Oktober 2012

Newsletter

Arbeitsgruppe Cardio-CT der Deutschen Gesellschaft für Kardiologie – Herz- und Kreislaufforschung

Liebe Kolleginnen und Kollegen,

nach einer etwas längeren Sommerpause senden wir Ihnen nun die Herbstausgabe des Newsletters der AG Cardio-CT (AG24) der DGK. Das Format hat sich leicht geändert. Wir hoffen es ist übersichtlich, und für Jeden etwas dabei.

Über Anregungen und Rückmeldungen freuen sich

Ihre Sprecher

Stefan Möhlenkamp und Axel Schmermund

Aus der AG Cardio-CT:

Wahlen in Mannheim:

Das Ergebnis der Wahlen zum Nukleus der AG 24 ist wie folgt:

Sprecher:	Prof. Dr. med. Stefan Möhlenkamp, Moers
Stellvertretender Sprecher:	Prof. Dr. med. Axel Schmermund, Frankfurt
Nukleus:	Prof. Dr. med. Stephan Achenbach, Giessen (Past-Sprecher)
	Prof. Dr. med. Jörg Hausleiter, München
	Priv-Doz. Dr. med. Gregorius Korosoglou, Heidelberg
	Priv-Doz. Dr. A. Leber, München
	Dr. med. Amir Mahabadi, Essen
	Prof. Dr. med. Werner Moshage, Traunstein
	Priv-Doz. Dr. med. Tobias Pflederer, Erlangen
	Dr. med. Johannes Rixe, Gießen
	Prof. Dr. med. Dieter Ropers, Erlangen
	Prof. Dr. med. Stephen Schröder, Göppingen
Zahl der Mitglieder:	n=132 (Stand: 05.10.2012)

Dem Antrag auf Verlängerung der AG 24 wurde zugestimmt

Turnusgemäß wurde ein Antrag auf Verlängerung der AG 24 „Cardio-CT“ gestellt. In der Vorstandssitzung der DGK am 11. September 2012 in Düsseldorf hat der Vorstand einer Verlängerung um zwei Jahre bis zur Herbsttagung 2014 zugestimmt. Im November 2012 muss wieder der Jahresbericht eingereicht werden.

Publikation der AG24

In der DMW erscheint ein Kurz-Beitrag der AG24: Möhlenkamp S, Schmermund A, für die AG Cardio-CT der DGK. Die Kardio-CT ist der invasiven Diagnostik der KHK überlegen – Pro (Coronary CT angiography is superior to invasive coronary angiography – pro). **DMW 2012;137:1914** [DOI 10.1055/s-0032-1305200]

Programm der AG 24 auf der Herbsttagung der DGK

CCH – Congress Center Hamburg

Freitag, 12. Oktober 2012 (Saal C2.2) 08:00-09:30

Kardiale CT – eine Hilfe für Therapieentscheidungen?

Vorsitz: S. Möhlenkamp (Moers), A. Schmermund (Frankfurt am Main)

(V214)	**Einführung** *S. Möhlenkamp (Moers)*
(V215)	**Plaque im Koronar-CT – wann Statine und für wen?** *A.-A. Mahabadi (Essen)*
(V216)	**Ischämienachweis mittels CT – klinisch nutzbar?** *J. Hausleiter (München)*
(V217)	**CT vor TAVI – Wie es geht und was geht!** *S. Achenbach (Gießen)*
(V218)	**CCT in der CPU – und gleich nach Hause?** *T. Pflederer (Erlangen)*
(V219)	**Die Aorta im CT: wann Verlaufskontrolle, wann Stenting, wann OP?** *H. Eggebrecht (Frankfurt am Main)*
(V220)	**Zusammenfassung** *A. Schmermund (Frankfurt am Main)*

Programm der AG 24 auf der Frühjahrstagung der DGK in Mannheim 2013

Save the Date!!!

Für die **Frühjahrstagung der DGK 2013** wurde die von uns vorgeschlagene Sitzung „**Cardio-CT-basierte koronare und myokardiale Diagnostik - aktuelle Entwicklungen**“ mit in das Programm aufgenommen. Die Sitzung wird am **Mittwoch, 3. April 2013, 13:30 – 15:00 Uhr** stattfinden. Details werden bekannt gegeben.

European Cardiac CT Registry:

(ehemals German Cardiac CT Registry)

Im Register, das von der „Stiftung Institut für Herzinfarktforschung“ ® (Leitung: Frau Kathe) geführt wird, sind derzeit 5737 Untersuchungen dokumentiert (Stand Mitte Juli 2012, 36% Frauen, Alter: 61 Jahre). Die Überweisungen zur Untersuchung erfolgen zu 41% von Kardiologen und zu 49% von Allgemeinärzten oder Internisten, wobei fast 2/3 der Zuweisungen aus dem eigenen Zentrum erfolgen. Über die Hälfte der eingegebenen Untersuchungen sind CTA + CAC, 9% nur CAC und 15% nur CTA.

In diesem Register können die Untersuchungen nach Indikationen evaluiert werden, die Anamnese (Myokardinfarkt / Stent / Bypass), Symptome (AP/CCS, Herzinsuffizienz/NYHA) und Begleiterkrankungen (COPD / PAD / Depression / Malignome) werden ebenso erfasst wie die Risikofaktoren und die Risikoscores. Ferner sind auch untersuchungsspezifische Daten verzeichnet wie Schweregrad der CAC-Last aber auch Herzfrequenz, Prämedikation (z.B. Beta-Blocker und NTG) und Lokalisation der Plaques. Schließlich werden auch Parameter der Strahlenexposition erfasst mit einer mittleren effektiven Dosis von 3.0 (1.6-5.9) mSv.

Die Daten können auch für die zuweisenden Institute getrennt und im Vergleich zur gesamten Registerpopulation analysiert werden, sodass dieses Register eine Qualitätskontrolle und Benchmarking ermöglicht.

Kongresse:

ESC 2012 - Highlights:

(von A. Mahabadi)

CT-Perfusion: In der **Core 320 Studie** wurde die diagnostische Genauigkeit von kombinierter CTA und CT-Myokardperfusions untersucht. Die diagnostische Genauigkeit im Vergleich zur invasiven Koronarangiographie als Goldstandart konnte von 0.81 für CTA alleine durch Hinzunahme von Perfusionsbildern auf 0.87 gesteigert werden. Bestätigt wurden diese Ergebnisse von **Ko et al.**, die im Vergleich zu invasiver **FFR-Bestimmung** einer signifikanten Stenose, mittels kombinierte CTA und CT-Perfusion eine diagnostische Genauigkeit von 0.95 ermittelten.
Dass neben dem 320-Zeilen MDCT auch mittels **high-pitch DSCT eine zuverlässige Detektion von myokardialer Hypoperfusion** bei geringer Stahlenbelastung gelingt, wurde von **Hausleiter et al** präsentiert.

Pontone et al. konnten an 151 **TAVI**-Patienten zeigen, dass MDCT der Echokardiographie in der Größenbestimmung des aortalen Annulus überlegen ist und so zuverlässiger paravalvuläre Regurgitationen vorhersagt.

An 94 Patienten mit durchgemachter ventrikulärer Tachykardie zeigten **Ozawa et al**, dass mittels 320-Zeilen MDCT ein Nachweis von **myokardialer Fibrose und myokardialer Verfettung** gelingt, welche mit dem Auftreten von Kammerflimmern und ventrikulärer Tachykardie verknüpft sind.

Die Möglichkeit der **Differenzierung nicht-kalzifizierter Plaqueanteile mittels CTA** wurde von **Marwan et al**. in einer in-vivo Studie mit IVUS als Referenz untersucht: lipidreiche Plaques hatten eine höheren Anteil an Pixeln mit <30 HU als fibrotische Plaques.

Am Kollektiv der **Heinz Nixdorf Recall Studie** wurde die Assoziation von **epikardialem Fett und aortaler Verkalkung mit inzidenten koronaren Ereignissen** überprüft. Hier konnte gezeigt werden, dass das epikardiale Fett zusätzlich zum koronararteriellen Kalk und traditionellen Risikofaktoren mit zukünftigen Ereignissen verbunden ist. Aortale Verkalkung jedoch konnte die Prädiktion erster Ereignisse nicht zusätzlich verbessern.

SCCT - Highlights:

(von J. Hausleiter und S. Achenbach)

Am 19 – 22 Juli 2012 fand in Baltimore die 7. Jahrestagung der SCCT statt. Ein Schwerpunkt war „Europe Presents“. Insgesamt haben fast 1000 Teilnehmer den Kongress besucht. Wesentliche Schwerpunkte waren

CT-Perfusionsuntersuchungen, die eine gute Korrelation zu anderen Ischämietests und zur invasiv gemessenen FFR aufweisen. Derzeit werden noch verschiedene Protokolle diskutiert, zB die Datenaufnahme zu nur einem Zeitpunkt nach Kontrastmittelgabe oder die wiederholte Datenakquisition, um die Anflutung des Kontrastmittels im Myokard beurteilen zu können. Multizentrische Studien sind aufgelegt und die Ergebnisse werden in Kürze erwartet.

Die CT-FFR Bestimmung, die es nach hydrodynamischen Berechnungen erlaubt, gestattet, aus statischen CT-Datensätzen die hämodynamische Relevanz von Koronarstenosen zu ermitteln, wurde mit mehreren Abstracts vorgestellt. Insbesondere bei intermediären Stenosen zeigte sich ein Vorteil gegenüber der alleinigen Analyse der CT-Angiographie hinsichtlich des Vorliegens von Stenosen.

Schließlich war ein weiteres wesentliches Thema die CT-Diagnostik bei Patienten vor TAVI. Wesentliche Einsatzgebiete sind hier zum einen die Bestimmung des Durchmessers der peripheren Zugangsgefäße, die exakte Bestimmung der Dimensionen des Aortenannulus (und hieraus abgeleitet die Wahl der Prothesengröße), sowie der Ermittlung eines geeigneten Winkels zur Fluoroskopie während der Klappenimplantation.

Die SCCT hat eine „Qualitätssicherungs- und –verbesserungskampagne“ initiiert. In dieser „Responsible Imaging Campaign“ können anonymisierte Scan-Daten (Indikation, Strahlendosis, Kontrastmittelmengen) über einen Web-Server in eine Datenbank eingegeben werden. Diese Datenbank wird von Prof. Hausleiter (derzeit Vorsitzender des Radiation Committee der SCCT) für die SCCT gepflegt. Etwa ¼-jährlich sollen die Daten des eigenen Zentrums als Benchmarking zurückgespiegelt werden.

Save the Dates:
Am **11. – 14. Juli** findet die **8. Jahrestagung der SCCT** in Montreal, Canada statt: www.scct.org/annualmeeting/2013

Am **1. März 2013** findet das nächste **Europäische SCCT-Meeting** in Erlangen oder Innsbruck statt. Wir werden informieren. Titel: *Cardiovascular Risk Assessment Using CT: From Coronary Calcium to Plaque Characterization*: *Practical Aspects, Recent Data, Future Potential*.

Aktuelles aus der Literatur

(das Wichtigste aus 2012 – seit dem letzten Newsletter)

Konsensusempfehlungen / Scientific Statements

Kardiologe 2012 Feb;6:105-125
Rofo. 2012 Apr;184(4):345-68. Epub 2012 Mar 17

Konsensusempfehlungen der DRG/DGK/DGPK zum Einsatz der Herzbildgebung mit Computertomographie und Magnetresonanztomographie

Consensus recommendations of the German Radiology Society (DRG), the German Cardiac Society (DGK) and the German Society for Pediatric Cardiology (DGPK) on the Use of Cardiac Imaging with Computed Tomography and Magnetic Resonance Imaging.

Achenbach S, Barkhausen J, Beer M, Beerbaum P, Dill T, Eichhorn J, Fratz S, Gutberlet M, Hoffmann M, Huber A, Hunold P, Klein C, Krombach G, Kreitner KF, Kühne T, Lotz J, Maintz D, Marholdt H, Merkle N, Messroghli D, Miller S, Paetsch I, Radke P, Steen H, Thiele H, Sarikouch S, Fischbach R.
im Auftrag der Klinischen Kommission der Deutschen Gesellschaft für Kardiologie - Herz- und Kreislaufforschung.
Abstract
Cardiac magnetic resonance imaging (MRI) and computed tomography (CT) have been developed rapidly in the last decade. Technical improvements and broad availability of modern CT and MRI scanners have led to an increasing and regular use of both diagnostic methods in clinical routine. Therefore, this German consensus document has been developed in collaboration by the German Cardiac Society, German Radiology Society, and the German Society for Pediatric Cardiology. It is not oriented on modalities and methods, but rather on disease entities. This consensus document deals with coronary artery disease, cardiomyopathies, arrhythmias, valvular diseases, pericardial diseases and structural changes, as well as with congenital heart defects. For different clinical scenarios both imaging modalities CT and MRI are compared and evaluated in the specific context.

CT-Angiografie

Atherosclerosis. 2012 Aug 24. doi: 10.1016/j.atherosclerosis.2012.08.002. [Epub ahead of print]
Statins use and coronary artery plaque composition: Results from the International Multicenter CONFIRM Registry.
Nakazato R, Gransar H, Berman DS, Cheng VY, Lin FY, Achenbach S, Al-Mallah M, Budoff MJ, Cademartiri F, Callister TQ, Chang HJ, Cury RC, Chinnaiyan K, Chow BJ, Delago A, Hadamitzky M, Hausleiter J, Kaufmann P, Maffei E, Raff G, Shaw LJ, Villines TC, Dunning A, Feuchtner G, Kim YJ, Leipsic J, Min JK.
Abstract
OBJECTIVE: The effect of statins on coronary artery plaque features beyond stenosis severity is not known. Coronary CT angiography (CCTA) is a novel non-invasive method that permits direct visualization of coronary atherosclerotic features, including plaque composition. We evaluated the association of statin use to coronary plaque composition type in patients without known coronary artery disease (CAD) undergoing CCTA.
METHODS: From consecutive individuals, we identified 6673 individuals (2413 on statin therapy and 4260 not on statin therapy) with no known CAD and available statin use status. We studied the relationship between statin use and the presence and extent of specific plaque composition types, which was graded as non-calcified (NCP), mixed (MP), or calcified (CP) plaque.
RESULTS: The mean age was 59±11 (55% male). Compared to the individuals not taking statins, those taking statins had higher prevalence of risk factors and obstructive CAD. In multivariable analyses, statin use was associated with increased the presence of MP [odds ratio (OR) 1.46, 95% confidence interval (CI) 1.27-1.68), p<0.001] and CP (OR 1.54, 95% CI 1.36-1.74, p<0.001), but not NCP (OR 1.11, 95% CI 0.96-1.29, p=0.1). Further, in multivariable analyses, statin use was associated with increasing numbers of coronary segments possessing MP (OR 1.52, 95% CI 1.34-1.73, p<0.001) and CP (OR 1.52, 95% CI 1.36-1.70, p<0.001), but not coronary segments with NCP (OR 1.09, 95% CI 0.94-1.25, p=0.2).
CONCLUSION: Statin use is associated with an increased prevalence and extent of coronary plaques possessing calcium. The longitudinal effect of statins on coronary plaque composition warrants further investigation.

Eur Heart J Cardiovasc Imaging. 2012 Aug 24. [Epub ahead of print]

Body mass index and the prevalence, severity, and risk of coronary artery disease: an international multicentre study of 13 874 patients.

Labounty TM, Gomez MJ, Achenbach S, et al.

Abstract

AIMS: Obesity is associated with the presence of coronary artery disease (CAD) risk factors and cardiovascular events. We examined the relationship between body mass index (BMI) and the presence, extent, severity, and risk of CAD in patients referred for coronary computed tomographic angiography (CCTA).

METHODS AND RESULTS: We evaluated 13 874 patients from a prospective, international, multicentre registry of individuals without known CAD undergoing CCTA. We compared risk factors, CAD findings, and risk of all-cause mortality and non-fatal myocardial infarction (MI) amongst individuals with underweight (18.5-20.0 kg/m(2)), normal (20.1-24.9 kg/m(2)), overweight (25-29.9 kg/m(2)), and obese (≥30 kg/m(2)) BMI. The mean follow-up was 2.4 ± 1.2 years with 143 deaths and 193 MIs. Among underweight, normal weight, overweight, and obese individuals, there was increasing prevalence of diabetes (7 vs.10% vs. 12 vs. 19%), hypertension (37 vs. 40% vs. 46 vs. 59%), and hyperlipidaemia (48 vs. 52% vs. 56 vs. 56%; P < 0.001 for trend). After multivariable adjustment, BMI was positively associated with the prevalence of any CAD [odds ratio (OR) 1.25 per +5 kg/m(2), 95% confidence interval (CI): 1.20-1.30, P < 0.001] and obstructive (≥50% stenosis) CAD (OR: 1.13 per +5 kg/m(2), 95% CI: 1.08-1.19, P < 0.001); a higher BMI was also associated with an increased number of segments with plaque (+0.26 segments per +5 kg/m(2), 95% CI: 0.22-0.30, P < 0.001). Larger BMI categories were associated with an increase in all-cause mortality (P = 0.004), but no difference in non-fatal MI. After multivariable adjustment, a higher BMI was independently associated with increased risk of MI (hazards ratio: 1.28 per +5 kg/m(2), 95% CI: 1.12-1.45, P < 0.001).

CONCLUSIONS: Amongst patients with suspected CAD referred for CCTA, individuals with increased BMI have greater prevalence, extent, and severity of CAD that is not fully explained by the presence of traditional risk factors. A higher BMI is independently associated with increased risk of intermediate-term risk of myocardial infarction.

Diabetes Care. 2012 Aug;35(8):1787-94. Epub 2012 Jun 14.

Differences in prevalence, extent, severity, and prognosis of coronary artery disease among patients with and without diabetes undergoing coronary computed tomography angiography: results from 10,110 individuals from the CONFIRM (COronary CT Angiography EvaluatioN For Clinical Outcomes): an InteRnational Multicenter Registry.

Rana JS, Dunning A, Achenbach S, Al-Mallah M, Budoff MJ, Cademartiri F, Callister TQ, Chang HJ, Cheng VY, Chinnaiyan K, Chow BJ, Cury R, Delago A, Feuchtner G, Hadamitzky M, Hausleiter J, Kaufmann P, Karlsberg RP, Kim YJ, Leipsic J, Labounty TM, Lin FY, Maffei E, Raff G, Villines TC, Shaw LJ, Berman DS, Min JK.

Abstract

OBJECTIVE: We examined the prevalence, extent, severity, and prognosis of coronary artery disease (CAD) in individuals with and without diabetes (DM) who are similar in CAD risk factors.

RESEARCH DESIGN AND METHODS: We identified 23,643 consecutive individuals without known CAD undergoing coronary computed tomography angiography. A total of 3,370 DM individuals were propensity matched in a 1-to-2 fashion to 6,740 unique non-DM individuals. CAD was defined as none, nonobstructive (1-49% stenosis), or obstructive (≥ 50% stenosis). All-cause mortality was assessed by risk-adjusted Cox proportional hazards models.

RESULTS: At a 2.2-year follow-up, 108 (3.2%) and 115 (1.7%) deaths occurred among DM and non-DM individuals, respectively. Compared with non-DM individuals, DM individuals possessed higher rates of obstructive CAD (37 vs. 27%) and lower rates of having normal arteries (28 vs. 36%) (P < 0.0001). CAD extent was higher for DM versus non-DM individuals for obstructive one-vessel disease (19 vs. 14%), two-vessel disease (9 vs. 7%), and three-vessel disease (9 vs. 5%) (P < 0.0001 for comparison), with higher per-segment stenosis in the proximal and mid-segments of every coronary artery (P < 0.001 for all). Compared with non-DM individuals with no CAD, risk of mortality for DM individuals was higher for those with no CAD (hazard ratio 3.63 [95% CI 1.67-7.91]; P = 0.001), nonobstructive CAD (5.25 [2.56-10.8]; P < 0.001), one-vessel disease (6.39 [2.98-13.7]; P < 0.0001), two-vessel disease (12.33 [5.622-27.1]; P < 0.0001), and three-vessel disease (13.25 [6.15-28.6]; P < 0.0001).

CONCLUSIONS: Compared with matched non-DM individuals, DM individuals possess higher prevalence, extent, and severity of CAD. At comparable levels of CAD, DM individuals experience higher risk of mortality compared with non-DM individuals.

J Nucl Cardiol. 2012 Aug;19(4):787-95.

What have we learned from CONFIRM? Prognostic implications from a prospective multicenter international observational cohort study of consecutive patients undergoing coronary computed tomographic angiography.

Otaki Y, Arsanjani R, Gransar H, Cheng VY, Dey D, Labounty T, Lin FY, Achenbach S, Al-Mallah M, Budoff MJ, Cademartiri F, Callister TQ, Chang HJ, Chinnaiyan K, Chow BJ, Delago A, Hadamitzky M, Hausleiter J, Kaufmann P, Maffei E, Raff G, Shaw LJ, Villines TC, Dunning A, Cury RC, Feuchtner G, Kim YJ, Leipsic J, Berman DS, Min JK.

Abstract
Coronary computed tomographic angiography (CCTA) employing CT scanners of 64-detector rows or greater represents a novel non-invasive method for detection of coronary artery disease (CAD), providing excellent diagnostic information when compared to invasive angiography. In addition to its high diagnostic performance, prior studies have shown that CCTA can provide important prognostic information, although these prior studies have been generally limited to small cohorts at single centers. The Coronary CT Angiography EVALUATION FOR CLINICAL OUTCOMES: An International Multicenter registry, or CONFIRM, is a large, prospective, multinational, dynamic observational cohort study of patients undergoing CCTA. This registry currently represents more than 32,000 consecutive adults suspected of having CAD who underwent ≥ 64-detector row CCTA at 12 centers in 6 countries between 2005 and 2009. Based on its large sample size and adequate statistical power, the data derived from CONFIRM registry have and will continue to provide key answers to many important topics regarding CCTA. Based on its multisite international national design, the results derived from CONFIRM should be considered as more generalizable than prior smaller single-center studies. This article summarizes the current status of several studies from CONFIRM registry.

