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Editorial

# Current Value of the Electrocardiogram in the 21st Century

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## Editorial

Surface 12-lead ECG remains in the 21st century, one of the diagnostic tools most extensively used in clinical practice. For the internist and the cardiologist, maintaining ECG interpretation skills is mandatory, as the ECG allows a rapid (and inexpensive) diagnosis of a large series of entities. The advances of new technologies have not replaced the ECG, which still is one of the most cost/effective tools in medicine. New imaging techniques allow us to further investigate the heart, once the surface ECG has revealed an abnormality. Several interventions (in the acute and chronic phases of a disease) are still guided by the proper analysis of the surface ECG.

We are delighted to provide a short updated review on the current value of the surface 12-lead ECG for this new clinical Journal. We selected few clinical scenarios that we believe all clinicians should be familiarized with. This is not intended as a systematic review but rather as a quick reminder on the value of the surface ECG in specific conditions.

In the following scenarios, the surface ECG is considered of "great help" to the physician:

### Acute Coronary Syndrome (ACS):

The ECG is the first-line diagnostic tool in the assessment of patients with suspected ACS. Patients with ACS are, for the most part, dichotomised by whether significant ST-segment elevation is present or not (1). Patients without ST-segment elevation can subsequently be categorized to have unstable angina or non-ST elevation myocardial infarction (NSTEMI). P**ersistent** ST-segment elevation **(>20 min) in at least two contiguous leads and/or new** left bundle branch block (LBBB) **suggests STEMI** and immediate action is taken based on the information provided by the ECG (percutaneous coronary intervention or thrombolytic drugs). Surface ECG provides the first diagnostic approach and has direct impact on the initial therapy.

The ECG not only helps in establishing the diagnosis of STEMI but also provides valuable information on infarct location, success or failure of reperfusion, as well as prognosis. The ECG is the first diagnostic tool that allows assessment of myocardial ischemia and despite multiple paradigm shifts in the management of ACS; it continues to be the pre-eminent test directing therapeutic management and prognostic stratification [1].

### Pacing and Cardiac Resynchronization Therapy (CRT)

Paced rhythms became a "sub-specialty" of elecrocardiology. In addition to the recognition of pacemaker malfunctions (failure to capture, over and undersensing, noise, etc), surface 12-lead ECG helps in the recognition of the so-called "pacemaker pseudo-malfunctions" that refers to the recognition of sophisticated pacing algorithms in the surface ECG [2]. A wide QRS complex depicting LBBB pattern is a pre-requisite to become eligible for CRT in patients with refractory heart failure, however; 30% of patients do not benefit from CRT [3]. Patients are considered as responders when left ventricular ejection fraction (LVEF) increases by ≥5% and New York Heart Association class by ≥1 after 3 months of CRT. The presence of LBBB pattern with QRS duration ≥130 ms (men) and 140 ms (women) associated to a "notch" in at least 2 leads (V1-V2 or V5-V6, I and aVL) seems to identify patients with better response [3]. Lately, a QRS >150 ms was found to be associated with better response [4]. Strict LBBB criteria identified patients with greater mechanical dyssynchrony compared with patient's only meeting non-strict LBBB criteria, whereas there was no significant difference between patients with non-strict LBBB criteria and non-LBBB [5-7].

Several algorithms to determine response to CRT after implantation were published in the last years, however; none has been completely validated so far. Narrowing of the QRS during CRT pacing does not predict outcome, however; on the other hand, widening of the QRS after CRT implant indicates poorer prognosis.

### Inherited arrhythmic disorders (cardiac channelopathies)

These infrequent disorders are hereditary "ion channelopathies", in which mutations in genes encode functional units of ion channels and/or their transporter-associated proteins in patients without apparent structural heart disease. The most frequent are: Brugada syndrome (BrS) [8], congenital long QT syndrome (LQTS) [9], congenital short QT syndrome (SQTS) [10,11], catecholaminergic polymorphic ventricular tachycardia (CPVT) [12] and early repolarization syndromes (ERS) [13]. The role of the surface ECG in the diagnosis, and sometimes prognosis of these conditions is of paramount importance. In **Brugada Syndrome,** the ECG is characterized by ST-segment elevation at least 2 mm coved to the top followed by a negative T-wave in the right precordial leads. The saddleback shaped ST elevation is non-diagnostic (Type 2 Brugada pattern) but raises concern as this entity associates with sudden cardiac death [8]. The Brugada ECG pattern is usually the first "red




