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WJCC mainly publishes articles reporting research results and findings obtained in the field of clinical medicine and covering a wide range of topics, including case control studies, retrospective cohort studies, retrospective studies, clinical trials studies, observational studies, prospective studies, randomized controlled trials, randomized clinical trials, systematic reviews, meta-analysis, and case reports.

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META-ANALYSIS

Diagnostic accuracy of ≥ 16-slice spiral computed tomography for local staging of colon cancer: A systematic review and meta-analysis

Dan Liu, Lin-Mei Sun, Jing-Hua Liang, Lei Song, Xiao-Pei Liu

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Abstract

BACKGROUND

Colorectal cancer is one of the most common cancers worldwide with high mortality and is classified as a single entity, although colon cancer and rectal cancer have largely different diagnoses, treatments, surgical methods, and recurrence rates. ≥ 16-slice spiral computed tomography (SCT) is mostly applied to detect the local stage of colon cancer; however, its diagnostic accuracy and whether it is conducive to distinguishing between high-risk and low-risk colon cancer are unclear.

AIM

To systematically review the diagnostic accuracy of ≥ 16-slice SCT for local staging of colon cancer.

METHODS

Based on the PubMed, EMBASE, Cochrane Library, and Web of Science databases, computers were used to search the literature from the establishment of the database to April 2021, and the results of the diagnostic tests on ≥ 16-slice SCT for local staging of colon cancer were collected according to the inclusion criteria. The data were then extracted and assessed on the basis of the Quality Assessment Checklist of the Institute of Economics of Canada, Reference Citation Analysis (https://www.referencecitationanalysis.com/). Afterward, a meta-analysis was performed using the statistical software Meta-disc 14.0 and Stata 15.0.

RESULTS

Eleven studies that provided data on 1613 subjects with computed tomography diagnostic tests were included in this study. Meta-analysis revealed that the pooled sensitivity, pooled specificity, pooled negative likelihood ratio (LR), pooled diagnostic odds ratio, and area under the fitted receiver operating characteristic (ROC) curve of ≥ 16-slice SCT for colon cancer T staging were 0.67 (95%CI: 0.65-0.70), 0.81 (95%CI: 0.80-0.83), 4.13 (95%CI: 2.66-6.41), 0.39 (95%CI: 0.31-0.49), 10.81 (95%CI: 7.33-15.94), and 0.829, respectively, while the specificity, negative LR, diagnostic odds ratio, and area under the fitted ROC curve of ≥ 16-slice SCT for N staging of colon cancer were 0.54 (95%CI: 0.49-0.59), 0.74 (95%CI: 0.70-0.77), 1.92 (95%CI: 1.36-2.70), 0.67 (95%CI: 0.51-0.87), 3.74 (95%CI: 1.76-7.94), and 0.829 respectively. The sensitivity and specificity of ≥ 16-slice SCT for colon cancer T staging were acceptable, while the sensitivity for colon cancer N staging was relatively low, though its specificity was acceptable.

CONCLUSION

≥ 16-slice SCT for local staging of colon cancer has good diagnostic value; however, the accuracy needs to be confirmed by further clinical practice.

Key Words: ≥ 16-detector CT; Diagnostic; Colon cancer; Systematic review; Meta-analysis

Core Tip: This systematic review and meta-analysis were based on eleven studies on 1613 patients with computed tomography diagnostic tests. The results indicated that ≥ 16-slice spiral computed tomography, which is most applied in clinical practice, displayed acceptable diagnostic accuracy and good diagnostic value for detecting the local stage of colon cancer. In addition, it is conducive to distinguishing between high-risk and low-risk colon cancer.

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INTRODUCTION

One of the most common cancers in the world is colorectal cancer[1-3], for which an update on the incidence is provided every 3 years by the American Cancer Society from population-based cancer registrations (as of 2016) and mortality data from the National Center for Health Statistics (as of 2017). These data indicate that colorectal cancer is the third most commonly seen cancer and the third leading cause of cancer death, with the prediction of approximately 147950 new cases of colorectal cancer diagnosed and 53200 deaths recorded by the year 2020[4]. The average annual incidence of colorectal cancer in men and that in women in the United States from 2011 to 2015 were also disclosed to be 45.9/100000 and 34.6/100000, respectively[5]. Classified by the World Health Organization as a single entity, colon cancer and rectal cancer are largely different in their diagnoses, treatments, surgical methods, and recurrence rates[6,7]. The early symptoms of colon cancer patients, such as hematoma, diarrhea, changes in bowel habits, local abdominal pain, and anemia, are easy to ignore, thus leading to approximately 20% of late-stage patients missing the best treatment time over the past 20 years[8]. Characterized by noninvasiveness, high sensitivity and specificity, safety, availability, convenience, and inexpensiveness, a full colonoscopy is the "ideal" screening test for colon cancer, as recommended by the guidelines, and involves varying measurements and strategies with advantages and disadvantages, but is well tolerated, especially under adequate sedation[9]. Full colonoscopy has been shown by a literature review to have a high sensitivity (96%-97%) and specificity (98%), with, aside from other high risks, a perforation rate of 0.1%, bleeding risk of greater than 0.3%, and mortality rate of 0.01%-0.03%[10,11]. Computed tomography (CT) colonography is highly sensitive and cost-effective in detecting colon cancer, and is a technique that applies the optimal bowel wall dilation 3D colon reconstruction (to create a virtual colonoscopy). Elias Nerad *et al*[12] demonstrated that such an analysis had an excellent sensitivity in detecting colorectal T3-T4, with the CT digits not screened, due to the low lymph node metastasis resulting from the challenge of distinguishing between T1-T3Ab and T3CD-T4. In recent years,≥ 16-slice spiral computed tomography (SCT) have been mostly applied to detect the local stage of

colon cancer. This meta-analysis was designed to specifically determine the diagnostic accuracy of ≥ 16-slice SCT used only for colon cancer staging, thus assessing whether ≥ 16-slice SCT is conducive to distinguishing between high-risk and low-risk colon cancer.

