

Practical US Guidance of GYN Implants with Real-time Doppler

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Disclosures

- None

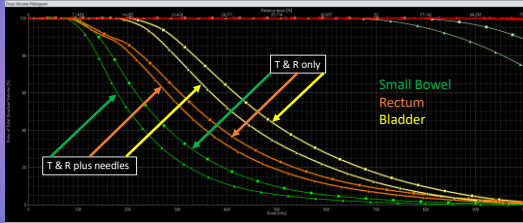


Objectives

- 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



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

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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.

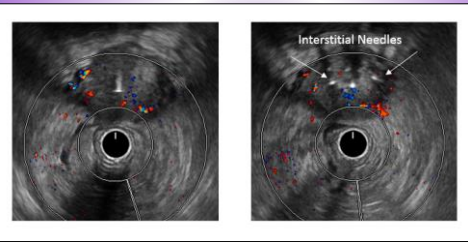


Doppler for Vessel Mapping

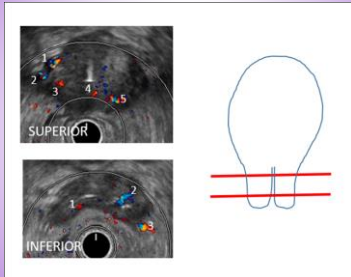
- Eleven patients were treated using this technique
- The cervix was imaged using color Doppler at superior and inferior axial slices
- Data included FIGO T-stage, Tumor size, number of vessels greater than 1-mm diameter in superior and inferior cervix
- Mapping was performed with data from all patients



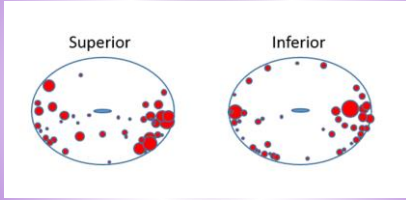
Real-time Guidance



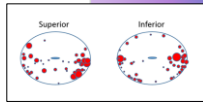
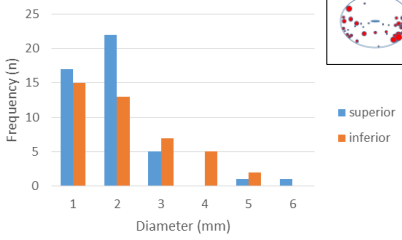
Superior and Inferior Cervix for Mapping



Composite Vessel Map for 11 patients



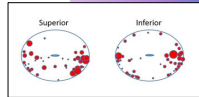
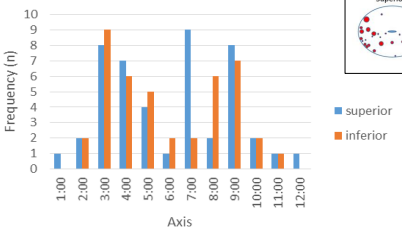
Vessel Size



■ superior
■ inferior

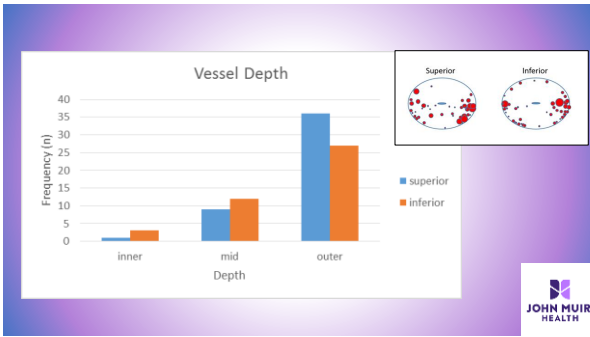


Vessel Location



■ superior
■ inferior





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

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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.
 - Yoshida, K. et al. J. Radiat. Res., 53, 154–158 (2012)
 - Avoidance of vessels in execution of interstitial brachytherapy of the pancreas.
 - Sun, X. et al. Oncotarget, 2017, Vol. 8, (No. 45), pp: 79099-79110

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Other uses of Doppler in Brachytherapy

- Imaging increased vasculature for tumor / target location
 - Doppler used to image vessels / dominant lesions for dose escalation.
 - Kovacs, G. et al. Brachytherapy 6 (2007) 142-148 and Brachytherapy 16 (2017) 277-281.
 - Dattoli, M. Great marketing!
- Miscellaneous imaging
 - Localization of brachytherapy seeds using magnetically induced vibration.
 - McAleavey, S. IEEE Trans Biomed Eng. 2003 Feb;50(2):252-5.
- Needle localization during prostate brachytherapy using Power Doppler
- Orlando, N. et al. MO-AB-303-5, 2019 AAPM National Meeting, San Antonio, TX



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