

NEGLECTIBLE EFFECTS OF SYMPATHETIC ACTIVATION ON DELAYED VENTRICULAR DEPOLARIZATIONS AFTER MYOCARDIAL INFARCTION

Lombardi F., Finocchiaro M.L., Dalla Vecchia L., Felcher A., Sala R., Garimoldi M., Baselli G.,
Cerutti S., Malliani A.

*Patologia Medica, Centro "Fidia", Cardiologia, Ospedale "L. Sacco"
Istituto di Ricerche Cardiovascolari, CNR; Dipartimento di Elettronica
Università di Milano (Italy)*

With appropriate recording and filtering technique it has recently become possible (1-5) to record delayed ventricular depolarizations (DVD). It has been proposed (6-8) that these micropotentials reflect slow activation and asynchronous electrical activity as may occur after a myocardial infarction, when surviving fibers are intermingled with fibrotic tissue. In patients after myocardial infarction the presence of DVD has been considered an index of electrical instability and has been associated to the development of ventricular arrhythmias (4,5,9). As changes in sympathetic drive to the heart may affect cardiac electrical properties (10) and facilitate the occurrence of malignant ventricular arrhythmias (11-13), in the present study we have evaluated if the proarrhythmic effect of an enhanced sympathetic activity could be detected by this non invasive index of cardiac instability. This was accomplished by analyzing the effects of 90° head up tilt and submaximal exercise stress test on filtered QRS duration and on the incidence of DVD in patients two weeks after the first myocardial infarction.

MATERIALS AND METHODS

The study population consisted of 57 men with a clinical enzymatic and electrocardiographic diagnosis of acute myocardial infarction. The mean age was 54±2. No one was taking antiarrhythmic medication nor beta blockers. Studies were performed in the late morning 2-3 days before patients were discharged from the hospital. All patients were placed on an electrically driven tilt table and connected to a low noise (<5µV), high gain (10-50.000x), AC (0.001-3KHz) amplifier (Marazza Elettronica). Recordings were obtained during resting conditions, during 90° upright tilt and during submaximal bicycle exercise stress test. In all experimental conditions high amplification x,y,z bipolar leads were recorded for 300 sec together with a x reference lead. All signals were recorded on a magnetic tape (Racal) and simultaneously stored on a PDP 11/24 minicomputer after conversion to digital format at 1000 sample/sec with a resolution of 1-2.5 µV (14,15). Signal averaging was performed after each new beat was tested with a template recognition program to reject ectopic and noisy beats. Acceptable beats were signal averaged over 900 msec segment beginning 300 msec before the QRS complex. Each averaged lead was then filtered with digital 25-250 Hz band pass filter (FIR, 64 coefficients, Weber Cappellini Window). The three filtered signals were then combined into a vector magnitude $\sqrt{(x^2+y^2+z^2)}$ which allowed the determination of filtered ventricular activation time and the detection of high frequency components. DVD were defined as a low voltage components (<40µV) in the last 40 msec of the filtered QRS. Data are presented as mean ± SEM. Analysis of variance with Sheffé test was used to determine the significance of the differences between the experimental conditions.

RESULTS

During resting conditions DVD were present in 20 out of 57 patients. As illustrated in Figs 1 and 2 the duration of filtered QRS was significantly greater in patients with DVD (128 ± 3 vs 111 ± 1 msec $p < 0.05$). Tilt did not significantly modify the duration of filtered QRS in any patient (Figs 1 and 2) nor augmented the incidence of DVD.

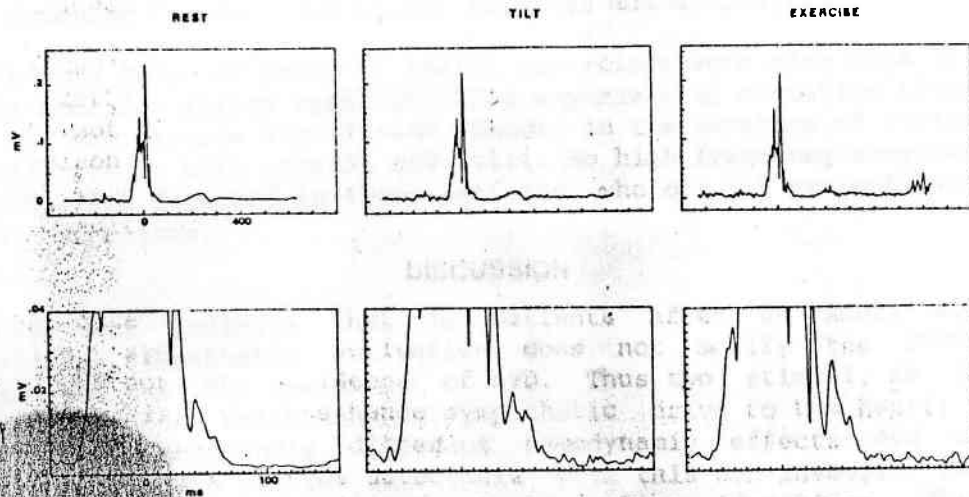


Fig 1 Example of signal averaged electrocardiograms of a patient with DVD and augmented filtered QRS duration during rest (left), tilt (middle) and exercise (right panels). Filtered QRS (upper) and expanded filtered QRS (lower tracing) are displayed.

