**The use of MRI scanning to triage patients**

Victor Kpandemoi Abu

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**Abstract**

The rise in the incidence of prostate cancer is mainly attributed to the increasing use of the serum prostate-specific antigen (PSA) blood test as a screening tool. Regardless of doubts over its sensitivity and specificity, PSA remain a key mechanism in the diagnosis and management of prostate cancer. The Department of Health (DH) in the UK recommends urgent specialist referral for patients presenting with age-elevated PSA. This national guideline, known as the National Cancer Wait Times (NCWT) system, aims at monitoring the process of referral, investigation and management of new suspicious prostate cancer cases. The use of trans-rectal ultrasound (TRUS) guided prostate biopsy is the gold-standard specialist investigation for prostate cancer. However, there is growing interest in the use of imaging techniques like magnetic resonance imaging (MRI) as first-line specialist investigation for suspicious prostate cancer.

**Key words:** Prostate cancer n Magnetic resonance imaging n Prostate specific antigen n Multidisciplinary team

**Introduction**

This article will evaluate the effectiveness of a multidisciplinary team (MDT) approach to prostate cancer management and compliance with the National Cancer Wait Times (NCWT) system. It is the outcome of an audited one-stop service including the use of magnetic resonance imaging (MRI) scanning as first-line specialist investigation to triage patients with age-elevated prostate specific antigen (PSA) and the impact of this approach on the NCWT system. The service involved same-day MRI scanning, MDT review of the MRI report, and clinic review of the patient by a urology clinical nurse specialist.

The sample of the audited service included all men referred by their general practitioners (GPs) with raised PSA via the NCWT. Prospective data was collected on the demographic and clinical background of each patient. Additional data was collected on dates of referrals and clinical tests and outcomes of clinical decisions. The objective of the audit was to assess the benefit of the one-stop service to the patients, clinicians and stakeholders.

The discussion incorporates background information about PSA screening, the NCWT system, and the utility of trans-rectal ultrasound (TRUS) guided prostate biopsy and MRI scanning in the investigation of suspicious prostate cancer. It will also highlight the pivotal role played by urology nurse specialists in the development of the service.

**Background**

The rise in the incidence of prostate cancer is principally attributed to the increasing use of the serum PSA blood test as a screening tool for prostate cancer. PSA is a serum protein produced by prostate gland, which may be elevated in the presence of prostate cancer and other prostatic disorders such as benign prostate hyperplasia (BPH) and prostatitis. Regardless of doubts over sensitivity and specificity of PSA as a screening tool for prostate cancer (Andriole et al, 2009; Schröder et al, 2009), it remains a key mechanism in the diagnosis and management of the prostatic diseases.

In recognition of the test’s significance as a measurement tool in prostate cancer, the Department of Health (DH) (2006) in the UK has recommended urgent specialist assessment for patients with age-elevated PSA. This national guideline, which is part of the NCWT system, is aimed at monitoring the process of referral, investigation and initiation of treatment for new suspicious prostate cancer cases. The timeline involves: 2 weeks from time of GP referral to first specialist assessment, 31 days from time of decision to treat to initiation of treatment, and 62 days for initiation of treatment from time of GP referral (DH, 2006).

Age-elevated PSA is associated with age-adjusted PSA, which determines normal PSA levels according to the age of the patient. There is no universal consensus about different PSA levels for different ages. Examples of PSA levels considered to be normal in accordance to age are illustrated in Table 1.

