Nuada Medical *Technology for Life*

London Uroradiology

Prostate MRI
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Prostate MRI: an introduction for patients

Introduction – Who We Are
London Uroradiology has been formed by a group of consultant radiologists working at University College Hospital. One of our specific interests is imaging the prostate. We have extensive NHS and private practice experience and are focusing our private MRI prostate scanning at Nuada Medical Specialist Imaging Centre's 3T Verio MRI scanner at 45 Queen Anne Street, just off Harley Street.

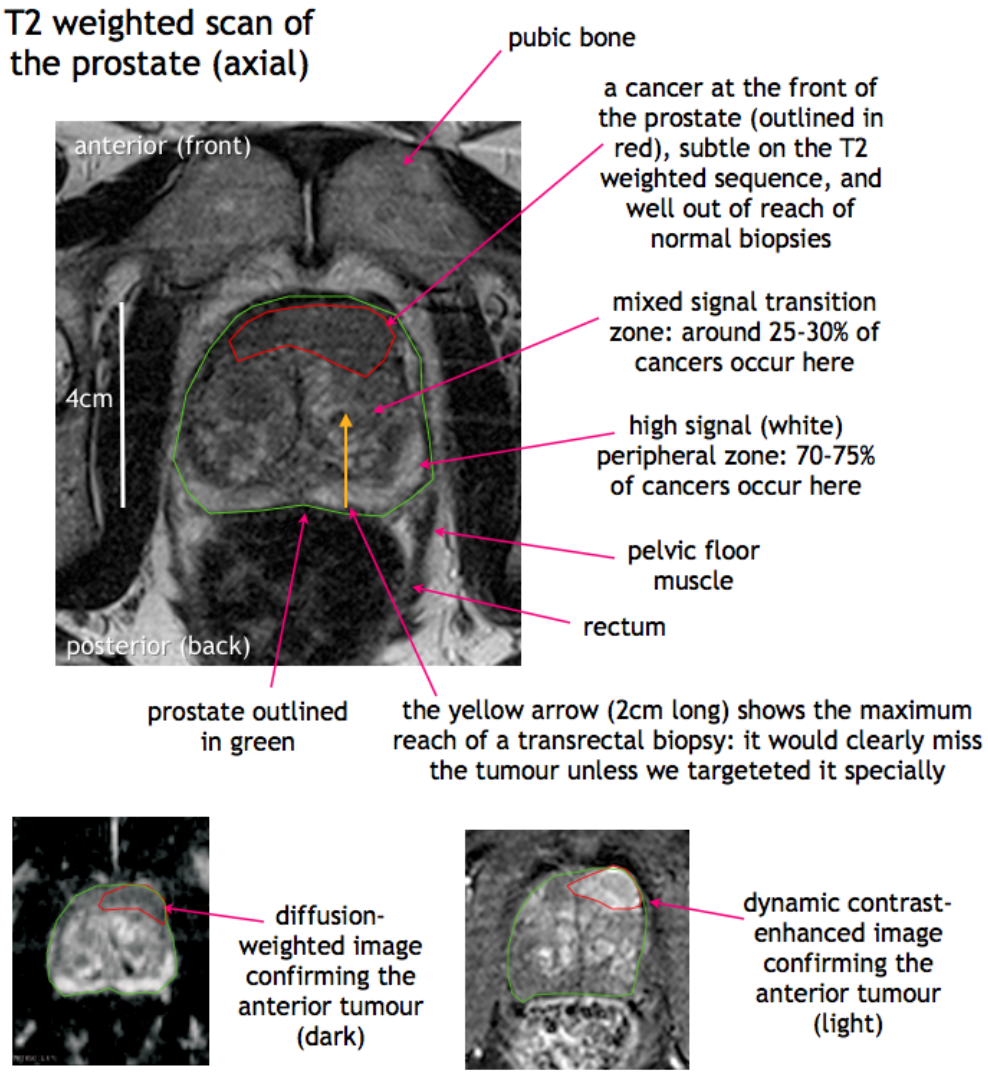
We report around 20 prostate MRI scans a week at UCH, and are involved in research into many of the different ways we might use the technique. We believe strongly in the value of prostate MR performed before biopsy. This short document explains what we believe are its benefits, and its limitations. We hope you find it helpful, but it is not necessary to read it before the scan.

