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### 3D SEGMENTATION WITH 3D SLICER IN PREOPERATIVE ASSESSMENT AND MANAGEMENT OF GIANT RIGHT RENAL MOIETY

Bojan Vučković<sup>1</sup>, Bratislav Vasiljević<sup>1</sup>, Milan Bašić<sup>2</sup>, Petar Vesović<sup>1</sup>, Ivana Mitrović<sup>3</sup>, Ivana Stanković<sup>3</sup>, Ivica Dinić<sup>3</sup>, Slađan Petrović<sup>4</sup>

<sup>1</sup>General hospital "Aleksa Savić", Department of Urology, Prokuplje, Serbia

<sup>2</sup>General hospital "Aleksa Savić", Emergency department, Prokuplje, Serbia

<sup>3</sup>General hospital "Aleksa Savić", Department of Radiology, Prokuplje, Serbia

<sup>4</sup>General hospital "Aleksa Savić", Department of General Surgery, Prokuplje, Serbia

*Duplicated renal collecting system often presents with dilated upper moiety and certain ureteral variations. Giant renal upper moiety containing over 1.000ml of fluid is rarely seen and also difficult to assess and treat adequately. We report a case of a 49-year-old man with a giant right renal moiety containing 8.200ml of fluid and extremely dilated blind ended adjacent ureter. The patient has been admitted in Surgery department initially and then after initial diagnostics and triage hospitalized in the department of Urology of General Hospital "Aleksa Savić", Prokuplje.*

*Presenting 3D segmentation model with 3D Slicer (BSD, opensource license) in assessment and planning of operative procedure. Furthermore, volume of moiety exceeded most of data found in literature.*

*3D segmentation of collected data with CT scan and and evaluation of results in 3D Slicer (BSD, opensource licence) we performed the heminephroureterectomy on the right side as nephronsparing procedure with success. Postoperative recovery of patient with biochemical and imaging examinations showed full morphological and physiological recovery of affected kidney.*

*This size giant upper moiety is certainly uncommon. We included 3D segmentation in order to outline the whole data in terms of better visualization, precise volumetric analysis and relations of hydronephrotic upper pole moiety with adjacent organs and vessels. Three-dimensional reconstruction and segmentation of blood vessels, organs, and kidney anomalies can assist urologists in assessment, planning operation and surgical implementation.*

**Key words:** hydronephrosis, kidney, heminephroureterectomy, 3D slicer, 3d segmentation, surgical planing

### 3D SEGMENTACIJA SA 3D SLICER-OM U PREOPERATIVNOJ PROCENI I UPRAVLJANJU GIGANTSKE DESNE BUBREŽNE GRUPE

*Duplicirani bubrežni sabirni sistem često se manifestuje proširenim gornjim delom i određenim varijacijama uretera. Ogroman gornji deo bubrega koji sadrži preko 1.000 ml tečnosti se retko viđa i takođe je teško proceniti i adekvatno lečiti. Prijavljujemo slučaj 49-godišnjeg muškarca sa džinovskom desnom bubrežnom grupom koja sadrži 8.200 ml tečnosti i izuzetno proširenim susednim ureterom sa slepim krajevima. Pacijent je prvobitno primljen na odeljenje hirurgije, a potom nakon inicijalne dijagnostike i trijaže hospitalizovan na odeljenju urologije Opšte bolnice „Aleksa Savić“, Prokuplje.*

*Predstavljanje 3D modela segmentacije sa 3D Slicer-om (BSD, opensource licenca) u proceni i planiranju operativnog postupka. Štaviše, obim grupe premašuje većinu podataka pronađenih u literaturi.*

*3D segmentaciju prikupljenih podataka sa CT skeniranjem i evaluaciju rezultata u 3D Slicer-u (BSD, opensource licenca) uspešno smo izvršili heminefroureterektomiju sa desne strane kao nefronsparing proceduru. Postoperativni oporavak pacijenta biohemijskim i slikovnim pregledima pokazao je potpuni morfološki i fiziološki oporavak zahvaćenog bubrega.*

*Ova velika gornja grupa je svakako neuobičajena. Uključili smo 3D segmentaciju da bismo prikazali celokupne podatke u smislu bolje vizuelizacije, precizne volumetrijske analize i odnosa*

