Papers and Originals

Assessment of Arrhythmias in Myocardial Infarction

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Brit. med. J., 1967, 2, 719–723

Continuous monitoring of patients with acute myocardial infarction has demonstrated the frequent occurrence of arrhythmias in the first few days after the acute episode (Julian *et al.*, 1964a; Robinson *et al.*, 1964; Meltzer and Kitchell, 1966; Goble *et al.*, 1966). It is claimed that the mortality of myocardial infarction increases when accompanied by arrhythmias (Rosenbaum and Levine, 1941; Imperial *et al.*, 1960; Julian *et al.*, 1964b). The prognosis of myocardial infarction when accompanied by specific arrhythmias has so far been determined without allowing for variables such as the severity of the patient's illness and the presence of other additional arrhythmias. Overall mortality figures thus may give an erroneous impression of the significance of specific arrhythmias in myocardial infarction. This study aims to answer the following questions:

1. Is the higher mortality of myocardial infarction, when associated with arrhythmias, due to the more frequent incidence of arrhythmias in severely ill patients? To answer this we analysed the incidence of mortality of arrhythmias in three groups of myocardial infarction classified according to clinical severity.

2. Is the higher mortality associated with arrhythmias related to the number occurring in the one patient? If so, is that mortality due to their occurrence in the more severely ill patient? The incidence and mortality of multiple arrhythmias in the three clinical groups were studied.

3. Are there any specific arrhythmias responsible for the increased mortality associated with multiple arrhythmias? The mortality rates of arrhythmias above and below the atrioventricular node were compared.

Materials and Methods

Two hundred patients admitted consecutively into a coronary care unit with the diagnosis of transmural myocardial infarction were studied. All had electrocardiographic evidence of transmural infarction and raised serum aspartate aminotransferase activity. Cases were classified according to clinical severity into one of three groups—namely, "mild," "severe," and "cardiogenic shock"—30 minutes after relief of pain and administration of oxygen. Severe cases were those with a systolic blood pressure of less than 100 mm. Hg and/or the presence of left ventricular failure as judged clinically. Cardiogenic shock was diagnosed in the presence of a systolic blood pressure of less than 80 mm. Hg, together with cyanosis, cold extremities, and diminished or absent peripheral pulses.

All patients were monitored throughout their stay in the coronary care unit as previously described (Robinson *et al.*, 1964). An automatic alarm with a delay period of eight seconds was preset to record arrhythmias of a rate less than 60 or greater than 120 a minute. In addition, hourly electrocardiographic strips were kept as a permanent record.

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Supraventricular tachycardia, atrial flutter, and atrial fibrillation were treated with the conventional drugs digoxin, procainamide, or propranolol, or with D.C. counter-shock; ventricular tachycardia and ventricular fibrillation with procainamide, propranolol, and D.C. shock; and atrioventricular block with atropine, isoproterenol and hydrocortisone. Cardiac arrest was managed as previously described (Robinson *et al.*, 1964; Stock, 1966).

Arrhythmias were divided into "major" and "minor." Major arrhythmias were those which were thought to be potentially serious—namely, atrial fibrillation, supraventricular tachycardia (including atrial flutter), nodal tachycardia, ventricular tachycardia, ventricular fibrillation, second- and third-degree atrioventricular block, and the conduction disturbance of left or right bundle-branch block. Ventricular standstill and idioventricular rhythm were not included, since these are usually terminal rhythms. The minor arrhythmias—namely, ventricular extrasystoles and sinus tachycardia—were also studied. When a solitary arrhythmia occurred in the one patient it was referred to as "lone" arrhythmia. If two or more arrhythmias occurred in the same patient they were termed "multiple" arrhythmias.

Results

Of the 200 patients studied 90 had mild infarction, 93 had severe infarction, and 17 had cardiogenic shock (Table I).

TABLE I.—*Incidence of Arrhythmias and Severity of Infarction*

	Mild	Severe	Shock	Total
Sinus rhythm	19	15	1	35
Minor arrhythmias ..	50	31	4	85
Major „	21	47	12	80
Total	90	93	17	200

Mild, severe, and shock denote severity of infarction as defined in text.

