

# Effect of Ventricular Ectopic Beats on Ventricular Repolarisation Measurements

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## Abstract

*The influence of premature ventricular ectopic beats on ventricular repolarisation measurements in patients undergoing chronic haemodialysis was investigated.*

*The ECGs from 5 patients were recorded during kidney dialysis treatment. Recordings were made on a 12-lead Mortara H-12 recorder, and transferred to a personal computer for analysis. 12-lead sections containing 5 consecutive beats were extracted at intervals of approximately 20 minutes, providing 13 rhythm sections from each recording. All sections contained four sinus beats and one centrally-positioned premature ventricular beat. QT was measured manually using an interactive computer display. The end of the QT was defined as the point at which the T wave returned to the TP baseline and it was assessed separately for each beat.*

*The aim of the study was to investigate changes in ventricular repolarisation due to ventricular ectopic beats and dialysis therapy.*

*It was not possible to measure QT in all ECGs because of noise or low amplitude T waves, but measurements were available from 82.1%. QT interval did not change significantly over the time course of the treatment. In all five patient recordings the ectopic beats had a significantly greater QT than the initial sinus beat (mean  $\pm$  SD QT  $416 \pm 38$  ms compared with  $371 \pm 20$  ms,  $p < 0.05$  in all patients). In three recordings, the sinus beat after the ectopic beat also had an elevated QT compared with the initial sinus beat. The final sinus beat had returned to the initial QT in all patients ( $p = ns$ ).*

*These results indicate that the presence of ectopic beats needs to be considered when presenting repolarisation measurements.*

## 1. Introduction

It has been observed that premature ventricular extrastimulation [1] and short trains of ventricular pacing [2] affect the repolarisation phase. In particular, QT

interval and QT dispersion in premature ventricular complexes are greater than in sinus beats [3-5]. However little is known about the effect of ectopic beats on the following sinus beats, although if there is an effect it is likely to be small [3].

The present study aimed to evaluate the influence of premature ventricular complexes and haemodialysis treatment on QT measurement. ECG recordings in patients undergoing chronic haemodialysis therapy were considered since haemodialysis promotes cardiac arrhythmias, and premature beats frequently occur in the course of this treatment. Several studies report that QT interval, QT dispersion and the occurrence of ventricular arrhythmias increase during and immediately after dialysis [6-8]. However, it is not clearly understood if the QT measurement increment is due to the therapy or to the increased number of ectopic events.

## 2. Method

### 2.1. Patients

The patient group consisted of 5 chronic uremic female subjects with a mean age of 68 years and range from 50 to 79 years. The subjects, recruited from Bologna Hospital and Imola Hospital, underwent three treatments a week and each treatment lasted at least 4 hours. The patients enrolled were selected from a larger group because they presented premature ventricular complexes throughout the treatment.

### 2.2. ECG recording

A 12-lead ECG Holter recording (H-12 Holter, Mortara Instrument Inc., Milwaukee, Wisconsin, USA) was obtained in all patients. Standard ECG electrodes were used, and the recorder connected using the specially formed ECG cable provided. ECGs were sampled at 180 Hz on each channel and stored to a PC hard disk for subsequent analysis. The Mortara Instrument's H-scribe software was used to detect ectopic beats.

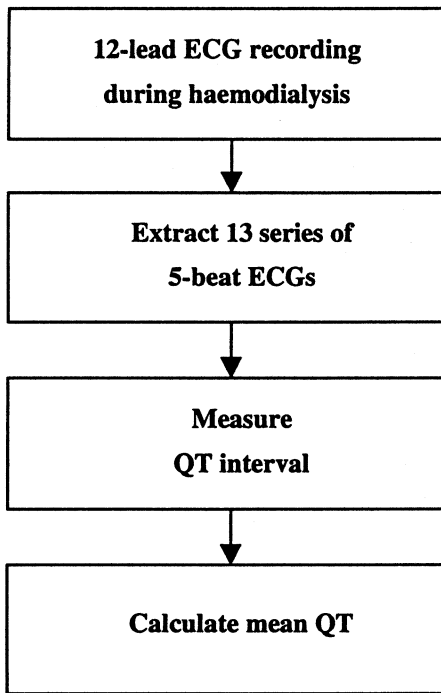


Figure 1. Schematic of data collection and analysis.

