Table. Immersive Virtual Reality (iVR) Surgeon and Patient Questionnaires

Surgeon Preoperative Imaging Assessment; Understanding (0 = poor; 10 = excellent)			
	CT (n = 20)	iVR (n = 20)	p-value
Arterial Anatomy	7.5	9.9	**< 0.001**
Venous Anatomy	7.2	9.8	**< 0.001**
Collecting System/Ureteral anatomy	7.1	9.5	**< 0.001**
Anatomy surrounding the kidney (spleen, pancreas, bowl)	8.6	8.9	**< 0.001**
Surgeon Preoperative Imaging Assessment; Understanding (0 = poor; 5 = excellent)			
Overall Confidence in understanding patient anatomy	3.8	4.9	**< 0.001**
Surgeon Preoperative Imaging Assessment (0 = straightforward; 5 = challenging)			
Anticipated technical challenge of procedure	2.9	2.3	**< 0.001**
Surgeon Preoperative Assessment (1 = strongly disagree; 5 = strongly agree)			
iVR model altered surgical plan	4.6		
iVR model improved understanding	4.9		
iVR was valuable in preoperative planning	4.9		
Would use iVR for future cases	4.9		
Recommend iVR to colleagues	4.9		
Use iVR to teach residents	4.9		
Surgeon Postoperative Imaging Assessment; correlation with actual anatomy (0 = poor; 10 = excellent)			
	CT (n = 20)	iVR (n = 20)	p-value
Arterial Anatomy	7.9	9.9	**< 0.001**
Venous Anatomy	7.5	9.4	**0.001**
Collecting System/Ureteral anatomy	8.2	9.8	**0.003**
Anatomy surrounding the kidney (spleen, pancreas, bowl)	8.2	9.2	**0.022**
Surgeon Postoperative Assessment (1 = strongly disagree; 5 = strongly agree)			
Surgery was technically difficult to perform	2.8		
iVR model improved navigation of anatomy	4.8		
Patient post-iVR Model Assessment (1 = strongly disagree, 5 = strongly agree)			
Better understand location of kidney	4.9		
Better understand size and shape of kidney	4.9		
Feel less concerned about surgery	4.5		

Source of Funding: n/a

PD23-06

KIDNEY TUMOR DETECTION WITH HISTOLOGICAL SUBTYPE DIFFERENTIATION USING MOLECULAR CHEMICAL IMAGING: AN INNOVATIVE, NON-INVASIVE INTRAOPERATIVE IMAGING DEVICE

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INTRODUCTION AND OBJECTIVE: Visualization and detection of tumors during extirpative surgeries can be challenging. Currently, there is no intraoperative imaging device to detect kidney tumors and determine their histological subtype with high accuracy. We are developing a non-invasive intraoperative Molecular Chemical Imaging (MCI) device for detecting critical structures, including tumors, in real-time and without the use of contrast agents. MCI is achieved by incorporating molecular spectroscopy and digital imaging. Used in conjunction with machine learning and computer vision strategies, MCI generates enhanced visualization of tissue structures against surrounding tissues. In this study, we report performance of kidney tumor differentiation from normal tissue and tumor histological subtype identification using MCI.

METHODS: We studied 22 human kidney cancer specimens after radical nephrectomy. During MCI, samples were exposed to white light, and the light reflected from the tissue was analyzed by a MCI device operating in the visible & near-infrared spectral regions. Discrimination of tumor from non-tumor tissue was demonstrated using a machine learning approach, partial least squared discriminant analysis (PLS-DA). Discrimination performance of the PLS-DA model was evaluated with metrics such as sensitivity (Sn), specificity (Sp), and accuracy. Tumor subtypes from 18 specimens were further investigated. A multi-class PLS-DA model from 13 clear cell renal cell carcinomas (ccRCC), 2 papillary RCC, 2 transitional cell carcinoma (TCC), and 1 chromophobe RCC was built, and classification accuracy for each tumor subtype was generated.

RESULTS: Tumor discrimination was achieved with high performance. The PLS-DA model differentiated between tumor and non-tumor tissues with 93.5% accuracy, 88.6% Sn, and 95.4% Sp. To evaluate MCI tumor subtyping capability, the multi-class PLS-DA model classified TCC with 100% accuracy, chromophobe RCC with 100% accuracy, ccRCC with 80.8% accuracy, and papillary RCC with 66.7% accuracy. A spectral peak at 975 nm, corresponding to water, was most intense for ccRCC which indicates hypervascularity, in contrast to other subtypes that showed hypovascularity.

CONCLUSIONS: These positive results demonstrate the potential of MCI for augmenting a surgeon's ability to accurately visualize kidney tumors and to identify histological subtype without the use of contrast agents. This innovative imaging modality has the capability of being applied to other forms of extirpative surgeries.

