What should we do about Coronary Calcification on Thoracic CT?

Was tun bei Koronarverkalkung in der Thorax-CT?

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Key words

cardiac, CT, outcomes analysis

received 06.09.2021
accepted 05.01.2022
published online 10.03.2022

Bibliography

Fortschr Röntgenstr 2022; 194: 833–840
DOI 10.1055/a-1752-0577
ISSN 1438-9029

Georg Thieme Verlag KG, Rüdigerstraße 14, 70469 Stuttgart, Germany

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ZUSAMMENFASSUNG

Hintergrund Die Verkalkung der Koronararterien ist ein häufiger Zufallsbefund der Thorax-Computertomografie (CT) bei nicht-kardialen Indikationen. In der EKG-getriggerten Herz-CT ist sie ein bekannter Marker für eine koronare Herzkrankheit und mit einem erhöhten Risiko für nachfolgende kardiale Ereignisse verbunden.

Materialien und Methoden Diese Übersichtsarbeit diskutiert die aktuelle Evidenz und die Leitlinien in Bezug auf den Nachweis einer Koronararterienverkalkung bei nicht EKG-gesteuerten Thorax-CT-Untersuchungen bei nicht-kardialen Indikationen.

Ergebnisse Bei Patienten, die sich einer routinemäßigen Thorax-CT unterziehen, ist eine Koronararterienverkalkung mit einem erhöhten Myokardinfarkt- und Mortalitätsrisiko verbunden. Koronararterienverkalkung kann bei der Thorax-CT ohne Gating im Vergleich zur Gating-CT genau beurteilt werden. Die Leitlinien unterstützen den Nachweis einer Koronararterienverkalkung in der Thorax-CT. Die Meinungen der Radiologen gehen jedoch auseinander. Der Nachweis einer Koronararterienverkalkung in der Thorax-CT kann Patienten mit zuvor unbekannter Koronararterienerkrankung erkennen. Bei asymptomatischen Patienten kann dies der Auslöser für die Beurteilung modifizierbarer kardiovaskulären Risikofaktoren sein und zum angemessenen Einsatz von Präventivmedikamenten führen.

Schlussfolgerung Zukünftige Forschungsarbeiten werden sich mit der Frage befassen, ob eine Veränderung der Behandlung auf Grundlage von Verkalkungen in der Thorax-CT zu einem besseren Outcome und zu einer Verbesserung der automatischen Bewertung von Verkalkungen durch maschinelles Lernen führt.

Kernaussagen:

- Koronararterienverkalkung ist ein häufiger Zufallsbefund in der Thorax-CT.
- Vorhandensein und Schweregrad einer Koronararterienverkalkung sind mit kardialen Folgen und Mortalität assoziiert.
- Nationale und internationale Leitlinien unterstützen, dass eine Koronararterienverkalkung in der Thorax-CT in den Arztbericht aufgenommen wird.

ABSTRACT

Purpose Coronary artery calcification is a frequent incidental finding on thoracic computed tomography (CT) performed for non-cardiac indications. On electrocardiogram-gated cardiac CT, it is an established marker of coronary artery disease and is associated with increased risk of subsequent cardiac events.

Materials and Methods This review discusses the current evidence and guidelines regarding the reporting of coronary artery calcification on non-electrocardiogram-gated thoracic CT performed for non-cardiac indications.

Results For patients undergoing routine thoracic CT, coronary artery calcification is associated with an increased risk of myocardial infarction and mortality. Coronary artery calcification can be accurately assessed on non-gated thoracic CT compared to gated CT. Guidelines support the reporting of coronary artery calcification on thoracic CT. However, radiologist opinions vary. The identification of coronary artery calcification on thoracic CT may identify patients with previously unknown coronary artery disease. For asymptomatic patients this may trigger an assessment of modifiable cardiovascular risk factors and guide the appropriate use of preventative medications.

Conclusion Future research will address whether changing management based on calcification on thoracic CT will improve outcomes and automated assessment of calcification using machine learning techniques.