Incidence of Major Arrhythmias

Incidence of Major Arrhythmias and the Clinical Severity of Infarction.—Thirty-five patients (17.5%) maintained sinus rhythm; the remaining 165 (82.5%) had arrhythmias. Eighty patients (40%) had major arrhythmias. The incidence of major arrhythmias increased with clinical severity, being statistically highly significant ($\chi^2=21.347$; $P>0.001$—χ^2 with Yates's correction).

Incidence of Lone and Multiple Major Arrhythmias and Severity of Infarction.—Of the 80 patients with major arrhythmias, 42 (52.5%) had lone and 38 (47.5%) had multiple arrhythmias (Table II). The frequency of multiple arrhythmias increased with clinical severity and was statistically significant ($\chi^2=10.23$; $P<0.01$).

Incidence of Specific Major Arrhythmias.—This varied between 8.5 and 12.5% (see Table VI), and all these arrhythmias except atrial fibrillation were more common in severe infarction.

TABLE II.—*Incidence of Lone and Multiple Major Arrhythmias in Myocardial Infarction*

	Mild	Severe	Shock	Total
Multiple	6	22	10	38
Lone	15	25	2	42
Total	21	47	12	80

Relative Incidence of Multiple Supranodal and Infranodal Arrhythmias and Severity of Infarction.—It has already been stated that the incidence of multiple arrhythmias increased with the severity of infarction. The ratio of patients with two arrhythmias below the node out of the total number of patients with multiple arrhythmias was also lower in mild infarction (two out of six) than in severe infarction (13 out of 22). The incidence of multiple arrhythmias of supraventricular arrhythmias with one arrhythmia or conduction disturbance below the node was similar in mild (two out of six) and severe (8 out of 22) infarction. Only one of these 22 patients had multiple supraventricular arrhythmias without associated infranodal arrhythmias.

Major Arrhythmias and Mortality

Lone and Multiple

Major arrhythmias were associated with an increased mortality which was most pronounced in patients with multiple arrhythmias (Table III). Thus the mortality of patients with sinus rhythm was 17% and of those with sinus tachycardia and ventricular extrasystoles 15%, whereas patients with major arrhythmias had a mortality of 51%. Mortality of patients with lone arrhythmias was 38%, compared with a mortality of 62% in multiple arrhythmias. This difference was statistically highly significant ($\chi^2=27.00$; $P<0.0005$).

TABLE III.—*Mortality of Patients in Sinus Rhythm with Minor and Major Arrhythmias in Myocardial Infarction*

	Sinus Rhythm	Arrhythmias				Total No. of Patients
		Minor	Major			
			Lone	Multiple	Total	
Deaths ..	6	13	16	25	41	60
Survivors	29	72	26	13	39	140
Total	35	85	42	38	80	200

For definition of lone, multiple, minor, and major, see text.

Clinical Severity

The mortality of patients in the three groups—mild, severe, and cardiogenic shock—was found to increase with increasing clinical severity (Table IV). The effect of arrhythmias on mortality could not be assessed in mild infarction, as overall mortality was extremely low ; nor could it be assessed in cardiogenic shock, which was almost always fatal. It was obvious, however, that arrhythmias were not a critical factor in either group. The group with severe infarction was, however, deserving of further analysis (Table V).

TABLE IV.—*Overall Mortality of Patients in the Three Clinical Groups of Infarction*

	Mild	Severe	Shock	Total
Deaths	3	41	16	60
Survivors	87	52	1	140
Total	90	93	17	200

TABLE V.—*Mortality of Patients in Sinus Rhythm, with Minor and Major Arrhythmias in Severe Myocardial Infarction*

	Sinus Rhythm	Arrhythmias				Total No. of Patients
		Minor	Major			
			Lone	Multiple	Total	
Deaths ..	4	10	12	15	27	41
Survivors	11	21	13	7	20	52
Total	15	31	25	22	47	93

Severe Infarction

Lone and Multiple.—The mortality of patients with severe infarction in sinus rhythm was 27%. There was a slight rise in the presence of sinus tachycardia and ventricular extrasystoles (32%), whereas the rate was appreciably higher in the presence of major arrhythmias (53%). The mortality of patients with multiple arrhythmias in severe infarction was much higher (68%) than that of lone arrhythmias (48%). The number of patients was inadequate for demonstration of statistical significance (Fisher's test: $P>0.05$), but the data would indicate that multiple arrhythmias are associated with a higher mortality than the lone variety.

