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

B. Jiang [a], J. Wang [a,*], X. Lv [b], W. Cai [c]

[a] *Department of Radiology, BenQ Medical Center, Nanjing Medical University, 71 Hexi Street, Jianye District, Nanjing 210019, China*

[b] *Department of Interventional Radiology, BenQ Medical Center, Nanjing Medical University, 71 Hexi Street, Jianye District, Nanjing 210019, China*

[c] *Department of Cardiology, BenQ Medical Center, Nanjing Medical University, 71 Hexi Street, Jianye District, Nanjing 210019, China*

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

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

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

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

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Introduction

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

* Guarantor and correspondent: J. Wang, Department of Radiology, BenQ Medical Center, Nanjing Medical University, 71 Hexi Street, Jianye District, Nanjing 210019, China. Tel.: +86 025 52238800 6135.
E-mail address: fskwjc@126.com (J. Wang).

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

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

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

Materials and methods

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

Search strategy

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

Criteria for study inclusion

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

Data extraction and quality assessment

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

Data synthesis and statistical analysis

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

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

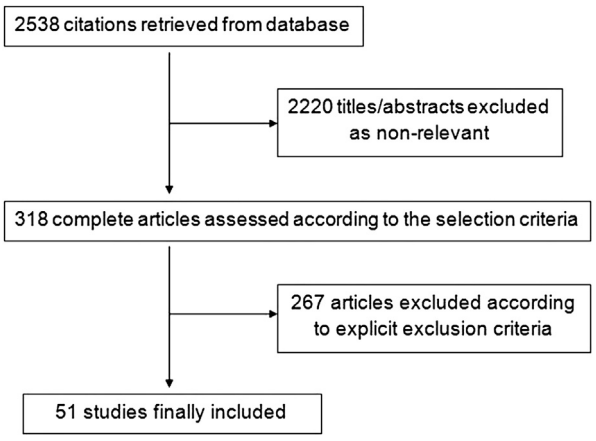


Figure 1 Flow diagram of the reviewing process.

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Cochran-Q test was used to assess the heterogeneity and meta-regression was performed to explore the possible sources of heterogeneity in terms of heart rate, sample size, use of β-blocker, and prevalence of CAD. A funnel plot was used to investigate whether the review was subject to publication bias, in which the log sample size was plotted against the log diagnostic odds ratio.

Statistical analysis was performed with Meta-Disc (version 1.4) and SPSS software (PASW Statistics 18; SPSS, Chicago, IL, USA). Two-tailed *p*-value of less than 0.05 was considered to be significant.

Results

Fifty-one studies[10–59] were included in this systematic review according to the inclusion and exclusion criteria (Fig 1). All studies were published between 2005 and 2013,

Table 1
Characteristics of included studies.

