Evaluating the perceptions of Canadian urology residents and program directors regarding the current training in genitourinary imaging

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ABSTRACT

Introduction: Competency in interpreting genitourinary (GU) imaging is an important skill for urologists; however, no nationally accredited GU imaging curriculum exists for Canadian urology residency training programs. The main objectives of our study were to 1) characterize GU imaging training in Canada; (2) evaluate residents' self-perceived competencies in interpreting GU imaging; (3) explore program directors' (PD) and residents' perceptions regarding the current imaging curriculum and suggestions for future directions.

KEY MESSAGES

- Most surveyed program directors and urology residents support the need for increased imaging training during urology residency.
- Only two programs have a formal imaging curriculum, and most residents gain their imaging knowledge via self-directed learning. This highlights the need for a more structured imaging curriculum.
- Urology residents are most interested in learning about prostate magnetic resonance imaging, kidney ultrasound, and testes ultrasound.
- Lack of time in the curriculum and lack of educators were identified as significant barriers to increasing imaging training.

Methods: From November to December 2022, a survey examining current imaging education in residency, perceived resident imaging knowledge, avenues for improvement in imaging education, and the role of point-of-care ultrasound within urology was distributed to all Canadian urology PDs and residents.
Results: All PDs (13/13) and 40% (72/178) of residents completed the survey. Only two programs had a formal GU imaging curriculum. PDs and residents reported trainees were least comfortable interpreting Doppler ultrasound of renal, gonadal, and penile vessels. PDs reported that residents were most comfortable with non-contrast computed tomography (CT) scans (9.5/10), CT urogram (9.3/10), and retrograde pyelography (9.3/10). All but one PD favored increasing imaging training in their program. PDs highlighted the lack of time in the curriculum (n=3) and lack of educators (n=3) as the primary barriers to increasing imaging training in their program.
Conclusions: Most PDs and residents believe there needs to be more imaging training offered at their institution; however, addressing this is challenging due to the limited time in the curriculum and the need for available educators.

INTRODUCTION

Diagnostic imaging has become integral to diagnosing, treating, and monitoring urological conditions. Urologists' knowledge and proficiency in diagnostic imaging are essential for providing optimal patient care and fostering effective collaboration between radiologists and urologists. The latest version of the urology competencies, as outlined by the Royal College of Physicians and Surgeons of Canada, enlists a set of imaging modality competencies that residents should be familiar with by the end of their urology residency training.[1] These modalities include ultrasound (US), abdominal computed tomography (CT), magnetic resonance imaging (MRI) of the urinary tract and the male reproductive system, as well as radioisotope studies. Despite these objectives, no formal imaging curriculum has been defined across Canadian urology residency programs, raising concern regarding the quality and uniformity of imaging training received by Canadian urology residents.[2]

Our study sought to (1) characterize genitourinary (GU) imaging training in Canada; (2) evaluate residents' self-perceived competencies in interpreting GU imaging; (3) explore PDs and residents' perceptions regarding the current imaging curriculum and suggestions for future directions. In doing so, we hope to help guide the development of a comprehensive and standardized imaging curriculum for Canadian urology programs.

METHODS

Ethics approval was granted by the University of Montreal's Institutional Review Board (Project number 2022-1654) before the start of the study.

Study design

A cross-sectional survey was administered via email to Canadian urology residents and residency PDs over a six-week period from November 2nd to December 14th, 2022.

Survey development

Two surveys were developed in English and French using an online platform (Google Forms). The first was developed for Canadian urology PDs and comprised 34 items; the second was developed for Canadian urology residents and included 41 items. These surveys aimed to obtain an overview of the current GU imaging knowledge of Canadian urology residents and assess the perceptions of PDs and residents regarding the current imaging curriculum offered in their residency programs. Questions were developed based on a review of the urology literature, the most updated Royal College competencies and previous studies evaluating perceptions regarding imaging training among surgery residents.[1,3,4] Subsequently, the initial surveys were pilot tested by three urology residents and reviewed by one academic radiologist and three academic urologists from different residency programs to ensure clarity, relevance, and consistent interpretation of the questions. Feedback gathered during the pilot testing led to refinements in the survey that clarified the terms of the imaging modalities used, including assessing point-of-care ultrasounds (Pocus) and adding a question assessing how residents proceed when interpreting different imaging modalities. The finalized surveys included a mix of Likert-score, multiple choice, and open-ended questions. The surveys can be found in (Appendix 1).

