cases. It is quite likely, of course, that patients may have been appropriately treated before blood cultures could become positive or the septicaemia become florid. But series which have been compiled on clinical data only may well be incomplete.

Summary

Forty-nine cases of staphylococcal septicaemia, which occurred during a period of nine years in a 360-bed hospital, are described. Forty cases were fatal. Necropsy evidence must be sought when the incidence is being assessed.

Septicaemia developed after hospital admission in 16 patients, only one of whom recovered. Surgery and steroid therapy were the two most important factors.

Attention is drawn to the frequency with which renal insufficiency may occur.

A study of the mortality trends suggests that staphylococcal septicaemia, especially when contracted subsequent to hospital admission, has become or is becoming as lethal a hazard as it was prior to the advent of antibiotics.

Some of this work was included in a thesis for the M.D. of the University of Edinburgh, and I thank the Dean of the Faculty of Medicine for permission to publish. I also thank the consultants of the United Cardiff Hospitals who allowed me to see their patients and examine clinical records: Professor J. Gough for ready access to pathological material; and Dr. W. A. Gillespie for his criticism and help in the preparation of this paper.

REFERENCES

- Anderson, D. G. (1945). *New Engl. J. Med.*, **232**, 400.
 Bradley, S. M. (1876). *Lancet*, **1**, 768.
 Clarkson, P. (1958). *Ibid.*, **1**, 428.
 Collins, H. S., Helper, A. N., Blevins, A., and Olenberg, G. (1956). *Ann. N.Y. Acad. Sci.*, **65**, 222.
 Faber, V. (1959). *Ugeskr. Læg.*, **121**, 1593.
 ———, Jessen, O., Rosendal, K., and Eriksen, K. R. (1960). *Brit. med. J.*, **2**, 1832.
 Finland, M., Jones, W. F., jun., and Barnes, M. W. (1959). *J. Amer. med. Ass.*, **170**, 2188.
 Florey, M. E. (1958). *Brit. med. J.*, **2**, 403.
 Hassall, J. E., and Rountree, P. M. (1959). *Lancet*, **1**, 213.
 Keefer, C., Blake, F. G., Marshall, E. K., jun., Lockwood, J. S., and Wood, W. B., jun. (1943). *J. Amer. med. Ass.*, **122**, 1217.
 Kellaway, C. H., MacCallum, P., and Tebbutt, A. H. (1928). *Med. J. Aust.*, **2**, 63.
 Knight, V., and Collins, H. S. (1955). *Bull. N.Y. Acad. Med.*, **31**, 549.
 Lowenstein, P. S. (1931). *Amer. J. med. Sci.*, **181**, 196.
 McDermott, W. (1956). *Brit. med. J.*, **2**, 837.
 MacNeal, W. J., and Frisbee, F. C. (1936). *Amer. J. med. Sci.*, **191**, 179.
 Mendell, T. H. (1939). *Arch. intern. Med.*, **63**, 1068.
 Neuhof, H., Aufses, A. H., and Hirshfeld, S. (1934). *Surg. Gynec. Obstet.*, **58**, 886.
 Powell, D. E. B. (1959). M.D. thesis, University of Edinburgh.
 ——— (1961). *J. Path. Bact.* In press.
 Reimann, H. A. (1936). *Arch. intern. Med.*, **58**, 329.
 Ryle, J. A. (1948). *The Natural History of Disease*, 2nd ed., chap. 16. Oxford Univ. Press, London. Quoted from *Guy's Hosp. Rep.*, 1930, **80**, 137.
 Scott, W. J. M. (1935). *J. Amer. med. Ass.*, **105**, 1246.
 Skinner, D., and Keefer, C. S. (1941). *Arch. intern. Med.*, **68**, 851.
 Smith, I. M., and Vickers, A. B. (1960). *Lancet*, **1**, 1318.
 Wilson, R., and Hamburger, M. (1957). *Amer. J. Med.*, **22**, 437.

The new British Standard for normal equal-loudness contours for pure tones and normal threshold of hearing under free-field listening conditions (B.S.3383:1961) follows closely the draft recommendations prepared by the Acoustics Committee of the International Organization for Standardization (I.S.O.). Copies of the standard may be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London W.1 (price 4s. 6d., postage extra to non-subscribers).

MITRAL VALVOTOMY

A COMPARISON OF RESULTS BY TWO OPERATIVE METHODS

BY

KENNETH FRASER, M.D., Ch.M., F.R.C.S.Ed.
F.R.F.P.S.

