patients with rheumatic heart disease. In the present small series, one patient was treated successfully for five years before death, but the infection recurred; the others died in spite of intensive antibiotic therapy.

Rheumatic Fever.—A history of rheumatic fever was obtained in 19 cases; recurrent attacks of rheumatic fever occurred in 5 of these. A history of chorea was obtained in eight patients. The age at which rheumatic fever or chorea was said to have occurred is shown in Table IV.

TABLE IV.—Age at Onset of Rheumatic Fever

	0–5	6–10	11–15	16–20	21–25	26–35	36–45
Rheumatic fever	1	7	4	1	2	1	3
Chorea	4	4					

Pregnancy.—There is a record of 12 of the 37 women in this series having borne altogether 27 children. This figure is rather lower than that of other series, but this may be due to incomplete documentation. Boas and Perla (1925) found that in a series of 46 patients over the age of 50, all with mitral stenosis, 30 women had borne 119 children. It is still commonly taught that women with mitral stenosis should not have children because of the adverse effect of pregnancy and the strain of bringing them up. It seems that in some cases of uncomplicated mitral disease pregnancy has little effect, as is shown by the numbers of these patients living to old age. Bunim and Appel (1950) could find no significant difference in the life-histories of 169 rheumatic mothers and 215 rheumatic childless women.

Symptoms

Shortness of breath on exertion was the presenting symptom in 12 out of 28 men. In women over the age of 50 it was the presenting symptom in 22 cases.

The earliest age of onset was in a woman of 50 who had had dyspnoea for 24 years. Two women, both aged 74, had rapidly progressive dyspnoea of less than one

year's duration. Seven males and six females had no significant dyspnoea. Of 18 males and 24 females with congestive heart failure, 14 males and 22 females had auricular fibrillation.

Four patients presented with angina pectoris, but all had atheroma of the coronary arteries.

Signs

Mid-diastolic Murmur.—Mid-diastolic murmur was recorded in 13 men and 17 women. Four cases of mitral stenosis were not diagnosed during life. In the other cases there was sufficient subsidiary signs for a diagnosis to be made.

Auricular Fibrillation.—This was present in 16 men and 24 women. Of these, 11 men and 18 women were in congestive cardiac failure. Thus five men and six women had auricular fibrillation but no congestive failure. Most observers state that auricular fibrillation precipitates congestive cardiac failure. Cookson (1949) believes that the onset of auricular fibrillation appears to be a turning-point in the life-history of patients who have suffered little or no handicap from mitral stenosis with normal rhythm up to middle or late life. In this series, however, seven patients had auricular fibrillation but no congestive failure. Conversely, five had congestive failure but there was no record of their having auricular fibrillation. Only one of these, a man of 76, had a raised blood-pressure (210/100). Thrombus in the left auricle was found at necropsy in two patients who had no clinical record of auricular fibrillation; one was a woman of 74, the other a man of 56.

Hypertension.—A blood-pressure greater than 150/90 was found in 8 (29%) men and 14 (36%) women. In 30% of the cases the diastolic blood-pressure was greater than 100 mm. Hg. The figure of 34% is similar to that obtained by other authors for the incidence of hypertension in elderly patients with mitral disease. Horns (1944) found hypertension in 31% of his patients over the age of 45; Baker and Musgrave (1947) found 38% in patients over the age of 50. Appel and Kossmann (1951) gave a lower figure of 12.6% in 71 cases; Boas and Fineberg (1926) found 52.1% in 46 patients over the age of 50. Levine and Fulton (1928) found a blood-pressure greater than 150/100 in 58% of patients over the age of 45 and have emphasized the frequency of hypertension in older patients with mitral stenosis. Anginal pain was recorded in four men and six women; three of the women and one man had blood-pressures in excess of 150/90. All these cases were recorded as having atheroma of the coronary vessels.

Discussion

Mitral stenosis is compatible with normal life until old age, and is often associated with complete freedom from symptoms. Usually the course of mitral stenosis is described as follows. The patient, usually a woman, presents with increasing dyspnoea in her early thirties and then dies in congestive cardiac failure after a few years of steadily increasing dyspnoea. In this series, which is representative of a general hospital, this type of case is in a minority. Some do present with this picture, but many live until middle age. The reason why some do live until old age is not yet clear.

White and Bland (1941) suggested the following reasons: (1) relatively mild mitral stenosis, (2) rheumatic fever late in life, (3) quite careful living, and (4) ancestral longevity.

In the present series the degree of mitral stenosis was often severe, even in old patients, so that the first postulate is not strictly true.

With regard to the age at onset of rheumatic fever, in 27 cases this averaged 13.4 years. The series is only a small one, but this figure does not support the theory that late onset of rheumatic fever is a factor in the survival of people with rheumatic heart disease until old age. Appel and Kossmann (1951) found that the average age at onset of rheumatic fever was 21.5 years in their series of 71 patients. This contrasts with the natural history of the disease as described by Cohn and Lingg (1943). These authors thought that a mild infection or an attack of chorea was the reason for longevity.

Most of the patients in this series had led normal lives although many were incapacitated by shortness of breath in their later years. Only three patients, aged 50, 54, and 54, had been in congestive failure for more than 10 years. In most cases the onset of shortness of breath or of congestive cardiac failure was a late occurrence and may be related to the onset of auricular fibrillation as suggested by Cookson (1949).

Other suggested causes for longevity in mitral valve disease are hypertension, the absence of auricular fibrillation—suggested by Kossmann and Connor (1942)—and involvement of the mitral valve only (Cabot, 1926). The figures given above do not suggest that longevity is due to any of these causes alone.