Key Points:

- Coronary artery calcification is a frequent incidental finding on thoracic CT.
- The presence and severity of coronary artery calcification is associated with cardiac outcomes and mortality.
- Reporting coronary artery calcification on thoracic CT is supported by national and international guidelines.

Citation Format

- Williams MC, Llewellyn O, . What Should We Do About Coronary Calcification on Thoracic CT?. Fortschr Röntgenstr 2022; 194: 833–840

Introduction

Coronary artery calcification is a common finding on thoracic computed tomography (CT) performed for reasons other than looking at the heart. It is easy to detect and can be recognized on computed tomography as high attenuation material that follows the path of the coronary arteries. It can also be identified on CT performed both with and without contrast. Calcification found in the wall of the coronary artery is a part of coronary atherosclerotic plaques and consequently can be used to identify patients with coronary artery disease. Coronary heart disease remains a leading cause of death around the world and was responsible for 17 % of global deaths in 2016 [1]. However, at present, the existence of coronary artery calcification is often not reported by radiologists or is ignored by referrers. This review discusses the clinical implications of coronary artery calcification identified as an incidental finding on thoracic CT, including current evidence and recent guidelines.

What is coronary artery calcification?

Coronary artery calcification is an indicator of atherosclerotic plaque in the wall of the coronary artery and indicates the presence of coronary artery disease. The development of atherosclerosis is a multifactorial process which remains incompletely understood. It begins with lipid deposition in the coronary artery intima, which is followed by an inflammatory response, macrophage infiltration, necrosis, and calcification [2]. Atherosclerosis is a dynamic process of plaque deposition, stabilization, rupture, and remodeling, which is frequently asymptomatic, particularly when myocardial ischemia or infarction is not present. The presence of calcified plaques is thus a sign of the presence of a resolved or resolving inflammatory process, potentially threatening the integrity of the coronary artery wall.

Micro-calcification occurs early in the development of atherosclerosis and is associated with the histological thin-cap fibroatheroma, a characteristic finding which is associated with risk of rupture and myocardial infarction. Although micro-calcification is too small to identify on CT, it can be identified on positron emission tomography imaging using the radiotracer 18-fluoride sodium fluoride [3]. Macroscopic calcification occurs later in the development of atherosclerotic plaques, representing established atherosclerosis. Current clinical CT scanners can resolve calcific densities down to 0.5 mm in diameter [4]. On electrocardiogram (ECG)-gated coronary computed tomography angiography (CCTA) atherosclerotic plaque is classified as calcified plaque, non-calcified plaque, and mixed plaque, with the non-calcified plaques and low attenuation plaques, in particular, being accompanied by the highest risk of subsequent cardiac events [5]. However, on non-ECG-gated routine thoracic CT, it is difficult to see non-calcified plaques with current technology, but calcified plaques can be readily identified.

What are the implications of coronary artery calcification on ECG-gated cardiac CT?

Dedicated coronary artery calcium score scans involve acquiring a non-contrast ECG-gated CT scan, with a field of view focused on the heart, 3 mm contiguous slices, and a tube voltage of 120 kV. This provides a reproducible method to assess coronary artery calcification and limits the effect of coronary motion artifacts and differences in tube current on quantification. Multiple studies have established the utility of this form of coronary artery scoring for the prognostic assessment of asymptomatic patients [6–8] and also patients with symptoms that are suggestive of coronary artery disease [9].

The Multi-Ethnic Study of Atherosclerosis (MESA) study recruited over 6000 asymptomatic participants aged between 45 and 84 years. At one of six sites in the United States, participants underwent non-contrast ECG-gated CT to assess coronary artery calcification [6]. After 3.8 years of follow-up, compared to those without coronary calcification, participants with a calcium score of 101–300 Agatston Units (AU) were 7.73 times more likely to undergo a coronary event (myocardial infarction, coronary heart disease death, revascularization, or definite angina) and those with a calcium score over 300 AU were at 9.67 times more likely [6]. In the older cohort of the Rotterdam study (mean age: 71 ± 5.1 years), a higher coronary calcium score was accompanied by a higher risk of myocardial infarction. Participants with a coronary calcium score above 2000 AU were 8 times more likely to experience myocardial infarction [7]. In a younger (30 to 49 years) cohort of 22 346 participants who were recruited as part of the CAC (Coronary Artery Calcium) Consortium, the presence of coronary artery calcification was linked to an increased risk of coronary artery disease mortality and all-cause mortality after 12.6 years [10]. Thus, coronary artery calcification is associated with both short and long-term events, irrespective of age.

