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Interventinal molecular imaging: the role of technology in precision surgery

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Chapter 7

Minimal-invasive robot-assisted image-guided resection of prostate- specific membrane antigen-positive lymph nodes in recurrent prostate cancer

Adapted from:

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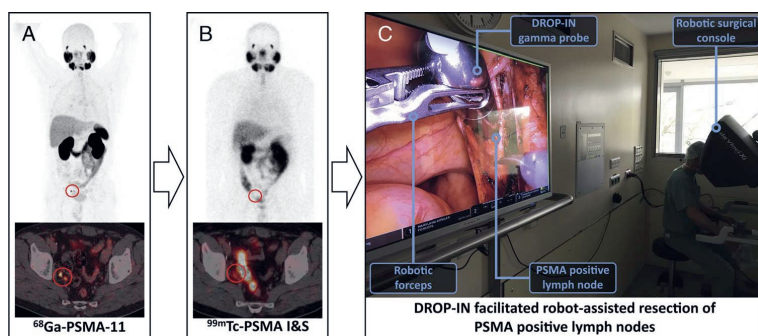
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ABSTRACT

With the rapid expansion of robot-assisted surgical procedures, the need for robot-compliant image guidance technologies has also been increased. Examples hereof are the integrated firefly fluorescence camera, the drop-in ultrasound probe and the recently introduced DROP-IN gamma probe. Combined with ^{68}Ga -PSMA-11 PET/CT (staging) and $^{99\text{m}}\text{Tc}$ -PSMA-I&S SPECT/CT (preoperative imaging), the latter DROP-IN gamma probe technology recently allowed us to perform the first clinical cases of robot-assisted PSMA-guided salvage surgery of lymphatic metastases.

Key words: PSMA, radioguided surgery, robot-assisted surgery, molecular imaging, PET, SPECT

Figure legend:



To our knowledge, we here display images of the first clinical example of prostate specific membrane antigen (PSMA)-receptor guided robotic salvage surgery of lymphatic metastases. In Europe it is becoming increasingly common that patients with rising prostate specific antigen (PSA) levels, as a result of recurrence, undergo prostate specific membrane antigen (PSMA) targeted positron emission tomography (PET) imaging. In the present study, lymphonodal recurrence within the right iliac internal region was identified on ⁶⁸Ga-PSMA-11 PET/CT¹ (Fig. 1A) in a patient with recurrent prostate cancer (PSA 0.58ng/mL) after primary radical prostatectomy. The day prior to surgery ^{99m}Tc-PSMA-I&S² was administered and in the morning of surgery a SPECT/CT image was obtained (Fig. 1B), which displayed the same PSMA positive lymph nodes as seen on PET/CT. Here it should be noted that the imaging resolution of the SPECT/CT had an inferior quality. ^{99m}Tc-PSMA-I&S has already proven its potential for intraoperative gamma tracing during salvage lymph node dissections performed in an open surgery setting.³ The recent translation of an innovative DROP-IN gamma probe technology has made this PSMA-targeted radioguided surgery concept also compatible with minimal-invasive robot-assisted laparoscopic procedures (Fig. 1C).⁴⁻⁶ Thereby empowering the robotic surgeon to identify the ^{99m}Tc-PSMA-I&S avid metastasis and guiding their resection in real-time. The tethered nature of the DROP-IN probe allowed easy interplay between gamma tracing and surgical exposure of the lymph nodes. Postoperative measurements confirmed the uptake of radioactivity, while histology confirmed the metastatic prostate cancer lesion. Subsequently, the PSA value became undetectable (<0.03ng/mL). Clearly the ability to translate PET findings to the operating room opens up new possibilities for the role of nuclear medicine in the rapidly evolving field of minimal-invasive surgery.

The ability to use targeted tracers to guide the resection of PSMA-avid macrometastatic lesions (> 2mm) provides an extension of the surgical guidance toolbox for prostate cancer patients.⁷ Uniquely, it compliments lymphatic mapping procedures that are focussed on the dissection of lymphatic micrometastases (< 2mm).⁸

REFERENCES

1. Schäfer M, Bauder-Wüst U, Leotta K, et al. A dimerized urea-based inhibitor of the prostate-specific membrane antigen for 68 Ga-PET imaging of prostate cancer. *EJNMMI Res.* 2012;2:23.
2. Robu S, Schottelius M, Eiber M, et al. Preclinical evaluation and first patient application of 99mTc-PSMA-I&S for SPECT imaging and radioguided surgery in prostate cancer. *J Nucl Med.* 2017;58:235-242.
3. Maurer T, Robu S, Schottelius M, et al. 99mTechnetium-based Prostate-specific Membrane Antigen–radioguided Surgery in Recurrent Prostate Cancer. *Eur Urol.* 2018.
4. Fuerst B, Sprung J, Pinto F, et al. First robotic SPECT for minimally invasive sentinel lymph node mapping. *IEEE Trans Med Imaging.* 2016;35:830-838.
5. Meershoek P, van Oosterom MN, Simon H, et al. Robot-assisted laparoscopic surgery using DROP-IN radioguidance: first-in-human translation. *Eur J Nucl Med Mol Imaging.* 2019;46:49-53.
6. van Oosterom MN, Simon H, Mengus L, et al. Revolutionizing (robot-assisted) laparoscopic gamma tracing using a drop-in gamma probe technology. *Am J Nucl Med Mol Imaging.* 2016;6:1-17.
7. Maurer T, Weirich G, Schottelius M, et al. Prostate-specific membrane antigen–radioguided surgery for metastatic lymph nodes in prostate cancer. *Eur Urol.* 2015;68:530-534.
8. van Leeuwen FWB, Winter A, van der Poel HG, et al. Technologies for image-guided surgery for managing lymphatic metastases in prostate cancer. *Nat Rev Urol.* 2019.