Screening of cancer predisposition syndromes (CPS): WBMRI vs. PET-MR

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Disclosures

• NONE

Acknowledgements

• Lisa States and PET-MR team
Objectives

- WBMRI for screening cancer predisposition syndromes (CPS)
  - What we know?
  - Indications
  - Diagnostic Performance
  - Limitations
- WBMRI vs. PET-MR
WBMRI: What we know?

• Increasing interest and adoption of WBMRI for CPS
• Awareness of need for screening
• MRI is more widely available
• Advanced improvements in MRI techniques/hardware/software
**WBMRI: Technical Factors to consider**

- “Head-Toe“ Imaging
- Non-contrast screening exam
- *60-90 minutes; mean scan time of 72 min (39-150 min)
- Stations with overlap of anatomical areas
  - Moving table
  - Images are composed
- Coronal STIR & T1, Axial STIR or T2 with fat suppression
- DWI

WBMRI Indications: Cancer Predisposition syndromes

• Li-Fraumeni Syndrome (most common indication of CPS)
• Hereditary Paraganglioma-Pheochromocytoma (HPP)
• NF 1 & NF 2/Schwanomatosis
• Hereditary Retinoblastoma
• CMMRD (Constitutional mismatch repair deficiency)
• DICER 1 Syndrome → considered
• RTS (Rothmund-Thomson Syndrome) → considered
<table>
<thead>
<tr>
<th>Syndrome</th>
<th>Gene</th>
<th>Sarcoma</th>
<th>Other Cancers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li-Fraumeni</td>
<td>TP53</td>
<td>OS, RMS, non-RMS soft tissue sarcoma</td>
<td>Brain, breast, Leukemia</td>
</tr>
<tr>
<td>Hereditary Retinoblastoma</td>
<td>RB1</td>
<td>Osteosarcoma(OS)</td>
<td>Breast</td>
</tr>
<tr>
<td>Neurofibromatosis 1 (NF1)</td>
<td>NF1 (chromosome 17)</td>
<td>MPNST</td>
<td>Optic gliomas, Neurofibromas</td>
</tr>
<tr>
<td>HLRCC (uterine leiomyomatosis/renal papillary cell carcinoma)</td>
<td>FH (fumarate hydratase), Chromosome 1</td>
<td>LMS, Leiomyomas</td>
<td>Renal Cell Carcinoma</td>
</tr>
<tr>
<td>DICER 1 syndrome</td>
<td>DICER 1 (chromosome 14)</td>
<td>Pleuropulmonary blastomas, Pineoblastomas</td>
<td>Benign tumors: Thyroid nodules, cysts, renal cysts</td>
</tr>
</tbody>
</table>
DICER 1 Syndrome

- Newly recognized
- Clinical suspicion in < 6 yrs of age with pleuropulmonary blastoma or pineoblastoma
- Pediatric publication
  - N=16 children (mean 4.2 yrs) multimodality imaging
  - 30 (62.5%) WBMRI were performed
- Authors do not recommend WBMRI (screening US & MRI)
  - Suggest its utility

**Bueno et al Ped Radiology 2017
*Fernandez-Martinez L. et al. BMC Cancer 2017**
WBMRI: Indications

• MEN syndromes
  • Not currently recommended
• Villani et al. Tumor surveillance protocol (WBMRI with other screening measures)
  • Adults and children with LFS
  • In 18 pts/ 10 tumors total- detected early
  • WBMRI detected only one of these 10 cancers
• Jasperson et al. reported prospective study of WBMRI with biochemical screening for HPP syndrome
  • 5/37 patients, 6 tumors were identified
  • High (87.5%) sensitivity and (94.7%) specificity

• Several false positives ➔ additional studies, follow-ups
WBMRI: Diagnostic Performance

- Anupindi SA et al. Retrospective study (n= 50 WBMRI)
  - Detected one cancer (thyroid)
  - Risk stratification method
  - 9 abnormalities, 3 False positives
  - Sens 100%; spec 94%; 24% PPV; 100% NPV

Anupindi SA et al AJR 2015
WBMRI: Pitfalls/Limitations

**Technical Issues**
- Motion artifacts (esp at 3T)
- Inhomogeneous fat suppression, field inhomogeneity artifacts, increased susceptibility, and chemical shift

**Sedation/General anesthesia**

**Billing**

**Interpretation**

*Mohan S et al. Indian J. Radiology and Imaging 2015*

*Chavhan GB et al. Radiographics Oct 2011*
WBMRI: Interpretation

- WBMRI Readers - experienced
- Risk stratification of the abnormalities
- Interpreted in context of labs, history, other imaging studies
- Discuss with oncologist → What is the next step?

Decrease False positives

Anupindi SA et al. AJR 2015
<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Functional and morphological data</td>
<td>• Longer examination time</td>
</tr>
<tr>
<td>• Perfusion/diffusion of a tumor can be evaluated</td>
<td>• Longer sedation/GA time</td>
</tr>
<tr>
<td>• Greater soft-tissue resolution &gt; CT</td>
<td>• Cost/Reimbursement/billing challenges</td>
</tr>
<tr>
<td>• Quantification with SUV</td>
<td>• Inhomogeneity in stitched area</td>
</tr>
<tr>
<td>• Reduction in radiation dose over PET-CT</td>
<td>• Incorrect attenuation correction</td>
</tr>
</tbody>
</table>
PET-MR vs. WBMRI

• No comparative data
• Do we use it for CPS?
PET-MR vs. PET-CT

• Overall equivalent lesion detection rate between PET-MR compared with PET-CT
  • Hirsch WF et al. Ped Radiology 2013
  • Schafer JF et al. Radiology 2014
  • Ponisio MR et al Ped Radiology 2016
  • Czernin J et al J of Nuc Med 2014 (review of studies total n=900 pts)

• Reduction in radiation dose

• Superior in evaluation of bone tumors, bone marrow, tumors with low PET uptake

• Catalano et al. – additional & incidental lesions (solid organs) and lymphadenopathy better detected on PET-MR
Take-Home Points

• WBMRI is being more accepted and adopted
• WBMRI is a valuable screening tool- high NPV
• Main indications are the CPS
• There are limitations (inherent to MRI)
Take-Home Points

• PET-MR provides the best of both worlds
• Performs equal to or superior to PET-CT
• Not sufficient data to use as a screening tool for CPS
Thank you!
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