Eur Heart J Cardiovasc Imaging. 2012 Aug 23. [Epub ahead of print]

Effects on costs of frontline diagnostic evaluation in patients suspected of angina: coronary CTA vs. conventional ischaemia testing.

Nielsen LH, Olsen J, Markenvard J, Jensen JM, Nørgaard BL.

Abstract
AIMS: The aim of this study was to investigate in patients with stable angina the effects on costs of frontline diagnostics by exercise-stress testing (ex-test) vs. coronary computed tomography angiography (CTA).
METHODS AND RESULTS: In two coronary units at Lillebaelt Hospital, Denmark, 498 patients were identified in whom either ex-test (n = 247) or CTA (n = 251) were applied as the frontline diagnostic strategy in symptomatic patients with a low-intermediate pre-test probability of coronary artery disease (CAD). During 12 months of follow-up, death, myocardial infarction and costs associated with downstream diagnostic utilization (DTU), treatment, ambulatory visits, and hospitalizations were registered. There was no difference between cohorts in demographic characteristics or the pre-test probability of significant CAD. The mean (SD) age was 56 (11) years; 52% were men; and 96% were at low-intermediate pre-test probability of CAD. All serious cardiac events (n = 3) during follow-up occurred in patients with a negative ex-test result. Mean costs per patient associated with DTU, ambulatory visits, and cardiovascular medication were significantly higher in the ex-test than in the CTA group. The mean (SD) total costs per patient at the end of thefollow-up were 14% lower in the CTA group than in the ex-test group, € 1510 (3474) vs. €1777 (3746) (P = 0.03).
CONCLUSION: Diagnostic assessment of symptomatic patients with a low-intermediate probability of CAD by CTA incurred lower costs when compared with the ex-test. These findings need confirmation in future prospective trials.

Circulation. 2012 Jul 17;126(3):304-13. Epub 2012 Jun 9.

Coronary computed tomographic angiography and risk of all-cause mortality and nonfatal myocardial infarction in subjects without chest pain syndrome from the CONFIRM Registry (coronary CT angiography evaluation for clinical outcomes: an international multicenter registry).

Cho I, Chang HJ, Sung JM, Pencina MJ, Lin FY, Dunning AM, Achenbach S, Al-Mallah M, Berman DS, Budoff MJ, Callister TQ, Chow BJ, Delago A, Hadamitzky M, Hausleiter J, Maffei E, Cademartiri F, Kaufmann P, Shaw LJ, Raff GL, Chinnaiyan KM, Villines TC, Cheng V, Nasir K, Gomez M, Min JK; CONFIRM Investigators.

Abstract
BACKGROUND: The predictive value of coronary computed tomographic angiography (cCTA) in subjects without chest pain syndrome (CPS) has not been established. We investigated the prognostic value of coronary artery disease detection by cCTA and determined the incremental risk stratification benefit of cCTA findings compared with clinical risk factor scoring and coronary artery calcium scoring (CACS) for individuals without CPS.
METHODS AND RESULTS: An open-label, 12-center, 6-country observational registry of 27 125 consecutive patients undergoing cCTA and CACS was queried, and 7590 individuals without CPS or history of coronary artery disease met the inclusion criteria. All-cause mortality and the composite of all-cause mortality and nonfatal myocardial infarction were measured. During a median follow-up of 24 months (interquartile range, 18-35 months), all-cause mortality occurred in 136 individuals. After risk adjustment, compared with individuals without evidence of coronary artery disease by cCTA, individuals with obstructive 2- and 3-vessel disease or left main coronary artery disease experienced higher rates of death and composite outcome ($P<0.05$ for both). Both CACS and cCTA significantly improved the performance of standard risk factor prediction models for all-cause mortality and the composite outcome (likelihood ratio $P<0.05$ for all), but the incremental discriminatory value associated with their inclusion was more pronounced for the composite outcome and for CACS (C statistic for model with risk factors only was 0.71; for risk factors plus CACS, 0.75; for risk factors plus CACS plus cCTA, 0.77). The net reclassification improvement resulting from the addition of cCTA to a model based on standard risk factors and CACS was negligible.
CONCLUSIONS: Although the prognosis for individuals without CPS is stratified by cCTA, the additional risk-predictive advantage by cCTA is not clinically meaningful compared with a risk model based on CACS. Therefore, at present, the application of cCTA for risk assessment of individuals without CPS should not be justified.

N Engl J Med. 2012 Jul 26;367(4):299-308.

Coronary CT angiography versus standard evaluation in acute chest pain.

Hoffmann U, Truong QA, Schoenfeld DA, Chou ET, Woodard PK, Nagurney JT, Pope JH, Hauser TH, White CS, Weiner SG, Kalanjian S, Mullins ME, Mikati I, Peacock WF, Zakroysky P, Hayden D, Goehler A, Lee H, Gazelle GS, Wiviott SD, Fleg JL, Udelson JE; ROMICAT-II Investigators.

Abstract

BACKGROUND: It is unclear whether an evaluation incorporating coronary computed tomographic angiography (CCTA) is more effective than standard evaluation in the emergency department in patients with symptoms suggestive of acute coronary syndromes.

METHODS: In this multicenter trial, we randomly assigned patients 40 to 74 years of age with symptoms suggestive of acute coronary syndromes but without ischemic electrocardiographic changes or an initial positive troponin test to early CCTA or to standard evaluation in the emergency department on weekdays during daylight hours between April 2010 and January 2012. The primary end point was length of stay in the hospital. Secondary end points included rates of discharge from the emergency department, major adverse cardiovascular events at 28 days, and cumulative costs. Safety end points were undetected acute coronary syndromes.

RESULTS: The rate of acute coronary syndromes among 1000 patients with a mean (±SD) age of 54±8 years (47% women) was 8%. After early CCTA, as compared with standard evaluation, the mean length of stay in the hospital was reduced by 7.6 hours (P<0.001) and more patients were discharged directly from the emergency department (47% vs. 12%, P<0.001). There were no undetected acute coronary syndromes and no significant differences in major adverse cardiovascular events at 28 days. After CCTA, there was more downstream testing and higher radiation exposure. The cumulative mean cost of care was similar in the CCTA group and the standard-evaluation group ($4,289 and $4,060, respectively; P=0.65).

CONCLUSIONS: In patients in the emergency department with symptoms suggestive of acute coronary syndromes, incorporating CCTA into a triage strategy improved the efficiency of clinical decision making, as compared with a standard evaluation in the emergency department, but it resulted in an increase in downstream testing and radiation exposure with no decrease in the overall costs of care. (Funded by the National Heart, Lung, and Blood Institute; ROMICAT-II ClinicalTrials.gov number, NCT01084239.).

Am J Cardiol. 2012 Jul 15;110(2):183-9. Epub 2012 Apr 3.

A computed tomography-based coronary lesion score to predict acute coronary syndrome among patients with acute chest pain and significant coronary stenosis on coronary computed tomographic angiogram.

Ferencik M, Schlett CL, Ghoshhajra BB, Kriegel MF, Joshi SB, Maurovich-Horvat P, Rogers IS, Banerji D, Bamberg F, Truong QA, Brady TJ, Nagurney JT, Hoffmann U.

Abstract

We tested the hypothesis that morphologic lesion assessment helps detect acute coronary syndrome (ACS) during index hospitalization in patients with acute chest pain and significant stenosis on coronary computed tomographic angiogram (CTA). Patients who presented to an emergency department with chest pain but no objective signs of myocardial ischemia (nondiagnostic electrocardiogram and negative initial biomarkers) underwent CT angiography. CTA was analyzed for degree and length of stenosis, plaque area and volume, remodeling index, CT attenuation of plaque, and spotty calcium in all patients with significant stenosis (>50% in diameter) on CTA. ACS during index hospitalization was determined by a panel of 2 physicians blinded to results of CT angiography. For lesion characteristics associated with ACS, we determined cutpoints optimized for diagnostic accuracy and created lesion scores. For each score, we determined the odds ratio (OR) and discriminatory capacity for the prediction of ACS. Of the overall population of 368 patients, 34 had significant stenosis and 21 of those had ACS. Scores A (remodeling index plus spotty calcium: OR 3.5, 95% confidence interval [CI] 1.2 to 10.1, area under curve [AUC] 0.734), B (remodeling index plus spotty calcium plus stenosis length: OR 4.6, 95% CI 1.6 to 13.7, AUC 0.824), and C (remodeling index plus spotty calcium plus stenosis length plus plaque volume <90 HU: OR 3.4, 95% CI 1.5 to 7.9, AUC 0.833) were significantly associated with ACS. In conclusion, in patients presenting with acute chest pain and stenosis on coronary CTA, a CT-based score incorporating morphologic characteristics of coronary lesions had a good discriminatory value for detection of ACS during index hospitalization.

Eur Heart J Cardiovasc Imaging. 2012 Mar 29. [Epub ahead of print]

Meaning of zero coronary calcium score in symptomatic patients referred for coronary computed tomographic angiography.

Kim YJ, Hur J, Lee HJ, Chang HJ, Nam JE, Hong YJ, Kim HY, Lee JW, Choi BW.

Abstract

AIMS: The clinical implication of a zero coronary calcium score (CCS) in patients with chest pain syndrome has been under debate. This study was undertaken to determine the meaning of a CCS of zero in a large sample of symptommatic patients referred for coronary computed tomographic (CT) angiography.

METHODS AND RESULTS: We consecutively enrolled 2088 patients (age 58 ± 10 years, 1028 men) who had undergone 64-slice cardiac CT due to chest pain syndrome. A CCS of zero was detected in 1114 patients (471 men and 643 women). Of these 1114 patients, obstructive coronary artery disease (CAD) was found in a total of 48 patients (4.3%); 35 men (7.4%) and 13 women (2.0%). Among the zero CCS patients with obstructive CAD, men had a higher prevalence of both premature CAD (49 vs. 0%) and multivessel disease (20 vs. 8%) than women. During the follow-up period (1033 ± 136 days), early revascularization was done in 25 patients (2.2%, 18 men and 7 women) and there were 14 major adverse cardiac events (1.3%, 8 men and 7 women) among the zero CCS patients. CAD severity was a strong prognostic indicator in the zero CCS patients.
CONCLUSION: A CCS of zero cannot be used by itself to exclude obstructive CAD in symptomatic patients referred for coronary CT angiography (CCTA). The prevalence of obstructive CAD and adverse cardiac events are not negligible in symptomatic patients with a CCS of zero, and CAD severity by CCTA is associated with higher rates of adverse cardiac event.

N Engl J Med. 2012 Apr 12;366(15):1393-403. Epub 2012 Mar 26.

CT angiography for safe discharge of patients with possible acute coronary syndromes.

Litt HI, Gatsonis C, Snyder B, Singh H, Miller CD, Entrikin DW, Leaming JM, Gavin LJ, Pacella CB, Hollander JE.

Abstract
BACKGROUND: Admission rates among patients presenting to emergency departments with possible acute coronary syndromes are high, although for most of these patients, the symptoms are ultimately found not to have a cardiac cause. Coronary computed tomographic angiography (CCTA) has a very high negative predictive value for the detection of coronary disease, but its usefulness in determining whether discharge of patients from the emergency department is safe is not well established.
METHODS: We randomly assigned low-to-intermediate-risk patients presenting with possible acute coronary syndromes, in a 2:1 ratio, to undergo CCTA or to receive traditional care. Patients were enrolled at five centers in the United States. Patients older than 30 years of age with a Thrombolysis in Myocardial Infarction risk score of 0 to 2 and signs or symptoms warranting admission or testing were eligible. The primary outcome was safety, assessed in the subgroup of patients with a negative CCTA examination, with safety defined as the absence of myocardial infarction and cardiac death during the first 30 days after presentation.
RESULTS: We enrolled 1370 subjects: 908 in the CCTA group and 462 in the group receiving traditional care. The baseline characteristics were similar in the two groups. Of 640 patients with a negative CCTA examination, none died or had a myocardial infarction within 30 days (0%; 95% confidence interval [CI], 0 to 0.57). As compared with patients receiving traditional care, patients in the CCTA group had a higher rate of discharge from the emergency department (49.6% vs. 22.7%; difference, 26.8 percentage points; 95% CI, 21.4 to 32.2), a shorter length of stay (median, 18.0 hours vs. 24.8 hours; P<0.001), and a higher rate of detection of coronary disease (9.0% vs. 3.5%; difference, 5.6 percentage points; 95% CI, 0 to 11.2). There was one serious adverse event in each group.
CONCLUSIONS: A CCTA-based strategy for low-to-intermediate-risk patients presenting with a possible acute coronary syndrome appears to allow the safe, expedited discharge from the emergency department of many patients who would otherwise be admitted.

J Am Coll Cardiol. 2012 Feb 14;59(7):688-95.

Coronary computed tomography angiography after stress testing: results from a multicenter, statewide registry, ACIC (Advanced Cardiovascular Imaging Consortium).

Chinnaiyan KM, Raff GL, Goraya T, Ananthasubramaniam K, Gallagher MJ, Abidov A, Boura JA, Share D, Peyser PA.

Abstract
OBJECTIVES: This study was conducted to evaluate the correlation between stress test results and coronary computed tomography angiography (CCTA) findings and comparative diagnostic performance of the 2 modalities in patients undergoing invasive coronary angiography (ICA).
BACKGROUND: Recent data suggest that only a third of patients undergoing ICA have obstructive coronary artery disease (CAD); accurate pre-ICA risk stratification is needed.
METHODS: At 47 centers participating in the ACIC (Advanced Cardiovascular Imaging Consortium) in Michigan, patients without known CAD who were undergoing CCTA within 3 months of a stress test were studied. Demographics, risk factors, symptoms, and stress test results were correlated with obstructive CAD (>50% stenosis) on CCTA and ICA.
RESULTS: Among 6,198 patients (age 56 ± 12 years, 48% men), >50% stenosis was seen in 1,158 (18.7%) on CCTA. Independent predictors included male sex (odds ratio [OR]: 2.37, 95% confidence interval [CI]: 1.83 to 3.06), current smoking (OR: 2.23, 95% CI: 1.57 to 3.17), older age (OR per 10-year increment: 2.14, 95% CI: 1.89 to 2.41), hypertension (OR: 1.8, 95% CI: 1.37 to 2.34), and typical angina (OR: 1.48, 95% CI: 1.03 to 2.12). Stress test results were not predictive. Among patients undergoing ICA (n = 621), there was a strong correlation of ICA with CCTA findings (OR: 9.09, 95% CI: 5.57 to 14.8, p < 0.001), but not stress results (OR: 0.79, 95% CI: 0.56 to 1.11, p = 0.17).
CONCLUSIONS: Stress test findings did not predict obstructive CAD on CCTA, observed in <20% of patients in this large study group. The strong association of CCTA with ICA suggests that it may serve as an effective "gatekeeper" to invasive testing in patients needing adjudication of stress test results.

Am J Cardiol. 2012 Apr 3. [Epub ahead of print]

A Computed Tomography-Based Coronary Lesion Score to Predict Acute Coronary Syndrome Among Patients With Acute Chest Pain and Significant Coronary Stenosis on Coronary Computed Tomographic Angiogram.

Ferencik M, Schlett CL, Ghoshhajra BB, Kriegel MF, Joshi SB, Maurovich-Horvat P, Rogers IS, Banerji D, Bamberg F, Truong QA, Brady TJ, Nagurney JT, Hoffmann U.

Abstract

We tested the hypothesis that morphologic lesion assessment helps detect acute coronary syndrome (ACS) during index hospitalization in patients with acute chest pain and significant stenosis on coronary computed tomographic angiogram (CTA). Patients who presented to an emergency department with chest pain but no objective signs of myocardial ischemia (nondiagnostic electrocardiogram and negative initial biomarkers) underwent CT angiography. CTA was analyzed for degree and length of stenosis, plaque area and volume, remodeling index, CT attenuation of plaque, and spotty calcium in all patients with significant stenosis (>50% in diameter) on CTA. ACS during index hospitalization was determined by a panel of 2 physicians blinded to results of CT angiography. For lesion characteristics associated with ACS, we determined cutpoints optimized for diagnostic accuracy and created lesion scores. For each score, we determined the odds ratio (OR) and discriminatory capacity for the prediction of ACS. Of the overall population of 368 patients, 34 had significant stenosis and 21 of those had ACS. Scores A (remodeling index plus spotty calcium: OR 3.5, 95% confidence interval [CI] 1.2 to 10.1, area under curve [AUC] 0.734), B (remodeling index plus spotty calcium plus stenosis length: OR 4.6, 95% CI 1.6 to 13.7, AUC 0.824), and C (remodeling index plus spotty calcium plus stenosis length plus plaque volume <90 HU: OR 3.4, 95% CI 1.5 to 7.9, AUC 0.833) were significantly associated with ACS. In conclusion, in patients presenting with acute chest pain and stenosis on coronary CTA, a CT-based score incorporating morphologic characteristics of coronary lesions had a good discriminatory value for detection of ACS during index hospitalization.

Circ Cardiovasc Imaging. 2012 Mar 1;5(2):233-42. Epub 2012 Feb 3.

Comparison of Exercise Treadmill Testing With Cardiac Computed Tomography Angiography Among Patients Presenting to the Emergency Room With Chest Pain: The Rule Out Myocardial Infarction Using Computer-Assisted Tomography (ROMICAT) Study.

Blankstein R, Ahmed W, Bamberg F, Rogers IS, Schlett CL, Nasir K, Fontes J, Tawakol A, Brady TJ, Nagurney JT, Hoffmann U, Truong QA.

Abstract

Background- The aims of our study were to (1) examine how data from exercise treadmill testing (ETT) can identify patients who have coronary plaque or stenosis, using CT angiography (CTA) as the reference standard, and (2) identify patient characteristics that may be used in selecting ETT versus CTA. Methods and Results- The Rule Out Myocardial Infarction Using Computer-Assisted Tomography (ROMICAT) trial was an observational cohort study of acute chest pain patients presenting to the emergency department with normal initial troponin and a nonischemic ECG. Univariate and multivariable analyses were performed to assess the relationship of baseline clinical data and ETT parameters with coronary plaque and stenosis on CTA. Of the 220 patients who had ETT (mean age, 51 years; 63% men), 21 (10%) had positive results. A positive ETT had a sensitivity of 30% and specificity of 93% to detect >50% stenosis. The sensitivity increased to 83% after excluding uninterpretable segments and evaluating the ability to detect a >70% stenosis. Predictors of plaque included older age, male sex, diabetes, hypertension, hyperlipidemia, lower functional capacity, and a lower Duke Treadmill Score. Both a positive ETT and a low Duke Treadmill Score were significant univariate and multivariable predictors of stenosis >50% on CTA Whereas the prevalence of stenosis by CTA was greater among patients with more risk factors, coronary stenosis was not present among men <40 years old or women <50 years old or individuals who achieved at least 13 metabolic equivalents on ETT. Conclusions- Among low- to intermediate-risk patients with acute chest pain, a positive ETT has a limited sensitivity but high specificity for the detection of >50% stenosis by CTA. Although patients with a high number of clinical risk factors are more likely to have obstructive coronary artery disease, those who are young or who would be expected to have a very high exercise capacity are unlikely to have coronary stenosis and therefore may benefit from initial ETT testing instead of CTA.

Koronarkalk:

JAMA. 2012 Aug 22;308(8):788-95.

Comparison of novel risk markers for improvement in cardiovascular risk assessment in intermediate-risk individuals.

Yeboah J, McClelland RL, Polonsky TS, Burke GL, Sibley CT, O'Leary D, Carr JJ, Goff DC, Greenland P, Herrington DM.

Abstract

CONTEXT: Risk markers including coronary artery calcium, carotid intima-media thickness, ankle-brachial index, brachial flow-mediated dilation, high-sensitivity C-reactive protein (CRP), and family history of coronary heart disease (CHD) have been reported to improve on the Framingham Risk Score (FRS) for prediction of CHD, but there are no direct comparisons of these markers for risk prediction in a single cohort.

OBJECTIVE: We compared improvement in prediction of incident CHD/cardiovascular disease (CVD) of these 6 risk markers within intermediate-risk participants (FRS >5%-<20%) in the Multi-Ethnic Study of Atherosclerosis (MESA).

DESIGN, SETTING, AND PARTICIPANTS: Of 6814 MESA participants from 6 US field centers, 1330 were intermediate risk, without diabetes mellitus, and had complete data on all 6 markers. Recruitment spanned July 2000 to September 2002, with follow-up through May 2011. Probability-weighted Cox proportional hazard models were used to estimate hazard ratios (HRs). Area under the receiver operator characteristic curve (AUC) and net reclassification improvement were used to compare incremental contributions of each marker when added to the FRS, plus race/ethnicity.

MAIN OUTCOME MEASURES: Incident CHD defined as myocardial infarction, angina followed by revascularization, resuscitated cardiac arrest, or CHD death. Incident CVD additionally included stroke or CVD death.

