Upsala J Med Sci 81: 167–173, 1976

Acute Myopericarditis

A Long-term Follow-up Study

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ABSTRACT

A follow-up study was made of 29 patients aged 21 to 45 years, some 15–158 months after acute myopericarditis. The mean follow-up period was 72.9 months. The follow-up investigation included recording of history, physical examination, laboratory tests, radiologic examination of the heart and lungs and electrocardiography. All but one of the patients were fit for fulltime work. Nine had residual cardiac symptoms, but the physical examination was negative in all but 2 of them. One patient had chronic cardiac insufficiency and hepatic enlargement. Another had sinus tachycardia and cardiac enlargement of moderate degree and impaired working capacity in relation to heart size. Cardiac murmurs without clinical significance were audible in three cases. The resting ECG was pathologic in only 6 cases. Orthostatic ECG evoked ECG abnormalities in 6 more cases. Exercise tolerance tests showed reduced working capacity in relation to heart volume in 5 of the 29 cases (17%). Four of these 5 patients had cardiac enlargement. There was thus good correlation between increase in heart volume and reduction of physical capacity. The prognosis in regard to cardiac function was good, as was also found in other comparable series in which the observation time was somewhat shorter.

INTRODUCTION

Acute myopericarditis can occur in previously healthy persons in connexion with acute infections of varying aetiology. In many cases the precise aetiology cannot be established (1, 16). In the differential diagnosis cardiomyopathy, ischaemic heart disease, collagenosis, rheumatic fever, tuberculosis and sarcoidosis must be excluded.

Some reports have recently been published on the incidence and course of acute myopericarditis (11, 3, 7, 2, 6). The prognosis of acute myopericarditis in regard to cardiac function is considered to be good, however, a few deaths and occasional cases of chronic cardiac insufficiency have been reported (11, 16, 13). Because of the paucity of long-term observations, we have followed up a selected series of patients who were treated at the medical clinic of Eskilstuna for myopericarditis between 1958 and 1970 (one patient was hospitalized in Stockholm). Our primary intention was to study the long-term prognosis in regard to cardiac function. The observation periods ranged from 15 to 158 months (mean 72.9 months).

MATERIAL AND METHODS

Patients:

The records of 64 cases classified as acute myopericarditis were reviewed. This diagnosis was altered in 2 patients who died soon after admission (of carbon monoxide and thioridazine intoxication). Other reasons for exclusion from the study were death from malignant disease in two cases and uncertain diagnosis in three. Thirteen patients could not be traced (most had left the district). In order to exclude ischaemic heart disease, the 15 patients who were older than 45 years at the time of follow-up were not studied.

The clinical material then consisted of 29 patients aged 21 to 45 years (mean 33.9 years), of whom 15 were men aged 21 to 43 (mean 31.7) years and 14 women aged 26 to 45 (mean 36.2) years. None of the patients had diabetes, hypertension, angina pectoris, collagenosis or rheumatic heart disease. No patient was under digitalis treatment at follow-up.

Observations in the acute stage

The clinical manifestations of acute myopericarditis has been reviewed by Klainer (10). In the present series the commonest clinical manifestations were raised erythrocyte sedimentation rate (24 cases), praecordial pain (22 cases), fever (21 cases), leukocytosis (16 cases), pharyngitis (14 cases), anaemia (13 cases), raised serum transferase (glutamic oxaloacetate transferase) level (9 cases) and joint and muscle pains (8 cases).

The antistreptolysin titre was elevated in only 5 of the 26 tested patients, the C-reactive protein test was positive in 3 of 8 cases and the antinuclear factor (ANF) was found in 6 of 10 cases. No LE cells were found in the 13 cases in which the tests were made.