The MESA and Framingham studies showed that the prevalence of calcification varies based on ethnicity, sex, and age [11, 12]. Men have more coronary artery calcification at a younger age compared to women, but this does not mean that coronary artery calcification can be ignored in women. The CAC Consortium study showed that among 63 215 patients followed up for 12.6 years, women with coronary artery calcification had a 1.3-fold greater risk of death due to cardiovascular disease compared to men [8]. They also identified a different pattern of coronary artery calcification in women undergoing CT compared to men, with women with more extensive, numerous, and larger calcified plaques having an increased cardiovascular mortality [8].

The occurrence and severity of coronary artery calcification area were both associated with traditional cardiovascular risk factors and cardiovascular risk scores [12]. Cardiovascular risk scores provide information on the probability of a patient having coronary heart disease, whereas the coronary artery calcium score shows the presence of the disease itself. Several studies show that measuring the coronary artery calcium score is superior or additive to cardiovascular risk scores for identifying patients who are at risk of subsequent cardiac events. In the MESA study, adding the coronary artery calcium score to standard risk factors significantly improved the ability to detect coronary events (area under the curve 0.82 versus 0.77) [6]. They also showed that the coronary artery calcium score surpassed novel markers of cardiovascular risk such as ankle-brachial index and CRP (C-reactive protein) [13]. Similarly, in the Heinz-Nixdorf study, which included over just 4000 asymptomatic participants between 45 and 75 years of age, the occurrence of coronary artery calcification improved the prediction of coronary death or non-fatal myocardial infarction after 5 years of follow-up in both men (area under the curve 0.602 versus 0.77) and women (area under the curve 0.660 versus 0.723) [14]. The Dallas Heart Study of just over 2000 asymptomatic participants showed that both calcium score and a family history of myocardial infarction provided additive risk stratification for identifying patients at risk of death due to coronary heart disease, myocardial infarction, or revascularization [15]. Therefore, these and other studies have shown that the presence of coronary artery calcification on ECG-gated CT is predictive of subsequent cardiac events and can be used to improve risk stratification compared to traditional cardiovascular risk scores.

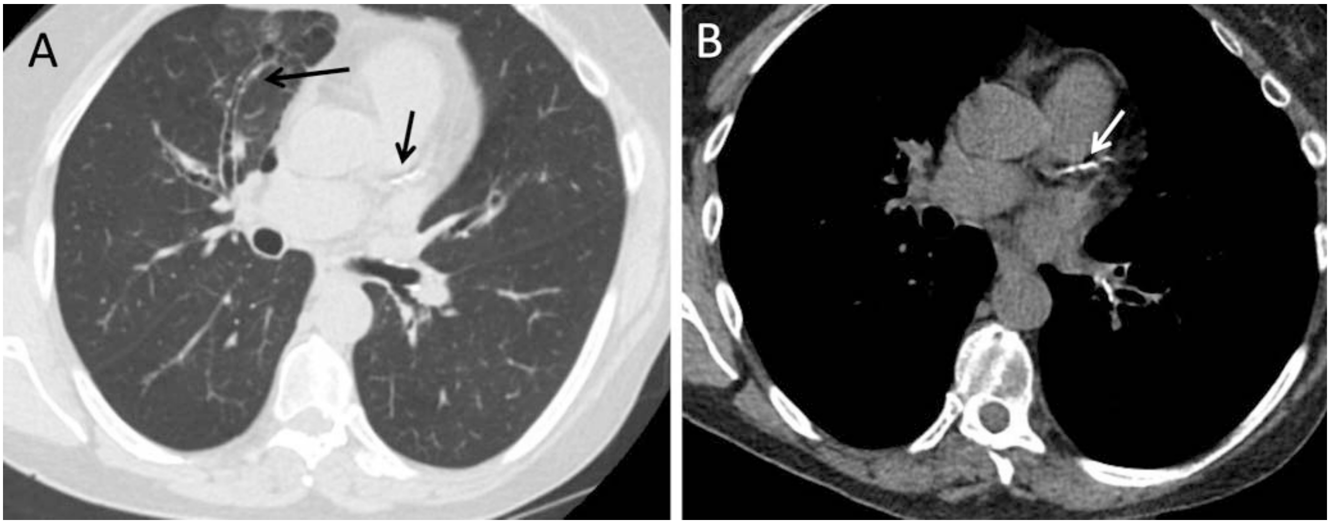
Nevertheless, it is vital to remember that calcification in the coronary arteries is only one part of atherosclerotic plaque. Non-calcified atherosclerotic plaque and low attenuation non-calcified plaque in particular [5] are more powerful predictors of subsequent cardiac events and are superior to the predictive abilities of coronary artery calcification. Coronary artery calcification cannot be used to “rule out” a patient having coronary heart disease, and conversely severe stenoses may be present even when coronary artery calcification is absent [16]. Nevertheless, the presence of the different atherosclerotic plaque subtypes does overlap, and the occurrence and severity of calcification in the coronary arteries are associated with increased plaque burdens and the occurrence of obstructive stenoses [5]. In conclusion, calcification in the coronary arteries is best interpreted as an indicator of coronary heart disease and of the risk of subsequent cardiac events.

