

Laparoscopic Radical Nephrectomy Under Near Real-Time Three- Dimensional Surgical Navigation with C-Arm Cone Beam Computed Tomography

Introduction and Objective: The imaging information provided by C-arm cone beam computed tomography (CBCT) is obtained using a C-arm system that rotates around the patient, and provides an image quality similar to that of CT images. The aim of this study was to demonstrate the advantages of C-arm CBCT for imaging guidance during laparoscopic radical nephrectomy (LRN).

Materials and Methods: Four patients referred to our institution for LRN were included in this study. After the exposure of the anterior Gerota's fascia, the responsible radiologist set up the C-arm CBCT system. To visualize the renal vascular anatomy, the Iopamiron 300 contrast agent was injected intravenously. After confirming the visualization of the renal arterial phase on the real-time fluoroscopic image, three-dimensional (3D) images were acquired in a 200° rotation of the C-arm equipped with a flat-panel detector. The scan time was approximately 8 seconds. Image reconstruction was performed on a workstation to define certain anatomical structures. After restarting the laparoscopic procedure, the obtained 3D reconstructed CT images were displayed on a submonitor and compared with the laparoscopic image of the surgical field, providing a virtual map for the surgeon. The surgeon could adjust the viewing angle and rotate the reconstructed 3D image manually by using a mouse-like controller.

Results: It was easy to create 3D CT images during the operation. Using the near real-time 3D navigation images, the surgeon was able to recognize the renal vascular anatomy. All procedures were successfully performed with a satisfactory diagnostic yield or therapeutic effect without procedure-related complications.

Conclusion: This novel technology has great potential for application in LRN because it enables accurate depiction of the renal vessels and increases surgeon confidence. Further studies are necessary to investigate the actual benefits of this system for use in performing LRN.