IMAGING-INFORMED PATIENT-SPECIFIC COMPUTATIONAL MODELING OF ORGAN-CONFINED PROSTATE CANCER

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Abstract. The current clinical management of prostate cancer (PCa) enables its detection at early organ-confined stages by combining regular screening and patient classification in risk groups. Although these newly diagnosed tumors are normally organ-confined and do not usually pose a threat to the patient, most PCa cases are prescribed a radical treatment immediately after diagnosis (e.g., surgery or radiotherapy). The limited individualization of the clinical management beyond risk-group definition has led to significant overtreatment and undertreatment rates, which might adversely impact the patients' lives and life expectancy, respectively. Thus, PCa is a paradigmatic disease in which an individualized predictive technology can make a crucial difference in clinical practice, as it would enable to early identify less aggressive tumors that could be safely monitored and potentially lethal tumors that require immediate treatment. To address this critical need, we can use routine clinical and imaging data to construct and parametrize personalized mathematical models of PCa growth including the key mechanisms involved in this pathology. Then, we can run computer simulations with these models to obtain a forecast of the growth of a patient's tumor, which can assist physicians in clinical-decision making. In this talk, I will show that these models can reproduce tumor growth over the local anatomy of a patient's prostate extracted from imaging data, along with the dynamics of the Prostate Specific Antigen (PSA, a ubiquitous biomarker in PCa clinical management). Additionally, I will discuss the importance of the inhibitive effect of growth-induced mechanical stress on PCa and how the compression exerted by concomitant benign prostatic hyperplasia dramatically impedes tumor growth. Finally, I will argue that these imaging-based models constitute a promising computational technology to assist physicians in providing a personalized clinical management of PCa.

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