How should we assess calcification in the coronary arteries on thoracic CT?

On ECG-gated CT, calcification in the coronary arteries is usually measured using the Agatston method [17]. Semi-automated software is used to recognize calcification above an attenuation density threshold of 130 Hounsfield units. The area of these is measured and this is multiplied by a weighting factor which is contingent on the maximum attenuation found inside the measured area. These values are then summed to create the Agatston score which can be interpreted as a continuous variable or divided into risk groups. A zero Agatston score represents very low risk of subsequent cardiac events [18]. The Society of Cardiovascular Computed Tomography and Society of Thoracic Radiology guidelines suggest that an Agatston score of 1 to 99 Agatston units (AU) can be interpreted as mildly increased risk, 100–299 AU as moderately increased risk and 300 AU as severely increased risk, based on expert consensus of the writing group [18]. Cut-off values of 400 AU or 1000 AU have also been used to identify high and very high risks of subsequent cardiac events by other authors. The mass score and the volume score are other quantitative alternatives to the Agatston score, but they are more often used in research studies than in clinical practice [19].

On non-ECG-gated thoracic CT, calculating a quantitative calcium score can be time-consuming, due to the larger number of thin slices, compared to the thicker slices used in dedicated calcium score CT. In addition, differences in reconstruction algorithms, tube voltage, and motion artifacts can all lead to variations in the calculated values. Nevertheless, an Agatston score that has been calculated on non-ECG-gated thoracic CT correlates well with that acquired from ECG-gated CT [20, 21]. Barriers to the use of quantitative scoring include the requirement of access to dedicated software and training and the time required to perform the semi-automated assessment. Hence, methods to visually assess calcification on thoracic CT are more widely used. In the future, machine learning techniques will be valuable in this area to improve the speed and accuracy of reporting.

Several semi-quantitative methods have been developed to assess coronary artery calcification on thoracic CT (▶ **Table 1**) [18, 22, 23]. These scores assign values of 0, 1, 2, or 3 to a calcification that is absent, mild, moderate, or severe, either on per vessel or per segment levels, thereby creating scores between 0 and 12 or between 0 and 30 [18]. An advantage of this form of visual scoring is that it can be used for contrast-enhanced and non-contrast CT. These scores correlate well with Agatston calcium scores, and their prognostic ability has been validated [22–25]. In order to facilitate reporting of coronary artery calcification in a more widescale manner on thoracic CT, the United Kingdom guidelines recently recommended the adoption of a simpler scoring system. In this system, the extent and severity of calcification in the coronary arteries is measured on a per patient basis and labelled as none, mild (▶ **Fig. 1**), moderate (▶ **Fig. 2**), or severe (▶ **Fig. 3**). This scoring system has good inter-observer agreement and correlates well with Agatston scoring [22].



