Review article

The 100 most-cited original articles in cardiac computed tomography: A bibliometric analysis

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ABSTRACT

Bibliometric analysis is the application of statistical methods to analyze quantitative data about scientific publications. It can evaluate research performance, author productivity, and manuscript impact. To the best of our knowledge, no bibliometric analysis has focused on cardiac computed tomography (CT). The purpose of this paper was to compile a list of the 100 most-cited articles related to cardiac CT literature using Scopus and Web of Science (WOS).

A list of the 100 most-cited articles was compiled by order of citation frequency, as well a list of the top 10 most-cited guideline and review articles and the 20 most-cited articles of the years 2014–2015. The database of 100 most-cited articles was analyzed to identify characteristics of highly cited publications. For each manuscript, the number of authors, study design, size of patient cohort and departmental affiliations were cataloged.

The 100 most-cited articles were published from 1990 to 2012, with the majority (53) published between 2005 and 2009. The total number of citations varied from 3354 to 196, and the number of citations per year varied from 9.5 to 129.0 with a median and mean of 30.9 and 38.7, respectively. The majority of publications had a study patients sample size of 200 patients or less. The USA and Germany were the nations with the highest number of frequently cited publications.

This bibliometric analysis provides insights on the most-cited articles published on the subject of cardiac CT and calcium volume, thus helping to characterize the field and guide future research.

1. Introduction

Bibliometric analysis is the application of statistical methods to analyze and report quantitative data about scientific publications. It can be used to evaluate research performance, author productivity, and manuscript impact. Citation analysis, a component of bibliometric analyses, is a useful way to assess the impact or influence an article has on its field and to characterize the field itself.[1–4]

Several specialties and journals have previously published lists of the most-cited articles in their field.[5–15] In diagnostic radiology, four bibliometric analyses of the 100 most-cited articles have recently been published.[5,11,14,15] To the best of our knowledge, no current bibliometric analysis has focused on cardiac computed tomography (cardiac CT).

The purpose of this bibliometric analysis was to compile and examine the 100 most-cited articles relating to cardiac CT across all peer-reviewed scientific journals. The analysis was not limited to radiology journals as to provide a list of the most influential articles across all domains of medicine. This bibliometric citation analysis reflects the most influential articles to date related to cardiac CT, and may facilitate the identification of current trends in cardiac CT research.

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2. Materials and methods

A bibliometric analysis of the most-cited articles in cardiac CT was conducted in April 2016. All journals from Elsevier's Scopus and Thomson Reuters' Web of Science (WOS) were eligible for inclusion, comprising over 22,000 and 12,000 of the most-cited journals in the world, respectively. All journals were selected for inclusion regardless of country of origin, language, medical specialty, or electronic availability of articles or abstracts.

The key-word based database search was formulated in consultation with a medical information specialist and consisted of a series of cardiac search terms combined with a series of radiology search terms. Cardiac search terms were: coronary, calcium, coronary angiography, cardiac, fractional flow reserve (FFR), transcatheter aortic valve replacement (TAVR), coronary CTA, stenosis, plaque, CONFIRM (COronary CT Angiography EvaluatioN For Clinical Outcmes: An InteRnational Multicenter) registry, and atherosclerosis. Radiology search terms were: computed tomography, CT, MDCT, EBCT, and emergency room use of CTA. The terms were combined as follows:

(Coronary OR "Cardiac" OR "Calcium" OR "Coronary Angiography" OR ("FFR" OR "Fractional Flow Reserve") OR
("TAVR" OR "Transcatheter Aortic Valve Replacement") OR
("COronary CT Angiography EvaluatioN For Clinical Outcomes" OR ("CONFIRM" AND "CCTA")) OR
(("Stenosis" OR "Plaque" OR "Atherosclerosis" OR
("Emergency" AND "CTA" OR "Computed Tomography Angiography")) AND
("Cardiac" OR "Coronary"))) AND
("Computed Tomography" OR "CT" OR "MDCT" OR "EBCT")

Each article was reviewed for its appropriateness for inclusion. The articles were independently reviewed by two board-certified and fellowship trained staff radiologists with over 20 years combined experience in reading cardiac CT. A third staff radiologist resolved differences in opinion with regards to article inclusion.

The inclusion criteria specified articles that focused on cardiac CT and coronary calcium. Articles were excluded if they did not relate to cardiac radiology, explored basic science research, or did not include human subjects (e.g. research with phantoms). Review articles, guidelines, and meta-analyses were also excluded from the 100 most cited article list.