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| **Table 1. Examples of age-adjusted prostate specific antigen** | |
| Age range | Normal PSA level |
| Men aged below sixty years | PSA level of 3 nanograms per millitre  or less (≤3 ng/ml) |
| Men aged between sixty and seventy | PSA level of 4 nanograms per millitre  or less (≤4 ng/ml) |
| Men aged over seventy years | PSA level of 5 nanograms per millitre  (=5 ng/ml) |

Where men present with age-elevated PSA, the gold standard specialist diagnostic investigation for prostate cancer is TRUS-guided prostate biopsy (Chapple et al, 2007). This approach is widely used and often the first specialist investigative tool in prostate cancer diagnosis. Pathology from TRUS-guided prostate biopsy is graded using the universal Gleason score (Epstein et al, 2005) which numerically categorizes prostate cancer into low, intermediate or high risk disease. Prostate biopsy findings help to determine disease burden based on number of positive cores, and stage or extent of disease based on distribution of cancer cells in the specimen. Patient uptake of TRUS-guided prostate biopsy is affected by its association with pain, anxiety, urosepsis, rectal bleeding, haematuria, heamatospermia, and disparities between Gleason score reports by general pathologists and urologic pathologists (Zisman et al, 2001; De Sio et al, 2005).

**Utility of MRI scanning in management of prostate cancer**

There is growing interest in the use of MRI techniques in the diagnosis and management of prostate cancer. MRI techniques provide defined intra- and extra-capsular prostatic tumour by use of signal intensities from morphological changes within and in the surroundings of the prostate (Borre et al, 2005). It provides three-dimensional spatial information and good contrast between different soft tissues, making it especially useful in imaging cancerous tissues. Compared with computed tomography (CT) scan or X-rays, MRI scanners do not use ionizing radiation. The limitations of MRI scanning in prostate cancer diagnosis have been summarised in Box 1.

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| **Box 1. Limitations of MRI scanning in prostate cancer diagnosis** |
| * MRI is contraindicated in patients with certain medical, biostimulation and surgical implants, like the pacemaker * Use of gadolinium contrast in MRI is contraindicated in patients with poor renal function, as it is associated with risk of nephrogenic systemic fibrosis * MRI is contraindicated in patients who suffer from claustrophobia, and has been reported as an uncomfortable and noisy experience * MRI scanners are expensive, which may result in the provision of poor quality MRI scanners in many departments   (Engelbrecht et al, 2002; Borre et al, 2005; Grobner, 2006; Marckmann et al, 2006; Kanal et al 2007; Ahmed et al, 2009) |

The traditional value of MRI scanning in prostate cancer has been for imaging of extra-prostatic areas such as seminal vesicles and pelvic lymph nodes. In most departments, it is primarily used in post-biopsy investigation of extraprostatic disease. However, intraprostatic investigation is now enabled by the use of specialized MRI scanners such as T1- and T2-weighted MRI, diffusion MRI, MRI endoscopic coil, MRI spectroscopy, contrast enhanced MRI, Tesla 1.5 and Tesla 3.0 MRI scanners (Govindaraju et al, 2008). Key manufacturers of MRI scanners are G E Medical Systems, Hitachi Medical Systems, Philips Medical Systems, Siemens Medical Solutions and Toshiba Medical Systems (magnetmri.org).

This creates the background to this article which focuses on a departmental interest in the utility of MRI prior to prostate biopsy. Box 2 presents the rationale for MRI scanning prior to prostate biopsy as demonstrated in a study by Ahmed et al (2009).

**Experience with MRI utility to triage patients at risk of prostate cancer**

At the University College London Hospitals (UCLH), MRI scanning has been in use for about 6 years as first-line specialist diagnostic test for men with suspicious prostate cancer. This novel approach has replaced the traditional use of TRUS-guided prostate biopsy as first-line specialist diagnostic tool. The rationale for this approach has been documented in a study by Ahmed et al (2009), as presented in Box 2.

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| **Box 2. Rationale for MRI prostate prior to prostate biopsies** |
| * Help in selection of men with obvious prostate tumour who may benefit from prostate biopsy * Help in selection of men with less significant or non-suspicious prostate lesion, who may avoid prostate biopsy and its associated adverse effects * May help prevent unnecessary treatment for low risk biopsy diagnosed prostate cancer * To avoid biopsy artifacts caused by post-biopsy haemorrhage and scarring that may affect staging accuracy * Help determine accurate disease burden |

A one-stop service has been developed at the UCLH NHS Trust, which guides the decision-making process for men presenting via the NCWT system or with suspicious prostate cancer. Rapid access is provided for same-day MRI scanning, followed by prostate MDT review, and nurse-led clinic review. The objective of the service is to use MRI findings and an MDT approach to decide suitable management options for this patient group.

