Syphilitic aortic regurgitation

An appraisal of surgical treatment

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Summary

During the 10 years from 1964 to 1973, fifteen patients with severe syphilitic aortic regurgitation were treated surgically at the National Heart Hospital. In thirteen the valve was replaced and in two it was repaired. In addition four had replacement of an aneurysmal ascending aorta with a Dacron graft and seven some form of plastic repair to the coronary ostia. Three patients died within 1 month of surgery and a further six during the follow-up period which varied from 1 to 55 months (mean 25.5). The six survivors have been followed-up for an average of 33 months.

Factors contributing to this high mortality were analysed and it was found that the mean duration of effort dyspnoea was 22 months in the survivors compared with 48 months in those who had died. Similarly the average duration of nocturnal dyspnoea was 4 months in the survivors compared with a mean of 8 months in those who had died. Only six out of the fifteen patients had angina; this was present in two of the survivors and in four of the fatalities. The pulse pressure, heart size, and haemodynamic findings were similar in the two groups. The prognostic value of an elevated erythrocyte sedimentation rate was also examined.

It was concluded that preoperative investigations should include aortography, coronary arteriography, an assessment of left ventricular function, and whenever possible myocardial biopsy.

These data were interpreted as suggesting that patients should be referred for surgery at an earlier stage in the disease—certainly before the onset of cardiac failure—and that if this more aggressive attitude was adopted, as it has been in non-syphilitic cases of aortic valve disease, the present high mortality in this group would be reduced.

Introduction

Campbell and Shackle (1932) reported that 19 per cent. of all cases of aortic valve disease were due to syphilis. Since then there has been a dramatic reduction in the incidence of cardiovascular syphilis due both to public health measures and to the introduction of penicillin therapy (Koulumies and Heinivaara, 1957). The natural history of cardiovascular syphilis has also changed; the disease has become more benign and cardiac complications less common, and the prognosis, even in untreated cases, is now relatively good. Heart failure due to syphilis used to be seen between the ages of 30 and 50 years. Now this complication is uncommon and tends to occur a decade later (Prewitt, 1970).

A proportion of syphilitic patients still develop heart disease, which includes syphilitic aortitis, with or without aneurysms of the ascending aorta, aortic regurgitation, and coronary ostial stenosis. The advent of open heart surgery has increased the available treatment, particularly for those with aortic regurgitation with or without coronary ostial stenosis. In spite of this surprisingly few cases of aortic regurgitation due to syphilis have been treated surgically (Michaud, Termet, Chassignolle, Dalloz, Agé, Delaye, du Grés, and Champsaur, 1970; Samaan, 1973).

In this report we review fifteen cases from the National Heart Hospital in which aortic valve replacement (13) or repair (2) was undertaken for severe syphilitic aortic regurgitation.

Material

Between the beginning of 1964 and the end of 1973 a total of 850 patients had an aortic valve repair or replacement at the National Heart Hospital. Fifteen (1.8 per cent.) of these had syphilitic aortic regurgitation. Seven were male and eight female. The age at operation varied from 33 to 60 years (mean 52). The postoperative follow-up period ranged from 1 to 55 months (mean 25.5). All had clinical evidence of severe aortic regurgitation.

A syphilitic aetiology was accepted on the following grounds. In all cases the macroscopic appearance of the ascending aorta at operation was compatible with syphilis. Twelve had positive results to serological tests (WR and VDRL), in nine of these histology of the aorta was

available and changes compatible with syphilis were present in eight. In all three cases with negative serological tests, the histology of the aortic wall was available and confirmed the diagnosis of syphilis (Table I). A history of primary syphilis was obtained in only three (Cases 10, 12, and 14) and in each of these infection occurred when the patient was in the late 'teens. Case 12 was of particular interest, syphilitic aortic regurgitation was diagnosed, and serology was positive, but histology of the aorta was not available. The aortic valve was successfully replaced but 30 months later the patient developed acute dissection of the ascending aortic and died after an operation. *Post mortem* histological examination of the aorta showed medionecrosis in addition to the changes of syphilis, a rare combination but one previously reported by Heggveit (1964).

