

CUA 2022 Annual Meeting Abstracts – Poster Session 4: Basic Science, Training, Technical Advances

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MP-4.4

Neurotrophin growth factor levels in bladder bells are regulated by nitric oxide secretion

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Introduction: Urine of patients with overactive bladder disease (OAB) shows low levels of neurotrophin NGF and stable amounts of its precursor proNGF. Higher levels of nitric oxide (NO) were shown in the same samples and may be a contributing factor of OAB.¹ Here, we investigated how NO may control the synthesis and secretion of NGF in bladder cells in vitro.

Methods: Primary cultures of urothelial (UROs) and smooth muscle cells (SMCs) from rat bladders were used. NO was measured using the Griess reaction. Expression of NGF, proNGF, and MMP-9 mRNA was determined by RT-qPCR. Intracellular MMP-9 was assessed by immunoblotting. ELISA kits were used to measure NGF, proNGF, and cyclic GMP (cGMP). The activity of major proteases involved in NGF metabolism (plasmin, MMP-7, MMP-9) was measured by specific enzymatic kits. Crisp-Cas9 was done to delete the genomic MMP-9 sequence.

Results: NO secretion increased in cells incubated in a hyperglycemic medium (27 mM). Incubation with the NO generator, sodium nitroprusside (SNP) (300 µM), led to decreased NGF and stable proNGF levels. SNP decreased cGMP levels in UROs but increased in SMCs. Stable permeable analogs of cGMP, 8-(4-Chlorophenylthio)-cGMP (3 mM) and N2,2'-O-Dibutyl-yl-cGMP (1 mM), respectively, decreased and increased NGF secretion in SMCs and UROs. SMCs had stable levels of NGF and MMP-9 mRNA, while UROs showed an increase. In Crisp-Cas9 transfected SMCs, NGF decrease was independent of MMP-9 but may be linked to decreased MMP-7 activity. Crisp-cas9 transfection in UROs partially inhibited the effect of SNP on NGF. MMP-7 levels were also enhanced by SNP. Plasmin activity was unaffected in both cell types.

Conclusions: High glucose levels increase the release of NO leading to decreased NGF. The signaling mechanism involves cGMP, MMP-7, and MMP-9 activity. These results are consistent with those obtained in urine of OAB patients,¹ suggesting that increased glycemia, by enhanced synthesis of NO, could be part of the pathological process.

Reference

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MP-4.5

Improved patient-reported and surgical outcomes following urological procedures under conscious sedation

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Introduction: The current standard of care for patients undergoing the majority of endourological, scrotal, and penile procedures is to administer general/spinal anesthesia. Our center previously demonstrated the feasibility of performing distal ureteroscopy under physician-directed, nurse-administrated intravenous (IV) conscious sedation for ureteric calculi. We have expanded our ability to perform a myriad of urological procedures under conscious sedation. This study sought to prospectively evaluate patient-reported and surgical outcomes.

Methods: We prospectively enrolled patients undergoing endourological, ureteric stent insertions/exchanges, scrotal/penile, urethral dilations, and advanced cystoscopic procedures. All procedures were conducted using fentanyl, midazolam, or both, and patient and procedural data were recorded upon completion. Patients were telephoned 4–6 weeks after their procedure to complete a standardized questionnaire. A multivariable-adjusted logistic regression analysis was performed to evaluate whether a patient would opt for conscious sedation again as opposed to general/spinal anesthesia.

Results: A total of 196 procedures were performed, with an overall procedure success rate of 96.5% and a complication rate of 0%. At 4–6-week follow-up, 83.4% completed the standardized patient tolerability questionnaire. If requiring a repeat procedure of this nature, 85% reported they would opt for conscious sedation as compared to general anesthesia. Predictors of opting for conscious sedation in the future were older age ($p=0.017$) and surgeon-perceived level of patient tolerability ($p<0.001$). No statistically significant difference was found with respect to body mass index, gender, prior conscious sedation experience, Charlson Comorbidity Index, type of procedure, or time of procedure.

Conclusions: Physician-directed, nursing-administered IV conscious sedation is a viable alternative for a majority of urological procedures. Careful patient selection is paramount to ensure a successful procedure with excellent patient tolerability.

Acknowledgment: Parts of this study will be presented at the 37th Annual European Association of Urology Congress.