The development of the MRI prostate service was research driven in a department interested in interventional radiological management of prostate cancer. Examples of such interventional radiological approaches include high intensity focused ultrasound (HIFU), photo-dynamic therapy (PDT) and cryoablation therapy (CAT). The dependence of these approaches on MRI utility has resulted in the availability of specialist MRI facilities and a highly experienced MDT with large MRI prostate patient throughput. The one-stop MRI prostate clinic activities have been presented in Table 2.

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| **Table 2. The one-stop MRI prostate clinic activities** | |
| **Time** | **Activity** |
| Monday morning | Patient receives MRI scanning |
| Monday early-afternoon | Prostate MDT meeting for review of MRI findings and making management recommendations |
| Monday mid-afternoon | Patient is reviewed at a nurse-led clinic with prostate MDT outcome, including MRI findings and management  recommendations |

This article has used the outcome of a prospective audit of this one-stop service between January and June 2010. The following data was collected: patient age, date of GP referral, presenting PSA, date of MRI scanning, MRI findings, prostate MDT recommendations, date of TRUS prostate biopsy, TRUS prostate biopsy findings and date of treatment of choice.

An arrangement is in place for five protected MRI scanning slots on Monday mornings for patients referred via the NCWT system. The patient referral criterion is in line with the NCWT, which requires patients with age-elevated PSA or clinical suspicious prostate cancer to have specialist assessment within 2 weeks. An administrative service is in place to ensure that this patient group is identified and appropriately booked for same-day MRI scanning and clinic review.

The prostate MDT is used as the forum for careful review of MRI findings and decision making. Its membership comprises consultant radiologists, consultant histo-pathologists, consultant interventional uro-oncologists, uro-oncology surgeons, urology academic fellows, urology specialist registrars, urology clinical nurse specialists, prostate clinical research fellows, prostate research nurses and data administrators. The radiologists report MRI findings as suspicious, non-suspicious or indeterminate for prostate cancer. A scoring (1–5) system helps to describe the degree of prostate lesion suspicion, where 2 out of 5 or less (≤2/5) is non-suspicious for prostate lesion, 4 out of 5 or above (≥4/5) is suspicious for prostate lesion, and 3 out of 5 (3/5) is indeterminate for prostate lesion. A similar scoring system were adopted by Shukla-Dave et al (2007), who used a 1–3 scale to determine - definitely insignificant (1/3), definitely significant (3/3), and indeterminate (2/3) for prostate lesion. Their definition was based on the surgical pathology of organ-confined cancer.

The prostate MDT provides information about areas of suspicious prostate lesions within or in the surrounding of the prostate. This involves the anatomical distribution of suspicious lesions, including zonal areas (peripheral, transition, central), lobes (left, right), basal, apical, anterior and posterior aspects of the prostate. Such anatomical distributions help to describe the stage of the disease and also the disease burden.

Finally, the prostate MDT makes management recommendations for each patient based on their MRI findings and individual circumstances, including age, PSA level, PSA density, PSA velocity and comorbidities. Table 3 illustrates the basis of management recommendations.

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| **Table 3. Outcome of prostate MDT meeting** | | |
| Scores (one to five) | Degree of suspicious prostate cancer | Recommended management options |
| Two out of five or less (<0.15 ug/L)  (≤2/5) | No significant prostate lesion on MRI | * PSA monitor if with normal PSA density (<0.15 ug/L) * TRUS prostate biopsy if abnormal PSA density (>0.15 ug/L) * PSA monitor only if patient is elderly or has significant comorbidities |
| Three out of five (3/5) | Indeterminate for significant prostate lesion on MRI | * TRUS prostate biopsy if patient is younger * PSA monitor if patient is elderly * PSA monitor is patient has significant * comorbidities |
| Four out of five or above (≥4/5) | Definite  significant  prostate lesion  on MRI | * Standard TRUS prostate biopsies * Standard TRUS prostate biopsies with suggested target area(s) * Limited targeted TRUS prostate biopsies if patient is elderly with significant disease * Trans-perineum (template) biopsies if anterior   prostate lesion is suspected   * Bone scan only if patient is elderly with significant disease and comorbidities |