AND

IAN F. KERR, M.B., F.R.C.S.Ed.
The Western Infirmary, Glasgow

Considerable changes have taken place in the technique of mitral valvotomy in recent years. In the earliest cases access to the valve was achieved via the left atrial appendage, and the stenosed valve was split by the finger or guillotine (Harken *et al.*, 1948; Bailey, 1949). The use of a knife attached to the finger was introduced by Brock (Baker *et al.*, 1950). In many cases a satisfactory split was impossible, owing to dense fibrosis, calcification, or the shape of the valve. To overcome these difficulties several types of valve dilator came into use. In 1954 Dubost performed valvotomy using a mechanical dilator through the atrium, and shortly thereafter Logan used a dilator by the transventricular route (Logan and Turner, 1959). In the same year a right-sided approach into the left atrium near the atrial septum was described, and may be indicated in cases where there are likely to be thrombosis of the appendage, concomitant tricuspid stenosis, other cardiac anomalies, or associated pathology in the right lung (Neptune and Bailey, 1954). In some centres mitral valvotomies are now being carried out by the open-heart technique using total cardio-pulmonary bypass (Bailey *et al.*, 1960; Bailey, 1960, personal communication).

From time to time critical assessment of results by various techniques is indicated in order that one can weigh the successes and shortcomings of one method against the hazards and advantages of another.

This paper describes the findings in two groups of patients submitted to different types of operation. In the first group the valvotomy was performed by the finger, or finger and Brock's knife, and, in the second, using a dilator by the transventricular route. Although the numbers are small compared with some published series, it is hoped that more attention has been paid to detail than could be reasonably expected in larger surveys.

Material.—The case records of 221 mitral valvotomies performed during the period 1951–60 have been reviewed. There were 19 (8.6%) operative deaths and 15 (6.8%) late deaths. Of the remaining 187 patients, 185 have been traced. All operations were carried out by one of us (K. F.). Three forms were completed for each patient. Form 1 contained details of the pre-operative history, clinical findings, and special investigations. The second form tabulated findings at operation and during the post-operative period in hospital. The third form was completed at the follow-up visit.

Clinical Picture

Sex-and-age Incidence.—Of the patients, 170 (77%) were female. The age distribution was as follows: 10–19 years, 3%; 20–29, 20%; 30–39, 45%; 40–49, 30%; 50 and over, 2%.

Degree of Dyspnoea.—It is most important that this symptom be recorded accurately. A satisfactory method of assessing breathlessness was found by questioning the patient carefully on the performance of several everyday activities—for example, "How far can you walk on level ground before requiring to stop because of shortness of breath?" "How many steps can be climbed before breathlessness necessitates a stop?" Can the patient cope with all, or part, of her housework—for example, scrubbing, polishing, washing, carrying purchases, etc.? Is there any task the patient cannot carry out because of breathlessness? Does paroxysmal nocturnal dyspnoea occur, and how many pillows are required at night? These findings were noted before operation in most of the patients in this series, and the same questions were asked at the follow-up review in order that some general idea of improvement or otherwise could be gained.

Other Findings.—A history of respiratory infections, haemoptysis, chest pain, palpitations, and oedema was sought and compared with the presence or absence of those symptoms after operation.

Physical Signs.—The presence or absence of cyanosis, the quality of the pulse, apex beat, heart sounds, and murmurs were noted pre- and post-operatively and compared. In all patients chest x-ray examinations, screening, E.C.G. recordings, full blood counts, and blood culture were carried out before operation.

Auricular Appendage Biopsy Results.—Accepting the finding on histological examination of poorly or well formed Aschoff bodies as a positive biopsy, we found that 58% of the entire series came into this category.

The E.S.R. (Westergren) was carried out at some time in the week preceding operation and correlated to the auricular biopsies obtained at operation. It was found that in spite of the histological evidence of rheumatic carditis the E.S.R. may be normal in about 80% of the positive-biopsy group in which data are available. The presence of a positive biopsy bore no relation to the prognosis. This finding is in agreement with that of Goodwin *et al.* (1955).

Evaluation of the "Opening Snap."—The opening snap is usually indicative of a pliant, diaphragmatic type of valve (Sellors *et al.*, 1953). In most cases this was certainly true, but it is interesting to note that in 56 instances where a funnel valve was present an opening snap was heard before operation. In 28 of these the deformity was considerable and 10 showed moderate calcification.

Operative Technique and Findings

In the first 150 patients of the series the valvotomy was performed through the left atrial appendage, using the index finger, or in some cases Brock's knife, to achieve the split. Since August, 1957, a Tubbs dilator has been employed in 71 cases by the transventricular route.