Survey distribution

Urology PDs and administrators were contacted via their email addresses retrieved from the urology program description on the CaRMS website.[2] When inviting PDs and administrators to participate in our study, they were asked to share the survey with their respective residents. Two reminder emails were sent to PDs and admins at approximately three-week intervals to encourage participation in this voluntary survey. In addition, the total number of residents enrolled in each urology residency program was obtained. No financial or other incentive was provided to respondents.

Statistical analysis

Collected data were stored securely in a password-protected document. A descriptive analysis was performed.

RESULTS

Resident survey

Demographics

A total of 40% (72/178) of residents from all 13 Canadian urology residency programs completed the resident survey. Among them, 58 respondents completed the English version, and

14 completed the French version of the survey. Survey respondents represented all five post-graduate years of residency, with the highest proportion (38%) in their third year. A comprehensive breakdown of resident respondent demographics can be found in (Table 1).

Current imaging education in residency

Residents reported that clinical teaching cases (51%), textbooks (47%), and didactic lectures (42%) were the most commonly available resources for their imaging training in urology. The majority (67%) preferred to utilize imaging websites and clinical cases to enhance their learning of imaging in urology.

To learn about interpreting CT scans of the abdomen and pelvis, most residents were self-taught (89%) and/or received informal/formal teaching from co-residents (86%) and/or from urologists (69%). For learning US and MRI interpretation, residents were also mainly self-taught (US: 65%; MRI: 53%) and/or received informal/formal teaching from staff urologists (51%; 46%) or co-residents (43%; 33%). Currently, most respondents spend either no time (44%) or 10-20 minutes per week (39%) reviewing imaging studies with a radiologist and an additional 10-20 minutes (38%) or 30-40 minutes (22%) reviewing imaging studies with a staff urologist every week.

Current resident imaging knowledge

When rating their self-perceived competency in interpreting various imaging modalities on a Likert-scale (1 = Unable to interpret accurately; 10 = Able to interpret accurately), residents were most comfortable with CT Urograms (Average score: 8/10; SD 1.8), Non-contrast CT scans (8/10; 1.4), and retrograde pyelography (7/10; 2.1). Conversely, they were least comfortable interpreting Doppler US of renal (3/10; SD 1.7), gonadal (3/10; 2.3) and penile (2/10; 2.0) vessels. Full self-perceived competency results can be found in (Table 2). When rating their comfort with imaging techniques during urological interventions (i.e. prostate biopsies) on a Likert-scale (1 = Not comfortable; 10 = Very comfortable), residents were, on average, moderately comfortable (5/10; 2.4).

Upon reviewing CT scans of the abdomen and pelvis, most residents (82%) opt to interpret the images themselves before consulting the radiologist's report. Alternatively, some residents first read the radiologist's report and subsequently examine the images (18%). Concerning US images, residents displayed a higher tendency to initially review the radiologist's report before examining the images themselves (42%). In other cases, residents either interpreted the US images themselves before reading the radiologists' report (35%) or relied solely on the radiologist's report (21%). Lastly, for MRI studies, residents were more likely to read the radiologist's report before evaluating the images themselves (49%). The remaining either exclusively relied on the radiologist's report (28%) or interpreted the images independently before referring to the radiologist's report (24%).

To be added

Avenues for improvement in urology resident imaging education

When evaluating residents' perceptions regarding the amount of imaging training in place on a Likert scale (1 = Completely insufficient; 5 = Completely sufficient), residents felt their residency program did not provide adequate training (3/5; SD 0.9). Nearly all residents surveyed (70/72) thought that there was not an excessive amount of imaging training included in their program.

When surveying resident impressions of a mandatory one-month radiology rotation, most residents (51%) agreed. Otherwise, residents were unsure (19%) or did not feel it was necessary as imaging exposure was sufficient in educational activities (15%) or other clinical rotations (14%). Among those interested or unsure, most residents felt that this rotation should be in either the second (51%) or first year (35%) of residency. The other residents preferred that the rotation be held in the third year (10%) or were unsure (4%). Residents felt that imaging didactic sessions should be held at least once per month (35%), once to twice per year (35%) or every two months (7%). Otherwise, residents were either unsure (15%) or felt there was no need for imaging didactic sessions (8%). The residents highlighted that a radiologist (90%) and/or urologist (76%) should lead these didactic imaging sessions. Residents were most interested in being taught prostate MRI (83%), kidney US (76%), and testes US (68%) interpretation. They were least interested in being taught how to interpret Doppler US of the gonadal (29%) and renal vessels (33%) and angiography of the renal vasculature (36%).

