Prostate Cancer MRI
Accuracy Diagnosis and Treatment

PSA to Prostate Imaging

HandBook for patients and curious doctors

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Forward

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This concise well written handbook is a must read for all who are interested in the revolution taking place in the way men are diagnosed and managed with prostate cancer.

For the first time, physicians have the capability to visualize prostate cancer. It is hard to believe that for so many years men were being diagnosed and treated for this most common male cancer without actually being able to see it.

This led to many inadvertent consequences, the most common being that too many men were diagnosed and treated for insignificant cancers with the associated side-effects.

With the advent of multiparametric prostate MRI this has changed dramatically and clinicians can now see cancers that are significant and life-threatening while at the same time avoiding the diagnosis of the insignificant ones and overtreatment. However, MRI utilization is not simple and requires new learnings for the urologists who perform prostate biopsy and incorporate it as part of prostate cancer treatment decisions.

This HandBook provides an excellent introduction to this important addition to the field.
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There are not too many times in a typical career when one is able to witness a true transformation in the way a common disease is managed. Gastric surgeons were certainly caught out by the advent of H2 antagonists and their fairly rapid effect on making gastric and duodenal ulcer surgery obsolete. In urology we happen to find ourselves in the middle of a similar revolution, though none of us has quite managed to fully embrace the likely consequences of it.

The revolution is one in which we go from an era when we were blind to the location of a prostate cancer tumour (an era that has lasted 100 years) to an era in which we are not. This handbook goes some way in describing what the ramifications might be. The good thing, as I read it, is that most of the changes that I can begin to see are all for the better.

In summary they are: fewer men biopsied; many men avoiding unnecessary biopsy; better, safer biopsy, fewer high risk cancers missed; more accurate risk stratification; more appropriate treatment allocation; and all, rather amazingly, at overall less cost to the payor. If this sounds too good to be true then please make sure to read on and see just how these benefits / attributes of the new approach to the management of early prostate cancers manage to make such a difference.
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can you imagine being treated for a high fever, racking cough and pneumonia without a chest x-ray?

can you imagine being diagnosed or treated for prostate cancer without your doctor being able to see it?

that is what we were doing

finally, the prostate can be seen in anatomic and functional detail with prostate MRI
Introduction

Welcome to the new world of accurate diagnosis and treatment of prostate cancer with Prostate MRI.

It has taken a number of years and many scientist and clinicians worldwide to develop Prostate MRI for clinical use.

The current practice of PSA Screening, Trans Rectal Ultrasound (TRUS) random biopsy are inaccurate and misses many of the aggressive prostate cancers that cause serious illness.

Random biopsies frequently diagnose the numerous not-aggressive cancers that are slow growing and cause no harm. Many men with not-aggressive cancers have undergone what we now know is unnecessary treatment.

TRUS/MRI fusion targeted prostate biopsy can diagnose the aggressive cancers at the initial biopsy session avoiding repeat biopsy sessions (target practice) and biopsy complications.

With MRI there is a decrease in over diagnosis and over treatment of the not-aggressive cancers. The aggressive cancers are diagnosed earlier with greater opportunity for cure.

When prostate cancers are diagnosed the MRI Images become key for monitoring men on active surveillance and for treatment selection, planning and evaluation. Prostate MRI is A Remarkable Achievement.
prostate and neighbors

bladder
prostate
urethra
rectum
Prostate MRI
A Major Advancement in Prostate Cancer Diagnosis, Treatment, Research, and Knowledge

Mr. MRI Machine

Prostate MRI T2w image

nodule
sector 4p, Rt mid PZ pl
0.9 cc

transition zone

peripheral zone

rectum

52 years, PSA 1.1 → 4.7 over 3 years, PSAD 0.12
DRE- no nodule
First you need to know some things about

A Prostate Cancer

B PSA, PSA Density

C Prostate Cancer Risk Assessment
Prostate Cancers Are

Not-Aggressive or Aggressive

Most Prostate Cancers are Not-Aggressive

- Common, frequent and small (less than 0.2 cc)
- Men die with it, not from it (very slow growing)
- Biologically inactive
- **Not visualized** on MRI
- Cause **no illness**
- Most older men have not-aggressive cancers

Some Prostate Cancers are Aggressive

- Less frequent and larger (greater than 0.5 cc)
- Grow faster
- Biologically active
- **Visualized** on MRI
- Can cause **serious illness** and death
**PSA (Prostate Specific Antigen)**

* A good misused test with a bad reputation

- PSA indicates benign prostate hypertrophy (BPH), urine infection, urinary tract retention, instrumentation and cancer

- Prostates grow bigger with age (BPH)
  PSA usually ↑ with age

- Obtain **Baseline** PSA  
  age 30, men at high risk  
  age 40, men with concern