MATERIALS AND METHODS

Literature index strategy

PubMed, EMBASE, Cochrane Library, and Web of Science were searched with computers from the establishment of the database to April 2021, with terms such as "colon cancer", "colon tumor", "colorectal cancer", "tumor staging", "computed tomography", and "CT" serving as keywords.

Inclusion criteria

After deleting duplicate publications, reasonable inclusion criteria and exclusion criteria were developed to review the remaining studies. The inclusion criteria were: (1) The purpose of the study was the diagnostic value of computed tomography in the diagnosis of colon cancer; (2) The experimental design was prospective or retrospective; and (3) The inclusion criteria were symptoms, signs, or laboratory tests of colon cancer, with histopathological results serving as the standard for diagnosis of cancer.

Exclusion criteria

The exclusion criteria were: (1) Reviews, case reports, editorials, correspondences, comments, or meeting abstracts/meeting minutes; (2) The number of CT slices was not described in the study and could not be determined, by other means, whether it was ≥ 16-slice CT or < 16-slice CT; (3) Studies without available diagnostic results in a two-by-two table; (4) Studies in languages other than English; and (5) Studies without available full texts.

Data extraction

The data from the literature were independently extracted by two researchers, and were put into a predrawn data table as follows: (1) Basic research information, including the first author, the publication year, the country from which the first author comes, the test time, and the type of the research design; (2) The characteristics of the tested population, including the patients' age, gender, the number of participants, and the pathological stage; (3) The CT slices; (4) The details of reference standards; (5) The research results, including the number of true positives, false positives, false negatives, and true negatives, for the purpose of determining the accuracy of the diagnoses; and (6) Reference Citation Analysis (https://www.referencecitationanalysis.com/).

Literature quality assessment

The methodological quality of the included studies was assessed by two researchers on the basis of the Quality Evaluation Checklist of the Canadian Institute of Economics (IHE)[13], then cross-checked, and finally an agreement was reached. In light of the misleading scoring of the item conformity[14], the scoring method was not included in the quality evaluation checklist of the IHE methodological case series, and corresponding options for each item were provided instead, leading to the assessment of 13 case series based on the final list. Studies were recommended as acceptable with 14 (70%) or more items in conformity despite the fact that a corresponding quality assessment system had not yet been formulated by the expert group.

Statistical methods

The data were analyzed with Meta-disc 14.0 and Stata 15.0. The threshold effect was determined with Meta-disc 14.0. All of the heterogeneity degrees were assessed by the heterogeneity index (I^2). The random effects model was adopted in the case of $I^2 > 50\%$. Conversely, the fixed effects model was applied for the purpose of analyzing indicators such as sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, diagnostic odds ratio (DOR,) and area under the curve (AUC). The publication bias of the included literature (≥ 10 articles) was examined by Deeks' test on Stata 15.0.

RESULTS

Literature index results

With 663 articles left after deleting duplicates from 751 preliminarily retrieved original articles, a full-text analysis was performed on the basis of the 58 articles remaining after screening by titles and abstracts, leaving 47 articles excluded with full-texts of 14 articles not available, 3 articles without TMN staging descriptions, and 30 articles with different detection methods, resulting in 11 articles finally

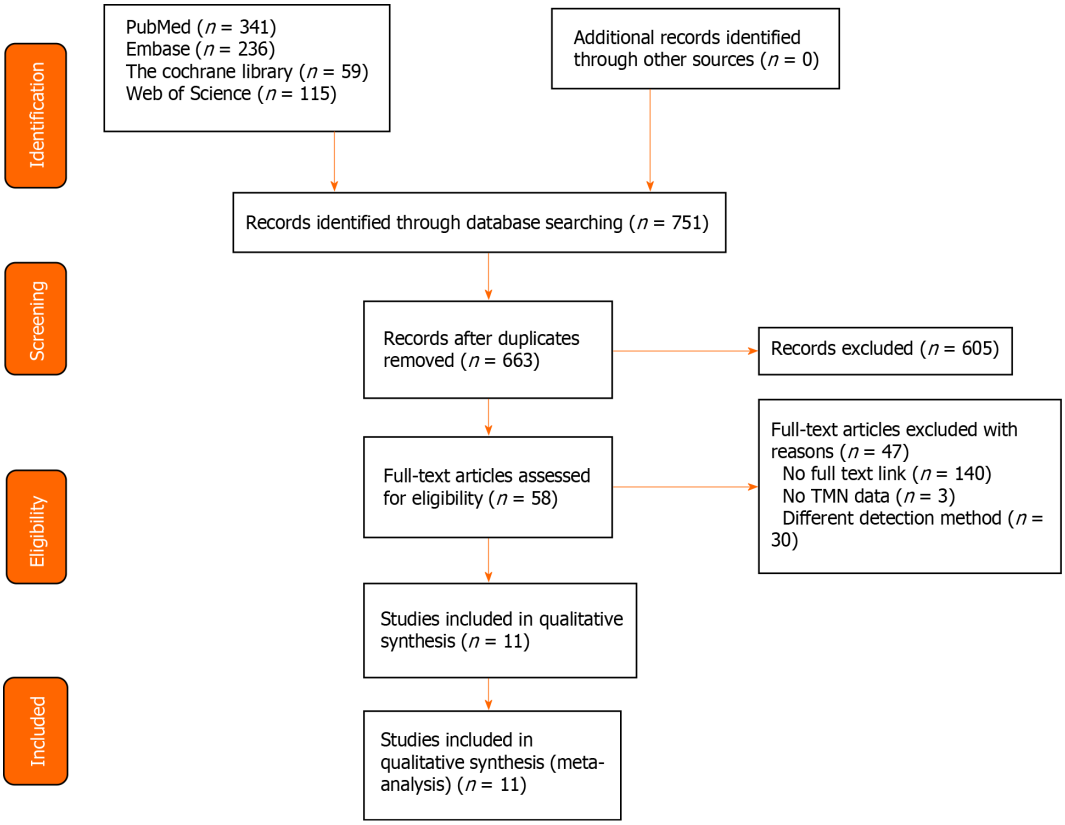

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Figure 1 Literature search and results.

included in this study (Figure 1)[15-25].