Literature	Scanner	Radiation dose[a] (mSv)	No. of patients	Per-patient prevalence of CAD (%)	Heart rate[a] (beats/min)	Rate of β-adrenergic blocking agent use (%)	Basis of assessment	Unassessable segments (%)	Excluded segments (%)
Leber 2005[8]	64 CT	10–14	59	56	62 ± 13	36	NR	0	0
Leschka 2005[9]	64 CT	NR	67	70	66 ± 15	60	≥1.5 mm	0	0
Mollet 2005[10]	64 CT	15–21	52	75	58 ± 7	73	NR	0	0
Pugliese 2005[11]	64 CT	15–20	35	71	58 ± 6	77	NR	3	0
Raff 2005[12]	64 CT	13–18	70	57	65 ± 10	100	NR	12	12
Schuijf 2006[13]	64 CT	NR	61	52	60 ± 11	72	NR	1	1
Ropers 2006[14]	64 CT	8–10	84	32	59 ± 9	74	≥1.5 mm	4	4
Ehara 2006[15]	64 CT	NR	69	90	72 ± 13	22	NR	8	8
Nikolaou 2006[16]	64 CT	8–10	72	57	61 ± 9	15	NR	10	10
Mulenbruch 2006[17]	64 CT	14–17	51	88	61 ± 8	NR	NR	5	5
Plass 2006[18]	64 CT	NR	50	NR	65 ± 11	NR	≥1.5 mm	3	0
Ghostin 2006[19]	64 CT	7 ± 2	66	44	67 ± 13	100	NR	6	0
Hoffmann 2006[20]	64 CT	NR	103	29	NR	NR	NR	NR	NR
Ong 2006[21]	64 CT	NR	134	73	62 ± 9	NR	≥1.5 mm	9.4	9.4
Brodoefel 2007[22]	64 CT	NR	102	63	NR	82	NR	2	2
Oncel 2007[23]	64 CT	NR	80	78	58 ± 10	54	NR	0	0
Schlosser 2007[24]	64 CT	NR	61	NR	58 ± 4	NR	NR	NR	NR
Bayrak 2008[25]	64 CT	NR	100	64	62 ± 6	76	NR	1.4	1.4
Husman 2008[26]	64 CT	NR	88	49	63 ± 9	47	≥1.5 mm	1.1	0
Meijiboom 2008[27]	64 CT	15.5–18.4	360	68	59 ± 9	NR	NR	0	0
Ravipati 2008[28]	64 CT	NR	145	NR	NR	NR	NR	NR	NR
Ulimon 2008[29]	64 CT	NR	48	75	NR	35	≥1.5 mm	NR	NR
Sheikh 2009[30]	64 CT	NR	73	73	NR	NR	NR	NR	NR
Gaudio 2009[31]	64 CT	10.6 ± 2.2	67	25	NR	NR	≥1.5 mm	NR	NR
Selcoki 2010[32]	64 CT	NR	73	84	80 ± 11	92	NR	1.3	1.3
Wehrschuetz 2010[33]	64 CT	NR	37	35	73 ± 2	0	NR	0	0
Kerl 2010[34]	64 CT	NR	50	42	65	NR	≥1.5 mm	NR	NR
Maffei 2012[35]	64 CT	NR	1372	53	58 ± 7	NR	NR	NR	NR
Sohns 2012[36]	64 CT	NR	86	9	67 ± 8	NR	≥1.5 mm	2	2
Gueret 2013[37]	64 CT	17.2 ± 5.9	746	54	63 ± 11	20	NR	0	0
Johnson 2007[38]	Dual CT	4.6–7.5	35	49	68(52–96)	0	≥1.5 mm	1.7	1.7
Leber 2007[39]	Dual CT	7.1–12.3	88	31	73(48–112)	0	NR	2.3	2.3
Ropers 2007[40]	Dual CT	15.56	100	41	64(37–100)	0	≥1.5 mm	3.7	3.7
Achenbach 2008[41]	Dual CT	14.6 ± 3.4	97	46	64 ± 12	43	≥1.5 mm	3.7	3.7
Alkadhi 2008[42]	Dual CT	7–9	150	39	69 ± 13	0	NR	1.9	0
Brodoefel 2008[43]	Dual CT	NR	125	75	65(37–110)	0	NR	8.3	0
Leschka 2008[44]	Dual CT	7–9	74	49	68(35–102)	0	NR	2.1	0
Scheffel 2008[45]	Dual CT	2.51	120	53	59(44–69)	21	≥1.0 mm	1.7	1.7
Stolzmann 2008[45]	Dual CT	2.65	100	55	61(47–69)	21	≥1.0 mm	5	5
Piers 2008[46]	Dual CT	7.3	60	63	63 ± 12	NR	NR	7	7
Meng 2009[47]	Dual CT	NR	109	81	72(50–115)	0	≥1.5 mm	1.6	0
Plass 2009[48]	Dual CT	7–9	40	53	76(35–88)	0	≥1.5 mm	1.3	1.3
Rix 2009[51]	Dual CT	13.8	76	53	68(49–85)	0	≥1.5 mm	0.8	0.8
Weustink 2009[50]	Dual CT	11.7–16.6	444	71	NR	0	NR	0	0
Chen 2010[51]	Dual CT	NR	110	NR	86(40–149)	0	>1.5 mm	1.4	1.4
Donati 2010[52]	Dual CT	2.5	47	70	<70	0	≥1 mm	NR	NR
Marwan 2010[53]	Dual CT	16(9–28)	60	35	70(32–107)	53	≥1.5 mm	NR	NR
Tsiflikas 2010[54]	Dual CT	NR	170	82	64(37–110)	0	NR	5	5
Yang 2010[55]	Dual CT	NR	44	100	59	NR	NR	0	0
Lin 2010[56]	Dual CT	NR	44	75	67 ± 14	0	≥1.5 mm	0	0
Maffei 2012[57]	Dual CT	7.2 ± 2.1	160	30	64 ± 12	95	NR	0	0

