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Letter

Reply to Grange PC, Morris PT, Benz HL, Buggele WA, Fryrear RS. Letter to the editor re: Amparore D, Pecoraro A, Piramide F, Verri P, Checcucci E, De Cillis S, et al. Three-dimensional imaging reconstruction of the kidney's anatomy for a tailored minimally invasive partial nephrectomy: A pilot study. Asian J Urol 2022;9:263–71. A further step towards personalized surgery through virtual clip application

Dear Editor,

We read with great interest the Letter relative to our recently published article on the role of three-dimensional (3D) imaging reconstruction of the kidney's anatomy for the management of minimally invasive partial nephrectomy [1].

We thank the Authors for the discussion points that they have raised, giving us the possibility to explain more in details the methodological draw of the study as well as to introduce some new steps in the evolution of 3D virtual models (3DVMs).

Firstly, as concern the methodology used, the choice of positive surgical margins is not always mandatory when the randomization is not feasible. However, only variables acting well before or shortly after the beginning of the treatment exposure of interest should theoretically be used to generate propensity score [2]. For example, Michiels et al. [3] did perform positive surgical margins according to age, pre-operative renal function, and R.E.N.A.L. tumor complexity score. Nonetheless, in our study, we considered only complex renal masses, and the two populations of interest (3D *vs.* no 3D) were virtually the same except for clinical T stage and tumor size. Due to the risk of redundancy of using two similar variables (clinical T stage is comprehensive of clinical tumor size), the positive surgical margins would have used only one variable for matching. For this reason, here we preferred to skip this type of analysis. With a larger sample size, maybe this analysis will be possible in another study, as suggested by the Authors.

Second, in this study we just wanted to investigate how the use of 3D can influence the success of the procedure in its whole, also focusing on complications, according to definition of margins, ischemia and complications [4]. In this achievement we acknowledge to be the first.

On the contrary, the studies that the Authors mentioned in their Letter [3,5,6] clearly demonstrated that 3D technology use during preoperative planning and surgery reduces operative time, estimated blood loss, clamp time, and length of hospital stay, as individual operative outcomes.

At last, we would like to give our contribution concerning the additional benefit of 3D modelling reported in this Letter, based on a virtual clip tool to simulate the control, visualize the potential ischemic distribution territory, and measure in percentage the impact of its application on renal arteries and branches.

In addition, our team of engineers has set a new generation of 3DVMs that we are testing in clinical practice, in which the virtual parenchyma of the kidney is composed by all the different perfusion regions of pertinence of all the third order vessels that compose the arterial vascular tree of the organ (Fig. 1).

To realize this new technological tool, 3DVMs were implemented with the Voronoi diagram, a Euclidean distance-based mathematical tool used to calculate vascular dominant regions in other organs [7].

We tested in a preliminary study its efficacy in performing selective clamping limited to the strict peritumoral renal tissue, maximizing the renal function recovery by the minimization of the ischemic injury to the kidney [8]. Of the 48 patients prospectively enrolled, 68.7% underwent selective clamping, with a 100% of concordance between the preoperative vascular management planning and the intraoperative evidence. A larger study is ongoing to confirm these preliminary data. However, our research is in line with the experience reported by the Authors, confirming that the implementation of mathematical

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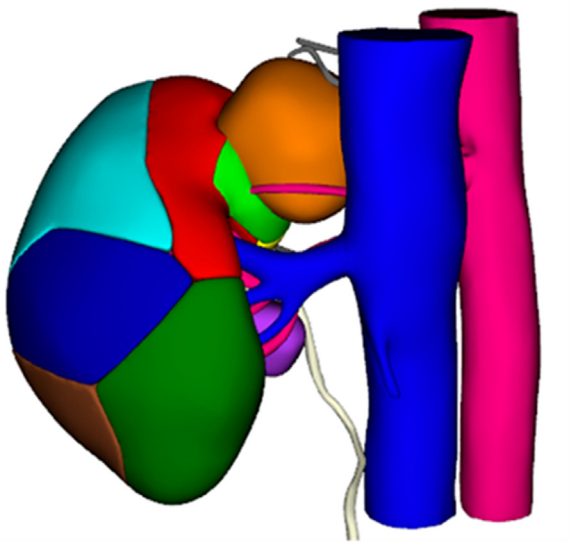

Figure 1 Three-dimensional virtual models with perfusion regions of a right kidney harboring a small renal mass of the upper pole.

algorithms to 3DVMs allows a precise estimation of the perfusion regions of each arterial branch feeding the organ, leading to plan and then perform a highly effective renal pedicle management.

Conflicts of interest

The authors declare no conflict of interest.

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