Table I. *Physical signs and ECG changes during the acute illness*

Case no.	Sex	Pericardial rub	Murmur	ECG changes (Minnesota code)
1	♂			9–2, 5–2
2	♀		+	8–4, 5–2, 4–2
3	♀			8–7, 5–3, 4–2
4	♀	+	+	9–1, 8–7, 5–2
5	♂	+	+	9–1, 8–7, 5–2
6	♂	+		5–1
7	♂			5–2, 4–3
8	♀			9–1, 5–3, 4–3
9	♀			5–2, 4–1
10	♂	+		9–2
11	♀			5–3, 4–3
12	♂		+	9–2, 5–1
13	♀			5–3
14	♂		+	8–7, 5–2, 4–2
15	♂	+		9–2
16	♀	+		5–2
17	♂			9–2, 5–2
18	♂			3–3
19	♀	+		5–2
20	♀		+	8–7
21	♀			7–3, 5–2, 4–1
22	♂			9–2, 5–3
23	♂			9–2, 8–7, 5–2
24	♀		+	8–7, 7–2
25	♂			9–2
26	♂			9–2, 5–1
27	♂			9–2, 5–2
28	♀			9–2, 5–2
29	♀	+		9–2

Physical findings

Auscultation of the chest revealed nothing abnormal in 16 of the 29 patients. In all of the remaining 13 patients various physical signs were found during the acute illness—pericardial rub in 8 cases, systolic murmur in 6 cases, diastolic murmur (aortic insufficiency) in one case (Case 14) (Table I).

Bacteriology

Beta-haemolytic streptococci were found in throat cultures from 7 of 19 tested patients (Cases 2, 6, 10, 13, 24, 26 and 27). Urine cultures were positive in 3 of 14 patients (Cases 3, 13 and 24), two of them also had beta-haemolytic streptococci in throat cultures. Blood cultures were done in 9 cases and faeces cultures in 3 cases. All were negative.

Virology

Attempts to isolate virus from faeces and throat were made in only a few cases and were negative.

Serology

Serologic studies (for neutralizing antibodies and complement fixation) were done in 10 cases and were negative. Mononucleosis tests were done in 3 cases and gave positive result in one case (Case 1).

Radiologic examination

Chest radiographs (Table II) were taken during the acute illness in all patients but one (Case 28), who was pregnant. The heart was somewhat enlarged in 5 cases, in one of them to 600 ml/m² body surface. Some pulmonary concestion was seen in 4 cases and pleural effusion in 2 cases. In Case 25 there were pleural adhesions from a healed tuberculous process. Case 19 had acute bronchopneumonia.

Electrocardiography

Electrocardiograms were taken on admission and thereafter at least once weekly, using standard leads I, II and III and praecordial leads CR 1, 2, 4, 5 and 7. In all cases there were some abnormality of the ECG during the acute illness. The Minnesota Code (4) was used for classification (Table I). T-wave changes were the only abnormality in 6 cases. T-wave changes together with ST-segment depression occurred in 8 cases, together with ST-segment elevation in 8 cases. Thus T-wave changes either alone or in combination with ST-segment abnormalities occurred in 22 cases, one of them also having incomplete right bundle-branch block (Case 21). ST-segment elevation occurred in 4 cases and disturbances of rhythm in 8 cases. One of

Table II. *Radiographic cardiac and pulmonary findings during the acute illness*

Case no.	Sex	Heart volume (ml) total/relative[a]	Pulmonary changes
1	♂	1 120/570	–
2	♀	470/300	–
3	♀	570/400	–
4	♀	480/320	–
5	♂	780/435	Bilateral pleural effusion
6	♂	1 190/600	Pulmonary congestion
7	♂	750/420	–
8	♀	280/215	–
9	♀	454/280	–
10	♂	560/310	–
11	♀	670/360	–
12	♂	775/440	–
13	♀	480/290	–
14	♂	/480	Pulmonary congestion
15	♂	655/350	Pleural effusion
16	♀	/470	Pulmonary congestion
17	♂	550/315	–
18	♂	860/460	–
19	♀	840/480	Pulmonary congestion and bronchopneumonia
20	♀	425/275	–
21	♀	520/300	–
22	♂	490/295	Pleural adhesions
23	♂	1 000/465	Pulmonary emphysema
24	♀	670/325	–
25	♂	605/310	Pleural adhesions
26	♂	935/390	–
27	♂	1 090/520	–
28	♀	No X-rays	No X-rays
29	♀	600/300	–

[a] ml/m² body surface.