TABLE I Criteria for the diagnosis of syphilitic aortitis

Case no.	Serology	Aorta	
		Macroscopic	Microscopic
1	+	+	— ^a
2	Neg	+	+
3	+	+	+
4	Neg	+	+
5	+	+	+
6	+	+	+
7	+	+	+
8	+	+	+
9	Neg	+	+
10	+	+	— ^a
11	+	+	— ^a
12	+	+	Neg
13	+	+	+
14	+	+	+
15	+	+	+
No. positive	12/15	15/15	11/12

^aHistology of valve only

Results

With the exception of one patient (Case 4) who was asymptomatic, all had severely limited exercise tolerance with evidence of heart failure. Fourteen of the fifteen had effort dyspnoea with a mean duration of 40 months (range 2 to 162), twelve had nocturnal dyspnoea with a mean duration of 7 months (range 1 to 24), and six had angina with a mean duration of 44 months (range 1 to 144).

Evidence of severe aortic regurgitation included an increased pulse pressure and cardiomegaly. All were in sinus rhythm, except Case 1 who had atrial fibrillation; the mean pulse pressure was 109 mm Hg (range 80 to 150); and the mean cardiothoracic ratio in the fourteen patients who had a preoperative chest radiograph was 59 per cent. (range 50 to 70). Pre-operative haemodynamic data were obtained in eleven patients, in whom the mean pulmonary artery pressure was 27 mm Hg (range 14 to 47) and the mean left ventricular end diastolic pressure was 20 mm Hg (range 5 to 38). There was inadequate information for a detailed study of left ventricular

function; only six patients had a left ventriculogram but in others the degree of reflux into the left ventricle from the aortogram gave some information. All appeared to have severe left ventricular dysfunction in keeping with their symptoms and the raised left ventricular diastolic pressure. Coronary arteriography was available in three (Cases 5, 7, and 10); in two it was normal, but in Case 7 stenosis of both coronary ostia was shown. In a further six patients who did not have preoperative coronary arteriography, ostial stenosis was noted at the time of operation and in an additional two patients there was slight thickening of the intima around the coronary ostia without stenosis. No myocardial biopsies were taken.

The preoperative erythrocyte sedimentation rate (Westergren) was available in fourteen patients and was elevated in thirteen; the mean reading was 47 mm/hr (range 5 to 120). In the three patients with positive serological results who had not been treated with penicillin, the mean ESR was 106 mm/hr (range 90 to 120) compared with a mean of 36 mm/hr (range 10 to 90) in the eight patients with positive serological results who had received penicillin therapy (usually procaine penicillin 600,000 units daily for 10 days) within the 12 months before surgery. Three patients with negative serological results who had not had any antibiotic treatment had a mean ESR of 19 mm/hr (range 5 to 37).

In two patients the aortic valve was repaired and in thirteen it was replaced, a Starr-Edwards prosthesis being used in ten, a Bjork-Shiley in two, and a frame-mounted fascia lata valve in one (Ionescu, Ross, Deac, Grimshaw, Taylor, Whitaker, and Wooler, 1970). In addition four had replacement of the ascending aorta with a dacron graft, seven had surgery to the coronary ostia and one had both (Table II).

The operative mortality (death within one month of surgery) was 20 per cent. (3 patients) and the late mortality 40 per cent. (6 cases), making a total mortality of 60 per cent (Table III). Of the seven patients who had surgical treatment before January, 1972, six died, whereas after that date there were only three deaths. Two of the three operative deaths occurred in the earlier period. Thus there was some evidence to suggest that increasing experience reduced the mortality. *Post mortem* examinations were obtained in six cases but information on the coronary arteries was available in only two (Cases 12 and 15).

Discussion

The outstanding and disturbing feature in these surgically treated cases of syphilitic aortic regurgitation was the operative mortality of 20 per cent. and late mortality of 40 per cent. at a time when the mortality for aortic valve replacement in non-syphilitic cases at the National Heart Hospital was

TABLE II *Types of aortic prosthesis used and additional operative procedures to the ascending aorta and coronary ostia*

Case no.	Valve ^a	Aorta	Coronary arteries
1	S.E	—	—
2	S.E	Dacron graft	—
3	S.E	—	—
4	S.E	Dacron graft	—
5	B-S	—	—
6	B-S	—	—
7	Repair	Endarterectomy	Endarterectomy
8	S.E	Dacron graft	Endarterectomy
9	Repair	—	Patch angioplasty
10	F.L	—	Patch angioplasty
11	S.E	—	Dilatation
12	S.E	—	—
13	S.E	—	Endarterectomy
14	S.E	Dacron graft	—
15	S.E	—	Endarterectomy

^aS.E = Starr-Edwards; B-S = Bjork-Shiley; F.L = Fascia lata

TABLE III *Surgical procedures, time, and cause of death in the nine patients who died*

