Rev Esp Cardiol. 2014;67(11):920–924

Special article

# Evolution of Cardiac Imaging According to the Number of Scientific Articles in Medical Journals: a Long and Fruitful Journey

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*Article history:*
Available online 1 October 2014

*Keywords:*
Echocardiography
Cardiac magnetic resonance imaging
Multislice computed tomography
Nuclear medicine

ABSTRACT

The use of cardiac imaging techniques as a diagnostic method in the understanding of physiopathology, as well as in cardiology research has been one of the most important revolutions in the management of cardiac patients, our understanding of physiopathology, and basic research in almost all heart diseases. This article analyzes the literature on echocardiography, cardiovascular magnetic resonance imaging, computed tomography, and nuclear medicine during the last 60 years and provides an overview of how these techniques have developed and how their introduction into daily practice has changed attitudes among cardiologists. The literature not only shows that the implementation of these techniques in daily practice requires an immense amount of research and effort by many working groups throughout the scientific world, but also that techniques that once seemed promising may finally be discarded.



## Evolución de la imagen cardiaca a través de las publicaciones científicas en revistas médicas: un largo y fecundo camino

*Palabras clave:*
Ecocardiografía
Cardiorresonancia magnética
Tomografía computarizada multicorte
Medicina nuclear

RESUMEN

Las técnicas de imagen cardiaca como método diagnóstico en la compresión de la fisiopatología, así como en la investigación en cardiología, han producido una de las más importantes revoluciones en el manejo del paciente cardiaco, la comprensión de la fisiopatología y la investigación básica de la práctica totalidad de las enfermedades cardiacas. El análisis bibliográfico de las publicaciones sobre ecocardiografía, cardiorresonancia magnética, tomografía computarizada multicorte y medicina nuclear en los últimos 60 años ofrece una perspectiva general de cómo se han ido desarrollando estas técnicas y cómo se ha ido modificando el interés del cardiólogo por ellas según las ha ido introduciendo en la práctica diaria. La historia bibliográfica enseña también que técnicas prometedoras pasan a un segundo plano y que la implantación en la clínica de muchas de ellas exige una gran carga de investigación y trabajo de muchos grupos de trabajo por todo el mundo científico.



## INTRODUCTION

Diagnostic imaging has been the most important revolution in medicine in recent years; it comes as no surprise that the editors of the *New England Journal of Medicine*, in a superb editorial published in the first issue of the new millennium, considered medical imaging as 1 of the 10 most important medical advances in the last 1000 years.[1] Cardiac diagnostic imaging techniques began to really develop with the arrival of echocardiographic imaging techniques,[2–8] which revolutionized and "democratized" diagnosis in cardiology, followed by various nuclear medicine techniques,[9–11] cardiac magnetic resonance imaging (CMRI),[12–17] and computed tomography (CT).[18–21]

This review of the scientific literature on cardiac imaging techniques provides a wide range of both interesting and educational information and an overview of how these techniques have developed. Young cardiologists can gain perspective on the evolution of imaging techniques and remind themselves of the long and arduous path that had to be travelled to acquire the body of knowledge that forms the scientific basis for the rational use of these techniques in daily clinical practice. It can also help those who have grown up with the techniques to put scientific information into perspective, given that many approaches that once seemed promising later proved sterile, and that the incorporation of new diagnostic tools very often requires an enormous effort involving many working groups worldwide.

## THE PROPORTION OF ARTICLES ON CARDIAC IMAGING IN SCIENTIFIC JOURNALS

We are all aware of the impact in clinical practice of imaging techniques (echocardiography, CT, CMRI, and nuclear medicine) on diagnosis and prognostic and therapeutic assessment in almost all

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http://dx.doi.org/10.1016/j.rec.2014.07.008
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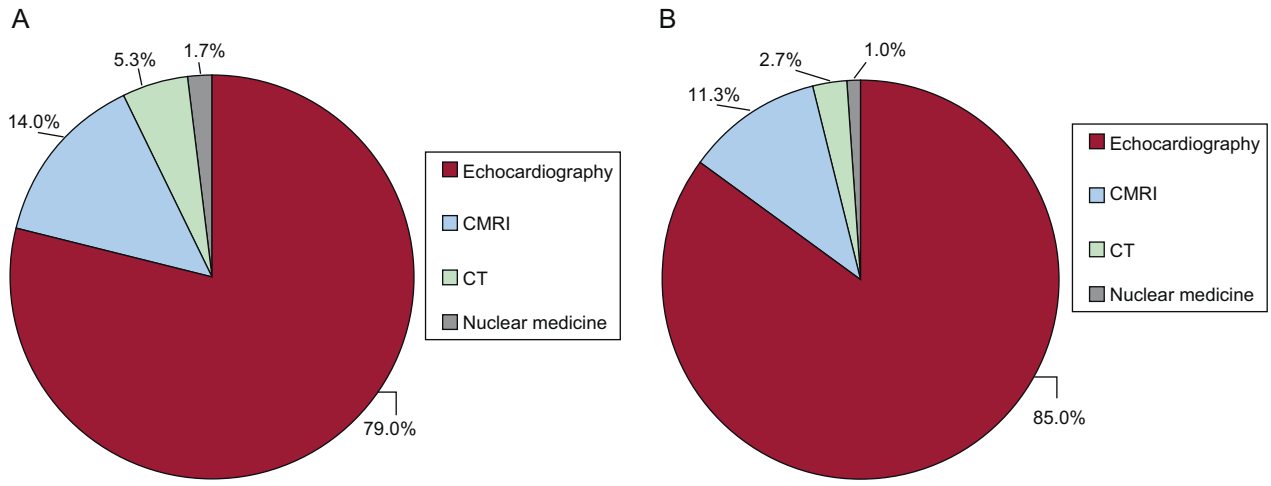


