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ST. segment displacement in myocardial infarction*

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ABSTRACT

The prognostic value of ST segment displacement after acute myocardial infarction is investigated, with particular reference to hospital practice without the service of continuous monitoring system. The electrocardiographs of thirty-three patients with proven myocardial infarction were studied for the relationship of ST segment displacement to the site of infarct, the rise in SGOT, and the frequency of persistent hypotension, heart failure and death within 48 hours of infarction. Anterior infarcts were found to have greater ST segment displacement than infarcts in other sites. There was a direct correlation between the extent of displacement and the rise in SGOT, suggesting a relationship between displacement of ST segment and size of infarct. The displacement was also greater in complicated cases which occurred more frequently in anterior than inferior infarction. It is concluded that ST segment displacement is of predictive value and may be the only clue to the size of infarct in rural hospitals without adequate laboratory service and monitoring system.

INTRODUCTION

THE ESTABLISHMENT OF coronary care unit in larger hospitals providing continuous monitoring has enabled recognition and treatment of life threatening arrhythmias and prevention of serious complications of acute myocardial infarctions and mortality has been reduced by from 14 to 18%. But what about smaller hospitals which are ill equipped for coronary care? Can a simple ECG, supported by clinical observation and serum enzyme estimation, be of help in identifying the group of high risk patients?

This paper attempts to answer the last question, and in particular, to assess the prognostic value of ST segment displacement. The scope of study covers the relationship between ST segment displacement and

1. the site of infarct
2. serum glutamic oxaloacetic transaminase (SGOT) level
3. persistent hypotension
4. heart failure
5. death within 48 hours of infarction.

PATIENTS AND METHODS

This is a retrospective study of patients with acute myocardial infarction admitted to the District Hospital in Segamat during the period from July 1974 to March 1976.

The diagnosis of myocardial infarction was established when two of the following three criteria were met with:

1. Typical clinical history;
2. Indubitable electrocardiographic evidence of recent infarction or sequential ST and T wave changes;
3. A significant rise in SGOT level.

The infarction was regarded as subendocardial when ST depression and/or T wave inversion without Q wave development was accompanied by significant increase in SGOT.

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Exclusions:

1. Sudden deaths occurring before ECG could be recorded, presumably due to acute myocardial infarction by virtue of history of ischaemic heart disease.
2. Patients whose symptoms lasted more than 48 hours before seeking hospital admission.
3. Patients whose ECG's showed bundle branch block.
4. Patients with pericardial rub on auscultation.

In each case the ECG taken about 48 hours after the onset of infarction was studied, except in those cases that died during the early hours of infarction when the initial ECG was the only one available. The displacement of the ST segment from the isoelectric line was measured by the method of Wilson & Pantridge. The lead showing the greatest displacement was chosen. The isoelectric line was taken as the TP segment, or as the PQ segment when the TP segment was difficult to locate because of tachycardia. The point of reference on the ST segment was 0.06 seconds after the nadir of the S or QS wave, or after the R wave when no S wave was present.

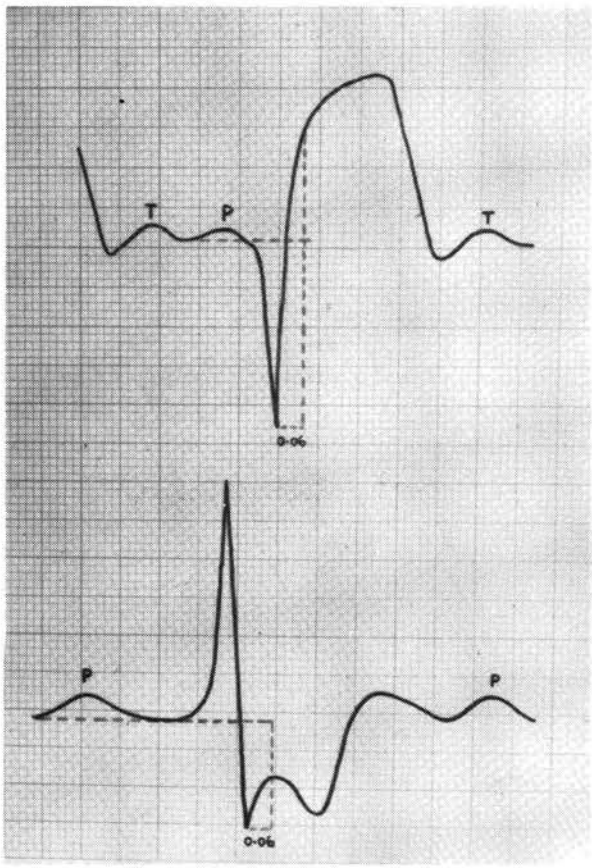

Fig. 1: Measurement of ST segment displacement. Upper tracing: transmural infarction with ST segment elevation. Lower tracing: subendocardial infarction with ST segment depression.