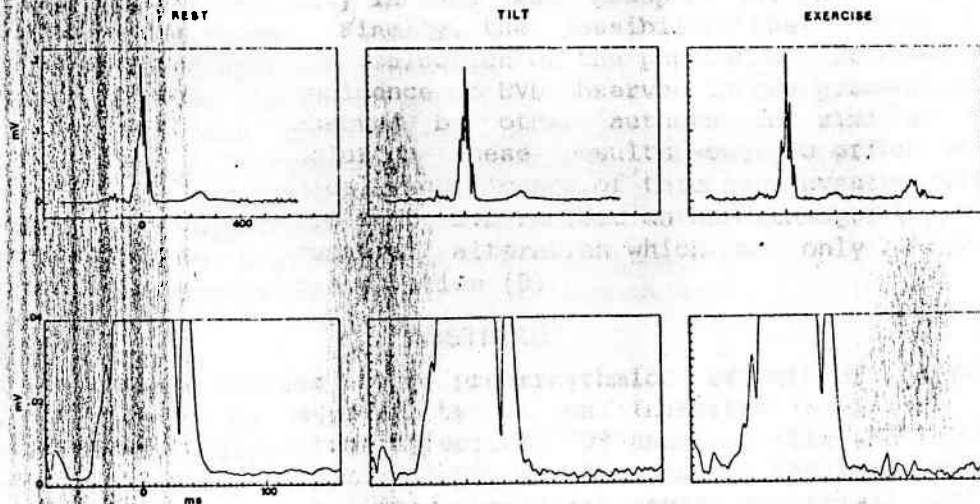


Fig 2 Example of signal averaged electrocardiograms of a patient without DVD and normal filtered QRS duration during rest (left), tilt (middle) and exercise (right panels). Filtered QRS (upper) and expanded filtered QRS (lower tracing) are displayed.

(middle) and exercise (right panels). Filtered QRS (upper) and expanded filtered QRS (lower tracing) are displayed.

In a limited group of patients (n=13) recordings were also obtained during bicycle exercise stress test. In this experimental condition (Figs 1 and 2) we did not observe significant changes in the duration of filtered QRS in comparison to both control and tilt. No high frequency components, in addition, were detected in those patients who did not present DVD during control conditions.

DISCUSSION

These data indicate that in patients after an acute myocardial infarction, sympathetic activation does not modify the duration of filtered QRS nor the incidence of DVD. Thus two stimuli, ie tilt and physical exercise, which enhance sympathetic drive to the heart, but are associated to profoundly different hemodynamic effects did not seem adequate to produce changes detectable with this non invasive technique. These negative findings may generate several considerations. There is a possibility that tilting and submaximal exercise stress test are ineffective stimuli to maximally increase the sympathetic drive to the heart. Indeed spectral analysis of heart rate variability has revealed (16) that in patients two weeks after myocardial infarction there is already a sympathetic predominance which cannot be further affected by tilt. In addition at variance to a previous report on patients with chronic ischemic heart disease (17) we have not observed an increase in ventricular ectopic activity in this small group of patients, during both sympathetic stimulations. Finally, the possibility that these negative results may depend upon the selection of the population studied must be considered; however the incidence of DVD observed in the present study was similar to the one observed by other authors in similar clinical conditions (5,9). In conclusion these results seem to offer a better understanding of the clinical significance of this non invasive technique: they support the hypothesis that DVD reflect an arrhythmogenic substrate which results from a structural alteration which can only be partially influenced by sympathetic activation (9).

ABSTRACT

To determine whether the proarrhythmic effect of sympathetic activation could be detected by a non invasive index of cardiac instability, we analyzed the effect of 90° head up tilt and submaximal exercise stress test on filtered QRS duration and on the incidence of DVD in 57 patients, two weeks after the first acute myocardial infarction. Using high amplification and signal averaging techniques, DVD were detected in 20 out of 57 patients who also presented a prolonged duration of filtered QRS. Tilt and exercise did not modify the incidence of DVD nor the duration of filtered QRS. These data support the hypothesis that DVD reflect an arrhythmogenic substrate which can only partially be affected by sympathetic activation.

KEY WORDS: signal averaging; cardiac instability; delayed ventricular depolarizations; sympathetic activation; myocardial infarction.