RESULTS: After 7.6-year median follow-up (IQR, 7.3-7.8), 94 CHD and 123 CVD events occurred. Coronary artery calcium, ankle-brachial index, high-sensitivity CRP, and family history were independently associated with incident CHD in multivariable analyses (HR, 2.60 [95% CI, 1.94-3.50]; HR, 0.79 [95% CI, 0.66-0.95]; HR, 1.28 [95% CI, 1.00-1.64]; and HR, 2.18 [95% CI, 1.38-3.42], respectively). Carotid intima-media thickness and brachial flow-mediated dilation were not associated with incident CHD in multivariable analyses (HR, 1.17 [95% CI, 0.95-1.45] and HR, 0.95 [95% CI, 0.78-1.14]). Although addition of the markers individually to the FRS plus race/ethnicity improved AUC, coronary artery calcium afforded the highest increment (0.623 vs 0.784), while brachial flow-mediated dilation had the least (0.623 vs 0.639). For incident CHD, the net reclassification improvement with coronary artery calcium was 0.659, brachial flow-mediated dilation was 0.024, ankle-brachial index was 0.036, carotid intima-media thickness was 0.102, family history was 0.160 and high-sensitivity CRP was 0.079. Similar results were obtained for incident CVD.

CONCLUSIONS: Coronary artery calcium, ankle-brachial index, high-sensitivity CRP, and family history were independent predictors of incident CHD/CVD in intermediate-risk individuals. Coronary artery calcium provided superior discrimination and risk reclassification compared with other risk markers.

J Am Coll Cardiol. 2012 Sep 5. [Epub ahead of print]

Adolescence Risk Factors Are Predictive of Coronary Artery Calcification at Middle Age: The Cardiovascular Risk in Young Finns Study.

Hartiala O, Magnussen CG, Kajander S, Knuuti J, Ukkonen H, Saraste A, Rinta-Kiikka I, Kainulainen S, Kähönen M, Hutri-Kähönen N, Laitinen T, Lehtimäki T, Viikari JS, Hartiala J, Juonala M, Raitakari OT.

Abstract

OBJECTIVES: The purpose of this study was to examine the roles of adolescence risk factors in predicting coronary artery calcium (CAC).

BACKGROUND: Elevated coronary heart disease risk factor levels in adolescence may predict subsequent CAC independently of change in risk factor levels from adolescence to adulthood.

METHODS: CAC was assessed in 589 subjects 40 to 46 years of age from the Cardiovascular Risk in Young Finns Study. Risk factor levels were measured in 1980 (12 to 18 years) and in 2007.

RESULTS: The prevalence of any CAC was 19.2% (27.9% in men and 12.2% in women). Age, levels of systolic blood pressure (BP), total cholesterol, and low-density lipoprotein cholesterol (LDL-C) in adolescence, as well as systolic BP, total cholesterol, diastolic BP, and pack-years of smoking in adulthood were higher among subjects with CAC than those without CAC. Adolescence LDL-C and systolic BP levels predicted CAC in adulthood independently of 27-year changes in these risk factors. The multivariable odds ratios were 1.34 (95% confidence interval: 1.05 to 1.70; p = 0.02) and 1.38 (95% confidence interval: 1.08 to 1.77; p = 0.01), for 1-SD increase in adolescence LDL-C and systolic BP, respectively. Exposure to both of these risk factors in adolescence (defined as values at or above the age- and sex-specific 75th percentile) substantially increased the risk of CAC (multivariable odds ratio: 3.5 [95% confidence interval: 1.7 to 7.2; p = 0.007]) between groups with no versus both risk factors.

CONCLUSIONS: Elevated adolescence LDL-C and systolic BP levels are independent predictors of adulthood CAC, indicating that adolescence risk factor levels play an important role in the pathogenesis of coronary heart disease.

JACC Cardiovasc Imaging. 2012 Apr;5(4):358-66.

Metabolic syndrome, diabetes, and incidence and progression of coronary calcium: the multiethnic study of atherosclerosis study.

Wong ND, Nelson JC, Granston T, Bertoni AG, Blumenthal RS, Carr JJ, Guerci A, Jacobs DR Jr, Kronmal R, Liu K, Saad M, Selvin E, Tracy R, Detrano R.

OBJECTIVES: This study sought to examine and compare the incidence and progression of coronary artery calcium (CAC) among persons with metabolic syndrome (MetS) and diabetes mellitus (DM) versus those with neither condition.

BACKGROUND: MetS and DM are associated with subclinical atherosclerosis as evidenced by CAC.

METHODS: The MESA (Multiethnic Study of Atherosclerosis) included 6,814 African American, Asian, Caucasian, and Hispanic adults 45 to 84 years of age, who were free of cardiovascular disease at baseline. Of these, 5,662 subjects (51% women, mean age 61.0 ± 10.3 years) received baseline and follow-up (mean 2.4 years) cardiac computed tomography scans. We compared the incidence of CAC in 2,927 subjects without CAC at baseline and progression of CAC in 2,735 subjects with CAC at baseline in those with MetS without DM (25.2%), DM without MetS (3.5%), or both DM and MetS (9.0%) to incidence and progression in subjects with neither MetS nor DM (58%). Progression of CAC was also examined in relation to coronary heart disease events over an additional 4.9 years.

RESULTS: Relative to those with neither MetS nor DM, adjusted relative risks (95% confidence intervals [CI]) for incident CAC were 1.7 (95% CI: 1.4 to 2.0), 1.9 (95% CI: 1.4 to 2.4), and 1.8 (95% CI: 1.4 to 2.2) (all $p < 0.01$), and absolute differences in mean progression (volume score) were 7.8 (95% CI: 4.0 to 11.6; $p < 0.01$), 11.6 (95% CI: 2.7 to 20.5; $p < 0.05$), and 22.6 (95% CI: 17.2 to 27.9; $p < 0.01$) for those with MetS without DM, DM without MetS, and both DM and MetS, respectively. Similar findings were seen in analysis using Agatston calcium score. In addition, progression predicted coronary heart disease events in those with MetS without DM (adjusted hazard ratio: 4.1, 95% CI: 2.0 to 8.5, $p < 0.01$) and DM (adjusted hazard ratio: 4.9 [95% CI: 1.3 to 18.4], $p < 0.05$) among those in the highest tertile of CAC increase versus no increase.

CONCLUSIONS: Individuals with MetS and DM have a greater incidence and absolute progression of CAC compared with individuals without these conditions, with progression also predicting coronary heart disease events in those with MetS and DM.

Am J Cardiol. 2012 Sep 13. pii: S0002-9149(12)01936-4. doi: 10.1016/j.amjcard.2012.07.044. [Epub ahead of print]

Risk Factors for Coronary Artery Calcium Among Patients With Chronic Kidney Disease (from the Chronic Renal Insufficiency Cohort Study).

He J, Reilly M, Yang W, Chen J, Go AS, Lash JP, Rahman M, Defilippi C, Gadegbeku C, Kanthety R, Tao K, Hamm LL, Ojo A, Townsend R, Budoff M; CRIC Investigators.

Abstract

Cardiovascular disease is the leading cause of death in patients with chronic kidney disease (CKD). We examined the cross-sectional association between novel risk factors and coronary artery calcium (CAC) measured using electron beam computed tomography or multidetector computed tomography among 2,018 patients with CKD. Using the total Agatston scores, the participants were classified as having no (0), moderate (>0-100), or high (>100) CAC. After adjustment for age, gender, race, study sites, cigarette smoking, previous cardiovascular disease, hypertension, and diabetes, the use of lipid-lowering drugs, body mass index, waist circumference, and cystatin C, several novel risk factors were significantly associated with high CAC. For example, the odds ratios of high CAC associated with 1 SD greater level of risk factors were 1.20 (95% confidence interval 1.04 to 1.38) for serum calcium, 1.21 (95% confidence interval 1.04 to 1.41) for serum phosphate, 0.83 (95% confidence interval 0.71 to 0.97) for log (total parathyroid hormone), 1.21 (95% confidence interval 1.03 to 1.43) for log (homeostasis model assessment-insulin resistance), and 1.23 (95% confidence interval 1.04 to 1.45) for hemoglobin A1c. Additionally, the multivariate-adjusted odds ratio for 1 SD greater level of cystatin C was 1.31 (95% confidence interval 1.14 to 1.50). Serum high-sensitive C-reactive protein, interleukin-6, tumor necrosis factor-α, and homocysteine were not statistically significantly associated with high CAC. In conclusion, these data indicate that abnormal calcium and phosphate metabolism, insulin resistance, and declining kidney function are associated with the prevalence of high CAC, independent of the traditional risk factors in patients with CKD. Additional studies are warranted to examine the causal effect of these risk factors on CAC in patients with CKD.

JACC Cardiovasc Imaging. 2012 Sep;5(9):923-30.

Yield of Screening for Coronary Artery Calcium in Early Middle-Age Adults Based on the 10-Year Framingham Risk Score: The CARDIA Study.

Okwuosa TM, Greenland P, Ning H, Liu K, Lloyd-Jones DM.

Abstract

OBJECTIVES: The purpose of this study was to assess the prevalence and distribution of coronary artery calcium (CAC) across Framingham Risk Score (FRS) strata and therefore determine FRS levels at which asymptomatic, young to early middle-age individuals could potentially benefit from CAC screening.

BACKGROUND: High CAC burden is associated with increased risk of coronary events beyond the FRS. Expert panel recommendations for CAC screening are based on data obtained in middle-age and older individuals.

METHODS: We included 2,831 CARDIA (Coronary Artery Risk Development in Young Adults) study participants with an age range of 33 to 45 years. The number needed to screen ([NNS] number of people in each FRS stratum who need to be screened to detect 1 person with a CAC score above the specified cut point) was used to assess the yield of screening for CAC. CAC prevalence was compared across FRS strata using a chi-square test.
RESULTS: CAC scores >0 and ≥100 were present in 9.9% and 1.8% of participants, respectively. CAC prevalence and amount increased across higher FRS strata. A CAC score >0 was observed in 7.3%, 20.2%, 19.1%, and 44.8% of individuals with FRSs of 0 to 2.5%, 2.6% to 5%, 5.1% to 10%, and >10%, respectively (NNS = 14, 5, 5, and 2, respectively). A CAC score of ≥100 was observed in 1.3%, 2.4%, and 3.5% of those with FRSs of 0 to 2.5%, 2.6% to 5%, and 5.1% to 10%, respectively (NNS = 79, 41, and 29, respectively), but in 17.2% of those with an FRS >10% (NNS = 6). Similar trends were observed when findings were stratified by sex and race.
CONCLUSIONS: In this young to early middle-age cohort, we observed concordance between CAC prevalence/amount and FRS strata. Within this group, the yield of screening and possibility of identifying those with a high CAC burden (CAC score of ≥100) is low in those with an FRS of ≤10%, but considerable in those with an FRS >10%.

JACC Cardiovasc Imaging. 2012 Sep;5(9):874-80.

Coronary calcification and the risk of heart failure in the elderly: the Rotterdam study.

Leening MJ, Elias-Smale SE, Kavousi M, Felix JF, Deckers JW, Vliegenthart R, Oudkerk M, Hofman A, Steyerberg EW, Stricker BH, Witteman JC.

Abstract
OBJECTIVES: The purpose of this study was to determine the association of coronary artery calcification (CAC) with incident heart failure in the elderly and examine its independence of overt coronary heart disease (CHD).
BACKGROUND: Heart failure is often observed as a first manifestation of coronary atherosclerosis rather than a sequela of overt CHD. Although numerous studies have shown that CAC, an established measure of coronary atherosclerosis, is a strong predictor of CHD, the association between CAC and future heart failure has not been studied prospectively.
METHODS: In the Rotterdam Study, a population-based cohort, 1,897 asymptomatic participants (mean age, 69.9 years; 58% women) underwent CAC scoring and were followed for the occurrence of heart failure and CHD.
RESULTS: During a median follow-up of 6.8 years, there were 78 cases of heart failure and 76 cases of nonfatal CHD. After adjustment for cardiovascular risk factors, increasing CAC scores were associated with heart failure (p for trend = 0.001), with a hazard ratio of 4.1 (95% confidence interval [CI]: 1.7 to 10.1) for CAC scores >400 compared with CAC scores of 0 to 10. After censoring participants for incident nonfatal CHD, increasing extent of CAC remained associated with heart failure (p for trend = 0.046), with a hazard ratio of 2.9 (95% CI: 1.1 to 7.4) for CAC scores >400. Moreover, adding CAC to cardiovascular risk factors resulted in an optimism-corrected increase in the c-statistic by 0.030 (95% CI: 0.001 to 0.050) to 0.734 (95% CI: 0.698 to 0.770) and substantially improved the risk classification of subjects (continuous net reclassification index = 34.0%).
CONCLUSIONS: CAC has a clear association with the risk of heart failure, independent of overt CHD. Because heart failure is highly prevalent in the elderly, it might be worthwhile to include heart failure as an outcome in future risk assessment programs incorporating CAC.

J Am Coll Cardiol. 2012 Sep 25;60(13):1148-55. doi: 10.1016/j.jacc.2012.04.050. Epub 2012 Aug 29.

The relationship between C-reactive protein and atherosclerosis differs on the basis of body mass index: the dallas heart study.

Gupta NK, de Lemos JA, Ayers CR, Abdullah SM, McGuire DK, Khera A.

Abstract
OBJECTIVES: This study sought to evaluate whether the relationship between C-reactive protein (CRP) and atherosclerosis is modified by body mass index (BMI).
BACKGROUND: CRP levels are affected by obesity, and it is unknown whether the associations between CRP and cardiovascular (CV) disease differ between obese and nonobese individuals.
METHODS: We measured CRP and multiple atherosclerosis phenotypes, including coronary artery calcification (CAC) (n = 2,685), aortic wall thickness (AWT) (n = 2,238), and aortic plaque burden (APB) (n = 2,224), in subjects ages 30 to 65 years from the Dallas Heart Study. The associations of CRP with CAC, AWT, and APB were compared across categories of BMI (normal, 18.5 to <25 kg/m(2); overweight, 25 to <30 kg/m(2); obese, ≥30 kg/m(2)) in sex-stratified analyses.
RESULTS: The overall prevalence of obesity was 38% in men and 53% in women. Increasing CRP levels (<1 mg/l, 1 to 3 mg/l, >3 mg/l) were associated with increased CAC prevalence in normal and overweight men and in normal weight women (p < 0.01), but not in obese subjects of either sex. Likewise, the correlations between CRP and AWT and APB diminished with increasing BMI and were nonsignificant in obese individuals (p < 0.05 in nonobese, p > 0.1 in obese). Interaction tests between CRP and obesity were significant for all atherosclerosis measures in men and for AWT and ABP in women (p interaction <0.05 each). In both sexes, the c-statistics of CRP for all 3 atherosclerosis measures were greater for normal weight than obese individuals.

CONCLUSIONS: In a large, population-based study, the association between CRP and multiple measures of atherosclerosis is diminished in obese individuals. The role of CRP for predicting CV outcomes in obese subjects requires further evaluation.

Am J Cardiol. 2012 Aug 23. [Epub ahead of print]

Multi-Ethnic Study of Atherosclerosis Arterial Age Versus Framingham 10-Year or Lifetime Cardiovascular Risk.

Villines TC, Taylor AJ.

Abstract

Methods to improve coronary heart disease (CHD) risk prediction include incorporation of coronary artery calcium (CAC) within risk models and considering longer time horizons such as evaluation of lifetime cardiovascular risk (LTR). We compared the accuracy of 10-year Framingham risk score (FRS), LTR, and Multi-Ethnic Study of Atherosclerosis (MESA) arterial age-adjusted 10-year risk for prediction of incident CHD events in men in the Prospective Army Coronary Calcium Project. We studied 1,633 healthy men (mean age 43 years, range 40 to 50 years, mean FRS 4.6%) with electron-beam computed tomography for CAC. Events (CHD death, myocardial infarction, acute coronary syndrome with nonelective coronary revascularization) were prospectively assessed over 5.6 ± 1.5 years. Predicted risk using 10-year FRS for CHD and cardiovascular disease, LTR, and MESA arterial age were evaluated in relation with CAC and CHD events. CAC prevalence was strongly related to LTR, increasing in a graded fashion from 10.1% to 66.7% across 8 categories of increasing LTR. On receiver operating characteristic analysis, MESA arterial age (area under curve 0.78, 95% confidence interval 0.64 to 0.93) had the largest area under the curve but similar areas under the curve were observed for 10-year risk (CHD 0.74, 0.61 to 0.86; cardiovascular disease 0.70, 0.59 to 0.82), LTR (0.68, 0.49 to 0.76), and LTR with CAC as a covariate (0.76, 0.63 to 0.89). Inclusion of family history of CHD or body mass index did not improve model accuracy. In conclusion, increasing LTR was associated with increasingly prevalent CAC in this low-risk cohort and inclusion of CAC improved the accuracy of LTR for short-term event prediction.

Hum Genet. 2012 Aug 23. [Epub ahead of print]

VKORC1 rs2359612C allele is associated with increased risk of coronary artery disease in the presence of coronary calcification.

Wang Y, Chen J, Zhang Y, Bin L, Sun K, Yu W, Liu J, Zhang C, Shen H, Hou Z, Yu F, Hui R.

Abstract

VKORC1 genetic polymorphisms affect warfarin dose response, aortic calcification, and the susceptibility of coronary artery disease as shown in our previous study. Little is known regarding the association of VKORC1 polymorphisms with coronary artery calcification (CAC) and the role of CAC in the association with coronary artery disease (CAD). Due to a natural haplotype block in the VKORC1 gene in Chinese, polymorphism rs2359612 was analyzed in a case-control study and a prospective study. The case-control study included 464 CAD patients with non-calcified plaque (NCP), 562 CAD patients with mixed calcified plaque (MCP), 492 subjects with calcified plaque (CP), and 521 controls. The rs2359612C was only associated with increased risk of MCP, the CAD in the presence of CAC; the odds ratio was 1.397 (95 % CI 1.008-1.937, P < 0.05), which was replicated in the second independent population. On the contrary, a negative correlation was observed between rs2359612 and log-transformed Agatston score, and rs2359612 was negatively associated with the number of calcified vessels. Moreover, in a prospective study including 849 CAD patients undergoing revascularization, rs2359612C predicted a higher incidence of cardiovascular events in MCP subgroup; the relative risk was 1.435 (95 % CI 1.008-2.041, P = 0.045), which was not observed in the NCP subgroup. We conclude that the rs2359612C was associated with a higher risk of CAD in the presence of CAC and a higher incidence of cardiovascular events in CAD patients with CAC, but a lower coronary calcification. VKORC1 polymorphisms may be associated with the endophenotype of CAD, calcification-related atherosclerosis.

Am J Cardiol. 2012 Aug 7. [Epub ahead of print]

Kidney Function and Progression of Coronary Artery Calcium in Community-Dwelling Older Adults (from the Rancho Bernardo Study).

Jassal SK, Chonchol M, Laughlin GA, Cummins KM, Smits G, Kramer CK, Ix JH, Barrett-Connor E.

Abstract

Longitudinal studies of the association of estimated glomerular filtration rate (eGFR) and albuminuria with coronary artery calcium (CAC), a measure of cardiovascular disease burden, are few and contradictory. In this study, 421 community-dwelling men and women (mean age 67 years) without known heart disease had eGFRs assessed using the Modification of Diet in Renal Disease (MDRD) equation and albuminuria assessed by urine albumin/creatinine ratio (ACR) from 1997 to 1999. The mean eGFR was 78 ml/min/1.73 m(2), and the median ACR was 10 mg/g. CAC was measured using electron-beam computed tomography from 2000 to 2001, when the median total Agatston CAC score was 77; 4.5 years later, 338 participants still without heart disease underwent repeat scans (median CAC score 112); 46% of participants showed CAC progression, defined as an increase ≥2.5 mm(3) in square root-transformed CAC volume score. Cross-sectional and longitudinal logistic regression analyses showed no separate or joint association

between eGFR or ACR and CAC severity or progression. In conclusion, this study does not support the use of eGFR or ACR to identify asymptomatic older adults who should be screened for subclinical cardiovascular disease with initial or sequential scanning for CAC. In the elderly, kidney function and CAC may not progress together.

Diabetes Care. 2012 Aug 8. [Epub ahead of print]

Progression of Vascular Calcification Is Increased With Statin Use in the Veterans Affairs Diabetes Trial (VADT).

Saremi A, Bahn G, Reaven PD; for the VADT Investigators.

Abstract

OBJECTIVETo determine the effect of statin use on progression of vascular calcification in type 2 diabetes (T2DM).RESEARCH DESIGN AND METHODSProgression of coronary artery calcification (CAC) and abdominal aortic artery calcification (AAC) was assessed according to the frequency of statin use in 197 participants with T2DM.RESULTSAfter adjustment for baseline CAC and other confounders, progression of CAC was significantly higher in more frequent statin users than in less frequent users (mean ± SE, 8.2 ± 0.5 mm(3) vs. 4.2 ± 1.1 mm(3); P < 0.01). AAC progression was in general not significantly increased with more frequent statin use; in a subgroup of participants initially not receiving statins, however, progression of both CAC and AAC was significantly increased in frequent statin users.CONCLUSIONMore frequent statin use is associated with accelerated coronary artery calcification in T2DM patients with advanced atherosclerosis.

Eur Heart J. 2012 Jul 26. [Epub ahead of print]

Coronary artery calcium for the prediction of mortality in young adults <45 years old and elderly adults >75 years old.

Tota-Maharaj R, Blaha MJ, McEvoy JW, Blumenthal RS, Muse ED, Budoff MJ, Shaw LJ, Berman DS, Rana JS, Rumberger J, Callister T, Rivera J, Agatston A, Nasir K.