[a] These data expressed as forms of mean ± SD or mean or mean (range).

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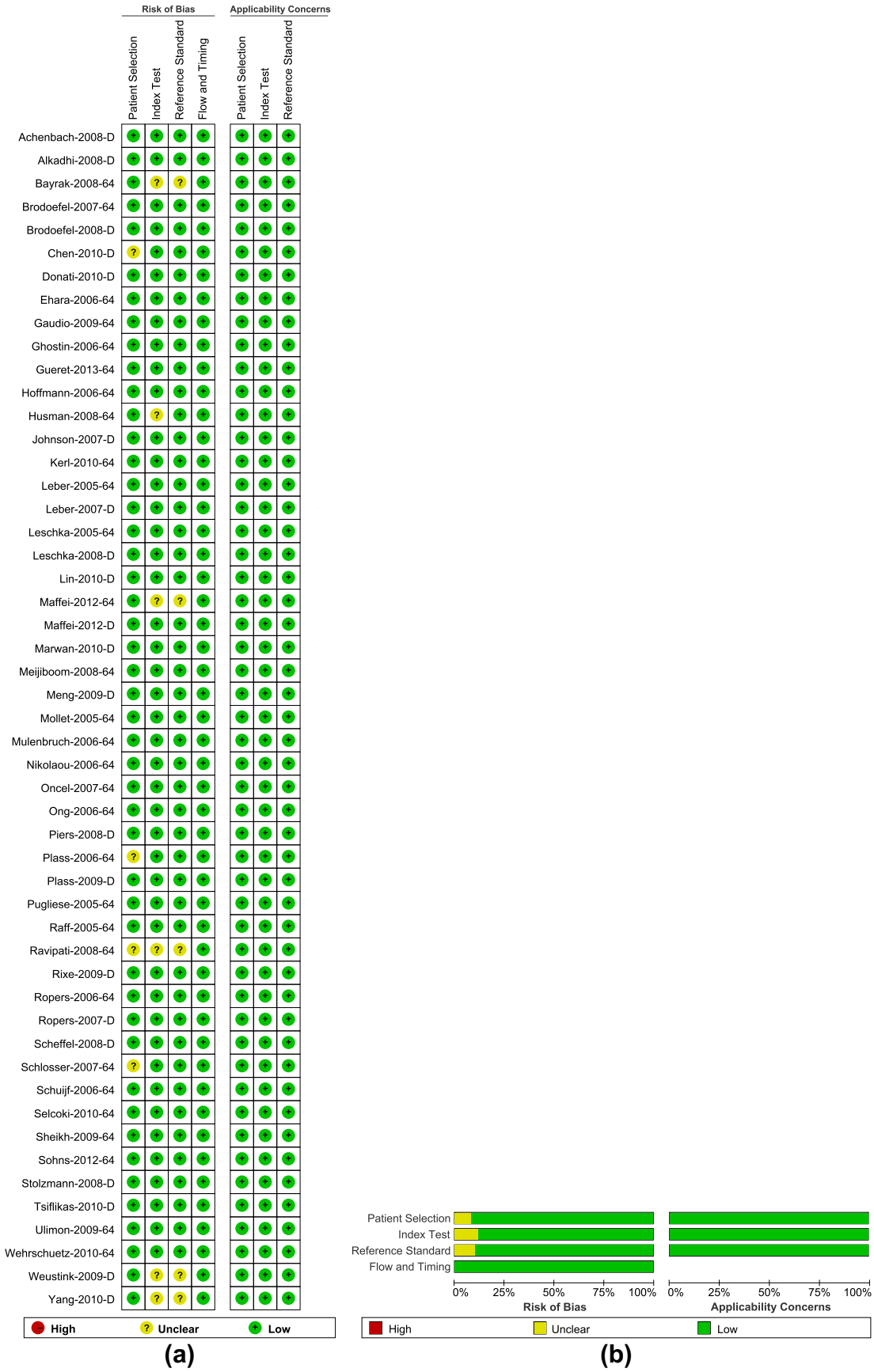