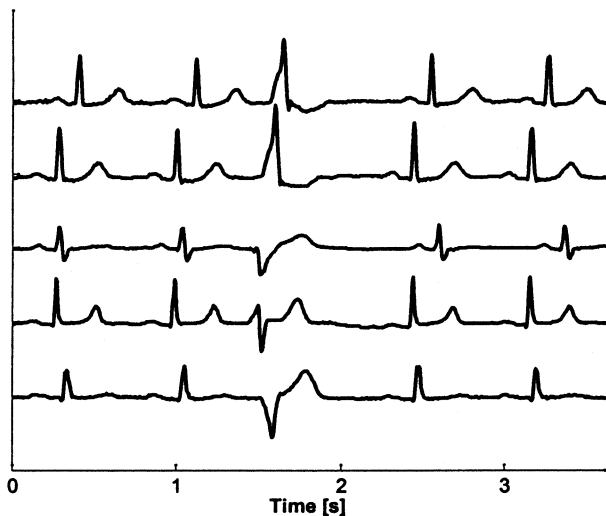


Figure 2. Example of a five-beat section extracted from each patient (sinus, sinus, ectopic, sinus, sinus).

### 2.3. Data analysis

12-lead sections, containing 5 consecutive beats, were extracted at intervals of approximately 20 minutes providing 13 sections from each recording. All sections contained four sinus beats and one centrally-positioned ectopic beat. The overall analysis is outlined in Figure 1, and in Figure 2 there is an example of a five-beat section

from each patient. The QT interval was assessed manually by an experienced researcher, using an interactive computer display, for each beat. Low T-wave amplitude and noise resulted in the exclusion of a small number of leads. QT interval was measured from the onset of the QRS complex to the end of the T wave. The mean QT for each subject and each beat was calculated from the available leads. We could not measure QT interval in the sinus beat preceding the premature ventricular complex because it often merged with the next beat. T-tests were performed to identify difference between QT intervals.

## 3. Results

### 3.1. Available measurements

The assessment of the data in sinus beats was more difficult than in the premature ventricular complexes. As Figure 3 shows, in sinus beats the percentage of QT measurements available was 78.8% compared with that for ectopic beats of 91.8%. The overall average was 82.1%. The leads with the greatest number of rejected data were I, aVF and V1 for sinus beats, and aVF and V1 and V2 for ectopic beats.

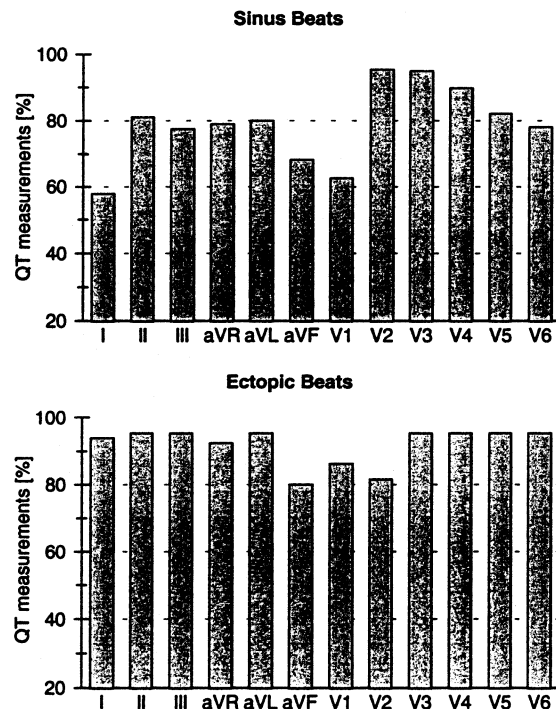


Figure 3. Percentage of available data for each lead in sinus beats and in ectopic beats.

