OBI and Radiology

James A. Overton

The University of Western Ontario

OBI Workshop, Philadelphia – October 14, 2011

Upshot

I don't have an ontology! I have an application, some goals, some terms, and a lot of questions.

case	structured reporting tool for prostate cancer
goals	Interoperability, search and analysis
terms	ultrasound procedure, ultrasound image, hyperechogenicity
questions	where do these terms fit?

Outline

1. Structured Reporting
2. Related Terminologies
3. Terms We Need

Structured Reporting

Image-Guided Prostate Cancer Management (IGPC)

CIHR Team Grant in Image-Guided Prostate Cancer Management. A major federal grant from the Canadian Institutes for Health Research.

We are comparing the use of ultrasound, MRI, and other imaging modalities for prostate cancer detection and management. Subjects are imaged in multiple modalities, and if their prostate is removed there is full pathology. The different "views" are compared.

Specialists from different fields need to communicate about tumour location and characteristics across these "views".

Plain-Text Ultrasound Report

CLINICAL HISTORY: Patient is 66 years old. DRE reveals a 1+ benign prostate. PSA is 7.65 ng/ml. Free to total PSA ratio was 0.088.

FINDINGS:

Measurements: The prostate measures 46 ccs. Predicted PSA for a gland of this size is 5.5 ng/ml.

Peripheral Zone: There is some heterogeneity with this zone. It seems to consist of some cystic areas. There are not focal mass lesions concerning for neoplasia. Contour remains smooth.

Transition Zone: There is mild to moderate BPH change present. There are more cystic spaces in this zone. There is a midline cyst as well that may be a seminal vesicle cyst in the base.

Seminal Vesicles: Normal.

Biopsies: 12 peripheral zone biopsies.

CONCLUSION 1. Sonographically, no cancer seen. 2. If any of the biopsies are positive, there is no evidence of T3 disease.

Annotated Ultrasound Report

CLINICAL HISTORY: **Patient** is 66 years old. **DRE** reveals a **1+ benign prostate**. **PSA** is 7.65 **ng/ml**. **Free to total PSA ratio** was 0.088.

FINDINGS:

Measurements: The **prostate measures** 46 **ccs**. **Predicted PSA** for a **gland** of this size is 5.5 **ng/ml**.

Peripheral Zone: There is some **heterogeneity** with this **zone**. It seems to consist of some **cystic areas**. There are not **focal mass lesions** concerning for **neoplasia**. **Contour** remains **smooth**.

Transition Zone: There is **mild to moderate BPH** change present. There are more **cystic spaces** in this **zone**. There is a **midline cyst** as well that may be a **seminal vesicle cyst** in the **base**.

Seminal Vesicles: **Normal**.

Biopsies: 12 **peripheral zone biopsies**.

CONCLUSION 1. **Sonographically**, no **cancer** seen. 2. If any of the **biopsies** are **positive**, there is no evidence of **T3 disease**.

Structured Report

Prostate Size: Vol. **46** ccs.
Predicted PSA: **5.5** ng/ml
Measured PSA: **7.65** ng/ml
PSA Ratio: **0.088**
Prostate: **Abnormal**

- Peripheral Zone: **Abnormal**
  - Diffuse Anomalies: **Heterogenous**
    Focal Anomalies: **0**
    Contour: **Smooth**
- Transition Zone: **Abnormal**
  - Diffuse Anomalies: **Heterogenous**
    Focal Anomalies: **1**
  - Location: **Midline**
    Size: Vol. **1** ccs.
    Echotexure: **Heterogenous**
    Rim: **None**
    Contour: **Smooth**
- Seminal Vesicles: **Normal**