*hidronefrotskog dela gornjeg pola sa susednim organima i sudovima. Trodimenzionalna rekonstrukcija i segmentacija krvnih sudova, organa i anomalija bubrega može pomoći urolozima u proceni, planiranju operacije i hirurškoj primeni.*

**Ključne reči:** *hidronefroza, bubreg, heminefroureterektomija, 3d Slicer, 3D segmentacija, hirursko planiranje*

## Introduction

The incidence of renal duplex moiety varies across different studies, with reported rates ranging from 1% to 3% in the general population (1). Duplex kidneys are considered one of the more common renal anomalies, occurring in approximately 1 in 125 individuals in postmortem studies (2). The incidence of duplex ureteric systems, a common congenital anomaly of the renal tract, is reported to be approximately 0.8% in the population (3). Additionally, the true incidence of incomplete duplicated renal systems with lower moiety obstruction is estimated to range from 2% to 7% among children with duplex kidneys (4). Duplicated renal collecting system often presents with dilated upper moiety and certain ureteral variations. Giant right renal upper moiety containing over 1.000 ml of fluid is rarely seen and also difficult to assess and treat adequately.

We report a case of a 49-year-old man with a giant right renal moiety containing 8.200 ml of fluid and extremely dilated blind ended adjacent ureter. The patient has been admitted in Surgery department initially and then after initial diagnostics and triage hospitalized in the Department of Urology of General Hospital "Aleksa Savić", Prokuplje due to a dull suprapubic pain, and abdominal distension. He had no urological symptoms and no medical history of familiar conditions.

## Objective

To present 3D segmentation model with 3D Slicer (BSD, opensource license) in assessment and planning of operative procedure. Furthermore, volume of moiety exceeded most of data found in literature (5).

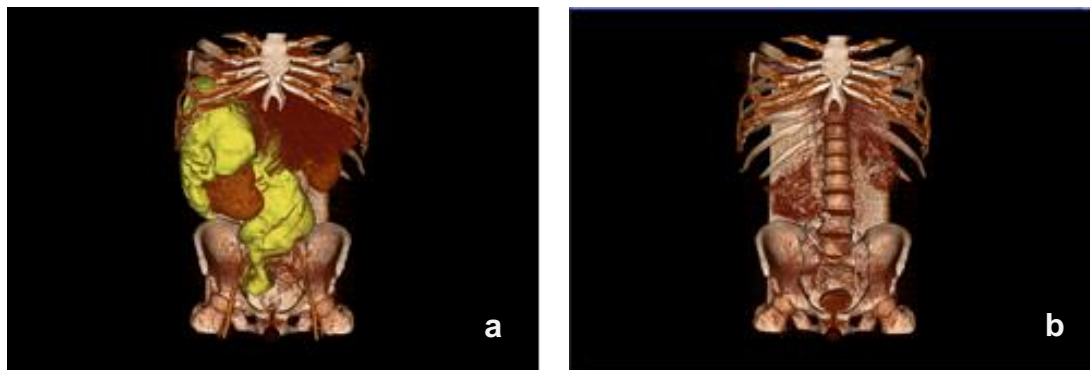
## Materials and methods

Use of 3D Slicer in preoperative planning has gained significant attention across various medical specialties. 3D Slicer has been identified as a

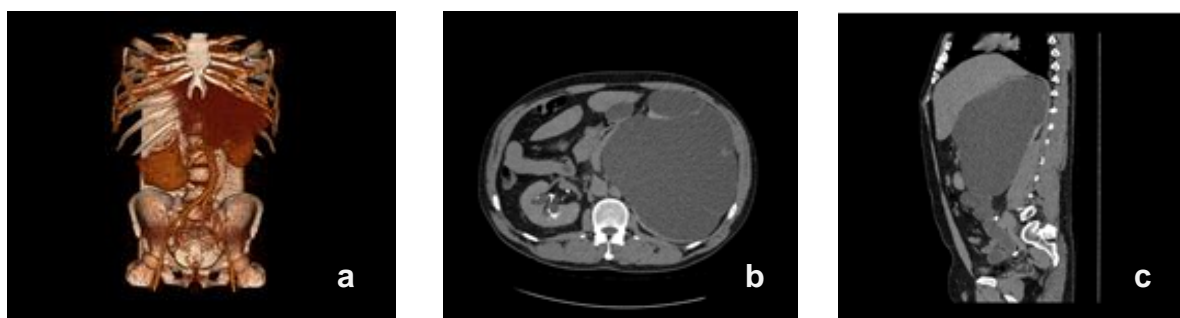
valuable tool in plastic and other branches of surgery for preoperative planning, intraoperative guidance, patient education, and customized implant development (6). Segmentation of images (also known as contouring or annotation) is a procedure to delineate regions in the image, typically corresponding to anatomical structures, lesions, and various other object space. It is a very common procedure in medical image computing, as it is required for visualization of certain structures, quantification (measuring volume, surface, shape properties), 3D printing, and masking (restricting processing or analysis to a specific region) (7). Source for this digitalized procedure is an CT, Ultrasound or MR generated data with all the slices made during the scan of patients region of interest.