Estimation of Valve Size.—If the forefinger could be passed into the valve orifice but the finger was tightly gripped by the valve, then the opening was adjudged to be just over 2 cm.; if the finger lay freely in the valve opening it was assessed at 2.5 cm.; if there was free mobility of the finger backwards and forwards within the valve it was regarded as fully 3 cm. in length, and, depending on the freedom of finger movement within the opening, 3.5 to 4.5 cm. This method of estimating the size of the valve is relatively accurate,

since all estimations were carried out by the same surgeon. The valve sizes before and after operation are shown in Table I. The much superior split achieved by the dilator is readily appreciated. It will be seen that 98.6% of dilator cases had a final valve size of 3.5 cm. or more. In the finger/knife series only 16.6% achieved a split of 3.5 cm. or more (Table I).

TABLE I.—Pre- and Post-operative Valve Diameters

Valve Diameter	Finger Knife (150)		Dilator (71)	
	Pre-operative	Post-operative	Pre-operative	Post-operative
0.5 cm. or less	17	—	11	—
1 cm.	80	—	30	—
1.5 "	36	1	21	—
2 "	9	20	6	—
2.5 "	4	56	1	—
3 "	—	48	1	1
3.5 "	3	22	1	12
4 "	1	2	—	24
4.5 "	—	1	—	34

Presence of Thrombus.—Thrombus was present in 33% of cases and varied in size from small adherent to free ball thrombus. In four cases thrombus in the atrium or appendage caused fatal operative emboli.

Calcification.—Calcification of the valve was present in 38%. It varied from subendocardial nodularity to gross spicule formation. In general the more severe the calcification the less satisfactory the split. This was certainly true in the finger/knife group. When the dilator was used calcification did not prevent a satisfactory split in the great majority of cases; indeed, no such case had a split of less than 3.5 cm. There was one instance of operative death due to calcific embolism.

Degree of Regurgitation Pre- and Post-operatively.—Mitral incompetence at operation was classified as slight, moderate, or marked. The commonest site was at the posterior commissure. In assessing the degree of incompetence with the finger, after valvotomy, one must bear in mind that the force of contraction of the heart may be diminished owing to the operative intervention; consequently the true magnitude of the regurgitant jet may not be accurately estimated. The cases with regurgitation are classified in Table II. There

TABLE II.—Pre- and Post-operative Regurgitation

	Slight	Moderate	Severe	Total
Pre-dilator series (150):				
Before operation ..	23 (15.3%)	5 (3.3%)	3 (2%)	31 (20.6%)
After ..	37 (24.6%)	10 (6.6%)	3 (2%)	50 (33.2%)
Dilator series (71):				
Before operation ..	9 (12.6%)	3 (4.2%)	1 (1.4%)	13 (18.2%)
After ..	23 (32.4%)	7 (9.9%)	1 (1.4%)	31 (43.7%)

is a greater tendency to regurgitation after the use of the dilator. This risk must be accepted if one is to achieve a larger split in a high percentage of cases. The regurgitation is nearly always slight in extent, and it has been shown that such small degrees of incompetence are clinically insignificant and at the most may produce an audible systolic murmur. In time most of them tend to diminish, and many become non-existent (Bailey, 1959; Mason, 1960). Table II shows that the production of moderate or severe incompetence is no more likely to follow the use of the dilator.

Mortality

Operative Deaths.—There were 14 deaths in the finger/knife series and five in the dilator series (Table III). All deaths from haemorrhage occurred in the early cases and resulted from the difficulties

TABLE III.—Operative Deaths

	Finger/Knife Series (14)	Dilator Series (5)
Haemorrhage	4	1
Congestive cardiac failure ..	4	—
Embolus:		
Cerebral	4	1
Aortic bifurcation	1	—
Sudden death 14th post-operative day	1	—
Torn cusp	—	3

associated with a small, friable, or awkward appendage. No death from post-operative haemorrhage occurred. One-third of the deaths were due to embolus. The complication of torn cusp was due to unawareness that the instrument should not be used, at least in the first attempt, to its maximum capacity. This error occurred in the early cases, and there have been no deaths from torn cusp in the last 50 valvotomies; for this reason regurgitation due to torn cusp has not been included in Table II.