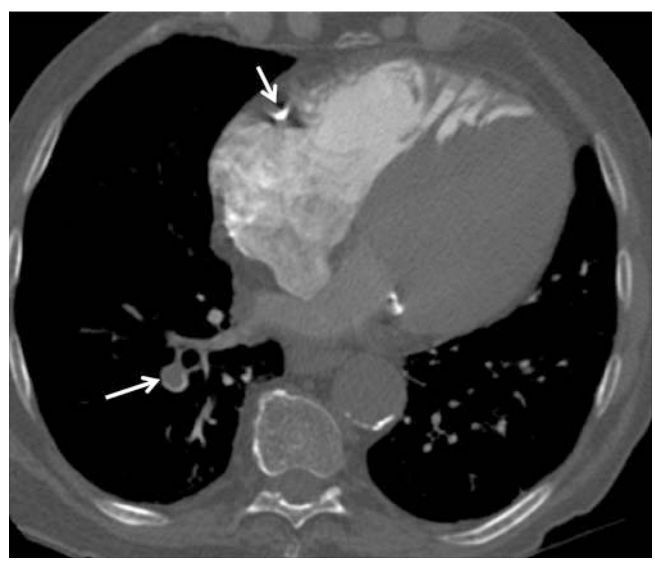
▶ **Fig. 1** Non-contrast CT images from a 63-year-old female with a history of breathlessness which showed tubular bronchiectasis in the middle lobe (**A**, long arrow) and both lower lobes (not shown). Mild coronary artery calcification is present and can be identified on lung windows on axial CT (**A**, short arrow) and soft tissue window orientated and mild coronary artery calcification was identified in the left anterior descending coronary artery (**B**, short arrow).

▶ **Abb. 1** CT-Bilder ohne Kontrastmittel einer 63-jährigen Frau mit der Anamnese Atemnot, die eine tubuläre Bronchiektasie im Mittellappen (**A**, langer Pfeil) und in beiden Unterlappen (nicht gezeigt) aufwies. Eine leichte Koronararterienverkalkung ist vorhanden und kann in den Lungenfenstern im axialen CT (**A**, kurzer Pfeil) und im Weichteilfenster erkannt werden. Im Ramus interventricularis anterior wurde eine leichte Koronararterienverkalkung festgestellt (**B**, kurzer Pfeil).

▶ **Table 1** Assessment of coronary artery calcium score on non-ECG-gated thoracic CT.

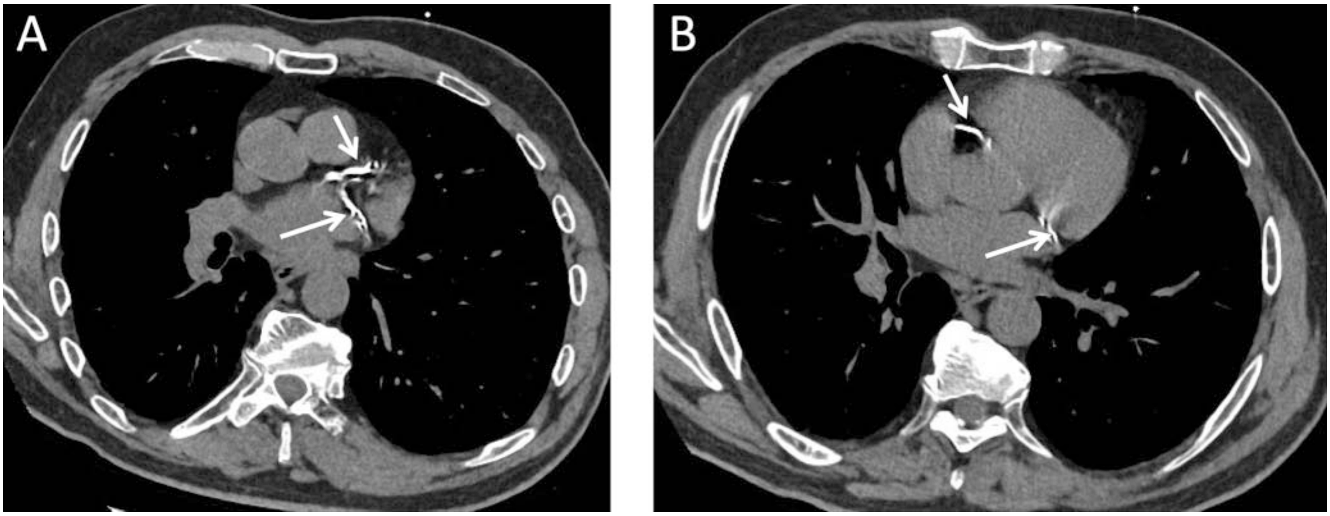
▶ **Tab. 1** Bewertung des Koronararterien-Kalkscores in der Thorax-CT ohne EKG-Gating.