MP-4.6**Short-term postoperative functional outcomes of Rezūm vs. Greenlight PVP 180W XPS: A propensity match score study**

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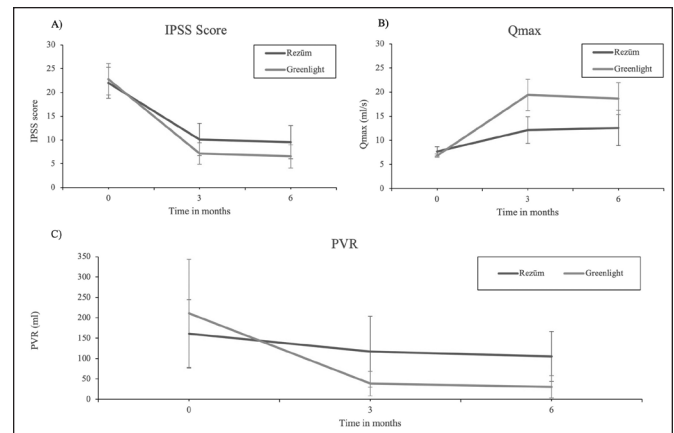
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Introduction: Rezūm steam vapor therapy has recently gained popularity as a new minimally invasive surgical technique for patients with benign prostatic hyperplasia (BPH). The currently available literature on Rezūm has been promising, showing good lower urinary tract symptom relief outcomes and favorable sexual outcomes. In this multicenter study, we sought to compare the functional outcomes of Rezūm against a similar cohort of patients undergoing 180W XPS GreenLight (GL) photoselective vaporization of the prostate (PVP).

Methods: Data were obtained from the Global GreenLight Group database, which includes eight high-volume, experienced surgeons from a total of seven international centers, as well as data from the Canadian Rezūm Database. Patients with previous BPH surgery were excluded. Six-month changes in International Prostate Symptom Score (IPSS), maximal flow rate (Qmax), and postvoid residual (PVR) were compared between GL and Rezūm using regression models, with inverse propensity treatment weighting adjusting for age and prostate size.

Results: The GL and Rezūm groups had significant baseline differences in age and Qmax (Table 1). At six-month followup, Rezūm demonstrated a Qmax of 12.6 ml/s compared to 18.7 ml/s ($p<0.01$), a PVR of 105 ml compared to 30 ml, and an IPSS score of 9.5 compared to 6.6 ($p<0.01$) in the GL group, respectively (Figure 1). Notably, compared to Rezūm, regression models demonstrate that GL boasts statistically significant advantages in IPSS change from baseline (4.4, 95% confidence interval [CI] 3.0–5.9, $p<0.01$), Qmax change from baseline (9.3 ml/s, 95% CI 5.8–12.7, $p<0.01$), and PVR decrease from baseline (157 ml, 95% CI 97–219, $p<0.01$) at six-month followup.

Conclusions: Rezūm and GL both demonstrated significant IPSS lower urinary tract symptom improvements, as well as postoperative functional parameters when compared to baseline. The significant differences in postoperative outcomes between the observed technologies relate to the degree of tissue ablation with the tradeoff of reduced side effects, sexual dysfunction, procedure time, length of stay, and cost. Such details should be discussed and evaluated during patient consultation and counselling.



MP-4.6. Figure 1. Six-month functional outcome of Rezūm and GreenLight PVP. (A) IPSS; (B) Qmax; (C) PVR.

MP-4.9**Flow-through uroflow: The design and development of a novel, toilet-attached uroflowmetry device**

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Introduction: Uroflowmetry or uroflow is an important tool for the assessment and management of patients with lower urinary tract symptoms (LUTS). Traditionally, the system requires a patient to urinate into a weight-sensing or gravimetric collection vessel and then outputs urine flowrate or volume over time. Although non-invasive, this approach has major limitations. Patients undergo testing in uncomfortable and unrepresentative voiding environments that may compromise diagnostic accuracy. Furthermore, it requires manual cleaning and setup between each use, which leads to interruptions in clinic workflow and longer wait times. This study aims to design and implement a toilet-attached uroflow device that performs the same standard of care measurements as gravimetric uroflow, but inside any standard toilet and without an external urine collection vessel.

Methods: The design leverages micro-electromechanical flow sensors housed in a unit that attaches via universal adapters to any standard toilet. Voided urine passes into the device to be measured, then empties into the toilet automatically. Standard uroflow metrics are output by custom software. Multiple flow states were simulated using saline irrigation bags and the device performance was tested for accuracy against a standard gravimetric uroflow device.

