The Accuracy of Magnetic Resonance Imaging in Radical Prostatectomy

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Key Words

Magnetic resonance imaging • Prostate cancer • Prostatectomy

Abstract

Aims: The aim of this study was to examine the accuracy of standard magnetic resonance imaging (MRI) in the localised staging of prostate cancer in those who had undergone radical prostatectomy. **Patients and Methods:** The cohort consisted of 110 patients who had undergone MRI for staging of prostate cancer and subsequently underwent radical prostatectomy. T stage was analysed both on MRI and from the specimen following radical surgery. **Results:** Of the patients 57% of patients had their disease up-staged following radical surgery from preoperative MRI findings. Of those patients who had their disease up-staged following surgery, nearly 50% of patients had gone from organ confined disease at time of MRI to extra-prostatic involvement from the surgical specimen. **Conclusion:** We have reported that MRI has a wide range of accuracy. Given developments in MRI technologies further work should be pursued to help in the staging of this disease for which decision to treat is difficult.

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Introduction

Prostate cancer is now recognised as a major burden on the global health-care system. In the United States and in Europe, it is the most common neoplasm diagnosed in men and is responsible for 11% of all male cancer deaths [1, 2]. After a diagnosis of prostate cancer is made, a number of treatments may be considered depending on the information provided by staging investigations. In patients who are thought to have organ confined prostate cancer treatment options include radical prostatectomy, external beam radiation therapy, brachytherapy and active monitoring.

In those treated by radical prostatectomy, seminal vesicle involvement (SVI) or extracapsular extension (ECE) are often associated with recurrent disease [3]. It is therefore of the upmost importance that imaging modalities are able to detect this accurately prior to surgery. When radical surgery is contemplated, computed tomography (CT) and/or magnetic resonance imaging (MRI) are utilised to stage the disease to ensure it is organ confined. Imaging evaluation of the prostate is challenging given tissue heterogeneity [4, 5].

Transrectal ultrasound (TRUS) is the most common modality used when imaging the prostate but is associated with the disease being under-staged [6]. This modality can only detect 50% of cancers due to tumor heterogeneity and it has been suggested that TRUS in combination with digital rectal examination can more accurately detect T3a tumors than either method alone [7] but despite this 60% of T3a tumors will not be detected by

TRUS alone [8]. The rate of detection of cancers can be increased by using color doppler [9–11] with some suggesting that it can optimise the number of biopsies taken [12]. In those with a new diagnosis of prostate cancer, it has been suggested that Gleason grade, prostate specific antigen and clinical stage are independent predictors of a CT scan being positive for metastases and therefore patients with low risk need not have a CT scan [13] but it is in this cohort that radical surgery maybe contemplated and therefore it is of upmost importance that all information about any possibility of local invasion is available before a treatment path is chosen. Currently MRI is used to detect evidence of ECE or SVI with a tendency to over-stage disease [6]. It has been suggested that MRI is cost effective [14]. In comparison to digital rectal examination, TRUS and CT, MRI has a higher accuracy in the assessment of unilateral or bilateral disease, ECE and SVI as well as the invasion of adjacent structures [15]. In cases of planning treatment with external beam radiotherapy, it has been reported that MRI provides more detailed information than CT when utilised as a radiotherapy tool [16]. Despite this, literature would suggest that there is a wide range in the accuracy of local staging (50–90%) [17]. Endorectal MRI (eMRI) has been suggested to be more accurate than conventional MRI in terms of localisation of the cancer predicting SVI and ECE [18–20] but in analysing previous data [20] it has been shown that this increased accuracy was only significant when eMRI was performed by genitourinary radiologists with substantial experience [21]. It has also been reported that eMRI has a sensitivity of 69% and specificity of 90% for the identification of ECE [22].

The aim of this study was to examine the accuracy of standard MRI in the localised staging of prostate cancer in those who had undergone radical prostatectomy.

Patients and Methods

Patients diagnosed with prostate cancer following TRUS guided biopsy in North Glasgow NHS Trust and who subsequently underwent radical prostatectomy were included. Patients were staged according to the TNM classification both on radiological imaging which was MRI and after the radical specimen was analysed. The Research Ethics Committee of North Glasgow NHS Trust approved the study.

All patients underwent a standard MRI based on local protocol for imaging for prostate cancer after initial diagnosis. One institution was involved with undertaking the MRI. Consultant radiologists with sub-speciality interest in urology undertook reporting the MRI. All surgery was performed by one unit at the Royal Infirmary.

Results

One hundred and ten patients were studied for whom all clinical data was available and had undergone radical prostatectomy. Median age of diagnosis was 61 years (range 43–73 years). Median time from MRI until surgery was 87 days. Of the cohort, 2% of patients were on active surveillance prior to radical prostatectomy.

Of all patients, only 27% ($n = 30$) showed no difference between radiological and pathological staging, 57% ($n = 63$) were up-staged after surgery and 16% ($n = 17$) had their disease from their MRI after surgery down-staged. Nearly 50% ($n = 30$) of those patients that were up-staged after surgery had gone from organ confined disease to ECE or SVI.

In this sub-group of patients that were up-staged after surgery, the median time from MRI imaging until surgery was 64 days whilst in comparison for all patients the median time from MRI until surgery was 87 days.

When assessing the Gleason sum of both tissue at time of TRUS and from the radical specimen, 42% ($n = 46$) had the Gleason sum increased after radical surgery was performed possibly indicating aggressive disease. Of these patients, 61% ($n = 28$) were up-staged on the basis of MRI and radical surgery.

Discussion

Results from the present study further reiterate the wide range of accuracy when assessing local staging for prostate cancer prior to radical surgery.

Previous reports have suggested that MRI has a tendency to over-stage disease [6, 23, 24] but these are historical studies with MRI technology improving in recent years. Our findings have suggested that MRI not only does not over-stage disease but if anything under-stages disease. Even though the decision to pursue radical surgery does not solely rely on MRI findings, this presents a further dilemma if MRI is under-staging the disease. This may deter both surgeon and patient in pursuing radical surgery if the likelihood of cure is reduced and other treatment options would need to be considered. The upstaging of cancer from MRI to the radical specimen could be accounted due to 61% of these patients had an increase in the Gleason sum from initial diagnosis to the radical specimen therefore suggesting aggressive disease.

The accuracy of MRI for staging purposes of prostate cancer varies from 50 to 90% [17,21]. Despite this variability it is still utilised for staging purposes and detec-

tion of recurrence. It has been reported that preoperative findings at MRI can be utilised as a strong predictor of biochemical recurrence [25] and that these findings can be utilised to predict relapse following external beam radiotherapy treatment [26]. It has been recently reported that MRI has a higher sensitivity (93%) for high grade tumors than low grade tumors (68%) [27] and therefore MRI would aid in those that would benefit most from surgery.

We have reported that MRI has a wide range of accuracy in staging prostate cancer in a cohort of patients that have undergone radical surgery. Given advancements in MRI technologies, further work is required to assess the accuracy of this technology, especially in those who are undergoing radical treatment.

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