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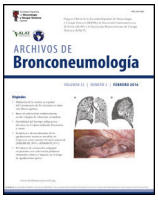

Editorial

The electrocardiogram in pulmonary hypertension: Scanning for an iceberg☆

El electrocardiograma en la hipertensión pulmonar: oteando un iceberg

A literature search with the terms "pulmonary hypertension" and "ECG" retrieves about 500 entries in the last 70 years, a quarter of which were published in the last 5 years. This is somewhat surprising, because ECG is a diagnostic technique that has been used for 120 years, even though in theory it has been surpassed by widely validated, accessible imaging techniques. The American Heart Association guidelines[1] for the diagnosis of hypertrophy state that "the ability of the ECG to detect right ventricular hypertrophy (RVH) may be expected to be low". Moreover, because the sensitivity of the different diagnostic criteria is quite low, they recommend using several criteria adjusted for patient- and disease-dependent clinical variables. So why the recent interest in an old and apparently inaccurate technique?

In healthy adults, the mass of the right ventricle (RV) is much lower than that of the left ventricle (LV), so the sum of the depolarization of both (the QRS complex) represents above all the magnitude and direction of the LV depolarization vector. Thus, the electrocardiographic pattern of RVH will only be detected when it is significant, and thus pulmonary hypertension (PH) will only be observed when it is at an already advanced stage. When a right axis deviation is observed, the patient will already have RVH and increased voltage and repolarization abnormalities in the right leads. Prolonged conduction times, with or without branch block, will also be observed due to an increase in the time required for RV depolarization. This is due not only to hypertrophy, but also to fibrosis that, when present, is usually associated with a worse prognosis.[2]

Standard ECG cannot be expected to show early phase changes in PH before significant RVH has developed, so it is not suitable for PH screening in the general population or in patients with suspected PH,[3] although the pediatric population may be an exception. Given the predominance of the RV in the fetal period and early life, high lung pressure can cause the fetal/infant pattern to persist, so PH can be detected in earlier phases.[4] In any case, despite the availability of useful tools such as cardiac resonance and computed tomography, echocardiography remains the first step for classifying patients by their likelihood of HT, and is also useful in follow-up. Right cardiac catheterization is the definitive diagnostic technique.[5]

The main advantage of standard electrocardiography in PH may lie in its ability to detect serious cases and determine prognosis. This is because electrocardiographic patterns change progressively as PH worsens,[6] and because a relationship between PH prognosis and several of those changes has been described.[7,8] We also know that these changes are reversible when techniques are applied to resolve chronic thromboembolic PH,[9,10] and that this reversal of electrocardiographic patterns is associated with a better prognosis.[11]

ECG should be used as just another clinical tool, one that is almost as accessible and inexpensive as physical examination. If it is used in this manner, we will see that the heart rate measured at the time of PH diagnosis apprises us of our patients' prognosis[12] and that the duration of the QRS complex is associated with their functional class and mortality.[13] If simple tools such as ECG and the determination of natriuretic peptides, oxygen saturation, and functional class are used correctly, we can achieve a high number of successful diagnoses when PH is suspected.[14]

Even so, we should be more ambitious. Today, the complete vectorcardiogram can be easily and readily calculated from standard ECG tracings,[15] and this can be used to determine the ventricular gradient (VG), an old concept that was abandoned in its day because of its conceptual and arithmetic complexity. VG is the vector representation of variation in the duration of myocardial excitation. Recent studies have shown that it is altered when pulmonary pressure rises in various situations,[8,16] and that it is more sensitive than Doppler echocardiography.[16] This alteration of the ventricular activation and repolarization sequence, prior to the appearance of hypertrophy criteria, opens a door for the simplified application of vectorcardiography in the field of PHT.

Standard ECG identifies a group of patients with more advanced PH and greater VH and fibrosis, revealing the tip of the iceberg. To examine the submerged part, however, echocardiography is useful for screening for earlier disease phases, although a VG study using vectorcardiography may also be helpful. Either way, electrocardiography is a fast, inexpensive technique that is readily available in

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routine clinical practice. It seems obvious that we should use it to keep a weather eye on the horizon in order to avoid, as far as possible, the PH iceberg, of which we will often only see the tip.

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