Figure 2 Risk of bias and applicability concerns graph: (a) for the quality of each study; and (b) brief result of quality assessment.

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including 30 studies on single-source 64-section CT and 21 studies on dual-source CT (20 for first-generation dual-source CT and one for 128-section dual-source CT; Table 1). Quality assessment with the QUADAS-2 criteria revealed good quality for all included studies (Fig 2). Per-segment analysis was pooled from 46 studies (single-source 64-section CT in 27 studies including 57,017 segments and dual-source CT in 19 studies including 29,950 segments) and per-patient analysis was pooled from 42 studies (single-source 64-section CT in 24 studies including 3966 patients and dual-source CT in 18 studies including 2047 patients; Table 2).

The median per-patient prevalence of CAD was 58% (range 9–100%) for all studies, and 58% (9–90%) versus 58% (30–100%; $p = 0.942$) for studies using single-source 64-section CT versus dual-source CT, respectively. Heart rate control with β-adrenergic blocking agents was used in 58% of patients who underwent single-source 64-section CT and in 12% of patients who underwent dual-source CT ($P < 0.001$). Mean rate of segments that could not be

Table 2
The count data on per segment and per-patient level for each included primary study.

Literature	Scanner	Per-segment				Per-patient			
		TP	FP	FN	TN	TP	FP	FN	TN
Leber 2005[8]	64 CT	90	19	51	638	22	3	3	17
Leschka 2005[9]	64 CT	165	24	11	805	47	0	0	20
Mollet 2005[10]	64 CT	93	30	1	601	38	1	0	12
Pugliese 2005[11]	64 CT	66	19	1	408	25	1	0	9
Raff 2005[12]	64 CT	79	41	13	802	38	3	2	27
Schuijf 2006[13]	64 CT	62	14	11	755	29	1	2	28
Ropers 2006[14]	64 CT	39	31	3	1010	25	5	1	50
Ehara 2006[15]	64 CT	275	35	29	545	59	1	1	6
Nikolaou 2006[16]	64 CT	97	43	21	762	38	6	1	23
Mulenbruch 2006[17]	64 CT	91	30	14	591	44	3	1	3
Plass 2006[18]	64 CT	111	18	17	404				
Ghostin 2006[19]	64 CT	68	7	26	889	28	2	1	35
Hoffmann 2006[20]	64 CT					14	48	0	41
Ong 2006[21]	64 CT	177	47	40	1067				
Brodoefel 2007[22]	64 CT	186	9	18	1087				
Oncel 2007[23]	64 CT	155	16	6	1023	62	0	0	18