Whenever possible, serial estimations of SGOT were done for three successive days and the mean recorded.

Persistent hypotension was considered to be present when the systolic blood pressure remained less than 90 mm.Hg for about twenty-four hours regardless of the clinical state of the patient.

Heart failure was diagnosed either clinically by the presence of breathlessness, basal lung crepitations, third heart sound and raised jugular venous pressure, or from chest X-ray appearance.

RESULTS

Age, sex, race

Thirty three patients were included in this study, thirty one being males. There were 17 Indians, 9 Chinese and 7 Malays. Their age distribution is shown in Table 1, ranging from 38 to 79.

Table 1

Age Distribution of Patients

Age \ Race	Malays	Chinese	Indians	Total
30 –	0	0	1	1
40 –	2	2	6	10
50 –	2	1	4	7
60 –	3	2	3	8
70 – 79	0	4	3	7
Total	7	9	17	33

Site of Infarct

Anterior infarct was the commonest, with 17 out of 33 cases. The remainder consisted of equal number of inferior and subendocardial infarcts.

Arrhythmias

Twenty-six patients or 78.8% showed some disturbances of rate or rhythm within the first 48 hours of infarction. Sinus tachycardia and sinus bradycardia were the commonest disturbance. Atrio-

Table 2

Site of Infarcts

Site of Infarct	No. of Pts.	%
Anterior	17	51.5
Inferior	8	24.25
Subendocardial	8	24.25
Total	33	100

ventricular block of all degrees was seen, with one case of complete heart block, which was successfully treated with Saventrine. There were two cases of ventricular tachycardia, both died shortly after their ECG's were taken. Ventricular ectopic beats were seen in three patients; in none of these were the ectopics frequent or conforming to R on T pattern. Supraventricular tachycardia was seen in one patient who presented with sudden collapse. He responded remarkably to intravenous digoxin.

Table 3

Arrhythmias as recorded from ECG tracings

Arrhythmias	No. of Pts.
Bradyarrhythmias	
1. Sinus Bradycardia	7
2. 1° A-V Block	3
3. 2° A-V Block	2
4. 3° A-V Block	1
Tachyarrhythmias	
1. Sinus Tachycardia	7
2. Supravent. Tachy.	1
3. Ventricular E.B.	3
4. Ventricular Tachy.	2
Total	26

ST segment Displacement

Displacement of less than 5 mm was seen in 23 patients, and in 12 of them it was less than 2.5 mm. One patient showed a displacement of 15 mm, and died a few hours after the onset of chest pain before further ECG's could be recorded.

Anterior infarcts were associated with greater displacement of ST segment; in six patients it exceeded 5 mm. None of the patients with inferior infarcts showed a displacement of ST segment exceeding 5 mm. Subendocardial infarcts ranked intermediate in the degree of ST segment displacement.

Rise in SGOT level

Twenty eight patients had SGOT level estimated, but in two the results were not traceable due to loss of specimens while being dispatched to the laboratory of a general hospital.

Majority of the 26 patients had a mean rise o SGOT up to 200 I.U./L. Anterior and subendocardial infarcts were associated with higher level of SGOT, the rise in SGOT being related to the degree of ST segment displacement. Inferior infarcts were associated with rise in SGOT of 200 I.U./L. and less.

Table 4

ST segment displacement in relation to site of infarct

ST Segment Displacement	Site of Infarct			Total
	Anterior	Inferior	Subendocardial	
0 –	5	5	2	12
2.5 –	6	3	2	11
5.0 –	4	0	3	7
7.5 –	1	0	1	2
10.0 –	0	0	0	0
12.5 – 15.0	1	0	0	1
Total	17	8	8	33

