PD23-05: Interactive Virtual Reality as an Educational and Preoperative Tool for Laparoscopic Donor Nephrectomy

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Introduction

- To guide surgery and minimize risk, surgeons review CT and MRI to analyze anatomy.
- CT and MRI scans require surgeons to translate over 2000 2D images into a 3D understanding of renal anatomy.
- Interactive virtual reality (iVR) provides a 3D “hands-on” experience with patient-specific anatomy.
- Our goal was to establish if iVR anatomy review could improve patient and surgeon understanding and improve surgical outcomes.

Methods

- 20 LDN patients prospectively recruited and compared with 45 LDN patients in a matched retrospective cohort
- Routine CT scans were used to create iVR models, which were viewed with a VR headset and hand-held device
- Questionnaires:
  - Surgeon understanding of anatomy (CT vs CT+iVR)
  - Patient understanding of anatomy and procedure
- Surgical outcomes

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Surgeons' Preoperative Assessment

Surgeon Preoperative Imaging Assessment			
	CT (n = 20)	iVR (n = 20)	p-value
Arterial Anatomy	7.5	10	< 0.001
Venous Anatomy	7	10	< 0.001
Collecting System/Ureteral Anatomy	8	10	< 0.001
Anatomy Surrounding the Kidney (spleen, pancreas, bowl)	9	10	0.021
Overall confidence in understanding patient anatomy	4	5	< 0.001
Anticipated technical challenge of procedure	3	2.5	< 0.001

T-test was used to determine significance for normally distributed data. Wilcoxon Signed-Rank Test was used for non-normally distributed data.

Patients' Preoperative Assessment

Patient Post-iVR Model Assessment	
Better understand location of kidney	5 (4-5)
Better understand size and shape of kidney	5 (4-5)
Feel less concerned about surgery	4.5 (4-5)

Surgeons' Postoperative Assessment

Surgeon Postoperative Imaging Assessment			
	CT (n = 20)	iVR (n = 20)	p-value
Arterial Anatomy	8	10	0.001
Venous Anatomy	7	10	0.002
Collecting System/Ureteral anatomy	8	10	0.005
Anatomy surrounding the kidney (spleen, pancreas, bowl)	9	10	0.022
iVR altered surgical approach	Yes	No	
	18 (90%)	2 (10%)	
Surgery was technically difficult to perform	2 (1-5)		
iVR model improved navigation of anatomy	5 (1-5)		

T-test was used to determine significance ($p<0.05$) for normally distributed data. Wilcoxon Signed-Rank Test was used for non-normally distributed data.

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Surgical Outcomes

	iVR (n = 20)	CT Scan (n = 45)	p-value
Operative Time (minutes)	190.4 ± 56.8	251.9 ± 66.9	< 0.001
EBL (mL)	30 (30)	50 (38.75)	0.402
LOS (days)	2 (0)	2 (1)	0.873
% Change Creatinine	35%	64%	< 0.001
% Change hemoglobin	–13%	–14%	0.892
30-Day Complications (#)	2 (10%)	10 (22%)	< 0.001

Conclusions

- In the setting of donor nephrectomy, iVR models improve the surgeon's confidence and understanding of the renal anatomy and alter the operative approach.
- Viewing iVR models can improve patients' understanding of the planned procedure and reduce their anxiety.
- Use of interactive virtual reality for laparoscopic donor nephrectomy was associated with significant decreases in:
  - Operative time
  - Postoperative renal dysfunction
  - Overall complications

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