Case no.	Surgical procedure	Interval before death	Cause
15	S.E C.O.S	10 days	*Gangrene of bowel ? Embolus
10	F.L C.O.S	10 days	Cerebral embolus
8	S.E C.O.S A.G	14 days	*Septicaemia Coliform organism
11	S.E C.O.S	4 mths	*Sudden death Valve obstruction
13	S.E C.O.S	7 mths	Sudden death ? Cause
7	Repair C.O.S A.E	8 mths	*B.E Coag. neg. <i>Staph.</i>
14	S.E A.G	27 mths	*B.E <i>Staph.</i>
12	S.E	30 mths	*Aortic dissection
9	Repair C.O.S	36 mths	Cardiac failure A.R

S.E = Starr-Edwards; F.L = Fascia lata; C.O.S = Coronary ostia surgery; A.G = Aortic graft; A.E = Aortic endarterectomy; B.E = Bacterial endocarditis; A.R = Aortic regurgitation.

^aConfirmed at necropsy

not higher than 13 per cent. and is currently 3 per cent. Over the same period the late mortality, including the early cases operated on in 1963, has not exceeded 24 per cent.

Part of the explanation for the high mortality became evident when data from the six survivors (Cases 1 to 6) was compared with that from the nine who had died (Cases 7 to 15). Regarding symptoms, all except one (Case 4) were severely limited by

dyspnoea, but in the survivors the mean duration of effort dyspnoea was 22 months (range 0–60) compared with a mean of 48 months (range 2 to 162) in those who had died. Similarly, the average duration of nocturnal dyspnoea in the survivors was 4 months (range 0 to 6) compared with a mean of 8 months (range 0 to 24) in those who had died. Only six of the fifteen patients had angina, which occurred in two of the survivors and in four of those who died (Table IV).

TABLE IV *Comparison of symptoms in the six survivors and nine fatalities*

Fate	Case no.	Duration of symptoms (mths)		
		Effort dyspnoea	P.N.D.	A.P.
Alive	1	12	1	—
	2	6	6	6
	3	24	—	—
	4	—	—	—
	5	6	6	—
	6	60	2	60
	Average	22	4	—
Dead	7	144	24	144
	8	18	3	—
	9	48	2	48
	10	18	15	6
	11	12	12	1
	12	24	—	—
	13	2	2	—
	14	24	1	—
	15	162	6	—
	Average	48	8	—

P.N.D = Paroxysmal nocturnal dyspnoea; A.P = Angina pectoris

The physical findings, chest radiograph, and haemodynamic state as assessed from the pulmonary artery pressure and left ventricular end diastolic pressure did not differ significantly in the two groups, although in the three survivors for whom data were available the mean left ventricular end diastolic pressure was 11 mm Hg (range 5 to 16) compared with 24 mm Hg (range 5 to 38) in those who died. A high ESR appeared to be a bad prognostic sign. In those who survived the mean ESR was 25 mm/hr (range 5 to 56) compared with a mean of 60 mm/hr (range 10 to 120) in those who died (Table V).

Leonard and Smith (1957) reported that the prognosis in patients with symptoms of heart failure treated medically was poor with a 15 per cent. survival at 5 years and a mean survival time after the onset of cardiac failure of 18 months. Comparing our data with these findings and accepting that the onset of effort dyspnoea in the presence of severe aortic regurgitation was a manifestation of heart failure, in both groups the duration of symptoms exceeded the mean expected survival time quoted by the above authors.

TABLE V Comparison of erythrocyte sedimentation rate, pulse pressure, cardiothoracic ratio, and haemodynamic findings in the six survivors and nine fatalities

		Objective findings				
Fate	Case no.	ESR (mm/hr)	Pulse pressure (mm/Hg)	C.T.R	P.A.P (mm/Hg)	L.V.E.D.P (mm/Hg)
Alive	1	—	110	—	—	—
	2	15	125	67	16	12
	3	29	130	65	—	—
	4	5	120	52	31	16
	5	20	90	55	25	5
	6	56	100	56	—	—
Average		25	112	59	24	11
Dead	7	25	100	50	14	5
	8	90	135	62	47	35
	9	37	100	64	—	—
	10	120	150	52	18	22
	11	25	80	70	30	20
	12	10	80	53	28	25
	13	110	110	64	22	30
	14	36	110	56	45	38
	15	90	100	57	16	15
Average		60	107	59	28	24

ESR = Erythrocyte sedimentation rate; C.T.R = Cardiothoracic ratio; P.A.P = Pulmonary artery pressure; L.V.E.D.P = Left ventricular end diastolic pressure

The duration of symptoms is not the sole factor influencing mortality, but our information on other parameters is incomplete—particularly left ventricular function. In syphilitic aortic regurgitation there are at least three factors which may impair left ventricular function:

