Prostate cancer diagnosis: more ultrasound scans, fewer needles

Prostate cancer is the most prevalent cancer among Dutch men. In the Netherlands, around 12,600 men are diagnosed with this disease annually. In current clinical practice, this diagnosis is made by blindly taking twelve needle biopsies distributed over the entire prostate. This is because the available imaging techniques are not sufficiently reliable and accurate. In our research, we established the feasibility of an ultrasound-based imaging strategy that is more accurate and would allow a considerable reduction in the number of biopsies required for prostate cancer diagnosis.

Ultrasound has the advantage of being cost-effective, practical to the urologist, and readily available all over the world. Moreover, ultrasound techniques can non-invasively highlight what makes tumours different from normal tissue: e.g. an increased number of blood vessels, an abnormal vascular architecture, reduced tissue elasticity, and lower tissue reflectivity.

The ultrasound strategy we developed is based on optimally combining multiple cancer markers, making it a multiparametric ultrasound imaging strategy. In addition to conventional ultrasound images, we studied elastographic techniques (that assess tissue stiffness) and contrast-enhanced techniques (that assess blood flow in tissue). We showed that automatic combination of these physics-driven algorithms through artificial intelligence substantially increases the diagnostic accuracy of the scans. Moreover, doctors were able to locate significantly more tumour hotspots using multiparametric ultrasound compared to single-parametric ultrasound.

The new ultrasound strategy also uses three-dimensional algorithms, rather than the conventional two-dimensional scans. This 3D implementation does not only allow for a quick and accurate assessment of the entire prostate, but also a more precise estimation of prostatic blood flow. By measuring the contrast-agent behaviour in three dimensions, tumour locations were more readily visualized in the prostate.

For this research, we worked closely together with the Amsterdam Academic Medical Centre (location AMC), the Jeroen Bosch Ziekenhuis in ’s-Hertogenbosch, the Martini Clinic in Hamburg and the Second Affiliated Hospital of the Zhejiang University in Hangzhou, China. Both the technical and clinical outcomes are an important step towards the use of ultrasound scans in prostate cancer diagnosis. Due to the high clinical interest, the methods are currently further developed in close collaboration with the clinic.

Title of PhD-thesis: Multiparametric and Multidimensional: A Three-Dimensional and Multiparametric Approach to Ultrasound Imaging of Prostate Cancer. Supervisors: prof. M. Mischi, TU/e; prof. H. Wijkstra, TU/e; dr. R.J.G. van Sloun, TU/e (co-supervisor). Other main parties involved: Amsterdam Academic Medical Centre; Philips Research; Jeroen Bosch Ziekenhuis; Martini Clinic Hamburg; Second Affiliated Hospital of the Zhejiang University