- PSA **Trend** is faster, higher with aggressive cancers

- **PSA** • 4 upper limit of normal is incorrect
  
  - less than 4 aggressive cancers may be present
  
  - over 4 mostly caused by BPH

---

**When used wisely**

**PSA is a good cancer predictor**
PSA Density (PSAD)

A more accurate use of PSA

> PSAD is the ratio of PSA to prostate volume

> \[ \text{PSAD} = \frac{\text{PSA}}{\text{prostate volume}} \]

(volume obtained from trans-rectal ultrasound or MRI)

> Prostate cancers usually produce more PSA than BPH

- **Normal** PSAD - less than 0.10
- **Borderline** PSAD - 0.10 to 0.15
- **Abnormal** PSAD - greater than 0.15

A normal PSAD \[
\frac{\text{PSA 6.2}}{\text{vol 77 cc}} = 0.08
\]

An abnormal PSAD \[
\frac{\text{PSA 6.2}}{\text{vol 38 cc}} = 0.16
\]

PSAD is doubly better than PSA as a cancer predictor
PCRA (Prostate Cancer Risk Assessment)

*Selects which men are candidates for a MRI*

**men at high risk of prostate cancer**

- Less than **70** years
- More than **10** year life expectancy
  (prostate cancers grow slowly, takes years to grow dangerous; older men’s years are limited)
- Family – Genetic **History** of prostate cancer
- Men of **African origin**
- Prostate **nodule** on digital rectal exam (DRE)
- PSA **Trend** faster, higher than expected
- PSA increase in men on **Avodart, Proscar, Testosterone**
- PSA more than **10**
- PSAD more than **0.15**
- **Abnormal** Prostate Cancer Biomarkers/Predictors
- **Previous** diagnosis of prostate cancer
All men at risk of prostate cancer need to be investigated

Some men investigated benefit from an MRI

Not all men who have an MRI require a biopsy
Prostate MRI
What Can It Really Do?

MRI Accurately Visualizes, Characterizes and Stages

Prostate Cancer **Nodules**

**Visualizes:**
- Number of nodules
- Nodule(s) location within the prostate
- Nodule volume
- Capsule invasion
- Cancer outside the prostate

**Characterizes:**
- Likelihood of Cancer
  - the 3 parameters score (T2w, DWI/ADC, DCE)
- Cancer aggressiveness (Gleason grade)

**Stages:**
- Cancer involving the capsule and outside the prostate (adjacent, seminal vesicles, bones, nodes)

Prostate MRI, **90 % accurate** in finding aggressive prostate cancer nodules
How Does It Do It?

3 parameters characterize prostate nodules

the presence of cancer

**T2w – anatomy** (chief TZ cancer detective)

*T2* weighted Images

**DWI/ADC - biology** (chief PZ cancer detective)

Diffusion *Weighted Images*

Apparent Diffusion *Coefficient*

(restriction of water diffusion among cancer cells)

**DCE - vascularity** (becoming optional in screening MRIs)

Dynamic Contrast Enhancement

mini angiogram, micro blood vessels

- **T2w** roadmap
- **DWI/ADC** traffic congestion
- **DCE** new arterial construction
the MRI parameters

normals

68 years, brother with prostate cancer, PSA 4.2 → 5.9, over 5 years, PSAD 0.08
DRE- no nodule, no biopsy indicated
The MRI Report

Patient Data – cancer risk assessment, previous biopsy
  – Initial MRI, Previous MRI

Prostate Volume, PSA, PSA Density

Visualization

  > Nodule(s) location - 27 sectors / 39 sectors
  > Nodule size
  > Capsule invasion
  > Cancer outside the prostate
  > Other pelvic organs (bowel, bladder, large blood vessels, hernia)

Characterization

3 Parameters – T2w, DWI/ADC, DCE – 5 point Score

1. Highly likely no aggressive cancer
2. Likely no aggressive cancer
3. Unsure
4. Likely aggressive cancer
5. Highly likely aggressive cancer

Tumor Staging – capsule, cancer outside the prostate
  (adjacent, seminal vessels, bones, nodes)

Comparison to previous MRI

Radiologist Summary

- Initial MRI – Screening - a baseline reference
  – Diagnostic - specifies nodule(s) to biopsy, cancer staging
- Repeat MRI – Monitoring - men at risk, active surveillance
  – Identification - residual or recurrent cancer after treatment
The **Significance** of a nodule imaged on MRI...