Table III. *Heart volume, work load and working capacity in relation to heart volume at follow-up*

Case no.	Age (yrs)	Sex	Heart volume (ml) total/relative	Work load at pulse 170/min (kpm/min)[a]	Working capacity in relation to heart volume
1	21	♂	980/490	990	
2	26	♀	390/270	390	
3	28	♀	530/360	740	
4	31	♀	420/270	750	
5	35	♂	1 030/530	930	Low
6	28	♂	810/430	1 250	
7	42	♂	760/415	1 090	
8	43	♀	400/300	300	
9	43	♀	505/315	625	
10	24	♂	680/370	1 200	
11	45	♀	900/480	830	
12	25	♂	770/430	950	
13	45	♀	580/335	300	Low[b]
14	37	♂	950/540	700	Low
15	37	♂	890/470	910	
16	43	♀	750/390	710	
17	32	♂	720/400	1 210	
18	25	♂	940/480	930	
19	33	♀	420/250	600	
20	27	♀	510/320	600	
21	44	♀	650/370	600	
22	24	♂	No X-rays	625	
23	43	♂	1 070/515	1 320	
24	31	♀	700/330	625	
25	40	♂	690/340	775	
26	30	♂	1 210/520	1 020	Low
27	33	♂	1 210/580	450	Low
28	38	♀	590/360	665	
29	30	♀	600/380	435	

[a] Conversion factor from Traditional Units to SI Units 1 kmp/min=0.163 Watt.
Mean load in males=957 kpm/min±244 S.D. (n=15).
Mean load in females=584 kpm/min±166 S.D. (n=14).
[b] Neurocirculatory asthenia.

these 8 cases had supraventricular tachycardia and 7 cases had sinus tachycardia, among which one having also complete right bundle-branch block. Only occasionally were sporadic monofocal ectopic ventricular extra systoles and ectopic supraventricular extra systoles detectable (not tabulated). Atrio-ventricular conduction defects were not seen.

METHODS IN FOLLOW-UP STUDIES

Anamnesis

The medical history was closely explored, particularly in regard to residual cardiopulmonary symptoms. A sociomedical investigation was made of the patient's current work situation, with emphasis on the possibility of heart-disease sequelae.

Physical examination

The general examination included auscultation of the heart and lungs and measurement of the blood pressure, using a cuff mercury manometer.

Laboratory tests

These included analyses in venous blood of haemoglobin, haematocrit, leukocytes, fasting blood sugar, cholesterol, creatinine, bilirubin and serum enzymes (glutamic oxaloacetatetransferase and lactate dehydrogenase).

Radiologic examination

X-rays of the heart and lungs in erect position were compared with films taken during the acute illness. All comparisons were made by the same roentgenologist. The total and the relative heart size (ml/m^2 body surface) were calculated according to Jonsell (9). The accepted upper limits of normal value were 500 ml/m^2 for men and 450 ml/m^2 for women.

Electrocardiography

A direct writing ink-recorder (Elema-Schönander, Stockholm) was used with standard leads I, II and III and praecordial leads CR 1, 2, 4, 5 and 7 for resting and orthostatic ECG. In exercise tolerance tests CH leads were used with the indifferent electrode on the forehead. ECG tracings were made after ten minutes in supine posi-

Table IV. *Heart volume, ECG and working capacity at follow-up (in cases with pathologic findings)*

