Effects of atrial fibrillation on prognosis of acute myocardial infarction

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SUMMARY Nine hundred and sixty-nine coronary care patients with acute myocardial infarction were followed for one year. Atrial fibrillation was documented in 107 patients. Compared with patients without atrial fibrillation, those with this arrhythmia were older, had clinically more severe infarction, and had a higher frequency of ventricular fibrillation or tachycardia, and right bundle-branch block. They had similar past histories of ischaemic heart disease and coronary risk factors. Patients with atrial fibrillation had a higher total mortality at 3 months and 12 months. The presence of atrial fibrillation was not associated with any significant increase in mortality within any decade of age or within any subgroup of clinical severity of infarction. The frequency of atrial fibrillation was similar in anterior and inferior infarction. Multiple episodes of atrial fibrillation occurred in 52 patients and episodes usually lasted for over 1 hour. In 50 per cent of patients with single episodes of atrial fibrillation the initial ventricular rate was greater than 120 beats per minute.

The association of atrial fibrillation with acute myocardial infarction is known to carry a high mortality (Stannard and Sloman, 1967; Klass and Haywood, 1970; Helmers *et al.*, 1973; Cristal *et al.*, 1976; Liberthson *et al.*, 1976). It is unlikely that this high mortality is the result of the arrhythmia itself but is more likely the result of the clinical situation in which atrial fibrillation develops. Thus atrial fibrillation is usually associated with older patients and with clinically more severe infarction (Stannard and Sloman, 1967; Klass and Haywood, 1970; Helmers *et al.*, 1973; Cristal *et al.*, 1976; Liberthson *et al.*, 1976). This study was undertaken to determine if the presence of the arrhythmia itself had any effect on mortality when patients with similar ages, with similar past histories of ischaemic heart disease or risk factors for coronary disease, or with similar degrees of cardiac decompensation were compared. To this end we have reviewed our coronary care experience over a 4-year period.

Patients

Patients presenting to the Royal Melbourne Hospital with suspected acute myocardial infarction were admitted if possible to the Coronary Care Unit (CCU) for monitoring and management. Pain was relieved by repeated doses of papaveretum

as necessary and intranasal oxygen given at a rate of 2 l/min for the first 12 hours. The patients' rhythms were displayed on multichannel oscilloscopes in a central nurses' station. Ten-second electrocardiograph strips were recorded every hour for the first 2 days and more often if arrhythmias were detected. A 4-channel tape recorder was available for part of the period under study. Blood was taken and measurements made of creatine kinase and aspartate transaminase on admission and then daily for at least 2 days. Routine 12-lead electrocardiograms and 2 metre postero-anterior chest radiographs with the patient sitting on the side of the bed were made on admission, daily for the first 2 days, and then according to need. Radiographs were examined for cardiomegaly (cardiothoracic ratio of over 50%) and pulmonary venous congestion (distention of upper lobe veins, perihilar blurring, intra-alveolar or interstitial oedema, and Kerley B lines).

Lignocaine by infusion was given for evidence of ventricular irritability. The patients' chests were examined at least daily by the attending cardiologist and more frequently by the nursing staff. The presence of basal crepitations persisting after vigorous coughing was taken to indicate pulmonary venous congestion. Pulmonary venous congestion when detected either clinically or radiologically was treated immediately with oral thiazides or frusemide, or intravenous frusemide if symptoms or signs

warranted it. Digoxin was given if failure persisted or worsened despite the aggressive use of diuretics, if frequent atrial ectopic beats occurred, or if atrial fibrillation developed. In the setting of atrial fibrillation, DC reversion was considered only if the ventricular rate was very rapid or distinct haemodynamic deterioration occurred.

Patients were not routinely treated with full doses of anticoagulants though many received 'minidose' heparin (5000 IU 3 times a day). They were mobilised after 24 hours if their general condition permitted. The modal stay in the unit was 3 days, but patients with severe pulmonary congestion or other complications remained longer. They were then transferred to a general medical ward. All patients were reviewed in a special coronary follow-up clinic 3 months after infarction. Many were followed in the clinic to 12 months and the remainder were reached by personal inquiries. Fifteen patients could not be contacted at 12 months after infarction. The Registrar of Deaths in Victoria had no record of any of them, but 4 had gone overseas and 2 had moved to another state. Only 1 patient with atrial fibrillation was lost to follow-up. The data concerning patient mortality were analysed using the χ^2 test. A P value of less than 0.05 was considered significant.

