# Correct Anatomical Orientation of the Heart and Reflections on the Nomenclature Used in Daily Practice

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In daily clinical practice and during the preparation of a scientific publication, it is important to use the appropriate nomenclature for an enhanced understanding of the descriptions provided. The correct use of anatomical terminology is the basis for universal communication in the field of health, and it is based on the Latin nomenclature originally published in 1895 (Basel Nomina Anatomica). In addition, it allows the standardization of reports, manuscripts, and scientific communication between different specialties and imaging techniques.

The first Brazilian edition of the Anatomical Terminology was published in 2001 and was used as reference for this report. This study is the result of a joint effort of the Federative Committee on Anatomical Terminology (FCAT) and 56 associations composed of members of the International Federation of Associations of Anatomists (IFAA). The Brazilian edition was translated by the Anatomical Terminology Commission of the Brazilian Society of Anatomy[1].

With regard to cardiac nomenclature, some terms suggested by FCAT are not the most commonly used; therefore, terms incorporated by usage may be employed more frequently but do not necessarily represent the correct way to designate anatomical structures. In particular, some terms deserve special attention because of their frequency of use. In addition, some of the terms present in the Basel Nomina Anatomica have been questioned for not representing the appropriate description of the anatomical position or even the shape of the structure[2-4].

A term that is usually used imprecisely in cardiology refers to the heart valves: mitral, tricuspid, aortic, and pulmonary, often referred to as "valvules." As a matter of fact, the components or functional units of the heart valves that are designated by the Terminology Commission as valvules, which are defined as "small valves." This same committee has long attempted to modify the term cuspid—which is defined as apex, acute end, peak, vertex—by another term considered more appropriate: valvules or leaflets, which are the subdivisions of the atrioventricular valves. Anatomically, the FCAT considers that the description of the valve shape as cusp or peak is not appropriate for the functional units (or valvules) of the atrioventricular valves[1].

In addition to the use of inappropriate terms with regard to the shape of the cardiac structures, another relevant concern is the failure to describe their location relative to the conventional anatomical position.

In 2002, Cerqueira et al.[5] published recommendations from the Cardiac Imaging Committee of the American Heart Association in an attempt to standardize the nomenclature of different cardiac imaging techniques, including nuclear medicine, magnetic resonance, computed tomography, echocardiography, and coronary angiography[5]. Despite the technical differences between these techniques, all of them aim to describe the heart and adjacent structures as accurately as possible. However, each of these techniques have evolved independently with respect to the description of cardiac orientation, number and classification of the myocardial segments, and distribution of coronary arteries, considering the inherent capabilities and limitations of each technique. Therefore, to facilitate communication and the correlation between the cardiac imaging techniques, the authors suggested that all techniques should guide and show the heart along its longitudinal axis, and the remaining planes should be oriented orthogonally with respect to the longitudinal axis of the heart.

A simple Internet search (October 2014) indicates that this study has been cited in the literature more than 2000 times; therefore, it became an important reference in cardiovascular nomenclature. In this study, the authors—who belong to a committee of the American Heart Association that met specifically to discuss nomenclature—corrected a clear failure in the nomenclature of the inferior cardiac wall, formerly and incorrectly designated as "posterior." However, they continued naming the wall opposite the inferior (diaphragmatic) wall as "anterior." The simple observation of Figure 1, showing the heart on a CT scan, leaves no doubt that the wall opposite the inferior wall is located superiorly. In addition, Figure 1 shows that the anterior portion of the left ventricular wall is in fact the ventricular septum. This inconsistency should be taken into consideration by those who examine the heart in its natural position within the chest.

A similar inconsistency is related to the current designation of the papillary muscles of the left ventricle. The group known as "anterior-lateral" is in fact located posteriorly in relation to the group usually designated as "posterior-medial" (Figure 1).

In addition, in the anatomical position, the heart chambers designated "right" are in reality located superoranteriorly to the chambers referred to as "left" (Figure 1). This standard nomenclature facilitates the description of right-left shunts, or vice versa, but does not reflect the true anatomical position.

## Keywords

Terminology as Topic; Systematized Nomenclature of Medicine; Cardiology/classification.