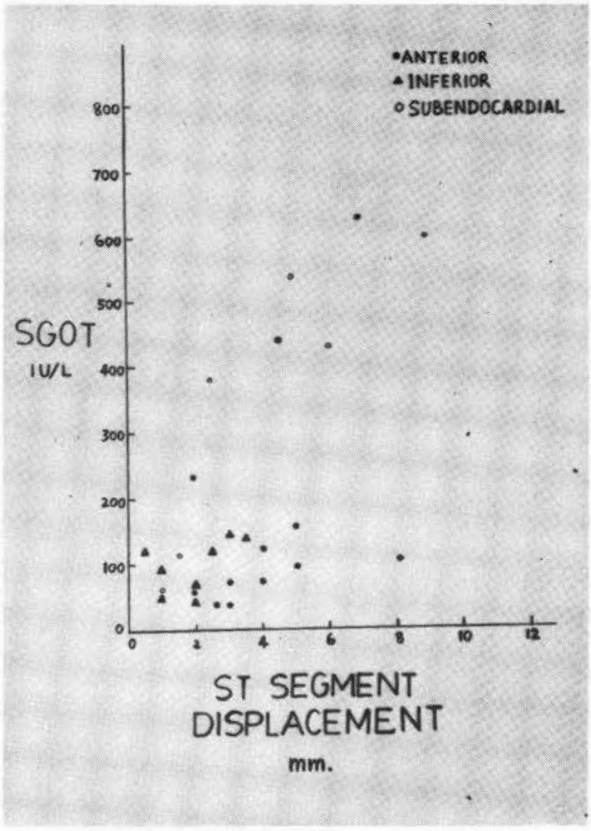

Fig. 2: Correlation between SGOT level and ST segment displacement.
Normal SGOT range: 2 to 20 I.U./L.

Complications within 48 hours of infarctions

There were 11 patients with persistent hypotension, 12 patients with heart failure and 9 patients died within the first 48 hours of infarction. Fig. 3 shows that the anterior and subendocardial infarctions were associated with a greater number of these complicated cases compared with inferior infarctions.

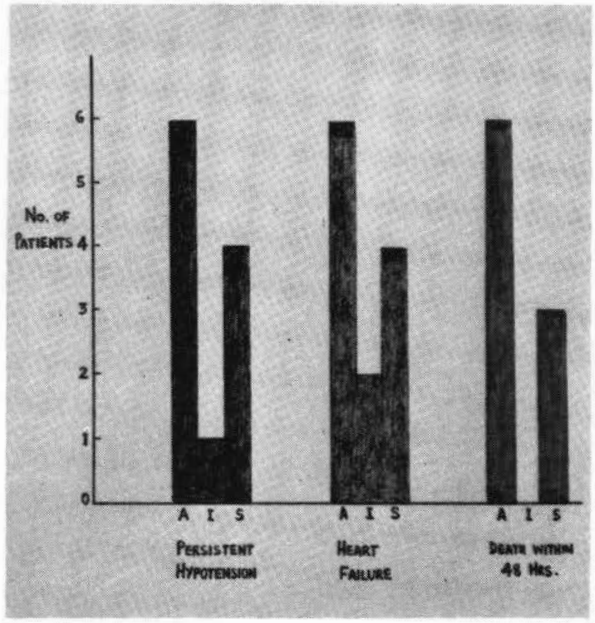

Fig. 3: Frequency of complications in relation to site of Infarct.
A = anterior infarct
I = inferior infarct
S = subendocardial infarct

Complicated cases occurred in association with ST segment displacement of various degrees. (Table 5) But in terms of the percentage of patients involved, there were more complicated cases when ST segment was greater than 5 mm. This is well

Table 5

ST segment displacement in relation to complications of infarction

ST Segment Displacement	No. of Patients	With Hypotension		With Heart Failure		Dead Within 48 hrs	
		No.	%	No.	%	No.	%
0 –	12	3	25	4	33	3	25
2.5 –	11	2	18.2	4	36.4	2	18.2
5.0 –	7	4	57.1	3	43	2	28.6
7.5 –	2	1	50	1	50	1	50
10.0 –	0	0	0	0	0	0	0
12.5 – 15.0	1	1	100	0	0	1	100
Total	33	11	33.3	12	36.4	9	27.3

seen in Figs. 4, 5 and 6 which showed that the percentage of patients with persistent hypotension, heart failure and death within 48 hours of infarction was higher when ST segment displacement exceeded 5 mm.