Case no.	Sex	Pulse rate at rest	Heart volume total/relative	ECG at rest	ECG after 8 min standing position	ECG during work	Working capacity W 170 in relation to heart volume
2	♀	110	390/270	Normal	Pathologic	Normal	Normal
4	♀	76	420/270	Normal	Pathologic	Normal	Normal
5	♂	85	1 030/530	Pathologic	Pathologic	Pathologic	Low
6	♂	75	810/430	Pathologic	Pathologic	Pathologic	Normal
8	♀	86	400/300	Normal	Pathologic	Normal	Normal
9	♀	83	505/315	Pathologic	Pathologic	Pathologic	Normal
11	♀	75	900/480	Pathologic	Pathologic	Pathologic	Normal
13	♀	115	580/335	Normal	Pathologic	Pathologic	Low[a]
14	♂	105	950/540	Normal	Normal	Normal	Low
18	♂	66	940/480	Normal	Pathologic	Pathologic	Normal
21	♀	108	650/370	Normal	Pathologic	Normal	Normal
24	♀	115	700/330	Pathologic[b]	Pathologic[b]	Pathologic[b]	Normal
26	♂	72	1 210/520	Normal	Normal	Normal	Low
27	♂	54	1 210/580	Pathologic	Pathologic	Pathologic	Low

[a] Neurocirculatory asthenia.
[b] Right bundle-branch block.

tion, immediately after adopting the erect position and after eight minutes' standing. Pulse rate and blood pressure were registered simultaneously.

Exercise tolerance test

In exercise tests the patient sat on an electrically braked bicycle as described by Holmgren & Mattsson (8). The work load was increased stepwise at 6-minute intervals. The pulse rate was measured every second minute of each increment. The work load at 170 beats/min in steady state (W 170) was calculated according to Sjöstrand (12) and Wahlund (15).

The working capacity in relation to the heart volume was compared with findings in a series of healthy persons published by Gerzén et al. (6). Deviation from the regression line exceeding 2 S.D. were classified as pathologic.

RESULTS

Subjective symptoms

Nine patients (31%) reported symptoms at follow-up which they associated with the myocarditis. Seven had unspecified praecordial discomfort or pain, one (Case 20) complained of sporadic pulse irregularity and one (Case 5) of dyspnoea and fatigue.

Sociomedical examination

All but one of the patients were fully fit for work. In Case 5 the working capacity was impaired as a result of hepatic dysfunction which presumably was of cardiac origin. This patient, however, worked part-time in his previous occupation. Five patients had progressed to better positions, probably because of more advanced training. Four had switched to less physically demanding work, as a result of the myocarditis.

Physical examination

Abnormal physical findings occurred only in 5 patients. Two of them (Cases 12 and 16) had systolic cardiac murmurs without clinical significance. In Case 14 moderate sinus tachycardia and slight hypertension were registered, but at repeated examination the pressure had normalized. In Case 20 a grade II–III pansystolic murmur was heard in the third intercostal space, which was considered to be due to physiologic flow and with no haemodynamic significance. Moderate hepatic enlargement was found in Case 5. Only these last 2 patients had both subjective and objective symptoms.

Laboratory tests

These showed moderate sideropenic anaemia in a young woman (Case 3). The serum protein level was slightly subnormal and the alkaline phosphatase reading was elevated in the man with hepatic dysfunction. All but two of the patients underwent the laboratory tests and these two were asymptomatic.

Radiologic examination

The relative heart size was increased in 5 male patients and one female. One of these patients (Case 27) suffered from cardiac enlargement during the acute illness, and this had now increased (Tables II and III).