Source of Funding: Internally funded by R&D of ChemImage Corporation

PD23-07

A MULTI-CENTER, PROSPECTIVE, RANDOMIZED, CONTROLLED STUDY TO EVALUATE THE SAFETY OF A VALVE-LESS TROCAR INSUFFLATION SYSTEM (AIRSEAL) VS. CONVENTIONAL INSUFFLATION FOR THE MANAGEMENT OF PNEUMOPERITONEUM DURING ROBOTIC PARTIAL NEPHRECTOMY

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INTRODUCTION AND OBJECTIVE: The use of valve-less insufflation is gaining significant popularity for robotic partial nephrectomy secondary to its ability to maintain a pneumoperitoneum during constant vigorous suction. This study evaluated a valve-less trocar system (AirSeal) compared with conventional insufflation and the effects of insufflation pressure on peri-operative safety outcomes.

METHODS: Subjects from three institutions were randomized equally in a 1:1:1 ratio into three different study arms: AirSeal - 12mmHg pressure (AIS12); AIS - 15mmHg (AIS15); and Conventional Insufflation - 15mmHg (CIS15). The rate of subcutaneous emphysema (SE) constituted the primary safety endpoint and was identified by physical exam intraoperatively, post-operatively and chest x-ray (CXR). Secondary safety endpoints included: pneumothorax, and/or pneumomediastinum identified on post-operative CXR and post-operative shoulder pain measured via a Visual Analogue Scale (VAS) administered during predetermined times after surgery.

RESULTS: A total of 198 patients were enrolled (n=66 in each study arm). There were no statistically significant differences in demographics including sex, ethnicity, age or BMI between the three groups. There was a statistically significant reduction in the rate of SE between AIS12 (15.25%) and CIS15 (30.9%) with a p value of 0.008. The incidence of pneumothorax was 0%, 5% and 5% for AIS12, AIS15 and CIS15, respectively (p=0.12). The incidence of pneumomediastinum was 6%, 12% and 11% for AIS12, AIS15 and CIS15, respectively (p=0.36). An 11.5% reduction in postoperative shoulder pain was seen in AIS12 vs. CIS15 (p=.0.049) and 14% reduction in shoulder pain AIS15 vs. CIS15 (p=0.01). Two patients randomized to CIS15 required conversion to AIS15 secondary to poor visualization and bleeding.

CONCLUSIONS: This study demonstrates that utilizing AIS12 provides a significant reduction in the incidence of SE compared to CIS15 in patients undergoing robotic partial nephrectomy. In addition, the use of the Airseal system at both 12mmHg and 15mmHg reduces postoperative shoulder pain compared with conventional insufflation. This suggests that for patients undergoing robotic partial nephrectomy the use of AIS 12 provides the highest safety profile compared to CIS15.

Source of Funding: Conmed

PD23-08

ENHANCED INTRAOPERATIVE NERVE VISUALIZATION: PROOF OF CONCEPT

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INTRODUCTION AND OBJECTIVE: Iatrogenic neurological injury is a risk in genitourinary surgery. Herein, we present our experience with an in-house designed agent to enhance the visualization of nerves during surgery.

METHODS: Illuminare-1 is an intravenous myelin-binding fluorophore. After completing murine tests and obtaining ethical

approval, we undertook dog and porcine experiments. Pigs were positioned supine, anesthetized, insufflated and then lateral abdominal nerves were visualized with a modified FDA-approved laparoscope under white and blue (370 – 424nm wave length) light. Induction doses of 0.5 – 1.4mg/kg were administered under continual visualization. Subjective and objective recordings of surgeon nerve delineation were taken up to 5 hours after injection. Afterwards, specimens were resected for histological confirmation of the presence of nerves, using a myelin basic protein (MBP) antibody. An additional robotically-assisted prostatectomy was conducted on a dog with blue light visualization achieved via the assistant port.

RESULTS: An optimal dose of 0.7 – 1.4mg/kg enabled visualization of lateral wall nerves. Under blue light, the nerves displayed a distinct hue, delineating them from fat and muscle (Figure 1). These nerve-like structures were resected with histology confirming ~200nm nerve fibers and staining positive for MBP (Figure 2). The dog studies showed sustained fluorescence of the obturator nerve throughout a 2.5-hour experiment (Figure 3).

CONCLUSIONS: Illuminare-1 enhances porcine and dog nerve visualization. In-human clinical studies are underway and will hopefully help reduce surgical morbidity.

Figure 1: Lateral abdominal wall nerve at baseline under white light (left), blue light (middle) and 15 minutes post injection under blue light (right)

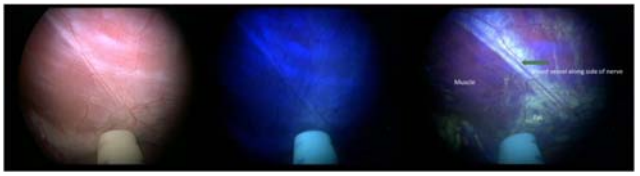


Figure 2: Nerve-like structures resected with H&E (left) confirming nerve tissue and myelin-basic protein antibody (right) confirming myelinated nerve

