Diagnostic value of diffusion-weighted magnetic resonance imaging compared with fluorodeoxyglucose positron emission tomography/computed tomography for pancreatic malignancy: a meta-analysis using a hierarchical regression model
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CRD summary
The review concluded that positron emission tomography with computed tomography was highly sensitive, and diffusion-weighted magnetic resonance imaging was highly specific, in diagnosing patients with pancreatic malignancy. Generally this was a well-conducted review, but there was some uncertainty surrounding the reliability and generalisability of the pooled estimates, and the conclusions seem too strong.

Authors' objectives
To assess the diagnostic performance of diffusion-weighted magnetic resonance imaging (MRI) and \textsuperscript{18}fluorine fluorodeoxyglucose (FDG) positron emission tomography (PET) with computed tomography (CT) in the detection of pancreatic malignancy.

Searching
MEDLINE and EMBASE were searched for studies published in English from 1995 to August 2011; the search strategy was reported. Science Direct, SpringerLink, Scopus, Cochrane Database of Systematic Reviews, and the reference lists of retrieved articles were searched.

Study selection
Studies with at least 10 patients that compared diffusion-weighted MRI or PET-CT against a reference standard of histology for the diagnosis of pancreatic malignancy, were eligible for inclusion. Studies had meet at least nine of the 14 Quality Assessment of Diagnostic Accuracy Studies (QUADAS) criteria and provide sufficient data to construct 2x2 tables of test performance.

In the included studies, the mean age of participants ranged from 23 to 94 years, and overall the number of men and women was similar. All studies used clinical follow-up in addition to histopathology. Where reported, the average lesion size ranged from 12 to 51mm.

It seems that two reviewers selected studies for the review, and a third reviewer resolved discrepancies.

Assessment of study quality
Two reviewers assessed study quality using the QUADAS tool; a third reviewer resolved discrepancies.

Data extraction
Two reviewers extracted the data to construct 2x2 tables of test performance, from which sensitivity and specificity were calculated. Study authors were contacted for missing data, and a third reviewer resolved any discrepancies.

Methods of synthesis
Summary estimates of sensitivity and specificity, with 95\% confidence intervals, were produced using a hierarchical summary receiver operating characteristic curve. The pooled estimates of sensitivity and specificity were used to calculate likelihood ratios; a positive ratio greater than 5.0 and a negative ratio less than 0.2 were considered to indicate a good diagnostic test. Heterogeneity was assessed using \( \chi^2 \) and \( I^2 \); if significant heterogeneity was observed, a random-effects model was used. Meta-regression was used to investigate heterogeneity. Subgroup analysis was used to investigate the impact of study design and quality, lesion size, and use of a contrast agent.

Results of the review
Sixteen studies were included in the review, with 804 patients; 10 studies were prospective, five were retrospective, and the other study was unclear. Eight studies recruited patients consecutively and nine blinded interpreters of the index test to other clinical data. Four studies used contrast-enhanced PET-CT and seven used PET-CT without contrast.
enhancement (some used both); seven studies used diffusion-weighted MRI.

For PET-CT (nine studies), sensitivity was 87% (95% CI 82 to 91; as reported), specificity was 83% (95% CI 71 to 91), the positive likelihood ratio was 5.84 (95% CI 4.59 to 7.42) and the negative likelihood ratio was 0.24 (95% CI 0.17 to 0.33). For diffusion-weighted-MRI (seven studies) sensitivity was 85% (95% CI 74 to 92), specificity was 91% (95% CI 71 to 98), the positive likelihood ratio was 9.53 (95% CI 2.41 to 37.65) and the negative likelihood ratio was 0.17 (95% CI 0.09 to 0.32). I² was over 50% for each estimate of sensitivity and specificity.

Enhanced PET-CT (four studies) had a sensitivity of 91% (95% CI 86 to 96) and specificity of 88% (95% CI 73 to 100); without enhancement PET-CT (seven studies) had a sensitivity of 84% (95% CI 78 to 90) and specificity of 81% (95% CI 69 to 94). The results of other subgroup analyses were reported.

Authors’ conclusions
PET-CT was highly sensitive, and diffusion-weighted MRI was highly specific, in diagnosing patients with pancreatic malignancy; they could therefore play different diagnostic roles. Enhanced PET-CT seemed to be superior to PET-CT without contrast enhancement.

CRD commentary
The review addressed a clear review question, supported by reproducible inclusion criteria. There was an extensive search for studies published in English; there were no attempts to reduce potential publication and language bias. It appears that each stage of the review process was conducted in duplicate, reducing the risk of error and bias. Study quality was assessed using relevant criteria and studies were excluded if they failed five or more QUADAS criteria, but there was no grading of the importance of different criteria. The risk of bias in some excluded studies could have been lower, or less important, than that in some included studies. Apart from blinding, the results of the assessment were not reported for each study, making it impossible to determine which studies suffered from which biases.

The authors used a robust hierarchical summary receiver operating characteristic model, but the pooled estimates of sensitivity and specificity presented in the text were from standard frequentist meta-analysis, based on clinically and statistically heterogeneous studies. The reliability and generalisability of estimates derived from these separate analyses is uncertain. The estimates derived from the hierarchical summary receiver operating characteristic appear to have been similar for diffusion-weighted MRI, but slightly lower for PET-CT, and the confidence intervals showed high uncertainty in these estimates. Appropriate subgroup and sensitivity analyses were conducted.

Generally this was a well-conducted review, but there was some uncertainty surrounding the reliability and generalisability of the pooled estimates and the conclusions seem too strong.

Implications of the review for practice and research
Practice: The authors did not state any implications for practice.

Research: The authors stated that further studies, with more patients, were needed to examine the efficacy, radiation exposure, and cost-effectiveness of contrast-enhanced PET-CT.

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