Significant and Insignificant Cancer.
The majority of men over 60 will have some prostate cancer, but only 3% will die from it. What is important is to find tumours that are likely to affect the patient's life. Such *significant* disease is hard to define, and depends on many things: how aggressive the tumour is (usually measured by *Gleason Grade*), the amount of tumour, the age of the patient and how well they are otherwise. Although deciding whether a tumour is significant is difficult, it is in our view very important. MRI is bad at picking up tiny amounts of low grade disease that are extremely unlikely to have any effect on the patient in their lifetime, and we see this as a major potential *advantage.* The aim of MRI should be to help diagnose dangerous tumours more reliably, and to help us to ignore those which are not dangerous. Any diagnosis of cancer has a huge effect on the patient, and we should avoid making it in cases where if undetected it would have had little effect on their life. Prostate biopsy quite often finds a small amount of low grade tumour, and it is very difficult to say whether this truly is a small amount of (almost certainly harmless) disease, or whether we have shaved the edge of a larger tumour. MRI can help us distinguish the two, or even reassure us enough not to do a prostate biopsy in the first place.

The Anatomy of the Prostate on MRI

Between two thirds to three quarters of cancers occur in the *peripheral zone* of the prostate. Most of the significant peripheral zone cancers are found by transrectal biopsy, in which 2cm long (at the most) samples are taken from the back of the prostate.

However, at least a quarter of cancers occur in the front (or *anterior*) part, often within the *transition zone*. This part of the prostate enlarges with age, and in some men can reach the size of a plum or even an orange.



MRI Sequences

When MRI was invented in the 1970s, the most commonly obtained images were T1 and T2 weighted sequences. There have been huge technical advances since then, but most MRIs performed in the UK today still rely mainly on T2 weighted images. Historically MRI has usually been used for *staging*: to see either whether the (already diagnosed) cancer went outside the prostate capsule. For this T2 sequences are adequate (though by no means perfect), but for *detecting* cancer – as opposed to *staging* it - they have serious limitations. Firstly, many other things look like tumour (inflammation, bleeding, scarring) so that very often we find it difficult to rule out cancer. Secondly, we do not detect around one third of significant cancers with T2 weighted sequences alone.

Adding dynamic contrast enhancement (which requires an intravenous line in the arm) and diffusion-weighted imaging (straightforward, and takes an extra 5-10 minutes) improves both the *detection* of tumour and also reduces *false positives* (the radiologist saying a cancer is likely when there is none). This 'multi-parametric MRI' will detect over 90% of tumours, including in the transition zone[4]. It should be noted that this figure is considerably higher than a 12 sample transrectal biopsy (around 80% for significant tumour [5]). It will also enable us to reliably exclude disease in around half of patients who do not have a significant tumour. There is still some way to go, and false positives (or the equivocal scan) remain a problem.

What are the Benefits of the 3T Scanner?

3T MRI scanners give more *signal*, the bread and butter of generating an MRI image. This can either make the scan *faster* or of *higher resolution*, or a combination of both. In particular, images of the edge of the prostate (important when staging the disease to look for extracapsular extension) are excellent on a 3T scanner *without* an endorectal coil. We have not found any significant drawbacks: in virtually all case we would prefer, as radiologists, to interpret images taken on a 3T scanner.

Is an Endorectal Coil Necessary? Is the Scan Painful?

Endorectal coils are extensively used in the USA. They have been used because the traditional 1.5T scanner has struggled to provide enough signal to provide diagnostic images, particularly when using spectroscopy. Recent evidence has suggested that spectroscopy adds little to a 'multi-parametric' MR which includes T2, diffusion, contrast and diffusion sequences. Such a scan can be obtained in around 30 minutes on a 3T machine with a flexible, lightweight 'surface' coil that lies on top of the lower abdomen and pelvis. It is not at all uncomfortable, in marked contrast to an endorectal coil: some patients fall asleep during the scan. We believe that the advent of 3T scanners and improved surface coils has obviated the need for endorectal coils in the great majority of cases.

How Can MRI be Used?

