

ORIGINAL ARTICLE

What's the point of ST elevation?

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Objective: The magnitude of ST elevation is a key piece of information in the decision to thrombolysise in acute myocardial infarction. The ability of clinicians to reliably identify ST elevation has not been previously assessed. This study sought to determine the variability in assessment of ST elevation in a group of doctors who commonly prescribe thrombolysis.

Methods: The study was conducted in three large teaching hospitals in Manchester, England. A convenience sample of 63 SHO's and SpRs from emergency and general medicine were recruited. Each was shown three sample ECG complexes. They were asked to identify and quantify the degree of ST elevation. They then indicated the points on the ECG from which they measured ST elevation.

Results: ST elevation was not identified in 12% of cases. Doctors used a wide variety of points on the ST segment to assess elevation, this resulted in a wide variation in the observed magnitude of ST elevation.

Conclusion: No guidance exists on where exactly ST elevation should be measured. This study shows a wide variation in practice. Protocol led thrombolysis decision pathways may be compromised by these findings.

The timing of thrombolysis in acute myocardial infarction (AMI) is important because the earlier it is given the more lives are saved.¹ If thrombolysis times are to be optimised, the decision must be made as soon as possible after the first doctor-patient contact. However, junior doctors are usually the first medical staff to see the patient with chest pain. Consequently thrombolysis decisions are typically made at a junior level. Strict guidelines are used in many hospitals to help identify those patients suitable for thrombolysis. An essential question in the decision to thrombolysise is the detection and quantification of ST elevation² as those patients with ST elevation have been shown to most benefit from thrombolysis.³

In early 1999 an internal audit of thrombolysis revealed a number of patients in whom AMI had been incorrectly diagnosed. It was postulated that one reason for this may be the variation in assessment of ST elevation among junior doctors.

The aim of this study was to determine if doctors who currently prescribe thrombolysis vary in their measurement techniques and quantification of ST elevation using sample ECG complexes.

METHODS

The study was conducted at three Manchester teaching hospitals. Doctors from acute medicine or accident and emergency were recruited. An A&E SpR in each hospital recruited a convenience sample of approximately 20 doctors. We chose junior doctors as it is at this grade that thrombolysis decisions are usually made.

Table 1 Number of ECGs in which ST elevation was not identified

	Total number missed (%)
ECG 1	4 (6)
ECG 2	5 (8)
ECG 3	14 (22)
Overall	23 (12)

Each doctor was shown a single enlarged complex from three different ECGs. The complexes were selected by the principal authors to demonstrate different patterns of ST elevation taken from patients with myocardial infarctions.

Participants were asked (a) If there was any ST elevation present, (b) How much ST elevation was present (if they considered any to be present), (c) They were then asked to mark

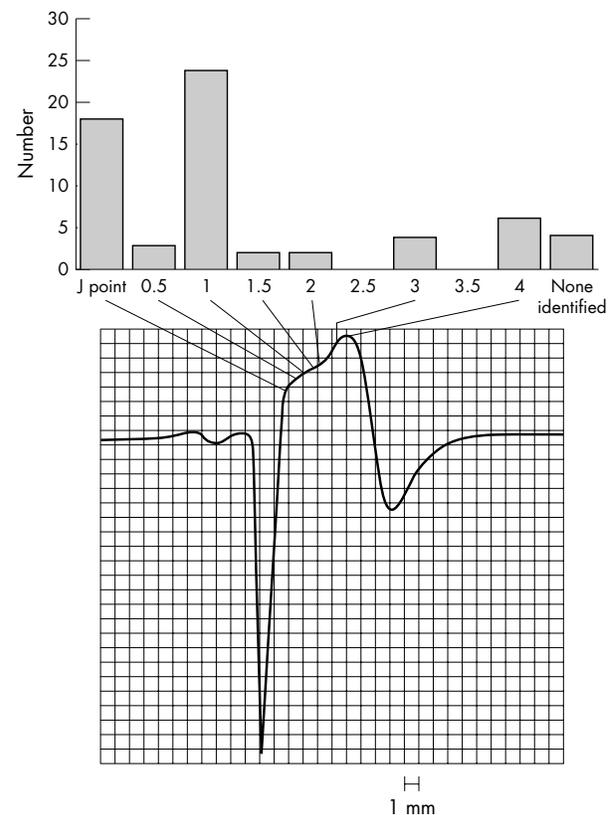


Figure 1 ECG 1. Point of measurement of ST elevation above baseline (in mm past J point).