Basic characteristics of the literature included in this research

The basic characteristics of the literature included in this study are shown in Table 1-4. A total of 1613 participants were included in the 11 studies, of which three[15,17,24] were on colorectal cancer while the remaining 8[16,18-23,25] were on colon cancer, with 5 of the 11 studies[15,17,18,20] performed with 16-slice CT, 6[16,21-25] with 64-slice CT, and 1[19] with 16-slice (Siemens SOMATON Sensation 16) or 64-slice CT (GE LightSpeed VCT). Four of the eleven [15,20,23,25] were performed as retrospective studies and the remaining 7[16-19,21,22,24] as prospective studies; only 2[19,24] were performed for the follow-up. In terms of the display of diagnostic results, 11 studies showed the diagnostic results of the T staging of colon cancer, among which Rollvén *et al*[16] reached different judgments on the CT diagnosis results, thus leading to ultimate disagreement, and 4 studies[15,17,19,23] showed the diagnostic results of N staging. With the methodological quality assessment conducted by the IHE quality assessment checklist, the assessment results showed that all 11 included studies met the requirement of more than 14 items (70%), indicating that the quality of the literature included in this study was acceptable.

Meta-analysis results

Heterogeneity of meta-analysis of T staging: In a diagnostic meta-analysis, heterogeneity is primarily generated by threshold and nonthreshold effects. In this study, there was no "shoulder-arm" distribution in the "ROC floor plan" results, showing no threshold effect (Figure 2A), no distribution along the same line DOR value as the pooled DOR value of each study in the DOR forest diagram, as well as a Cochran-Q = 155.64 (I^2 = 76.9%, P < 0.001), indicating that the heterogeneity was generated by a nonthreshold effect (Figure 2B).

Summary effect size of T staging: The pooled sensitivity of all the studies had an I^2 = 91.7%, and the sensitivity was combined with the random effects model, which resulted in a pooled sensitivity of 0.67 (95%CI: 0.65-0.70) (Figure 2C). The pooled specificity of the studies had an I^2 = 96.7%, and the specificity was combined with the random effects model, which resulted in a pooled specificity of 0.81 (95%CI: 0.80-0.83) (Figure 2D). The pooled positive LR of the studies had an I^2 = 97.6%, and the positive likelihood ratio was combined with the random effects model, which resulted in a pooled positive LR of 4.13 (95%CI: 2.66-6.41) (Figure 3A). The pooled negative likelihood ratio of the studies had an I^2 = 91.6%, and the negative LR was combined with the random effects model, which resulted in a pooled negative LR of 0.39 (95%CI: 0.31-0.49) (Figure 3B). The pooled DOC of the studies had an I^2 = 76.9%, and the DOC

Table 1 Basic characteristics of studies included

Ref.	Year	Nationality	Sample size (case)	Gender (male/female)	Average age	Subjects	Slices of CT scan	Type of research
Tezcan *et al*[15]	2013	Turkey	159	115/44	60 (28-82)	Colorectal cancer	16	Retrospective
Rollven *et al*[16]	2013	Stockholm	29	17/11	73 ± 11.25	Colon cancer	64	Prospective
da Fonte *et al*[17]	2012	Turkey	25	12/13	59.8 ± 10	Colorectal cancer	16	Prospective
Sibileau *et al*[18]	2014	France	53	27/26	70 ± 11.75	Colon cancer	16	Prospective
Hunter *et al*[19]	2017	UK	58	34/26	69.3 ± 13.6	Colon cancer	16 or 64	Prospective
Lee *et al*[20]	2014	Korea	266	154/112	63.7 ± 13	Colon cancer	16	Retrospective
Maupoey *et al*[21]	2019	Spain	217	128/89	70 ± 13.75	Colon cancer	64	Prospective
Dighe *et al*[22]	2010	Royal	84		75 ± 10.5	Colon cancer	64	Prospective
Lao *et al*[23]	2013	Taiwan	152	82/70	66 ± 5.125	Colon cancer	64	Retrospective
Flor *et al*[24]	2013	Italy	69	31/38	68 ± 9	Colorectal cancer	64	Prospective
Malmstrøm *et al*[25]	2018	Denmark	501	271/230	69.4 ± 9.7	Colon cancer	64	Retrospective

CT: Computed tomography; MDCT: Multidetector row computed tomography.

value was combined with the random effects model, which resulted in a pooled DOC value of 10.81 (95%CI: 7.33-15.94) (Figure 2B). The area under the fitted ROC curve was 0.829 (Figure 3C).

Publication bias of T staging: Deeks' funnel plot asymmetry test was conducted to assess the publication bias of the studies in the meta-analysis, with $P = 0.02$ as shown in Figure 3D, indicating a significant publication bias in the included literature on the 16-slice CT diagnosis of colorectal cancer T staging.

Heterogeneity of meta-analysis of N staging: There was no "shoulder-arm" distribution in the "ROC floor plan" results, showing no threshold effect (Figure 4A), no distribution along the same line of DOR value as the pooled DOR value of each study in the DOR forest diagram, as well as a Cochran-Q = 28.09 ($I^2 = 75.1\%$, $P < 0.001$), indicating that the heterogeneity was generated by a nonthreshold effect. Qualitative details are provided in Figure 4B.