The role of point-of-care ultrasound within urology training

Most residents (44%) thought they would need more knowledge to perform their own pocus. A smaller proportion of residents (32%) foresaw proficiency in pocus at the end of their residency, while others remained uncertain (24%). Pocus was highlighted as a helpful screening tool (hydronephrosis and testicular torsion) and an adjunctive skill for technical procedures such as inserting a suprapubic catheter. Nevertheless, concerns were raised about potential medico-legal liability arising from inadequate training. Those hesitant to adopt pocus emphasized the necessity of implementing formal teaching sessions and access to the appropriate equipment during residency. Among those that were not interested (18%), they did not see the benefit of pocus within urology, positing that confirmatory input from expert radiologists would still be indispensable.

Program director survey

All 13 Canadian urology residency program directors completed the survey.

Current imaging training in residency programs

Only two participating programs have a formal imaging curriculum, of which only one program includes a mandatory four-week radiology rotation. However, four other PDs believed that a radiology rotation should be integral to urology residency training.

PDs highlighted the lack of time in the curriculum (n=3) and lack of educators (n=3) as the primary barriers to increasing GU imaging training in their program. Otherwise, PDs found no barriers (n=4) or did not think there was enough interest from trainees (n=2). Only one PD did not favour increasing imaging training in their program.

Six of the 13 programs formally assess their residents' competencies in interpreting GU imaging studies with the help of different modalities, including assessments via simulation-based sessions (i.e. objective structured clinical examinations) (n=5), direct observations in the clinical setting (i.e. specific entrustable professional activities) (n=4), and both written (n=3) and oral assessments (n=1).

Perceived resident competencies and expectations

When rating their impression of graduating residents' competencies in accurately interpreting imaging studies on a scale from 1-10, on average, residency PDs reported that residents were most comfortable with non-contrast computed tomography (CT) scans (i.e. Uroscan, renal colic CT, etc.) (average score of 9.5/10 ± 0.66), CT urogram (contrast study with delayed phase images) (9.3/10 ± 0.75), and retrograde pyelography (9.3/10 ± 0.82). PDs reported that residents were least comfortable in interpreting Doppler US of the penile vessels (3.3/10 ± 2.43), of the gonadal vessels (3.5/10 ± 2.43), and of the renal vessels (3.9/10 ± 2.43). The detailed PD perceived resident competencies can be found in (Table 3).

Among training programs, all PDs felt that residents should be able to interpret the following imaging modalities at the end of their residency: voiding cystourethrogram, renal scan, CT urogram, and non-contrast CT. The imaging modalities that PDs deemed least important were Doppler US of the penile vessels (n=2), of the gonadal vessels (n=3), and of the renal vessels (n=3). The detailed PDs' expectations of graduating residents' imaging interpretation skills are summarized in (Table 4).

The role of point-of-care ultrasound within urology

Twelve PDs believed that urologists should perform their own pocus as this could be useful for identifying testicular torsion and performing renal transplant US. Ten PDs mentioned that residents should have the knowledge to perform their own POCUS. Three PDs highlighted that a pocus curriculum is part of their residency program. Two PDs noted that residents should be able to perform their own pocus but not required to graduate from residency successfully. It was also emphasized that it is important to have radiology colleagues involved for support and review.

DISCUSSION

We evaluated Canadian urology residents' self-perceived GU imaging interpretation ability and the perceptions of PDs and residents regarding the current imaging curriculum offered in their residency programs. Most residents and PDs believed they did not have or provide sufficient imaging training, with only two programs reporting a formalized GU imaging training curriculum. In addition, most residents learned imaging of CT, US and MRI on their own time

rather than during their residency curriculum. A formal radiology rotation was only a part of one training program in Canada.

The knowledge gap in imaging interpretation within urology residency programs has been previously identified in the literature. For instance, Eswara et al. studied American urology and radiology residents' abilities to interpret retrograde urethrograms and voiding cystourethrograms.[5] They found that urology residents in the United States have poor urethrography interpretation skills, particularly in cases involving multiple strictures. Another study aimed to assess urologists' proficiency in interpreting multiparametric magnetic resonance imaging (mpMRI), the gold standard imaging modality for suspicious prostate cancer.[6] Less than half of urologists achieved the authors' standard of proficiency. Overall, the study highlighted the necessity for urologists to receive formal training in mpMRI, especially given its utility in biopsy decision-making, fusion targeted biopsy, focal therapy, and prostatectomy planning.[7] This gap in imaging training is not unique to urology and extends to other specialties such as general surgery.[4] One study gathered general surgery residents' knowledge and perspectives regarding formal radiology didactics. Around 75% of residents noted that no structured radiological didactics were being offered at their institution. In addition, most respondents emphasized the need for imaging training in surgical residency programs and favoured monthly imaging didactics to teach standard imaging modalities used in general surgery. Imaging training is particularly important for surgical residents since, at times, they are required to make decisions based on their independent interpretation of images, especially in acute scenarios.[3]