Score	Value	Interpretation
Agatston Score	0	None
	1–99	Mild
	100–299	Moderate
	>= 300	Severe
Ordinal score – per vessel	0	None
	1–4	Mild
	5–8	Moderate
	9–12	Severe
Ordinal score – per segment	0	None
	1–5	Mild
	6–11	Moderate
	12–30	Severe
Ordinal score – per patient	None	None
	Mild	Mild
	Moderate	Moderate
	Severe	Severe



▶ **Fig. 2** Axial CT image from a CT pulmonary angiogram in a patient with a pulmonary embolism (long arrow) and moderate coronary artery calcification in the right coronary artery (short arrow). The image also shows mild mitral annular calcification and thoracic aorta calcification.

▶ **Abb. 2** Axiales CT-Bild aus einer CT-Pulmonalisangiografie bei einem Patienten mit einer Lungenembolie (langer Pfeil) und mäßiger Koronararterienverkalkung in der A. coronaria dextra (kurzer Pfeil). Das Bild zeigt auch eine leichte Verkalkung des Mitralklappenannulus und eine Verkalkung der Aorta thoracica.



▶ **Fig. 3** Non-contrast CT images from a 69-year-old male with breathlessness which shows severe coronary artery calcification in all three coronary arteries. Image **A** shows severe calcification in the left anterior descending (short arrow) and left circumflex coronary arteries (long arrow). Image **B** coronary artery calcification in the right coronary artery (short arrow) and left circumflex coronary artery (long arrow).

▶ **Abb. 3** CT-Bilder ohne Kontrastmittel eines 69-jährigen Mannes mit Atemnot, die schwere Koronararterienverkalkungen in allen drei Koronararterien zeigen. Bild **A** zeigt schwere Verkalkungen im Ramus interventricularis anterior (kurzer Pfeil) und im Ramus circumflexus (langer Pfeil). Bild **B** Koronararterienverkalkung in der A. coronaria dextra (kurzer Pfeil) und im Ramus circumflexus (langer Pfeil).

What are the implications of calcification in the coronary arteries on non-ECG-gated thoracic CT?

Several cohort studies have assessed the frequency and prognostic implications of incidental calcification in the coronary arteries in patients having non-ECG-gated thoracic CT for non-cardiac indications (▶ **Table 2**). The prevalence of calcification in the coronary arteries on thoracic CT is driven by the indication for imaging and the age of the population being studied, and it varies between 26 % and 93 % [26–31]. In all studies performed to date coronary artery calcification on thoracic CT is associated with subsequent cardiovascular outcomes or mortality, often over and above other risk factors or other underlying diseases.

In the National Lung Screening Trial (NLST), the use of low radiation-dose CT reduced mortality from lung cancer [32]. However, more patients in the low radiation-dose CT group died from cardiovascular disease than from lung cancer (26.1 % versus 22.9 %) [32]. The evaluation of calcification in the coronary arteries in the NSLT trial showed that compared to participants with no calcification in their coronary arteries, those with mild calcification were twice as likely to die due to coronary heart disease, those with moderate calcification were four times more likely, and those with severe calcification were seven times more likely [22]. Other studies have shown similar findings, with the prevalence and severity of calcification in the coronary arteries associated with cardiovascular events, cardiovascular mortality, and all-cause mortality for patients undergoing CT for lung cancer screening [23, 33–35]. This highlights that it is important to incorporate the assessment of calcification in the coronary arteries into the assessment of lung cancer screening CT scans. The importance of calcification in the coronary arteries for the stratification of patients with other forms of cancer has also been established. For example, in a study including 408 patients with breast cancer who were followed up for 6.5 years, coronary artery calcification and cancer stage were both independent predictors of cardiovascular outcomes, but the cardiovascular risk score was not [29].

