Left main stem coronary artery disease
Retrospective review of 26 patients treated surgically or medically

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Day, L. J., Vallin, H. O., and Sowton, E. (1976). *Thorax, 31*, 522–526. Left main stem coronary artery disease. Retrospective review of 26 patients treated surgically or medically. The clinical, angiographic, exercise testing, operative, and follow-up data of 26 patients found at angiography to have left main stem coronary artery stenosis, defined as a reduction in the lumen diameter of 50% or more, are reviewed. There was a high incidence of significant proximal stenosis in the branches of the left main stem. No clinical features were found to distinguish patients with left main stem stenosis.

All patients were considered for saphenous vein bypass grafting, selection being based upon the severity of symptoms, left ventricular function, and suitability of the coronary vessels for grafting. Two patients died within 24 hours of coronary angiography.

Nine patients were operated on with no mortality. There has been one late cardiac death during a mean follow-up time of 13 months. All patients were symptomatically improved with a significant (\(p<0.01\)) increase in exercise ability postoperatively.

Fifteen patients were not operated on. Six of these patients were regarded as operable but surgery was deferred; five have died at a mean time of 7.2 months. Five of the nine patients regarded as inoperable have died at a mean follow-up time of 14.8 months. The five non-surgical survivors remain symptomatic with no significant change in exercise ability.

Recently reported surgical and medical series of patients with left main stem stenosis are reviewed.

Significant left main stem disease usually occurs in combination with major stenoses elsewhere in the coronary circulation and has been reported to have a poor prognosis (Webster, Moberg, and Rincon, 1974; Burggraf and Parker, 1975). Good results in some surgical series suggest that saphenous vein bypass grafting may be the preferred method of treatment (Lavine *et al.*, 1972; Zeft *et al.*, 1974; Balcon, Banim, and Donaldson, 1975).

In this paper we report our experience with 26 patients who had 50% or greater stenosis of the left main stem coronary artery.

METHODS

The clinical records and angiographic findings in 454 patients seen since 1971 who had coronary artery disease were reviewed. Information was obtained regarding length of history of angina, clinical status before presentation, and physical examination at admission. Angina was classified according to severity (Balcon *et al.*, 1970) (grade 1—angina with greater than normal exertion; grade 2—pain with normal exertion such as walking briskly; grade 3—pain with less than normal exertion; grade 4—angina at rest). Unstable angina was defined as progressive angina with severe episodes, some of which occurred at rest and were only partially relieved by or totally unresponsive to trinitrin. The incidence of previous myocardial infarction was assessed by reviewing electrocardiograms according to the usual criteria (Hurst *et al.*, 1974). Cardiomegaly was defined as a cardiothoracic ratio of more than 50% on the chest radiograph.

Left ventriculography and selective coronary angiography was performed in all patients. Left ventricular end-diastolic pressure, post A wave, was measured before any contrast medium was injected. Left ventriculograms were classified:

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Class 0 normal function
Class 1 minor general reduction of function
Class 2 hypokinetic, akinetic or aneurysmal area
Class 3 moderate general reduction of function
with or without class 2
Class 4 grossly reduced function with or without
class 2.

Left main stem stenoses were classified as
50-70% or greater than 70% reduction in dia-
meter of the vessel lumen. Significant additional
vessel involvement was said to have occurred if
the left anterior descending artery, the circumflex
artery or the right coronary artery had a stenosis
of 70% or more.

Exercise tests were carried out in the sitting
position on either the Elema-Schonander or
Monark exercise bicycles (Roy, Day, and
Sowton, 1975).

A perioperative myocardial infarction was
regarded as having occurred if in comparison with
the tracing before surgery there were pathological
Q waves in two or more leads or loss of R voltage
in two or more of the chest leads.

Recent information was obtained when 11 of
the 13 living patients were reviewed and a full
history, examination, ECG, chest radiograph, and
exercise test were performed. Follow-up data from
the other two were obtained from their physicians.
Functional classification was according to the
New York Heart Association.