Specific Arrhythmias.—The overall mortality associated with each specific arrhythmia appeared to be higher than the mortality of patients in persistent sinus rhythm. In severe infarction each specific arrhythmia appeared to be associated with a high mortality. Mortality of each arrhythmia was higher when multiple than when lone (Table VI).

TABLE VI.—*Specific Major Arrhythmias*

	Mild		Severe						Mild + Severe			Total including Shock
				Multiple								
	Lone	Total	Lone	With One I.N.A. ± S.V.A.	Total S.V.A. ± I.N.A.	With Two I.N.A. ± S.V.A.	Total Multiple	Total	Lone	Multiple	Total	
Atrial fibrillation	2 (0)	7 (0)	2 (1)					8 (5)	4 (1)	11 (4)	15 (5)	17 (7)
Supraventricular tachycardia, including atrial flutter	1 (1)	3 (1)	3 (1)					11 (6)	4 (2)	10 (5)	14 (7)	18 (11)
Nodal tachycardia ..	1 (0)	2 (0)	5 (2)					13 (8)	6 (2)	9 (6)	15 (8)	20 (13)
All patients with S.V.A. ..	4 (1)	9 (1)	10 (4)	8 (2)	9 (3)	7 (6)	16 (9)	26 (13)	14 (5)	21 (9)	35 (14)	47 (25)
Ventricular tachycardia ..	5 (0)	6 (0)	1 (0)					16 (11)	6 (0)	16 (11)	22 (11)	25 (14)
" fibrillation ..	3 (0)	6 (0)	6 (4)					14 (10)	9 (4)	11 (6)	20 (10)	20 (10)
2nd and 3rd degree atrioventricular block ..	1 (0)	3 (0)	4 (2)					14 (10)	5 (2)	12 (8)	17 (10)	22 (15)
Complete right or left bundle-branch block ..	2 (1)	2 (1)	4 (2)					8 (6)	6 (3)	4 (4)	10 (7)	14 (11)
All patients with I.N.A. ..	11 (1)	15 (1)	15 (8)					36 (22)	26 (9)	25 (14)	51 (23)	60 (32)
All patients with arrhythmia	15 (2)	21 (2)	25 (12)		9 (3)	13 (12)	22 (15)	47 (27)	40 (14)	28 (15)	68 (29)	80 (41)
Total No. of patients ..		90 (3)						93 (41)			183 (44)	200 (60)

I.N.A. = Infranodal arrhythmias. S.V.A. = Supraventricular arrhythmias. ± = With or without. Numbers in parentheses denote number of deaths.

Comparison of Mortality of Supraventricular and Nodal Arrhythmias with Arrhythmias and Conduction Disturbances below the Atrioventricular Node in Severe Infarction.—The mortality of patients with severe infarction and lone arrhythmias or conduction disturbances below the atrioventricular node (8 out of 15) (Table VI) was higher than that of patients with severe infarction and lone arrhythmias at or above the atrioventricular node (4 out of 10) (Table VI), but this was not statistically significant (Fisher's test: $P>0.05$). There was only one patient with severe infarction and multiple arrhythmias above the node only, and he died. The mortality among patients with severe infarction and multiple arrhythmias of one or more arrhythmias above the node and one arrhythmia or conduction disturbance below the node was less (two out of eight) (Table VI) than among patients with multiple arrhythmias of two arrhythmias or conduction disturbance below the node (12 out of 13) (Table VI), and this was statistically significant (Fisher's test: $P<0.05$). Mortality was similar whether these were accompanied by arrhythmias above the node (six out of seven) (Table VI) or unaccompanied by arrhythmias above the node (six out of six). Though the samples were small these findings suggested that the infranodal arrhythmias were the more serious.

