**Peri-Urethral and Anterior Vaginal Wall Masses: Does Radiological Imaging Change the Predicted Diagnosis?**

**Nawar Touma** | **Henry H. Yao** | **Samer Shamout** | **Jordyn Shaw** | **Richard J. Baverstock** | **Kevin V. Carlson**

1Faculty of Medicine, McGill University, Montreal, Québec, Canada
2Department of Surgery, Division of Urology, University of Calgary, Calgary, Alberta, Canada
3Eastern Health Clinical School, Monash University, Melbourne, Victoria, Australia
4Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada

**Correspondence**
Jordyn Shaw, Cumming School of Medicine, University of Calgary, 6601, 7007 14th St SW, Calgary, AB T2V 1P9, Canada.
Email: jordyn.shaw@ucalgary.ca

**Abstract**

**Introduction:** This study aims to determine the accuracy of radiological imaging compared with surgical pathology in patients with periurethral (PU) and anterior vaginal wall (AVW) lesions.

**Methods:** This study is a retrospective analysis of 126 women who underwent surgical treatment for PU and AVW masses between 2011 and 2020. Clinicopathological data were extracted along with radiological findings from medical records. The primary outcome was the diagnostic accuracy of preoperative imaging compared to the gold standard, pathological diagnosis. The secondary outcome was the rate of imaging correcting the clinical diagnosis.

**Results:** A total of 126 women with a median age of 42 underwent surgical treatment for PU and AVW masses. The most diagnoses were periurethral cysts (PUC) (52%) and urethral diverticulum (UD) (39%). Clinical diagnosis was accurate in 102 cases (81%) for the group of pathological diagnoses. Magnetic resonance imaging (MRI) and transvaginal ultrasound (TV US) were performed in 82 (65%) and 22 (17%) cases. The accuracy of MRI and TV US for the diagnosis of PU and AVW lesions was 76% and 82%, respectively. MRI and TV US corrected the clinical diagnosis in five (6%) and two (9%) cases, respectively. Voiding cystourethrography (VCUG) and double balloon urethrography (DBU), each performed in six (5%) cases, were accurate in four (67%) and three (50%) cases. No statistical difference was found for any imaging modality compared to clinical diagnosis.

**Conclusion:** Clinical diagnosis based on pelvic and cystoscopy examinations was sufficient for diagnosing PU and AVW masses and was not significantly different from imaging diagnosis. Imaging may be helpful with preoperative surgical planning in selected cases.

**Keywords**
anterior vaginal wall mass, MRI, periurethral cyst, urethral mass

Nawar Touma and Henry H. Yao contributed equally to this study.

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INTRODUCTION

Periurethral (PU) and anterior vaginal wall masses (AVW) are relatively rare entities with an estimated prevalence of 3–4% and 1%, respectively.1,2 Asserting the clinical diagnosis may not be simple considering the anatomic location, common presenting signs and symptoms, including lower urinary tract symptoms and dysuria, and the broad differential diagnosis.3,4 While some are asymptomatic, lesions and masses may induce symptoms with increasing size and affect patients’ quality of life.3 Advances in imaging techniques have helped with the ability to diagnose and distinguish different etiologies of PU and AVW masses.

Magnetic resonance imaging (MRI) has become the gold standard in evaluating PU and AVW masses. Compared to computed tomography (CT), MRI is less invasive and produces higher-quality images due to its superior soft tissue differentiation, superior contrast resolution, and multiplanar capability.4,5 With recent advances in software and hardware engineering, MRI is a handy tool for diagnosing and planning surgery.6 Ultrasound (US) techniques have also evolved to include transvaginal (TV) and transperineal approaches. US is less expensive than MRI and may have acceptable sensitivity and specificity in evaluating urethral diverticulum (the most common cystic etiology of PU and AVW masses).4 Although the US is highly user dependent7 and poorly discriminates between different etiologies,8 it remains useful when MRI is unavailable or contraindicated. Other diagnostic modalities include voiding cystourethrography (VCUG) and double-balloon catheter urethrography (DBU), which are less commonly used due to their invasive nature and use of ionizing radiation.8,9 Furthermore, DBU and VCUG are unable to diagnose noncommunicating urethral diverticulum (intraurethral wall diverticulum)10 and cannot evaluate the radial and circumferential extent of periurethral lesions.9