Similar results have also been found in studies of patients undergoing CT for respiratory conditions. In 1000 patients with COPD who underwent thoracic CT in the ECLIPSE (Evaluation of COPD Longitudinally to Identify Predictive Surrogate Endpoints) study, the presence of coronary artery calcification was associated with increased risk of death after adjusting for smoking, age, and gender (hazard ratio: 1.42, 95 % confidence interval: 1.12 to 1.78) [36]. Similarly, among pulmonary embolism patients, the presence of calcification in the coronary arteries is associated with both short- and long-term mortality [37, 38]. In another study including 479 patients who underwent CT pulmonary angiography (CTPA) and transthoracic echocardiography, coronary artery calcification was associated with a higher frequency of all-cause mortality and pulmonary embolism mortality at thirty days [38]. In another cohort of 400 patients with pulmonary embolism on CTPA, calcification in the coronary arteries was an independent predictor of mortality at 3 years, over and above the index pulmonary embolism severity [37]. This suggests that once a patient has received successful treatment for their pulmonary embolism, it is coronary heart disease that continues to be the most likely basis of longer-term mortality. Interestingly, in patients with bronchiectasis, both the presence of calcification in the coronary arteries and the severity of bronchiectasis were associated with mortality after 6 years [39]. This highlights an important similarity between cardiovascular disease and respiratory diseases in terms of both risk factors and the prediction of subsequent death.

▶ **Table 2** Major cohort studies of coronary artery calcification on thoracic CT.

▶ **Tab. 2** Wichtige Kohortenstudien über Koronararterienverkalkung in der Thorax-CT.

	Number	Population	Follow-up (years)	Prevalence of CAC	Outcome
Chiles [22]	1575	Lung cancer screening	6.5	–	CHD death
Shemesh [23]	8782	Lung cancer screening	6	69.2 %	CVD death
Jacobs [33]	958	Lung cancer screening	1.8	79 %	All-cause mortality, CVD endpoint, CHD endpoint
Takx [35]	3559	Lung cancer screening	2.9	81 %	CVD event
Phillipiis [29]	408	Breast cancer	6.5	26 %	Cardiac event
Williams [36]	942	COPD	3	72 %	Death
Williams [37]	400	Pulmonary embolism	3	68 %	Death
Heidinger [38]	479	Pulmonary embolism	30 days	53 %	Death, PE mortality
Williams [39]	362	Bronchiectasis	6	54 %	Death
Jacobs [40]	1285	Routine thoracic CT	1.5	67 %	CVD event
Shao [41]	410	Respiratory indications	7 years	49 %	All-cause death, myocardial infarction
Hughes-Austin [42]	157 cases; 494 controls	Healthy screening	10 years	–	Death

CHD: coronary heart disease; CVD: cardiovascular disease.

A similar pattern is seen in thoracic CT being performed in unselected patients. A multicenter retrospective cohort study including 1285 patients undergoing thoracic CT in the Netherlands found that compared to those without calcification in the coronary arteries, the presence of severe coronary artery calcification was associated with a 3-fold increase in the risk of cardiovascular disease events (hazard ratio: 2.7, 95 % confidence interval: 2.0 to 3.7) [40]. In a study that followed up 410 patients for 7 years, the presence of calcification in the coronary arteries on thoracic CT performed for a variety of respiratory indications was associated with a higher frequency of death or myocardial infarction, after adjusting for cardiovascular risk factors [41]. In a study of patients undergoing CT for self- or physician-referred health screening, the severity of calcification in the coronary arteries was associated with all-cause death at 10 years, independent of traditional cardiovascular risk factors [42]. Thus, these findings are translatable to patients undergoing thoracic CT for both respiratory and non-respiratory conditions.