Summary effect size of N staging: The pooled sensitivity of all the studies had an $I^2 = 91.9\%$, and the sensitivity was combined with the random effects model, which resulted in a pooled sensitivity of 0.54 (95%CI: 0.49-0.59) (Figure 5A). The pooled specificity of the studies had an $I^2 = 92.9\%$, and the specificity was combined with the random effects model, which resulted in a pooled specificity of 0.74 (95%CI: 0.70-0.77) (Figure 5B). The pooled positive LR of the studies had an $I^2 = 77.8\%$, and the positive LR was combined with the random effects model, which resulted in a pooled positive likelihood ratio of 1.92 (95%CI: 1.36-2.70) (Figure 5C). The pooled negative LR of the studies had an $I^2 = 78.5\%$, and the negative LR was combined with the random effects model, which resulted in a pooled negative LR of 0.67 (95%CI: 0.51-0.87) (Figure 5D). The pooled DOC of the studies had an $I^2 = 76.9\%$, and the DOC value was combined with the random effects model, which resulted in a pooled DOC value of 3.74 (95%CI: 1.76-7.94) (Figure 4B). The area under the fitted ROC curve had an AUC of 0.829 (Figure 6).

Publication bias of N staging: With little literature included ($n < 10$), the publication bias of the ≥ 16-slice CT diagnosis of colorectal cancer N staging was not assessed.

DISCUSSION

The staging of colon cancer is mostly performed according to the American Joint Committee on Cancer (AJCC)[26], which distinguishes patients based on the degree of primary tumor invasion (T stage), lymph node status (N stage), and distant spread (M stage). Clinical studies have disclosed that the invasion depth, the presence or absence of lymph node metastasis, and distant metastasis are key factors affecting the clinical prognosis of rectal cancer[27], leading to the conclusion that the application of

Table 2 Results of T staging in included studies

Ref.	Stage	Number	Histology +	Histology -	TP	FP	FN	TN	Sensitivity (%)	Specificity (%)
Tezcan *et al*[15]	T1/T2	159	17	142	13	3	4	139	76.47	97.89
Tezcan *et al*[15]	T3	159	121	38	116	8	5	30	96.00	79.00
Tezcan *et al*[15]	T4	159	21	138	17	1	4	137	81.00	99.00
Rollvén *et al*[16]	T0-T3ab	29	16	13	14	4	2	9	87.50	69.23
Rollvén *et al*[16]	T3cd-T4	29	13	16	9	2	4	14	69.23	87.50
Rollvén *et al*[16]	T0-T3ab	29	16	13	13	4	3	9	81.25	69.23
Rollvén *et al*[16]	T3cd-T4	29	13	16	9	3	4	13	69.23	81.25
da Fonte *et al*[17]	T1/T2	25	7	18	4	2	3	16	57.10	88.90
da Fonte *et al*[17]	T3	25	16	9	14	3	2	6	87.50	66.70
da Fonte *et al*[17]	T4	25	2	23	2	0	0	23	100.00	100.00
Sibileau *et al*[18]	T1/T2	53	10	43	6	1	4	42	60.00	97.67
Sibileau *et al*[18]	T3	53	32	21	26	8	6	13	81.25	61.90
Sibileau *et al*[18]	T4	53	11	42	9	5	2	37	81.82	88.10
Hunter *et al*[19]	T3/T4	53	42	11	34	7	8	4	81.00	36.00
Hunter *et al*[19]	T1/T2	53	11	42	4	8	7	34	36.36	80.95
Hunter *et al*[19]	T3/T4	53	42	11	29	5	13	6	69.00	55.00
Hunter *et al*[19]	T1/T2	53	11	42	6	13	5	29	54.55	69.05
Lee *et al*[20]	T3	266	138	128	138	128	0	0	100.00	0.00
Lee *et al*[20]	T4	266	63	203	61	195	2	8	97.40	4.00
Maupoey *et al*[21]	T1/T2	225	69	156	58	18	11	138	84.06	88.46
Maupoey *et al*[21]	T3	225	77	148	51	26	26	122	66.23	82.43
Maupoey *et al*[21]	T4a	225	71	154	45	14	26	140	63.38	90.91
Maupoey *et al*[21]	T4b	225	8	217	7	6	1	211	87.50	97.24
Dighe *et al*[22]	T3 ≥ 5 mm and T4	84	48	36	40	12	8	24	83.33	66.67
Dighe *et al*[22]	T1/T2 and T3 < 5 mm	84	36	48	24	8	12	40	66.67	83.33
Lao *et al*[23]	T0 or Tis	153	4	149	2	19	2	130	50.00	87.25
Lao *et al*[23]	T1	153	18	135	1	0	17	135	5.56	100.00
Lao *et al*[23]	T2	153	25	128	6	27	19	101	24.00	78.91
Lao *et al*[23]	T3	153	98	55	74	19	24	36	75.51	65.45
Lao *et al*[23]	T4	153	8	145	1	4	7	141	12.50	97.24
Lao *et al*[23]	T0–Tis, T1–T2	153	47	106	33	22	14	84	70.21	79.25
Lao *et al*[23]	T3/T4	153	106	47	84	14	22	33	79.25	70.21
Flor *et al*[24]	T1/T2	75	17	58	16	17	1	41	96.00	71.00
Flor *et al*[24]	T3/T4	75	58	17	41	1	14	16	70.69	94.12
Malmstrøm *et al*[25]	T1/T2	501	163	338	136	141	27	197	83.44	58.28
Malmstrøm *et al*[25]	T3 ≤ 5 mm	501	211	290	55	44	156	246	26.07	84.83
Malmstrøm *et al*[25]	T3 > 5 mm	501	68	433	34	53	34	380	50.00	87.76
Malmstrøm *et al*[25]	T4	501	59	442	19	19	40	423	32.20	95.70

TP: True positive; FP: False positive; FN: False negative; TN: True negative.