Electrocardiography

Pathologic *resting ECG* was found in only 6 patients (21%). In 5 of them previously observed T-wave

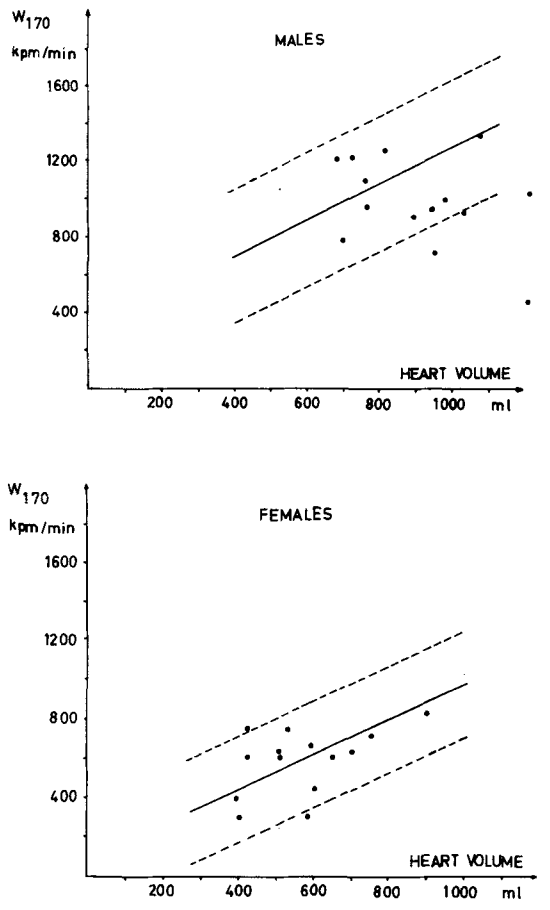

Fig. 1 a, b. The individual relation between working capacity and the heart volume as compared with normal regression lines (±2 S.D.).

changes had diminished. Complete right bundle-branch block was still present in Case 24 (Table IV).

The *orthostatic ECG* was pathologic in 12 patients (41%), 6 of whom showed normal patterns during rest. The new changes in standing were inversion or flattening of T-waves, except in the patient with right bundle-branch block, who showed this pattern also during rest. In Case 13 the resting pulse rate of 115 beats/min rose to 140 in standing position.

The *exercise ECG* was pathologic in 8 patients (27%), all of whom also had pathologic orthostatic ECG. Two patients with pathologic ST–T changes during work had a normal resting ECG. Complete right bundle-branch block was again seen in Case 24 (Table IV).

Working capacity

The total work load at pulse 170 beats/min (W 170) averaged 957 kpm/min±244 S.D. in the male patients and 584 kpm/min±166 S.D. in the females (Table III). Five patients (4 males and one female) showed low exercise tolerance in relation to cardiac volume (Fig. 1*a, b*). In one of them (Case 27) the break point was well below a pulse rate of 170 beats/min (450 kpm/min at pulse 98 beats/min). His working capacity was regarded as equivalent to the highest tolerated load for 6 minutes according to Sjöstrand (12). In cases 14 and 26 the low physical capacity was not accompanied by ECG changes (Table IV). Case 13 showed sinus tachycardia and low working capacity, probably because of neurocirculatory asthenia. Her heart size was normal, in contrast to the other patients with impaired exercise tolerance (Table IV). In only one of these 5 patients (Case 5) did the follow-up examination also reveal subjective and objective physical sequelae and pathologic ECG.

DISCUSSION

During the acute infectious illness all 29 patients showed signs of cardiac disorder, in particular pathologic ECG at rest, but also physical signs. A presumptive aetiologic diagnosis was made in 13 cases (45%): 7 had beta-haemolytic streptococci in throat swabs, 4 had elevated antistreptolysin titre without positive throat swabs, one had mononucleosis and one had urinary tract infection. In the remaining cases the symptoms and the physical findings during the acute illness indicated viral infection. A relevant point is that 15 of the 29 patients were treated before 1966, when virologic studies were relatively rare at this hospital.

Our frequency of aetiologic diagnosis tallies with Bergström et al. (2) and Gerzén et al. (6).

The physical examination at follow-up was negative in all but 5 of the patients, one of whom had hepatic dysfunction (Case 5). Repeated biopsies in this case yielded normal liver tissue, indicating a cardiac causation. The same patient also had dyspnoea of effort and progressive cardiac enlargement with pleural effusion which necessitated diuretic medication.

