Changes in the ST- and ventricular gradient vectors over a period of 20 years

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The current guidelines for acute coronary syndrome (ACS) discern ST-elevation ACS (STE-ACS) and non-ST-elevation ACS (NSTEACS). Primary treatment for STEACS is percutaneous coronary intervention (PCI), and for NSTE-ACS antithrombotic treatment. Recent research has shown that, although there are gradual differences, STE-ACS and NSTE-ACS are srongly overlapping forms of ACS, in the sense that in both variants complete and incomplete occlusions of the culprit artery are found, and that both variants may cause either transmural or nontransmural infarctions. Whether or not ACS will manifest as STEACS or NSTEACS depends on the location of the culprit artery and on the involved are at risk.

As a consequence, some investigators propose to consider PCI as primary treatment for all ACS patients. In that case, the role of the ECG in the initial triaging process would rather be the corroberation of the diagnosis of ACS (in the setting of the very complex differential diagnosis associated with chest pain) than to discriminate STE-ACS and NSTE-ACS. That would require sensitive detection of ST amplitude changes, irrespective of the direction, and in case of conduction disturbances another indicator of ischemia is needed, e.g., the ventricular gradient (VG) (1-3).

Our group is currently investigating the possibility of a vectorcardiographic differential ECG analysis (intra-individual comparison of acute ischemic and preceding nonischemic ECGs), focussing on the difference of the ST vectors, ΔST, at J+60ms and the difference of the VG vectors, ΔVG (1-3). One of our previous studies (2) suggests that ΔST and ΔVG thresholds of 50 µV and 16.2 ms·mV would yield appropriate sensitivity for the detection of acute ischemia.

The current study is meant to explore the specificity of these thresholds if two ECGs of the same person 20 years apart are compared. In other words, how does the ECG change over a long period with respect to the ST and VG values. Especially data about VG changes with ageing and with developing disease are unknown.

We investigated a group of patients of whom there were 2 technically acceptable ECGs >20 years apart in the LUMC database of digital ECGs, created in 1986. Inclusion conditions were regular sinus rhythm and an identifiable J point (necessary for ST+60 measurements). Patients with acute ischemia during the baseline or follow-up ECGs were excluded. Here we present preliminary results of this study.

The study group comprised 114 patients (67/47 male/female mean ± SD age at baseline was 41 ± 12 years); 85 (74%) had one or more cardiovascular diagnoses at baseline. At follow up, several new diagnoses had emerged. Serial ECG analysis with our LEADS program revealed that 49% of the patients had a ΔST value > 50 µV and 90% had a ΔVG > 16.2 mV·ms. As VG is known to depend on heart rate, we looked for a relation between ΔVG and the difference in heart rate between the baseline and follow-up ECG, but no correlation was found. In conlusion, the first results of our study suggest that ECG changes over 20 years due to emerging/developing disease, medication changes and ageing are considerable. More frequent sampling of the ECG than once per 20 years is required to obtain reference ECGs that are useful for serial ECG analysis intended to detect acute ischemia.

1) Ter Haar CC, Maan AC, Warren SG, Ringborn M, Horáček BM, Schalij MJ, Swenne CA. Difference vectors to describe dynamics of the ST segment and the ventricular gradient in acute ischemia. J Electrocardiol 2013;46:302-311
2) Ter Haar CC, Maan AC, Schalij MJ, Swenne CA. Improved electrocardiographic detection of hyperacute ischemia by difference vector analysis. Comput Cardiol 2013; 40:9-12
3) Ter Haar CC, Maan AC, Schalij MJ, Swenne CA. Directionality and proportionality of the ST and ventricular gradient difference vectors during acute ischemia. J Electrocardiol, 1 April 2014 (Article in Press DOI: 10.1016/j.jelectrocard.2014.03.008)