Table 3 Results of N staging in included studies

Ref.	Staging	Number	Histology +	Histology -	TP	FP	FN	TN	Sensitivity (%)	Specificity (%)
Tezcan *et al*[15]	N0	159	75	84	24	0	51	84	32.00	100.00
Tezcan *et al*[15]	N1	159	46	113	28	23	18	90	61.00	80.00
Tezcan *et al*[15]	N2	159	38	121	38	46	0	75	100.00	62.00
Hunter *et al*[19]	N1/N2	53	22	31	14	12	8	19	64.00	60.00
Hunter *et al*[19]	N1/N2	53	22	31	16	18	6	13	73.00	43.00
Lao *et al*[23]	Nx or N0	153	76	77	48	34	28	43	63.16	55.84
Lao *et al*[23]	N1	153	34	119	8	31	26	88	23.53	73.95
Lao *et al*[23]	N2	153	43	110	17	15	26	95	39.53	86.36

TP: True positive; FP: False positive; FN: False negative; TN: True negative.

Table 4 Diagnostic results of included studies

Ref.	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20
Tezcan *et al* [15]	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Unclear	Y	N	Y	Y	N	Y	Y	N	Unclear
Rollven *et al* [16]	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Unclear	Y	N	Y	Y	N	Y	Y	Y	Unclear
da Fonte *et al*[17]	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Unclear	Y	N	Y	Y	N	Y	Y	Y	Unclear
Sibileau *et al* [18]	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Unclear	Y	N	Y	Y	N	Y	Y	Y	Unclear
Hunter *et al* [19]	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Unclear	Y	Y	Y	Y	N	Y	Y	Y	Unclear
Sibileau *et al* [18]	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Unclear	Y	N	Y	Y	N	Y	Y	N	Unclear
Maupoey *et al*[21]	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Unclear	Y	N	Y	Y	N	Y	Y	Y	Unclear
Dighe *et al* [22]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Unclear	Y	N	Y	Y	N	Y	Y	Y	Unclear
Lao *et al*[23]	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Unclear	Y	N	Y	Y	N	Y	Y	N	Unclear
Flor *et al*[24]	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Unclear	Y	Y	Y	Y	N	Y	Y	Y	Unclear
Malmstrøm *et al*[25]	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Unclear	Y	N	Y	Y	N	Y	Y	N	Unclear

A1-A20 in the table correspond to the 20 items in the IHE quality assessment checklist, namely, A1: Were the hypotheses/aims/objectives of the research clearly stated in the abstract, introduction and methodology? A2: Were the characteristics of the participants included in the research described? A3: Were the cases collected from multiple centers? A4: Are the entry eligibility criteria (inclusion and exclusion criteria) clear and appropriate? A5: Were the participants recruited continuously? A6: Were the participants involved in the study at the similarity of the disease? A7: Were the interventions clearly described in the research? A8: Were additional interventions (combined interventions) clearly reported in the research? A9: Was the results measurement clearly defined in the introduction or the method section? A10: Were the relevant results appropriately measured by objective and/or subjective methods? A11: Were the results measured before and after the interventions? A12: Were the statistical tests used to assess the relevant results appropriate? A13: Were the lengths of follow-ups reported? A14: Were the losses reported with follow-ups? A15: Was the random variability of the data analysis on the relevant results assessed in the research? A16: Were the adverse events reported? A17: Were the conclusions of the research supported by the results? A18: Were the interest conflicts and supporting sources of the research reported? A19: Is this study prospective? A20: Are the major assessment results irrelevant to the intervention status?

imaging methods to accurately assess and summarize tumor stage, the surrounding anatomical relationships, and metastasis is of great value for rationally formulating treatment plans and improving clinical prognosis. This study systematically assessed the accuracy of 16-slice SCT in the diagnosis of localized colon cancer.