Biopsy: **Yes**

Imaging

John

Image

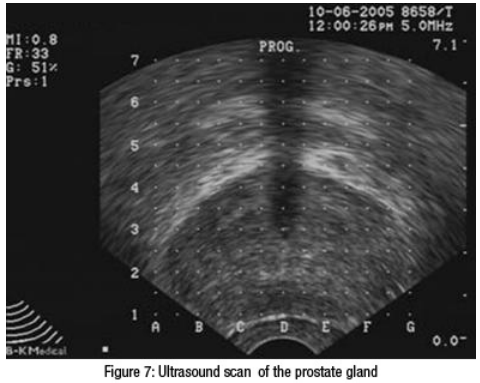


Figure 7: Ultrasound scan of the prostate gland

Segmentation

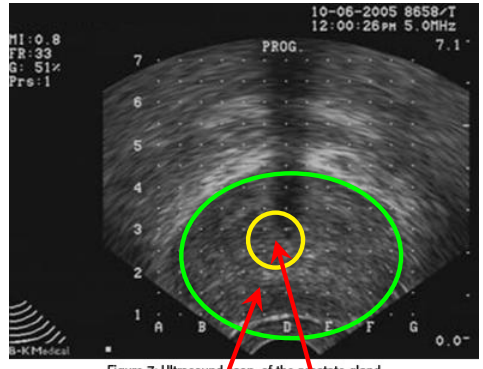


Figure 7: Ultrasound scan of the prostate gland

John's prostate

Region #1: hypoechoic, 2.5cm, elliptical

Region #1: gray, 5cm, elliptical

John's tumour

Region #2: hypere-choic, 1cm, circular

Region #2: white, 2cm, circular

Anatomical Entities

Radiology Qualities

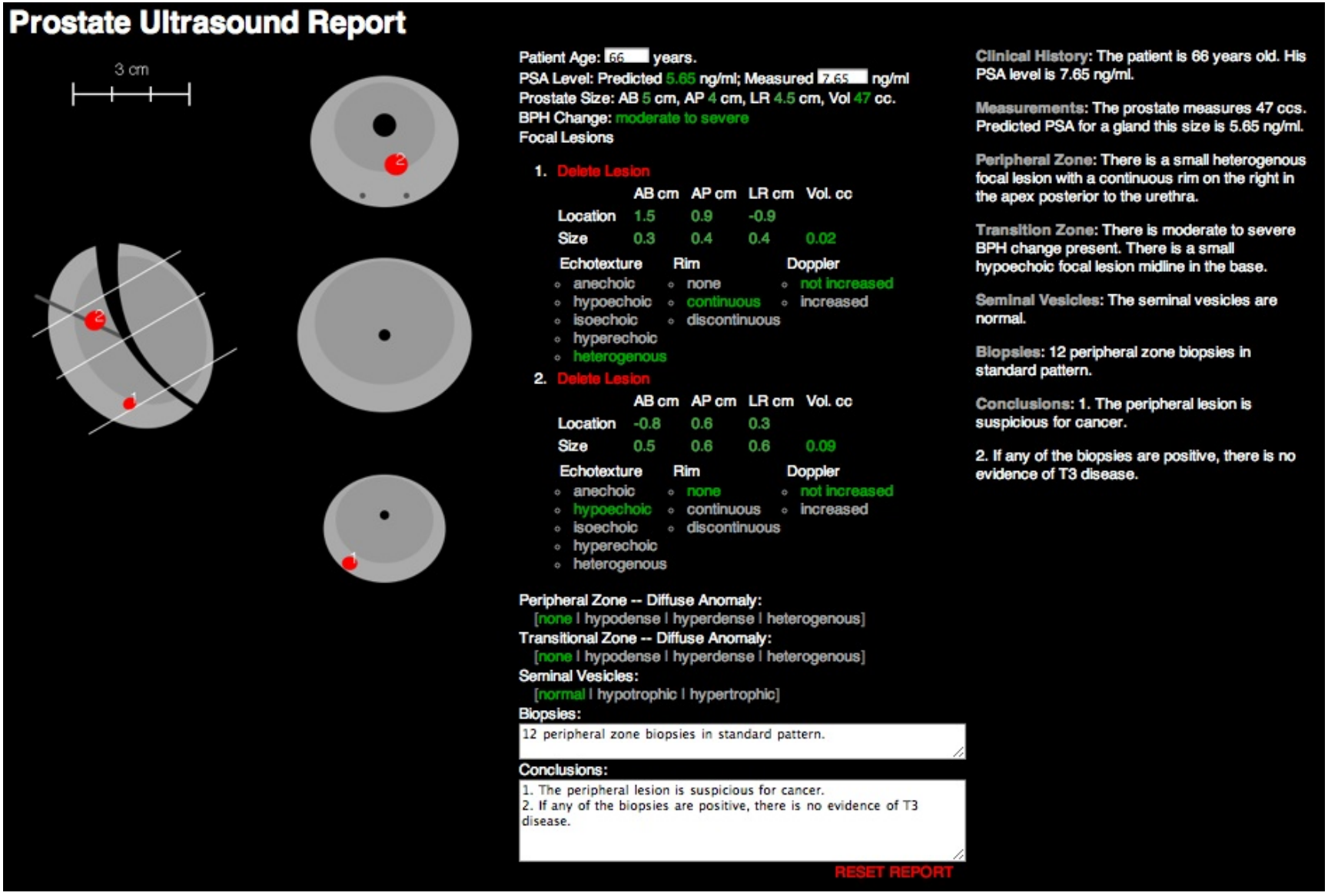
Region Qualities

Structured Reporting Tool

We're developing a structured reporting tool to implement these ideas:

1. designed to facilitate communication, search, and analysis in IGPC
2. backwards compatible with plain-text system
3. currently focused on radiology so far (ultrasound, MRI)
4. future addition: pathology