Results: The novel uroflow device enables uroflow measurements in any standard toilet and automatically empties after each use. The device is accurate to within $\pm 5\%$ for total volume and ± 1 cc/sec for maximum and average flow rates, consistent with International Continence Society equipment performance guidelines.

Conclusions: This novel uroflow device has the potential to reduce disruptions to clinician workflow, improve diagnostic accuracy through more representative voiding, and enhance the patient experience through improved comfort, reduced test anxiety, and shorter wait times. A trial is being conducted to confirm results in an outpatient urology clinic.

MP-4.6. Table 1. Baseline unweighted patient demographics

	GreenLight (n=3647)	Rezūm (n=254)	p
Age, years, mean (SD)	70.31 (8.90)	67.53 (9.74)	<0.01
TRUS volume, ml, mean (SD)	72.67 (37.16)	71.62 (33.72)	0.66
IPSS, mean (SD)	22.80 (6.64)	22.04 (6.51)	0.10
PSA, ng/dl, mean (SD)	6.99 (40.31)	4.41 (4.45)	0.31
PVR, ml, median (IQR)	120.00 (32.00–290.00)	118.00 (42.00–227.00)	0.37
Qmax, ml/s, median (IQR)	6.10 (4.00–9.00)	8.00 (5.00–11.65)	<0.01

MP-4.10

Scholarship in surgical residency: Can the trait for research productivity be identified in medical students?

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Introduction: Scholarship in surgery is a key driver of innovation and improvement in patient care. The scholar role has been recognized as a key component of the CanMEDS framework. Despite that, most trainees appear to be ambivalent towards research, even with curricular introductions at the undergraduate level and residency mandates.^{1,2} This leads to the question of whether motivation for research can be nurtured during residency or if this trait is identifiable in applicants. This study hypothesized that research in medical school is a predictor of scholarship productivity in residency.

Methods: Surgical residency program administration were emailed between July and October 2021 for names of residents who graduated in 2019 and 2020. Residents were searched on PubMed, ResearchGate, and Google Scholar. Peer-reviewed research items were assessed to determine whether they occurred during medical school or residency, using dates of publication and author affiliation. We recorded the number of publications/abstracts, including first author and specialty-specific. Descriptive statistics, non-parametric correlation, and Kruskal-Wallis tests were used in data analysis.

Results: The median number of peer-reviewed papers and abstracts published was four (interquartile range [IQR] 1–8) in residency and one (IQR 0–2) in medical school. There was a significant positive association between published papers in medical school and residency (ρ 0.345, $p < 0.001$), abstracts (ρ 0.159, $p = 0.014$), and combined paper/abstracts (ρ 0.317, $p < 0.001$). Using a non-parametric linear regression equivalent, it is predicted that for every abstract/peer-reviewed paper in medical school, a resident would be expected to produce 5.3.

Conclusions: Research work in medical school, particularly peer-reviewed papers, seems to predict greater research output in residency. While nurture and mentorship are important drivers for scholarship in residency, motivation, as exhibited by pre-residency research involvement, is an important predictor.

Acknowledgment to Wilma Hopman for statistical analysis of data set.

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MP-4.11

Use of virtual-reality simulator to compare renal access techniques (bull's eye vs. triangulation) among surgical trainees in percutaneous nephrolithotomy

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Introduction: Percutaneous nephrolithotomy is a challenging procedure that urology trainees should be familiar with during residency. The advent of simulators, such as the PERC Mentor, allows the development of this competency in a safer and stress-free environment. There are two primary methods of gaining percutaneous renal access: the triangulation method and the bull's eye method. It is generally believed that it is more difficult to teach triangulation access; however, to our knowledge, there is no study comparing the skill acquisition of both techniques. Our goal was to assess which method is associated with easier attainment in aptitude by using the PERC Mentor simulator. A secondary goal was to assess differences in subjective and objective outcomes between the two methods.

Methods: Fifteen simulator- and procedure-naïve medical trainees were randomized into two groups using a crossover randomized study design.

Participants were provided with written, video, and live in-person instructions on how to perform each technique. They all performed both methods on the PERC Mentor simulator and were assessed objectively using the PERC Mentor performance data report and subjectively using the Percutaneous Nephrolithotomy-Global Rating Scale (PCNL-GRS) scoring system. Statistical analysis was performed using Student's t-test and non-parametric Wilcoxon signed-rank test.