- The degree of reflux, which in all our cases was severe.
- The degree of coronary ostial stenosis and the state of the coronary arteries. In only three of the patients were coronary arteriograms obtained before surgery; these were normal in two and showed coronary ostial stenosis in the third. Coronary ostial stenosis however was found at surgery in a further six patients and in an additional two there was slight thickening of the intima around the coronary ostia without stenosis. Endarterectomy was performed in four, patch angioplasty in two, and dilatation of the ostia in one. None of these patients was a long-term survivor.
- The possibility of a syphilitic myocarditis, although previously considered rare (Ince and Mahabir, 1974), has to be reconsidered and with the increasing use of left ventricular myocardial biopsies this information should not be difficult to obtain (Brooksby, Jenkins, Coltart, Webb-Peploe, and Davies, 1974). In this context Case 14

was of particular interest, for after successful replacement of the aortic valve with a Starr-Edwards prosthesis and replacement of an aneurysmal ascending aorta with a dacron graft, the patient developed progressive cardiomegaly and first-degree heart block with left bundle branch block 18 months after surgery. The coronary ostia appeared normal at surgery, but there was no pre- or postoperative coronary arteriogram. The patient died from infective endocarditis 27 months after operation. Although a *post mortem* examination was obtained, there was no information on the coronary arteries and no histological examination of the myocardium.

We have inadequate data to make any valid correlations between angina, coronary ostial stenosis, coronary artery disease, and the degree of elevation of the ESR. Perhaps, however, it should be noted that, of the ten patients in whom coronary ostial stenosis or slight thickening of the intima around the coronary ostia was found at operation, five had angina, whereas of the five patients with normal coronary ostia only one had angina. The coronary arteries themselves were normal in the three patients (Cases 5, 7, and 10) who had preoperative coronary arteriography, but in one of these (Case 7) ostial stenosis was demonstrated angiographically. The technique of selective coronary arteriography is such, however, that ostial stenosis, even of moderate severity, can be missed as the catheter is introduced into the proximal part of the artery. The ten patients with ostial stenosis had a mean ESR of 65 mm/hr (range 25 to 120) compared with a mean ESR of 16 mm/hr (range 5 to 29) in those with normal ostia, but in the former group six had had treatment with penicillin compared with three in the latter group; this makes it impossible to correlate the elevation of the ESR with coronary ostial stenosis although it is conceivable that adequate penicillin treatment given early in the disease might prevent this complication. *Post mortem* data of the coronary arteries were limited to two patients (Cases 12 and 15). The coronary arteries were normal in one and showed generalized atheroma with calcified plaques in the other.

Reviewing the causes of death (Table III), there did not appear to be anything in the syphilitic aetiology itself to account for the high mortality. Although none of the patients who had any form of coronary surgery (endarterectomy, patch angioplasty and ostial dilatation) was amongst the six long-term survivors, there was no indication that these techniques contributed to either the operative mortality or the late deaths. A study of the pre- and post-operative electrocardiograms showed no evidence of intraoperative myocardial damage. On theoretical grounds saphenous vein bypass grafts should be satisfactory for relieving syphilitic ostial stenosis, and

since the close of this series one case, similar to those reported here, has been successfully treated (J.P.) with a combination of aortic valve replacement and a saphenous vein graft for left coronary ostial stenosis.

It is concluded that aortic valve replacement correctly timed is probably the best treatment for severe syphilitic aortic regurgitation and that cases should be referred for operation before the onset of cardiac failure. This view is supported by the poor prognosis with medical treatment.

In the past too much attention has been given to the degree of aortic regurgitation and insufficient attention to left ventricular function, coronary ostial stenosis, and the state of the coronary arteries. Pre-operative investigations should include aortography, coronary arteriography, an assessment of left ventricular function, and possibly myocardial biopsy. The present series is too small to determine the place of preoperative penicillin. The operative procedure in these cases may not be confined to aortic valve replacement but may include resection of an aneurysmal ascending aorta and repair, disobliteration, or bypassing of the coronary ostia. The postoperative course in the six long-term survivors (average follow-up 33 months) surpasses anything that can be achieved with medical treatment alone and earlier referral for surgery should reduce the present high mortality.