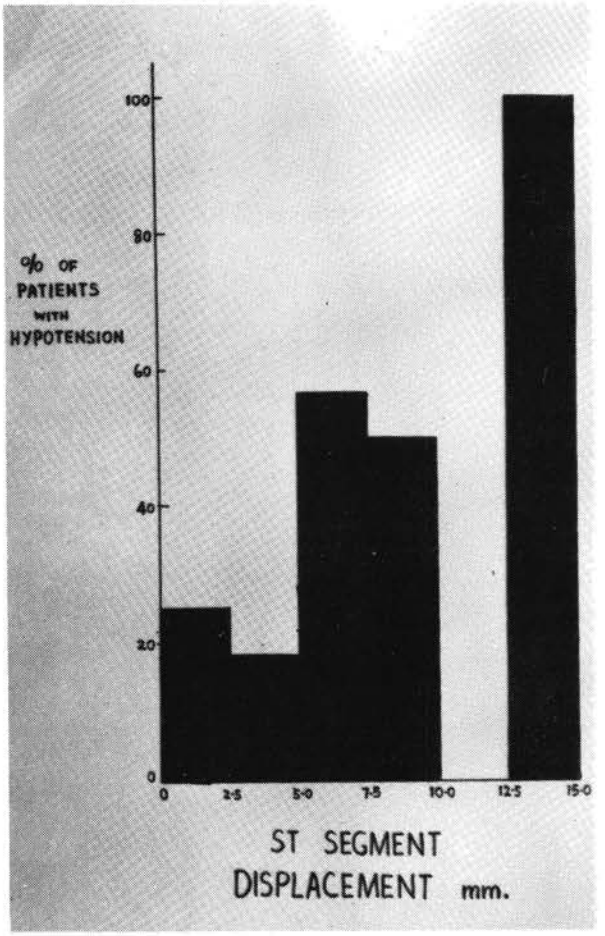

Fig. 4: Percentage of patients with hypotension in relation to ST segment displacement.

DISCUSSION

Myocardial infarction is an unpredictable disease. Sudden death may occur at any time in the mildest cases, while others who are gravely ill during the acute stage may survive to many years. Indications of grave prognosis include persistence of shock over 24 hours and early development of congestive heart failure. Transient arrhythmias are common and prognosis is not adversely affected, but a persistent irregularity, especially when due to multiple ventricular ectopic beats, ventricular tachycardia, heart block or atrial fibrillation, is of grave significance. (Scott R.B. 1973)

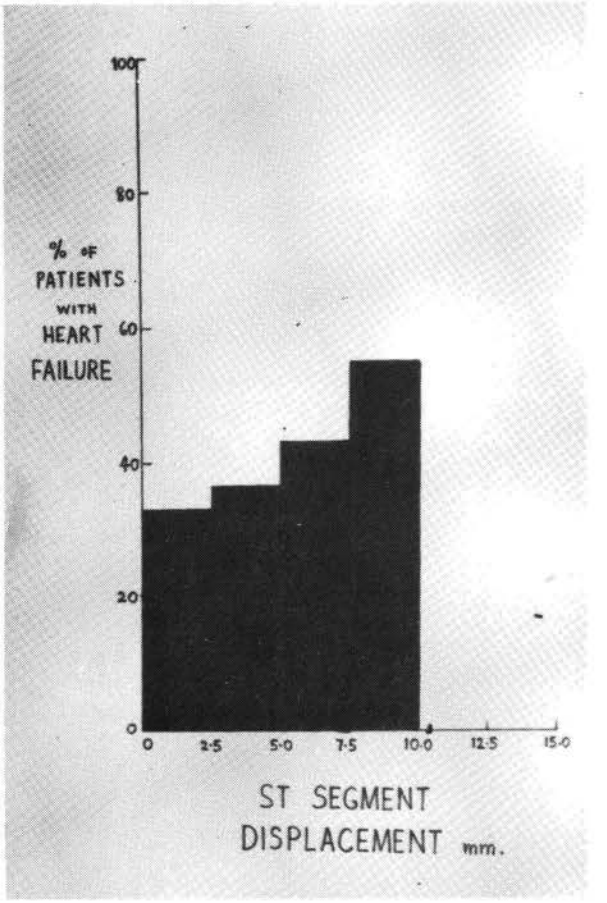

Fig. 5: Percentage of patients with heart failure in relation to ST segment displacement.

The recorded incidence of arrhythmia depends on, among other things, the availability of continuous monitoring of patients. Eric Stock (1968) reported that the incidence of monitored arrhythmias varied between 73 and 95%.

In the setting of rural hospital practice where facilities for continuous monitoring are absent, the diagnosis of arrhythmia rests on the chance finding from a routinely taken ECG tracing and is therefore limited. Thus in this study, only one case of supraventricular tachycardia and two cases of ventricular tachycardia were noted.

The incidence of major arrhythmia is known to increase with the severity of infarction, as judged by persistent hypotension, cardiac decompensation and cardiogenic shock. In these complicated cases, it is therefore worthwhile to have serial recordings of ECG taken, so that prompt treatment may be instituted, for example, when multiple ventricular ectopic beats appear.