Each patient was considered for saphenous vein
bypass grafting of the coronary arteries, and
selection for operation was based upon severity of
symptoms, adequacy of left ventricular func-
tion, and suitability of vessels for grafting.

RESULTS (Table I)
Twenty-six patients were found to have significant
left main stem stenosis, all male, giving an inci-
dence of 5.7% in the 454 coronary angiograms
reviewed. Two patients died within 24 hours of
coronary angiography and are considered
separately: nine patients underwent aorto-
coronary saphenous vein bypass grafting and 15
patients were not operated on.

ANGIOGRAPHIC FINDINGS (Table II) Only one
patient was found to have a normal ventricle.
Fourteen were found to have either a class 3 or 4
ventricle, 12 of whom were in the non-surgical
group.

Sixteen patients had greater than 70% stenosis
of the left main stem coronary artery. An isolated
left main stem stenosis was not found. There was
an average of 2.2 vessels involved per patient in
addition to the left main stem stenosis.

ANGIOGRAPHY-RELATED MORTALITY (Table I) Two
patients died within 24 hours of coronary angio-
graphy. Both patients were severely incapacitated
by angina and one was in cardiac failure with a
past history of myocardial infarction.

The first patient had a class 4 ventricle. There
was significant involvement of all the coronary
arteries and a 70% stenosis of the left main stem.
Six hours after investigation he became uncon-
cious and died. At necropsy major cerebral
emboli were shown to have originated from the
left ventricle in which there was an aneurysm
containing thrombus.

The second patient had an unsatisfactory
ventriculogram that could not be assessed. There
was significant involvement of all the coronary
arteries and a 50% stenosis of the left main stem.
During angiography there was an episode of
ventricular fibrillation which was successfully
treated. He died the next day after an episode
of chest pain. At necropsy a recent thrombosis
of the left anterior descending artery was found.

| TABLE I |
| PATIENT DATA |
|-----------------|-----------------|-----------------|-----------------|
| Number of patients | Total Group | Surgical | Non-Surgical | Angiographic Deaths |
| Age (years) | 51.1 | 48 | 43.5 | 6 | 9 | 54.2 | 52.1 | 37.7 | 4.0 | 7.0 | 50.1 |
| Duration of angina (months) | 49.5 | 43.8 | 37.7 | 6 | 9 | 54.2 | 52.1 | 37.7 | 4.0 | 7.0 | 50.1 |
| Angina: Grade 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Grade 2 | 6 | 6 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| Grade 3 | 12 | 12 | 6 | 6 | 6 | 3 | 3 | 3 | 3 | 3 | 3 |
| Grade 4 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Unstable angina | 5 | 5 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Recent exacerbation of angina | 16 | 16 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 |
| Cardiomegaly | 12 | 12 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 |
| Cardiac failure | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
One showed ST depression, and the mean ventricular end-diastolic pressure exceeded 2 mmHg before and after fatigue. All showed patients were symptomatic. The total work performed was 1518 kpm (range 8-25).

Angiographic findings (Table II) In the survivors, four are completely free of angina. Seven patients had exercise testing performed both before and after surgery. In the initial test a mean total work of 1518 kpm was performed. Six patients were stopped by angina and one by fatigue. All showed ST segment depression which exceeded 2 mm in three patients.

After surgery all patients did more work and the mean total work performed was 3102 kpm. One patient was stopped by angina, three by dyspnea, and three by fatigue. Two patients showed ST depression of 1.5 and 2 mm respectively. The difference in work performed by the group was significant (p<0.01).

Surgical group (Table III) Nine patients underwent aortocoronary saphenous vein bypass grafting. There were no operative deaths. One patient had a perioperative myocardial infarction (11%). One patient with a class 4 ventricle has died six months after surgery in congestive cardiac failure. There have been no late myocardial infarctions. All surviving patients are symptomatically improved and four are completely free of angina.

