Systematic review of the diagnostic accuracy of MRS and enhanced MRI techniques in aiding the localisation of prostate abnormalities for biopsy

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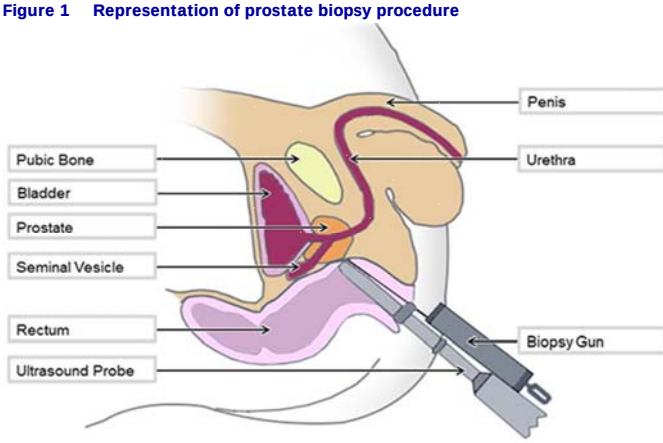
BACKGROUND

Prostate cancer is the most common cancer in men in the UK and the second most common cause of cancer death in men after lung cancer. Diagnosis can be confirmed only by prostate biopsy (Figure 1). However, men with a negative biopsy often continue to have a raised prostate specific antigen (PSA) level. These men may undergo repeated biopsies which can be painful and provide little additional diagnostic information. The optimal strategy for their management is currently uncertain.

New imaging techniques have therefore been introduced in order to reduce unnecessary follow-up biopsies. Conventional standard magnetic resonance imaging (MRI) can be performed with add-ons including three-dimensional magnetic resonance spectroscopy (MRS), dynamic contrast enhanced MRI (DCE-MRI) and diffusion weighted MRI (DW-MRI). These techniques may provide more specific information regarding the location, size and aggressiveness of any tumours.

Figure 1 Representation of prostate biopsy procedure



Royal United Hospital, Bath NHS Trust www.ruh.nhs.uk/ [accessed October 2012]

OBJECTIVES

To conduct a systematic review of the literature following the general principles of the Centre for Reviews and Dissemination guidance[1] to assess the diagnostic accuracy of MRS and enhanced MRI techniques (DCE-MRI, DW-MRI) in aiding the localisation of prostate abnormalities for biopsy in men with suspected prostate cancer and elevated PSA but previously negative biopsy.

METHODS

Electronic searches of 15 databases and websites were undertaken using sensitive search strategies. Types of studies considered included direct (head-to-head) studies and randomised controlled trials reporting diagnostic outcomes. Index tests were MRS, DCE-MRI and DW-MRI while comparator tests were standard (T2-weighted) MRI and transrectal ultrasonography (TRUS). The reference standard was histopathological assessment of biopsied tissue. The population was men with suspected prostate cancer and elevated PSA but previous negative biopsy. Meta-analysis models were fitted using hierarchical summary receiver operating character (HSROC) curves.

RESULTS

Fifty-one studies (39 full text, 12 abstracts) were included, involving over 10,000 men. Table 1 displays a summary of meta-analysis results. In pooled estimates, sensitivity (95% CI) was highest for MRS at 92% (86 to 95%), followed by T2-MRI at 86% (74 to 93%) and DCE-MRI at 79% (69 to 87%), while specificity (95% CI) was highest for TRUS (used as an imaging test) at 81% (77 to 85%), followed by MRS at 76% (61 to 87%). Only one small study involving 43 participants reported DW-MRI, with sensitivity of 100% (specificity not reported).

For combinations of tests, when both tests were required to be positive for the combination to be positive, the test combination was linked by 'and'. When only one of the tests was required to be positive for the combination to be positive, the test combination was linked by 'or'. Sensitivity was highest for 'MRS or T2-MRI at 96% (90 to 98%) followed by 'DCE-MRI or T2-MRI' at 88% (80 to 96%), while specificity was highest for 'MRS and T2-MRI' at 74% (65 to 84%). The gain in sensitivity from MRS as a single test (92%) to the combination 'MRS or T2-MRI' (96%) was offset by a large decrease in specificity from 76% to 31%.

In the meta-analysis of the six studies directly comparing MRS with T2-MRI, sensitivity and specificity for MRS were 89% and 71%, respectively, compared with 77% and 68% for T2-MRI.

Table 1 Summary of meta-analysis results (patient level data)

Test	No of studies	Sensitivity	Specificity
MRS	10	92 (86 to 95)	76 (61 to 87)
DCE-MRI	3	79 (69 to 87)	52 (14 to 88)
T2-MRI	15	86 (74 to 93)	55 (44 to 66)
TRUS	6	27 (16 to 42)	81 (77 to 85)
Combinations of tests			
MRS or T2-MRI	8	96 (90 to 98)	31 (21 to 42)
MRS and T2-MRI	5	60 (46 to 75)	74 (65 to 84)
DCE-MRI or T2-MRI	3	88 (80 to 96)	14 (8 to 20)
Studies directly comparing MRS with T2-MRI			
MRS	6	89 (79 to 95)	71 (51 to 85)
T2-MRI		77 (55 to 90)	68 (59 to 75)

CONCLUSIONS

For individual tests, MRS had higher sensitivity and specificity than T2-MRI. Evidence relating to DCE-MRI and DW-MRI was limited. TRUS used as an imaging test had low sensitivity but high specificity.

For combinations of tests, sensitivity was highest for 'MRS or T2-MRI' at followed by 'DCE-MRI or T2-MRI', while specificity was highest for 'MRS and T2-MRI'.

Prospective studies are required comparing the utility of the individual and combined components of a multi-parametric magnetic resonance (MR) approach (MRS, DCE-MRI and DW-MRI) with both an MR-directed biopsy (i.e. to identify suspicious areas prior to biopsy) or MR-guided biopsy (i.e. to obtain tissues samples from previously identified suspicious areas) and an extended 14 core TRUS-guided biopsy scheme against a reference standard of histopathological assessment of biopsied tissue obtained via saturation biopsy, template biopsy or prostatectomy specimens.

REFERENCE

1. CRD's guidance for undertaking systematic reviews in health care [document on the Internet]. *Centre for Reviews and Dissemination.* 2009.
URL: http://www.york.ac.uk/inst/crd/SysRev/!SSL!/WebHelp/SysRev3.htm

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