The results justify the conclusion that, no matter how serious the rheumatic heart condition may be, pregnancy should not be terminated at any stage, nor abdominal delivery resorted to.

Summary

The case histories of 289 pregnancies complicated by rheumatic heart disease are analysed.

One mother died before the end of the puerperium (0.3%). Thirteen viable infants did not survive the neonatal period (4.6%). Mitral commissurotomy was performed on three occasions (1%). No caesarean section or induction of labour was performed for heart disease. No therapeutic abortion was performed.

We are grateful to our colleagues at the National Maternity Hospital for their co-operation in the management of these patients.

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PROGNOSIS OF INTERMITTENT CLAUDICATION

BY

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More than a century has passed since Brodie (1846) first described in man the symptom-complex which we now call intermittent claudication. He clearly recognized its association with obliterative arterial disease of the main arteries of the lower limbs, and he pointed out that it was frequently a premonitory symptom of what was then called "senile gangrene." Although we still recognize these associations there is little reliable information about the prognostic significance of intermittent claudication. Most physicians are familiar with patients who have had claudication for many years without developing gangrene or any other serious cardiovascular catastrophe, but they can also recall others who, within a short time of presenting with claudication, have lost a limb or suffered a myocardial infarction or had a cerebrovascular accident. Such patients are remembered, but it is difficult to obtain accurate data on what happens to the majority of patients who present with intermittent claudication.

Stammers (1954) has said that nearly all those who complain of claudication at the age of 55 to 60 years are dead within five years. Hines and Barker (1940) reviewed a series of 116 patients with arteriosclerosis obliterans many of whom had gangrene as well as claudication, and found that 54.5% were dead within three years. Spaulding (1956) reported that of 108 patients who had had claudication for more than three years only 13% had died. In a report on a clinical trial of the value of nicotinyl alcohol tartrate in the treatment of claudication Gillhespy (1957) stated that 15 out of 50 patients died before the trial period of 18 months was completed. In view of these conflicting statements it seemed desirable to review a series of patients who had presented with intermittent claudication as their main symptom and who had been under observation for at least five years.

Clinical Material

The material consists of 60 patients who were seen at the Vascular Clinic of the Western Infirmary, Glasgow, prior to December 31, 1951, and who have been under continuous observation for at least five years or who are known to have died during this follow-up period. The presenting symptom in all the patients was typical intermittent claudication, and at the time of their initial examination none of them had more than slight nutritional changes in the feet. Patients with obvious ischaemia of the feet were excluded from the series, so that the results are applicable only to patients who have uncomplicated intermittent claudication. The duration of the claudication before the patients were seen varied from a few days to five years. There were 55 men and 5 women in the series. Their ages ranged from 24 to 69, with a mean of 52.9 years. Exactly half were in the sixth decade; 6 were under 40, and 15 were 60 or more. There were only four diabetics in the series.

Clinical Observations

Type of Peripheral Arterial Disease

Two of the youngest patients in the series, aged 30 and 36 respectively, had thrombo-angiitis obliterans; the remainder were thought to have atherosclerosis (arteriosclerosis obliterans). It is of interest that the youngest patient, who presented with claudication at the age of 24 and who died of myocardial infarction at the age of 27, did not have thrombo-angiitis obliterans but widespread atherosclerosis. The majority (41 patients) presented clinical findings which suggested arterial occlusion at the level of the lower part of the femoral artery or the proximal part of the popliteal artery—that is, they had good femoral pulses in the femoral triangle, but pulsation could not be felt distal to this. In this group the occlusion was initially bilateral in 29 patients and unilateral in 12 (Table I). Four patients

TABLE I.—Type of Peripheral Arterial Disease

Type of Arterial Disease	Unilateral	Bilateral	Total
Atherosclerosis with high occlusion	2	2	4
" " femoral or popliteal occlusion	12	29	41
Atherosclerosis with distal occlusion	2	2	4
" " asymmetrical occlusion	0	9	9
Thrombo-angiitis obliterans	1	1	2
Total	17	43	60

had high arterial occlusions: two had obstruction of the common or external iliac artery on one side only, one had a bilateral iliac occlusion, and one had an aortic occlusion. Four patients had a distal type of arterial disease—that is, they had good femoral and popliteal pulses but absent pedal pulses. In nine cases there was evidence of bilateral arterial disease, but the occlusions were at different levels on the two sides: five had a high arterial occlusion on one side with a femoral or popliteal occlusion in the other limb, and four had a femoral or popliteal occlusion on one side with a distal lesion in the other limb. Four patients, including one of those with thrombo-angiitis obliterans, presented with an acute arterial occlusion; in the remainder the onset of claudication was gradual.