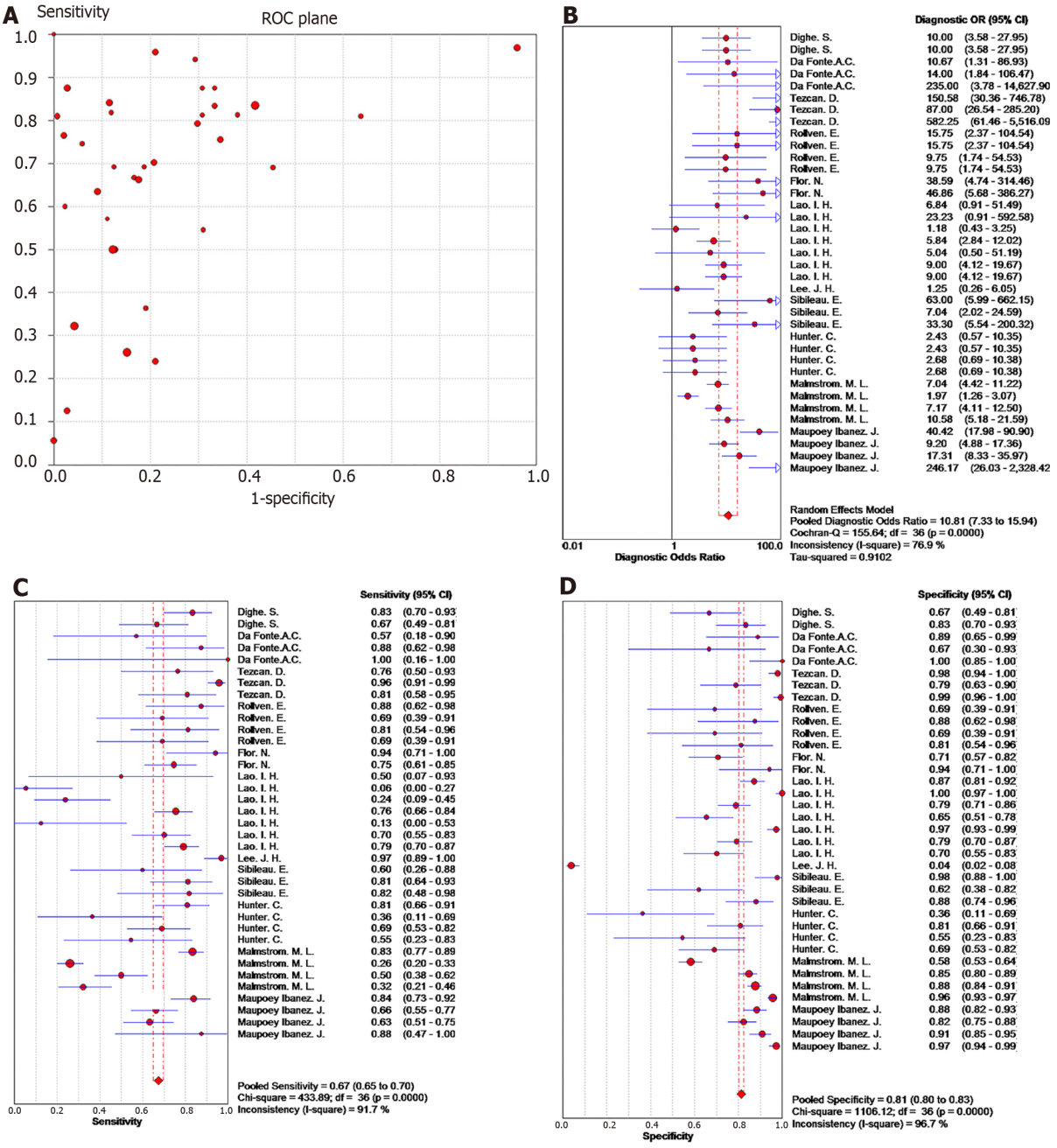

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Figure 2 Forest plot of meta-analysis of studies using ≥ 16-slice computed tomography for colorectal cancer T staging. A: Receiver operating characteristic plan; B: Forest plot of diagnostic odds ratio; C: Forest plot of sensitivity; D: Forest plot of specificity.

T staging

In this study, ≥ 16-slice SCT were shown to have a relatively low sensitivity of only 67% and specificity of 81% for the diagnosis of colon cancer T staging, with the relatively low sensitivity ascribed mainly to the following factors: (1) In this study, the T stages were divided into subgroups and discussed in more detail, with the diagnostic results of T1 and T2 of the colorectal cancer displayed and T4 discussed only by Lao *et al*[23], with unsatisfactory sensitivity and no bowel preparation applied; (2) Two independent investigators' diagnostic results were adopted by Rollvén *et al*[16], with inconsistent judgments, and in most cases, the treatment plans for different colon cancer T stages would not be changed, since most primary tumor resections in patients were conducted when symptoms such as rectal bleeding or intestinal obstruction were already in existence or might occur in the near future[28,29].

N staging

In this study, ≥ 16-slice SCT were shown to have a relatively low sensitivity of only 54% and specificity of 74% for the diagnosis of colon cancer N staging, although there is little literature on the staging reported. During the process of colon cancer treatment, the different lymph node stages will only affect