Our survey identified the imaging modalities residents felt least comfortable with, including Doppler US of penile, gonadal, and renal vessels. This was consistent with the PDs' perceptions of their residents' skills. Interestingly, these modalities were also perceived by PDs as least important for residents to know by the end of their residency. Additionally, Doppler US of gonadal and renal vessels were identified as two tests that residents are least interested in being taught. It is worth noting, however, that these tests are included in the most updated version of the Royal College of Physicians and Surgeons of Canada urology competencies.[1] Moreover, the clinical utility of these techniques in evaluating and managing Peyronie's disease and the diagnosis and follow-up assessment of vascular complications of renal transplantation cannot be understated.[8,9] Due to the pertinence of these imaging techniques, urology programs can seek to improve their residents' imaging skills. It is also worth noting that, in general PDs felt residents were more competent than residents' self-perception of their skills in GU imaging. However, this may be due to the fact that most respondents were in their earlier years of training. Regarding potential avenues for improvement, our study showed that most residents favour implementing a mandatory one-month radiology rotation and imaging didactic sessions led by radiologists or urologists. Of all the imaging modalities, residents were most interested in being taught prostate MRI, kidney US, and testes US interpretation. Thus, urology programs can emphasize these imaging modalities when creating educational programs for residents.

Pocus is a goal-directed, bedside US examination performed by a healthcare provider to answer a specific diagnostic question or to guide the performance of an invasive procedure.[10-12] It serves as a screening tool for cases which may require formal imaging and interpretation by radiology. It has a variety of applications in urology, including the timely diagnosis of an undifferentiated acute scrotum, the assessment of hydronephrosis in renal colic, and guidance for suprapubic catheter placement; however, operator competence is critical as it is a user-dependent modality.[13] Lack of training can lead to misdiagnosis, poor clinical management, and adverse patient outcomes.[14,15] Our study demonstrated that most residents did not think they would have the knowledge to perform their own pocus by the end of their residency. Interestingly, most PDs mentioned that residents should be able to perform their own pocus. This discrepancy highlights the need for increased formal training in this domain. In 2020, Uy et al. developed and evaluated a low-cost, feasible introductory pocus program for Canadian urology residents.[13] The course comprised two main components: a 3-hour online module with recorded lectures and assessment forms and a 3-hour hands-on session facilitated by licensed sonographers. The residents who participated in the program significantly improved in theoretical knowledge and skill confidence. In addition, all residents demonstrated an interest in pocus and stated that pocus training should be integrated into Canadian urology residency programs.[13] Considering the positive outcomes of this study, urologists can refer to this training model to create their own educational programs for residents. Fortunately, the study used homemade imaging simulators instead of simulated patients, which renders it cost-effective and reproducible at any academic urology center. It is worth noting, however, that this type of training program requires a significant amount of time and enough educators, which were the two main barriers identified by PDs in our study concerning imaging training in their programs. In addition, while imaging exposure and proficiency among urology residents is important, we must recognize the role and importance of collaboration with radiologists.

The findings of this study should be interpreted in the context of its limitations. First, the voluntary nature of the resident survey might have introduced a nonresponse bias, as the participants who elected to respond are more likely to be actively involved and interested in medical education or imaging. A potential solution for mitigating this bias could have been offering incentives for questionnaire completion, which may have resulted in higher response rates. In addition, the resident response rates across the residency programs were not uniform, and less than 25% of the respondents were senior residents (postgraduate years four and five), which could introduce selection bias. Therefore, this sample may not adequately reflect residents' comfort with GU imaging at the end of their residency. Lastly, residents provided self-perceived imaging interpretation competencies, which were not corroborated with objective measures. While the Royal College examination and entrustable professional activities may evaluate residents on these competencies, we don't have objective data to comment on how our results affect graduating urologists in clinical practice. Future studies, including objective

measurements of urology residents' competencies using validated assessment tools are recommended.