At the nurse-led clinic, the patient is assessed and clinically assessed. They are informed about their MRI findings, often with the aid of diagrammatic representations of suspicious lesions. They are then carefully counselled about their management recommendations (Table 4) and rationale for the management approach. It is noticeable that the age of the patient is an essential element of management of suspicious or known prostate cancer. This is owing to the established age dependent management approaches in management of prostate cancer, ranging from radical therapies in younger age range (often less than 75 years) to conservative management in the elderly (above 75 years) (Oelke et al, 2011).

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| **Table 4. Management options offered to patients** | | | |
| Management  recommendation | Rationale for  recommendation | Number of  patients offered  or accepted  recommendation  (total number 58) | Percentage of  patients offered  or accepted  recommendation |
| PSA monitor | • No MRI significant  prostate lesion with  normal PSA density  (<0.15 ug/L), or  elderly age range,  or significant  co-morbidities  • MRI indeterminate  for significant  prostate lesion in  elderly age range,  with significant  co-morbidities | 20 patients | 34.8% |
| TRUS prostate  biopsies (standard  or limited or  targeted) | * No MRI significant prostate lesion, but with abnormal PSA density ≥ 0.15 ug/L * MRI indeterminate for significant lesion, in younger age range * MRI definite prostate lesion | 33 | 56.8% |
| Template prostate  biopsy | * MRI suspicious * anterior prostate * lesion * Patient considering * minimal therapy * such as INDEX * lesion HIFU | 4 | 6.8% |
| Bone scan | * Significant Prostate lesion on MRI, in elderly patients, with significant co-morbidities | 3 | 5.1% |

PSA monitor was recommended for patients whose MRI findings indicated; non-suspicious MRI prostate lesion, no significant MRI prostate lesion, significant comorbidities, and indeterminate MRI with low PSA density. This patient group avoided prostate biopsies and exposure to associated complications. Standard prostate biopsy was offered in the majority of cases of suspicious prostate lesion, while limited targeted biopsy helped to minimize risk of morbidity in elderly patients. Trans-perineum prostate biopsy was offered to patients with suspicious anterior prostate lesion that may be difficult to biopsy with the standard TRUS prostate biopsy approach (Bott et al, 2002). It was also offered to patients considering minimally invasive treatment such as INDEX Lesion HIFU. Bone scan only was offered to patients within the older age range (75 years and over) with significant MRI prostate lesion.

The management options adopted by the patients had consequent impact on the departmental compliance with the NCWT. Such compliance was dependent on times taken for arranging clinical tests like MRI scanning and TRUS prostate biopsy, and the clinic review of test reports and management recommendations.

There was 100% compliance with the 14 days wait times when patients should have their first specialist assessment from time of GP referral. This was achieved as a result of the robust administrative and clinical arrangements in place for the identification of target referrals, booking of target patients for same-day MRI scan and nurse-led clinic review. Ninety-one percent (53) started their management of choice within 31 days from time of decision to treat to treatment. Also, 91% (53) complied with the 62-days target from time of GP referral to treatment date. Five patients (about 9%) breached the NCWT system. Four breaches were owing to delay in arranging trans-perineum biopsy which often has longer waiting time, while one patient failed to attend further clinic review. Hence, the five breaches were because of patients’ choice of management and not the one-stop service pathway.