Results

Over a 4-year period starting January 1972, 969 patients with acute myocardial infarction (WHO Class 1) were admitted to the CCU. Of these, 87 (9%) died in the CCU and a further 46 (an additional 5%) died in the general wards after discharge from

Fig. 1 The percentage survival of the patients with atrial fibrillation (solid circles) and without atrial fibrillation (open circles) is shown. There is a significant difference at three months ($P < 0.05$) and 12 months ($P < 0.01$).

the CCU. Of the patients admitted to the CCU, a total of 253 (26%) had died by 12 months. Of the 969, 107 were documented as having atrial fibrillation at some time during their stay in the CCU.

Fig. 1 shows the mortality in the 107 patients with atrial fibrillation and the 862 patients without atrial fibrillation; these two groups of patients had mortality rates in the CCU of 7 per cent and 9 per cent, respectively ($P > 0.05$), in the general ward of 14 per cent and 4 per cent, respectively ($P < 0.0005$), from hospital discharge to 3 months of 11 per cent and 7 per cent, respectively ($P > 0.05$), and from 3 to 12 months of 11 per cent and 7 per cent, respectively ($P > 0.05$). There was no statistically significant difference in total mortality rates between the two groups to hospital discharge but total mortality rates to 3 months and to 12 months were significantly greater in patients with atrial fibrillation ($P < 0.05$ and $P < 0.01$, respectively).

Of the 7 patients with atrial fibrillation who died in the CCU, 5 had cardiogenic shock, 4 had pulmonary oedema, 5 had ventricular fibrillation, and 4 had complete atrioventricular block.

The patients with atrial fibrillation tended to be older than those without atrial fibrillation; there were significantly less of the former in the age group under 60 years ($P < 0.0005$) (Fig. 2). Though patients with atrial fibrillation had a higher total mortality rate than those without atrial

Fig. 2 The distribution of the two groups of patients according to age is shown. There is a significantly higher percentage of the patients with atrial fibrillation in the 60 and over age groups than there is without atrial fibrillation ($P < 0.0005$).

Table 1 Past history of ischaemia and cardiac risk factors

	Atrial fibrillation (107 cases)	No atrial fibrillation (862 cases)	Difference in frequency
Previous myocardial infarction	18%	27%	*
Previous angina	43%	44%	NS
Neither infarction nor angina	54%	49%	NS
Smoker	48%	52%	NS
Diabetes	8%	7%	NS
Hypertension	29%	29%	NS
Pulmonary disease	3%	2%	NS

Percentage of the groups of patients with and without atrial fibrillation who have the various past histories and risk factors are shown in the two columns and any differences between these frequencies are shown in the right-hand column. NS, not significant, * $P < 0.05$.

Table 2 Site of infarction

Frequency			Mortality		
Atrial fibrillation (107 cases)	No atrial fibrillation (862 cases)	Differences in frequency	Atrial fibrillation (107 cases)	No atrial fibrillation (862 cases)	Differences in frequency
48%	44%	NS	Anterior	43%	31%
44%	43%	NS	Inferior/posterior	28%	21%
9%	13%	NS	Others	44%	18%

Location of the infarctions are shown for patients with and without atrial fibrillation. The columns on the left of the table show the frequencies and those on the right the mortality to 12 months associated with the different sites of infarction. NS, not significant.

Table 3 Mechanical complications

Frequency				Mortality		
Atrial fibrillation (107 cases)	No atrial fibrillation (862 cases)	Difference in frequency		Atrial fibrillation (107 cases)	No atrial fibrillation (862 cases)	Difference in mortality
64%	53%	*	Radiological evidence of pulmonary congestion or oedema	42%	32%	NS
25%	11%	†	Radiological pulmonary oedema	63%	59%	NS
49%	36%	*	Radiological cardiomegaly	47%	43%	NS
20%	8%	†	Radiological pulmonary oedema and cardiomegaly	64%	59%	NS
6%	6.5%	NS	Cardiogenic shock	100%	95%	NS
18%	8%	‡	Hypotension without cardiogenic shock	53%	61%	NS
9%	24%	‡	No clinical or radiological evidence of mechanical complications	0%	7%	NS

Severity of infarction assessed by clinical and radiological criteria are shown for patients with and without atrial fibrillation. The left-hand columns compare the frequency of each abnormality and the right-hand columns the mortality to 12 months of patients with that abnormality. NS, not significant, * $P < 0.05$, † $P < 0.005$, ‡ $P < 0.001$.