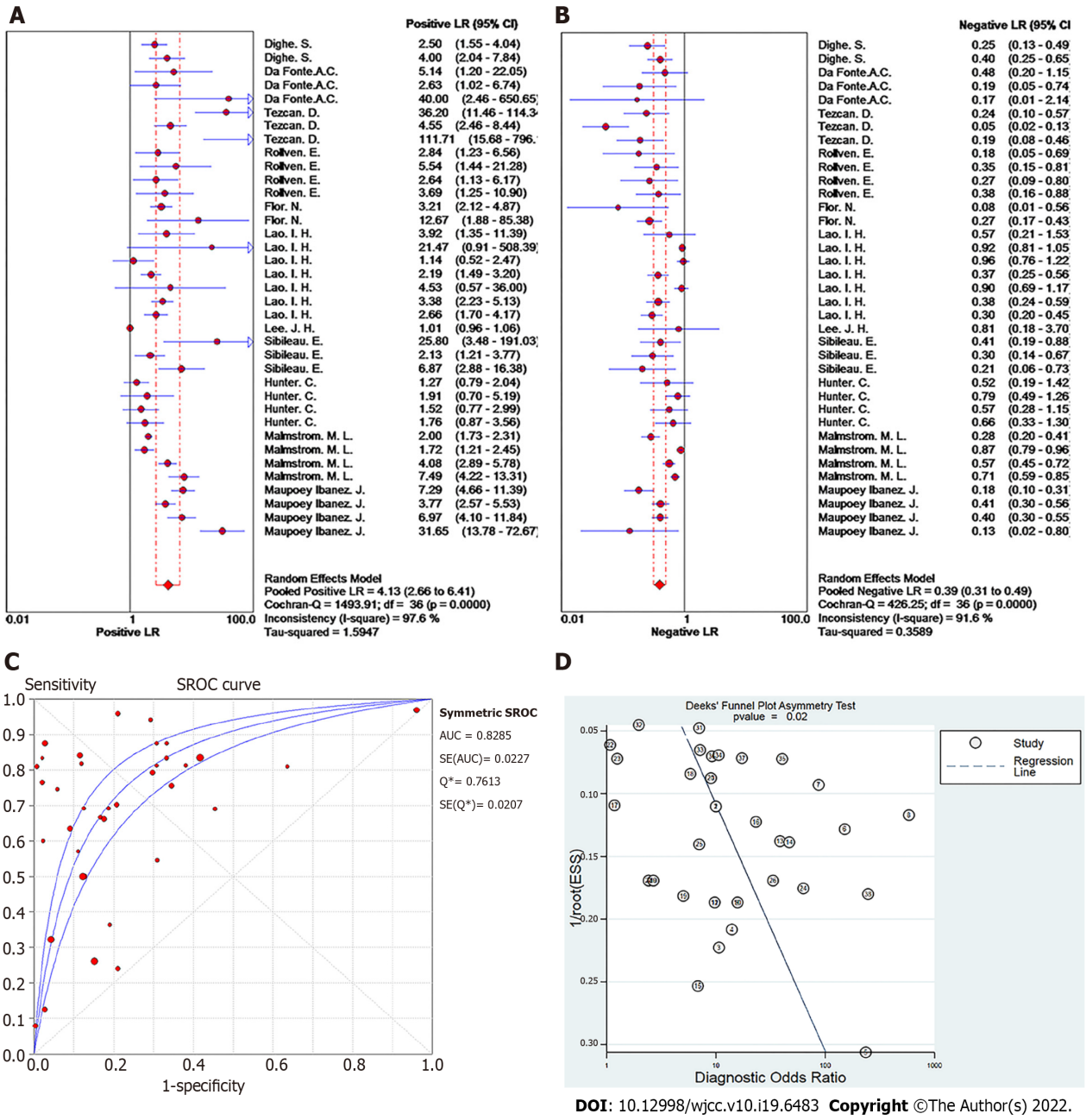

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Figure 3 Forest plot of meta-analysis of studies using ≥ 16-slice computed tomography for colorectal cancer T staging. A: Positive LR; B: Negative LR; C: Summary receiver operating characteristic curve; D: Deeks' funnel plot.

the need for lymph node resection beyond the surgical margin, which largely depends on the existence of distant metastases and/or the presence of clinically relevant complications, and adjuvant chemotherapy is determined based on the presence of metastatic lymph nodes in the resected specimen, rather than on the suspicion of its existence based on imaging techniques[30,31].

Limitations

The limitations of this study are: (1) This system was explored by only 11 studies (5 using 16-slice CT, 6 using 64-slice CT, and 1 using the combination of the 16- and 64-slice CT), with the different slices of CT divided into subgroups going undiscussed, thus failing to determine whether there is a difference in the detection effect of different slices on the local stage of colon cancer; (2) This system only explored the diagnostic effects of ≥ 16-slice SCT for colon cancer T staging and N staging, without discussion over the more detailed staging; (3) Of the 11 included studies, 4 are retrospective reviews, where only some of the patients were possibly recommended to have a CT test, indicating a low inclusion probability of the patients with early or advanced stage of colon cancer; and (4) There was a significant publication bias in the studies included in this system.

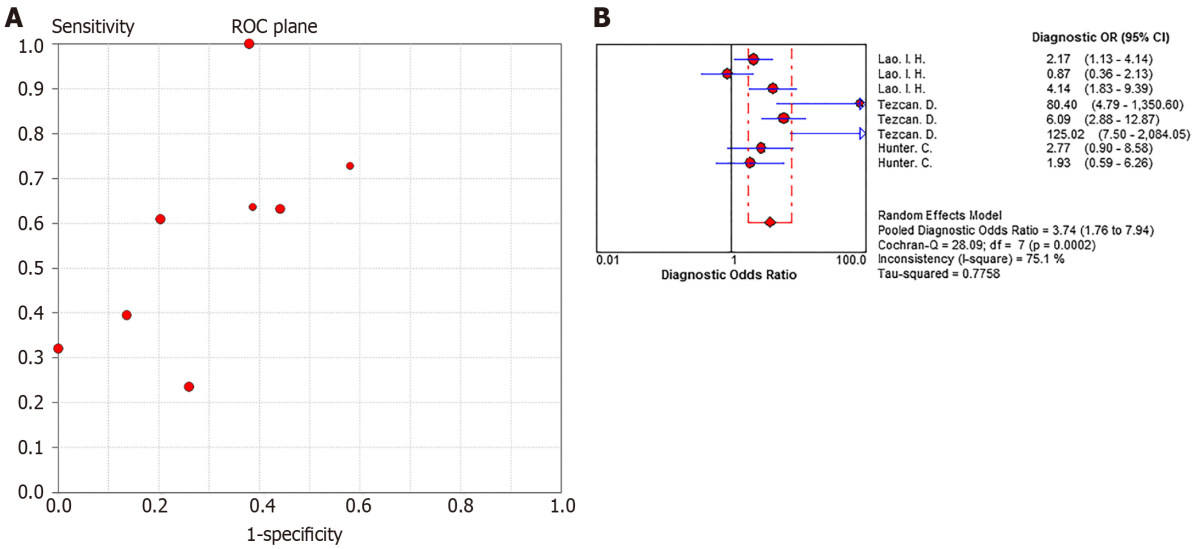

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Figure 4 Pooled effect plot of ≥ 16-slice computed tomography for colorectal cancer N staging. A: Receiver operating characteristic plan; B: Diagnostic odds ratio.