**The urology nurse**

The nursing role in the provision of the one-stop service was crucial and profound. The role of two urology nurse specialists involved with the service included:

* The coordination of out-patient appointments for MRI scan and clinic review
* Presentation of the patient’s history at the prostate MDT
* Documentation of management recommendations at the prostate MDT
* Patient clinic consultation involving assessment, clinical examinations, information giving about MRI findings and prostate MDT management recommendations
* Giving information to patients about knowing your prostate, understanding PSA, prostate cancer diagnosis and management of prostate cancer
* Requesting clinical tests such as PSA and electrolyte pathologies, ultrasound cystodynogram, TRUS prostate biopsies, trans-perineum prostate biopsies and bone scan
* Compilation and filing of outcomes from prostate MDT
* Auditing and reporting of one-stop MRI prostate services
* Provision of the key worker link through multimedia communication facilities (telephone, email, letters) between the patient and the hospital and other services.

This novel extended role of the specialist nurse has also involved the understanding and interpretation of radiological information about prostatic disease. The high level of dependence on radiological information about patient care has been conveniently accommodated within the flexibility of specialist nursing which is often configured in accordance with service requirement.

**Discussion**

There has been a clear demonstration of the positive impact of the utility of MRI scanning to triage patients with raised PSA or prostate cancer concerns. This non-invasive investigation has helped in expediting specialist assessment and MDT decision making over management options. The one-stop service has also helped in compliance with a national guideline on cancer management.

As a non-standard approach, a pre-prostate biopsy MRI scan will inevitably encounter acceptability challenges among different disciplines. Whether radiological diagnosis of prostate cancer will become mainstream will have to contend with limitations of this technological approach in prostate cancer management. However, the role of MRI scanning in prostate care will continue to be fascinating with growing development of high quality MRI facilities and interests demonstrated by radiologists and interventional urological surgeons. Cost implication of the service is significant, involving acquisition of quality MRI scanners and training uro-radiologists with a specific interest in prostate imaging.

The MDT approach to care is a significant clinical governance and quality assurance aspect of the service. The weekly team meeting among clinicians from different backgrounds, including radiology, pathology, surgery, research, nursing and administration, have helped to develop a forum for critical case review of individual patients. The outcome of the exercise results in different clinical perceptions of patient care and increases the team’s understanding of the radiological management of prostate cancer.

The impact of the one-stop MRI prostate clinic on prostate cancer management is in its embryonic stage. It provokes further inquiries into other aspects of this service, including the patient experience with short notice and long day appointments, and the quality of nurse-led clinic review of radiological findings and MDT recommendations. There is also the need to understand the long-term prostate cancer risk for patients managed with PSA monitor on the basis of MRI findings.

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| **Table 5. Impact of management options on NCWT** | | | |
| **Target wait times** | **Description** | **Compliance** | **Percentage** |
| Fourteen days or  two weeks target | Time from GP referral to  first specialist assessment | 58 | 100% |
| Thirty-one days  target | Time from decision to treat  to start of treatment of choice | 53 | 91.3% |
| Sixty-two days  target | Time from GP referral to start  of treatment of choice | 53 | 91.3% |

**Conclusion**

This article has used the findings from the audit of a one-stop MRI prostate service to understand its impact on prostate cancer care. The key focus has been on whether the use of MRI prostate as a triage investigation can help improve compliance with the National Cancer Wait Times system. These findings have provided encouraging results on the prospect of MRI use in prostate cancer care. Similarly, the article has indicated that there is need for further understanding of a developing aspect of care, especially from the perspective of patients, clinicians and stakeholders.

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| **Key points**   * Serum PSA blood test is the key determinant used by the NCWT for initiating specialist investigation for prostate cancer, and is an essential test for the management of the disease * Though TRUS prostate biopsy is used for definitive diagnosis of prostate cancer, imaging techniques like MRI scanning are promising first-line specialist investigative tools * A one-stop service that involves MRI scanning, MDT discussion and nurse-led clinic review has demonstrated clinical usefulness in the management of men with raised PSA or prostate cancer concern * The role of the urology clinical nurse specialist has proven to be pivotal in the coordination of services around the management of patients with raised PSA or prostate cancer * The emerging use of MRI scanning as first-line investigation for prostate cancer will continue to attract patients, clinicians and stakeholders |

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