Results: There was no statistical difference in the outcomes and complication rates between the two methods. However, the bull's eye method of obtaining percutaneous renal access was associated with significantly decreased operative time, as well as fluoroscopy time compared to the triangulation method.

Conclusions: Teaching of both techniques was equally well-received by students. Percutaneous renal access could be obtained using either technique successfully. The bull's eye method, however, was associated with less operative and fluoroscopy time when compared to the triangulation method.

MP-4.12

Simulation-based enucleation training: A first experience using 3D-printed organ phantoms

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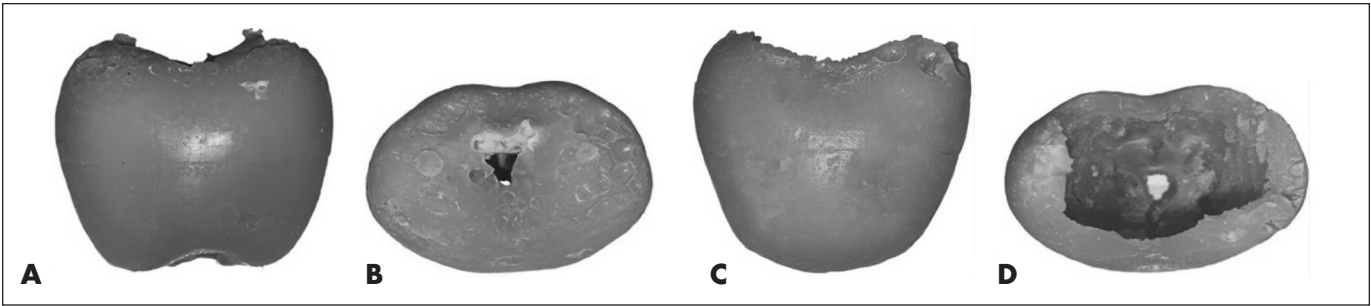
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Introduction: Anatomical endoscopic enucleation of the prostate (AEEP) is an effective treatment for benign prostatic hyperplasia (BPH) but it is a urological surgery with a steep learning curve. Simulator-based training is designed to mimic real-life AEEP, and ideally should help surgeons develop skills they can transfer to the operating room. This study aimed to evaluate the validity of a novel organ phantom for use in AEEP simulation training.

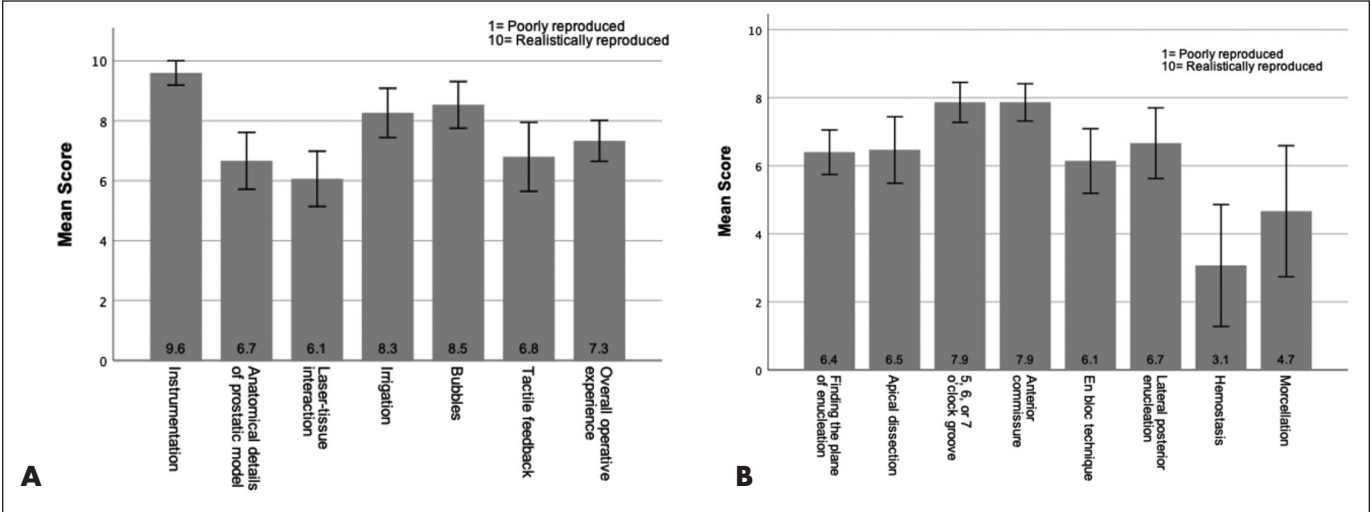
Methods: Participants practiced AEEP on simulators during a MasterClass hosted by the Canadian Urological Association using one of three lasers: holmium, thulium, and bipolar. The organ phantom is composed of hydrogels and uses 3D molds to recreate prostatic tissue and anatomy (Figure 1). Participants completed a questionnaire assessing content and face validity, as well as feasibility and acceptability of using the organ phantom in training.