*depends on*

- Patient’s Prostate Cancer **Risk Assessment**  
  (PCRA includes many of these criteria)  
  life expectancy, major illnesses, family-genetic history,  
  Race, chemical-medication exposures, previous (urinary infections, MRI, biopsy, pelvic surgery or radiation),  
  predictor tables, DRE, urine culture, PSA trend,  
  biomarkers, TRUS-PSAD

- **Patient data** provided in the MRI requisition

- **Quality** of the MRI image acquisition

- **Experience** of the Radiologist and Urologist

- **Nodule(s) Size and Location**

- 3 Parameter **Score (1, 2, 3, 4, 5)**

- **Capsule** invasion

- Cancer **outside** the prostate
Prostate Sectors

27 Sectors

39 Sectors
PI-RADS v2
American College Radiology
pub. online 2015

AS  anterior stroma
TZ  transition zone
PZ  peripheral zone
CV  central zone
a   anterior
p   posterior
pl  posterior lateral
pm  posterior medial
Prostate MRI

Selects

For Diagnosis
➢ Which men to biopsy
➢ Which sector to target the biopsy
➢ Monitor patients not requiring biopsy

When Cancer
➢ Treatment type, planning and evaluation

Therapy Options
➢ Pre Programmed Follow Up (PPF) – MRI monitoring men at risk, no cancer diagnosed
➢ Active Surveillance (AS) – MRI monitoring diagnosed not-aggressive untreated cancers
➢ Surgery, Radiation, Focal Therapy, Medical Oncology and combinations
Have a **PSA Density** frequently avoid an MRI

**Do a MRI**
commonly avoid a biopsy

Undergo a TRUS/MRI **targeted biopsy**
usually avoid repeat biopsy sessions

**TRUS Prostate Biopsy**

Biopsy performed only when clinically warranted
TRUS/MRI Fusion Targeted Biopsy

Like cell phones in your pocket, co-registration fusion software gets better every year!

software co-registration

UroNav

Koelis

Artemis

BioJet

software co-registration companies
How to tell Not-Aggressive From Aggressive Prostate Cancer

1. Prostate Cancer Risk Assessment
2. Prostate MRI
3. TRUS/MRI Fusion Targeted Biopsy
Prostate Cancer Diagnostic Pathways

**Old**

1. PSA Screening
2. TRUS Biopsy
3. Cancers: Not Aggressive, Aggressive

**New**

1. Prostate Cancer Risk Assessment
2. Prostate MRI
3. TRUS/MRI Fusion
4. Targeted Biopsy
5. Aggressive Cancers

Adapted from Dr. Caroline Moore
Cancer Detection

TRUS Random Biopsy

- BPH
- Aggressive Cancers
- Not Aggressive Cancers

TRUS/MRI Fusion Targeted Biopsy

- BPH
- Not Aggressive Cancers
- Aggressive Cancers
Prostate MRI: A Team Effort

Radiologists  Provide and interpret the MRI to identify the undiagnosed, residual or recurrent cancers

Urologist  Use the MRI to select which men to biopsy, where to biopsy, in treatment decisions and monitoring

Pathologists  Provide the tissue proof of the presence of cancer
MRI Instructions for Patients

➢ Try to refrain from sexual activities for 3 days
➢ Liquid diet starting the night before the exam
➢ No eating or drinking 3 hours before the exam (maybe a sip of water)
➢ Two hours before, give yourself a Fleet Enema (purchased at any pharmacy)
➢ Remove all jewelry, metal, rings, watches, etc.
➢ Just before the exam begins, empty your bladder

Let us know if you have metal in your body, your kidneys are not functioning 100% or trouble voiding.

Patient’s who are uncomfortable in a small enclosed space may not be happy.

The examination takes 40-50 minutes.

The MRI machine surrounds you from chin to knees. A soft mat may be placed on your abdomen. A sensation of warmth may occur – don’t be worried. MRI is noisy, shakey and vibrates; earphones provided.

You will receive a small intravenous needle injection of gadolinium and buscopan. The Buscopan may make voiding difficult for a few hours.

Relax, think of (a sandy beach, turquoise blue warm water, ski trail in the clouds, fresh powder snow) something else.
My Prostate MRI Experience

After 3 years of regular follow-ups the urologist who performed prostate surgery on me, removing 50% of my enlarged prostate, wanted to do an “immediate biopsy” when my PSA rose slightly to over 5. I sought out a second opinion with a urologist at a clinic that did prostate MRI.

For most of my life I have suffered from mild claustrophobia, so I was nervous before the test itself, and not only about possible test results. The MRI technician was thoughtful and helpful as I arrived even asking whether I was nervous and had ever experienced any claustrophobia. He explained what I should expect and how the test would proceed which prepared me for what was to follow.