Schlosser 2007[24]	64 CT	34	28	0	853				
Bayrak 2008[25]	64 CT	126	12	18	1226	64	4	0	32
Husman 2008[26]	64 CT	106	192	8	885	38	2	5	43
Meijiboom 2008[27]	64 CT	422	471	59	4345	244	41	2	73
Ravipati 2008[28]	64 CT					101	11	2	31
Ulimon 2008[29]	64 CT	47	54	13	374	32	6	4	6
Sheikh 2009[30]	64 CT					51	1	2	19
Gaudio 2009[31]	64 CT	21	12	1	856	16	2	1	48
Selcoki 2010[32]	64 CT	116	24	25	900	58	2	3	10
Wehrschuetz 2010[33]	64 CT	24	40	11	480				
Kerl 2010[34]	64 CT	59	13	5	673	21	2	0	27
Maffei 2012[35]	64 CT	1567	894	102	16573	723	51	8	590
Sohns 2012[36]	64 CT	9	15	1	829				
Gueret 2013[37]	64 CT	506	1098	619	8485	367	172	36	171
Johnson 2007[38]	Dual CT	28	8	4	433	17	2	0	16
Leber 2007[39]	Dual CT	38	4	9	1165	20	1	7	60
Ropers 2007[40]	Dual CT	72	19	8	1244	39	10	1	47
Achenbach 2008[41]	Dual CT	81	6	14	1236	39	1	6	51
Alkadhi 2008[42]	Dual CT	215	68	10	1766	57	12	2	79
Brodoefel 2008[43]	Dual CT	264	24	87	1189	85	9	0	31
Leschka 2008[44]	Dual CT	132	21	7	826	35	4	1	33
Scheffel 2008[45]	Dual CT	238	31	8	1498	64	2	0	54
Stolzmann 2008[45]	Dual CT	188	11	3	1260	55	2	0	43
Piers 2008[46]	Dual CT	64	136	40	526	38	12	0	10
Meng 2009[47]	Dual CT	213	113	12	1195	83	5	2	19
Plass 2009[48]	Dual CT	239	13	2	226				
Rix 2009[49]	Dual CT	49	9	1	1012	40	5	0	23
Weustink 2009[50]	Dual CT	710	242	37	5799	315	19	0	110
Chen 2010[51]	Dual CT	282	30	6	1064				
Donati 2010[52]	Dual CT					32	1	1	13
Marwan 2010[53]	Dual CT					14	0	7	39
Tsiflikas 2010[54]	Dual CT	336	151	28	1574	98	13	6	53
Yang 2010[55]	Dual CT	112	10	0	498				
Lin 2010[56]	Dual CT	89	9	44	393	32	6	1	5
Maffei 2012[57]	Dual CT	173	152	19	2127	48	19	0	93

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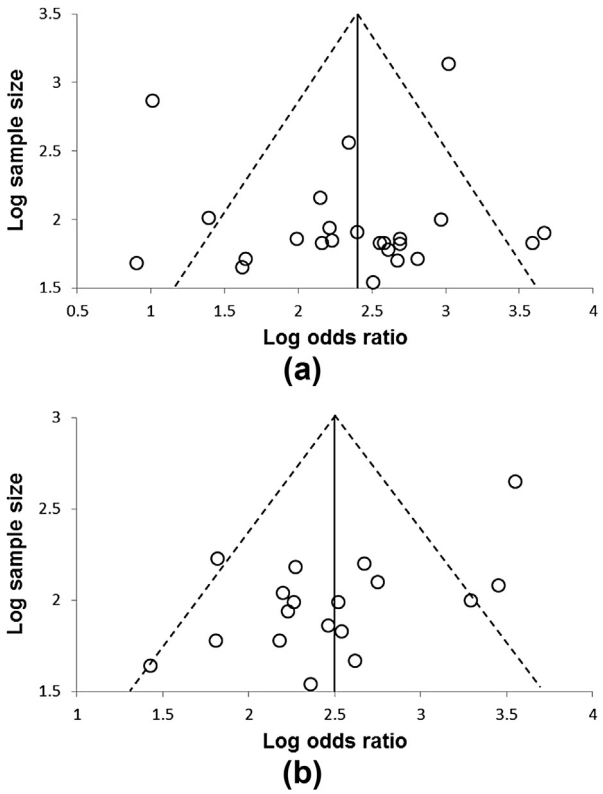


Figure 3 Funnel plots for single-source 64-section CT (a) and dual-source CT (b) on a per-patient basis.

assessed was 3% (range, 0–12%) and 2.5% (range, 0–8%) for single-source 64-section CT and dual-source CT, respectively ($p = 0.518$). The effective radiation dose was 13.3 ± 4 mSv for single-source 64-section CT and 9.1 ± 4.7 mSv for dual-source CT based on the available data ($p = 0.023$).