Late Deaths.—There were 15 late deaths, all in the pre-dilator group; details are given in Table IV. Five patients were found to be suffering from moderate or

TABLE IV.—Details of Late Deaths

Cause of Death	Contributing Factors	Time after Operation
Cong. card. failure ..	Mitral incompetence	Within one year
" " " ..	" "	
" " " ..	" "	
Cerebral embolus ..	Thrombus in auricle	During second year
Cancer of colon ..	—	
Cong. card. failure ..	Mitral incompetence	
Cong. card. failure ..	Mitral incompetence	During fourth year
" " " ..	?	
Cerebral embolus ..	Thrombus in appendage	
Cong. card. failure ..	?	During sixth year
Cong. card. failure ..	?	
" " " ..	Mitral regurg. and tri-	
" " " ..	cuspid incompetence	During seventh year
" " " ..	Severe mitral stenosis	
" " " ..	at necropsy	
Cerebral embolus ..	Thrombus in appendage	During eighth year

severe mitral incompetence and should not have been operated on—four died within the first two years and the fifth during the seventh year. Two had incompetence, inadvertently induced during the valvotomy. One case restenosed and would have benefited from reoperation.

Results

All patients were questioned and examined by two observers. The follow-up sheet was substantially the same as the pre-operative form, but note was taken of such features as pregnancies since operation, earning ability, digitalis requirements, and the patient's own assessment of the operative result.

From the facts discovered at the follow-up the examiner classified the results as excellent, very good, good, slight improvement, no improvement, or worse. In most cases the patient's assessment and the examiner's were in agreement. No case with fibrillation was accepted as excellent. In a few instances the examiner's assessment was a grade lower than the patient's. The results recorded here are based on the examiner's assessment.

TABLE V.—Results of Mitral Valvotomy in 100 Patients After Six Months and After Four to Nine Years

Time of Assessment	No Improvement	Slight Improvement	Good	Very Good	Exc.	Dead	Re-op.
6 months ..	4	3	18	47	24	4	—
4-9 years* ..	3	6	18	30	14	13	14

* Two cases not traced.

Results in First 100 Cases.—In these, the pre-dilator series, the results at the end of six months had fortunately been carefully recorded. An attempt has been made to compare the early results with the results after four years or more. Comparison of the assessment at six months with the final assessment shows a distinct move towards a less satisfactory category. At six months 89% are in the good, very good, or excellent category, but at the end of four to nine years only 62% are still in this group.

Results in Entire Series.—The ultimate result of any operative treatment cannot be assessed until after the passage of a long time. One must therefore be content to review cases from time to time and hope that worthwhile conclusions can be drawn from such observations. With this in mind the results of the whole series were assessed during the space of a few weeks, and an attempt has been made to correlate the result to the size of split achieved at operation. The time interval between assessment and date of operation varied from six months to nine years (Table VI). With a split of 2 cm.

TABLE VI.—Final Assessment (Six Months to Nine Years) of 202 Patients* Surviving Operation Compared with Size of "Split" in Finger/Knife and Dilator Series

Split cm.	Worse or No Improvement	Slight Improvement	Good to Excellent	Reoperation	Late Death
4 cm. + ..	—	—	6	—	—
3 " + ..	—	—	38	1	—
2 " + ..	2	1	54	9	4
1 " + ..	1	5	49	10	8
0-1 cm. ..	—	2	6	1	3

* Two cases not traced.

or more 85.2% of the cases were in the good to excellent grade. When the split was less than 2 cm. only 64.7% were regarded as good to excellent. Similarly, 26.7% of the late deaths occurred in cases with a split of 2 cm. or more, while 73.3% of the late deaths were in patients with a split of under 2 cm. Of the 121 survivors of the pre-dilator series 89 (73.5%) were in the good to excellent category after three to nine years. All 66 survivors of the dilator series were in the good to excellent category after six months to three years.

Effect of Auricular Fibrillation on Results.—There is a higher operative mortality and less chance of a satisfactory result in cases with pre-operative auricular fibrillation than in those in sinus rhythm (Table VII).

TABLE VII.—Results at Six Months to Nine Years Related to Pre-operative Rhythm (221 Patients*)

	Mortality		Worse	No Improvement	Slight Improvement	Good	Very Good	Exc.
	Operative	Late						
Sinus rhythm 166 cases (75.8%) ..	5.4%	7.2%	0.6%	1.8%	8.4%	12%	28.4%	36.2%
Fibrillation 53 cases (24.2%) ..	18.8%	7.5%	1.9%	—	5.7%	19.8%	46.3%	—

* Two cases not traced.

The operative mortality in cases with pre-operative fibrillation is 18.8% compared with 5.4% for those in sinus rhythm. Furthermore, 66.1% of cases with fibrillation are assessed in the category good to excellent compared with 76.6% of cases in sinus rhythm. These findings are in agreement with other published series (Baker *et al.*, 1955; Diveley *et al.*, 1958). It is noteworthy that fibrillation does not seem to be a major

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.