What should we do about calcification in the coronary arteries on thoracic CT?

National and international guidelines have now been published that support commenting on calcification in the coronary arteries on radiological reports for thoracic CT. The Society of Cardiovascular Computed Tomography (SCCT) and the Society of Thoracic Radiology (STR) published guidelines in 2016 that supported the reporting of calcification in the coronary arteries on non-contrast non-cardiac thoracic CT. They gave a class 1 indication to coronary artery calcification evaluation and reporting on all CT examinations of the chest performed without contrast, with the option to perform either visual ordinal assessment or quantitative Agatston scoring. In 2020, joint United Kingdom guidelines were published by the British Society for Cardiovascular Imaging (BSCI), British Society of Cardiovascular Computed Tomography (BSCCT), and British Society of Thoracic Imaging (BSTI). These guidelines similarly recommended that calcification in the coronary arteries be reported on all CT examinations of the chest performed without ECG gating, but these guidelines suggested that this should include both contrast-enhanced and non-contrast imaging. They also recommended the use of a simpler per patient visual score (labelled as none, mild, moderate, severe) to assess calcification in the coronary arteries. The BSCI/BSCCT/BSTI guidelines also provide suggestions for subsequent patient management. For asymptomatic patients, an assessment of modifiable risk factors (hypertension, hyperlipidemia, smoking, etc.) was recommended. If patients are symptomatic, the BSCI/BSCCT/BSTI guidelines recommended that they should be managed as per established guidelines for patients with symptoms of suspected coronary heart disease.

Reporting the existence of coronary artery calcification may lead to changes in preventative medication use and identify patients who had previously ignored their symptoms of coronary artery disease. In the Lung Screening Uptake Trial, near all of the patients had a 10-year cardiovascular risk score of above 10 %, but less than half of them were taking statin medication. Many of the estimated 7 million people in the United States that meet the criteria to participate in screening for lung cancer will also have intermediate or higher cardiovascular risk, based principally on their smoking status and their age. These individuals may benefit from both screening for lung cancer and the potential supplementary cardiovascular risk stratification provided by assessing their coronary artery calcium score [43]. Thus, the potential to change management and improve outcomes on a population basis is significant. In addition, patient awareness of their own coronary artery calcium burden has been shown to improve compliance with disease-modifying medications, thereby having the potential to improve prognosis [44]. However, to date, no randomized controlled trials that assess the prognostic implications of changing management based on thoracic CT have been performed.

Radiologist opinions vary concerning the reporting of calcification in the coronary arteries on thoracic CT [45]. A survey of 200 United Kingdom radiologists found that 11 % never reported the presence of calcification in the coronary arteries and the radiologists who were not sub-specialists in cardiac imaging were less likely to report calcification in the coronary arteries [45]. Other studies show that incidental calcification in the coronary arteries is not mentioned on between one quarter and one fifth of thoracic CT reports [27, 28, 46, 47]. Automated assessment of calcification on thoracic CT using machine learning techniques may aid the speed and accuracy of radiologist reporting [48]. There are also issues with the understanding of referrers regarding what coronary artery calcification means and what actions should be taken. A survey of 132 physicians found that only half understood that calcification in the coronary arteries on non-contrast CT meant that coronary artery disease was present, and only 4 % reported that they would alter management recommendations for patients based on the existence of incidental calcification in the coronary arteries [27].

Conclusion

Calcification in the coronary arteries on thoracic CT is an established marker of coronary heart disease. Its prevalence and severity are associated with traditional cardiovascular risk, ensuing cardiovascular events, and mortality. Guidelines are now available that support the reporting of incidental calcification in the coronary arteries on routine thoracic CT, and this includes scans performed with and without contrast. Future research will address whether changing management based on the presence of calcification on thoracic CT will improve outcomes and automated assessment of calcification using machine learning will improve both the speed and accuracy of reporting.

Conflict of Interest

MCW has given lectures for Canon Medical Systems.

Acknowledgements

MCW is funded by the British Heart Foundation (FS/11/014, CH/09/002, FS/ICRF/20/26 002).

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