Appendix

Case reports

Case 1, a 58-year-old white female with a 1-year history of effort dyspnoea, presented in 1971 with heart failure. Clinically she had aortic regurgitation. The Venereal Diseases Reference Laboratory (VDRL) test was positive, Reiter protein complement-fixation (RPCF) test positive, fluorescent treponemal antibody (absorbed) (FTA-Abs) test positive. She was given a course of penicillin. One month later she developed cardiorespiratory arrest and was transferred to the National Heart Hospital (NHH) for emergency surgery. She had gross pulmonary oedema with atrial fibrillation and was already on a ventilator. The electrocardiogram (ECG) showed left ventricular hypertrophy and right bundle branch block. At operation (25.3.71), which was carried out without a detailed haemodynamic assessment, there was gross aortic regurgitation from prolapse of the right coronary cusp. The other two cusps appeared normal. There was slight dilation of the ascending aorta and both coronary ostia were small. The aortic valve was replaced with a No. 10 composite seat Starr-Edwards prosthesis. Postoperative progress was uneventful apart from Klebsiella pneumonia which was treated with penicillin and she remains well with a competent aortic valve 4 years and 7 months after surgery.

Histological examination of the aortic valve cusps

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showed fibrous thickening with distinct rolling of the free margins. Histology of the aortic wall was not available.

Case 2, a 57-year-old white female presented in January 1972 with a 6-month history of paroxysmal dyspnoea, effort dyspnoea, and angina. Clinically there was severe aortic regurgitation. The VDRL, RPCF, FTA-Abs, treponemal immobilization (TPI) tests were all negative, but a chest radiograph showed cardiac enlargement with a dilated calcified ascending aorta and the electrocardiogram indicated left axis deviation and left ventricular hypertrophy with strain. Aortography showed severe aortic regurgitation with aneurysmal dilatation of the ascending aorta. At operation (24.3.72) the aneurysm of the ascending aorta and the dilated aortic root were confirmed. The coronary ostia were normal. The valve and ascending aorta were replaced using a No. 10 Starr-Edwards prosthesis and a 35 mm Dacron graft. The post-operative course was uneventful and the patient has remained well with minimal effort dyspnoea for the last 3 years. Histology of the aorta confirmed the presence of syphilis and the aortic cusps were normal.

Case 3, a 52-year-old white male, presented in September 1972 with a 2-year history of effort dyspnoea.

He had been given a course of penicillin for syphilitic aortic regurgitation 6 months previously. Clinical examination showed severe aortic regurgitation. The Wassermann reaction (WR), and the RPCF and FTA-ABS tests were positive. A chest radiograph showed cardiac enlargement with dilatation of the aorta and the ECG indicated left atrial hypertrophy and left ventricular hypertrophy with strain. Aortography confirmed aortic regurgitation. On 29.9.72 the VDRL test was positive 1:128, and the RPCF and FTA-ABS tests were positive. At operation (6.10.72) there was a dilated ascending aorta with thin valve cusps and normal coronary ostia. The valve was replaced with a No. 11 Starr-Edwards prosthesis. The post-operative course was uneventful and the patient has remained well with minimal effort dyspnoea for the last 2 years and 9 months. Histology of the aorta confirmed the presence of syphilis.

Case 4, a 56-year-old asymptomatic white male, was referred for assessment of a heart murmur discovered at routine medical examination. Clinically there was severe aortic regurgitation, a chest radiograph showed cardiac enlargement with a prominent ascending aorta, and the electrocardiogram left axis deviation, left atrial hypertrophy, and left ventricular hypertrophy with strain. Syphilis was not suspected, and the serology was not checked until after the operation, when the VDRL and FTA-ABS tests were negative and the RPCF test doubtful. At operation (17.5.73), there was aortic regurgitation with thickened and slightly shortened valve cusps. The ascending aorta showed aneurysmal dilatation and the coronary ostia were normal. The valve was replaced by a No. 10 Starr-Edwards prosthesis and the aorta by a 30 mm Dacron graft. The postoperative course was uneventful and the patient has remained well for 2 years but has essential hypertension (205/110). Histology of the aorta confirmed a syphilitic aetiology.

Case 5, a 57-year-old white female known to have a systolic murmur, developed infective endocarditis and heart failure in 1973. Blood cultures grew *Streptococcus viridans*. Subsequently there was clinical evidence of aortic and mitral regurgitation. She was given a 6-week course of penicillin, and the blood cultures became negative but cardiac failure persisted. A chest radiograph showed cardiac enlargement with calcification of the ascending aorta and the ECG showed first-degree heart block and indicated left ventricular hypertrophy with strain. Syphilis was not suspected, but after operation serological tests showed VDRL positive 1:16 and FTA-ABS positive. Cardiac catheterization, left ventricular angiography, and aortography confirmed severe aortic regurgitation and moderate mitral regurgitation. Coronary arteriograms were normal. At operation (3.10.73) each aortic cusp was perforated and there was a 6 mm perforation in the anterior cusp of the mitral valve. The ascending aorta was calcified and the coronary ostia were normal. The aortic valve was replaced with a 21 mm Bjork-Shiley prosthesis and the mitral valve repaired. The postoperative course was uneventful and the patient has remained well for 2 years. Histology of the aorta confirmed the presence of syphilis.