Results: The novice group consisted of 12 urologists with an average of 11.7 years of practice and one urology resident. The median number of prior AEEP performed by trainees was 0 (interquartile range 0–2). Two experts in AEEP, who have performed at least 100 cases, also participated. All participants agreed or strongly agreed that there is a role for simulators in general surgical training and specifically in AEEP training. Participants positively rated the overall operative experience (7.3/10). Creating the 5, 6, or 7 o'clock groove and the anterior commissure (7.9/10) were the most realistic steps of enucleation; morcellation (4.7/10) and hemostasis (3.1/10) were the least (Figure 2). All participants considered it feasible to incorporate this organ phantom into training programs and 92.9% agreed that it teaches skills transferrable to the operating room (Figure 3).

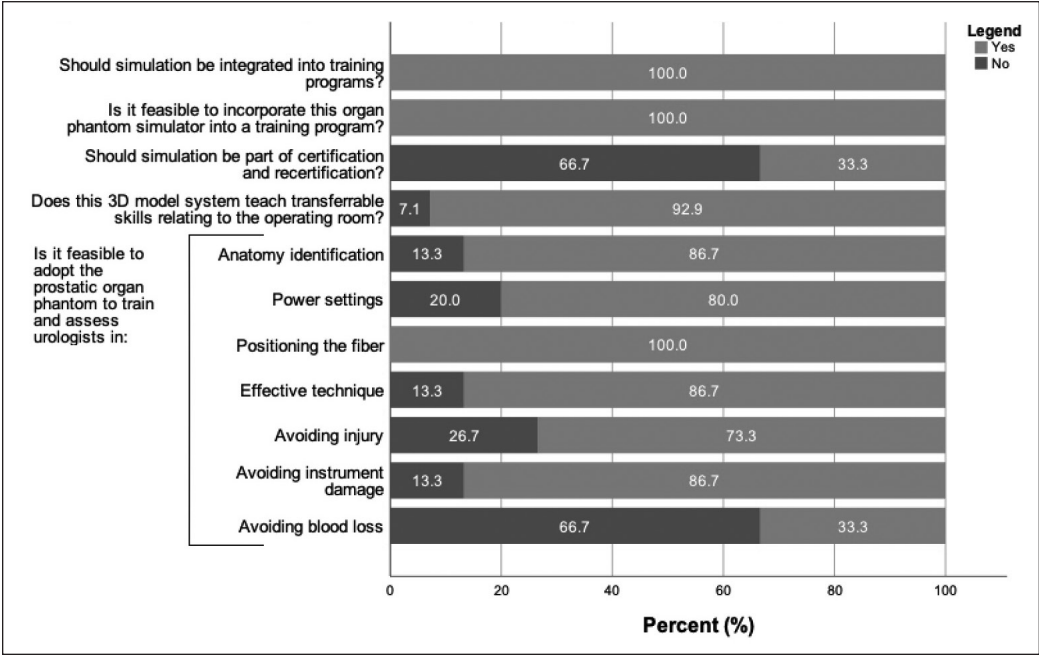
Conclusions: This study has established content and face validity for AEEP with three different energy sources on an organ phantom. Participants considered its use both feasible and acceptable for AEEP training purposes.



MP-4.12. Figure 1. Organ phantom before (A: anterior view; B: base view) and after complete enucleation (C: anterior view; D: base view).



MP-4.12. Figure 2. Face validity of (A) the operative experience; and (B) each step of enucleation using the simulator.



MP-4.12. Figure 3. Feasibility and acceptability of the organ phantom in training.

MP-4.13

Use of a teaching video to educate staff regarding difficult urethral catheterization

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Introduction: Frontline staff are frequently challenged by difficult urethral catheterization. This skill is usually acquired through exposure in clinical practice. This quality improvement project aimed to equip the frontline staff, such as registered nurses and licensed practical nurses, with the assessment of difficult urethral catheterization and improve their toolkit to successfully perform it.

