PE23 Robot-assisted radioguided surgery – In-human evaluation of a DROP-IN gamma probe

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Introduction & Objectives: In the last years, robot-assisted laparoscopic surgery has rapidly evolved in to an established surgical technique, especially in the field of prostate cancer. While these robotic platforms offer many advantages, challenges can arise in the translation of some traditional laparoscopic techniques, such as the application of radioguided surgery using a rigid laparoscopic gamma probe. In the robot-assisted setup, the surgeon can no longer perform gamma tracing him-/her-self and has to rely on the bedside assistant for positioning of the probe. Additionally, the limited maneuverability of such a rigid probe further complicates lesion identification when lesions with low radiopharmaceutical uptake are located close to a high-uptake background. To regain autonomy and improve maneuverability during radioguidance, we designed a small and tethered DROP-IN gamma probe in 2014, which can be positioned with the wristed robotic instruments. Subsequently, we have successfully translated this technology into humans with proof-of-concept in vivo studies in 2018, exploring the sentinel lymph node biopsy (SN) procedure and PSMA-targeted lymphatic salvage procedure in prostate cancer. In this study, we evaluate the DROP-IN technique in a larger SN patient group and render an in-depth comparison with fluorescence guidance and traditional laparoscopic gamma probe guidance.

Materials & Methods: 25 prostate cancer patients were included in this study, all receiving a SN procedure, extended pelvic lymph node dissection and prostatectomy. Tracer administrations with (indocyanine green-)^{99m}Technetium-nanocolloid were injected intraprostatically and preoperative SN mapping was performed using lymphoscintigraphy and SPECT/CT. Surgical localization of the SNs was facilitated by a combination of DROP-IN radioguidance, traditional laparoscopic radioguidance and fluorescence guidance.

Results: 44 SNs were resected under DROP-IN radioguidance (average count rate of 1090 in vivo and 1681 ex vivo). 91% of these SNs could also be detected in vivo using fluorescence imaging (95% ex vivo). 17 of these SNs (39%) were also surgically pursued with the traditional laparoscopic gamma probe (average count rate of 742 in vivo and 969 ex vivo). Due to the restricted maneuverability in specific anatomical locations (i.e. left iliaca externa regions, right communis, right paravesical and right cloquet), one quarter of these lesions could not be (clearly) identified without assistance of either the DROP-IN or fluorescence modalities

Conclusions: This *in vivo* study further underlines the potential to bring radioguided surgery within reach of robot-assisted procedures using the DROP-IN gamma probe technology. As a result of the improved maneuverability obtained with this probe, an increased detection rate was even suggested with respect to the traditional laparoscopic gamma probe.