Case 6, a 50-year-old white male with a 5-year history of effort dyspnoea and angina, presented in 1973 with left ventricular failure of 2 months' duration. In 1955 he had developed a urethral discharge and the WR was then negative. When he developed heart failure the WR was positive. Subsequently he was given a course of penicillin. Clinically, there was severe aortic regurgitation. The chest radiograph showed cardiac enlargement with calcification of a dilated ascending aorta and the ECG indicated left ventricular hypertrophy with strain. Haemodynamic studies were not performed. On 24.9.73 serological tests were positive (VDRL 1:16, TPHA, FTA-ABS) and he was given a further course of procaine penicillin 600,000 units daily for 21 days before surgery. At operation (10.10.73) there was aortic regurgitation with thickened and shortened valve cusps. The ascending aorta was calcified and showed changes typical of syphilitic aortitis, the right coronary ostium could not be located, and the left was obscured by calcium in the aortic sinus. The valve was replaced with a 21 mm Bjork-Shiley prosthesis using left coronary perfusion. The post-operative progress was uneventful and the patient has remained well with no symptoms for 2 years. Histology of the aorta confirmed the presence of syphilis.

Case 7, a 57-year-old white female originally presented in 1951, 12 years before operation, with angina and effort dyspnoea. Syphilitic aortic regurgitation was diagnosed (WR and Kahn test positive) and she was given a course of penicillin. Left ventricular failure developed in 1963, one year before surgery. Clinically, there was severe aortic regurgitation and cardiac failure. The WR and TPI test were positive, and the RPCF test weakly positive. A chest radiograph showed an enlarged heart with a calcified ascending aorta and the ECG showed moderate left ventricular hypertrophy. Cardiac catheterization and aortography confirmed severe aortic regurgitation and coronary arteriography showed partial occlusion of the left coronary ostium but failed to demonstrate a right coronary ostium or right coronary artery. At operation (3.4.64) there was aortic regurgitation with thickening of the aortic cusps. The aorta was calcified and the macroscopic appearances were compatible with syphilis. Neither coronary ostium was visualized. The aortic valve was reconstructed using a pericardial patch, and a left and right coronary endarterectomy was performed. The symptoms improved but signs of moderate aortic regurgitation persisted postoperatively. She was given crystalline penicillin 1 m.u. 6-hrly for 10 days, but 3 months after surgery she developed coagulase-negative staphylococcal endocarditis and died. Surgical and *post mortem* histology of the aorta confirmed the presence of syphilis. There was no information on the state of the coronary arteries.

Case 8, a 33-year-old white female presented in 1965 with a 3-month history of paroxysmal dyspnoea preceded by effort dyspnoea for 15 months. The WR was positive, syphilitic aortic regurgitation was diagnosed, and she was given a course of penicillin. Clinically there was severe aortic regurgitation with cardiac failure. The chest radiograph showed a large heart with pulmonary oedema and the ECG indicated left ventricular hypertrophy with strain. In October 1966 the WR was positive 1:320, and

the VDRL and TPI tests were positive. Cardiac catheterization confirmed severe aortic regurgitation in addition to mild mitral regurgitation and pulmonary hypertension. Before surgery peritoneal dialysis was carried out for intractable cardiac failure, but she did not respond. At operation (30.1.67) there was aortic regurgitation with thickening of the aortic wall extending into the valve cusps. The valve was replaced with a No. 9 Starr-Edwards prosthesis after the outflow tract had been enlarged by the insertion of a Dacron patch. Endarterectomy of the left coronary ostium was also performed. Postoperatively she was in low output cardiac failure and developed a coliform septicaemia. She died 2 weeks after surgery during haemodialysis for renal failure. Surgical and *post mortem* histology of the aorta confirmed the presence of syphilis. There was no information on the state of the coronary arteries.