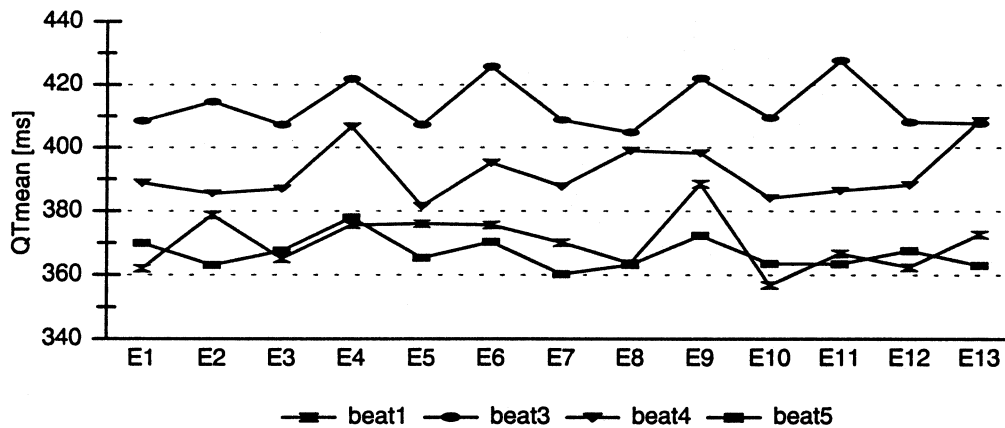


Figure 4. Trend of mean QT

### 3.2. QT in sinus and ventricular beats

Figure 4 shows that during the treatment the average for all patients of the ectopic QT (beat 3) was greater than that for all sinus beats. Also the average for the beat after the ectopic beat was greater than for the other sinus beats. Moreover, it illustrates that the therapy did not affect the QT interval: the difference between mean QT interval in the first 5 beat section (E1: mean QT 382 ms) and in the last (E13: mean QT 388 ms) was not significant.

Figure 5 illustrates the mean QT over the thirteen sections for each of the five patients. Mean QT in the premature ventricular complexes was significantly greater than QT of the first sinus beat of the 5 beat sections in all subjects ( $p < 0.05$ ). There was no significant difference between the mean QT of the first beat and the last sinus beat. In three recordings the sinus beat following the premature ventricular complex had a significantly elevated QT ( $p < 0.001$ ).

Figure 6 shows the mean  $\pm$  SD of the mean value for all subjects for each beat. Overall QT in ectopic beats was significantly greater than QT in the first sinus beats ( $416 \pm 38$  ms compared with  $371 \pm 20$  ms,  $p < 0.05$ ).

## 4. Discussion

QT interval changes are related to inhomogeneity of ventricular repolarisation. Haemodialysis has arrhythmogenic effects, but the mechanism by which it alters ventricular repolarisation and thus QT interval is poorly understood. Some authors have suggested that variations of electrolyte concentration, fluid volume alterations, fast correction of pH or ischaemia may be implicated [6-8].

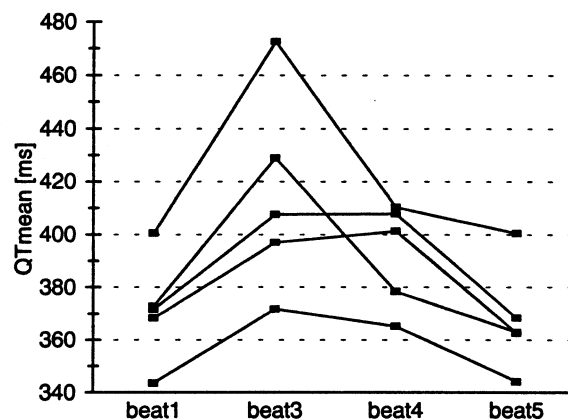


Figure 5. Mean QT over the therapy in each beat for all patients (beat 1, beat 4, beat 5 sinus; beat 3 ectopic).

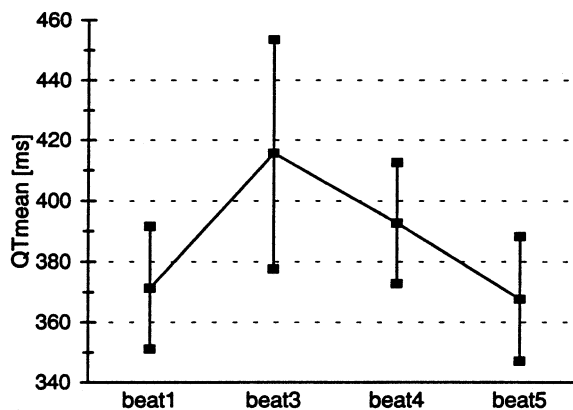


Figure 6. Mean and standard deviation of the QT interval for each beat over all patients (beat 1, beat 4, beat 5 sinus; beat 3 ectopic).

In our data QT interval did not change during the treatment, and QT in premature ventricular beats was significantly higher than sinus beats. It has been suggested that QT in ectopic beats could be a better marker of risk of ventricular arrhythmias [4].

In three patients the QT in the sinus beat following the premature ventricular complex was significantly greater than the other sinus beats. The presence of ectopic beats would therefore influence measurements of QT.

As our results have been demonstrated in a small number of patients, further studies are required.

## 5. Conclusion

The occurrence of premature ventricular complexes should be considered when repolarisation measurements are performed because our results show that QT interval is significantly higher in ectopic beats and also elevated in the following sinus beat.

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