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ORIGINAL ARTICLE

Diagnostic Accuracy of Anti-Carbamylated Protein Antibodies in Rheumatoid Arthritis: a Systematic Review and Meta-Analysis

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SUMMARY

Background: **The purpose of this study was to estimate the diagnostic accuracy of anti-carbamylated protein (anti-CarP) antibodies in rheumatoid arthritis.**
Methods: **We searched the PubMed, EMBASE, Cochrane Library, Web of Science, and Scopus databases for studies published before January 1, 2019. Two investigators independently evaluated studies to determine their inclusion in the analysis, assess their quality, and extract the relevant data. The articles were assessed with the Quality Assessment of Diagnostic Accuracy Studies tool, and a bivariate mixed effects model was used to estimate the diagnostic indexes across studies.**
Results: **We included 16 published studies in this meta-analysis. The pooled sensitivity and specificity of anti-CarP were 43.1% and 94.4%, respectively. The area under the summary receiver operator characteristic curve was 0.55. The specificity estimates were highly heterogeneous, which could be partly explained by the higher specificity in the healthy control group (43.0%, 96.8%) than in the other disease group (43.4%, 89.8%).**
Conclusions: **Anti-CarP antibodies have a relatively low sensitivity and high specificity for rheumatoid arthritis. However, the specificity was lower in the other disease subgroups than in the healthy controls.**
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Supplementary Tables and Figures

S2 PRISMA checklist.

Section/Topic	#	Checklist Item	Reported in section
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	Title page
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number	Abstract
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known	Introduction
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS)	Introduction
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number	None
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale	Study selection criteria
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched	Data sources and searches
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated	Data sources and searches
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis)	Data sources and searches
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators	Data extraction and study quality assessment
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made	Data extraction and study quality assessment
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis	Data extraction and study quality assessment
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means)	Data analysis
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis	Data analysis

S2 PRISMA checklist (continued).

Section/Topic	#	Checklist Item	Reported on Page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies)	Data analysis
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified	Data analysis
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram	Search results
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations	Search results
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12)	Search results
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot	Diagnostic accuracy of anti-CarP antibody
Synthesis of results	21	Present the main results of the review. If meta-analyses done, include for each, confidence intervals and measures of consistency	Diagnostic accuracy of anti-CarP antibody
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15)	Heterogeneity and subgroup analysis; Publication bias
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16])	Heterogeneity and subgroup analysis; Publication bias
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers)	Discussion
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias)	Discussion
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research	Discussion
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review	None