Abstract

AimsTo determine if coronary artery calcium (CAC) scoring is independently predictive of mortality in young adults and in the elderly population and if a young person with high CAC has a higher mortality risk than an older person with less CAC.Methods and resultsWe studied a cohort of 44 052 asymptomatic patients referred for CAC scans for cardiovascular risk stratification. All-cause mortality rates (MRs) were calculated after stratifying by age groups (<45, 45-54, 55-64, 65-74, and ≥75) and CAC score (0, 1-100, 100-400, and >400). Multivariable Cox regression models were constructed to assess the independent value of CAC for predicting all-cause mortality in the <45- and ≥75-year-old age groups. The MR increased in both the <45- and ≥75-year-old age groups with an increasing CAC group. After multivariable adjustment, increasing CAC remained independently predictive of increased mortality compared with CAC = 0 [<45 age group, hazard ratio (95% confidence interval): CAC = 1-100, 2.3 (1.2-4.2); CAC = 100-400, 7.4 (3.3-16.6); CAC > 400, 34.6 (15.5-77.4); ≥75 age group: CAC = 1-100, 7.0 (2.4-20.8); CAC = 100-400, 9.2 (3.2-26.5); CAC > 400, 16.1 (5.8-45.1)]. Persons <45 years old with CAC = 100-400 and CAC > 400 had 2- and 10-fold increased MRs, respectively, compared with persons ≥75 with no CAC. Individuals ≥75 years old with CAC = 0 had a 5.6-year survival rate of 98%, similar to those in other age groups with CAC = 0 (5.6-year survival, 99%).ConclusionThe value of CAC for predicting mortality extends to both elderly patients and those <45 years old. Elderly persons with no CAC have a lower MR than younger persons with high CAC.

Radiology. 2012 Sep;264(3):679-90. Epub 2012 Jul 19.

Incremental Prognostic Value of Different Components of Coronary Atherosclerotic Plaque at Cardiac CT Angiography beyond Coronary Calcification in Patients with Acute Chest Pain.

Nance JW Jr, Schlett CL, Schoepf UJ, Oberoi S, Leisy HB, Barraza JM Jr, Headden GF, Nikolaou K, Bamberg F.

Abstract

Purpose: To systematically evaluate the incremental predictive value of cardiac computed tomographic (CT) angiography beyond the assessment of coronary artery calcium (CAC) in patients who present with acute chest pain but without evidence of acute coronary syndrome (ACS). Materials and Methods: The human research committee approved this study and waived the need for individual written informed consent. The study was HIPAA compliant. A total of 458 patients (36% male; mean age, 55 years ± 11) with acute chest pain at low to intermediate risk for coronary artery disease underwent coronary calcification assessment with cardiac CT angiography. All patients who did not experience ACS at index hospitalization were followed for instances of a major adverse cardiac event (MACE), such as a myocardial infarct, revascularization, cardiac death, or angina requiring hospitalization. CAC score and cardiac CT angiography were used to derive the presence and extent of atherosclerotic plaque (calcified, noncalcified, or mixed), and obstructive lesions (>50% luminal narrowing) were related to outcomes by using univariate and adjusted Cox proportional hazards models. Results: Of the 458 patients, 70 (15%) experienced MACE (median follow-up, 13 months). Patients with no plaque at cardiac CT angiography remained free of events during the follow-up period, while 11 (5%) of 215 patients with no CAC had MACE. The extent of plaque was the strongest predictor of MACE independent of traditional risk factors (hazard ratio [HR], 151.77 for four or more segments containing plaque as compared with those containing no plaque; P < .001). Patients with mixed plaque were more likely to experience

MACE (HR, 86.96; P = .002) than those with exclusively noncalcified plaque (HR, 58.06; P = .005) or exclusively calcified plaque (HR, 32.94; P = .02). Conclusion: The strong prognostic value of cardiac CT angiography is incremental to its known diagnostic value in patients with acute chest pain without ACS and is independent of traditional risk factors and CAC.

BMC Cardiovasc Disord. 2012 Jul 17;12(1):53. [Epub ahead of print]

Coronary artery calcium findings in asymptomatic subjects with family history of premature CAD.

Taraboanta C, Hague C, Mancini JG, Forster BB, Frohlich J.

Abstract

ABSTRACT: BACKGROUND: To evaluate the frequency of positive coronary arteries calcium (CAC) scores in a unique population of asymptomatic first degree relatives (FDRs) of patients with angiographically confirmed early onset of coronary artery disease (CAD) and to assess their association with carotid ultrasound findings and other cardiovascular risk factors. Method and Results: We scanned, using 64-slice multi-detector computed tomography, 57 asymptomatic FDRs (47+9 years old; 44% male, 56% female), out of the 111 FDRs previously phenotyped for cardiovascular (CV) risk factors. The controls were 616 individuals (57+10 years old; 76% male, 24% female) with no family history of cardiovascular disease, chest pain or diabetes selected out of the 3500 subjects scanned between 2002 and 2007. FDRs had higher risk of abnormal CAC scores compared to controls; odds ratio (OR) for the 75th percentile was 1.96 (95%CI 1.04 - 3.67, p<0.05). CONCLUSION: The frequency of abnormal CAC scores is two-fold higher in asymptomatic FDRs than in controls. CAC scan provides additional information on CV risk assessment in asymptomatic FDRs, particularly for those in the intermediate risk category.

Diabetes Care. 2012 Sep;35(9):1944-50. Epub 2012 Jul 6.

Fasting glucose, obesity, and coronary artery calcification in community-based people without diabetes.

Rutter MK, Massaro JM, Hoffmann U, O'Donnell CJ, Fox CS.

Abstract

OBJECTIVE Our objective was to assess whether impaired fasting glucose (IFG) and obesity are independently related to coronary artery calcification (CAC) in a community-based population. RESEARCH DESIGN AND METHODS We assessed CAC using multidetector computed tomography in 3,054 Framingham Heart Study participants (mean [SD] age was 50 [10] years, 49% were women, 29% had IFG, and 25% were obese) free from known vascular disease or diabetes. We tested the hypothesis that IFG (5.6-6.9 mmol/L) and obesity (BMI ≥30 kg/m(2)) were independently associated with high CAC (>90th percentile for age and sex) after adjusting for hypertension, lipids, smoking, and medication. RESULTS High CAC was significantly related to IFG in an age- and sex-adjusted model (odds ratio 1.4 [95% CI 1.1-1.7], P = 0.002; referent: normal fasting glucose) and after further adjustment for obesity (1.3 [1.0-1.6], P = 0.045). However, IFG was not associated with high CAC in multivariable-adjusted models before (1.2 [0.9-1.4], P = 0.20) or after adjustment for obesity. Obesity was associated with high CAC in age- and sex-adjusted models (1.6 [1.3-2.0], P < 0.001) and in multivariable models that included IFG (1.4 [1.1-1.7], P = 0.005). Multivariable-adjusted spline regression models suggested nonlinear relationships linking high CAC with BMI (J-shaped), waist circumference (J-shaped), and fasting glucose. CONCLUSIONS In this community-based cohort, CAC was associated with obesity, but not IFG, after adjusting for important confounders. With the increasing worldwide prevalence of obesity and nondiabetic hyperglycemia, these data underscore the importance of obesity in the pathogenesis of CAC.

Circ Cardiovasc Imaging. 2012 Jul;5(4):467-73. Epub 2012 Jun 19.

Interplay of coronary artery calcification and traditional risk factors for the prediction of all-cause mortality in asymptomatic individuals.

Nasir K, Rubin J, Blaha MJ, Shaw LJ, Blankstein R, Rivera JJ, Khan AN, Berman D, Raggi P, Callister T, Rumberger JA, Min J, Jones SR, Blumenthal RS, Budoff MJ.

Abstract

BACKGROUND: Current guidelines recommend the use of coronary artery calcium (CAC) scoring for intermediate-risk patients; however, the potential role of CAC among individuals who have no risk factors (RFs) is less established. We sought to examine the relationship between the presence and burden of traditional RFs and CAC for the prediction of all-cause mortality.

METHODS AND RESULTS: The study cohort consisted of 44,052 consecutive asymptomatic individuals free of known coronary heart disease referred for computed tomography for the assessment of CAC. The following RFs were considered: (1) current cigarette smoking, (2) dyslipidemia, (3) diabetes mellitus, (4) hypertension, and (5) family history of coronary heart disease. Patients were followed for a mean of 5.6 ± 2.6 years for the primary end point of all-cause mortality. Among individuals who had no RF, Cox proportional model adjusted for age and sex identified that increasing CAC scores were associated with 3.00- to 13.38-fold higher mortality risk. The lowest survival rate was observed in those with no CAC and no RF, whereas those with CAC ≥ 400 and ≥3 RFs had the highest all-cause

fatality rate. Notably, individuals with no RF and CAC ≥ 400 had a substantially higher mortality rate compared with individuals with ≥3 RFs in the absence of CAC (16.89 versus 2.72 per 1000 person-years).
CONCLUSIONS: By highlighting that individuals without RFs but elevated CAC have a substantially higher event rates than those who have multiple RFs but no CAC, these findings challenge the exclusive use of traditional risk assessment algorithms for guiding the intensity of primary prevention therapies.

Circulation. 2012 Jul 24;126(4):410-7. Epub 2012 Jun 18.

Depressive symptom clusters and 5-year incidence of coronary artery calcification: the coronary artery risk development in young adults study.

Stewart JC, Zielke DJ, Hawkins MA, Williams DR, Carnethon MR, Knox SS, Matthews KA.

Abstract
BACKGROUND: Because depression is a multidimensional construct and few studies have compared the relative importance of its facets in predicting cardiovascular risk, we evaluated the utility of depressive symptom clusters in predicting the 5-year incidence of coronary artery calcification (CAC).
METHODS AND RESULTS: Participants were 2171 middle-aged adults (58% female; 43% black) from the Coronary Artery Risk Development in Young Adults (CARDIA) study who were free of cardiovascular disease. Depressive symptom clusters (z scores) were measured by questionnaires in 2000 to 2001, and CAC was measured by electron beam computed tomography in 2000 to 2001 and 2005 to 2006. There were 243 cases (11%) of incident CAC, defined as the absence of CAC at baseline and the presence of CAC at follow-up. Total depressive symptoms (odds ratio, 1.16; 95% confidence interval, 1.02-1.33; P=0.03) and the depressed affect cluster (odds ratio, 1.17; 95% confidence interval, 1.03-1.33; P=0.02) predicted incident CAC; however, the somatic, interpersonal distress, low positive affect, and pessimism clusters did not. The depressed affect-incident CAC relationship was independent of age, sex, race, education, and antidepressant use; was similar across sex and racial groups; and was partially accounted for by tobacco use and mean arterial pressure.
CONCLUSIONS: In contrast to recent results indicating that the somatic cluster is the most predictive of cardiovascular outcomes, we found that the prospective association between depressive symptoms and incident CAC was driven by the depressed affect cluster. Our findings raise the possibility that there may not be 1 facet of depression that is the most cardiotoxic across all contexts.

Psychosom Med. 2012 Jun;74(5):526-34.

Mood patterns based on momentary assessment of positive and negative moods over a day and coronary artery calcification in the CARDIA study.

Kroenke CH, Seeman T, Matthews K, Adler N, Epel E.

Abstract
OBJECTIVE: Retrospective assessments of negative mood have predicted coronary artery disease development and progression. Using momentary assessment, we evaluated associations between average positive and negative mood states and diurnal mood patterns, with prevalent and incident coronary artery calcification (CAC), a measure of calcified atherosclerosis.
METHODS: In a prospective cohort study of 669 white and African American men and women, aged 33 to 45 years, from the Coronary Artery Risk Development in Young Adults Study, mood was assessed at Year 15 examination, six times over a weekday. Prevalent, progressive, and 5-year incident CAC (any detectable CAC [score >0]) and substantial CAC (CAC score ≥ 20) were assessed at examinations at Years 15 and 20 by electron-beam tomographic scans. We employed a modified Poisson regression approach for binary data with robust error estimation to quantify relative risk.
RESULTS: In multivariate-adjusted analyses, those with high-average positive mood that improved over a day had a lower risk of prevalent CAC higher than 0 (relative risk [RR] = 0.17 [95% confidence interval {CI} = 0.04-0.67]) and substantial CAC (RR = 0.25 [95% CI = 0.06-0.95]). In contrast, those with high-average, increasingly negative mood over a day had a higher risk of prevalent CAC (RR = 1.85 [95% CI = 0.86-3.99]) and substantial CAC (RR = 3.11 [95% CI = 1.29-7.49]). Findings were similar for progressive CAC at Year 20. This pattern of high/worsening negative mood (not positive mood) during the day was also predictive of 5-year incident CAC (RR = 2.99 [95% CI = 1.00-8.93]).
CONCLUSIONS: Diurnal mood patterns were associated with the progression of calcified atherosclerosis, with negative mood predicting greater progression and positive mood predicting lower progression.

Ann Saudi Med. 2012 Jul-Aug;32(4):378-83.

The relationship between coronary artery calcification and myocardial perfusion in asymptomatic women.

Fathala A, Al Amer A, Shukri M, Abouzied MM, Alsugair A.

Abstract
BACKGROUND AND OBJECTIVES: No data are available in Saudi Arabia on the relationship between coronary artery calcification (CAC) and myocardial perfusion scintigraphy (MPS) in asymptomatic women, for determining

subclinical coronary artery disease (CAD). The main objective of this study was to investigate the relationship between the presence of CAC and stress-induced myocardial ischemia by MPS in asymptomatic women.
DESIGN AND SETTING: Single-center retrospective study over a 2-year period.
METHODS: One hundred and one women (mean [SD] age, 56 [11] years) without known CAD underwent both MPS and CAC scanning within 3 months. The frequency of ischemia by MPS was compared with the presence or absence of CAC and the number of CAD risk factors.
RESULTS: The prevalence of ischemic MPS was 22% (22/101). Among the 22 patients with ischemic MPS, the CAC score was 0 in 5 patients of 22 (23%), 1 to 200 in 4 patients of 22 (18%), and more than 200 in 13 patients of 22 (59%) (P=.0001). In contrast, among the 79 patients with normal MPS, the CAC score was 0 in 44 of 79 (56%) patients, 1 to 200 in 25 of 79 (32%), and more than 200 in 10 of 79 (13%). The presence or absence of CAC was the single most important predictor of the MPS result (P=.0001).
CONCLUSIONS: Moderate to severe CAC is associated with ischemic MPS in more than 50% of asymptomatic women with 2 or more CAD risk factors. Abnormal MPS is rarely associated with a 0 CAC score. Normal MPS does not exclude subclinical CAD. Therefore, CAC screening is an appropriate initial screening test for CAD in asymptomatic women.

Hypertension. 2012 Jun;59(6):1157-63. Epub 2012 Apr 30.

Nighttime blood pressure dipping in young adults and coronary artery calcium 10-15 years later: the coronary artery risk development in young adults study.

Viera AJ, Lin FC, Hinderliter AL, Shimbo D, Person SD, Pletcher MJ, Jacobs DR Jr.

Abstract
Nighttime blood pressure (BP) dipping can be quantified as the ratio of mean nighttime (sleep) BP to mean daytime (awake) BP. People whose dipping ratio is ≥ 0.90 have been referred to as nondippers, and nondipping is associated with cardiovascular disease events. We examined the relationship between systolic nighttime BP dipping in young adults and the presence of coronary artery calcium (CAC) 10 to 15 years later using data from the ambulatory BP monitoring substudy of the Coronary Artery Risk Development in Young Adults Study. Among 239 participants with adequate measures of both nighttime and daytime readings and coronary artery calcium, the systolic BP dipping ratio ranged from 0.72 to 1.24 (mean, 0.88; SD, 0.06), and CAC was present 10 to 15 years later in 54 participants (22.6%). Compared with those whose systolic BP dipping ratio ranged from 0.88 to 0.92 (quartile 3), the 57 participants (23.9%) with less pronounced or absent dipping (ratio, 0.92-1.24; quartile 4) had an unadjusted odds ratio of 4.08 (95% CI, 1.48-11.2) for the presence of CAC. The 60 participants (25.1%) with a more pronounced dipping (ratio, 0.72-0.85; quartile 1) also had greater odds for presence of CAC (odds ratio, 4.76 [95% CI, 1.76-12.9]). When modeled as a continuous predictor, a U-shaped relationship between systolic BP dipping ratio and future CAC was apparent and persisted after adjustment for multiple potential confounders (P<0.001 for quadratic term). Both failure of systolic BP to dip sufficiently and "overdipping" during nighttime may be associated with future subclinical coronary atherosclerosis.

J Diabetes. 2012 Jun 2. doi: 10.1111/j.1753-0407.2012.00212.x. [Epub ahead of print]

CAC Scanning in Asymptomatic Patients with Diabetes Mellitus: A Paradigm Shift.

Hecht HS, Narula J.

Abstract
Coronary artery calcium (CAC) is the most powerful cardiac risk prognosticator in the asymptomatic population, with consistent superiority to all risk factor based paradigms. More recently, the strong prognostic value of changes in CAC has been demonstrated. The application of CAC to asymptomatic patients with diabetes mellitus (DM), all of whom have been presumed to be of high risk, has yielded a range of risks from low to high, proportional to the amount of calcified plaque as in patients without DM. These risks are higher than in nondiabetic patients at corresponding CAC levels, except for those without CAC who have the same low risk as nondiabetic patients. In addition, the value of serial scanning to assess plaque progression and prognosis in persons with DM has been demonstrated. Therefore, we propose that : 1) DM is not a coronary artery disease equivalent; 2) CAC be routinely employed in all asymptomatic diabetic patients older than 40 years as proposed by ACC/AHA guidelines; 3) serial CAC scanning be considered for evaluation of the response to therapy.

Angiology. 2012 Sep 11. [Epub ahead of print]

CAC Progression in Asymptomatic Individuals With Initial Score of Zero.

Koulaouzidis G, Charisopoulou D, Maffrett S, Tighe M, Jenkins PJ, McArthur T.

Abstract
The aim of this study is to determine the progression of coronary artery calcification (CAC) using electron beam computed tomography (CT) when the initial CAC score (CACS) is zero and to determine the best interval to repeat a CAC scan. We studied 388 individuals with zero CACS (308 males; mean age: 48.8 ± 8.26 years) who underwent 2 consecutive CT scans in a period of at least 12 months apart. The interscan period was 2.99 ± 1.35 years (range: 1-6 years). Three-quarters of the individuals (75%) did not develop any CAC progression, 20.87% presented CAC progression of 1 to 10, 3.6% had 11 to 50, whereas only 0.51% had >50. The average time of new CAC development

was 4.2 ± 1.1 years. Individuals with CAC progression presented higher incidence of hypertension, diabetes mellitus, hypercholesterolaemia and higer frequency of male gender than those with without CAC changes (p<0.02). No cardiac events occurred during the follow-up period.

Angiology. 2012 Apr 12. [Epub ahead of print]

Prevalence of Noncalcified Coronary Plaque in Patients With Calcium Score of 0: The Silent Enemy.

Koulaouzidis G, Charisopoulou D, Jenkins PJ, Koulaouzidis A, McArthur T.

Abstract: Noncalcified coronary artery plaques (NCAPs) are susceptible to rupture, resulting in coronary artery thrombosis. Using computer tomography coronary angiography (CTCA), we evaluated the prevalence and degree of stenosis caused by NCAP in patients without coronary artery calcification (CAC). A retrospective analysis of 447 symptomatic patients with 0 CAC score revealed negative CTCA in 400 (89.5%). Noncalcified coronary artery plaques were demonstrated in 47 (10.5%), with 4 presenting stenosis >50%. Patients with positive CTCA, compared to those with normal CTCA, had significantly higher mean age (56.2 years vs 50.6 years, P < .004) and higher pretest coronary artery disease (CAD) probability (26% vs 34%, P < .0001). Noncalcified coronary artery plaque was predominantly developed in the proximal segment of the left anterior descending artery. Noncalcified coronary artery plaque is present in up to 10% of patients with a CAC score of 0. Computer tomography coronary angiography could be of diagnostic value in symptomatic patients with multiple risk factors for CAD, even in the absence of CAC.

JACC Cardiovasc Imaging. 2012 Apr;5(4):358-66.

Metabolic syndrome, diabetes, and incidence and progression of coronary calcium: the Multi-ethnic Study of Atherosclerosis study.

Wong ND, Nelson JC, Granston T, Bertoni AG, Blumenthal RS, Carr JJ, Guerci A, Jacobs DR Jr, Kronmal R, Liu K, Saad M, Selvin E, Tracy R, Detrano R.

Abstract

OBJECTIVES: This study sought to examine and compare the incidence and progression of coronary artery calcium (CAC) among persons with metabolic syndrome (MetS) and diabetes mellitus (DM) versus those with neither condition.

BACKGROUND: MetS and DM are associated with subclinical atherosclerosis as evidenced by CAC.

METHODS: The MESA (Multiethnic Study of Atherosclerosis) included 6,814 African American, Asian, Caucasian, and Hispanic adults 45 to 84 years of age, who were free of cardiovascular disease at baseline. Of these, 5,662 subjects (51% women, mean age 61.0 ± 10.3 years) received baseline and follow-up (mean 2.4 years) cardiac computed tomography scans. We compared the incidence of CAC in 2,927 subjects without CAC at baseline and progression of CAC in 2,735 subjects with CAC at baseline in those with MetS without DM (25.2%), DM without MetS (3.5%), or both DM and MetS (9.0%) to incidence and progression in subjects with neither MetS nor DM (58%). Progression of CAC was also examined in relation to coronary heart disease events over an additional 4.9 years.

RESULTS: Relative to those with neither MetS nor DM, adjusted relative risks (95% confidence intervals [CI]) for incident CAC were 1.7 (95% CI: 1.4 to 2.0), 1.9 (95% CI: 1.4 to 2.4), and 1.8 (95% CI: 1.4 to 2.2) (all $p < 0.01$), and absolute differences in mean progression (volume score) were 7.8 (95% CI: 4.0 to 11.6; $p < 0.01$), 11.6 (95% CI: 2.7 to 20.5; $p < 0.05$), and 22.6 (95% CI: 17.2 to 27.9; $p < 0.01$) for those with MetS without DM, DM without MetS, and both DM and MetS, respectively. Similar findings were seen in analysis using Agatston calcium score. In addition, progression predicted coronary heart disease events in those with MetS without DM (adjusted hazard ratio: 4.1, 95% CI: 2.0 to 8.5, $p < 0.01$) and DM (adjusted hazard ratio: 4.9 [95% CI: 1.3 to 18.4], $p < 0.05$) among those in the highest tertile of CAC increase versus no increase.