Case 9, a 51-year-old female with a 4-year history of effort dyspnoea and angina, presented early in 1967 with paroxysmal nocturnal dyspnoea and congestive heart failure. Clinically there was moderate aortic regurgitation. A chest radiograph showed a large heart with a dilated and calcified ascending aorta and the ECG showed left bundle branch block and left ventricular hypertrophy. On 18.4.67 the WR, Kahn test, and RPCF test were negative. Serology was negative. Aortography confirmed an aneurysm of the ascending aorta with moderate aortic regurgitation. At operation (21.4.67) there was aortic regurgitation with normal valve cusps and a dilated ascending aorta with macroscopic appearances compatible with syphilis. The right coronary ostium was reduced to a pinhole but the left was normal. The valve was repaired with three 'x'-sutures to elevate the commissures and the right coronary artery was repaired with a pericardial patch. There was no improvement after operation and both the aortic regurgitation and heart failure persisted. In February 1968 she was given procaine penicillin 600,000 units daily for 21 days. She died 3 years later having refused a second operation. Histology (surgical material) of the aorta confirmed the presence of syphilis. A *post mortem* examination was not performed.

Case 10, a 55-year-old white male with an 18-month history of effort dyspnoea and a 6-month history of angina, presented in January 1968 with left ventricular failure. He had contracted primary syphilis at the age of 18 years. Clinically there was severe aortic regurgitation. The chest radiograph showed cardiac enlargement with widening of the ascending aorta and the ECG showed left atrial and left ventricular hypertrophy with strain. Aortography confirmed severe aortic regurgitation; the coronary arteriogram was normal. The WR, VDRL, and RPCT tests were positive and he was given a course of 1 m.u. penicillin twice daily for 21 days in January 1968. In July 1969 he was given a preoperative course of procaine penicillin 600,000 units daily for 21 days. At operation (6.8.69) there was aortic regurgitation and the valve cusps were retracted with rolled edges. The left coronary orifice was normal, and the right was partially occluded, but bilateral coronary artery perfusion was possible. The aortic valve was replaced with a fascia lata graft mounted on an Ionescu frame and a right coronary patch angioplasty was performed. Postoperatively the patient was

hypotensive and failed to regain consciousness. It was thought that he might have suffered a cerebral embolism. He died 10 days after operation. A *post mortem* examination was not performed. Histology (surgical material) of the valve showed only simple fibrous thickening; the aorta was not examined.

Case 11, a 52-year-old white female, presented in 1968, 2 years preoperatively with a pulsatile swelling in the root of the neck. The WR was positive and syphilitic aortic regurgitation was diagnosed. She was given a course of penicillin lasting 3 weeks. Subsequently she developed cardiac failure and angina with dysphagia thought to be due to compression of the oesophagus from an aortic aneurysm. Clinically there was severe aortic regurgitation. The chest radiograph showed cardiac enlargement with an aneurysm of the ascending aorta and the ECG showed left axis deviation and left ventricular hypertrophy with strain. Aortography confirmed severe aortic regurgitation and diffuse dilatation of the ascending aorta. The VDRL test was positive and she was given a further course of procaine penicillin 600,000 units daily for 21 days before surgery. At operation (11.12.70) there was severe aortic regurgitation with thickening and retraction of the valve cusps. The aorta showed aneurysmal dilatation and there was severe stenosis of the right coronary ostium. The left ostium was normal. The aortic valve was replaced with a No. 9 Starr-Edwards prosthesis. The postoperative course was uneventful, and the patient improved, but died suddenly 4 months after operation. *Post mortem* examination showed that the valve was obstructed by fibrin clot although the patient had been on anticoagulants since operation. Neither the aorta nor the coronary arteries were examined. Histology (surgical material) of the valve showed only fibrous thickening.

Case 12, a 47-year-old white male with a history of urethritis at the age of 19 years, presented in 1971 with a 2-year history of effort dyspnoea. Clinically there was severe aortic regurgitation. The chest radiograph showed cardiac enlargement with dilatation of the ascending aorta and no obvious calcification in the aortic wall. The ECG showed left ventricular hypertrophy. Aortography confirmed severe aortic regurgitation with dilatation of the ascending aorta. The WR and RPCF test were negative, the VDRL test weakly positive, and the FTA-ABS test positive. He was given procaine penicillin 600,000 units daily for 14 days in May 1971. At operation (10.8.71) there was severe aortic regurgitation due to dilatation of the aortic root; the valve cusps were thin. The ascending aorta was diffusely dilated with plaques of calcium in the wall but the coronary ostia were normal. The valve was replaced with a No. 11 Starr-Edwards prosthesis. Histology (surgical material) of the valve showed fibrous rolling; the aorta was not examined.