Mortality

Seventeen patients (28.3%) have died during the follow-up period. The cause of death is known for all but two. Seven died of myocardial infarction, three of a cerebrovascular accident, two of congestive cardiac failure, one of the combined effects of diabetes mellitus, tuberculous empyema, and amputation of a leg for gangrene, and two of causes not directly connected with the cardiovascular system—perforation of a peptic ulcer and carcinoma of the pancreas. Analysis of the deaths shows that 13 occurred in patients who were over 50 at the time of their first attendance and only four in patients less than 50. Ten of the

patients who died had hypertension (more than one casual reading of diastolic blood pressure over 100 mm. Hg) and 15 had bilateral peripheral arterial disease when they were first seen. In this group the mean duration of life from the onset of claudication was exactly five years.

Progress of Peripheral Arterial Disease

In assessing the progress of the peripheral arterial disease minor changes in the patient's claudication distance have been ignored. It is well known that intermittent claudication is a variable symptom and that quite considerable fluctuations in its severity may occur spontaneously (Hamilton and Wilson, 1952). Unless a patient had marked reduction in his claudication distance associated with objective evidence of deterioration in the nutrition of the affected limb or limbs his condition has been assessed as unchanged or improved. Twenty-seven of the 43 survivors (60%) fall into this category (Table II). Definite evidence

TABLE II.—Survivors: Progress of Peripheral Arterial Disease

Unchanged or improved	..	..	..	27
Worse	..	..	..	14
Unilateral→bilateral	..	..	..	3
Acute arterial occlusion	..	..	..	3
Definite deterioration	..	..	..	5
Amputation	..	..	..	3
Quiescent thrombo-angiitis obliterans	..	..	..	2
				43

of progression of the peripheral arterial disease was observed in 14 cases; three patients who originally had unilateral involvement later developed claudication in the other leg, three had an episode of acute arterial occlusion, and in eight there was obvious gradual worsening of the state of the affected limbs with the development of marked nutritional changes and rest pain in some instances, but only three of these required amputation of a limb. In the two cases of thrombo-angiitis obliterans the disease has apparently been quiescent for two to three years. The mean duration of claudication in the group of 43 survivors is 7.3 years.

Evidence of Generalized Cardiovascular Disease

More than two-thirds of the survivors complained of breathlessness on exertion. No attempt was made to grade the severity of the dyspnoea, and it is known that some of these patients had chronic bronchitis. No significance can therefore be placed on this finding as an indication of cardiovascular disease. Thirteen patients (30%) had definite hypertension (more than one casual diastolic blood pressure reading over 100 mm. Hg). Seventeen patients (39%) complained of angina of effort, and 13 (30%) gave a good clinical history of a myocardial infarction. Only two patients had suffered attacks of congestive cardiac failure. Three had definite cerebrovascular episodes which left neurological sequelae. Considering the series as a whole, after five years, 13 patients had died from cardiovascular causes, and 31 (72%) of the survivors had definite clinical evidence of generalized vascular disease. There were only 12 cases in which the disease was still apparently confined to the lower limbs.

Electrocardiograms were obtained on 34 of the survivors. Only five electrocardiograms were regarded as within normal limits. The most common abnormality was definite evidence of myocardial infarction. This was present in 14 cases; 12 of these were cases in which there was a clear history of myocardial infarction; the electrocardiogram of the thirteenth patient who gave a history of infarction showed left bundle-branch block. There were two instances in which, although the electrocardiogram indicated infarction, there was no clear history of an episode which could be interpreted as an attack. In five cases the electrocardiographic pattern was that of coronary insufficiency, and in four patients, all in the hypertensive group, the electrocardiogram showed evidence of left ventricular hypertrophy. In six cases there were other electrocardiographic abnormalities, bundle-branch block, extrasystoles, or changes in the T waves.