CONCLUSIONS: Individuals with MetS and DM have a greater incidence and absolute progression of CAC compared with individuals without these conditions, with progression also predicting coronary heart disease events in those with MetS and DM.

J Epidemiol. 2012 Apr 7. [Epub ahead of print]

CAC by CT in Epidemiologic Research and CVD Prevention.

Sekikawa A, Curb JD, Edmundowicz D, Okamura T, Choo J, Fujiyoshi A, Masaki K, Miura K, Kuller LH, Shin C, Ueshima H.

Abstract

Both American and European guidelines recommend coronary artery calcification (CAC) as a tool for screening asymptomatic individuals at intermediate risk for coronary heart disease (CHD). These recommendations are based on epidemiologic studies mostly in the United States. We review (1) the use of CAC in primary prevention of CHD in the United States, (2) epidemiologic studies of CAC in asymptomatic adults outside of the United States, and (3) international epidemiologic studies of CAC. This review will not consider clinical studies of CAC among patients or symptomatic individuals. US studies have shown that CAC is a strong independent predictor of CHD in both sexes among middle-aged and old age groups, various ethnic groups, and individuals with and without diabetes and that CAC plays an important role in reclassifying individuals from intermediate to high risk. Studies in Europe support these conclusions. The Electron-Beam Tomography, Risk Factor Assessment Among Japanese and US Men in the Post-

World-War-II birth cohort (ERA JUMP) Study is the first international study to compare subclinical atherosclerosis, including CAC among Japanese, Japanese Americans, Koreans, and whites. It showed that as compared with whites, Japanese had lower levels of atherosclerosis, whereas Japanese Americans had similar or higher levels. CAC is being increasingly used as a screening tool for asymptomatic individuals in Europe and the United States. CAC is a powerful research tool, because it enables us to describe differences in atherosclerotic burden across populations. Such research could identify factors responsible for differences among populations, which may improve CHD prevention.

Ann Intern Med. 2012 Mar 20;156(6):438-44.

Evaluation of newer risk markers for coronary heart disease risk classification: a cohort study.

Kavousi M, Elias-Smale S, Rutten JH, Leening MJ, Vliegenthart R, Verwoert GC, Krestin GP, Oudkerk M, de Maat MP, Leebeek FW, Mattace-Raso FU, Lindemans J, Hofman A, Steyerberg EW, van der Lugt A, van den Meiracker AH, Witteman JC.

Abstract

Background: Whether newer risk markers for coronary heart disease (CHD) improve CHD risk prediction remains unclear. Objective: To assess whether newer risk markers for CHD risk prediction and stratification improve Framingham risk score (FRS) predictions. Design: Prospective population-based study. Setting: The Rotterdam Study, Rotterdam, the Netherlands. Participants: 5933 asymptomatic, community-dwelling participants (mean age, 69.1 years [SD, 8.5]). Measurements: Traditional CHD risk factors used in the FRS (age, sex, systolic blood pressure, treatment of hypertension, total and high-density lipoprotein cholesterol levels, smoking, and diabetes) and newer CHD risk factors (N-terminal fragment of prohormone B-type natriuretic peptide levels, von Willebrand factor antigen levels, fibrinogen levels, chronic kidney disease, leukocyte count, C-reactive protein levels, homocysteine levels, uric acid levels, coronary artery calcium [CAC] scores, carotid intima-media thickness, peripheral arterial disease, and pulse wave velocity). Results: Adding CAC scores to the FRS improved the accuracy of risk predictions (c-statistic increase, 0.05 [95% CI, 0.02 to 0.06]; net reclassification index, 19.3% overall [39.3% in those at intermediate risk, by FRS]). Levels of N-terminal fragment of prohormone B-type natriuretic peptide also improved risk predictions but to a lesser extent (c-statistic increase, 0.02 [CI, 0.01 to 0.04]; net reclassification index, 7.6% overall [33.0% in those at intermediate risk, by FRS]). Improvements in predictions with other newer markers were marginal. Limitation: The findings may not be generalizable to younger or nonwhite populations. Conclusion: Among 12 CHD risk markers, improvements in FRS predictions were most statistically and clinically significant with the addition of CAC scores. Further investigation is needed to assess whether risk refinements using CAC scores lead to a meaningful change in clinical outcome. Whether to use CAC score screening as a more routine test for risk prediction requires full consideration of the financial and clinical costs of performing versus not performing the test for both persons and health systems.

Am J Cardiol. 2012 Mar 15. [Epub ahead of print]

Comparative Value of Coronary Artery Calcium and Multiple Blood Biomarkers for Prognostication of Cardiovascular Events.

Rana JS, Gransar H, Wong ND, Shaw L, Pencina M, Nasir K, Rozanski A, Hayes SW, Thomson LE, Friedman JD, Min JK, Berman DS.

Abstract

The value of coronary artery calcium (CAC) scoring versus multiple biomarkers in increasing risk prediction for cardiovascular disease (CVD) remains unknown. The study group consisted of 1,286 asymptomatic participants (mean ± SD 59 ± 8 years old) with no known coronary heart disease. Mean follow-up time was 4.1 ± 0.4 years with the primary outcome of combined CVD (cardiac death, myocardial infarction, stroke, and late target vessel revascularization). CAC was calculated by the method of Agatston. Biomarkers measured were C-reactive protein, interleukin-6, myeloperoxidase, B-type natriuretic peptide, and plasminogen activator-1. During follow-up 35 participants developed CVD events including cardiac deaths (6%), myocardial infarction (23%), strokes (17%), and late revascularizations (54%). In Cox proportional-hazards models adjusted for Framingham Risk Score (FRS), presence of log CAC beyond FRS was associated with increased hazards for CVD events (hazard ratio 1.7, 95% confidence interval [CI] 1.4 to 2.0, p <0.001). Multiple biomarkers score was also associated with increased risk beyond FRS (hazard ratio 2.1, p = 0.02) per 1-U increase in score; however, the c-statistic did not increase significantly (0.75, 95% CI 0.68 to 0.84, p = 0.32). The c-statistic increased when log CAC was incorporated into FRS without or with multiple biomarkers score (c-statistic 0.84, p = 0.003 and p = 0.008 respectively). Addition of CAC to risk factors showed significant reclassification (net reclassification improvement 0.35 (95% CI 0.11 to 0.58, p = 0.007; integrated discrimination index 0.076, p = 0.0001), whereas addition of multiple biomarkers score did not show significant reclassification. In conclusion, in this study of asymptomatic subjects without known CVD, addition of CAC but not biomarkers substantially improved risk reclassification for future CVD events beyond traditional risk factors.

Ann Intern Med. 2012 Mar 20;156(6):438-44.

Evaluation of newer risk markers for coronary heart disease risk classification: a cohort study.

Kavousi M, Elias-Smale S, Rutten JH, Leening MJ, Vliegenthart R, Verwoert GC, Krestin GP, Oudkerk M, de Maat MP, Leebeek FW, Mattace-Raso FU, Lindemans J, Hofman A, Steyerberg EW, van der Lugt A, van den Meiracker AH, Witteman JC.

Abstract

BACKGROUND: Whether newer risk markers for coronary heart disease (CHD) improve CHD risk prediction remains unclear.

OBJECTIVE: To assess whether newer risk markers for CHD risk prediction and stratification improve Framingham risk score (FRS) predictions.

DESIGN: Prospective population-based study.

SETTING: The Rotterdam Study, Rotterdam, the Netherlands.

PARTICIPANTS: 5933 asymptomatic, community-dwelling participants (mean age, 69.1 years [SD, 8.5]).

MEASUREMENTS: Traditional CHD risk factors used in the FRS (age, sex, systolic blood pressure, treatment of hypertension, total and high-density lipoprotein cholesterol levels, smoking, and diabetes) and newer CHD risk factors (N-terminal fragment of prohormone B-type natriuretic peptide levels, von Willebrand factor antigen levels, fibrinogen levels, chronic kidney disease, leukocyte count, C-reactive protein levels, homocysteine levels, uric acid levels, coronary artery calcium [CAC] scores, carotid intima-media thickness, peripheral arterial disease, and pulse wave velocity).

RESULTS: Adding CAC scores to the FRS improved the accuracy of risk predictions (c-statistic increase, 0.05 [95% CI, 0.02 to 0.06]; net reclassification index, 19.3% overall [39.3% in those at intermediate risk, by FRS]). Levels of N-terminal fragment of prohormone B-type natriuretic peptide also improved risk predictions but to a lesser extent (c-statistic increase, 0.02 [CI, 0.01 to 0.04]; net reclassification index, 7.6% overall [33.0% in those at intermediate risk, by FRS]). Improvements in predictions with other newer markers were marginal.

LIMITATION: The findings may not be generalizable to younger or non-white populations.

CONCLUSION: Among 12 CHD risk markers, improvements in FRS predictions were most statistically and clinically significant with the addition of CAC scores. Further investigation is needed to assess whether risk refinements using CAC scores lead to a meaningful change in clinical outcome. Whether to use CAC score screening as a more routine test for risk prediction requires full consideration of the financial and clinical costs of performing versus not performing the test for both persons and health systems.

Am J Cardiol. 2012 May 15;109(10):1449-53. Epub 2012 Mar 16.

Comparative value of coronary artery calcium and multiple blood biomarkers for prognostication of cardiovascular events.

Rana JS, Gransar H, Wong ND, Shaw L, Pencina M, Nasir K, Rozanski A, Hayes SW, Thomson LE, Friedman JD, Min JK, Berman DS.

Abstract

The value of coronary artery calcium (CAC) scoring versus multiple biomarkers in increasing risk prediction for cardiovascular disease (CVD) remains unknown. The study group consisted of 1,286 asymptomatic participants (mean ± SD 59 ± 8 years old) with no known coronary heart disease. Mean follow-up time was 4.1 ± 0.4 years with the primary outcome of combined CVD (cardiac death, myocardial infarction, stroke, and late target vessel revascularization). CAC was calculated by the method of Agatston. Biomarkers measured were C-reactive protein, interleukin-6, myeloperoxidase, B-type natriuretic peptide, and plasminogen activator-1. During follow-up 35 participants developed CVD events including cardiac deaths (6%), myocardial infarction (23%), strokes (17%), and late revascularizations (54%). In Cox proportional-hazards models adjusted for Framingham Risk Score (FRS), presence of log CAC beyond FRS was associated with increased hazards for CVD events (hazard ratio 1.7, 95% confidence interval [CI] 1.4 to 2.0, p <0.001). Multiple biomarkers score was also associated with increased risk beyond FRS (hazard ratio 2.1, p = 0.02) per 1-U increase in score; however, the c-statistic did not increase significantly (0.75, 95% CI 0.68 to 0.84, p = 0.32). The c-statistic increased when log CAC was incorporated into FRS without or with multiple biomarkers score (c-statistic 0.84, p = 0.003 and p = 0.008 respectively). Addition of CAC to risk factors showed significant reclassification (net reclassification improvement 0.35 (95% CI 0.11 to 0.58, p = 0.007; integrated discrimination index 0.076, p = 0.0001), whereas addition of multiple biomarkers score did not show significant reclassification. In conclusion, in this study of asymptomatic subjects without known CVD, addition of CAC but not biomarkers substantially improved risk reclassification for future CVD events beyond traditional risk factors.

Eur Heart J Cardiovasc Imaging. 2012 Apr;13(4):317-23. Epub 2012 Feb 28.

Carotid artery intima-media thickness, but not coronary artery calcium, predicts coronary vascular resistance in patients evaluated for coronary artery disease.

Danad I, Raijmakers PG, Kamali P, Harms HJ, de Haan S, Lubberink M, van Kuijk C, Hoekstra OS, Lammertsma AA, Smulders YM, Heymans MW, Tulevski II, van Rossum AC, Knaapen P.

Abstract

AIMS: There is growing evidence that coronary artery disease (CAD) affects not only the conduit epicardial coronary arteries, but also the microvascular coronary bed. Moreover, coronary microvascular dysfunction (CMVD) often precedes the stage of clinically overt epicardial CAD. Coronary artery calcium (CAC) and carotid intima-media thickness (C-IMT) measured with computed tomography (CT) and ultrasound, respectively, are among the available techniques to non-invasively assess atherosclerotic burden. An increased CAC score and C-IMT have also been associated with CMVD. It is therefore of interest to explore and compare the potential of CAC against C-IMT to predict minimal coronary vascular resistance (CVR).
METHODS AND RESULTS: We evaluated 120 patients (mean age 56 ± 9 years, 58 men) without a documented history of CAD in whom obstructive CAD was excluded. All patients underwent C-IMT measurements, CAC scoring, and vasodilator stress (15)O-water positron emission tomography (PET)/CT, during which the coronary flow reserve (CFR) and minimal CVR were analysed. Minimal CVR increased significantly with increasing tertiles of C-IMT (22 ± 6, 27 ± 11, and 28 ± 9 mmHg mL(-1)min(-1) g(-1), P < 0.01), whereas the CFR was comparable across all C-IMT groups (P = 0.50). Minimal CVR increased significantly with an increase in CAC score (23 ± 9, 27 ± 8, 32 ± 10, and 32 ± 7 mmHg mL(-1) min(-1) g(-1), P < 0.01), whereas the CFR did not show a significant decrease with higher CAC scores (P = 0.18). Multivariable regression analysis revealed that C-IMT (P = 0.03), but not CAC, was independently associated with minimal CVR.
CONCLUSION: C-IMT, but not CAC score, independently predicts minimal CVR in patients with multiple cardiovascular risk factors and suspected of CAD.

Hypertension. 2012 Jan;59(1):44-53. Epub 2011 Nov 28.

Subclinical coronary atherosclerosis predicts cardiovascular risk in different stages of hypertension: result of the Heinz Nixdorf Recall Study.

Erbel R, Lehmann N, Möhlenkamp S, Churzidse S, Bauer M, Kälsch H, Schmermund A, Moebus S, Stang A, Roggenbuck U, Bröcker-Preuss M, Dragano N, Weimar C, Siegrist J, Jöckel KH; Heinz Nixdorf Recall Study Investigators.

Abstract
Prehypertension is a frequent condition and has been demonstrated to increase cardiovascular risk. However, the association with coronary atherosclerosis as part of target organ damage is not well understood. We investigated the cross-sectional relationship and longitudinal outcome between blood pressure categories and coronary artery calcification (CAC), quantified by electron beam computed tomography, in 4181 participants from the population-based Heinz Nixdorf Recall Study cohort. At baseline, we observed a continuous increase in calcium scores with increasing blood pressure categories. During a median follow-up period of 7.18 years, 115 primary end points (2.8%; fatal and nonfatal myocardial infarction) and 152 secondary end points (3.6%; stroke and coronary revascularization) occurred. We observed a continuous increase in age- and risk factor-adjusted secondary endpoints (hazard ratios [95% CI]) with increasing blood pressure categories (referent: normotension) in men: prehypertension, 1.80 (0.53-6.13); stage 1 hypertension, 2.27 (0.66-7.81); and stage 2 hypertension, 4.10 (1.27-13.24) and in women: prehypertension, 1.13 (0.34-3.74); stage 1 hypertension, 2.14 (0.67-6.85); and stage 2 hypertension, 3.33 (1.24-8.90), respectively, but not in primary endpoints. Cumulative event rates were determined by blood pressure categories and the CAC. In prehypertension, the adjusted hazard ratios for all of the events were, for CAC 1 to 99, 2.05 (0.80-5.23; P=0.13); 100 to 399, 3.12 (1.10-8.85; P=0.03); and ≥400, 7.72 (2.67-22.27; P=0.0002). Risk of myocardial infarction and stroke in hypertension but also in prehypertension depends on the degree of CAC. This marker of target-organ damage might be included, when lifestyle modification and pharmacotherapeutic effects in prehypertensive individuals are tested to avoid exposure to risk and increase benefit.

Perikardfett

Atherosclerosis. 2012 Aug;223(2):389-93. Epub 2012 Jun 17.

Epicardial adipose tissue is increased in patients with systemic lupus erythematosus.

Lipson A, Alexopoulos N, Hartlage GR, Arepalli C, Oeser A, Bian A, Gebretsadik T, Shintani A, Stillman AE, Stein CM, Raggi P.

Abstract
OBJECTIVE: Morbidity and mortality secondary to premature cardiovascular disease (CVD) in systemic lupus erythematosus (SLE) remain significant issues. The pathogenesis of CVD in SLE patients has not been fully explored. Epicardial adipose tissue (EAT) is believed to contribute to atherosclerosis development, through a paracrine and systemic inflammatory effect. We measured EAT volume in 162 SLE patients and 86 matched controls to assess the association of EAT with markers of atherosclerosis, cardiovascular risk and immunoactivation.
METHODS: Clinical and laboratory characteristics collected included anthropomorphic measures, disease activity and damage indices, blood pressure measurement, lipid profile, inflammatory indices, adipokine levels and measures of adiposity. Coronary artery calcium (CAC) and EAT volume were measured using non-contrast cardiac computed tomography.

RESULTS: EAT volume was greater in patients with SLE [(mean±SD) 96.8±45.9 cm(3)] than controls (78.2±40.7 cm(3); P=0.001). The EAT volume was 31% larger (95% CI, 16.5%-47.4%) in SLE patients than controls (P<0.001 adjusted for age, sex, and race; after additional adjustment for waist circumference P=0.007). Within SLE patients, after adjusting for age, race, sex, and waist circumference, EAT volume was associated with cumulative corticosteroid dose (P=0.007), current corticosteroid use (P<0.001), HDL cholesterol (P=0.033), and triglycerides (P=0.005). EAT was significantly correlated with CAC score (P<0.001), but the association was attenuated after adjustment for Framingham risk score (P=0.051).
CONCLUSION: The increased EAT volume seen in SLE patients is associated with corticosteroid use. Corticosteroids could have adverse cardiovascular effects in SLE via an increase in EAT volume, a marker of risk in the general population.

Cardiology. 2012 Apr 19;121(4):220-227. [Epub ahead of print]

Determination of Pericardial Adipose Tissue Increases the Prognostic Accuracy of Coronary Artery Calcification for Future Cardiovascular Events.

Greif M, Leber AW, Saam T, Uebleis C, von Ziegler F, Rümmler J, D'Anastasi M, Arias-Herrera V, Becker C, Steinbeck G, Hacker M, Becker A.

Abstract
Objectives: Pericardial adipose tissue (PAT) is associated with coronary artery plaque accumulation and the incidence of coronary heart disease. We evaluated the possible incremental prognostic value of PAT for future cardiovascular events. Methods: 145 patients (94 males, age 60 ± 10 years) with stable coronary artery disease underwent coronary artery calcification (CAC) scanning in a multislice CT scanner, and the volume of pericardial fat was measured. Mean observation time was 5.4 years. Results: 34 patients experienced a severe cardiac event. They had a significantly higher CAC score (1,708 ± 2,269 vs. 538 ± 1,150, p < 0.01), and the CAC score was highly correlated with the relative risk of a future cardiac event: 2.4 (1.8-3.7; p = 0.01) for scores >400, 3.5 (1.9-5.4; p = 0.007) for scores >800 and 5.9 (3.7-7.8; p = 0.005) for scores >1,600. When additionally a PAT volume >200 cm(3) was determined, there was a significant increase in the event rate and relative risk. We calculated a relative risk of 2.9 (1.9-4.2; p = 0.01) for scores >400, 4.0 (2.1-5.0; p = 0.006) for scores >800 and 7.1 (4.1-10.2; p = 0.005) for scores >1,600. Conclusions: The additional determination of PAT increases the predictive power of CAC for future cardiovascular events. PAT might therefore be used as a further parameter for risk stratification.

Eur Heart J Cardiovasc Imaging. 2012 Feb 5. [Epub ahead of print]

Epicardial adipose tissue volume as a predictor for coronary artery disease in diabetic, impaired fasting glucose, and non-diabetic patients presenting with chest pain.

Versteylen MO, Takx RA, Joosen IA, Nelemans PJ, Das M, Crijns HJ, Hofstra L, Leiner T.

Abstract
AIMS: Epicardial adipose tissue (EAT) volume has been associated with coronary artery disease (CAD). As diabetes mellitus type 2 (DM2) patients have higher EAT volumes, it has been suggested that EAT may play a role in promoting CAD in these patients. The aim of this study was to examine the association between EAT and CAD in DM2, impaired fasting glucose (IFG) and control patients presenting with stable chest pain.
METHODS AND RESULTS: A total of 410 stable chest pain patients underwent multidetector cardiac computed tomography angiography (CCTA) to assess the presence of CAD. The extent of CAD was expressed as the number of affected segments. The EAT volume was measured using three-dimensional volumetric quantification. The EAT was compared using ANOVA, logistic and linear regression models were used to assess its predictive value. Multivariable regression analysis corrected for traditional risk factors was performed. Eighty-three patients had DM2, 118 IFG and there were 209 controls. DM2 as well as IFG patients had higher EAT volumes compared with controls (98 ± 41, 92 ± 39, and 75 ± 34 cm(3), respectively; P < 0.001). EAT predicted the presence (OR: 1.01; P < 0.001) and the extent of CAD (B: 0.01; P < 0.001). The associations were equal in all subgroups. However, in a multivariable regression model corrected for traditional cardiovascular risk factors, EAT was not an independent predictor for the presence or extent of CAD (OR: 1.00; P = 0.88 and B: -0.11; P = 0.68, respectively).
CONCLUSION: The EAT volume is associated with CAD in DM2, IFG, and control patients. However, EAT is not an independent predictor for CAD in patients presenting with stable chest pain.

