Computational model explains the mechanical obstruction of prostate cancer growth in pathologically enlarged prostates

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ABSTRACT

Prostate cancer is a public health burden and a major concern among ageing men worldwide, with high rates of incidence and mortality. Thanks to regular screening and risk-group triaging most patients are currently diagnosed and successfully treated when the tumor is in early stage and confined within the prostate. Benign prostatic hyperplasia (BPH) is another common pathology in ageing men that causes the prostate to gradually enlarge over time, which may produce bothersome lower urinary tract symptoms. Prostatic tumors originating in men with larger prostates tend to present more favorable pathological features [1], but the fundamental mechanisms that explain this interaction between BPH and prostate cancer are largely unknown and much debated in the medical community.

Here, we propose a mechanical explanation for this phenomenon: the mechanical stress fields that originate as tumors grow are known to slow down their dynamics, and BPH contributes to these mechanical stress fields, hence further restraining prostate cancer growth. To explore this hypothesis, we run a qualitative simulation study using an extension of our previous model of prostate cancer growth to include the mechanical deformation of the prostate caused by tumor growth and BPH [2]. Our simulations show that the mechanical stress fields accumulated in the prostate by BPH over time impede prostatic tumor growth and limit its invasiveness. These results suggest major shifts in the clinical management of both diseases to include the protective mechanical restraint of BPH over prostate cancer. Additionally, our technology may also assist physicians in the clinical management of these diseases by predicting pathological outcomes and devising optimal therapies on a organ-scale, patient-specific basis.

REFERENCES

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