The patient made satisfactory progress after the operation and improved for 1 year, but then developed recurrent gastro-intestinal haemorrhages due to acute gastric erosions. Investigations also showed polycystic kidneys with impaired renal function. Anticoagulants were stopped for a time but were restarted after he developed multiple cerebral emboli. A pyrexial illness developed 2½ years after operation and a chest radiograph showed widening of the ascending aorta. There was no pain.

Aortography showed aneurysmal dilatation of the ascending aorta. Operation (January 1974) showed a dissection of the ascending aorta; a Dacron graft was inserted but the patient died from haemorrhage. *Post mortem* examination of the aorta showed medionecrosis suggesting Marfan's syndrome. The coronary arteries were normal.

Case 13, a 51-year-old Sri Lankan male, presented 2 months before operation with an attack of acute left ventricular failure followed by effort dyspnoea. There was severe aortic regurgitation and a chest radiograph showed cardiac enlargement with dilatation of the ascending aorta. There was left ventricular hypertrophy on the electrocardiogram. Aortography confirmed severe aortic regurgitation with an aneurysm of the ascending aorta. Syphilis was not suspected and the WR which was positive was not checked until after surgery. At operation (24.4.72) there was severe aortic regurgitation with thin and retracted valve cusps. The aorta was thickened and dilated with appearances typical of syphilis. The aortic valve was replaced by a No. 11 Starr-Edwards prosthesis, and a right coronary ostial endarterectomy was performed. The patient was given procaine penicillin 600,000 units daily for 21 days after the operation. The immediate postoperative course was uneventful but he died suddenly 7 months later. An embolus was suspected, in spite of anticoagulants since the time of operation. A *post mortem* examination was not made. Histology (surgical material) of the aorta confirmed the presence of syphilis.

Case 14, a 51-year-old white male with a 2-year history of effort dyspnoea, developed left ventricular failure in 1972. He had had primary syphilis when aged 19. Clinically there was severe aortic regurgitation. A chest radiograph showed cardiac enlargement with a moderately dilated ascending aorta and the ECG showed left ventricular hypertrophy with strain. Cardiac catheterization and aortography confirmed severe aortic regurgitation with raised left and right heart pressures. The VDRL test was positive 1 : 64 and the RPCF and FTA-ABS tests were also positive. He was given procaine penicillin 600,000 units daily for 21 days before surgery. At operation (28.11.72) there was severe aortic regurgitation with thickening and shortening of the valve cusps. The ascending aorta was aneurysmal and there was slight thickening of the intima at the site of the coronary ostia.

The valve and aorta were replaced with a No. 10 Starr-Edwards prosthesis and a 30 mm Dacron graft. Post-operative progress was initially uneventful and the patient improved. After 18 months there was an increase in heart size confirmed by the chest radiograph and the ECG showed first-degree heart block and left bundle branch block. The patient developed staphylococcal endocarditis and died 27 months after the operation. Histology (surgical material) of the aorta confirmed the presence of syphilis. *Post mortem* examination showed vegetation involving the suture line of the aorta prosthesis. Left ventricular hypertrophy was confirmed but there was no mention of the state of the coronary arteries.

Case 15, a 60-year-old white female, presented in 1959 with effort dyspnoea due to syphilitic aortic regurgitation and was given a course of bismuth. The WR and RPCF test were positive. In April 1973, 6 months before operation, she developed left ventricular failure. There was a past history of duodenal ulcer and hypothyroidism. Clinically she had severe aortic regurgitation; a chest radiograph showed cardiac enlargement with calcification and slight dilatation of the ascending aorta, and the ECG showed left ventricular hypertrophy. Left ventricular angiography and aortography confirmed severe aortic regurgitation and mild mitral regurgitation. The VDRL was positive 1 : 4, the RPCF test negative, and the FTA-ABS test positive. She was given procaine penicillin 600,000 units daily for 21 days before surgery. At operation (8.10.73) there was severe aortic regurgitation with thickened and retracted valve cusps. The aorta was calcified and there was stenosis of the left coronary ostium with a normal right coronary ostium. The valve was replaced with a No. 11 Starr-Edwards prosthesis and a left coronary endarterectomy was performed. Post-operatively renal failure developed followed by ileus and peritonitis. Laparotomy 10 days after the original operation showed a gangrenous bowel from duodenojejunal flexure to rectum. This was thought to be due to emboli although the patient had been on heparin since the valve replacement. Histology (surgical material) of the valve showed slight thickening. A *post mortem* examination of the aorta showed macroscopic and histological evidence of syphilis. The coronary ostia were normal but there was uniform thickening with atheromatous calcified plaques involving all major coronary arteries. None was occluded.