Atherosclerosis. 2012 Feb 23. [Epub ahead of print]

Association of pericardial fat and coronary high-risk lesions as determined by cardiac CT.

Schlett CL, Ferencik M, Kriegel MF, Bamberg F, Ghoshhajra BB, Joshi SB, Nagurney JT, Fox CS, Truong QA, Hoffmann U.

Abstract
OBJECTIVE: Pericardial adipose tissue (PAT) is a pathogenic fat depot associated with coronary atherosclerosis and cardiovascular events. We hypothesized that higher PAT is associated with coronary high-risk lesions as determined by cardiac CT.

METHODS: We included 358 patients (38% female; median age 51 years) who were admitted to the ED with acute chest pain and underwent 64-slice CT angiography. The cardiac CT data sets were assessed for presence and morphology of CAD and PAT. Coronary high-risk lesions were defined as >50% luminal narrowing and at least two of the following characteristics: positive remodeling, low-density plaque, and spotty calcification. PAT was defined as any pixel with CT attenuation of -190 to -30HU within the pericardial sac.
RESULTS: Based on cardiac CT, 50% of the patients (n=180) had no CAD, 46% (n=165) had CAD without high-risk lesions, and 13 patients had CAD with high-risk lesions. The median PAT in patients with high-risk lesions was significantly higher compared to patients without high-risk lesions and without any CAD (151.9 [109.0-179.4]cm(3) vs. 110.0 [81.5-137.4]cm(3), vs. 74.8 [58.2-111.7]cm(3), respectively p=0.04 and p<0.0001). These differences remained significant after adjusting for traditional risk factors including BMI (all p<0.05). The area under the ROC curve for the identification of high-risk lesions was 0.756 in a logistic regression model with PAT as a continuous predictor.
CONCLUSION: PAT volume is nearly twice as high in patients with high-risk coronary lesions as compared to those without CAD. PAT volume is significantly associated with high risk coronary lesion morphology independent of clinical characteristics and general obesity.

Obesity (Silver Spring). 2012 Mar 8. [Epub ahead of print]

Physical Activity, Sedentary Time, and Pericardial Fat in Healthy Older Adults.

Hamer M, Venuraju SM, Urbanova L, Lahiri A, Steptoe A.

Abstract
Pericardial fat is emerging as a unique risk factor for coronary disease. We examined the relationship between objectively measured physical activity during free-living and pericardial fat. Participants were 446 healthy men and women (mean age = 66 ± 6 years), without history or objective signs of cardiovascular disease (CVD), drawn from the Whitehall II epidemiological cohort. Physical activity was objectively measured using accelerometers (Actigraph GT3X) worn around the hip during waking hours for 7 consecutive days (average daily wear time = 889 ± 68 min/day), and was classified as sedentary (<200 counts/min (cpm)), light (200-1,998 cpm), or moderate-vigorous physical activity (MVPA; ≥1,999 cpm). Pericardial fat volume was measured in each participant using electron beam computed tomography. Average daily cpm in men was 338.0 ± 145.0 and in women 303.8 ± 130.2. There was an inverse association between average cpm and pericardial fat (B = -0.070, 95% confidence interval (CI), -0.101, -0.040, P < 0.001), and this remained significant after adjusting for age, sex, registered wear time, BMI, lipids, glycemic control, blood pressure, smoking, statins, and social status. Both sedentary time (B = 0.081, 95% CI, 0.022, 0.14) and MVPA (B = -0.362, 95% CI, -0.527, -0.197) were also associated with pericardial fat, although associations for sedentary time did not remain significant after adjustment for MVPA. The inverse association between physical activity and pericardial fat was stronger among overweight and obese adults than in normal weight. Objectively assessed daily activity levels are related to pericardial fat in healthy participants, independently of BMI. This might be an important mechanism in explaining the association between physical activity and CVD prevention.

Aorta und Aortenklappe

Am J Cardiol. 2012 Sep 15;110(6):891-6. Epub 2012 Jun 20.

Prevalence and Distribution of Abdominal Aortic Calcium by Gender and Age Group in a Community-Based Cohort (from the Framingham Heart Study).

Chuang ML, Massaro JM, Levitzky YS, Fox CS, Manders ES, Hoffmann U, O'Donnell CJ.

Abstract
Abdominal aortic calcium (AAC) is associated with incident cardiovascular disease. However, the age- and gender-related distribution of AAC in a community-dwelling population free of standard cardiovascular disease risk factors has not been described. A total of 3,285 participants (aged 50.2 ± 9.9 years) in the Framingham Heart Study Offspring and Third Generation cohorts underwent abdominal multidetector computed tomography from 1998 to 2005. The presence and amount of AAC was quantified (Agatston score) by an experienced reader using standardized criteria. A healthy referent subsample (n = 1,656, 803 men) free of hypertension, hyperlipidemia, diabetes, obesity, and smoking was identified, and participants were stratified by gender and age (<45, 45 to 54, 55 to 64, 65 to 74, and ≥75 years). The prevalence and burden of AAC increased monotonically and supra-linearly with age in both genders but was greater in men than in women in each age group. For those <45 years old, <16% of the referent subsample participants had any quantifiable AAC. However, for those >65 years old, nearly 90% of the referent participants had >0 AAC. Across the entire study sample, AAC prevalence and burden similarly increased with greater age. Defining the 90th percentile of the referent group AAC as "high," the prevalence of high AAC was 19% for each gender in the overall study sample. The AAC also increased across categories of 10-year coronary heart disease risk, as calculated using the Framingham Risk Score, in the entire study sample. We found AAC to be widely prevalent, with the burden of AAC associated with 10-year coronary risk, in a white, free-living adult cohort.

Int J Cardiovasc Imaging. 2012 Sep 18. [Epub ahead of print]

Inter-individual variance and cardiac cycle dependency of aortic root dimensions and shape as assessed by ECG-gated multi-slice computed tomography in patients with severe aortic stenosis prior to transcatheter aortic valve implantation: is it crucial for correct sizing?

Lehmkuhl L, Foldyna B, Von Aspern K, Lücke C, Grothoff M, Nitzsche S, Kempfert J, Haensig M, Rastan A, Walther T, Mohr FW, Gutberlet M.

Abstract

To evaluate the inter-individual variance and the variability of the aortic root dimensions during the cardiac cycle by computed tomography (CT) in patients with severe aortic stenosis prior to transcatheter aortic valve implantation (TAVI). Fifty-six patients (m/w = 16/40, 81 ± 6.8 years), scheduled for a transapical aortic valve implantation with available preprocedural ECG-gated CT were retrospectively included. The evaluation included sizing of the aortic annulus and the aortic sinus, measurements of the coronary topography, aortic valve planimetry and scoring of calcification. The new defined aortic annulus sphericity ratio revealed a mostly elliptical shape with increasing diastolic deformation. The calculated effective diameter (ED), determined from the annulus' lumen area, turned out to be the parameter least affected from cardiac cycle changes while systolic and diastolic annulus dimensions and shape (diameter and area) differed significantly ($p < 0.001$). In about 70 % of the patients with relevant paravalvular leaks the finally implanted prosthesis was too small according to the CT based calculated ED. The ostial height of the coronaries showed a high variability with a critical minimum range <5 mm. The degree of the aortic calcification did not have an influence on the aortic annulus deformation during the cardiac cycle, but on the occurrence of paravalvular leaks. The aortic root anatomy demonstrated a high inter-individual variability and cardiac cycle dependency. These results must be strongly considered during the patient evaluation prior to TAVI to avoid complications. The systolic effective diameter, as measured by ECG-gated CT, represents an appropriate parameter for sizing the aortic annulus.

Eur Radiol. 2012 Jun 12. [Epub ahead of print]

Multi-detector computed tomography is equivalent to trans-oesophageal echocardiography for the assessment of the aortic annulus before transcatheter aortic valve implantation.

Rixe J, Schuhbaeck A, Liebetrau C, Moellmann H, Nef HM, Szardien S, Brandt R, Schmitt J, Neumann T, Schneider C, Krombach G, Hamm CW, Achenbach S, Rolf A.

Abstract

OBJECTIVES: In transcatheter aortic valve implantation (TAVI), assessment of the aortic annulus is mandatory. We sought to investigate the correlation between trans-oesophageal echocardiography (TEE) and multi-detector computed tomography (MDCT) for annulus diameter assessment before TAVI.

METHODS: A total of 122 patients (67 male, mean age 84 ± 6years) underwent MDCT and TEE for TAVI planning. In TEE annulus diameters were obtained in a long-axis view at diastole. MDCT data were evaluated using MPR images, and corresponding projections were adjusted for MDCT and TEE. Patients were classified by the predominant localisation of aortic valve calcifications, and annulus diameters between TEE and MDCT were correlated. Additionally, the eccentricity of the aortic annulus was calculated.

RESULTS: Mean eccentricity of the aortic annulus determined by MDCT was 0.34□±□0.17, with no difference according to valve calcification. Regarding the aortic annulus diameter, the mean values measured were 24.3□±□2.1mm in MDCT and 24.0□±□2.5mm in TEE (P□<□0.0001 for agreement).

CONCLUSIONS: Independent of the pattern of aortic valve calcification, close correlation is found between CT and TEE measurements of the aortic annulus diameter. In addition, CT demonstrates the non-circular shape of the aortic annulus. KEY POINTS : • Accurate assessment of aortic annulus before transcatheter aortic valve implantation is crucial. • Trans-oesophageal echocardiography has been the preferred method for aortic annulus assessment. • We demonstrated a strong correlation between TEE and CT for annulus dimensions. • CT reliably demonstrates the non-circular shape of the aortic annulus. • CT could therefore be generally used for aortic annulus assessment before TAVI.

Radiographics. 2012 Sep;32(5):1399-420.

CT and MR Imaging of the Aortic Valve: Radiologic-Pathologic Correlation.

Bennett CJ, Maleszewski JJ, Araoz PA.

Abstract

Valvular disease is estimated to account for as many as 20% of cardiac surgical procedures performed in the United States. It may be congenital in origin or secondary to another disease process. One congenital anomaly, bicuspid aortic valve, is associated with increased incidence of stenosis, regurgitation, endocarditis, and aneurysmal dilatation of the aorta. A bicuspid valve has two cusps instead of the normal three; resultant fusion or poor excursion of the valve leaflets may lead to aortic stenosis, the presence of which is signaled by dephasing jets on magnetic resonance (MR) images. Surgery is generally recommended for patients with severe stenosis who are symptomatic or who have significant ventricular dysfunction; transcatheter aortic valve implantation (TAVI) is an emerging therapeutic option for patients who are not eligible for surgical treatment. Computed tomography (CT) is an essential component of preoperative planning for TAVI; it is used to determine the aortic root dimensions, severity of peripheral vascular disease, and status of the coronary arteries. Aortic regurgitation, which is caused by incompetent closure of the aortic

valve, likewise leads to the appearance of jets on MR images. The severity of regurgitation is graded on the basis of valvular morphologic parameters; qualitative assessment of dephasing jets at Doppler ultrasonography; or measurements of the regurgitant fraction, volume, and orifice area. Mild regurgitation is managed conservatively, whereas severe or symptomatic regurgitation usually leads to valve replacement surgery, especially in the presence of substantial left ventricular enlargement or dysfunction. Bacterial endocarditis, although less common than aortic stenosis and regurgitation, is associated with substantial morbidity and mortality. Electrocardiographically gated CT reliably demonstrates infectious vegetations and benign excrescences of 1 cm or more on the valve surface, allowing the assessment of any embolic complications.

Eur J Cardiothorac Surg. 2012 May 2. [Epub ahead of print]

Computed tomography-based evaluation of aortic annulus, prosthesis size and impact on early residual aortic regurgitation after transcatheter aortic valve implantation.

Buzzatti N, Maisano F, Latib A, Cioni M, Taramasso M, Mussardo M, Colombo A, Alfieri O.

Abstract

OBJECTIVES: Computed tomography (CT) is an increasingly utilized method for the evaluation of patient suitability for transcatheter aortic valve implantation (TAVI). The aim of this study was to analyse the role of CT in the choice of prosthesis and the prevention of residual aortic regurgitation (RAR).

METHODS: From November 2007 to September 2010, 115 patients (median age 81 years, inter-quantile range (IQR) 76-85; median ejection fraction 55%, IQR 45-60; median logistic EuroSCORE 19.7, IQR 11.0-32.1) undergoing TAVI were evaluated with a pre-procedural CT. An aortic complex was evaluated with multi-planar reconstructions, and we defined significant early RAR as RAR ≥ 2, and prosthesis/annulus mismatch (PAM) as the ratio between prosthesis size and mean annular size. All analyses were conducted for the whole sample and then separately for the two types of prosthesis implanted.

RESULTS: An Edwards-SAPIEN(®) prosthesis was implanted in 62 patients (54.7%), and a Medtronic CoreValve(®) in 52 (45.2%). Aortic annulus minimum and maximum diameters were 22.6±2.1 and 26.0±2.3 mm, respectively. The aortic annulus diameter and the length of the free edge of the aortic cusps were linearly related to a 1:1 ratio ($P<0.0001$). Significant RAR (34 patients, 30%) appeared directly related to the annulus diameters (particularly maximum and medium diameters, $P=0.0003$ and $P=0.0010$, respectively) and cusp length ($P=0.0007$) but inversely correlated with PAM ($P=0.0006$). Prosthesis/annulus oversizing was associated with a reduction in RAR, with a cut-off of 7% as the limit below which RAR increases; moreover, we observed different cut-off values for the Edwards and CoreValve prostheses, although statistical significance was not reached for the CoreValve (respectively, 2% with $P < 0.0001$, 11% with $P=0.16$). No association was found between PAM and possible PAM-related complications.

CONCLUSIONS: CT evaluation prior to TAVI showed that RAR was directly correlated with aortic root dimensions (particularly maximum and medium annulus diameters and cusp lengths) and inversely correlated with PAM. Oversizing the prosthesis by at least 7% reduces the risk of RAR. CT is an essential and invaluable tool in the assessment of patients undergoing TAVI.

Int J Cardiovasc Imaging. 2012 Apr 22. [Epub ahead of print]

Prevalence of thoracic aortic calcification and its relationship to cardiovascular risk factors and coronary calcification in an unselected population-based cohort: the Heinz Nixdorf Recall Study.

Kälsch H, Lehmann N, Möhlenkamp S, Hammer C, Mahabadi AA, Moebus S, Schmermund A, Stang A, Bauer M, Jöckel KH, Erbel R; on behalf of the Investigator Group of the Heinz Nixdorf Recall Study.

Abstract: Thoracic aortic calcification (TAC) and coronary artery calcium (CAC) have been proposed for risk assessment of coronary artery and cardiovascular disease events. The aim of this analysis is to assess the prevalence of TAC and to determine its relationship with cardiovascular risk factors and CAC in a general unselected population. TAC was measured from electron beam computed tomography scans and quantified by Agatston-Score in 4,025 participants aged 45-75 years (mean age 59.4±7.8 years, 53% female) from the Heinz Nixdorf Recall Study. Multivariable generalized linear regression was used to evaluate relationships between TAC and cardiovascular risk factors and CAC. Overall 2,538/4,025 (63.1%) participants revealed TAC. Prevalence of TAC was greater in men than in women (65.2 vs. 61.7%, p=0.009). TAC was most strongly associated with age, systolic blood pressure, smoking and high levels of LDL-cholesterol. Prevalence of CAC was significantly higher in participants with TAC than without (74.0 vs. 57.6 %, p<0.0001) demonstrating an increased risk of having CAC in the presence of TAC (prevalence ratio (PR) 1.29 [95 % CI: 1.22-1.35], p<0.0001, PR adjusted for risk factors 1.14 [1.09-1.20], p<0.0001). In general population, TAC has high prevalence and largely shares cardiovascular risk factors with CAD while being independently associated with present CAC.

J Am Coll Cardiol. 2012 Apr 3;59(14):1287-94. Epub 2012 Feb 22.

3-dimensional aortic annular assessment by MDCT predicts moderate or severe paravalvular regurgitation after transcatheter aortic valve replacement: a multicenter retrospective analysis.

Willson AB, Webb JG, Labounty TM, Achenbach S, Moss R, Wheeler M, Thompson C, Min JK, Gurvitch R, Norgaard BL, Hague CJ, Toggweiler S, Binder R, Freeman M, Poulter R, Poulsen S, Wood DA, Leipsic J.

Abstract
OBJECTIVES: This study sought to analyze multidetector computed tomography (MDCT) 3-dimensional aortic annular dimensions for the prediction of paravalvular aortic regurgitation (PAR) following transcatheter aortic valve replacement (TAVR).
BACKGROUND: Moderate or severe PAR after TAVR is associated with increased morbidity and mortality.
METHODS: A total of 109 consecutive patients underwent MDCT pre-TAVR with a balloon expandable aortic valve. Differences between transcatheter heart valve (THV) size and MDCT measures of annular size (mean diameter, area, and circumference) were analyzed concerning prediction of PAR. Patients with THV malposition (n = 7) were excluded. In 50 patients, MDCT was repeated after TAVR to assess THV eccentricity (1 - short diameter/long diameter) and expansion (MDCT measured THV area/nominal THV area).
RESULTS: Moderate or severe PAR (13 of 102) was associated with THV undersizing (THV diameter - mean diameter = -0.7 ± 1.4 mm vs. 0.9 ± 1.8 mm for trivial to mild PAR, $p < 0.01$). The difference between THV size and MDCT annular size was predictive of PAR (mean diameter: area under the curve [AUC]: 0.81, 95% confidence interval [CI]: 0.68 to 0.88; area: AUC: 0.80, 95% CI: 0.65 to 0.90; circumference: AUC: 0.76, 95% CI: 0.59 to 0.91). Annular eccentricity was not associated with PAR (AUC: 0.58, 95% CI: 0.46 to 0.75). We found that 35.3% (36 of 102) and 45.1% (46 of 102) of THVs were undersized relative to the MDCT mean diameter and area, respectively. THV oversizing relative to the annular area was not associated with THV eccentricity or underexpansion (oversized vs. undersized THVs; expansion: 102.7 ± 5.3% vs. 106.1 ± 5.6%, $p = 0.03$; eccentricity: median: 1.7% [interquartile range: 1.4% to 3.0%] vs. 1.7% [interquartile range: 1.1% to 2.7%], $p = 0.28$).
CONCLUSIONS: MDCT-derived 3-dimensional aortic annular measurements are predictive of moderate or severe PAR following TAVR. Oversizing of THVs may reduce the risk of moderate or severe PAR.

AJR Am J Roentgenol. 2012 Apr;198(4):939-45.

Aortoiliac CT Angiography for Planning Transcutaneous Aortic Valve Implantation: Aortic Root Anatomy and Frequency of Clinically Significant Incidental Findings.

Apfaltrer P, Schymik G, Reimer P, Schroefel H, Sueselbeck T, Henzler T, Krissak R, Nance JW Jr, Schoepf UJ, Wollschlaeger D, Schoenberg SO, Fink C.

Abstract
OBJECTIVE: The purpose of this article is to assess aortic root and iliofemoral vessel anatomy and the frequency of clinically significant incidental findings on aortoiliac CT angiography (CTA) performed for planning of transcutaneous aortic valve implantation.
MATERIALS AND METHODS: Aortoiliac CTA studies of 207 patients scheduled for transcutaneous aortic valve implantation were analyzed. Anatomic dimensions relevant to the interventional procedure, including diameter of the aortic annulus and sinus of Valsalva, distance between aortic annulus and coronary ostia, coronary leaflet length, left ventricular outflow tract diameter, and vessel diameter of iliac arteries, were analyzed. Clinically significant incidental findings were recorded.
RESULTS: The mean (± SD) maximum and minimum diameters of the aortic annulus were 29 ± 3.9 mm and 23.5 ± 4.1 mm, respectively. The mean distances between aortic annulus and the ostium of the left and right coronary artery were 13.5 ± 3.2 mm and 14.8 ± 3.9 mm, respectively. The mean maximum and minimum diameters of the left ventricular outflow tract were 27 ± 4 mm and 1.9 ± 4 mm, respectively. The mean diameter of the sinus of Valsalva was 33.4 ± 5.1 mm. The mean diameters of the right and left external iliac artery were 8 ± 1 and 8 ± 2 mm, respectively. Almost half the patients (101/207) had clinically significant incidental findings, including noncalcified pulmonary nodules larger than 8 mm (n = 7), pulmonary embolism (n = 3), or aortic aneurysm (n = 12).
CONCLUSION: Aortoiliac CTA provides relevant information on aortic root and iliofemoral vessel anatomy for preinterventional planning. CTA reveals clinically significant incidental findings in a high number of patients considered for transcutaneous aortic valve implantation, which may have a significant impact on patient selection.

J Vasc Interv Radiol. 2012 Apr 9. [Epub ahead of print]

Dynamic CT Angiography after Abdominal Aortic Endovascular Aneurysm Repair: Differences in Contrast Agent Dynamics in the Aorta and Endoleaks-Preliminary Results.

Lehmkuhl L, Andres C, Lücke C, Foldyna B, Grothoff M, Scheinert D, Nitzsche S, Gutberlet M.