Effect of Treatment

The critical studies of Hamilton and Wilson (1952) and Hamilton *et al.* (1953) have shown that it is difficult to prove that any form of medicinal therapy influences the progress of intermittent claudication. During the five-year period most of the patients in the present series had courses of treatment with vasodilator drugs such as tolazoline hydrochloride ("priscol"), nicotinic alcohol tartrate ("ronicol"), or spasmocyclone ("cyclospasmol"), or with alpha-tocopherol (vitamin E). Some patients appeared to obtain benefit from one or other of these drugs, but no attempt was made to assess their value by objective tests or to carry out a controlled trial. It is probable that fluctuations in the severity of the claudication represented the natural history of the disease rather than the effects of medical treatment.

Opinion is divided about the value of lumbar sympathectomy in the treatment of intermittent claudication. American surgeons (de Takats *et al.*, 1946; Berry *et al.*, 1955; Edwards and Crane, 1956) are favourably impressed with the results, but most British surgeons (Learmonth, 1950; Mavor, 1955) feel that the operation is of little value in the treatment of the patient whose only complaint is of intermittent claudication. In the present series 27 patients had lumbar sympathectomy performed, unilateral in 21 and bilateral in 6. In Table III the progress of the patients

TABLE III.—Effect of Lumbar Sympathectomy

Status at 31/12/56	Medical Treatment Only	Lumbar Sympathectomy
Peripheral arterial disease:		
Unchanged or improved	20	7
Worse	5	9
Quiescent thrombo-angiitis obliterans	0	2
Dead	8	9
Total	33	27

who had sympathectomy is compared with that of those who had medical treatment only. The figures are too small to be of statistical significance, but they offer no evidence that the patients who were operated upon did any better than those treated conservatively. It will be noted that in the group which underwent sympathectomy there are a relatively large number of patients whose peripheral arterial disease was progressive. This is certainly due to the fact that the operation was performed in many of these cases because of the progression of the disease and with the hope of preventing the development of gangrene.

Discussion

Intermittent claudication is almost always a symptom of obliterative arterial disease affecting the blood vessels of the lower limb. The common cause of the arterial disease is atherosclerosis (arteriosclerosis obliterans). Thrombo-angiitis obliterans is a relatively infrequent cause of claudication; it is an uncommon disease, and patients who suffer from it more often present with ischaemic lesions of the feet. The ratio of one patient with thrombo-angiitis obliterans to 30 with atherosclerosis is probably about the average. The age-and-sex incidence of the present series, with a preponderance of patients in the sixth decade but with some younger patients and a number over 60, and with a ratio of 11 males to one female, is typical of degenerative arterial disease.

Atheroma may be confined to one artery or even to a portion of a single artery, but it is commoner for the process to be generalized, although it seldom affects all parts of the arterial tree to the same extent. Therefore it should not be surprising to find that in a group of patients with intermittent claudication there is a high incidence of cardiovascular catastrophes and of symptoms of both ischaemic heart disease and cerebrovascular disease.

McDonald (1953) has already commented upon the association of ischaemic heart disease with peripheral occlusive arterial disease. He studied 129 patients—79 who presented

with intermittent claudication and 50 who presented with angina of effort. When he followed the 79 patients with claudication over a period of two years he found that 23% had developed angina and that 31 of them had abnormal electrocardiograms. These figures may be compared with a 39% incidence of angina and 29 abnormal electrocardiograms in the 43 survivors of the present series. In his 50 patients who presented with angina McDonald (1953) found that four of these had also intermittent claudication and eight others had objective evidence of occlusive arterial disease of the lower limbs. Thus, of 129 patients, 43 (33%) had both peripheral arterial disease and ischaemic heart disease. In this series the incidence of ischaemic heart disease is higher; if all cases of myocardial infarction, angina of effort, and congestive cardiac failure are included the figure is 57%. The present series may also be compared with that reported by Spaulding (1956). In his group of claudicants who were followed for three years he found angina of effort in 22 patients (20%) and electrocardiographic abnormalities in 47%. These figures are also lower than those noted in this study, and the implication must be that the longer a group of patients with claudication is followed the greater the number that will show signs of ischaemic heart disease.

The association of cerebral vascular disease with peripheral arterial disease does not appear to have been studied before, and the number of recognizable cerebrovascular episodes in the present series—6 out of 60, three of them fatal—is too small for any conclusions to be based upon them.

