Local staging of prostate cancer using magnetic resonance imaging: a meta-analysis

Authors' objectives
The authors assessed the extent to which the performance of magnetic resonance imaging (MRI) for local staging in prostate cancer is affected by patient characteristics, study design and characteristics of the imaging protocol.

Searching
MEDLINE and EMBASE were searched from January 1984 to May 2000; the search terms were listed in the review. There were no language restrictions. The reference lists of retrieved articles and the authors' personal files were consulted for additional studies. The authors also searched abstracts (1998 to May 2000) of the Radiological Society of North America, the International Society of Magnetic Resonance in Medicine, and the European Society of Magnetic Resonance in Medicine.

Study selection
Study designs of evaluations included in the review
The authors did not specify any inclusion criteria for the study designs in the review. Both prospective and retrospective designs appear to have been included. Duplicate studies, reanalyses and reviews were excluded.

Specific interventions included in the review
No inclusion criteria relating to the index test characteristics were specified. The authors did not provide details of the MRI protocols used in the individual studies included in the review.

Reference standard test against which the new test was compared
The reference standard was a comparison with the surgically resected prostate. Studies that did not compare MRI with histological diagnosis were excluded.

Participants included in the review
The participants in the primary studies included in the review were men with prostate cancer. The authors did not describe the inclusion criteria used for participants in the primary studies.

Outcomes assessed in the review
Studies that included data on, or allowed the calculation of the sensitivity or specificity of MRI for local staging in prostate cancer were eligible. The authors recorded or calculated the sensitivity and specificity of MRI for detecting extracapsular extension, seminal vesicle invasion and clinical stage cT3 tumours in each study. Studies that included data only on nodal staging were excluded.

How were decisions on the relevance of primary studies made?
Three reviewers assessed each study independently. The exclusion criteria were applied in the following order.

1. Reanalysis/review.
2. Only data on nodal staging.
3. No comparison with surgical resection.
4. No data on, or that allowed the calculation of the specificity and sensitivity.

The first exclusion criterion found was recorded for each study excluded. Any disagreements were resolved by consensus.
Assessment of study quality
Methodological characteristics pertaining to study quality were extracted: verification of imaging results, study design, inclusion of consecutive patients and sample size. These were used in the analysis. It appears that three authors assessed validity independently. However, they appear to have assessed whether methodological features affected the study findings, rather than excluding studies on the basis of methodological quality.

Data extraction
Data were extracted on the patients' characteristics, methodological features and MRI protocol using a standardised form. The authors did not state how many reviewers performed the data extraction.

Patient group characteristics included average age, prostate specific antigen level, tumour grade, hormonal pre-treatment, and the proportion of participants with pathological stage T3 tumour (pT3). Methodological characteristics included publication year, department of origin, verification bias (whether all imaging results were verified by a reference standard), time between biopsy and MRI, consensus reading, prospective or retrospective study, consecutive patients, sample size and histological preparation. Imaging protocol characteristics included the number of imaging planes, the imaging sequence, inclusion of the endorectal coil, magnetic field strength, image resolution, use of glucagons, contrast agents, use of magnetic resonance spectroscopy and dynamic contrast-enhanced imaging.

Methods of synthesis
How were the studies combined?
Summary receiver operating characteristic (sROC) curves were constructed for the performance of MRI in detecting extracapular extension, seminal vesical invasion, and stage cT3, using a random-effects model weighted for sample size. The sROC analysis was performed for publication year, consensus reading, prospective versus retrospective design, sample size, imaging planes, turbo spin echo imaging, use of the endorectal coil, and contrast agents. Only studies using the per-prostate histological gold standard and with 24 or less missing values were included in these analyses. Area under the curve was used as a summary measure.

How were differences between studies investigated?
A univariate regression analysis was used to determine which patient, study design and imaging protocol characteristics were significant sources of heterogeneity. Characteristics which caused significant variation in staging performance were the subject of subgroup sROC analyses.

Results of the review
Seventy-one articles and 5 abstracts, containing a total of 146 studies, were included. A study was defined as a set of sensitivity and specificity data resulting from one diagnostic evaluation. One article or abstract could, therefore, contain more than one study of the same participants. The authors did not specify the overall number of participants included in the review. It was difficult to extract this information from the review because the statistical subgroup analyses were based on varying sample sizes.

There was a trend towards lower staging performance in studies with samples of 50 and above (P<0.001) and where studies used per-prostate scoring (P<0.001). Staging performance was improved where multiple imaging planes (P=0.012), contrast agents (P=0.0024), and turbo spin echo and endorectal coil (P=0.05) were used. There was no significant difference in staging performance associated with year of publication, consensus reading, or prospective versus retrospective studies.

Authors' conclusions
It was not possible to fully explain the heterogeneity of MRI performance found in different studies. This was partly due to the poor reporting in primary studies, and partly because it was not possible to evaluate the role of clinical information and reader experience. The authors suggested that turbo spin echo, endorectal coil and multiple imaging planes may all improve local staging performance of MRI in prostate cancer. They also noted that small sample sizes may result in higher performance, which may be of importance when interpreting the literature.
CRD commentary
This review addressed a defined research question. The general exclusion criteria were provided and there were no language restrictions. The search strategy appears to have been reasonable, although it might have been useful to search additional databases such as Cancerlit. It was unclear whether unpublished studies, other than those in abstract form, were eligible for inclusion in the review. This may mean that publication bias was evident. The authors did not report a method for assessing publication bias.

The authors did not provide full details of the methods used to assess the validity of the studies in the review. Information was extracted about methodological features. Details of the individual studies included in the review were not reported, making it difficult to assess the generalisability of the review's findings.

The data were synthesised using sROC analyses, which were reported in detail. Between-study heterogeneity was not formally assessed, as an acknowledgment of heterogeneity was implicit in the study objectives: the investigation of the impact of potential sources of heterogeneity on staging performance. The methods used to conduct this analysis were rigorous, appropriate and well described.

The authors drew broad conclusions that appear to have been supported by the data presented. However, caution is advised when interpreting these findings because the authors did not present sufficient details about the individual studies.

Implications of the review for practice and research
Practice: The authors stated that turbo spin echo, endorectal coil, and multiple imaging planes may all improve the local staging performance of MRI in prostate cancer.

Research: The authors stated that the quality of reporting in future studies should be improved. They also suggested that care should be taken when conducting and interpreting small studies, as these may contain a bias towards higher staging performance.

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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.