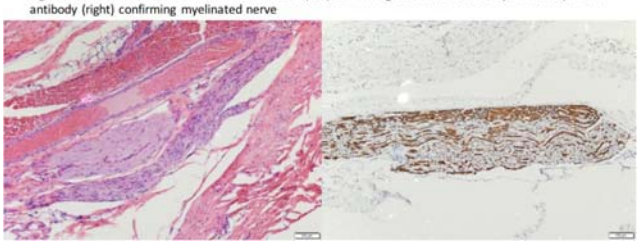
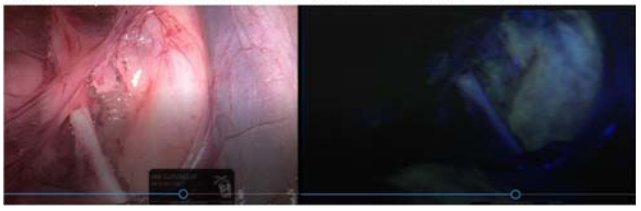


Figure 3: Obturator nerve visualized 15 minutes after injection under white (left) & blue light (right)



Source of Funding: This study was supported by the Sidney Kimmel Cancer for Prostate and Urologic Cancers, the NIH NCI Cancer Centre Support Grant P30CA008747, and by the Prostate Cancer Foundation.

PD23-09
INITIAL EXPERIENCE OF NEW SENHANCE ROBOTIC SYSTEM IN UROLOGIC SURGERY

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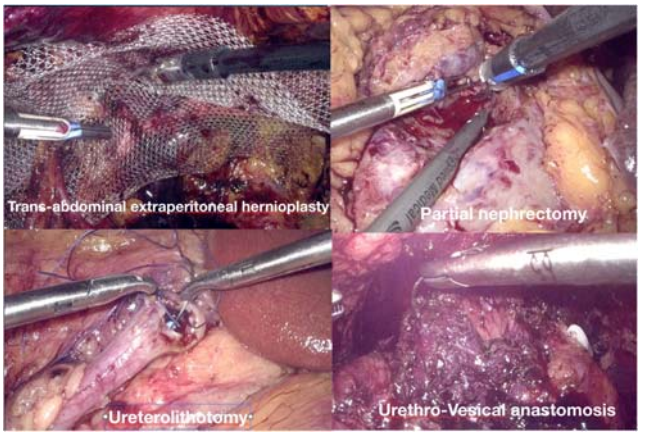
INTRODUCTION AND OBJECTIVE: The use of robotic surgeries is increasing in urologic field. Recently, the Senhance robotic system, a novel robotic platform was introduced on the market. It is based on standard laparoscopic surgery, equipped with haptic feedback and eye tracking system. Currently, the surgical platform is only used in general surgery, colo-rectal surgery and gynecological surgery. This study describes the initial, single center experience, evaluating the feasibility and safety of the new robotic system in performing urologic surgeries.

METHODS: From July 2019 to October 2019, total 34 patients undergoing urologic surgery with Senhance robotic system were collected. Their peri-operative data were analyzed. Indications for surgery include inguinal hernia, stone disease, ureteral stricture, renal cell carcinoma, urothelial carcinoma and prostate cancer.

RESULTS: The median age was 69 years-old (42-85). Surgical procedures include 15 cases (44.1%) hernioplasty, 6 cases (17.6%) radical prostatectomy, 5 cases (14.7%) ureterolithotomy and ureteral reconstruction, 2 cases (5.8%) partial nephrectomy, 2 cases (5.8) adrenalectomy, 2 cases (5.8%) renal cysts unroofing, 1 case (2.4%) abdominal exploration for cryptorchidism, 1 case (2.4%) nephroureterectomy and bladder cuff excision. Nine cases (26.4%) were operated for malignant diseases (6 adenocarcinoma of prostate, 2 renal cell carcinoma, and 1 urothelial carcinoma) The median docking time was 10 min (8-30). The median operative time was 125 min (93-325). The median time to discharge was 7 days (3-10). The incidence of post-operative complications was 20.5% (Clavien-Dindo I/II- 7 patients) . There's no Clavien-Dindo III/IV complications. No patient was re-admitted and no patient require re-operation.

CONCLUSIONS: The results showed Senhance surgical robotic system could be adopted in urologic surgery. It is safe and feasible, and could performed most urologic procedures. The learning curve is quick and its special advantage offer urologist more choices of robotic surgery. More clinical data are needed to determine whether it could provide any other benefits.



Source of Funding: nil

PD23-10
A PILOT STUDY TO INVESTIGATE THE USE OF VIDEO VISITS IN REDUCING READMISSIONS AFTER MAJOR UROLOGIC SURGERY

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INTRODUCTION AND OBJECTIVE: Telemedicine is an innovative field that resulted in an increase in health care access and reduction of associated costs. The role of telemedicine in a post-operative setting and its impact upon readmission rates have not been studied. We aim to evaluate the feasibility of postoperative video visits and assess the impact in reducing readmissions following major urologic oncologic surgery.

METHODS: Patients undergoing major urological surgery by a single provider (DSS) were screened to participate in our study. All