Ultrasonography, computed tomography and magnetic resonance imaging for diagnosis and determining resectability of pancreatic adenocarcinoma: a meta-analysis


CRD summary
This well-conducted and reported review addressed the comparative accuracy of ultrasonography, magnetic resonance imaging, and conventional and helical computed tomography (CT) to diagnose and assess the resectability of pancreatic adenocarcinoma. The authors' conclusion, that helical CT is preferable as an imaging modality, is reasonable given the data presented.

Authors' objectives
To compare the accuracy of ultrasonography (US), computed tomography (CT) and magnetic resonance imaging (MRI) in diagnosing and determining the resectability of pancreatic adenocarcinoma.

Searching
MEDLINE, EMBASE, the Cochrane Library and Cancerlit were searched from January 1990 to December 2003 for relevant articles published in English or German; the search terms were reported. Additional studies were sought by manually checking the reference lists of retrieved articles and reviews. Unpublished studies were excluded.

Study selection
Study designs of evaluations included in the review
The included studies were required to report data for a minimum of 20 patients.

Specific interventions included in the review
Studies assessing US, CT or MRI for the diagnosis or grading of pancreatic adenocarcinoma were eligible for inclusion. The included studies used both helical and conventional CT. The included studies were conducted in departments of radiology, nuclear medicine, gastroenterology, surgery and internal medicine.

Reference standard test against which the new test was compared
The included studies were required to use one or more of the following reference standards: for diagnosis, histopathology obtained at surgery or autopsy, laparotomy or ultrasound-guided biopsy, or follow-up in patients lacking histology; for determining resectability, surgical findings (histopathology or intra-operative), autopsy and follow-up.

Participants included in the review
The included studies were of patients with known or suspected pancreatic adenocarcinoma (based on laboratory results or ultrasound findings). The median age of the participants ranged from 39 to 74 years. The percentage of males was 57% (derived from 53 of the 68 included studies).

Outcomes assessed in the review
The included studies were required to report sufficient data for the construction of 2x2 contingency tables of the results of the imaging technique versus those of the reference standard. All results for different readers (inter-observer variability), multiple observations per reader (intra-observer variability), and multiple MRI systems or sequences were counted as separate data sets, and respective correlations were taken into account in subsequent meta-analyses. Sensitivity and specificity were the main outcomes calculated in the review.

How were decisions on the relevance of primary studies made?
All retrieved articles were selected by two reviewers, based on the stated inclusion criteria.

Assessment of study quality
The methodological quality of the included studies was assessed on the basis of the following: patient selection (consecutive or non-consecutive); adequate reporting of the characteristics of the study population and the reference standard and index tests; interpretation of the test results (blinded or not blinded); prospective or retrospective data collection; verification complete (>90% of verified using the reference standard), partial (>10% did not receive the reference standard), or unknown. This assessment formed part of the data extraction process.

**Data extraction**

Two reviewers independently extracted the data using a standardised form based on the Standards for the Reporting of Diagnostic Accuracy Studies (STARD) criteria (see Other Publications of Related Interest no.1). The reviewers were not blinded with respect to authors, their affiliations, or journal of publication. Any disagreements were resolved by consultation with a third reviewer.

**Methods of synthesis**

How were the studies combined?

The pooled sensitivity and specificity were calculated, along with their 95% confidence intervals (CIs), using a bivariate random-effects linear regression model (see Other Publications of Related Interest nos.2-5); details of the methods used were fully reported.

The results of individual studies were plotted in receiver operating characteristic (ROC) curve space, separately for diagnosis and determination of resectability.

How were differences between studies investigated?

Regression analyses were used to determine whether sensitivity and specificity values were significantly (P<0.05) associated with the year of publication, sample size (less than or equal to 50 versus more than 50), study setting, and each of the study design characteristics assessed. Significant variables were then included in a random-effects multivariable regression model (variables were retained where P<0.10). The final model was used to compare the diagnostic performance of US, MRI and CT by including imaging modality as an additional variable (P<0.05 was considered to indicate a significant difference between modalities). The statistical methods used were described in full. The effect of including CT criteria for invasion of the portal system (encasement of more than 180 degrees, occlusion, and thrombosis) on the accuracy of estimates of resectability was also assessed.

**Results of the review**

Sixty-eight studies, with a total of 7,405 participants, were included in the review.

Most included studies had flaws in the design characteristics assessed: 39 (57%) did not use consecutive patient selection; interpretation of the test results was not blinded in 38 (56%); data collection was retrospective or unknown in 35 (51%); and 42 (62%) provided insufficient or no description of the reference standard.

**Diagnosis.**

Sufficient description of the patients was included as a variable in the final models for helical CT, MRI and US, while blind interpretation of the results was included as a variable in the final model for conventional CT. The summary sensitivities for helical CT, conventional CT, MRI and US were 91%, 86%, 84% and 76%, respectively; the corresponding specificities were 85%, 79%, 82% and 75%. The sensitivities for MRI and US were significantly lower than that of helical CT (P=0.04 and P=0.0001).

**Resectability.**

The final model included year of publication (set to 2002), study setting (radiology or nuclear medicine), and sufficient description of the imaging tests as covariates for helical CT, and sample size (more than 50 patients) as a covariate for conventional CT. The summary sensitivities for helical CT, conventional CT, MRI and US were 81%, 82%, 82% and 83%, respectively; the corresponding specificities were 82%, 76%, 78% and 63%. The sensitivities were comparable, whereas the specificity for US was significantly lower than that for helical CT (P=0.0011).
CT criteria for invasion of the portal system.

The use of predefined CT criteria showed no improvements in sensitivity or specificity in comparison with the overall results of helical CT (based on 19 studies).

Authors' conclusions
Helical CT is preferable as an imaging modality for the diagnosis and determination of the resectability of pancreatic adenocarcinoma.

CRD commentary
This was a rigorously conducted and well-reported systematic review addressing a clearly stated research question. Appropriate inclusion criteria were defined and measures were taken to avoid the introduction of error and bias during the review process. The restriction of the literature search to publications in English and German might have resulted in the omission of some relevant data. A thorough assessment of the methodological quality of the included studies was conducted and incorporated into the meta-analysis. Though complex and novel meta-analytic methods were used, these were clearly described and appropriately applied. The authors' conclusions follow from the data presented.

Implications of the review for practice and research
The authors made no specific recommendations for research or practice.

Bibliographic details

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Other publications of related interest

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Subject indexing assigned by NLM

MeSH
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Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.