Methods: A pre-assessment survey was made to assess the knowledge, perception, and confidence to perform regular and difficult urethral catheterization. An educational video was developed about the difficult urethral catheterization, with recommendations to build on this skill. After the video, in-service staff completed the same survey for post-assessment purposes.

Results: There were 217 pre-surveys and 186 post-surveys included in the analysis; 27% of nursing staff rated themselves as "very confident" and 62% as "confident" to assess for difficult catheter post-video intervention compared to 11% and 45%, respectively, pre-video intervention ($p < 0.001$). Similarly, an increase in confidence to choose for size and type of catheter based on the patient's history has also increased from 45% to 67% ($p < 0.001$). The perception of regular urethral catheter insertion skills and the confidence to perform the skill did not change significantly post-intervention.

Conclusions: The video education made a significant difference to improve the confidence and knowledge of nursing staff about difficult urethral catheterization. There was an increase in knowledge from 19% and 9% pre-video intervention to 73% and 90%, respectively, in two out of three areas mentioned in the survey post-video intervention. We have not seen a difference in perception to perform the regular catheterization. This video has already been widely used in various hospitals in Calgary, as well as at the provincial level to enhance frontline staff education.

MP-4.14

Knowledge gaps of graduating Canadian urology residents

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Introduction: Urology residency training encompasses a broad spectrum of subspecialty training. There is an expectation of competency in all aspects of practice upon certification. However, there is variability in exposure to subspecialty care, as well as heterogeneity in teaching sessions offered by different training programs. The objective of this study is to assess whether knowledge gaps exist among graduating Canadian urology residents.

Methods: A retrospective review of graduating residents' performance on an annual mock exam (QUEST) held a few months before the Royal College exam was conducted for three graduating years: 2020, 2021, and 2022. The written exam, consisting of multiple-choice questions, was itemized under eight separate topics: oncology, andrology/benign prostatic hyperplasia (BPH), physiology/anatomy, female/neurourology, pediatrics, infections, nephrolithiasis, and trauma/reconstruction. A one-way ANOVA, a posthoc Tukey, and non-parametric Kruskal-Wallis tests were conducted.

Results: The exams of 115 participants from all three years were reviewed. The distribution of questions was as follows: oncology (n=60), andrology/BPH (n=39), physiology/anatomy (n=54), female/neurourology (n=39), pediatrics (n=48), infections (n=23), nephrolithiasis (n=21), and trauma/reconstruction (n=16). Overall, there was a statistically significant difference in performance on the various topics ($p < 0.001$). On posthoc Tukey, residents performed better on female/neurourology compared to

andrology/BPH ($p = 0.004$), and female/neurourology compared to pediatrics ($p = 0.001$).

Conclusions: Graduating Canadian urology residents appear to have knowledge gaps in andrology/BPH and pediatrics. Future Canadian Urological Association courses in these topics should be considered to address these gaps.

MP-4.15

RoboticSurgery101: A novel, online, learning management system for implementing a robotic-assisted surgery training curriculum

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Introduction: There is a need for structured, as well as validated training and evaluation of robotic-assisted surgery (RAS) skills in Canada. To address this need, we have developed RoboticSurgery101 (RS101), an online learning management system (LMS) with an embedded RAS training curriculum. Our LMS allows educators to easily monitor, track, assess, and provide feedback to trainees as they progress through the curriculum.

Methods: Our novel LMS was developed in collaboration with a team of web designers. The RAS training curriculum includes pre-clinical (orientation videos, hands-on workshops, virtual reality training modules) and clinical components (bedside assistant, console surgeon, procedure-specific assessments): it is structured, evidence-based, and comprehensive. It is a standardized curriculum that can be customized to suit the specific requirements of different residency and fellowship programs. Moreover, while the current curriculum is designed for training on the da Vinci Surgical System, it can easily be modified for any future RAS platform. All assessment criteria are modeled on two previously validated tools for surgical skills assessment: the Global Evaluative Assessment of Robotic Skills and the Objective Structured Assessment of Technical Skills.

Results: Approved RAS trainees are assigned a user account on the LMS (www.RoboticSurgery101.com) where educators upload assignments and learning materials (e.g., lectures, surgical videos). Trainees can request performance assessments and track their progress using the dashboard. Educators can verify and track trainee progress, provide performance assessments, and modify the curriculum based on the needs and demonstrated competencies of individual learners.