Although imaging modalities may assist clinicians in diagnosing these rare entities, evaluation should include a physical exam that may provide valuable information on lesions’ location, mobility, tenderness, borders’ definition, and internal consistency.11 Due to the limited availability of imaging studies, it is imperative to determine whether different imaging studies, such as MRI, can influence preoperative diagnosis or surgical management so that resource stewardship recommendations can be made in the future. This study aims to determine the accuracy of clinical evaluation and radiological imaging compared with surgical pathology in patients with PU and AVW lesions.

MATERIALS AND METHODS

2.1 Data source and patient selection

This is a retrospective single surgeon case series. All patients who underwent surgical treatment for PU and AVW masses between November 2001 and July 2021 at a tertiary referral center were included in this study. The following clinicopathological data were extracted: age, clinical diagnosis based on history, physical examination, cystoscopy and imaging findings, and final pathological diagnosis. The surgeon determined the use of imaging modality. Early in the case series, MRI was less available; thus, the US was used more frequently. Diagnoses were divided into groups based on pathological findings, including urethral diverticulum (UD), periurethral cyst (PUC), benign mass, urethral cancer, and foreign body. PUC includes Gartner duct cyst, Bartholin gland cyst, Skene duct cyst, Müllerian cyst, epidermal inclusion cyst, endometrioma, and others undefined (Table 1). Benign masses include leiomyoma, polyps, mucinous cysts, epidermoid cysts, mesonephric cysts, and suprapubic cartilaginous cysts (Table 1). These diagnostic groups were used for statistical comparison based on the assumption that the pathologies within a particular group have similar treatment strategies.

2.2 Surgical pathology

For this retrospective review, surgical pathology was considered the gold standard for diagnosis. All patients
had surgical pathology specimens examined by dedicated pathologists at our tertiary care center. All pathology reports were retrospectively reviewed. Surgical pathological diagnoses were then extracted, and each mass was categorized into UD, PUC, benign mass, urethral cancer, or foreign body for statistical analysis. In the case of an equivocal pathological diagnosis \((n = 3)\), categorization was performed in conjunction with operative findings.

### 2.3 Image evaluation

Imaging modalities included MRI, TV US, VCUG, and DBU and varied between cases due to resource availability and the surgeon’s discretion. Imaging reports were retrospectively reviewed, and the diagnoses most in keeping with radiological findings were extracted for comparison to clinical and pathological diagnoses.

### 2.4 Statistical analysis

The study’s primary outcome is imaging diagnostic accuracy compared to the final pathological diagnosis. The secondary outcome is the rate at which imaging corrects preoperative clinical diagnosis. Statistical analysis was performed using Stata Statistical Software: Release 16 (StataCorp LLC). Diagnostic accuracy rates between imaging and clinical diagnoses were compared using \(\chi^2\) or Fisher’s exact test. \(p < 0.05\) was considered statistically significant. Ethics approval was obtained by the study institution’s Conjoint Health Research Ethics Board (ethics number: REB21-0464).

### 3 RESULTS

Between November 2011 and July 2020, a total of 126 women with a median age of 42 (Interquartile range 33–50) years underwent treatment for PU and AVW masses in a single tertiary care center. The most common diagnoses were PUC (52%) and UD (39%). In addition, two patients had concomitant UD and PUC, and one had UD and urethral cancer. The most common individual diagnoses included Skene’s gland cyst or abscess \((n = 38)\) and Gartner’s cyst \((n = 9)\). The groups of pathological diagnoses are shown in Table 2. Clinical diagnosis was accurate in 65.9% (83/126) of patients for pathological diagnosis and 81% (102/126) for the final group of pathological diagnoses.

