DEBATE

Coronary computed tomography angiography is the new reference standard for the diagnosis of coronary artery disease: pros and cons

Marc Dewey[1]*, MD; Federico Biavati[1], MD; Alfredo Marchese[2], MD, PhD; **Roberta Rossini**[3]**, MD, PhD

Corresponding author: pros: Department of Radiology, Charité – Universitätsmedizin Berlin, Charité Campus Mitte, Charitéplatz 1, Freie Universität Berlin and Humboldt-Universität zu Berlin, 10117, Berlin, Germany. E-mail: marc.dewey@charite.de

**Corresponding author: cons: Cardiology Department, Ospedale S. Croce e Carle Cuneo, via Michele Coppino 26, 12100, Cuneo, Italy. E-mail: roberta.rossini2@gmail.com*

Accurate and timely diagnosis is essential in patients with suspected coronary artery disease (CAD). Traditionally, invasive coronary angiography (ICA) has been the gold standard for CAD detection, but coronary computed tomography angiography (CCTA) is rapidly emerging as a non-invasive alternative. Indeed, CCTA offers important advantages, as it avoids procedural risks (e.g., bleeding) while providing detailed information on coronary anatomy, subclinical atherosclerosis and plaque morphology. In particular, clinical trials have shown that CCTA has a high negative predictive value, resulting in it being particularly appealing to rule out the diagnosis of CAD in patients at low-to-intermediate risk. However, CCTA is not without limitations, especially in patients with extensive coronary calcification, irregular heart rhythm, or renal impairment. Despite the accruing evidence on the role of CCTA and its expanding use in clinical practice, the question remains whether it should replace ICA as the standard diagnostic tool in patients with suspected CAD.

Pros

Marc Dewey, MD; Federico Biavati, MD

CAD remains the leading cause of death worldwide. CCTA has emerged as a non-invasive alternative to diagnose CAD, competing with traditional invasive methods like coronary angiography. Key studies, including the DISCHARGE, PROMISE, and SCOT-HEART trials, highlight significant advantages of CCTA.

Non-invasive and safe: one of the main benefits of CCTA is that it does not require catheter insertion, unlike coronary angiography. The DISCHARGE trial[1] demonstrated that CCTA offers comparable diagnostic accuracy to invasive coronary angiography but with significantly fewer risks, such as bleeding and arterial injury (0.5% vs 1.9%). This makes CCTA particularly suitable for patients at low-to-intermediate risk of CAD, improving patient comfort and safety[1].

High diagnostic accuracy: the PROMISE trial compared CCTA with functional testing and found that CCTA was associated with fewer invasive catheterisations, showing no obstructive CAD (3.4% vs 4.3%) and comparable clinical outcomes over two years[2]. These findings reinforce CCTA as an excellent first-line diagnostic tool for detecting significant coronary artery stenosis.

Detailed visualisation of coronary arteries: CCTA provides detailed imaging of coronary arteries, including plaque morphology. The quantitative cardiovascular imaging (QCI) consensus highlighted the role of CCTA in offering vital insights into plaque composition, aiding in risk stratification and personalised treatment[3]. Traditional tests focus on functional outcomes like ischaemia, but CCTA directly visualises atherosclerosis, providing more precise diagnoses. The SCOT-HEART trial showed that CCTA significantly improved diagnostic accuracy, reclassifying 27% of coronary heart disease (CHD) diagnoses and leading to targeted interventions that reduced myocardial infarction rates by 38%[4].

Early detection of subclinical atherosclerosis: CCTA's ability to detect subclinical atherosclerosis, even before symptoms appear, makes it valuable for early intervention. Artificial intelligence (AI)-enhanced CCTA, as discussed by the QCI Study Group, is currently under evaluation for the early detection of vulnerable plaques in trials like SCOT-HEART 2 and DANE-HEART[5]. This may allow preventive measures to be taken earlier, reducing the risk of adverse cardiac events.

Technological advancements: ongoing technological innovations in CCTA, such as iterative reconstruction and AI integration, have improved both the accuracy and safety of the procedure. The QCI Study Group noted that AI enhances

diagnostic precision, reduces observer variability, and improves the analysis of coronary imaging[5]. These advancements are expanding the scope of CCTA in more complex cases of CAD.