Multiple Infranodal Arrhythmias and Severity of Infarction.—Mortality in the group of patients with multiple arrhythmias below the atrioventricular node was 12 out of 13 (Table VI). In those with multiple arrhythmias of which only one arrhythmia arose below the node, mortality was two out of eight (Table VI). This suggests that it is not the specific infranodal arrhythmias which are responsible for mortality but that the multiple infranodal arrhythmias are more likely to occur in the more severely ill patients. Furthermore, this suggestion is supported by the occurrence of ventricular fibrillation, atrioventricular block, and atrial fibrillation in one patient with mild infarction, and ventricular fibrillation and ventricular tachycardia in another patient with mild infarction, both patients having survived.

Minor Arrhythmias

Sinus Tachycardia.—This occurred more often in severe myocardial infarction than in mild infarction (Table VII). Furthermore, sinus tachycardia appeared to be associated with increased mortality in severe infarction (Table VII). However, when those patients who had other accompanying major arrhythmias were excluded (see Table VIII a) the mortality of patients with severe infarction and sinus tachycardia but without other arrhythmias (33%) was almost the same as that of patients with sinus rhythm (27%) (Table VIII d).

TABLE VII.—*Incidence and Mortality of Patients with Minor Arrhythmias*

	Mild	Severe	Shock	Total
	Sinus Tachycardia			
Deaths	2	19	4	25
Survivors	24	20	1	45
Total	26	39	5	70
	Ventricular Extrasystoles			
Deaths	2	27	12	41
Survivors	54	34	1	89
Total	56	61	13	130

Ventricular Extrasystoles.—Table VII shows that 130 (65%) out of 200 patients had accompanying ventricular extrasystoles. The incidence of ventricular extrasystoles increased with clinical severity. The mortality of patients with severe infarction when accompanied by ventricular extrasystoles (44%) appeared to be higher than that of patients in sinus rhythm (27%); however, when patients with ventricular extrasystoles and accompanying major arrhythmias were excluded (Table VIII b) the mortality of those with lone ventricular extrasystoles (27%) was similar to that of those with severe infarction in sinus rhythm (27%). Patients with severe infarction and accompanying ventricular extrasystoles and sinus tachycardia had an associated mortality of 36%, and this did not (Table VIII c) significantly differ when compared with the mortality of patients with severe infarction in sinus rhythm (27%) (Table VIII d).

TABLE VIII.—*Incidence and Mortality of Patients with Minor Arrhythmias, Excluding Those with Accompanying Major Arrhythmias*

	Mild	Severe	Shock	Total
(a) *Lone. Sinus Tachycardia*				
Deaths	0	2	—	2
Survivors	7	4	—	11
Total	7	6	—	13
(b) *Lone. Ventricular Extrasystoles*				
Deaths	0	3	—	3
Survivors	35	8	—	43
Total	35	11	—	46
(c) *Ventricular Extrasystoles and Sinus Tachycardia*				
Deaths	0	5	3	8
Survivors	8	9	1	18
Total	8	14	4	26
(d) *Sinus Rhythm*				
Deaths	1	4	1	6
Survivors	18	11	0	29
Total	19	15	1	35

Review of Specific Arrhythmias (In mild and severe infarction only)

Atrial Fibrillation.—There were 15 patients with atrial fibrillation, of whom five died. All seven with mild infarction survived. Of two patients with severe infarction and lone atrial fibrillation one died. Of four patients with multiple arrhythmias, excluding those with two or more infranodal arrhythmias, two died. Both patients with two or more associated infranodal arrhythmias also died.

Supraventricular Tachycardia.—Of 14 patients with this arrhythmia, seven died. Of three with mild infarction, one died of an unrelated condtion 20 days after infarction. One of three patients died with severe infarction and lone supraventricular tachycardia. One of three patients died with multiple arrhythmias, those with two or more infranodal arrhythmias being excluded. Four out of five patients with two or more infranodal arrhythmias died.