CONCLUSIONS

Overall, our study shows that most surveyed PDs and residents favour increasing formal GU imaging training in urology residency programs. However, integrating such a curriculum is difficult due to the limited time in the curriculum and the number of educators available. Notwithstanding these obstacles, our findings can offer valuable insights for urology residency programs aiming to better serve the imaging training demands of Canadian urology residents, for instance by increasing US training using pocus simulators. Future studies should further assess resident imaging knowledge using objective and standardized assessments.

To be added

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To be added

FIGURES AND TABLES

Table 1. Resident survey respondent demographics by university and by post-graduate year of study	
Demographics	**Resident responses (%)**
University	
Queen's University	6/6 (100%)
Université de Sherbrooke	5/6 (83%)
McMaster University	10/16 (63%)
Université de Montréal	8/14 (57%)
McGill University	8/17 (47%)
University of Manitoba	4/9 (44%)
University of Alberta	6/14 (43%)
Université Laval	4/10 (40%)
Dalhousie University	4/12 (33%)
Western University	4/15 (27%)
University of Toronto	6/24 (25%)
University of Ottawa	4/20 (20%)
University of British Columbia	3/15 (20%)
Postgraduate year	
1	22%
2	21%
3	33%
4	15%
5	8%
Total	**72/178 (40%)**

Table 2. Residents' impression of their competencies in interpreting imaging studies		
Imaging modality	**Average (/10)**	**SD**
Voiding cystourethrogram	5.56	2.18
Voiding cystogram	5.94	2.31
Kidney ultrasound	5.40	2.20
Prostate ultrasound	4.10	2.10
Testes ultrasound	4.83	2.30
Retrograde urethrogram	6.21	1.88
Retrograde pyelography	6.85	2.07
Doppler ultrasound of the renal vessels	3.06	2.05
Doppler ultrasound of the gonadal vessels	2.93	2.25
Doppler ultrasound of the penile vessels	2.04	1.67
Angiography of the renal vasculature	4.26	2.48
Renal scan	5.42	2.49
Bone scan	4.35	2.30
PSMA-PET scan	3.14	2.15
CT urogram (contrast study with delayed phase images)	7.79	1.83
Non-contrast CT (uroscan, renal colic CT, etc.)	8.36	1.43
MRI of urinary tract (excluding the prostate)	3.90	2.31
MRI of the prostate	3.42	1.99

CT: computed tomography; MRI: magnetic resonance imaging; PSMA-PET: prostate-specific membrane antigen positron emission tomography; SD: standard deviation.

To be added

Table 3. Imaging modalities that residents should be able to interpret by the end of their residencies, according to program directors	
Imaging modality	**Program directors (n)**
Voiding cystourethrogram	13
Voiding cystogram	9
Kidney ultrasound	11
Prostate ultrasound	10
Testes ultrasound	9
Doppler ultrasound of the renal vessels	3
Doppler ultrasound of the gonadal vessels	3
Doppler ultrasound of the penile vessels	2
Angiography of the renal vasculature	3
Renal scan	13
Bone scan	8
PSMA-PET scan	4
CT urogram (contrast study with delayed phase images)	13
Non-contrast CT (Uroscan, renal colic CT, etc.)	13
MRI of urinary tract (excluding the prostate)	8
MRI of the prostate	12

CT: computed tomography; MRI: magnetic resonance imaging; PSMA-PET: prostate-specific membrane antigen positron emission tomography.

Table 4. Program directors' impression of graduating urology residents in interpreting imaging modalities		
Imaging modality	**Average (/10)**	**SD**
Voiding cystourethrogram	8.20	1.24
Voiding cystogram	7.70	2.06
Kidney ultrasound	7.60	2.10
Prostate ultrasound	6.30	2.06
Testes ultrasound	5.90	2.27
Retrograde urethrogram	8.00	1.15
Retrograde pyelography	9.30	0.82
Doppler ultrasound of the renal vessels	3.92	2.43
Doppler ultrasound of the gonadal vessels	3.50	2.47
Doppler ultrasound of the penile vessels	3.30	2.14
Angiography of the renal vasculature	5.50	2.50
Renal scan	7.90	1.38
Bone scan	7.20	2.20
PSMA-PET scan	5.20	2.15
CT urogram (contrast study with delayed phase images)	9.30	0.75
Non-contrast CT (uroscan, renal colic CT, etc.)	9.50	0.66
MRI of urinary tract (excluding the prostate)	6.90	2.27
MRI of the prostate	5.70	2.36

CT: computed tomography; MRI: magnetic resonance imaging; PSMA-PET: prostate-specific membrane antigen positron emission tomography; SD: standard deviation.