Magnetic Resonance Guided High Intensity Focused Ultrasound for the Treatment of Desmoid Tumors

Raffi S. Avedian M.D., Pejman Ghanouni M.D., Ph.D., Rachelle Bitton, PhD, Kim Butts-Pauly Ph.D.

Department of Orthopaedic Surgery and Department of Radiology, Stanford University Medical Center
Goals of Lecture
Answer Theses Questions

- What is MR guided HIFU?
- Who is a candidate for HIFU?
- What is the success rate?
- What are the side effects?
- What is the patient experience with HIFU? What can you expect?
- What are the pros and cons compared to other treatments?
What is MR guided HIFU?
What is Focused Ultrasound?

- Sound travels as a pressure wave
- Shearing and heating occurs on a microscopic level
- High intensity at the focus point and low intensity in the intervening tissues
MRI Guidance

- MR used to verify accuracy of heating and ablation
Commercially Available Devices
(The HIFU Machine)

- In Table Device: InSightech Exablate
Who is a Candidate for HIFU?

- What does it take for HIFU to be successful?
  - There has to be a clear path for the ultrasound to travel to the tumor
  - No major scars which can block the ultrasound
  - Not too much tissue between the skin and tumor
  - Tumor at least 1 centimeter from skin.
What is the Success Rate?

- 15 patients, 25 treatments
- Average follow-up: 17.5 months (0 – 38 months)
- Patient age: 24 years (7 – 66 years)
- Median viable tumor volume (pre→post tx→most recent MRI):
  - 105 mL (4 – 1010 mL) → 54 mL (1 – 420 mL) → 7 mL (0 – 228 mL)
- Pain relief:
  - Max: 7.5 ±1.9 → 2.7 ± 2.6 (P = 0.027, n = 6)
  - Avg: 6 ± 2.3 → 1.3 ± 2 (P = 0.21, n = 5)
What are the Side Effects?

- 1st or 2nd degree skin burn
  - 8 of 25 treatments
- Non-target heating
  - 3 of 25 treatments
- Nerve injury
  - 3 of 25 treatments
- Asymptomatic pancreatitis
- Deep infection after breakdown of previous surgical incision
What are the challenges?

- Using a table designed for uterine fibroids to treat arms and legs
  - Positioning on the table
  - Frequency of ultrasound not ideal of extremity tumors

- Hard to treat tumors
  - near arteries and nerves
  - previous surgical scars
  - close to skin
  - very deep tumors
What is the Patient Experience?

- Mail MRI scans to us for review
- “Desmoid Clinic” office visit review options for treatment
What is the Patient Experience?

- If a person is a candidate and wishes to proceed with HIFU
  - Day starts at 6:30 AM
  - Anesthesiologists reviews plan
  - Position on the table and start treatment
  - Wake up from anesthesia and go to recovery room then home the same day
  - Expect varying degrees of discomfort for several days
  - Followup with MRI scans every few months to monitor progress
  - Common to need multiple treatments i.e. 1-3 times per year.
  - Treatment time: 3.5 hours (0.8 – 8 hours)
What is the Patient Experience?

- Mail MRI scans to us for review
- "Desmoid Clinic" office visit review options for treatment
## Pros and Cons

<table>
<thead>
<tr>
<th></th>
<th>Radiation</th>
<th>Chemotherapy</th>
<th>Surgery</th>
<th>Cryotherapy</th>
<th>HIFU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary Cancer</td>
<td>1-5% in 10-30 years</td>
<td>Unlikely at these doses</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Fibrosis and Edema</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Unlikely</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Skin Burns</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Rare</td>
<td>Yes</td>
</tr>
<tr>
<td>Dose Limit</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Nerve damage</td>
<td>Unlikely</td>
<td>No</td>
<td>Possible</td>
<td>Possible</td>
<td>Possible</td>
</tr>
<tr>
<td>Tumor Recurrence</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Limited by location</td>
<td>No</td>
<td>No</td>
<td>Possible</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Unknown risks</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>no</td>
<td>yes</td>
</tr>
</tbody>
</table>
Patient Stories

11 year old boy
Recurrence at age 16

Tumor
Post Treatment Contrast MRI

Non Perfused Tumor
Resolution of Tumor

(Sciatic Nerve Stump, Asymptomatic)
Resolution of Tumor

Sciatic Nerve Stump, Asymptomatic
55 year old man with flank desmoid, previous resection in 2009 including rib and chest wall reconstruction
Conclusions

- MR guided HIFU is a non-invasive treatment modality for desmoid tumors.
- It has the potential to achieve durable local control in some patients.
- HIFU is not for everyone
- Side Effects can definitely happen and skin burns of some degree should be expected
- Avoids side effects of chemo, surgery, radiation
- May be used in combination with other treatments
- HIFU should be considered in the context of your tumor and a multidisciplinary team approach.