Contrast ultrasound dispersion imaging in prostate cancer diagnostics

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CONTRAST ULTRASOUND DISPERSION IMAGING IN PROSTATE CANCER DIAGNOSTICS

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Introduction: In the United States, prostate cancer (PCa) accounts for 28% and 10% of all cancer diagnoses and deaths in males, respectively. Although efficient focal therapies are available, their use is hampered by a lack of reliable imaging that enables accurate PCa localization. Contrast-ultrasound dispersion imaging (CUDI) has been proposed as a new alternative method for PCa localization based on dynamic contrast-enhanced ultrasound (DCE-US) data. Different from other DCE-US methods for cancer localization, invariably based on the assessment of blood perfusion, the intravascular dispersion of ultrasound contrast agents is directly influenced by the microvascular changes produced by those angiogenic processes supporting cancer growth. Characterization of the microvascular architecture opens therefore new possibilities for noninvasive assessment of PCa aggressiveness (cancer grading).

Methods: CUDI is performed after an intravenous injection of a 2.4-mL SonoVue® (Bracco, Milan) bolus. The bolus passage through the prostate is imaged by an iU22 ultrasound scanner (Philips Healthcare, Bothell) equipped with a transrectal probe (C8-4v or C10-3v). Contrast sensitivity is increased by employment of contrast-specific imaging. Time concentration curves (TCCs) are obtained at each video pixel after data linearization. Local dispersion is analyzed by assessment of the shape similarity between neighbor TCCs. As shown in Figure 1, a parametric dispersion map is generated that highlights angiogenic areas (in red color) and, therefore, aggressive cancer areas. A preliminary validation was performed at the Academic Medical Center University of Amsterdam by comparing the obtained dispersion images with the histology results after radical prostatectomy (Figure 1) in 12 datasets recorded from 8 patients.

Results: In all patients, the dispersion images showed a good agreement on a pixel level with the histology. The resulting average receiver operating characteristic (ROC) curve area was 0.89, with sensitivity and specificity equal to 77.3% and 86.0%, respectively. These results were superior to those obtained by all the tested perfusion parameters which were previously proposed in the literature.

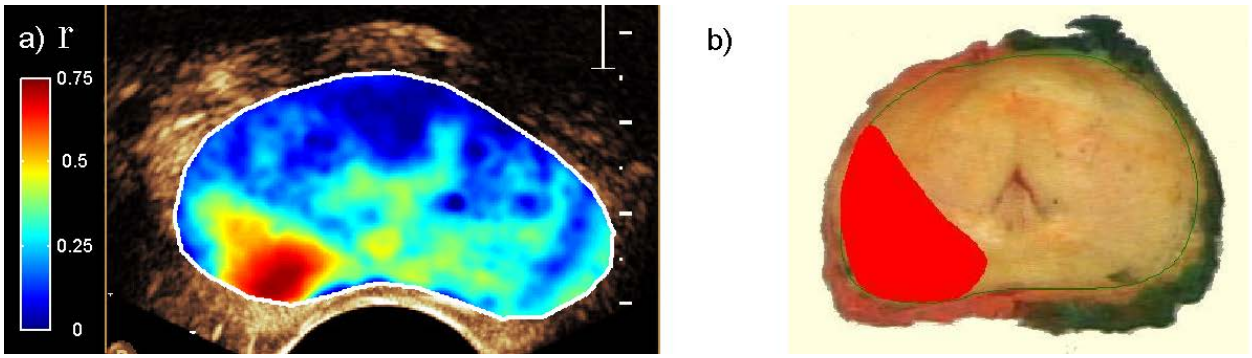

Figure: Dispersion map (a) with corresponding histology result (b).

Conclusion: Our preliminary results evidence a promising value of CUDI for PCa localization and motivate towards an extensive validation. Once validated, CUDI could support targeting of biopsy and focal-therapy, as well as therapeutic decision making based on noninvasive cancer grading.