## Patient and procedure

A 49-old male patient admitted at surgery department due to a dull suprapubic pain, and abdominal distension. He had no urological symptoms. Physical examination revealed a distended abdomen. Routine hematology, biochemistry, and serum tumor markers were within reference range. At first on ultrasonographic examination suspicion has fallen at ascites. But further diagnosis of giant upper moiety of right kidney founded with Computed tomography (CT). Initial diagnose included possible upper pole renal cyst. DICOM data retrieved from CT were then loaded into 3D Slicer as an opensource medical software that can reconstruct and visualize various medical image data in three dimensions (6). Careful segmentation and volume rendering precisely revealed an enlarged upper pole moiety of right kidney and extremely dilated ureter blindly closing posteriorly to bladder. Excretory phase showed undilated lower pole excretory duct. Abdominal viscera were displaced to the left with aortal disposition too. Segmentation revealed 8.238 ml of fluid with mean Hounsfield units (HU) -6.5. Elongation of renal vessels and relation of mass to adjacent aorta and its branches was clearly distinguished.



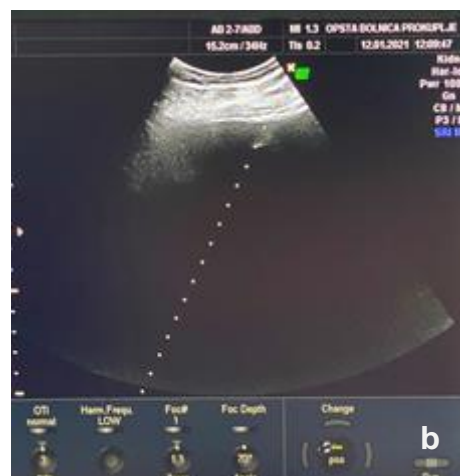
**Figure 1.** (a) Green segment representing segmented and isolated Giant upper moiety of right kidney with dilated blind ended ureter juxtavesicaly.  
 (b) Excretory phase showing normal ureter for the lower caliceal collecting system of right kidney.



**Figure 2.** (a) Aortal disposition,  
 (b, c) Visceral disposition

Cystoscopy revealed normally developed trigone and orthotopic orifices. Regarding size and volume of dilated moiety patient underwent initial continuous percutaneous catheter drainage. 8.150

ml of brownish fluid has been removed with negative cytology and negative bacterial cultures.



**Figure 3.** (a) PCN drained fluid.  
 (b) US image of cavity taking whole screen of the transduced image.

6 weeks delayed right heminephroureterectomy was then performed as a definite surgery. Initial percutaneous nephrostomy appeared as first stage of treatment in order to slowly decompress abdominal viscera and great vessels. Subsequent surgery, of course, provided definite solution. To date, there is no postoperative complications. Patient laboratory findings are within reference range with no subjective symptoms.

### Conclusion

This size and volume giant upper moiety is certainly uncommon and very rare in literature. Often, diagnosis can be mistaken for renal cyst or

ascites. CT represents a gold standard and refines whole diagnostic process. We included 3D segmentation in order to outline the whole data in terms of better visualization, precise volumetric analysis and relations of hydronephrotic upper pole moiety with adjacent organs and vessels. Careful planning and two-staged procedure with draining and then surgical removal of complete anomaly within nephronsparing approach makes the best outcome for patient.

Three-dimensional reconstruction and segmentation of blood vessels, organs, and kidney anomalies can assist urologists in assessment, planning operation and surgical implementation.

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