PROSTATE CANCER

Getting on your nerves—prostatectomy imaging

In a new report in *BJU International*, Mattieu Durand and colleagues have described promising preclinical results for real-time *in vivo* periprostatic nerve tracking using multiphoton microscopy (MPM).

Surgical nerve injury, leading to erectile dysfunction and incontinence, can occur during radical prostatectomy. Accordingly, the ability to identify nerves during surgery would help surgeons avoid them.

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Using a custom-built multiphoton microscope and an *in vivo* rat model, Durand *et al.* performed *in situ* MPM imaging, and assessed the ability of this technique to identify the anatomy of the prostatic tissue. MPM has been shown to generate high-quality 3D images from fresh, unsectioned and unstained human periprostatic and prostatic tissues in real time *ex vivo*. MPM works on the principle that different tissue types have unique fluorescence characteristics, and generate different intrinsic tissue emissions after they have been excited with a laser. This phenomenon eliminates the need for exogenous dyes or contrast agents, and images can be processed to colour different tissues, based on their unique optical properties.

After initial optimization, rats underwent the MPM procedure for the ‘survival phase’

of the study. Surgical exposure was performed, and the right lobe of the prostate and the surrounding tissue were imaged. A subsequent imaging procedure was completed 15 days later, followed by animal sacrifice and histological analysis of the entire prostate and surrounding tissue, with the unimaged left lobe serving as the control.

Analysis of the images revealed that the periprostatic nerve was easily distinguished from blood vessels and from collagen bundles in the stroma. Imaging of the prostate gland showed the acini, surrounding fibromuscular stroma and—on higher magnification—the lining of the acini. Images from day 0 and day 15 were similar in quality, indicating that MPM images are stable and reproducible in the short term. Histological analysis of the corresponding tissue confirmed the cytological and architectural features identified in the tissue using MPM imaging. No tissue damage was evident using this technique, and perioperative mortality was not associated with the procedure. However, one haematoma from the surgical dissection was reported.

The results of this study suggest that the preservation of nerves in radical prostatectomy by MPM imaging is achievable and the technique is promising. However, MPM does have limitations, such as motion artefacts, difficulty imaging uneven structures and slow image acquisition, but these shortcomings could be easily resolved. Indeed, miniaturization of the MPM probes for laparoscopy is already being investigated.

Durand stated that “this technique generates real-time, high-resolution ‘histology-quality’ images from fresh, unprocessed tissue, without the need for exogenous agents.”

This is the first time that the feasibility of *in vivo* mapping of periprostatic nerves using MPM has been demonstrated and imaging was performed without any major complications or tissue damage in the rat model.

Integration of MPM into laparoscopic instruments could provide surgeons with real-time histological images, enabling them to identify tissues, such as nerves and the prostate gland, which would facilitate nerve preservation and, ultimately, reduce complications. Wider resection could also be possible, thanks to the ability of this technique to identify the prostate glands at the resection margin. This might reduce the rate of positive surgical margins and, therefore, recurrence of prostate cancer.

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Original article Durand, M. *et al.* Real-time *in vivo* periprostatic nerve tracking using multiphoton microscopy in a rat survival surgery model: a promising pre-clinical study for enhanced nerve-sparing surgery. *BJU Int.* doi:10.1111/bju.12903