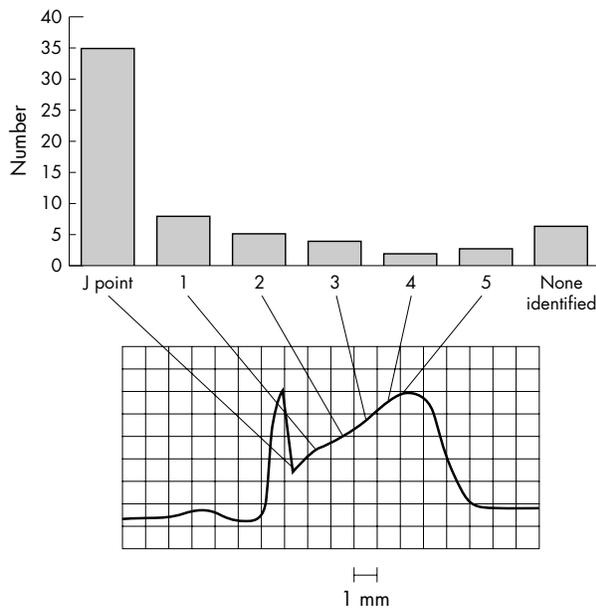


Figure 2 ECG 2. Point of measurement of ST elevation above baseline (in mm past J point).

on the ECG where they took the measurements from and to in deciding if ST elevation was present.

Ethical committee approval was not sought for this study as it did not involve patients or patient records. As this was essentially a descriptive study, no power study was performed.

RESULTS

Eleven (17%) specialist registrars (or senior SHOs) and 52 (83%) SHOs were sampled. Thirty one were from A&E medicine and 32 from general medicine.

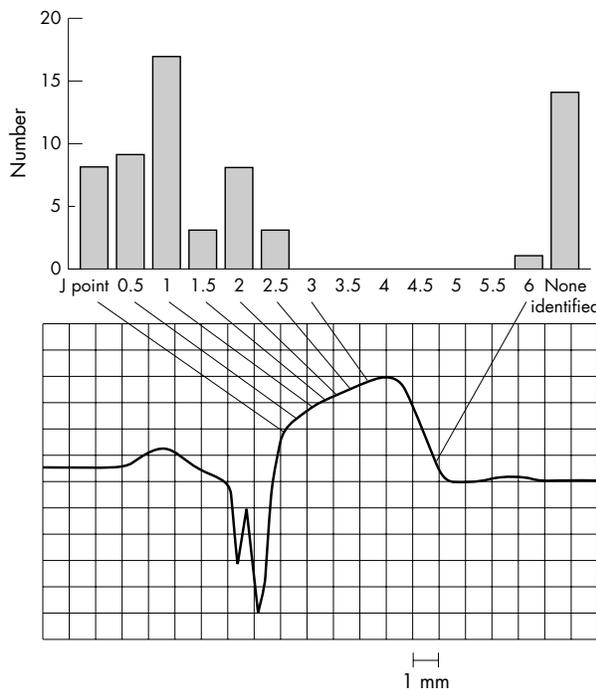


Figure 3 ECG 3. Point of measurement of ST elevation above baseline (in mm past J point).

Ability to identify ST elevation (table 1)

Overall ST elevation was not identified in 23 (12%) of cases. This proportion was highest for ECG 3.