At the per-patient level, funnel plots for single-source 64-section and dual-source CT showed no significant publication bias (Fig 3). Between-study heterogeneity was significant ($p < 0.001$), indicating the need for a random-effects model that considers such heterogeneity. Meta-regression did not find any predicting covariant indicating the source of heterogeneity ($p > 0.05$). The results of single-source 64-section CT versus dual-source CT were 97% [95% confidence interval (CI): 96%, 97%] versus 97% (95% CI: 96%, 98%) for sensitivity ($p = 0.386$), 78% (95% CI: 76%, 78%) versus 86% (95% CI: 84%, 89%) for specificity ($p < 0.001$), 90% (95% CI: 89%, 92%) versus 85% (95% CI: 84%, 87%) for PPV ($p < 0.001$), 93% (95% CI: 93%, 94%) versus 97% (95% CI: 96%, 98%) for NPV ($p = 0.001$), 6.8 (95% CI: 4.2, 10.9) versus 6.5 (95% CI: 4.4, 9.5) for positive likelihood ratio ($p = 0.018$), 0.04 (95% CI: 0.02, 0.08) versus 0.04 (95% CI: 0.04, 0.09) for negative likelihood ratio ($p = 0.625$), and 191.59 (95% CI: 72.92, 503.34) versus 207.37 (95% CI: 117.88, 364.79) for diagnostic odds ratio ($p = 0.043$), respectively (Table 3). The symmetric area under the curve was 0.98 for single-source 64-section CT and 0.98 for dual-source CT at per-patient level (Fig 4). For patients with negative CT results, graphs of conditional probabilities indicated single-source 64-section CT and dual-source CT are equally valuable for ruling out CAD (lower curves). However, with dual-source CT a positive test result is more accurate than with single-source 64-section CT (upper curves; Fig 5).

Discussion

Currently, the main task of coronary CTA is to rule out CAD at a per-patient level in patients with an intermediate CAD risk, in order to avoid unnecessary coronary catheter angiographies and direct further investigation in CAD-negative patients. The results of the present study show that dual-source CT and single-source 64-section CT have similar negative likelihood ratios and, therefore, do not have significant differences in their main task. However, dual-source CT has significantly higher specificity than single-source 64-section CT, so that CT-based decisions for subsequent coronary catheter angiography or other further investigations are more accurate. At per-segment level, a similar conclusion was reached. Because the PPV and NPV are strongly dependent on disease prevalence, for a better understanding, it could be useful to provide graphs of conditional probabilities for single-source 64-section CT and dual-source CT.[60] For patients with negative CT results, the single-source 64-section CT and dual-source CT were equally valuable for ruling out CAD. However, with dual-source CT, a positive test result is more accurate than with single-source 64-section CT (Fig 5). Dual-source CT reduces the number of patients who undergo subsequent coronary catheter angiography or other investigations because of a lower false-positive CT result. This effect is most obvious in the lower intermediate-risk range (disease prevalence 20–50%), which is the future target population for coronary CTA.

Table 3
Per-segment and per-patient meta-analysis.

