Application of artificial intelligence in identifying the extracapsular extension during 3D automatic augmented reality RARP: A pilot study

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Introduction & Objectives: The aim of this study was to evaluate the accuracy of our new Artificial Intelligence based Automatic Augmented Reality (AR) system, in order to identify tumor’s extracapsular extension (ECE) at the end of the extirpative phase of robot assisted radical prostatectomy (RARP) for cT3 tumors.

Materials & Methods: From December 2020, RARP candidates with suspicious ECE at preoperative high-resolution multi-parametric magnetic resonance imaging (mpMRI, 1-mm slices) were enrolled in the study according to a dedicated protocol. The obtained three-dimensional (3D) reconstruction was overlapped to the endoscopic in-vivo anatomy and sent back to the DaVinci robotic console by using the Tile-Pro, allowing to perform AR-RARP. Specifically for this study we developed a new AR software based on artificial intelligence convolutional neuronal networks that was able to automatically identify the catheter in the prostatic lodge at the end of the extirpative phase, overlapping automatically the 3D virtual images. Selective biopsies guided by 3D AR images were then performed at the level of suspicious ECE. The Cohen kappa coefficient (k) was calculated to define correspondence between preoperative suspected ECE and pT3 stage at final pathological examination.

Results: 10 patients with suspicious ECE detected with preoperative mpMRI were enrolled. The final pathology confirmed ECE (pT3a) in 8/10 cases, with a Cohen Kappa coefficient (κ) of 0.68. After standard nerve-sparing RARP, AR guided biopsies of the surgical bed revealed the presence of cancer in 75% of the cases, confirming the accuracy of the 3D models overlapping.

Conclusions: Present findings suggest that the new evolution of our AR platform based on artificial intelligence convolutional neuronal networks allows an effective Automatic AR RARP. The 3D virtual images, automatically anchored to the catheter, allow to correctly identify the location of ECE at the level of NVBs.