

Precision of MRI/ultrasound-fusion biopsy in prostate cancer diagnosis: an ex vivo comparison of alternative biopsy techniques on prostate phantoms

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Abstract

Purpose: Comparing the accuracy of MRI/ultrasound-guided target-biopsy by transrectal biopsy (TRB) with elastic versus rigid image fusion versus transperineal biopsy (TPB) with rigid image fusion in a standardized setting.

Methods: Target-biopsy of six differently sized and located lesions was performed on customized CIRS 070L prostate phantoms. Lesions were only MRI-visible. After prior MRI for lesion location, one targeted biopsy per lesion was obtained by TRB with elastic image fusion with Artemis™ (Eigen, USA), TRB with rigid image fusion with real-time virtual sonography (Hitachi, Japan) and TPB with rigid image fusion with a brachytherapy approach (Elekta, Sweden), each on a phantom of 50, 100 and 150 ml prostate volume. The needle trajectories were marked by contrast agent and detected in a postinterventional MRI.

Results: Overall target detection rate was 79.6% with a slight superiority for the TPB (83.3 vs. 77.8 vs. 77.8%). TRB with elastic image fusion showed the highest overall precision [median distance to lesion center 2.37 mm (0.14-4.18 mm)], independent of prostate volume. Anterior lesions were significantly more precisely hit than transitional and basal lesions ($p = 0.034$; $p = 0.015$) with comparable accuracy for TRB with elastic image fusion and TPB. In general, TRB with rigid image fusion was inferior [median 3.15 mm (0.37-10.62 mm)], particularly in small lesions.

Conclusion: All biopsy techniques allow detection of clinically significant tumors with a median error of 2-3 mm. Elastic image fusion appears to be the most precise technique, independent of prostate volume, target size or location.