The 100 most-cited articles were compiled in a single database. The abstracts and articles included in the list of the top 100 most-cited articles were compiled and analyzed using the methods of Lim et al.[10] The database included: Article Title, WOS all database citations, WOS Core Collection citations, Scopus citations, Year, Journal, Authors, Number of Authors, Department Affiliation, Number of Institutions, Country of Primary Institution, Study Type, Study Design, and Sample Size. The Scopus citation count is reported in the results.

An important limitation of this study was the potential for excluding relatively recent papers from the list of top 100 most-cited articles. Due to their recent publication, these papers would inherently have lower citation counts than their older counterparts. A second more focused search was performed in an attempt to address this. This was done by performing the same search with the same terms within a narrower time range (2014–2015) and selecting the top 20 most-cited articles.

As per design of this study, non-original articles, namely review articles and guidelines were excluded. In order to capture the most-cited non-original articles, a separate search was conducted to identify the top 10 most-cited review articles and guidelines.

3. Results

Table 1 shows the total number of citations and the average citations per year for the top 100 most-cited articles. The 3 most-cited articles were "Quantification of Coronary Artery Calcium Using Ultrafast Computed Tomography" with a total of 3354 citations, "Diagnostic Accuracy of Noninvasuve Coronary Angiography using 64-lsice Spiral Computed Tomography" with a total of 1196 citations, and "Cornary Artery Calcium Score Combined with Framingham Score for Risk Prediction in Asymptomatic Individuals" with a total of 1065 citations.

Table 1
The 100 most-cited articles in cardiac CT literature (Scopus and Web of Science).

Rank	Article	Total citations	Average citations per year
1	Agatston AS, Janowitz WR, Hildner FJ, Zusmer NR, Viamonte Jr. M, Detrano R. **Quantification of coronary artery calcium using ultrafast computed tomography**. J Am Coll Cardiol, 1990:827–32.	3354	129.0
2	Raff GL, Gallagher MJ, O'Neill WW, Goldstein JA. **Diagnostic accuracy of noninvasive coronary angiography using 64-slice spiral computed tomography**. J Am Coll Cardiol, 2005:552–7.	1196	108.7
3	Greenland P, LaBree L, Azen SP, Doherty TM, Detrano RC. **Coronary Artery Calcium Score Combined with Framingham Score for Risk Prediction in Asymptomatic Individuals**. Journal of the American Medical Association, 2004:210–5.	1065	88.8
4	Leber AW, Knez A, Von Ziegler F, Becker A, Nikolaou K, Paul S, Wintersperger B, Reiser M, Becker CR, Steinbeck G, Boekstegers P. **Quantification of obstructive and nonobstructive coronary lesions by 64-slice computed tomography: A comparative study with quantitative coronary angiography and intravascular ultrasound**. J Am Coll Cardiol, 2005:147–54.	1006	91.5
5	Budoff MJ, Dowe D, Jollis JG, Gitter M, Sutherland J, Halamert E, Scherer M, Bellinger R, Martin A, Benton R, Delago A, Min JK. **Diagnostic Performance of 64-Multidetector Row Coronary Computed Tomographic Angiography for Evaluation of Coronary Artery Stenosis in Individuals Without Known Coronary Artery Disease. Results From the Prospective Multicenter ACCURACY (Assessment by Coronary Computed Tomographic Angiography of Individuals Undergoing Invasive Coronary Angiography) Trial**. J Am Coll Cardiol, 2008:1724–32.	990	123.8
6	Rumberger JA, Simons DB, Fitzpatrick LA, Sheedy PF, Schwartz RS. **Coronary artery calcium area by electron-beam computed tomography and coronary atherosclerotic plaque area: A histopathologic correlative study**. Circulation, 1995:2157–62.	990	47.1
7	Miller JM, Rochitte CE, Dewey M, Arbab-Zadeh A, Niinuma H, Gottlieb I, Paul N, Clouse ME, Shapiro EP, Hoe J, Lardo AC, Bush DE, De Roos A, Cox C, Brinker J, Lima JAC. **Diagnostic performance of coronary angiography by 64-row CT**. N Engl J Med, 2008:2324–36.	946	118.3
8	Nieman K, Cademartiri F, Lemos PA, Raaijmakers R, Pattynama PMT, De Feyter PJ. **Reliable noninvasive coronary angiography with fast submillimeter multislice spiral computed tomography**. Circulation, 2002:2051–4.	882	63.0
9	Mollet NR, Cademartiri F, Van Mieghem CAG, Runza G, McFadden EP, Baks T, Serruys PW, Krestin GP, De Feyter PJ. **High-resolution spiral computed tomography coronary angiography in patients referred for diagnostic conventional coronary angiography**. Circulation, 2005:2318–23.	864	78.5