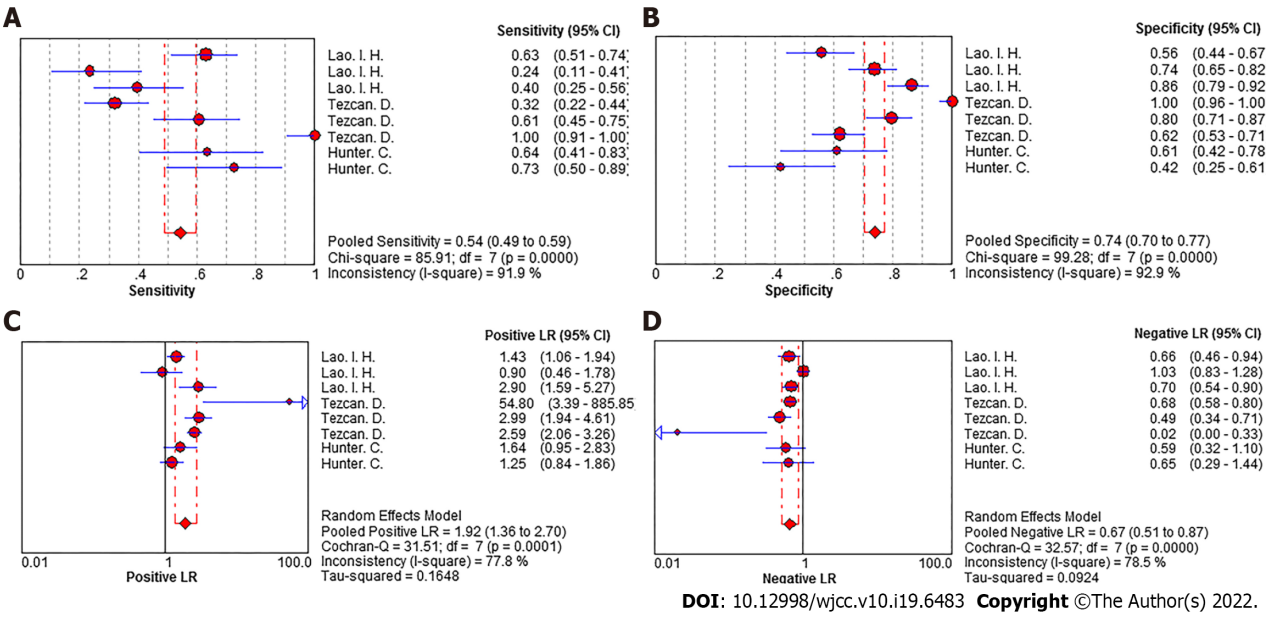

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Figure 5 Forest plot of summary effect of ≥ 16-slice computed tomography for colorectal cancer N staging. A: Sensitivity; B: Specificity; C: Positive LR; D: Negative LR.

CONCLUSION

With the detection of tumors by CT depending largely on the sizes of the tumors, some locally advanced tumors that are confirmed by histopathological tests may be too small to be detected by CT. Thus, sensitivity and specificity are of special importance in the development of screening tests because individuals with the diseases are preferred for recruitment. It was revealed in this study that the sensitivity and specificity of ≥ 16-slice SCT for colon cancer T staging and N staging are acceptable, which is indicative of the good diagnostic value of ≥ 16-slice SCT for local staging of colon cancer. The accuracy of these findings will need to be confirmed by further clinical studies.

ACKNOWLEDGMENTS

We would like to thank all authors of the included primary studies.

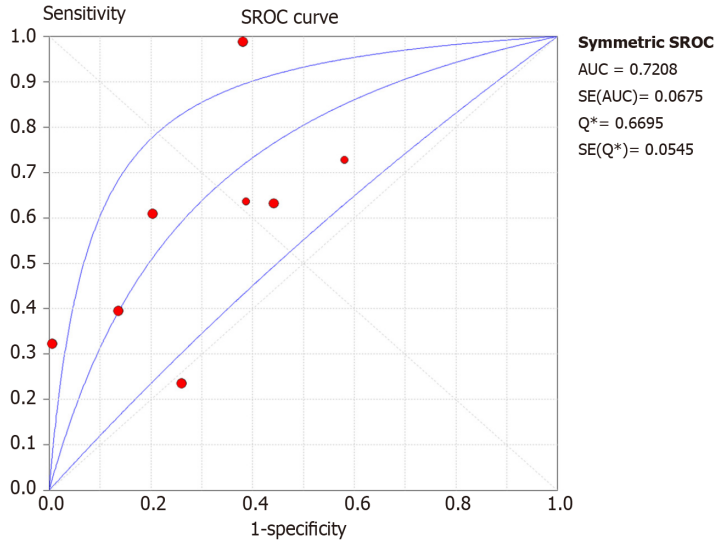

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Figure 6 Summary receiver operating characteristic curve of ≥ 16-slice computed tomography for colorectal cancer N staging.

ARTICLE HIGHLIGHTS

Research background

Colorectal cancer is a common, high-mortality cancer. Classified by the World Health Organization as a single entity, colon cancer and rectal cancer are largely different in their diagnoses, treatments, surgical methods, and recurrence rates. Since early symptoms are easily overlooked, it is important to find a more accurate staging method.

Research motivation

By looking for a method to detect local stages of colon cancer, we hoped to find a method that has better accuracy and can distinguish between high-risk and low-risk colon cancer.

Research objectives

This study aimed to evaluate the diagnostic accuracy of ≥ 16-slice spiral computed tomography (SCT) in detecting local colon cancer staging.

Research methods

Based on the PubMed, EMBASE, Cochrane Library, and Web of Science databases, computers were used to search the literature from the establishment of the database to April 2021. The results of the diagnostic tests on ≥ 16-slice SCT for local colon cancer staging were collected according to the inclusion criteria, and then the data were extracted and assessed on the basis of the Quality Assessment Checklist of the Institute of Economics of Canada. Afterward, a meta-analysis was performed using the statistical software Meta-disc 14.0 and Stata 15.0.

Research results

Eleven studies with a total of 1613 subjects were included. The pooled sensitivity, pooled specificity, pooled negative LR, pooled diagnostic odds ratio, and the area under the fitted receiver operating characteristic curve of ≥ 16-slice SCT for colon cancer T staging and N staging were analyzed. The results revealed that the sensitivity and specificity of ≥ 16-slice SCT for colon cancer T staging were acceptable, while the sensitivity of colon cancer N staging was relatively low, but its specificity was acceptable.

Research conclusions

It was revealed in this study that the sensitivity and specificity of ≥ 16-slice SCT for colon cancer T staging are acceptable, while there is a relatively low sensitivity and specificity for colon cancer N staging, which is indicative of the good diagnostic value of ≥ 16-slice SCT for local staging of colon cancer. These findings need to be confirmed in further clinical studies.

Research perspectives

In the future, further clinical studies should be carried out to prove the accuracy of 16-slice SCT for local staging of colon cancer.

FOOTNOTES

Author contributions: Liu D wrote the main manuscript and fully participated in all analyses; Liu D and Sun LM contributed to the study concept and design; Liang JH, Liu XP, and Song L participated in literature search, data extraction, and quality assessment; all authors read and approved the final manuscript.

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