Abstract
PURPOSE: To assess differences in aortic and endoleak enhancement in patients after endovascular aneurysm repair (EVAR) with dynamic computed tomography (CT) angiography.
MATERIALS AND METHODS: Twenty-one consecutive patients (mean age, 74.5 y ± 6; range, 61-88 y) with endoleaks after EVAR of the abdominal aorta were examined on a second-generation dual-source CT unit with 10 unidirectional scan phases (temporal resolution, 5 s; 80 kV; 120 reference-mAs; z-axis field of view, 283 mm), followed by a venous scan phase. Enhancement was assessed in aorta and endoleaks for all phases by density measurements. The diagnostic reliability of endoleak detection was assessed on a five-point confidence scale.
RESULTS: In total, 26 endoleaks (type I, n = 1; type II, n = 25) were detected. The highest detection rate was found in phase 5 (22 s after threshold; $P < .01$ vs other dynamic phases). Mean peak aortic enhancement (560 HU ± 96) was present in an early arterial phase (phase 3, 12 s after threshold), whereas the mean peak endoleak enhancement (398

HU ± 174) for type II endoleaks was present later, in phase 4 (17 s after threshold). Despite perceived high diagnostic confidence in phases 1 and 2 (ie, typical arterial phase of biphasic CT protocol), only 23% and 62% of endoleaks were detected, respectively, whereas peak diagnostic confidence (phases 4 and 5) corresponded well with the maximum endoleak detection rate but decreased significantly in later phases (ie, 6-10).
CONCLUSIONS: Preliminary dynamic CT angiography results in post-EVAR follow-up revealed notably different peaks of endoleak and aortic enhancement, which are not covered sufficiently by conventional biphasic CT protocols. Phase 5 demonstrated the highest type II endoleak detection rate, with high diagnostic confidence.

Myokardperfusion / FFR_{CT}

Circ Cardiovasc Imaging. 2012 Sep 1;5(5):587-95. Epub 2012 Aug 10.

Aligning Coronary Anatomy and Myocardial Perfusion Territories: An Algorithm for the CORE320 Multicenter Study.

Cerci RJ, Arbab-Zadeh A, George RT, Miller JM, Vavere AL, Mehra V, Yoneyama K, Texter J, Foster C, Guo W, Cox C, Brinker J, Di Carli M, Lima JA.

Abstract
Background- Appropriate clinical decisions concerning diagnosis and treatment of coronary artery disease rely on correct integration of data on coronary anatomy and myocardial perfusion. The purpose of this article is to introduce a new left ventricular segmentation model for improved alignment of coronary arterial segments and myocardial perfusion territories, designed for the CORE320 study. Methods and Results- CORE320 is a prospective, multicenter study with a primary objective to evaluate the diagnostic accuracy of 320-row detector computed tomography (CT) to detect coronary artery luminal stenosis and corresponding myocardial perfusion deficits in patients with suspected coronary artery disease compared with the gold standard of conventional coronary angiography and single-photon emission CT myocardial perfusion imaging. We describe a 19-coronary segment and 13-myocardial territory alignment model, its application in both standard and CT image data sets, and the adjudication process of the initial cohort of patients recruited for the CORE320 study. Adjudication committees reviewed the images of the first 101 gold standard and 107 CT data sets. On the basis of the presented model and rules, all cases for adjudication were correctly identified. During image review, 6 (5.9%) gold standard and 9 (8.4%) CT data sets needed further realignment not triggered by the algorithm. Conclusions- We present a vascular territory distribution model developed for the CORE320 multicenter study, which accounts for variability in coronary anatomy and potential myocardial perfusion territory overlap. Clinical Trial Registration- URL: http://www.clinicaltrials.gov. Unique identifier: NCT00934037.

JAMA. 2012 Sep 26;308(12):1237-45.

Diagnostic accuracy of fractional flow reserve from anatomic CT angiography.

Min JK, Leipsic J, Pencina MJ, Berman DS, Koo BK, van Mieghem C, Erglis A, Lin FY, Dunning AM, Apruzzese P, Budoff MJ, Cole JH, Jaffer FA, Leon MB, Malpeso J, Mancini GB, Park SJ, Schwartz RS, Shaw LJ, Mauri L.

Abstract
CONTEXT: Coronary computed tomographic (CT) angiography is a noninvasive anatomic test for diagnosis of coronary stenosis that does not determine whether a stenosis causes ischemia. In contrast, fractional flow reserve (FFR) is a physiologic measure of coronary stenosis expressing the amount of coronary flow still attainable despite the presence of a stenosis, but it requires an invasive procedure. Noninvasive FFR computed from CT (FFR(CT)) is a novel method for determining the physiologic significance of coronary artery disease (CAD), but its ability to identify ischemia has not been adequately examined to date.
OBJECTIVE: To assess the diagnostic performance of FFR(CT) plus CT for diagnosis of hemodynamically significant coronary stenosis.
DESIGN, SETTING, AND PATIENTS: Multicenter diagnostic performance study involving 252 stable patients with suspected or known CAD from 17 centers in 5 countries who underwent CT, invasive coronary angiography (ICA), FFR, and FFR(CT) between October 2010 and October 2011. Computed tomography, ICA, FFR, and FFR(CT) were interpreted in blinded fashion by independent core laboratories. Accuracy of FFR(CT) plus CT for diagnosis of ischemia was compared with an invasive FFR reference standard. Ischemia was defined by an FFR or FFR(CT) of 0.80 or less, while anatomically obstructive CAD was defined by a stenosis of 50% or larger on CT and ICA.
MAIN OUTCOME MEASURES: The primary study outcome assessed whether FFR(CT) plus CT could improve the per-patient diagnostic accuracy such that the lower boundary of the 1-sided 95% confidence interval of this estimate exceeded 70%.
RESULTS: Among study participants, 137 (54.4%) had an abnormal FFR determined by ICA. On a per-patient basis, diagnostic accuracy, sensitivity, specificity, positive predictive value, and negative predictive value of FFR(CT) plus CT were 73% (95% CI, 67%-78%), 90% (95% CI, 84%-95%), 54% (95% CI, 46%-83%), 67% (95% CI, 60%-74%), and 84% (95% CI, 74%-90%), respectively. Compared with obstructive CAD diagnosed by CT alone (area under the receiver operating characteristic curve [AUC], 0.68; 95% CI, 0.62-0.74), FFR(CT) was associated with improved discrimination (AUC, 0.81; 95% CI, 0.75-0.86; P < .001).

CONCLUSION: Although the study did not achieve its prespecified primary outcome goal for the level of per-patient diagnostic accuracy, use of noninvasive FFR(CT) plus CT among stable patients with suspected or known CAD was associated with improved diagnostic accuracy and discrimination vs CT alone for the diagnosis of hemodynamically significant CAD when FFR determined at the time of ICA was the reference standard.

Eur Heart J Cardiovasc Imaging. 2012 Jul 26. [Epub ahead of print]

Quantification of myocardial blood flow by adenosine-stress CT perfusion imaging in pigs during various degrees of stenosis correlates well with coronary artery blood flow and fractional flow reserve.

Rossi A, Uitterdijk A, Dijkshoorn M, Klotz E, Dharampal A, van Straten M, van der Giessen WJ, Mollet N, van Geuns RJ, Krestin GP, Duncker DJ, de Feyter PJ, Merkus D.

Abstract

AIMS: Only few preliminary experimental studies demonstrated the feasibility of adenosine stress CT myocardial perfusion imaging to calculate the absolute myocardial blood flow (MBF), thereby providing information whether a coronary stenosis is flow limiting. Therefore, the aim of our study was to determine whether adenosine stress myocardial perfusion imaging by Dual Source CT (DSCT) enables non-invasive quantification of regional MBF in an animal model with various degrees of coronary flow reduction.

METHODS AND RESULTS: In seven pigs, a coronary flow probe and an adjustable hydraulic occluder were placed around the left anterior descending coronary artery to monitor the distal coronary artery blood flow (CBF) while several degrees of coronary flow reduction were induced. CT perfusion (CT-MBF) was acquired during adenosine stress with no CBF reduction, an intermediate (15-39%) and a severe (40-95%) CBF reduction. Reference standards were CBF and fractional flow reserve measurements (FFR). FFR was simultaneously derived from distal coronary artery pressure and aortic pressure measurements. CT-MBF decreased progressively with increasing CBF reduction severity from 2.68 (2.31-2.81)mL/g/min (normal CBF) to 1.96 (1.83-2.33) mL/g/min (intermediate CBF-reduction) and to 1.55 (1.14-2.06)mL/g/min (severe CBF-reduction) (both $P < 0.001$). We observed very good correlations between CT-MBF and CBF ($r = 0.85$, $P < 0.001$) and CT-MBF and FFR ($r = 0.85$, $P < 0.001$).

Am J Cardiol. 2012 Oct 1;110(7):971-6. Epub 2012 Jun 29.

Usefulness of noninvasive fractional flow reserve computed from coronary computed tomographic angiograms for intermediate stenoses confirmed by quantitative coronary angiography.

Min JK, Koo BK, Erglis A, Doh JH, Daniels DV, Jegere S, Kim HS, Dunning AM, Defrance T, Lansky A, Leipsic J.

Abstract

Coronary lesions of intermediate severity often cause ischemia, and fractional flow reserve (FFR)-guided revascularization for these coronary lesions is safe and effective. FFR derived from coronary computed tomography (FFR(CT)) is a noninvasive method for diagnosis of lesion-specific ischemia, but its performance for intermediate stenoses has not been examined to date. We examined the performance of FFR(CT) versus FFR at the time of invasive angiography in 66 vessels of 60 patients who were identified as having an intermediate stenosis, defined by quantitative coronary angiographic percent diameter stenosis 40% to 69%. Ischemia for FFR(CT) and FFR was defined as ≤0.80. Diagnostic performance of FFR(CT) was determined compared to an invasive FFR standard. Mean age of the study group was 63.5 ± 8.1 years (81% men). Thirty-one patients (47%) demonstrated ischemia with an FFR ≤0.80, with 2 of 16 (12.5%), 21 of 37 (56.8%), and 8 of 13 (61.5%) lesions of 40% to 49%, 50% to 59%, and 60% to 69% stenosis causal of ischemia, respectively. At an FFR ≤0.80 cutoff for lesion-specific ischemia, accuracy, sensitivity, specificity, positive predictive value, and negative predictive value of FFR(CT) were 86.4%, 90.3%, 82.9%, 82.4%, and 90.6%, respectively, with an area under the receiver operator characteristics curve of 0.95 ($p < 0.001$) and good correlation to FFR (0.60, $p < 0.0001$). No biases between FFR(CT) and FFR were noted by Bland-Altman analysis (0.03 ± 0.12, $p = 0.054$). In conclusion, FFR(CT) is a novel noninvasive method for diagnosis of lesion-specific ischemia of coronary lesions of intermediate stenosis severity.

J Cardiovasc Comput Tomogr. 2012 May;6(3):191-9. Epub 2012 Apr 27.

Effect of image quality on diagnostic accuracy of noninvasive fractional flow reserve: results from the prospective multicenter international DISCOVER-FLOW study.

Min JK, Koo BK, Erglis A, Doh JH, Daniels DV, Jegere S, Kim HS, Dunning A, Defrance T, Leipsic J.

Abstract

BACKGROUND: Fractional flow reserve calculated from coronary CT (FFR(CT)) is a novel method for determining lesion-specific ischemia.

OBJECTIVE: To assess the effect of CT quality on accuracy of FFR(CT), we compared performance of FFR(CT) with severe stenosis by CT in relation to image quality; heart rate; signal-to-noise ratio (SNR); and common CT artifacts, including calcification, motion, and poor contrast enhancement.

METHODS: FFR(CT) was performed on 159 vessels in 103 patients undergoing CT, FFR(CT), and FFR. Ischemia was defined as FFR(CT) and FFR ≤ 0.80, and severe stenosis by CT was defined by ≥50% reduction in luminal diameter. FFR(CT) and CT stenosis were compared with FFR, which served as the reference.

RESULTS: On a vessel basis, accuracy of FFR(CT) was higher than CT stenosis for satisfactory or poor quality CTs (87.5% vs 64.6%), for heart rates > 65 beats/min (100% vs 52.9%), and for SNR less than the median (26.3) (84.4% vs 64.1%). Accuracy of FFR(CT) was superior to CT stenosis in the presence of calcification (85.7% vs 66.7%), motion (90.5% vs 57.1%), and poor contrast opacification (100.0% vs 71.4%). Similar relations were observed for exploratory analyses of FFR(CT) and CT stenosis on a patient basis. In 42 subjects who underwent coronary calcium scanning, accuracy of FFR(CT) was 77.8% (n = 18), 100% (n = 11), and 100% (n = 13) for coronary calcium scores of 0-100, 101-400, and >400, respectively.
CONCLUSIONS: Accuracy of FFR(CT) is superior to CT stenosis for determining lesion-specific ischemia. The performance of FFR(CT) remains robust across an array of factors known to adversely affect CT quality.

Int J Cardiovasc Imaging. 2012 Jun 20. [Epub ahead of print]

Optimal timing for first-pass stress CT myocardial perfusion imaging.

Bischoff B, Bamberg F, Marcus R, Schwarz F, Becker HC, Becker A, Reiser M, Nikolaou K.

Abstract
CT-based myocardial perfusion imaging (CTP) has been shown to accurately detect myocardial perfusion defects when compared to SPECT. When performing single-phase first-pass stress CTP, timing is of major importance. The aim of this study was to provide guidance for optimal timing of single-phase first-pass stress CTP acquisitions. 16 patients (12 male, age, 69 ± 8 years) with known or suspected coronary artery disease underwent invasive coronary angiography with fractional flow reserve (FFR) measurements using a pressure wire as well as a time-resolved CTP protocol under adenosine stress, performed on a dual-Source CT scanner over a period of 30 s. From the CTP data, time-attenuation curves have been determined both in known ischemic myocardium with a corresponding coronary artery stenosis as proven by a FFR below 0.75 in invasive coronary angiography, as well as in non-ischemic reference myocardium during pharmacological stress. Furthermore, contrast enhancement in the ascending aorta was determined. The time point for an optimal contrast (i.e., difference in Hounsfield Units, HU) between ischemic and normal myocardium was determined. Under pharmacological stress using adenosine, a maximum mean HU difference between ischemic and non-ischemic myocardium (17.7-22.5 HU) was observed 24-32 s after injection of contrast medium. The maximal attenuation difference between normal and ischemic myocardium ranged from 15 to 77 HU in the analyzed patient cohort. When applying a bolus-tracking technique with an automatic contrast detection in the proximal ascending aorta, the optimal time frame for stress CTP was between 8 and 16 s after contrast enhancement in the aorta exceeds 100 HU, or between 7 and 15 s using a threshold of 150 HU. For first-pass CT myocardial perfusion imaging there is a time frame of approximately 8 s for optimal differentiation of ischemic and non-ischemic myocardium, which will be helpful to optimize single-phase CTP scans.

J Cardiovasc Transl Res. 2011 Aug;4(4):437-48. Epub 2011 Jun 14.

CT-based myocardial perfusion imaging-practical considerations: acquisition, image analysis, interpretation, and challenges.

Mehra VC, Ambrose M, Valdiviezo-Schlomp C, Schuleri KH, Lardo AC, Lima JA, George RT.

Abstract
Methods for non-invasive, cardiac risk assessment have historically relied on exercise stress testing with or without echocardiography or radionuclide imaging and pharmacological stress testing when appropriate. More recently, CT-based modalities like CT angiography (CTA) have been shown to reliably differentiate low from high-risk coronary disease. The advent of newer CT technology now allows for CT-based myocardial perfusion imaging (CTP) that provides functional information, that when analyzed with anatomic data from CTA, can provide a comprehensive risk assessment strategy. In this review, we discuss the research and implementation; as well as the quantitative, semiquantitative, and qualitative methods of image analysis of CT-based perfusion. We also discuss the present state of technology and challenges associated with the methodology. In each section, when appropriate, we provide some information regarding the translation of these methods being utilized in the international, multicenter CORE320 study that is evaluating the combined CT-based imaging (CTA and CTP) strategy of risk assessment in comparison to the combined reference standard of radionuclide myocardial perfusion imaging and invasive angiography.

Circ Cardiovasc Imaging. 2012 Mar 23. [Epub ahead of print]

Computed Tomography Myocardial Perfusion Imaging with 320-Row Detector CT Accurately Detects Myocardial Ischemia in Patients with Obstructive Coronary Artery Disease.

George RT, Arbab-Zadeh A, Miller JM, Vavere AL, Bengel FM, Lardo AC, Lima JA.

Abstract
BACKGROUND: Computed tomography coronary angiography (CTA) has been shown to be accurate in detecting anatomic coronary arterial obstruction, but is limited for the detection of myocardial ischemia. The primary aim of this study was to assess the accuracy of 320-row CT perfusion imaging (CTP) to detect atherosclerosis causing myocardial ischemia.
METHODS AND RESULTS: Fifty symptomatic patients with recent single photon emission computed tomography myocardial perfusion imaging (SPECT-MPI) underwent a comprehensive cardiac CT protocol that included 320-CTA

followed by adenosine stress CTP. CTP images were analyzed quantitatively for the presence of subendocardial perfusion deficits. All analyses were blinded to imaging and clinical results. CTA alone was a limited predictor of myocardial ischemia compared with SPECT with a sensitivity, specificity, positive (PPV) and negative predictive value (NPV) of 56%, 75%, 56%, 75%, and the AUC was 0.65 (95%CI: 0.51-0.78, p=0.07). CTP was a better predictor of myocardial ischemia with a sensitivity, specificity, PPV, and NPV of 72%, 91%, 81%, 85%, with an AUC of 0.81 (95%CI: 0.68-0.91, p<0.001) and was an excellent predictor of myocardial ischemia on SPECT-MPI in the presence of stenosis (≥50% on CTA) with a sensitivity, specificity, PPV, and NPV of 100%, 81%, 50%, 100%, with an AUC of 0.92 (95%CI: 0.80-0.97, p<0.001). The radiation dose for the comprehensive cardiac CT protocol and SPECT were 13.8±2.9 and 13.1±1.7; respectively (p=0.15).
CONCLUSIONS: CTP imaging with rest and adenosine stress 320-row CT is accurate in detecting obstructive atherosclerosis causing myocardial ischemia.

J Cardiovasc Comput Tomogr. 2011 Nov-Dec;5(6):345-56. Epub 2011 Oct 24.

CT stress myocardial perfusion imaging using multidetector CT - A review.

Ko BS, Cameron JD, Defrance T, Seneviratne SK.

Abstract
Computed tomography coronary angiography (CTA) accurately detects and excludes coronary artery disease (CAD); however, the physiological significance of coronary artery lesions may be uncertain. CT myocardial perfusion imaging (CTP) acquired during vasodilator stress provides a novel and emerging method for detection of myocardial ischemia. Multiple studies have established the feasibility of CTP and suggested its incremental value when used in combination with CTA in the identification of hemodynamically significant stenoses as compared with CTA alone. Despite these encouraging clinical data, CT perfusion assessment is in its infancy, as further research is required to validate and optimize this new technique. Combined CTA/CTP imaging has significant potential, as it offers the convenience of assessing both coronary anatomy and myocardial perfusion in one single examination at a radiation dose equivalent to contemporary nuclear medicine imaging. In this review, we provide an overview of the fundamentals of CT perfusion imaging, recent advances in scanner types and imaging techniques and protocols, and current literature on the accuracy of CTP, concluding with its future challenges and directions.

AJR Am J Roentgenol. 2012 Mar;198(3):521-9.

Adenosine-stress dynamic myocardial perfusion imaging with second-generation dual-source CT: comparison with conventional catheter coronary angiography and SPECT nuclear myocardial perfusion imaging.

Wang Y, Qin L, Shi X, Zeng Y, Jing H, Schoepf UJ, Jin Z.

Abstract
OBJECTIVE: The purpose of this article is to evaluate the feasibility of adenosine-stress dynamic myocardial perfusion imaging (MPI) with 128-MDCT dual-source CT for detecting myocardial ischemia in comparison with conventional catheter coronary angiography and nuclear MPI.
SUBJECTS AND METHODS: Thirty patients (21 men and nine women; mean [± SD] age, 59.2 ± 7.6 years) prospectively underwent a combined stress CT perfusion and CT angiography (CTA) examination. Complete time-attenuation curves of the myocardium were acquired with prospectively ECG-triggered axial images at two alternating positions. Myocardial blood flow (MBF) was quantified according to dynamic CT perfusion, and MBF values of normal and abnormal segments were compared. Findings on CT perfusion were compared with those for stress and rest SPECT. Perfusion defects according to CT were correlated to flow-obstructing stenosis detected on CTA and catheter coronary angiography.
RESULTS: On stress CT perfusion, 19 patients (63%) and 83 of 504 segments (16%) had perfusion abnormalities. There was a significant difference in MBF values between normal (142.9 ± 30.6 mL/100 mL/min) and hypoperfused (90.0 ± 22.8 mL/100 mL/min) segments (p < 0.001). With nuclear MPI results as a comparison, the sensitivity, specificity, positive predictive value, and negative predictive value of CT perfusion for identifying segments with perfusion defects were 0.85, 0.92, 0.55, and 0.98, respectively. On a per-vessel basis, sensitivity, specificity, positive predictive value, and negative predictive value for detecting flow-obstructing stenosis were, respectively, 1.00, 0.757, 0.541, and 1.00 for CT perfusion; 0.90, 0.514, 0.346, and 0.947 for CTA; and 0.90, 0.814, 0.581, and 0.966 for CT perfusion combined with CTA.
CONCLUSION: Adenosine-stress CT perfusion detects myocardial perfusion defects in good correlation with nuclear MPI. CT perfusion combined with CTA improves the diagnostic accuracy for identifying flow-obstructing stenosis compared with CTA alone.

Lungenembolie

Eur J Radiol. 2012 Apr 9. [Epub ahead of print]

Prognostic value of perfusion defect volume at dual energy CTA in patients with pulmonary embolism: Correlation with CTA obstruction scores, CT parameters of right ventricular dysfunction and adverse clinical outcome.