Moderate sinus tachycardia was found in Case 14. This patient also had moderate cardiac enlargement and impaired physical capacity in tolerance test, but had no subjective symptoms. Systolic

murmurs without any clinical significance was heard in 3 patients. One of them (Case 20) complained of sporadic pulse irregularity, but the ECG at follow-up showed sinus rhythm without extra systoles.

Of the 9 patients who reported residual symptoms, only Cases 5 and 20 showed deviation from the normal at physical examination, and of these only Case 5 had reduced capacity at function test. Of the five patients with pathologic physical findings, only Cases 5 and 14 showed low exercise tolerance. Similar observations were made by Bergström et al. (2). By contrast, Bengtsson & Lamberger (3) reported good correlation between the patients' symptoms, ECG changes and reduction of working capacity.

The cardiac volume in this series was increased at follow-up in 21% of cases. Bengtsson & Lamberger (3) reported 20% in a considerably larger case series.

The follow-up resting ECG was pathologic in only 6 of the 29 cases. Two of the six had low working capacity (Cases 5 and 27). Change to standing position gave pathologic ECG in 6 more cases, with altered ST and T tracings. This illustrates the value of the orthostatic test for providing supplementary information. Similar findings were published by others (11, 3, 2, 6). The pulse rate in the orthostatic test rose by more than 20 beats/min in 11 of the 29 cases. One of them (Case 13) had sinus tachycardia at rest and sympatheticotonic ECG changes appeared during standing, indicating neurocirculatory asthenia. The mean pulse increase in the orthostatic test was 15 beats/min, which tallies with Bergström et al. (2) and Gerzén et al. (6).

Exercise tolerance tests produced no additional ECG changes are compared with the orthostatic tests. Gerzén et al. (6) found arrhythmia in 5 of 45 cases and in two others T-wave changes, which were not apparent at rests or during the orthostatic test. Levander-Lindgren (11) reported that ECG changes arose during work in 22% of her cases. Bergström et al. (2) found abnormal ECG at rest in 33%, in standing in 53% and during work in 73% of cases. Corresponding figures reported by Bengtsson & Lamberger (3) were 19, 10 and 30%. Work tests thus can evoke otherwise unseen ECG changes, though this did not occur in our case series. In 4 of our patients with pathologic orthostatic ECG the ST and T tracings were normal during work.

The physical capacity was low in relation to the heart volume in 5 of the 29 cases (17%). The corresponding frequency reported by Bergström et al. (2) was 13%. Two patients with subnormal physical capacity had normal ECG tracing (resting, standing and working). Gerzén et al. (6) reported residual cardiac symptoms in 35% of their cases, but work tests showed normal capacity in relation to total haemoglobin and to heart volume.

Physical working capacity in healthy persons is in linear relation to the heart volume. Myocardial damage of functional significance may, however, impair the working capacity while the heart size tends to increase. Calculation of working capacity in relation to heart size may therefore be helpful in detecting deviations from the normal. In our series 4 of the 5 patients whose working capacity was low in relation to heart size had cardiac enlargement. The fifth patient was classified as neurocirculatory asthenia. Bengtsson & Lamberger (3) similarly found good correlation between cardiac enlargement and impaired physical working capacity.

The mean work loads at a pulse rate of 170 beats/min (W 170) were similar to those found by Frisk et al. (5). In 67 healthy males they reported 1 050 kpm/min$\pm$125 S.D. In 58 healthy females they found 750 kpm/min$\pm$100 S.D. In the general population, however, the physical working capacity shows wide variations. It may have diminished in recent years. Ström (14) reported a study from 1964–1965 in which healthy Swedish students showed mean readings of 1 009 kpm/min in 61 males and 555 kpm/min in 22 females.

Our conclusion is that the prognosis in this series of patients with earlier myopericarditis is good. The results are in agreement with those in other comparable series in which the observation time was somewhat shorter.

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Received August 8, 1976

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