Practical US Guidance of GYN Implants with Real-time Doppler

William Bice, PhD
Department of Radiation Oncology, John Muir Health, Walnut Creek, CA

Disclosures
• None

Objectives
• Present a specific example of the use of ultrasound guidance in gynecological brachytherapy
  • Cervical cancer treatment with HDR Brachytherapy
  • Doppler US imaging
  • Blood vessel avoidance
  • Mapping techniques
• Other potential uses of Doppler US in brachytherapy
Anatomy / staging

Cervical Cancer Staging

Better Conformity with Needles
Dose Volume Histogram Comparison

- Dose optimized to deliver 1400 cGy in 2 fractions to 90% of PTV

Real-Time Doppler Ultrasound to Identify Vessels and Guide Needle Placement for Gynecologic Interstitial Brachytherapy

- Rajni Sethi, Yueh Chun Kuo, Babak Edraki, Dimitry Lerner, Daniel Paik, William Bice
- 1Department of Radiation Oncology, John Muir Health, Walnut Creek, CA
- 2Department of Gynecologic Oncology, John Muir Health, Walnut Creek, CA


Doppler for Vessel Avoidance

- HDR implants: Tandem insertion, followed by needle / catheter insertion, followed by ring and packing. The entire apparatus is held in place using dental putty.
- At least two interstitial catheters are placed 1-1.5 cm lateral to the tandem; needles are inserted under US guidance.
- Vessel avoidance using Doppler imaging.
- Danger! Inserting the needles into the cervix can result in vessel perforation.
  - Up to 4% of needle insertions
  - Requires packing and pressure to stop the bleeding
  - Use of Color Doppler to visualize vessel location in real time has reduced vessel perforation to near zero.
Doppler for Vessel Mapping

- Eleven patients were treated using this technique
- The cervix was imaged using color Doppler at superior and inferior axial slices
- Data included FIGO T-stage, Tumor size, number of vessels greater than 1-mm diameter in superior and inferior cervix
- Mapping was performed with data from all patients

Real-time Guidance

Superior and Inferior Cervix for Mapping
Results and Conclusions

• The average number of vessels > 1 mm in diameter
  • 4.2 inferior
  • 3.8 superior
• The majority of the vessels were small, ¾ were under 3 mm in diameter
• Most of the vessels were lateral and / or posterior and in the outer 1/3 of the cervix—if Doppler is not available more central and anterior placement of the needles is advised
• The number of vessels in the cervix did not correlate with stage
  • In the superior cervix higher vessel number correlated with tumor size

Other uses of Doppler in Brachytherapy

• Imaging vessels for avoidance
  • Doppler used to visualize neurovascular bundles and the dorsal venous complex in prostate brachytherapy.
  • Many investigators...
  • Doppler used to localize large vessels adjacent to oligometastatic of vaginal cancer to the internal iliac lymph node.
  • Avoidance of vessels in execution of interstitial brachytherapy of the pancreas.
Other uses of Doppler in Brachytherapy

- **Imaging increased vasculature for tumor / target location**
  - Dattoli, M. Great marketing!

- **Miscellaneous imaging**

UCSF – Redefining Possible

- With acknowledgement to Dr. I-Chow Hsu and his premium quality physics staff.
- John Muir Health / UCSF Cancer Consortium in San Francisco and the East Bay: “UCSF, we promise to treat you gently.” – John. Muir Radiation Oncology Staff