Conclusions: RS101 is a novel LMS and RAS training curriculum that enables easy, structured, and validated tracking and evaluation of progress in RAS skills training. While several RAS basic skills curricula have previously been proposed, there has never been a published or industry-offered LMS solution to manage RAS trainees.

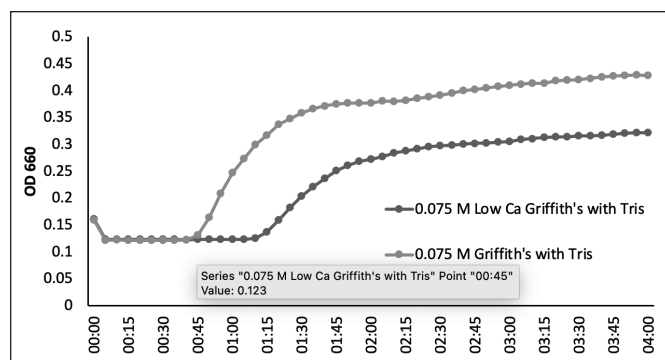
UP-4.1

Development of a high throughput model for testing urinary modulators in infectious stone disease

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Introduction: Infection-related stones represent 10–15% of human kidney stones, are difficult to prevent, and are known to have high recurrence rates.¹ They typically are composed of magnesium ammonium phosphate (struvite) or calcium phosphate (apatite). However, the factors that result in either struvite or apatite formation have not been fully elucidated. In addition, multiple urinary modulators — such as osteopontin — polyanionic acid, glycosaminoglycans, and inorganic pyrophosphate have been proposed to impact the growth of infection-based stones. Our study aimed to develop and validate an experimental model for infectious stones that could be used to test numerous potential compounds to identify novel preventative strategies.



UP-4.1. Figure 1. Optical density of Griffith's artificial urine over time.

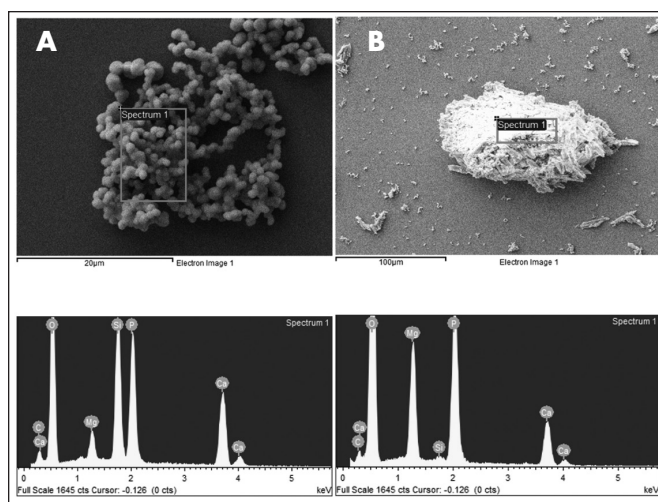
Methods: Multiple urine media, including Griffith's artificial urine, Brooks' artificial urine, pooled human urine, and human urine from a non-stone former, were tested using a wide range of urease concentrations and analyzed in a microplate spectrophotometer to quantitate crystal precipitation. Based on the results, we adjusted our choice of medium and urease concentrations on subsequent experiments to maximize crystal yield. The supernatant of the reaction was analyzed with scanning electron microscopy and X-ray diffraction (SEM-EDX) to determine crystal structure and composition.

Results: Griffith's artificial urine with a urease concentration of 0.075 M showed the most consistent results with spectrophotometry (Figure 1). A Tris buffer was added to maintain a pH of 8.0. SEM-EDX confirmed that normal Griffith's produced predominantly calcium phosphate crystals compared to a low calcium Griffith's medium which produced struvite crystals (Figure 2).

Conclusions: We were able to develop a highly reproducible model that successfully creates both calcium phosphate and struvite crystals and can be used to analyze multiple urinary modulators in a high-throughput fashion. Further investigation employing this model will be conducted to test potential preventative agents.

Reference

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UP-4.1. Figure 2. Photo of crystals with SEM with EDX analysis below.

- (A) Griffith's artificial urine showing calcium phosphate crystals;
 (B) low-calcium Griffith's artificial urine showing struvite crystals.