Apfaltrer P, Bachmann V, Meyer M, Henzler T, Barraza JM, Gruettner J, Walter T, Schoepf UJ, Schoenberg SO, Fink C.

Abstract

PURPOSE: To investigate the prognostic value of perfusion defect volume (PDvol) at dual-energy-CT-angiography (DE-CTA) in patients with acute pulmonary embolism (PE) by correlating PDvol with CTA-obstruction-scores (OS), CT parameters of right-ventricular-dysfunction (RVD), and adverse-clinical-outcome.

MATERIALS AND METHODS: DE-CTA of 60 patients (mean age: 65±14.4 years) with PE were analyzed. Iodine maps were generated, and normalized PDvol - defined as volume of perfusion defects/total lung volume - was quantified. Furthermore, established prognostic parameters (Qanadli and Mastora-OS, and CT parameters of RVD) were obtained. CT parameters of RVD - namely the right ventricle/left ventricle (RV/LV) diameter ratio measured on transverse sections (RV/LVtrans), four-chamber views (RV/LV4ch), and RV/LV volume ratios (RV/LVvol) - were assessed. PDvol was correlated with OS, CT parameters of RVD and adverse clinical outcome (defined as the need for intensive care treatment or death).

RESULTS: 10 of 60 patients with PE experienced adverse clinical outcome. Patients with adverse clinical outcome showed significantly higher PDvol (35±11% vs. 23±10%, p=0.002), RV/LV ratios (RV/LV4ch 1.46±0.32 vs. 1.18±0.26, p=0.005; RV/LVvol 2.25±1.33 vs. 1.19±0.56, p=0.002) and higher Mastora global scores (52 vs. 13, p=0.02) compared to those without adverse clinical outcome. A weak correlation was observed between PDvol and the Mastora global score (r=0.5; p=0.0003), as well as between PDvol and RV/LV4Ch (r=0.432, p=0.0006). No correlation was found between PDvol and the Qanadli score or the remainder of the RVD-CT parameters.

CONCLUSION: The extent of perfusion defects as assessed by DE-CTA correlates with adverse clinical outcome in patients with PE. Therefore, volumetric quantification of perfusion defects at DE-CTA allows the identification of low-risk patients who do not require intensified monitoring and treatment.

Circ Cardiovasc Imaging. 2012 Jan;5(1):147-54. Epub 2011 Dec 16.

Reference values for normal pulmonary artery dimensions by noncontrast cardiac CT: the Framingham Heart Study.

Truong QA, Massaro JM, Rogers IS, Mahabadi AA, Kriegel MF, Fox CS, O'Donnell CJ, Hoffmann U.

Abstract

BACKGROUND: Main pulmonary artery diameter (mPA) and ratio of mPA to ascending aorta diameter (ratio PA) derived from chest CT are commonly reported in clinical practice. We determined the age- and sex-specific distribution and normal reference values for mPA and ratio PA by CT in an asymptomatic community-based population.

METHODS AND RESULTS: In 3171 men and women (mean age, 51±10 years; 51% men) from the Framingham Heart Study, a noncontrast, ECG-gated, 8-slice cardiac multidetector CT was performed. We measured the mPA and transverse axial diameter of the ascending aorta at the level of the bifurcation of the right pulmonary artery and calculated the ratio PA. We defined the healthy referent cohort (n=706) as those without obesity, hypertension, current and past smokers, chronic obstructive pulmonary disease, history of pulmonary embolism, diabetics, cardiovascular disease, and heart valve surgery. The mean mPA diameter in the overall cohort was 25.1±2.8 mm and mean ratio PA was 0.77±0.09. The sex-specific 90th percentile cutoff value for mPA diameter was 28.9 mm in men and 26.9 mm in women and was associated with increase risk for self-reported dyspnea (adjusted odds ratio, 1.31; P=0.02). The 90th percentile cutoff value for ratio PA of the healthy referent group was 0.91, similar between sexes but decreased with increasing age (range, 0.82-0.94), though not associated with dyspnea.

CONCLUSIONS: For simplicity, we established 29 mm in men and 27 mm in women as sex-specific normative reference values for mPA and 0.9 for ratio PA.

Methodik

Radiology. 2012 Oct;265(1):70-7. Epub 2012 Jul 6.

Interplatform Reproducibility of CT Coronary Calcium Scoring Software.

Weininger M, Ritz KS, Schoepf UJ, Flohr TG, Vliegenthart R, Costello P, Hahn D, Beissert M.

Abstract

Purpose: To investigate whether coronary artery calcium (CAC) scoring performed on three different workstations generates comparable and thus vendor-independent results. Materials and Methods: Institutional review board and Federal Office for Radiation Protection approval were received, as was each patient's written informed consent. Fifty-nine patients (37 men, 22 women; mean age, 57 years ± 3 [standard deviation]) underwent CAC scoring with use of

64-section multidetector computed tomography (CT) with retrospective electrocardiographic gating (one examination per patient). Data sets were created at 10% increments of the R-R interval from 40%-80%. Two experienced observers in consensus calculated Agatston and volume scores for all data sets by using the calcium scoring software of three different workstations. Comparative analysis of CAC scores between the workstations was performed by using regression analysis, Spearman rank correlation (r(s)), and the Kruskal-Wallis test. Results: Each workstation produced different absolute numeric results for Agatston and volume scores. However, statistical analysis revealed excellent correlation between the workstations, with highest correlation at 60% of the R-R interval (minimal r(s) = 0.998; maximal r(s) = 0.999) for both scoring methods. No significant differences were detected for Agatston and volume score results between the software platforms. At analysis of individual reconstruction intervals, each workstation demonstrated the same score variability, with the consequence that 12 of 59 patients were assigned to divergent cardiac risk groups by using at least one of the workstations. Conclusion: While mere numeric values might be different, commercially available software platforms produce comparable CAC scoring results, which suggests a vendor-independence of the method; however, none of the analyzed software platforms appears to provide a distinct advantage for risk stratification, as the variability of CAC scores depending on the reconstruction interval persists across platforms. Supplemental material: http://radiology.rsna.org/lookup/suppl/doi:10.1148/radiol.12112532/-/DC1.

Eur Radiol. 2012 Sep 16. [Epub ahead of print]

Image quality of ultra-low radiation exposure coronary CT angiography with an effective dose <0.1 mSv using high-pitch spiral acquisition and raw data-based iterative reconstruction.

Schuhbaeck A, Achenbach S, Layritz C, Eisentopf J, Hecker F, Pflederer T, Gauss S, Rixe J, Kalender W, Daniel WG, Lell M, Ropers D.

Abstract

OBJECTIVES: We evaluated the potential of prospectively ECG-triggered high-pitch spiral acquisition with low tube voltage and current in combination with iterative reconstruction to achieve coronary CT angiography with sufficient image quality at an effective dose below 0.1 mSv.

METHODS: Contrast-enhanced coronary dual source CT angiography (2□×□128□×□0.6 mm, 80 kV, 50 mAs) in prospectively ECG-triggered high-pitch spiral acquisition mode was performed in 21 consecutive individuals (body weight <100 kg, heart rate ≤60/min). Images were reconstructed with raw data-based filtered back projection (FBP) and iterative reconstruction (IR). Image quality was assessed on a 4-point scale (1 = no artefacts, 4 = unevaluable).

RESULTS: Mean effective dose was 0.06□±□0.01 mSv. Image noise was significantly reduced in IR (128.9□±□46.6 vs. 158.2□±□44.7 HU). The mean image quality score was lower for IR (1.9□±□1.1 vs. 2.2□±□1.0, P□<□0.0001). Of 292 coronary segments, 55 in FBP and 40 in IR (P□=□0.12) were graded "unevaluable". In patients with a body weight ≤75 kg, both in FBP and in IR, the rates of fully evaluable segments were significantly higher in comparison to patients >75 kg.

CONCLUSIONS: Coronary CT angiography with an estimated effective dose <0.1 mSv may provide sufficient image quality in selected patients through the combination of high-pitch spiral acquisition and raw data-based iterative reconstruction.

KEY POINTS: Coronary CT angiography with an estimated effective dose <0.1 mSv is possible. • Combination of high-pitch spiral acquisition with iterative reconstruction achieves sufficient image quality. • Diagnostic accuracy remains to be assessed in future trials.

Am J Epidemiol. 2012 Sep 15;176(6):473-81. Epub 2012 Aug 8.

Interpreting incremental value of markers added to risk prediction models.

Pencina MJ, D'Agostino RB, Pencina KM, Janssens AC, Greenland P.

Abstract

The discrimination of a risk prediction model measures that model's ability to distinguish between subjects with and without events. The area under the receiver operating characteristic curve (AUC) is a popular measure of discrimination. However, the AUC has recently been criticized for its insensitivity in model comparisons in which the baseline model has performed well. Thus, 2 other measures have been proposed to capture improvement in discrimination for nested models: the integrated discrimination improvement and the continuous net reclassification improvement. In the present study, the authors use mathematical relations and numerical simulations to quantify the improvement in discrimination offered by candidate markers of different strengths as measured by their effect sizes. They demonstrate that the increase in the AUC depends on the strength of the baseline model, which is true to a lesser degree for the integrated discrimination improvement. On the other hand, the continuous net reclassification improvement depends only on the effect size of the candidate variable and its correlation with other predictors. These measures are illustrated using the Framingham model for incident atrial fibrillation. The authors conclude that the increase in the AUC, integrated discrimination improvement, and net reclassification improvement offer complementary information and thus recommend reporting all 3 alongside measures characterizing the performance of the final model.

BMC Med Imaging. 2012 Jul 2;12:14.

An alternative method for quantifying coronary artery calcification: the multi-ethnic study of atherosclerosis (MESA).

Liang CJ, Budoff MJ, Kaufman JD, Kronmal RA, Brown ER.

Abstract

BACKGROUND: Extent of atherosclerosis measured by amount of coronary artery calcium (CAC) in computed tomography (CT) has been traditionally assessed using thresholded scoring methods, such as the Agatston score (AS). These thresholded scores have value in clinical prediction, but important information might exist below the threshold, which would have important advantages for understanding genetic, environmental, and other risk factors in atherosclerosis. We developed a semi-automated threshold-free scoring method, the spatially weighted calcium score (SWCS) for CAC in the Multi-Ethnic Study of Atherosclerosis (MESA).

METHODS: Chest CT scans were obtained from 6814 participants in the Multi-Ethnic Study of Atherosclerosis (MESA). The SWCS and the AS were calculated for each of the scans. Cox proportional hazards models and linear regression models were used to evaluate the associations of the scores with CHD events and CHD risk factors. CHD risk factors were summarized using a linear predictor.

RESULTS: Among all participants and participants with AS > 0, the SWCS and AS both showed similar strongly significant associations with CHD events (hazard ratios, 1.23 and 1.19 per doubling of SWCS and AS; 95% CI, 1.16 to 1.30 and 1.14 to 1.26) and CHD risk factors (slopes, 0.178 and 0.164; 95% CI, 0.162 to 0.195 and 0.149 to 0.179). Even among participants with AS = 0, an increase in the SWCS was still significantly associated with established CHD risk factors (slope, 0.181; 95% CI, 0.138 to 0.224). The SWCS appeared to be predictive of CHD events even in participants with AS = 0, though those events were rare as expected.

CONCLUSIONS: The SWCS provides a valid, continuous measure of CAC suitable for quantifying the extent of atherosclerosis without a threshold, which will be useful for examining novel genetic and environmental risk factors for atherosclerosis.

Eur Radiol. 2012 Jul;22(7):1529-36. Epub 2012 Mar 27.

Interobserver agreement for the detection of atherosclerotic plaque in coronary CT angiography: comparison of two low-dose image acquisition protocols with standard retrospectively ECG-gated reconstruction.

Schuhbäck A, Marwan M, Gauss S, Muschiol G, Ropers D, Schneider C, Lell M, Rixe J, Hamm C, Daniel WG, Achenbach S.

Abstract

BACKGROUND: We compared the interobserver variability concerning the detection of calcified and non-calcified plaque in two different low-dose and standard retrospectively gated protocols for coronary CTA.

METHODS: 150 patients with low heart rates and less than 100 kg body weight were randomised and examined by contrast-enhanced dual-source CT coronary angiography (100 kV, 320 mAs). 50 patients were examined with prospectively ECG-triggered axial acquisition, 50 patients with prospectively ECG-triggered high pitch spiral acquisition, and 50 patients using spiral acquisition with retrospective ECG gating. Two investigators independently analysed the datasets concerning the presence of calcified and non-calcified plaque on a per-segment level.

RESULTS: Mean effective dose was 1.4□±□0.2 mSv for axial, 0.8□±□0.07 mSv for high-pitch spiral, and 5.3□±□2.6 mSV for standard spiral acquisition (P□<□0.0001). In axial acquisition, interobserver agreement concerning the presence of atherosclerotic plaque was achieved in 650/749 coronary segments (86.8%). In high-pitch spiral acquisition, agreement was achieved in 664/748 segments (88.8%, n.s.). In standard spiral acquisition, agreement was achieved in 672/738 segments (91.0%, P□<□0.0001). Interobserver agreement was significantly higher for calcified than for non-calcified plaque in all data acquisition modes.

CONCLUSION: Low-dose coronary CT angiography permits the detection of coronary atherosclerotic plaque with good interobserver agreement.

KEY POINTS: Low-dose CT protocols permit coronary plaque detection with good interobserver agreement. • Image noise is a major predictor of interobserver variability. • Interobserver agreement is significantly higher for calcified than for non-calcified plaque.

J Cardiovasc Comput Tomogr. 2012 Mar;6(2):91-8. Epub 2012 Jan 28.

Influence of heart rate and phase of the cardiac cycle on the occurrence of motion artifact in dual-source CT angiography of the coronary arteries.

Achenbach S, Manolopoulos M, Schuhbäck A, Ropers D, Rixe J, Schneider C, Krombach GA, Uder M, Hamm C, Daniel WG, Lell M.

Abstract

BACKGROUND: Coronary CT angiography allows visualization of the coronary arteries. However, motion artifact can impair delineation of the coronary artery lumen and detection of coronary artery stenoses.

OBJECTIVE: We investigated the influence of heart rate and the segment of the cardiac cycle during which images are reconstructed on the occurrence of motion artifacts.

METHODS: We evaluated coronary CT angiography datasets obtained by 64-slice dual-source CT in 100 consecutive patients. Data were reconstructed at 13 time instants during the cardiac cycle and evaluated for the presence of motion artifact.
RESULTS: Mean heart rate was 66±14 beats/min. Overall, 98 of 100 patients had evaluable datasets. For heart rates ≤60 beats/min, optimal image quality was uniformly found during late diastole (100% of cases with evaluable image quality during a time window between 65% and 75% of the cardiac cycle). With increasing heart rates, images reconstructed during late systole more frequently provided best image quality. However, image reconstruction could not be restricted to a systolic time period. To achieve evaluable image quality in 95% of cases, data acquired between 25% and 75% of the cardiac cycle had to be available for patients with heart rates >60 beats/min.
CONCLUSION: Dual-source CT provides high image quality across a wide range of heart rates. Although data acquisition may be limited to diastole for patients with heart rates ≤60 beats/min, the availability of data acquired both during systole and diastole is necessary for patients with higher heart rates.

Cardiol Clin. 2012 Feb;30(1):9-17. Epub 2011 Dec 2.

Minimizing radiation dose for coronary CT angiography.

Vorobiof G, Achenbach S, Narula J.

Abstract
Coronary CT angiography is a rapidly growing technique that offers distinct advantages over traditional imaging techniques. However, because of rapid growth of this technique, radiation dose safety has been placed under the spotlight. There are several main determinants of total radiation dose, and these are outlined in this review. Integration of these dose-saving techniques will go a long way in maintaining diagnostic image quality and improving patient safety.

Cardiol Clin. 2012 Feb;30(1):1-8. Epub 2011 Dec 9.

Technical advances in cardiac CT.

Achenbach S, Kondo T.

Abstract
Cardiac computed tomography (CT) and its main clinical application, coronary CT angiography, have made major progress during the past years. Advances were driven by progress in CT hardware technology and CT image reconstruction and processing software. Technical innovations have successfully been used to lower the radiation exposure of coronary CT angiography and to improve image quality, especially in challenging situations, such as individuals with high heart rates or severe calcification. Some of the most important recent contributions have been the development of area detectors, dual-source CT, and the introduction of iterative reconstruction algorithms.

AJR Am J Roentgenol. 2012 Apr;198(4):931-8.

Image Quality, Contrast Enhancement, and Radiation Dose of ECG-Triggered High-Pitch CT Versus Non-ECG-Triggered Standard-Pitch CT of the Thoracoabdominal Aorta.

Bolen MA, Popovic ZB, Tandon N, Flamm SD, Schoenhagen P, Halliburton SS.

Abstract
OBJECTIVE: We sought to compare image quality, contrast enhancement, and radiation dose in patients undergoing ECG-triggered high-pitch helical CT or non-ECG-synchronized helical CT of the thoracoabdominal aorta.
MATERIALS AND METHODS: We retrospectively assessed data from 101 consecutive patients (81 men, 20 women; mean age, 71 ± 11 [SD] years) undergoing clinically indicated CT angiography (CTA) of the thoracoabdominal aorta on a dual-source scanner using either the ECG-triggered high-pitch helical mode (group 1, n = 52) or non-ECG-synchronized standard-pitch helical mode (group 2, n = 49) during the arterial phase. Two independent readers assessed image quality, noise, and contrast enhancement throughout the thoracoabdominal aorta. Scanner-reported dose-length product values were used to estimate effective dose values.
RESULTS: Image quality at the root-proximal ascending level was higher in group 1 (mean ± SD, 2.81 ± 0.40) than in group 2 (1.22 ± 0.47; $p < 0.0001$), with similar quality for both groups noted at other levels. Group 1 scans displayed higher image noise at all levels. The groups received a similar volume of contrast material ($p = 0.77$), and similar percentages of cases with acceptable contrast enhancement (> 250 HU) were noted in the two groups. The estimated radiation burden was significantly lower in group 1 (mean ± SD, 5.4 ± 1.8 mSv) than in group 2 (14.4 ± 5.1 mSv; $p < 0.0001$).
CONCLUSION: Imaging of the thoracoabdominal aorta with ECG-triggered high-pitch CTA provides higher quality images of the aortic root and ascending aorta with sufficient contrast enhancement and decreased estimated radiation dose compared with non-ECG-synchronized standard-pitch helical CT.

Eur Heart J Cardiovasc Imaging. 2012 Sep;13(9):786-92. Epub 2012 Apr 17.

Measuring coronary artery calcification using positron emission tomography-computed tomography attenuation correction images.

Mylonas I, Kazmi M, Fuller L, Dekemp RA, Yam Y, Chen L, Beanlands RS, Chow BJ.

Abstract

AIMS: Cardiac computed tomography (CT) measured coronary artery calcium (CAC-CT) is a well-validated and accurate tool for estimating atherosclerotic burden and prognosis. Computed tomography attenuation correction (ACCT) obtained during cardiac positron emission tomography (PET) has been used to visually estimate CAC; however, quantification using a non-gated ACCT images has not been described. We sought to understand the relationship between CAC measured using cardiac computed tomography (CT) and CAC using ACCT images obtained during cardiac PET perfusion imaging.

METHODS AND RESULTS: Patients with both CAC-CT and cardiac PET within 6 months of each other were identified. CAC-CT images were scored using the Agatston scoring method, while ACCT images were scored using different attenuation thresholds for calcium. CAC-CT and ACCT scores were compared. Between August 2007 and October 2010, 91 patients were included in the analysis. Interobsever reliability was excellent at all thresholds of detection tested. Pearson correlation was strongest between CAC-CT and ACCT at 50 HU threshold of detection (ACCT(50)). Implementing CAC categories (0, 1-100, 101-400, >400), there was a high degree of agreement between observers as well as between CAC-CT and ACCT(50). Correlation was best for lower CAC scores; however, as CAC-CT increased, ACCT(50) underestimated CAC.

CONCLUSION: Quantifying CAC using ACCT images appears to be feasible and accurate. In a single cardiac PET examination, information regarding perfusion, LV function, flow quantification, and CAC can be obtained without additional radiation.

Emerg Radiol. 2012 Mar 27. [Epub ahead of print]

The iPad as a mobile device for CT display and interpretation: diagnostic accuracy for identification of pulmonary embolism.

Johnson PT, Zimmerman SL, Heath D, Eng J, Horton KM, Scott WW, Fishman EK.

Abstract

Recent software developments enable interactive, real-time axial, 2D and 3D CT display on an iPad by cloud computing from a server for remote rendering. The purpose of this study was to compare radiologists' interpretative performance on the iPad to interpretation on the conventional picture archive and communication system (PACS). Fifty de-identified contrast-enhanced CT exams performed for suspected pulmonary embolism were compiled as an educational tool to prepare our residents for night call. Two junior radiology attendings blindly interpreted the cases twice, one reader used the PACS first, and the other interpreted on the iPad first. After an interval of at least 2 weeks, the cases were reinterpreted in different order using the other display technique. Sensitivity, specificity, and accuracy for identification of pulmonary embolism were compared for each interpretation method. Pulmonary embolism was present in 25 patients, ranging from main pulmonary artery to subsegmental thrombi. Both readers interpreted 98 % of cases correctly regardless of display platform. There was no significant difference in sensitivity (98 vs 100 %, p=1.0), specificity (98 vs 96 %, p=1.0), or accuracy (98 vs 98 %, p=1.0) for interpretation with the iPad vs the PACS, respectively. CT interpretation on an iPad enabled accurate identification of pulmonary embolism, equivalent to display on the PACS. This mobile device has the potential to expand radiologists' availability for consultation and expedite emergency patient management.