I was warned to expect loud noise, and the technician offered me earphones or earplugs (I refused) so I was not surprised by the series of deep powerful “thumps” that I heard when the procedure began. As the test continued the technician asked if I was okay and I replied that the experience reminded me of a Pink Floyd concert I had once attended sitting close to the speakers and the stage. To sum up my MRI experience, I can say that I was never uncomfortable in any way and the test proceeded without incident.

Subsequently the test showed I was at very low risk for prostate cancer and it was real clear that the biopsy the first doctor had urged to me rush into was not needed. Given the possible complications and discomfort that can result from conventional, old science prostate biopsies this new, more precise, effective and useful alternative impressed me enormously and saved me from potential unneeded grief and suffering.

Hooray for prostate MRI! G.R.
Tips for patients

- If you are concerned about prostate cancer, go to a friendly urologist for **Prostate Cancer Risk Assessment**.
  - Early prostate cancer has no symptoms
  - **Never believe** one PSA value. PSAs increase with age and for many reasons other than cancer.
  - PSA trend and PSA density are **better** predictors.
  - Newer advanced prostate cancer **biomarkers** are remarkably precise.
- If the urologist feels a **bump** on your prostate it may be prostate stones, BPH, granulomas or cancer.
- Prostate MRI is usually indicated if you have a **high risk** for prostate cancer.
- MRI cannot be done or the study is limited when you have **metallic** body parts, poor **kidney function** and **claustrophobia**.
- The advice to have a prostate **biopsy** is based upon your prostate cancer risk assessment and the MRI.
  - A highly suspicious prostate MRI usually requires biopsy
  - Mildly suspicious MRI may only need monitoring
  - Always better, do prostate MRI **before** biopsy

**If biopsy detects not aggressive cancer do not get alarmed**
**not-aggressive cancers are common cause no illness and only require monitoring**
Remarkable Achievements

Large and small

- PSA, PSA Density
- Prostate cancer biomarkers (PSA Free/Total, PCA3, 4K, etc.)
- Prostate Cancer Predictor Tables (ERSPC, Kattan, PCPT, Sunnybrook, etc.)
- Active Surveillance (monitor diagnosed not aggressive untreated cancer)
- Defining the Index Nodule (aggressive cancer, the largest cancer nodule within the prostate)
- Precise multi-parametric prostate MRI
- TRUS/MRI fusion targeted biopsy
- Decrease in over diagnosis and over treatment of prostate cancer
- Focal Therapy (preserve the prostate, destroy the index cancer nodule)
- MRI image guided prostate cancer treatments and monitoring
From PSA Screening
to
Prostate Cancer Imaging
Inaccurate ➞ Accurate

- PSA Screening to thorough prostate cancer risk assessment
- Limited prostate imaging to detailed multi parametric prostate MRI
- PSA indication for biopsy to MRI selection for biopsy
- Random blind TRUS biopsy to TRUS/MRI fusion targeted biopsy
- Diagnosing cancer with repeat biopsy sessions to diagnosis with one MRI targeted biopsy session
  - Fewer biopsy sessions, fewer biopsy complications
  - Decreased over diagnosis of not-aggressive cancers
  - Decreased unnecessary treatment
- Active surveillance with periodic biopsy to MRI indicated biopsy
- Experienced guesstimate based prostate cancer therapy decisions to MRI guided decisions
- Radical prostate surgery for localized cancers to Active Surveillance or MRI based Focal Therapy
- PSA Evaluation after treatment for residual or recurrent cancer to PSA and MRI evaluation
An Advanced Complex Technology

41 years, African American, PSA 4.5, PSAD 0.1
DRE - no nodule, MRI Score 1, no biopsy indicated

Cancer nodule
sector 11p12p, Apex PZ pm, pl
1.3 cc, score 5

53 years, PSA 0.3 → 6.8 over 5 years, PSAD 0.18
DRE - nodule left, prostate, biopsy
gleason cancer 8/10
Prostate MRI
A Remarkable Achievement

Advanced complex technology which is **time consuming** to learn, perform, interpret, and implement

**Accuracy** in prostate cancer management that was **inaccurate** without detailed imaging

The basis for prostate cancer **diagnosis**, **treatment selection** and **planning**

**Key** for patients at risk of prostate cancer, on active surveillance and monitoring after treatment

Prostate MRI is a **major advancement** in prostate cancer care, knowledge and research

**Concerned About PSA, Prostate Cancer?**

Consider Prostate MRI
Bedtime Readings

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To view and print the online English and French publication of this HandBook visit

www.pcamri.com

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The HandBook is the opinion of Dr. Aronson and may not reflect the opinion of experts in the Prostate MRI field, Jewish General Hospital or McGill University.

Appreciations
It has taken many scientists and clinicians years to develop prostate MRI. The radiologist, urologist and pathologist receive tremendous help and support from their hospitals, departments, colleagues and staff.

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