Screenshot


Prostate Ultrasound Report
3 cm
Patient Age: 66 years.
PSA Level: Predicted 5.65 ng/ml; Measured 7.65 ng/ml
Prostate Size: AB 5 cm, AP 4 cm, LR 4.5 cm, Vol 47 cc.
BPH Change: moderate to severe
Focal Lesions
1. Delete Lesion
AB cm AP cm LR cm Vol. cc
Location 1.5 0.9 -0.9
Size 0.3 0.4 0.4 0.02
Echotexture
anechoic
hypoechoic
isoechoic
hyperechoic
heterogenous
Rim
none
continuous
discontinuous
Doppler
not increased
increased
2. Delete Lesion
AB cm AP cm LR cm Vol. cc
Location -0.8 0.6 0.3
Size 0.5 0.6 0.6 0.09
Echotexture
anechoic
hypoechoic
isoechoic
hyperechoic
heterogenous
Rim
none
continuous
discontinuous
Doppler
not increased
increased
Peripheral Zone -- Diffuse Anomaly:
[none | hypodense | hyperdense | heterogenous]
Transitional Zone -- Diffuse Anomaly:
[none | hypodense | hyperdense | heterogenous]
Seminal Vesicles:
[normal | hypotrophic | hypertrophic]
Biopsies:
12 peripheral zone biopsies in standard pattern.
Conclusions:
1. The peripheral lesion is suspicious for cancer.
2. If any of the biopsies are positive, there is no evidence of T3 disease.
RESET REPORT
Clinical History: The patient is 66 years old. His PSA level is 7.65 ng/ml.
Measurements: The prostate measures 47 ccs. Predicted PSA for a gland this size is 5.65 ng/ml.
Peripheral Zone: There is a small heterogenous focal lesion with a continuous rim on the right in the apex posterior to the urethra.
Transition Zone: There is moderate to severe BPH change present. There is a small hypoechoic focal lesion midline in the base.
Seminal Vesicles: The seminal vesicles are normal.
Biopsies: 12 peripheral zone biopsies in standard pattern.
Conclusions: 1. The peripheral lesion is suspicious for cancer.
2. If any of the biopsies are positive, there is no evidence of T3 disease.

Related Terminologies

RadLex

Radiology Lexicon, developed by the Radiological Society of North America (RSNA)

"As images, imaging reports, and medical records move online, radiologists need a unified language to organize and retrieve them. Radiologists currently use a variety of terminologies and standards, but no single lexicon serves all of their needs. RadLex is a single unified source of radiology terms that is designed to fill this need."

RadLex is on Bioportal, latest version 3.5 (October 2011).

RadLex and OBO

Daniel Rubin (chair of the RadLex steering committee) said in an email this week:

"I can say that RadLex is moving toward OBO Foundry principles – it's just a matter of resources/time getting there."

RadLex and OBO

- designed as a lexicon, and not an ontology
- does not follow OBO best practices
- few definitions
- starting to integrate with BFO
- not orthogonal – duplicates terms for anatomy (FMA), disease (DOID), chemical elements (ChEBI), reports and components (IAO), and investigations (OBI)

RadLex Playbook

"The RadLex Playbook is a special component of the RadLex controlled terminology being developed by RSNA. The Playbook will provide a standard, comprehensive lexicon of radiology orderables and imaging procedure step names."

RadLex Structured Reporting Initiative

"The goals and current efforts of the Radiological Society of North America Radiology Reporting Committee are described. The committee's charter provides an opportunity to improve the organization, content, readability, and usefulness of the radiology report and to advance the efficiency and effectiveness of the reporting process."

`http://reportingwiki.rsna.org` provides Microsoft Word templates for reports

SNOMED CT

- has some related terms: Radiological service, Ultrasound - action
- there are efforts to integrate RadLex with SNOMED

DICOM

- Digital Imaging and Communications in Medicine (DICOM)
- a set of standards for medical imaging files, their storage, and their transmission
- DICOM Structured Reporting, uses SNOMED CT, might be dead, and doesn't seem to fit my use case

OBI and OBO

- We would like the terms we use to be fully interoperable with OBO. The closest ontology for our domains seems to be OBI. (What about OCRE, OCI?)

Terms We Need

Medical Imaging Procedures

Examples: ultrasound imaging procedure, MRI imaging procedure

- RadLex has [RID13060 imaging procedure], [RID7467 procedure steps]
- OBI has [obi:OBI_0000185 imaging assay], [obi:OBI_0001007 image acquisition]

Contrast Agents

Examples: barium contrast agent, microbubbles contrast

- RadLex has [RID11582 contrast agent]
- Some of these are probably in ChEBI

Medical Imaging Modalities

Examples: ultrasound, MRI, PET-CT

- RadLex has specific terms under [RID10311 imaging modality]
- OBI has general terms: process [obi:OBI_0001007 image acquisition], image [obi:IAO_0000101 image], [obi:IAO_0000185 photograph]

Qualities of Image Segments

- length, height, width, volume, shapes
- axes of measurement: longitudinal, anterior-posterior, transverse
- Qualities specific to radiology – RadLex has [RID34346 echotexture], [RID29023 imaging sign], [RID28530 opacity]
- RadLex also has radiology specific signs... [RID29023 imaging sign]: [RID35000 air crescent sign]: "Crescent-shaped lucency around a lesion in the lung, visible on both radiography and CT. Typically suggests invasive pulmonary aspergillosis."

Relations Between These

- imaging procedures has contrast agent
- imaging procedures produces medical image
- image has modality, or sequence type
- image has segment (2D, 3D)
- image region has quality
- image region represents anatomical structure, pathological structure, pathology