One surprising feature was the absence of Aschoff nodes, although each heart was examined for their presence. This contrasts with the figures of de la Chapelle *et al.* (1934), who found Aschoff nodes in 33% of patients dying over the age of 40.

The significance of these findings is that patients with severe mitral valve disease can live to old age and not have symptoms referable to mitral stenosis. We do not know the reason why some people live to old age. One of the more important considerations is the prognosis after mitral valvotomy. Many factors must be considered—for example, the presence of pulmonary hypertension—but it may be that some cases have an as yet undiscovered fault in the myocardium, and this is why they acquire symptoms at an early age. It is these patients who are subjected to mitral valvotomy. We do not yet know why some patients develop pulmonary hypertension. This may be due to a mechanical effect of stenosis of the valve or there may be an underlying myocardial defect as well. It is probable that survival to old age is due to a variety of factors, some of which cannot be determined by present investigational methods.

Summary

The incidence of mitral valve disease found at post-mortem examination in patients over the age of 50 is reviewed. In a 13-year period 2,086 necropsies were performed in patients over the age of 50. Of these, 64 (3.1%) had mitral valve disease: in 47 (73%) of them death was thought to be due directly to that condition. In four cases the presence of a mitral valve lesion was not suspected during life.

The heart was enlarged in 62 (97%) cases. Gross dilatation of the left atrium was found in six cases and gross dilatation of the right atrium in one case. Active rheumatism was present in one case. Emboli were found in 13 (20%) cases at necropsy.

A history of rheumatic fever or chorea was found in 27 (42%) cases. Twelve of the 37 women had borne altogether 27 children.

Shortness of breath on exertion was the presenting symptom in 34 (53%) cases. A mid-diastolic murmur was present in 30 (47%) cases. There was a record of auricular fibrillation at some period during life in 40 (63%) cases. A blood-pressure of greater than 150/90 was recorded in 22 (34%) cases.

The possible causes of longevity in mitral stenosis and the significance of the findings in relation to valvotomy and its prognosis are discussed.

I thank Professor H. A. Mangus for his interest and advice in the preparation of this paper.

REFERENCES

- Appel, S. B., and Kossmann, C. E. (1951). *J. Amer. med. Ass.*, **146**, 1474.
 Baker, L. A., and Musgrave, D. (1947). *Ann. intern. Med.*, **26**, 901.
 Boas, E. P., and Fineberg, M. H. (1926). *Amer. J. med. Sci.*, **172**, 648.
 — and Perla, D. (1925). *Ibid.*, **170**, 529.
 Brenner, O. (1934). *Bgham med. Rev.*, **9**, 193.
 Bunim, J. J., and Appel, S. B. (1950). *J. Amer. med. Ass.*, **142**, 90.
 Cabot, R. C. (1926). *Facts on the Heart*. Saunders, Philadelphia.
 Cohn, A. E., and Lingg, C. (1943). *J. Amer. med. Ass.*, **121**, 1.
 Cookson, H. (1949). *Brit. Heart J.*, **11**, 155.
 de la Chapelle, C. E., Graef, I., and Rottino, A. (1934). *Amer. Heart J.*, **10**, 62.
 Coombs, C. F. (1924). *Rheumatic Heart Disease*. Wright, Bristol.
 Fulton, M. N., and Levine, S. A. (1932). *Amer. J. med. Sci.*, **183**, 60.
 Hammond, J. D. S., and Platts, M. M. (1960). *Brit. med. J.*, **1**, 691.
 Hebbert, F. J., and Rankin, J. (1954). *Acta med. scand.*, **150**, 101.
 Horns, H. L. (1944). *Amer. Heart J.*, **28**, 435.
 Kaufman, P., and Poliakov, H. (1950). *Ann. intern. Med.*, **32**, 889.
 Kossmann, C. E., and Connor, C. A. R. (1942). *Amer. Heart J.*, **24**, 215.
 Levine, S. A., and Fulton, M. N. (1928). *Amer. J. med. Sci.*, **176**, 465.
 Registrar-General (1958). *Statistical Review of England and Wales for the Year 1957. Part I. Tables, Medical*, p. 190. H.M.S.O., London.
 White, P. D., and Bland, E. F. (1941). *J. Amer. med. Ass.*, **116**, 2001.
 Zeman, F. D. (1945). *Amer. Heart J.*, **29**, 661.

"All planners of new hospitals in Great Britain are interested in the design of central sterile supply departments, which have, of course, been common in North America since before the second world war. Although Americans and Canadians are still including these departments in their new hospitals, they have pointed out that, just at a time when Europe is beginning to be interested in them, they are expecting the eventual replacement of these departments by commercial pre-sterilization. In British eyes it is now thought to be an inopportune time to establish central syringe services because the Ministry itself has arranged contracts for disposable syringes, and pre-sterilized non-disposable syringes also are obtainable commercially. A number of firms, as you know, in this country now provide pre-sterilized disposable gloves and dressings, and the Americans and Canadians feel that sterilization commercially on a large scale may eventually produce all that is needed from a central sterile supply department—with the exception of operating theatre instruments. Central sterile supply departments in America are, by the way, usually combined as part of a central supply room which dispenses in addition non-sterilized medical and surgical instruments and equipment such as oxygen tents, suction apparatus and the like." (Mr. W. E. Bardgett, B.A., F.H.A., Group Secretary, Uxbridge Group Hospital Management Committee: "Hospital Planning Trends in North America," Hospital Management Committee's Conference, Portsmouth, June 16.)