	Scanner	Sensitivity [95% CI]	Specificity [95% CI]	PPV [95% CI]	NPV [95% CI]	Positive LR [95% CI]	Negative LR [95% CI]	Diagnostic OR [95% CI]
Per-segment	64-section	0.81[0.80, 0.82]	0.94[0.93, 0.94]	0.71[0.69, 0.73]	0.98[0.96, 0.99]	23.5[17.0, 32.4]	0.12[0.07, 0.20]	215.0[99.2, 466.1]
	Dual-source	0.91[0.90, 0.92]	0.96[0.96, 0.96]	0.78[0.76, 0.79]	0.98[0.98, 0.99]	33.4[22.4, 49.9]	0.07[0.04, 0.12]	503.8[230.2, 1102.5]
	p-Value	<0.001	<0.001	<0.001	0.293	0.001	0.171	0.001
Per-patient	64-section	0.97[0.96, 0.97]	0.78[0.76, 0.80]	0.90[0.89, 0.92]	0.93[0.93, 0.94]	6.8[4.2, 10.9]	0.04[0.02, 0.08]	191.6[72.9, 503.3]
	Dual-source	0.97[0.96, 0.98]	0.86[0.84, 0.89]	0.85[0.84, 0.87]	0.97[0.96, 0.98]	6.5[4.4, 9.5]	0.04[0.02, 0.09]	207.4[117.9, 364.8]
	p-Value	0.386	<0.001	<0.001	0.001	0.018	0.625	0.043

CI, confidence interval.

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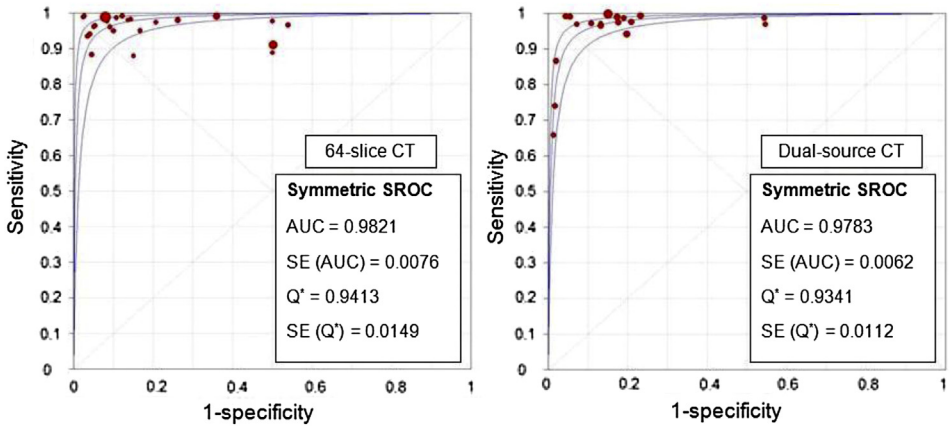


Figure 4 Plot of symmetric summary receiver operating characteristic (SROC) on a per-patient basis for single-source 64-section and dual-source CTA.

Technical improvements with dual-source CT offer multiple advantages compared with single-source 64-section CT. Reasons for non-assessability of CAD are cardiac motion, respiratory artefacts, poor opacification, and the presence surgical clips. The temporal resolution of the dual-source CT is 83 ms, which makes cardiac imaging less dependent on the patient's heart rate and also facilitates breath-holding. In addition, the increased temporal resolution in dual-source CT may result in less strict criteria for application of coronary CTA in common clinical circumstances in which there are contraindications to β-blockers, which may have resulted in arrhythmia.[61] In the present study, 12% of the total number of patients received β-blocker before image acquisition with dual-source CT, which was significantly smaller than 58% for single-source 64-section CT.

