Robot-assisted MRI-guided ultrasound biopsy (Biobot)

Robot-assisted navigation systems allow for the targeted biopsy of prostate areas with suspected malignant growth which have previously been diagnosed by means of high-resolution examination techniques (MRI or HistoScanning sonography). To this end, all image data of areas with suspected tumour growth are previously read into the biopsy system, marked and then integrated into the image processing of the high-resolution robot-assisted ultrasound biopsy unit (Biobot®) to plan the puncture during the ongoing ultrasound examination.

This way, this navigation data is made available to the biopsy robot in real time and in anatomical alignment (ultraprecise MRI-assisted navigation). In the first step, the 3D reconstruction of the MRI data record and the reconstruction of lesions with suspected malignant growth take place. For this purpose, the digital data record of a previously performed MRI of the prostate is loaded into the ultrasound scanner. Based on the MRI, anatomical reference points are marked.

This system features a robot-assisted positioning mechanism; navigation takes place through a rectally introduced protective sheath in which the transducer head can move freely without deforming the prostate. The entire system is covered with sterile material. Now the TRUS and MRI data records are fused. The MRI-TRUS image fusion combines the benefits of both techniques: The dynamic guidance of ultrasound is combined with the high diagnostic accuracy of MRI. To minimise the needle deviation resulting from the bevelled tip of the biopsy needle, we use a special needle tip. The successful performance of the biopsy
is monitored in the sonographic image on the screen. The samples are taken via a perineal access under completely sterile conditions. The annual number of prostate needle biopsies performed throughout Europe is estimated at 1 million.

Over the last few years, however, the rate of infectious complications following transrectal prostate needle biopsy has increased, caused predominantly by fluoroquinolone-resistant faecal bacteria. The rate of infectious complications rose from 1% in 1996 to 4.1% in 2005. This trend calls for new technical concepts. The maximum of only 2 tiny biopsy puncture sites also reduces the risk of tissue trauma and infections. Moreover, the system precisely records the removal site of every single tissue sample in all three dimensions similarly to a stereotactic biopsy. This makes it possible to accurately locate and classify every single tumour following the biopsy, which is, in turn, the most important prerequisite for the planning of both present and future focal therapeutic concepts.