Nodal Tachycardia.—Of 15 patients with this arrhythmia, eight died. Only one patient with mild infarction developed this arrhythmia and survived. Two out of five patients died with severe infarction and lone nodal tachycardia. Two out of four patients died with multiple arrhythmias, those with two or more infranodal arrhythmias being excluded. All four patients with two or more infranodal arrhythmias died.

Ventricular Tachycardia.—Of 22 patients with ventricular tachycardia 11 died. All six patients with mild myocardial infarction and ventricular tachycardia survived. In severe infarction, ventricular tachycardia associated with atrioventricular block, ventricular fibrillation, or bundle-branch block had a very high mortality (9 out of 10). When it was associated with supraventricular arrhythmias only, or when lone, four out of six patients survived.

Ventricular Fibrillation.—Of 20 patients with ventricular fibrillation 10 died. All six with mild infarction and ventricular fibrillation survived, whether lone or multiple. The mortality of patients with severe infarction and ventricular fibrillation was high, whether lone (four out of six) or multiple (six out of eight). Ventricular fibrillation if associated with atrioventricular block or ventricular tachycardia was almost always fatal (six deaths among seven patients).

Atrioventricular Block.—Of 17 patients with second- or third-degree block, 10 died. All three patients with mild infarction and atrioventricular block survived. When the condition occurred as a lone arrhythmia in severe infarction, two out of four patients died. When it was multiple, 8 out 10 patients died. When associated with ventricular tachycardia or ventricular fibrillation, all died. The two survivors with severe infarction and atrioventricular block had atrial fibrillation and nodal tachycardia respectively.

Right or Left Bundle-branch Block.—Ten patients had bundle-branch block, of whom seven died. In one of two mild cases death occurred from lone bundle-branch block, and of four patients with severe infarction and lone bundle-branch block two died. All those with severe infarction, bundle-branch block, and any other accompanying infranodal arrhythmias died.

Discussion

Incidence of Arrhythmias

The observed incidence of arrhythmias in myocardial infarction is affected by a number of variables. First, as arrhythmias occur more commonly in the first 24 hours, observations of myocardial infarction from the onset will result in a higher incidence than if patients are observed at a later stage, even for a longer period. The frequency with which arrhythmias are recorded will also affect results. Thus continuous tape recordings of electrocardiograms are likely to pick up more arrhythmias than the method employed in this series.

It is therefore not surprising that the reported incidence of monitored arrhythmias in myocardial infarction varies between 73 and 95% (Imperial *et al.*, 1960 ; Spann *et al.*, 1964 ; Julian *et al.*, 1964a ; Robinson *et al.*, 1964). The reported mortality associated with arrhythmias will be less the greater the frequency with which they are recorded. Thus in series where transient episodes are recorded mortality will be lower than in series which record the electrocardiogram on a delayed alarm system or at even less frequent intervals.

It was shown that the overall incidence of major arrhythmias increases with the severity of infarction (Table I), and that the more severe the clinical condition the more often were they associated with multiple arrhythmias (Table II).

The overall incidence of specific arrhythmias in this series (Table VI) varied from 8.5% in the case of atrial fibrillation to 12.5% in ventricular tachycardia. Julian *et al.* (1964a), in 100 patients, found an incidence of 6% for supraventricular tachycardia, 16% for atrial fibrillation, 6% for ventricular tachycardia, 10% for ventricular fibrillation, 18% for first- and third-degree atrioventricular block, and 13% for bundle-branch block. Spann *et al.* (1964), in a small series of 20 patients, stated that more than one arrhythmia was observed to occur in 40% of their arrhythmia cases. In the present series 47% of patients with major arrhythmias were multiple cases, and the incidence of all arrhythmias, excluding sinus tachycardia, was 76% ; including sinus tachycardia, it was 82.5%.

