

Title: USE OF A ST SEGMENT TREND MONITORING ELECTROCARDIOGRAPH FOR DETECTION OF MYOCARDIAL ISCHEMIA

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Introduction. A sensitive and continuous display of ST segment changes should aid in the early detection of myocardial ischemia. This study was designed to test a specially modified version of the Marquette Electronics MAC electrocardiograph with option 305 (MAC/305) combined with a four-channel non-fade oscilloscope (Hewlett Packard model 7830A).

Methods. This modification permits ST segment trending in addition to the option 305 features which include: noise reduction by use of incremental updating, automatic arrhythmia documentation and storage of EKG complexes at pre-selected intervals (30, 20, 10 or 1 minute). The ST trend represents the summation of the absolute values of an orthogonal lead set displayed at four times normal scale (40 mm/mv). That is, if a 1 mm change occurred in a single axis, the trend would deflect 4 mm. Since most changes are reflected in multiple axes, the four-fold sensitivity gain is a theoretical minimum. The trend thus acts as a sensitive indicator which alerts the anesthesiologist to examine the orthogonal leads (V_5 , V_1 , AVF) for early signs of ischemic changes. For cardiovascular surgical procedures we utilized a $-V_1$ electrode on the patient's back. In the current software version the ST segments (J point + 60 msec) are sampled every twelve seconds. A trend of the most recent 20 minutes is always displayed and available for hard copy on the third channel of the electrocardiograph. The longer ST trend shown in Fig. 1 has been cut and pasted together for illustrative purposes.

Results. To date fifty-five cardiovascular surgery patients have been studied and subtle as well as major changes in ST segment deviations were detected in ten of these patients. They were related to pre-operative, intraoperative and post-pump events including changes in heart rate, arterial blood pressure, volume over-load, coronary artery air embolism and conduction disturbances. A good illustration is the case of a 62 y/o Class III white male scheduled for coronary artery bypass surgery. The change in the ST segment trend beginning at point A of Fig. 1 was coincident with cannulation of the patient's internal jugular vein while in the head-down position. Point B of Fig. 1 indicates the time when the patient's head was brought up and nitroglycerin infusion started. Fig. 2 shows the changes in the ST trend plotted against the depression seen in the stored V_5 complexes. The 6:10 complex is used as the reference and the depression is estimated at the J

point + 60 msec. Linear regression analysis indicates, for this particular case, that the trend deflected 8.7 mm for each 1 mm depression in the single lead V_5 ($r=.975$). This enhanced sensitivity is due to detection of changes in the ST segments of the remaining axes of the orthogonal set (AVF, $-V_1$) as well as the additional 4X amplification built into the trend display.

Discussion. Use of a computerized ST segment analyzer was attempted by Kaplan¹ with mixed results. Our series of cases demonstrates both the sensitivity and ease of recognition of myocardial ischemia using the MAC/305 for ST segment trend monitoring.

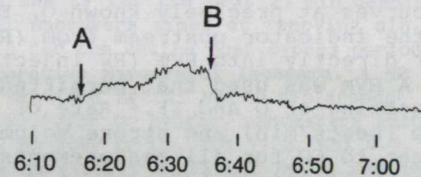


Fig. 1. ST trend and stored V_5 complexes

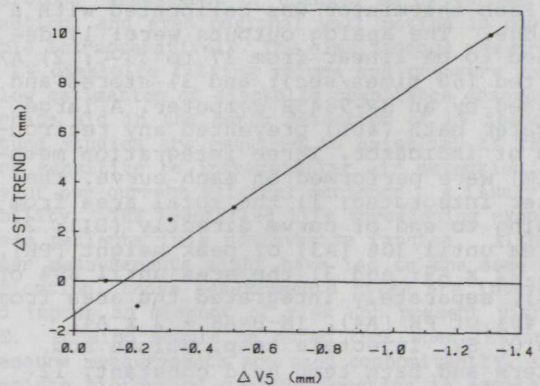


Fig. 2. Comparison of change in ST trend (V_5 , $-V_1$, AVF) and depression in V_5

References.

1. Kaplan JA: The present status of the electrocardiogram in the operating room, Essential Noninvasive Monitoring in Anesthesia. Edited by Gravenstein JS, Newbower RS, Ream AK, Smith NT. New York, Grune and Stratton, 1980, pp. 89-98