1. *Before biopsy*: Performing MRI before biopsy has several potential advantages:

i) The biopsy can be targeted. In particular, the 25-30% of tumours that occur in the front (*anterior*) part of the prostate can be reliable detected [4 7], and biopsies targeted to this

area. All of us who perform prostate MRI regularly have several examples of large anterior tumours which were missed on standard biopsies but detected on targeted samples.

ii) In some patients (around one third to half at the moment), the MRI is so convincingly negative that we can say *more reliably than with biopsy* that there is unlikely to be significant disease in the gland. MRI will miss a large proportion of *insignificant* disease, which might be seen as an advantage. Whether to proceed with the biopsy can then be left to the patient: is he willing to risk a small chance of significant disease for the benefit of not detecting an insignificant tumour? If he proceeds to biopsy, the combination of MRI (with its ability to detect anterior tumours) and 12 core sampling of the peripheral zone is very reassuring if negative, and may reduce the need for repeat (or 'saturation') biopsies.

iii) There is no artefact from post biopsy blood in the prostate. We regularly see outside MRIs at UCH in which blood has resulted in the reporting of equivocal or likely extracapsular extension when there is none. This is such a problem that we normally recommend that a post biopsy scan is not performed for at least 8 weeks: a long wait for the patient before planning treatment.

In summary: MRI may, in between one third and one half of people, prevent the need for biopsy. Even if biopsy goes ahead, it will be more accurate with the MRI at hand. If the biopsy is then negative, MRI adds considerably to the certainty that a significant tumour is not being missed. If the biopsy is positive, we have straight away the most accurate possible information about the location, size and spread to plan treatment - without a wait of 2 months for the bleeding to settle. *Whether tumour has been detected or not, MRI has been useful.*

2. *Staging after the detection of tumour:* If it is imperative to scan soon after biopsy, we can still obtain useful information, and in particular diffusion-weighted images can still be used to rule out an anterior tumour.

MRI is likely to detect around 85% of cancer spread outside the prostate[8], but the performance of MRI in detecting spread to the pelvic lymph nodes is not as good: almost half of involved nodes will not be detected. However, if there are enlarged nodes in the context of a positive biopsy, they are highly likely to represent spread [9].

3. *Previously negative biopsies, PSA still raised or rising:* This is in our opinion a strong indication for MRI. Anterior tumours can be beyond the reach of even repeat 'saturation' biopsies, and there is convincing recent data that shows increased pickup of tumours at repeat biopsy if MRI has been used for targeting [10]. If the biopsy is *negative*, the reassurance it provides may reduce the need for subsequent saturation biopsies.

4. *Active surveillance:* Very often patients undergoing active surveillance have low grade, low volume disease which is not well seen on MRI. However, 0.5cc lesions (at the borderline of significance) still measure around 1cm in diameter, and can often be seen

on MRI. In both cases, MRI can be used to check that there has not been significant growth of the tumour, and we suspect that it will perform better than repeat biopsy in this context, although there little published data (we are looking at this at UCH). There is very little correlation between PSA level and tumour size in patients likely to be undergoing active surveillance [11], so that MRI may well be better than PSA surveillance too.

5. *Rising PSA after radical treatment*. MRI performs well in this context, picking up around three quarters of recurrent disease after radiotherapy [12]. MRI is also an excellent tool for monitoring the early and late effects of cryotherapy and High Intensity Focused Ultrasound, and for following up patients for any cancer left behind [13]. It is likely to become even more important in focal therapy (just treating the part of the prostate with the tumour): for targeting, and for follow up, the latter because because small rises in PSA from recurrent tumour are likely to be masked by production from residual prostate.

How the Scan will be Reported

Prostate MRI is challenging, and there is still room for perceptual error. Fifteen years ago, transition zone disease was regarded as virtually undetectable; now, because we have learned about its appearance, we very often see it on T2 weighted sequences. The technology has improved, but experience plays a large part. For this reason, all London Uroradiology scans will be reported by two consultant radiologists.

This has implications for reporting time. In some cases, an urgent MRI is important, and if requested we can produce a report within 48 hours, although in some cases the second reporter may have to issue the final report outside this time. In normal cases we will produce the report within 5 working days.

Many of the benefits of MRI to the urologist stem from localising the disease, and we will produce reports both with a diagrammatic representation of the tumour and several representative images. We will be happy to provide some sample reports.

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