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flag" of this condition. In congenital **Long QT syndrome (LQTS),** the ECG allows to speculate on the mechanism linking to life-threatening arrhythmias (torsades des pointes) depending on the morphology of the QT interval. It also allows classifying them into types 1, 2 and 3, and selecting appropriate treatment depending on the QT morphology [9]. **Congenital short QT syndrome** is a very rare channelopathy, characterized by very short QT/QTc interval, (QTc interval ≤ 330 ms) and frequently associated with life-threatening arrhythmias [10,11]. **Catecholaminergic polymorphic ventricular tachycardia (CPVT)** is another rare entity characterized in the surface ECG by presenting a typical bidirectional ventricular tachycardia [12] and frequently associated with sudden cardiac death. Its rapid recognition links to proper treatment with either beta-blockers or ICDs. **Early repolarization syndromes (ERS)** can manifest in the surface ECG as Early Repolarization Pattern (ERP), consisting on J-point elevation and distinct J-wave with or without ST-segment elevation or slurring of the terminal part of the QRS. ERP was considered a benign ECG manifestation for decades. Later, a subgroup of patients with associated life-threatening arrhythmias was described calling attention to this new arrhythmic syndrome. Its correct identification will avoid warning people at no risk and at the same time prompt proper and rapid action for ones with the malignant forms of the disease [13,14].

### Diagnosis and classification of cardiac arrhythmias.

The surface ECG allows rapid recognition of the origin and electrophysiological mechanisms involved in the genesis of most cardiac arrhythmias [2]. ECG helps guiding further diagnosis and medical treatment. Narrow complex tachycardias, in 90% of the cases, correspond to supraventricular arrhythmias whereas 90% of wide complex tachycardias are ventricular in origin. The surface ECG remains irreplaceable for the diagnosis of cardiac rhythm disturbances [2].

### Other Major contributions.

- **Hypertrophic cardiomyopathy:**

The electrocardiogram remains an important tool for the initial diagnosis and for guiding an initial morphological classification [15]. Recently, surface ECG predictors of worse evolution were described. fQRS was identified as an ECG marker for ventricular arrhythmias or ICD discharges [16].

- **Arrhythmogenic right ventricular dysplasia (ARVD):**

The surface ECG remains a major contributor to the diagnosis of this disease as per the Revised Task Force Criteria. It considers the following major criteria [17]: presence of epsilon-waves, T-wave inversion from leads V1 to V3 in the absence of complete right bundle branch block; and non-sustained or sustained episodes of monomorphic VT with LBBB morphology and superior axis.

Other ECG features to remember in ARVD are prolonged S-wave upstroke from lead V1 to V3 (QRS > 110 ms) and frequent premature ventricular contractions (>100º in 24h) with LBBB pattern and extreme left axis deviation [17].

- **Congenital heart diseases:**

Surface ECG provides help in the diagnosis of several congenital heart conditions. It is also useful for the post-op follow-up. Secundum atrial septal defect (ASD) is the most common type of ASD within the spectrum of congenital cardiac abnormalities in children. An ECG with incomplete right bundle branch block (RBBB) or complete RBBB pattern associated with tumultuous, brief RV impulse, wide and fixed split second heart sound, SS 3/6+ in pulmonary focus in 2nd left intercostal space, strongly suggest ASD. Children with systolic murmur by mitral insufficiency, ejection murmur in pulmonary focus and split, wide and fixed second heart sound with an ECG depicting RBBB, associated to left and superior deviation of the QRS axis (pseudo-left anterior fascicular block) and biventricular enlargement, strongly suggest endocardial cushion defect [18]. A cyanotic infant, with non-circular pupil, presenting with an ECG pattern depicting right atrial enlargement, left ventricular enlargement and left anterior fascicular block, is characteristic of tricuspid atresia.

## Conclusion

These are only few but not all clinical scenarios where the ECG is still irreplaceable. We wanted to highlight that despite major advanced in medical technology, surface ECG remains as a useful tool that helps the cardiologist in many different clinical situations. Proper skill ECG interpretation should still be part of the medical curricula and new methods to teach and evaluate knowledge should be develop in order to avoid erosion of skills usually learnt at early stages of the medical career.

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