Seven patients had exercise testing performed both before and after surgery. The mean total work performed was 1518 kpm (range 6-16).

Surgical group (Table III) Of the 15 patients in this group, nine were regarded as inoperable. Five of these have died from cardiac causes at a mean time of 14.8 (range 3-26) months.

Six patients were regarded as operable, but surgery was deferred because of symptomatic improvement in four and because of the intention to investigate symptomatic peripheral vascular disease in two. Five of these patients have died from cardiac causes at a mean follow-up time of 7.2 (range 6-10) months.

There has been no significant symptomatic improvement in the survivors. All are taking antianginal medication, and two are taking diuretics in addition.

Four of the five surviving patients have had exercise tests, achieving a mean total work at the most recent test of 2071 kpm, which was not significantly different from the test performed at the time of coronary angiography.

<table>
<thead>
<tr>
<th>TABLE II</th>
<th>ANGIOGRAPHIC FINDINGS†</th>
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<tbody>
<tr>
<td></td>
<td>Surgical</td>
</tr>
<tr>
<td>Number of patients</td>
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</tr>
<tr>
<td>Left main stem stenosis (LM) &gt; 70°</td>
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<tr>
<td>Left anterior descending (LAD)</td>
<td>2</td>
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<tr>
<td>Circumflex (Cx)</td>
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<tr>
<td>LM + LAD + Cx</td>
<td>5</td>
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<tr>
<td>Right coronary artery (RCA)</td>
<td>7</td>
</tr>
<tr>
<td>LM + Cx + LAD + RCA</td>
<td>4</td>
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<tr>
<td>Left ventricular angiogram: Class 0</td>
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</tr>
<tr>
<td>Class 1</td>
<td>3</td>
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<tr>
<td>Class 2</td>
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<td>Class 3</td>
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</tr>
<tr>
<td>Class 4</td>
<td>1</td>
</tr>
<tr>
<td>Left ventricular end-diastolic pressure (mmHg)</td>
<td>(10-25)</td>
</tr>
</tbody>
</table>

†Excluding two angiographic deaths.

<table>
<thead>
<tr>
<th>TABLE III</th>
<th>FOLLOW-UP DATA</th>
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<tr>
<td></td>
<td>Surgical</td>
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<tr>
<td>Number of patients</td>
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<tr>
<td>Mortality—Surgical</td>
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<tr>
<td>—Late</td>
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<td>Follow-up mean (months)</td>
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<td>range (months)</td>
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<tr>
<td>Survivors</td>
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<td>Follow-up mean (months)</td>
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<td>Class 4</td>
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<td>Anginal medication</td>
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</table>
**DISCUSSION**

In considering left main stem coronary artery stenosis, a reduction in lumen diameter of 50% or more was regarded as significant. Although flow at rest remains relatively unaffected by a stenosis of less than 70%, blood flow is restricted by lesser degrees of obstruction when demand increases (Logan, 1975; Newman, Wylesby, and Bowden, 1975). Distal flow in patients with left main stem stenosis is further reduced by the frequent occurrence of severe proximal stenosis in the left anterior descending and circumflex branches. When these stenoses in series are critical the net effect on flow is additive (Gould and Lipscomb, 1974). In this report 23 patients had significant proximal stenoses of these arteries, and other reports have noted similar incidences (Cohen et al., 1972; Lavine et al., 1972; Zeft et al., 1974).

In reported results of 280 patients with left main stem stenosis treated surgically by saphenous vein bypass grafting there was a 13.5% surgical mortality (range 4–29%) (Cohen et al., 1972; Lavine et al., 1972; Harrell et al., 1974; Khaja et al., 1974; Talano et al., 1974; Zeft et al., 1974; Balcon et al., 1975; DeMots et al., 1975). The late mortality was 5.1% at an average time of 20.5 months, and the survivors were reported as having symptomatic improvement.

