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Dual-source CT versus single-source 64-section CT angiography for coronary artery disease: A meta-analysis

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AIM: To perform a meta-analysis to compare the diagnostic performance of single-source 64-section computed tomography (CT) versus dual-source CT angiography for diagnosis of coronary artery disease (CAD).

MATERIALS AND METHODS: The Cochrane Library, MEDLINE, and EMBASE were searched for relevant original papers. Inclusion criteria were (1) significant CAD defined as ≥50% reduction in luminal diameter by invasive coronary angiography as reference standard; (2) single-source 64-section CT or dual-source CT was used; (3) results were reported in absolute numbers of true-positive, false-positive, true-negative, and false-negative results or sufficiently detailed data for deriving these numbers were presented. A random-effects model was used for the meta-analysis.

RESULTS: Fifty-one papers including 3966 patients who underwent single-source 64-section CT and 2047 patients who underwent dual-source CT at a per-patient level were pooled. The diagnostic values of single-source 64-section CT versus dual-source CT were 97% versus 97% for sensitivity ($p = 0.386$), 78% versus 86% for specificity ($p < 0.001$), 90% versus 85% for positive predictive value (PPV; $p < 0.001$), 93% versus 97% for negative predictive value (NPV; $p = 0.001$), 6.8 versus 6.5 for positive likelihood ratio ($p = 0.018$), 0.04 versus 0.04 for negative likelihood ratio ($p = 0.625$), and 191.59 versus 207.37 for diagnostic odds ratio ($p = 0.043$), respectively.

CONCLUSION: Dual-source CT and single-source 64-section CT have similar negative likelihood ratios and, therefore, there was no significant difference in their utility to rule out CAD in intermediate-risk patients. However, compared to single-source 64-section CT, dual-source CT has significantly higher specificity, so that CT-based decisions for subsequent coronary catheter angiography are more accurate.

Introduction

Coronary artery disease (CAD) is the leading cause of death in developed countries. Regardless of the decline in mortality attributable to CAD recently, the burden of disease remains high.[1] Invasive coronary angiography is considered the reference standard for the diagnosis of CAD because of

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its superior temporal and spatial resolution. However, it is invasive and carries risk of morbidity, albeit small.[2]

Over the past decade, electrocardiogram (ECG)-gated multidetector computed tomography (CT) has emerged as a promising method that could potentially alter the indications for diagnostic coronary catheter angiography. It has been documented that single-source 64-section CT is superior to 16-section CT in assessing coronary luminal stenosis.[3] The recently introduced dual-source CT is also a very promising technique.[4–6] Although the dual-source CT coronary angiography is characterized by higher temporal resolution of 83 ms (even 75 ms in the 128-section dual-source CT) through simultaneous acquisition of data with two x-ray tubes and detectors,[6] single-source 64-section CT is the current recognized as minimum standard of care for cardiac CT angiography (CTA) in clinical applications and the majority of centres still use single-source 64-section CT. Therefore, it is necessary to know the difference in diagnostic performance between single-source 64-section CT and dual-source CT coronary angiography.

The aim of the present study was to perform a meta-analysis to compare the diagnostic performance of single-source 64-section CT versus dual-source CTA for the diagnosis of CAD.

Materials and methods

The principle of the Cochrane Handbook for Systematic Reviews of Diagnostic Test Accuracy[7] was followed. Written informed consent was not deemed to be necessary by the institutional review board.

Search strategy

Database searches of the Cochrane Library, MEDLINE, and EMBASE for relevant original articles published until June 2013 were performed by two investigators independently (B.J. and P.J.). The medical subject headings for ("coronary artery disease" OR "coronary artery stenosis") AND ("computed tomography" OR "CT") AND ("coronary angiography") were combined based on the PICOS criteria.[8] In addition, references of all published reviews and those of the included studies were screened. The retrieved studies were carefully examined to exclude potentially duplicate or overlapping data by the same two investigators.

Criteria for study inclusion

A study was included if[1] it reported significant CAD defined as $\geq$50% reduction in luminal diameter by using coronary catheter angiography as the reference standard[2]; single-source 64-section CT or dual-source CT was used[3]; results were reported in absolute numbers of true-positive, false-positive, true-negative, and false-negative results or sufficiently detailed data for deriving these numbers were presented. Studies were excluded for the following reasons: (1) they included patients who had undergone coronary artery bypass graft surgery; (2) they included patients who had undergone percutaneous coronary intervention for stent patency assessment; (3) they included a subset of patients who underwent prior heart transplantation; (4) they included fewer than 30 enrolled patients.

Data extraction and quality assessment

The same two investigators performed the data extraction and quality assessment independently, and consensus was obtained by consultation. The following information was extracted from each study: first author, year of publication, and journal; study population characteristics including sample size (number of patients evaluated with both tests), sex, age, heart rate, prevalence of CAD, time interval between coronary CTA and coronary catheter angiography; technical characteristics including radiation dose, rate of β-adrenergic blocking agent usage, basis of assessment (minimum coronary artery diameter in millimetre), rate of unassessable and excluded segments (in percentage). Data were recorded separately at segment level and patient level, whenever available. Studies were assessed using the Quality Assessment of Diagnostic Accuracy Studies (QUADAS-2) tool by RevMan 5.2, as modified by the Cochrane Collaboration.[7]

Data synthesis and statistical analysis

The analysis was done with data at the coronary artery segment level and at the patient level. Using the true-positive, true-negative, false-positive, and false-negative results, the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), positive and negative likelihood ratios, and diagnostic odds ratio were calculated. Although PPV and NPV are well known as measures of diagnostic accuracy, these results are influenced by the prevalence of disease in tested subjects. Sensitivity and specificity as well as positive/negative likelihood ratios are more independent of prevalence of disease.[9] Measures of diagnostic accuracy were reported as point estimates with 95% confidence intervals (CI).

All statistics were computed for individual studies and then combined using a random-effects model using the DerSimonian Laird method. Weighted symmetric summary receiver operating characteristic plots were computed. The

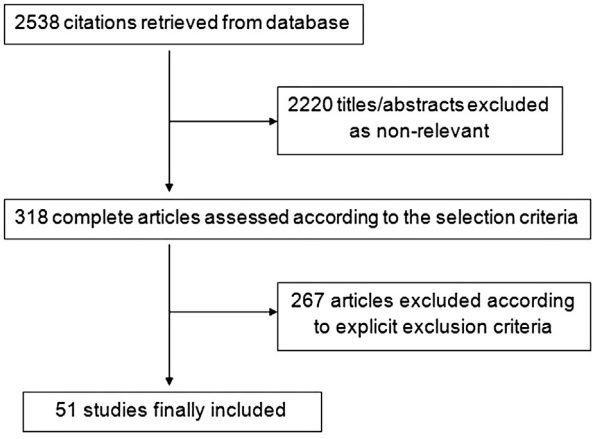

Figure 1 Flow diagram of the reviewing process.