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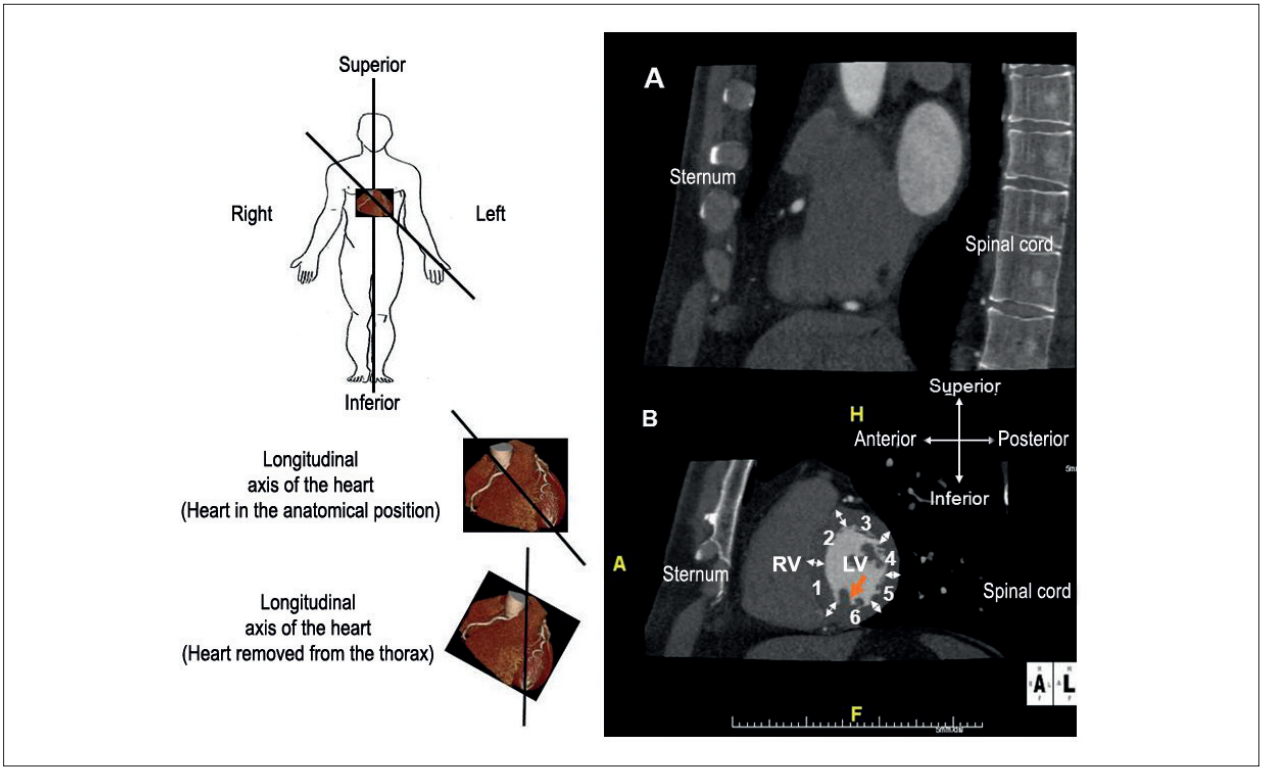


**Figure 1 – Left**, *schematic representation of the location of the heart in relation to its anatomical position within the thorax, showing the cardiac longitudinal axis (above). View of the heart when the cardiac longitudinal axis is positioned with the heart in the anatomical position (middle) and according to the vertical orientation used in the conventional nomenclature that is currently employed (below), considering the heart removed from the chest and resting on its apex.* **Right** *(above), computed tomography images showing the position of the heart in relation to the spinal cord and the sternum (A). B, CT scan image of the ventricular mass in short (transverse) axis at the level of the papillary muscles shows the anterior location of the "posterior-medial" muscle group (orange arrow) in relation to the "anterior-lateral" papillary muscle group. The location of the myocardial walls in relation to the anatomical position is evidenced (correlate with Table 1).*
*A: anterior; H: head-cranial or superior; F: foot-caudal or inferior; RV: right ventricle; LV: left ventricle.*

In another example, the coronary artery known as the posterior descending artery is located on the diaphragmatic surface of the heart and has an interventricular and inferior trajectory (not descending and posterior)[6,7]. Its occlusion leads to an infarction designated by cardiologists as "infarction of the inferior wall," despite the name of the coronary artery involved.

The issue of the use of nomenclature considering the anatomical position of the heart has been treated with great attention and care by electrophysiologists to facilitate the teaching and understanding of the diagnostic and interventionist catheterization performed by doctors in training[2]. During the insertion of a catheter into the inferior vena cava towards the apex of Koch's triangle, where the atrioventricular node is located, the direction of movement was, in a not too distant past, described as "anterior," in view of the incorrect habit of describing the heart out of the chest and supported vertically on its apex. However, the apex of Koch's triangle is located superiorly in relation to the vena cava orifice, when considering the anatomical position of the heart. These old habits of nomenclature can lead to errors in learning and even iatrogenic errors.

Cosio et al.[2] suggested a nomenclature of the cardiac walls taking into consideration the correct anatomical orientation of the heart (Table 1).

## Closing remarks

This study does not intend to exhaust the subject nor recommend an immediate change in the current nomenclature. It aims to acknowledge and educate the reader about the frequent use of terms that are not completely adequate in describing the cardiac morphology evaluated with different imaging techniques. The nomenclature based on the correct anatomical orientation significantly facilitates the spatial location of the cardiac structures and the relationship of the heart with the other organs. It also allows the exchange and comparison of information between different imaging techniques and guides diagnostic and therapeutic procedures, e.g., in electrophysiology or multimodal examination.

However, the adoption of changes in nomenclature already established by usage will require increased user awareness and recognition of the need for change and efforts towards the implementation and acceptance of these changes.

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## Author contributions

Conception and design of the research: Hotta VT, Aiello VD. Writing of the manuscript: Hotta VT, Aiello VD. Critical revision of the manuscript for intellectual content: Hotta VT, Aiello VD.

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**Table 1 – Conventional nomenclature vs. nomenclature that considers the anatomical position**

| Myocardial wall (Conventional nomenclature) | Myocardial wall (Nomenclature that considers the anatomical position) |
|---|---|
| 1. Inferior-septal | Inferior-septal (maintained) |
| 2. Anterior-septal | Superior-septal |
| 3. Anterior | Superior |
| 4. Anterior lateral | Posterior superior |
| 5. Inferior lateral or posterior | Posterior inferior |
| 6. Inferior | Inferior (maintained) |

*Source: Adapted from Cosío et al.*[2]

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