In reports of medically treated groups with left main stem stenoses followed for up to six years there has been a yearly mortality ranging between 10-9 and 17% (Bruschke, Proudfit, and Sones, 1973; Webster et al., 1974; Burggraf and Parker, 1975). In a recent report of 141 patients followed up for a minimum of five years, Lim, Proudfit, and Sones (1975) found a five-year mortality of 51%. There is no long-term randomized study available to compare medical and surgical treatment of patients with left main stem stenosis. However, DeMots et al. (1975) have found in a comparable but non-randomized group that the survival of the surgical group between 15 and 36 months was better but did not reach statistical significance.

Our own finding that five out of six patients in whom surgery was deferred died after an average of seven months gives a mortality of 83% which is greater than would be expected from the reports of medically treated patients reviewed above. However, Talano et al. (1974) and DeMots et al. (1975) have also found a high mortality in medically treated patients in the first year after investigation. Four of our five medically treated operable patients who died presented with a recent exacerbation of angina, and we now believe that this clinical feature indicates the need for early operation.

In contrast to the medically treated patients, the surgical patients in this series have a low late mortality and there has been a significant symptomatic improvement. The progress of the surgical patients suggests that this is the method of choice for patients with left main stem stenosis providing left ventricular function is adequate.

In assessing the suitability of the left ventricle for saphenous vein bypass grafting, patients with class 4 ventricles were generally regarded as inoperable. The one patient with a class 4 ventricle operated upon was improved by surgery initially but died after six months in cardiac failure. The left ventricular end-diastolic pressure was found to span a wide range, and the mean value was comparable in both our operated and non-operated groups. We feel it is not a useful guide to selection for surgery in the individual patients.

No clinical features were found which would allow patients with left main stem stenosis to be distinguished from other groups with severe coronary artery disease, and this confirms similar conclusions by others (Harrell et al., 1974). Khaja et al. (1974) found that 82% of his patients with left main stem stenosis presented with the clinical picture of unstable angina. Although 16 of the patients in this report presented with an exacerbation of angina, only five had unstable angina. During the period covered by this review 46 patients presented with unstable angina, only five of whom (19%) were found to have a left main stem stenosis.

Cohen et al. (1972) reported 2 mm or more ST depression on exercise testing in 82% of their patients with left main stem stenosis and considered this a useful guide in distinguishing patients with either left main stem disease or proximal stenosis of all three major coronary vessels. However, we found only 42% of the patients exercised had ST depression of 2 mm or more.

The two patients who died in relation to coronary arteriography, an incidence of 8.2%, were both studied by the Judkins technique although this was not apparently implicated.

A similar mortality at investigation in patients with left main stem stenosis has been noted by other authors (Cohen et al., 1972; Lavine et al.,...
1972), emphasizing the risks of coronary angiography in these patients. We feel these risks are related to the extent of additional disease rather than the presence of the left main stem obstruction itself.

CONCLUSIONS

Our conclusions are:

1. Patients with left main stem stenosis cannot be distinguished clinically.
2. Surgical treatment of patients with acceptable left ventricular function can be carried out with a low mortality both operative and late. This treatment results in symptomatic relief and improved exercise tolerance.
3. There is a high mortality during the first year after investigation among patients suitable for surgery but in whom the operation is delayed.
4. Exacerbation of angina is a serious prognostic sign, and surgery should be carried out urgently before infarction occurs.

We thank Dr. D. Deuchar for allowing us access to his patients, Mr. D. Ross and Mr. A. Yates who operated on these patients for allowing us to review the operative reports, and Dr. J. Dow in whose department these patients were investigated. Our thanks are also due to Mrs. G. Lockton who helped to perform the exercise tests.

REFERENCES


Requests for reprints to: Dr. E. Sowton, Cardiac Department, Guy's Hospital, London SE1.
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