CCTA has solidified its position as a powerful diagnostic tool for CAD. Its non-invasive nature, high diagnostic accuracy, detailed plaque visualisation, early detection capabilities, and continuous technological advancements make it a formidable alternative to traditional invasive angiography. Key studies, such as DISCHARGE, SCOT-HEART, and PROMISE, affirm CCTA's growing role, positioning it as a potential new non-invasive reference standard for diagnosing CAD.

Conflict of interest statement

Cons

Roberta Rossini, MD, PhD; Alfredo Marchese, MD, PhD

"Poor ugly creature, how gladly he would have lived even with the ducks had they only given him encouragement."

Hans Christian Andersen, The Ugly Duckling

Over the last decade, little has changed regarding the role of ICA in the diagnostic work-up of chronic coronary syndromes (CCS). The misfortune of ICA, a poor ugly creature, has been counterbalanced by the implementation of CCTA and (unexpectedly) by invasive functional coronary angiography (FCA), which is recommended in symptomatic patients with normal coronary arteries at non-invasive imaging[6].

The pros of CCTA, mainly based on its high negative predictive value, are strongly counteracted by the cons, including its low specificity, especially in identifying functionally significant CAD[7]. Furthermore, CCTA is not recommended in patients with severe renal failure (should we apply this contraindication also to ICA?), with decompensated heart failure (do we have a standard definition?), extensive coronary calcification (how can we know in advance?), fast irregular heart rate (not infrequent), etc…[6]. The demonstrated benefits of CCTA should be reconsidered: what has been found in a highly selective population cannot be applied to all real-world patients.

ICA with functional testing has a Class I recommendation in patients with suspected angina or ischaemia with non-obstructive coronary arteries (ANOCA/INOCA) at non-invasive imaging whereas, paradoxically, it does not have the same recommendation in patients with typical angina and unknown coronary anatomy[6].

What (exactly) are the risks of ICA? Reservations over ICA are due to the "potential complications" it can cause[8]. The only study cited in the reported complications rate is a meta-analysis of randomised clinical trials including patients undergoing ICA with or without percutaneous coronary intervention (PCI). Notably, 95% of the patients presented with acute coronary syndrome (ACS), and 75.2% underwent PCI. More than 1/3 of patients were treated with prasugrel or ticagrelor, and 1/5 patients received glycoprotein IIb/IIIa inhibitors. Of note, many studies included in the meta-analysis might be considered "obsolete" (which might suggest a very low rate of echo-guided femoral punctures), as demonstrated by the wide use of bare metal stents (37.8% of patients).

In the absence of recent (any?) data on the risks of the solely elective coronary angiography, we might consider studies on CCTA such as the CONSERVE study[9], which randomised over 1,600 patients to CCTA compared with a direct referral strategy using ICA, which demonstrated a similar rate of major adverse cardiovascular events and major bleeding in the 2 groups.

Angina matters (because symptoms matter). The diagnosis of angina is clinical. Symptoms guide cardiac procedures, as demonstrated by the fact that the New York Heart Association Class guides cardiac defibrillator implantation and symptoms in atrial fibrillation guide transcatheter ablation. Angina should guide ICA. Symptoms in CCS are crucial, as they distinguish between stable and unstable angina and between CCS and ACS. Such a distinction can be extremely difficult and, in many cases, the transition from an unstable to a stable disease may be due to logistical issues, such as the timeliness of a clinical evaluation. From this point of view too, ICA is one step above, as it is the standard of care in all ACS.

Sooner is better than later. One-year mortality in patients with CCS can be as high as 2.5%, with 27.1% of patients being hospitalised at least once[10]. These data tell us that a prompt and accurate diagnosis, and treatment, must be provided, which can be guaranteed only by ICA (with or without FCA).

So much promise, so little delivery (for CCTA). Despite its appeal, the limits of CCTA strongly reduce its feasibility. It is probably high time for us to see that ICA, which has finally grown into a beautiful swan, finds a wider indication in patients with angina.

Conflict of interest statement

Authors' affiliations

1. Department of Radiology, Charité – Universitätsmedizin Berlin, Charité Campus Mitte, Freie Universität Berlin

and Humboldt-Universität zu Berlin, Berlin, Germany; 2. Interventional Cardiology Department, Ospedale Santa Maria, GVM Care & Research, Bari, Italy; 3. Cardiology Department, Ospedale S. Croce e Carle Cuneo, Cuneo, Italy

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