Mortality and Arrhythmias

Comparison of reported mortality rates associated with arrhythmias in acute myocardial infarction is difficult because of the variation of the types of arrhythmias included in the different series. Thus Rosenbaum and Levine (1941), in a retrospective study of 208 unmonitored patients, found the incidence of arrhythmias to be 38% and the mortality 42%. Imperial *et al.* (1960), in a series of 173 patients, found an incidence of 73% and a mortality of 45% ; and Julian *et al.* (1964a), in a study of 100 patients, found an incidence of 95% and a mortality of 60%. In the present series the incidence of arrhythmias was 82.5% and the mortality of patients with major arrhythmias only was 51% (Table IV).

Julian *et al.* (1964a) found that the mortality rate associated with supraventricular tachycardia was 50%, with atrial fibrillation 31%, ventricular tachycardia 67%, ventricular fibrillation 90%, atrioventricular block 34%, and bundle-branch block 62%. Askey and Neurath (1945) found atrial fibrillation to be associated with a mortality of 80%. Rosenbaum and Levine (1941) reported a mortality of 36% associated with atrial fibrillation and of 50% with ventricular tachycardia. The overall mortality of specific arrhythmias in the present series (Table VI) was 41% in atrial fibrillation, 61% in supraventricular tachycardia, 65% in nodal tachycardia, 56% in ventricular tachycardia, 50% in ventricular fibrillation, 68% in atrioventricular block, and 79% in bundle-branch block.

The above results in this series, as in others quoted, were obtained by collecting all patients with a specific arrhythmia and determining the number of deaths among them. Such a procedure ignores the severity of infarction, the presence of cardiogenic shock, and the occurrence of other accompanying arrhythmias in the same patient. We found that the prognostic significance of arrhythmias in myocardial infarction could be assessed only in conjunction with the clinical severity as judged by the haemodynamic effects accompanying the infarction. Thus under conditions of observation and treatment in a coronary care unit, none of the major arrhythmias, with the possible exception of the conduction disturbance of complete bundle-branch block, adversely affected mortality of patients with mild infarction. The prognosis in those with cardiogenic shock was almost uniformly fatal, irrespective of the presence of associated arrhythmias. In severe infarction the presence of two or more infranodal arrhythmias was with one exception uniformly fatal (Table VI), this finding being statistically significant.

These results suggest that the high mortality among patients with multiple arrhythmias is due to the frequent occurrence of multiple infranodal arrhythmias in association with severe infarction.

The prognostic effect of specific major arrhythmias was therefore reassessed in the light of these findings. None of the arrhythmias, if treated, were found to affect the prognosis of mild infarction adversely, nor were they of any apparent significance in the fatal result of cardiogenic shock. In severe infarction, when cases of multiple infranodal arrhythmias were excluded, the mortality ranged between 33% for supraventricular tachycardia, ventricular tachycardia, and atrioventricular block ; and 50% for atrial fibrillation, nodal tachycardia, ventricular fibrillation, and bundle-branch block, thereby demonstrating a lack of demarcation between the mortality associated with arrhythmias above or below the atrioventricular node.

Cause of Mortality : Severity or Arrhythmia

This study has shown that the overall mortality of patients with arrhythmias was higher than that of those without arrhythmias (Table III), this difference being statistically significant. Further, it was shown that multiple arrhythmias had a higher mortality rate than lone arrhythmias ; this difference was also statistically significant. Both findings were expected because of the observed increasing overall incidence of major arrhythmias, multiple arrhythmias, and multiple infranodal arrhythmias with more severe infarction. However, it was found that within the group of patients with severe infarction (Table VI) the mortality of those with all major arrhythmias was higher than in those with the same clinical severity of infarction and no accompanying arrhythmias, though this difference was not statistically significant. The observation that the combination of two or more infranodal arrhythmias was fatal in severe infarction but not in mild infarction would support the theory that it is the severity of infarction and not the arrhythmia which causes the increased mortality.