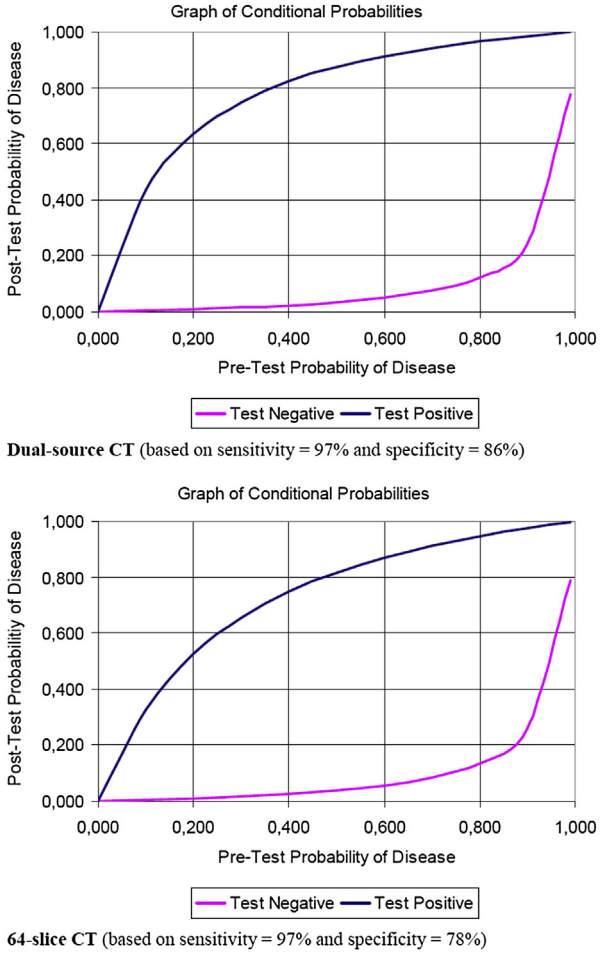


Figure 5 Graphs of conditional probabilities for dual-source CT and single-source 64-section CT based on per-patient level. The lower curves show the pre-test probability of CAD (defined as have at least one ≥50% stenosis) when having a negative CT result. The upper curves show the post-test probability of CAD when having a positive CT result.

In the past, coronary CTA had the disadvantage of high radiation dose and associated high radiation risks. In the future, this may be less problematic when using modern low-dose techniques. In general, the effective radiation dose is 11.7 ± 6.3 mSv for single-source 64-section CT and 6.7 ± 4.6 mSv for dual-source CT. Furthermore, the effective radiation dose is 9.5 ± 3.9 and 2.8 ± 1.7 mSv in retrospective and prospective ECG-gating with dual-source CT, and 13.4 ± 5.7 and 6.8 ± 5.1 mSv in retrospective and prospective ECG-gating with single-source 64-section CT.[62] Several techniques are introduced to reduce the radiation dose in coronary CTA in order to accomplish the rule "as low as reasonably achievable", such as automatic exposure control, ECG-triggered current modulation, lower tube voltage settings, adjustments of pitch value, and prospective ECG-gated imaging. Of these dose-saving strategies, prospective ECG-gated imaging enables significant reduction of radiation dose when compared to that of retrospective ECG-gating, while offering comparable image quality and diagnostic value.[63,64] In addition, iterative reconstruction technique can enable a 32–65% reduction in CT radiation dose.[65] In the present meta-analysis, the effective radiation dose of dual-source CT varied from 2.5 to 28 mSv and was lower than that of single-source 64-section CT. However, it is unknown whether an appropriate tissue-weighting factor was used to calculate radiation dose in each original study. The weighting factor for different dual and single source CT machines may also be different.

Between-study heterogeneity is a limitation of the present study, and sources of that heterogeneity were not

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identified by meta-regression analysis. However, a random-effects model was applied to consider the heterogeneity. Second, the average disease prevalence in the primary studies was 58%, in the upper part of the "intermediate-risk" population. Therefore, in a low-risk population the parameters of diagnostic accuracy might be somewhat different from the present meta-analysed results. However, such an evaluation is unlikely to be performed for ethical reasons, as low-risk patients do usually not undergo catheter angiography. Therefore, the meta-analysis in the primary studies may represent the best available evidence. In addition, the heterogeneity pre-test probability of CAD could offer a broader range of applicability. Third, data could not be extracted and subdivided based on prospective/retrospective or iterative reconstruction in this meta-analysis.

In summary, dual-source CT and single-source 64-section CT have similar negative likelihood ratios and, therefore, there was no significant difference in their utility to rule out CAD in intermediate-risk patients. Compared to single-source 64-section CT, however, dual-source CT has significantly higher specificity, so that CT-based decisions for subsequent further investigations are more accurate.

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