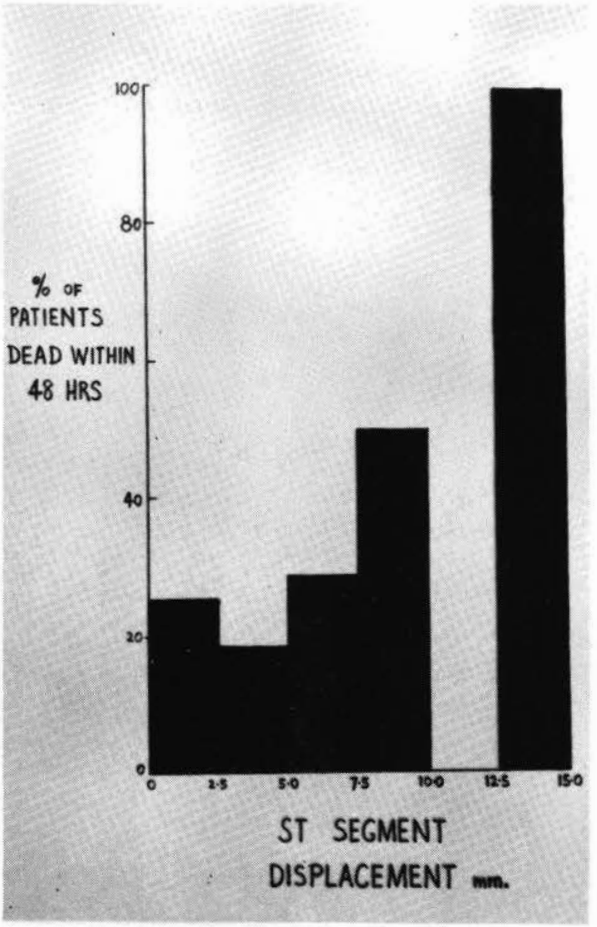

Fig. 6: Percentage of patients dead within 48 hours of infarction in relation to ST segment displacement.

However, early ventricular fibrillation is not related to the severity of the infarction (Lawrie *et al.* 1968); its detection and treatment depends very much on a specialised coronary care unit. These cases present as "sudden deaths" in hospitals without continuous monitoring service. On the other hand, late ventricular fibrillation occurring after the period of continuous monitoring, is a real risk in patients with severe infarction (Thomson & Sloman 1971) and among these patients, the finding of greatest predictive value is persistent displacement of ST segment. (Wilson & Pantridge 1973)

Cardiogenic shock and pump failure indicate the presence of a large infarct, shock occurring when more than 40% of the left ventricular muscle mass is destroyed. However, ventricular function is diminished in nearly all patients with acute transmural infarction including those without complications. Thus, there is a wide spectrum of depression of ventricular performance in transmural infarction: most extreme in cardiogenic shock, intermediate in congestive heart failure without hypotension, and least in uncomplicated infarction. (Mason D.T. 1973)

The size of an infarct may be assessed by two recently described techniques, namely the disappearance curves of serum creatinine phosphokinase (Sobel *et al* 1972) and the mapping of praecordial ST segment elevation in a 48 lead system. (Reid *et al* 1974) The results of this study have shown that even simple measurement of ST segment displacement in a single lead is itself of predictive value after myocardial infarction.

There was a good correlation between the rise in SGOT level and the extent of ST segment displacement. Furthermore, complicated cases occurred more frequently when ST segment displacement was greater. These findings suggest that ST segment displacement is a good indicator to the size of infarct.

This study has also shown that anterior infarcts were associated with greater rise in SGOT levels as well as extent in ST segment displacement, as stated by other workers (Morris et al 1974). Moreover, severe pump failure occurred more commonly with extensive anterior infarcts, compared to inferior infarcts (Mason D.T. 1973) and this too, was observed in the present study.

These findings are of particular importance to doctors practising in rural hospitals where laboratory facilities for serum enzyme estimation are often lacking, let alone continuous monitoring service. Besides clinical findings, the only clue to the severity of infarction would then be the extent of ST segment displacement. Even in hospitals with continuous monitoring, the study of ST segment displacement is still worthwhile because those cases exhibiting persistent displacement would require longer period of monitoring for late ventricular dyarrhythmias.

CONCLUSION

This study has shown that ST segment displacement is of predictive value after myocardial infarction for these reasons:

1. The extent of ST segment displacement is correlatable to the rise in SGOT level and hence to the size of the infarct.

2. Cases complicated at 48 hours by persistent hypotension, heart failure and deaths were associated with greater ST segment displacement.

3. Anterior infarcts when compared to infarcts in other sites were associated with greater ST segment displacement and more complicated cases.

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