Minor Arrhythmias

Sinus tachycardia and ventricular extrasystoles were not associated with an increased mortality if patients who had other major accompanying arrhythmias were excluded (Table VIII). Previous calculations of mortality associated with arrhythmias have, by failing to allow for this factor, fallaciously overemphasized the effects and importance of these arrhythmias in myocardial infarction. Thus Julian *et al.* (1964a) report a mortality of 44% in patients with sinus tachycardia, and Rosenbaum and Levine (1941) found a mortality of 52% in 208 cases and Mintz and Katz (1947) a mortality of 57% in 572 cases. Mintz and Katz (1947) reported a mortality of 50% and Woods and Barnes (1942) a mortality of 82% in patients with frequent ventricular extrasystoles.

Significance of Arrhythmias

It is now generally agreed that arrhythmias are very common in myocardial infarction, but their significance is still under consideration.

In the present series arrhythmias were found in 82.5% of 200 monitored patients. The significance of short bursts of spontaneously resolving arrhythmias is uncertain. We now know that such bursts do occur, and that, though they may serve as a warning for the institution of prophylactic measures, they are unlikely to cause any direct deterioration. Prolonged arrhythmias may reduce the stroke volume, the length of diastole, and therefore coronary perfusion with consequent hypotension or cardiac failure. It is difficult to ascertain if continuous monitoring results in mortality reduction due to the early recognition of arrhythmias, as a control series of untreated patients is not available for comparison. However, this study has shown that under conditions of observation, nursing, and treatment in a coronary care unit arrhythmias in mild infarction, if treated, do not appear to present a problem, nor do they seem to affect adversely the mortality of the patients with mild myocardial infarction. These results may be due to the early recognition and effective control of arrhythmias made possible by continuous monitoring in a coronary care unit. In severe infarction with more than two associated infranodal arrhythmias, and in cardiogenic shock, the mortality is high, despite correction of the arrhythmias.

It appears that the prognosis of myocardial infarction should be improved if patients are monitored in a coronary care unit. Ten patients who were reverted to sinus rhythm and lived after ventricular fibrillation would not have survived without the recognition and reversion of the arrhythmia. It is known that ventricular fibrillation can spontaneously revert to sinus rhythm, but this is rare (Goble, 1965). In our series a further 39 patients (19 with mild infarction and 20 with severe infarction) with major arrhythmias survived. It is difficult to assess if these survivors owed their better fate to the recognition and correction of arrhythmias, and therefore the prevention of other complications, or if prognosis was improved by the early recognition and correction of hypotension and cardiac failure. It is probable that both pathways are operative in breaking a vicious cycle of the interaction of arrhythmias and haemodynamic complications with resulting deterioration of the patient.

Summary

The incidence of arrhythmias occurring in 200 patients with the diagnosis of acute transmural myocardial infarction monitored in a coronary care unit is presented.

Major arrhythmias were frequent complications in the early phase of myocardial infarction. They occurred in association with other arrhythmias in the same patient as often as they occurred singly. Their frequency increased with increasing severity of the patient's clinical condition.

Mortality associated with arrhythmias varied with the severity of the clinical condition and the presence of multiple arrhythmias. In "mild" infarction, major arrhythmias, including ventricular fibrillation, if treated, did not cause an increase of mortality. In patients with "cardiogenic shock" mortality was so high that arrhythmias were not a critical factor. With "severe" infarction ventricular fibrillation, atrioventricular block, and bundle-branch block, despite treatment, were associated with a high mortality if occurring alone, and were invariably fatal if occurring together in the one patient. The apparently higher mortality associated with infranodal arrhythmias in severe infarction was related to the frequent occurrence of other infranodal arrhythmias in the one patient.

The minor arrhythmias—namely, ventricular extrasystoles and sinus tachycardia—did not affect the mortality rate when occurring alone.

The value of continuous monitoring in the improvement of the prognosis of myocardial infarction is discussed.

We thank the physicians of the Royal Melbourne Hospital for their co-operation in this study. The National Heart Foundation of Australia and the Committee of the Royal Melbourne Hospital supported this work. The valuable assistance of Dr. J. S. Robinson in the management of patients and of Dr. Russell Langley in the statistical analyses is acknowledged.

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