With regard to mortality, the only figures which can be compared with the present study are those recorded by Spaulding (1956). Of his 108 patients, 13% died within three years of the onset. Since not all his patients were followed for five years, he could give only an estimate of the five-year mortality, and this he put at 25%. There were 32 deaths in his series, and 21 of these were due to cardiovascular disease.

The mortality in the present series (28%) is higher than Spaulding's estimate, and the number of deaths from cardiovascular disease is also higher (13 out of 17). In this series, as in Spaulding's, there is evidence that the association of hypertension with occlusive peripheral arterial disease makes the prognosis worse: 60% of those who died were hypertensive, compared with 30% of the survivors. He also commented on the fact that the prognosis was on the whole better if the peripheral arterial disease was unilateral when the patient was first seen. This view is supported by the present study: in only two of the fatal cases was the arterial disease unilateral. The age of the patient at the time of the onset of claudication is probably also of prognostic significance. Spaulding (1956) noted that, in general, the younger the patient when his claudication began the longer its duration before death. This is also true of the present series, although there are notable exceptions—for example, the patient who developed claudication at 24 and died at the age of 27.

It is instructive to compare the mortality figures for these patients with intermittent claudication with the published results for the prognosis in cases of angina pectoris, and in cases where a patient has survived the immediate effects of a myocardial infarction. For angina pectoris the figures based on the largest number of cases are those of Block *et al.* (1952). They followed 6,882 patients who presented with angina; the average age of the patients was 58.8 years, and the duration of the angina at the time the patient was first seen varied from a few days to 18 years. The overall mortality five years after the patients came under observation was 42.2%. In a smaller series reported by White *et al.* (1943), the five-year mortality was 29.8%. Both of these mortality rates are higher than that observed in the present study. Considering myocardial infarction, Cole *et al.* (1954) found that, of 390 patients, 105 died in the first two months and 95 of the 285 survivors died in the next five years, a mortality rate of 33%. Although the numbers in the present series are small the results do suggest that the prognosis for

the patient with intermittent claudication is rather better than that for the patient who has angina pectoris or who has survived the immediate effects of a myocardial infarction.

With regard to the peripheral arterial disease itself, the present study indicates that the prognosis is relatively good. At the end of the five-year period more than half the survivors were no more disabled by their intermittent claudication than they had been when they were first seen, and several were convinced that they were better. In some cases this symptomatic improvement could be due to the fact that the patients were unable to walk so fast because of either angina of effort or cardiac dyspnoea, but, on the other hand, it is true to say that none of the patients in this group showed any objective evidence of progression of their peripheral arterial disease. The incidence of gangrene necessitating amputation is low; only six amputations were done in the 60 patients, whereas both Hines and Barker (1940) and Spaulding (1956) report a 25% amputation rate in their series. These good results are probably due not to any medicinal or surgical treatment but to the fact that the patients are a select group who have been kept under close observation during the five-year period by physicians and surgeons who have been keenly interested in their welfare and who have encouraged them to take good care of their feet and to be as active as possible within the limits of their disability. For the patient with intermittent claudication adherence to simple rules of foot hygiene and the taking of a moderate amount of regular exercise are probably more important therapeutic measures than the prescription of any drug or the performance of any surgical operation.

Summary and Conclusions

Intermittent claudication is generally regarded as a chronic but rather annoying symptom which is not of serious prognostic significance. This study of a select series of 60 patients, all of whom have been followed for at least five years or to death, indicates that claudication is often the first symptom of general cardiovascular disease which may prove fatal within a few years. The prognosis as regards life, however, is not as serious as that of angina pectoris or that of myocardial infarction from which the patient has apparently made a good immediate recovery. The outlook so far as the claudication itself is concerned, and also for the affected limb or limbs, is probably better than is generally realized, and as time goes on the patient is more likely to be disabled by the effects of coronary or cerebral arterial disease than by his peripheral arterial disease. These facts must be taken into consideration when any direct surgical approach to the treatment of intermittent claudication, such as arterial grafting, is being planned.

I should like to thank my colleagues in the Vascular Clinic, Professor W. A. Mackey, Mr. G. Smith, Dr. J. Allan, and Dr. J. Buchanan, for their help in compiling the excellent clinical notes which made this study possible.

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