**Figure 1.** A, distribution of articles on imaging techniques from their first appearance in the literature to the present based on all journals included in Scopus. Total number of articles: 53 864. B, distribution of articles on imaging techniques from their first appearance in the literature to the present based on the most important cardiology journals included in Scopus. Total number of articles: 9100. CMRI, cardiac magnetic resonance imaging; CT, computed tomography.

areas of cardiac pathology. An analysis of the number of articles on cardiac imaging in the scientific literature provides a real measure of the importance of each diagnostic technique in clinical practice.

Based on the phrase "imaging technique" specifically appearing in the title (Figure 1A), a search of bibliographic databases and more than 6000 journals (Appendix) shows that 53 864 scientific papers were specifically devoted to imaging techniques as the main topic of the article. Most of these scientific papers were dedicated to echocardiography (79.0%), followed by CMRI (14.0%), CT (5.3%), and nuclear medicine techniques in cardiology (1.7%).

However, a search of the 6 most important scientific journals on cardiology (*Circulation, American Journal of Cardiology, Journal of the American College of Cardiology, European Heart Journal, Heart, and American Heart Journal*) shows that 167 022 scientific papers were published in the last 60 years of which 9100 (5.44%) were specifically dedicated to cardiac imaging techniques (Figure 1B): echocardiography (85%), CMRI (11.3%), CT (2.7%), and nuclear medicine techniques in cardiology (1%). There are very few differences between the percentage of articles dedicated to each technique in medical journals and those in cardiology journals, although the percentage of articles dedicated to CMRI and multidetector CT is slightly higher in cardiology journals.

## EVOLUTION OF SCIENTIFIC ARTICLES ON CARDIAC IMAGING TECHNIQUES

In addition to determining the number of articles on each of the 4 diagnostic imaging techniques, it is also important to know how these figures have evolved over time. Beginning in the early 1950s, echocardiography was the first cardiac imaging technique to be addressed in the literature. Exponential growth in articles dedicated to this topic began in the 1970s (Figure 2), rising to the current rate of 1800 per year. Articles on CMRI began to increase at the beginning of the new millennium and reached a peak of 700 articles this year (2014) whereas the literature on CT in cardiology began to increase around 2005 and reached > 400 articles this year (2014). However, the number of articles on nuclear medicine has remained steady since the 1980s with little variation.

The number of articles on each of the four techniques published in the last 5 years sheds light on the growth in knowledge in these areas. There was a total of 12 958 publications in this period (Figure 3) and although most of the articles were on echocardiography (60.5%) the percentage significantly decreased (Figure 1A), whereas the number of articles on CMRI (23.5%) and CT (14.7%) sharply increased. In contrast, the number of articles on nuclear medicine techniques remained steady (1.3%). Thus, despite the recent decrease, echocardiography remains the most published topic in cardiac imaging techniques.

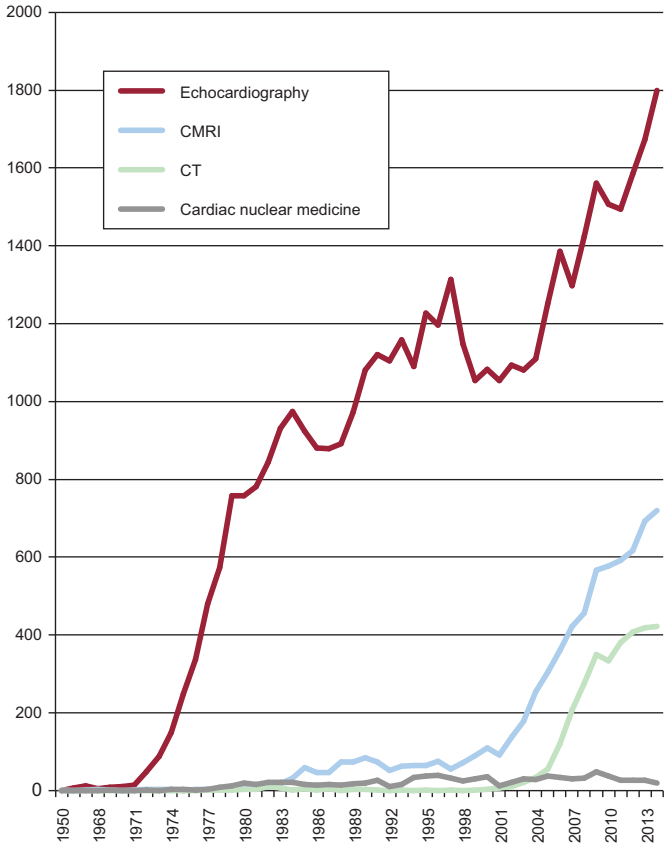


**Figure 2.** Number of articles published on each imaging technique over time. The number is based on the name of the technique or a synonym appearing in the title of the journal included in Scopus. CMRI, cardiac magnetic resonance imaging; CT, computed tomography.