ECG 1 (fig 1)

Eighteen (29%) of doctors measured ST segment elevation at the J point, a further 27 doctors (43%) measured up to 1 mm past the J point. The remaining 18 doctors (29%) measured beyond this with six (9.5%) using the peak of the T wave. The observed magnitude of ST elevation was wide with 43% of doctors identifying more than 3 mm of ST elevation (the J point lies at 3–3.5 mm on the ECG).

ECG 2 (fig 2)

Thirty five (61%) of measurements were made at the J point. Fourteen measurements (18%) were made at 80 msec or beyond the J point. Three (5%) used the peak of the T wave. ST elevation was identified at more 2.5 mm on 28 (48%) ECGs (the J point lies at just under 2 mm on the ECG). One doctor identified ST elevation as 1 mm only.

ECG 3 (fig 3)

Eight (13%) of the measurements were made at the J point. A further 26 doctors measured within 1 mm of the J point. The J point lies at 1.6 mm or more of ST elevation. Thirty one (47%) of doctors measured more than 2 mm of ST elevation.

DISCUSSION

We have shown that there is a high failure rate to identify ST elevation in doctors currently deciding on the prescription of thrombolysis. The interobserver variability of ST segment interpretation has been identified recently by Tandberg *et al*⁴ and in previous studies.^{5,6} Tandberg *et al* demonstrated inconsistencies of 14% at an ST threshold of 2 mm in carefully selected ECG complexes with straight ST segments parallel with the ECG baseline. However, in clinical practice such complexes are less frequent than the “up-sloping” segments used in this study. Variation in measurement will lead to a difference in observed magnitude and therefore have implications on the decision to prescribe thrombolysis.

The ST segment begins at the J point, the first point of inflexion on the upstroke of the S wave. In this study the J point or a point up to 40 msec (one small square) beyond the J point were the favoured points of measurement. However, many doctors used other points with a significant number using the peak of the T wave. The precise point at which ST elevation should be measured in AMI is unclear. Many texts on general medicine⁷⁻¹¹ or electrocardiology¹²⁻¹⁴ do not specify the point at which ST elevation should be measured. Of the major clinical trials of thrombolysis, most fail to specify where ST elevation should be measured.^{4,17-24} Of the few trials that have specified a point there is inconsistency. Koren *et al*¹⁵ specified an ST segment of >0.2 mV persisting for more than 80 msec beyond the J point, whereas Verstraete *et al*¹⁶ used a point 60 msec past the J point.

In practice, a doctor would not be presented with a single complex from an ECG. The results of this study cannot be extrapolated to assume that a similar number of patients with AMI would be missed. In clinical practice the doctor may gain additional information from other information on the ECG (for example, reciprocal changes in other leads or Q waves). Similarly, the morphology of the ST segment itself changes in AMI. Experienced clinicians may therefore rely more on pattern recognition rather than on an absolute measurement of the ST segment. However, in devolving the decision to thrombolysate to inexperienced doctors such subtlety and experience may be lacking. This risk is compounded by the fact that the point of ST segment measurement in automated ECG recording may be determined by the customer (personal communication Marquette monitors).

Our sample is typical of doctors who currently decide on thrombolysis. If the aim of early thrombolysis in AMI is to be achieved it is important that clear instructions are given to junior staff with regard to ST measurement. This study cannot determine the correct point of measurement, further work is required.

In conclusion, there is no accepted point at which ST segment elevation should be measured in AMI. There is wide variation in the point at which junior doctors measure ST elevation. This results in a significant variation in the observed magnitude of ST elevation. Such variation has the potential to result in an inappropriate prescription, or a failure to prescribe thrombolysis

Contributors

Simon Carley participated in the design the study, discussed core ideas, collated and analysed the data and is the guarantor of the paper. Roger Gamon participated in the original study hypothesis, discussed core ideas, helped design the study, collected data and helped write the paper. Peter Driscoll participated in the original study hypothesis, discussed core ideas, helped design the study and helped write the paper. Ged Brown and Paul Wallman discussed core ideas, collected data and helped write the paper.

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