Table 4 Arrhythmias or conduction abnormalities

Frequency			Mortality			
Atrial fibrillation (107 cases)	No atrial fibrillation (862 cases)	Difference in frequency	Atrial fibrillation (107 cases)	No atrial fibrillation (862 cases)	Difference in mortality	
19%	9%	†	Ventricular fibrillation	60%	59%	NS
22%	14%	*	Ventricular tachycardia without ventricular fibrillation	52%	26%	*
32%	34%	NS	Premature ventricular contractions without ventricular tachycardia or ventricular fibrillation	30%	19%	NS
13%	13%	NS	Complete AV block	57%	52%	NS
18%	9%	*	Right bundle-branch block	47%	52%	NS
9%	8%	NS	Left bundle-branch block	83%	70%	NS

Frequency of occurrence of various arrhythmias and conduction defects in the patients with and without atrial fibrillation are shown in the left columns and the right-hand columns show the mortality associated with that abnormality. NS, not significant, * $P < 0.05$, † $P < 0.005$.

Fig. 3 Patients with and without atrial fibrillation are divided into age groups and the numbers on top of each column indicate the total numbers of patients in each group. Within each column, the hospital mortality, as a percentage, is shown by the open bars and the additional mortality to one year by the stippled bars.

fibrillation in any particular age group, the differences were not statistically significant (Fig. 3).

The patients with atrial fibrillation tended to have similar past histories to those without atrial fibrillation except that the former had a lower incidence of previous myocardial infarction ($P < 0.05$) (Table 1). The frequency of different sites of infarction was similar in both groups (Table 2); the presence of atrial fibrillation tended to be associated with a higher mortality rate irrespective of the site of infarction but these results were not statistically significant.

Radiological abnormalities (cardiomegaly, pulmonary congestion, or oedema) and isolated hypotension were more commonly found in patients with atrial fibrillation (Table 3). The incidence of cardiogenic shock was the same in both groups. For patients with any of these abnormalities, however, the mortality rate was unaffected by the presence or absence of atrial fibrillation.

Table 4 shows frequency of conduction abnormalities and arrhythmias other than atrial fibrillation; the patients with atrial fibrillation had a significantly higher frequency of ventricular fibrillation, ventricular tachycardia, and right bundle-branch block, but a similar frequency of isolated premature ventricular complexes and complete atrioventricular block.

Single episodes of atrial fibrillation were documented in 55 patients, 2 episodes in each of 22 patients, while 30 patients had 3 or more separate episodes. Of the 220 episodes of atrial fibrillation, 26 lasted less than 30 minutes, 35 less than 60 minutes, 46 between 1 and 2 hours, 41 between 2 and 4 hours, and 98 over 4 hours. The duration of atrial fibrillation could not be determined in a further 3 episodes. Episodes of atrial fibrillation tended to be shorter in patients in whom they were multiple. Of the 55 patients with single episodes of atrial fibrillation, 17 (31%) died, of the 22 with 2 episodes, 9 (41%) died, and of the 30 with multiple episodes, 13 (43%) died; these differences in mortality were not significant.

Among the 55 patients with single episodes of atrial fibrillation, the mean ventricular rate after atrial fibrillation developed was less than 100/minute in 20 patients, 100 to 119/minute in 7 patients, 120 to 140/minute in 20 patients, and over 140/minute in 8 patients.

Discussion

Atrial fibrillation is a relatively frequent arrhythmia in patients with acute myocardial infarction managed in a CCU, occurring in 11 per cent of our patients and 7 to 20 per cent of other reported series (Stannard and Sloman, 1967; Klass and Haywood, 1970; Helmers *et al.*, 1973; Cristal *et al.*, 1976; Liberthson *et al.*, 1976). Our data showed that patients with atrial fibrillation tended to have a higher hospital mortality, especially in the general wards after discharge from the CCU, and had a significantly higher mortality at 1 year than those patients without atrial fibrillation. Higher hospital mortality rates were found in almost half of the reports reviewed by Klass and Haywood in 1970 and in one (Cristal *et al.*, 1976) of two reports since then (Cristal *et al.*, 1976; Liberthson *et al.*, 1976). Any increase in mortality found in association with atrial fibrillation is probably the result of more extensive myocardial damage rather than of the arrhythmias (Stannard and Sloman, 1967; Klass and Haywood, 1970; Helmers *et al.*, 1973; Cristal *et al.*, 1976; Liberthson *et al.*, 1976).

