

PE45 3D digital reconstruction of renal model to guide the arterial clamping during partial nephrectomy

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Angiolini A.¹, Barbaresi U.¹, Bianchi L.¹, Cevenini M.¹, Borghesi M.¹, D'agostino S.¹, Ercolino A.¹, Chessa F.¹, Piazza P.¹, Droghetti M.¹, Bortolani B.², Cercenelli L.², Gaudio C.³, Sessagesimi E.³, Schiavina R.¹, Marcelli E.², Brunocilla E.¹

¹S.Orsola-Malpighi University Hospital, Dept. of Urology, Bologna, Italy, ²University of Bologna, Dept. of Experimental, Diagnostic and Specialty Medicine (DIMES), Cardio-Nephro-Thoracic Sciences Doctorate, Bologna, Italy, ³University of Bologna, S. Orsola-Malpighi University Hospital, Dept. of Radiology, Bologna, Italy

Introduction & Objectives: To evaluate the feasibility and effectiveness of three-dimensional digital (3D) reconstruction of renal model for surgical planning of partial nephrectomy (PN).

Materials & Methods: We prospectively enrolled patients with clinical diagnosis of renal mass scheduled for PN. Before surgery, patients were randomly assigned to two distinct groups: Patients with 3D reconstruction of renal model based on contrast enhanced computed tomography (CE-CT) (Group 1), and a control group with CE-CT only (Group 2). In Group 1, 3D virtual reconstructions of anatomical models including the lesion, renal parenchyma, urinary collecting system (UCS) and vascular anatomy were used. We compared both the preoperative characteristics and surgical planning concerning the level of arterial clamping (clampless, main artery, selective or super-selective) and the need of UCS suture between the two groups. Moreover, the intraoperative effective clamping approach, as well as warm ischemia time (WIT), intraoperative and post-operative complications and pathologic reports were recorded in the two groups.

Results: Forty-three patients (25 males and 18 females) were enrolled. Overall, no significant differences were recorded between the study and control group concerning preoperative clinical stage, PADUA and R.E.N.A.L score. All patients underwent robotic PN. In Group 1 the preoperative clamping approach based on 3D model results in higher plan of selective clamping compared to Group 2 (68% vs. 0 %; $p < 0.001$). During surgery, we found no significant difference between two groups in terms of clampless and non-selective clamping technique ($p > 0.05$). However, the effective intraoperative selective clamping approach was significantly higher in patients with 3D reconstruction compared to control group (32% vs. 5.6%, $p = 0.03$). Median WIT and global operative time were 13 and 130 minutes, respectively, with no differences between two groups. No conversion to radical nephrectomy or to open technique was needed. Overall, 20 (46.5%), 10 (23.3%) and 2 (4.7%) tumours were pathologic T1a, T1b and T3a, respectively. Mean pathologic tumour's diameter was significantly higher in Group 1 compared to Group 2 (3.7 vs. 2.6 cm; $p = 0.03$). Group 1, the mean postoperative creatinine value was similar between the two group (0.9 mg/dl in Group 1 vs. 1 mg/dl in Group 2, $p = 0.2$) at mean follow up of 5 months.

Conclusions: The use of 3D virtual models facilitates the preoperative and intraoperative knowledge of the tumour's and vascular anatomy. 3D digital renal model allows higher use of selective arterial clamping to preserve more healthy parenchyma by non-selective ischemia even in case of complex and larger renal masses.