We examined the frequency of and mortality associated with atrial fibrillation in relation to other known prognostic factors, such as the age of the patient, site of infarction, and the occurrence of mechanical or electrical complications. Patients with atrial fibrillation tended to be in an older age group; 64 per cent of our patients with atrial fibrillation were over 60 years and they had a mean age of 62.3 years compared with 63 to 67 years in other reports (Klass and Haywood, 1970; Cristal *et al.*,

1976; Liberthson *et al.*, 1976). The mortality of patients with myocardial infarction either with or without atrial fibrillation is clearly related to age (Norris *et al.*, 1969; Hunt *et al.*, 1977). Within each age group, however, our patients with atrial fibrillation had a similar mortality rate to those without atrial fibrillation. Thus the increased mortality associated with atrial fibrillation was at least partly related to the association of this arrhythmia with an older age group.

Although it has been reported that atrial fibrillation was more frequent with anterior than with inferior infarctions (Meltzer and Cohen, 1972), we and others found that the different sites of infarction were associated with similar frequencies of atrial fibrillation (Klass and Haywood, 1970; Helmers *et al.*, 1973; Cristal *et al.*, 1976; Liberthson *et al.*, 1976). Patients with atrial fibrillation tended to have a higher mortality, wherever the site of infarction. Cristal *et al.* (1976) reported a 50 per cent mortality in patients with anterior infarction and atrial fibrillation compared with only 10 per cent in patients with inferior infarction and atrial fibrillation, though there were only 10 patients in the latter group; they speculated that different mechanisms might be responsible for the production of atrial fibrillation in anterior and inferior infarction.

The association of atrial fibrillation with more severe myocardial infarction has already been suggested as a major cause of the high mortality associated with this arrhythmia (Stannard and Sloman, 1967; Klass and Haywood, 1970; Helmers *et al.*, 1973; Cristal *et al.*, 1976; Liberthson *et al.*, 1976). Our data certainly confirm this association with increased severity of infarction assessed on either clinical or radiological grounds, but within any subgroup of severity the presence of atrial fibrillation was not associated with an increased mortality.

As well as having more mechanical complications our patients with atrial fibrillation had a higher incidence of ventricular fibrillation and tachycardia. The association of atrial fibrillation with other atrial arrhythmias has previously been noted (Liberthson *et al.*, 1976) but the association with ventricular arrhythmias has not been previously mentioned.

In the setting of acute myocardial infarction, atrial fibrillation was found to be a recurrent arrhythmia in half of our present series and of our previously reported series (Stannard and Sloman, 1976) and in 17 to 26 per cent of other reports (Klass and Haywood, 1970; Helmers *et al.*, 1973; Cristal *et al.*, 1976). Episodes lasted 2 hours or less in 40 per cent of our patients and over 4 hours

in another 40 per cent of patients. Cristal *et al.* (1976) found that 56 per cent of episodes lasted less than 1 hour, and that the duration of atrial fibrillation was inversely related to mortality. We also found a trend towards high mortalities in association with prolonged episodes.

The haemodynamic effects of atrial fibrillation in acute myocardial infarction have previously been reported elsewhere (Liberthson *et al.*, 1976); 11 per cent of their patients tolerated the arrhythmia without difficulty, 74 per cent were 'marginally compensated', and 15 per cent 'acutely unstable'. Cardioversion was required in 6 to 9 per cent of other reported series (Klass and Haywood, 1970; Liberthson *et al.*, 1976) but only for one of our patients. Rapid ventricular rates have been reported to be associated with a high mortality as might be expected (Klass and Haywood, 1970; Helmers *et al.*, 1973), but not all reports have confirmed this (Cristal *et al.*, 1976). Ventricular rates of over 120 per minute were found in half of our patients also and in other series (Klass and Haywood, 1970; Helmers *et al.*, 1973; Cristal *et al.*, 1976). We have no data on how many patients were receiving digitalis at the time of development of atrial fibrillation but there were probably few as our policy is to treat patients with failure initially with diuretics.

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