Diagnostic accuracies of different imaging modalities are shown in Table 3. MRI performed in 82 (65.1%) patients accurately corrected the clinical diagnosis in five (6.1%) and group of pathological diagnoses in eight (9.8%) patients for whom MRI was performed. Compared to clinical diagnostic accuracy, there was no statistically significant difference. TV US performed in 17.5% (22/126) of patients accurately corrected the clinical diagnosis in two (9.1%) patients and group of pathological diagnoses in four (18.2%) patients for whom TV US was performed. There was no statistically significant difference in diagnostic accuracy compared to clinical diagnosis. VCUG was performed in 6 (4.8%) patients and did not correct the clinical diagnosis in any patient. Only the diagnostic accuracy of individual diagnoses was inferior \((p = 0.024)\). DBU was performed in six (4.8%) patients and did not correct the clinical diagnosis in any case. There was no statistically significant difference in diagnostic accuracy.

### 4 DISCUSSION

Our study has the largest cohort of female patients diagnosed with PU and AVW masses. It aimed to correlate clinical and preoperative imaging diagnoses with pathological findings, which were considered definitive. On clinical evaluation, experienced surgeons correctly differentiated between etiologies of PU and AVW masses in 65.9% of cases and accurately identified the group of diagnoses in 81% of cases. Imaging was not statistically superior to clinical expertise at diagnosing the cause of PU and AVW masses. MRI accurately modified the clinical diagnosis and management in only eight (9.8%) patients in this study. Similarly, Foster et al. found that MRI altered the management in 14% (3/21) of patients receiving preoperative MRI. However, the utility of imaging extends beyond establishing a diagnosis as it delineates the anatomical configuration of the mass.
making it a valuable tool for surgical planning and patient counseling.\textsuperscript{10} Though the latter study found 100% sensitivity for MRI diagnosis of UD,\textsuperscript{12} the overall accuracy found in our study (75.6%) aligns with other previous studies (70%–79%\textsuperscript{13–15}). This study supports MRI in differentiating underlying etiologies. Another utility of MRI may be in the follow-up of patients postoperatively, especially in patients with malignant or pre-malignant lesions.\textsuperscript{16,17}

TV US performed in 22 patients correctly identified the group of diagnoses in 18 patients allowing it an 82% sensitivity. Gerrard et al.\textsuperscript{f} found a similar but higher sensitivity for TV US (90%).\textsuperscript{18} Similar to MRI, there was no difference in the diagnostic accuracy of TV US compared with clinical diagnosis. TV US only changed the underlying group of diagnosis in four patients. MRI gradually replaced the use of TV US as the latter is user dependent and requires extensive training for proper examination and diagnosis, which may be impossible in specific regional centers.

While VCUG and DBU diagnostic accuracies of different pathological groups appeared high (66.7% and 50%, respectively), they were employed in less than 5% of patients, thus making any meaningful conclusion hard to draw. Compared to TV US, they appeared to be less sensitive. TV US correctly diagnosed missed UD on VCUG and DBU.\textsuperscript{18} In this study, they did not add any diagnostic benefit. Both modalities have very selected indications and are hardly used anymore in contemporary practice with the advent of more reliable and less invasive diagnostic tools like MRI and US.

MRI is an accurate tool to assess both PW and AVW masses. However, diagnostic accuracy based on imaging results was not superior to clinical diagnosis. It is essential to reiterate that clinical diagnoses were performed by a fellowship-trained and experienced surgeon working in a tertiary academic center. Based on these results, preoperative imaging may not be necessary for diagnosis, but it can be an appropriate tool to assist in operative planning and discussing informed management decisions with patients. Therefore, we suggest imaging modalities be used at the surgeon’s discretion and case-by-case basis. Our study has its strengths. All of our patients had pathology specimens available and examined by dedicated pathologists at our tertiary care center. Also, all images were performed and dictated by fellowship-trained radiologists.

Nonetheless, there are several limitations to this study. First, its retrospective nature might have introduced selection bias. However, the data were prospectively collected over a long period at our center. Thus, all patients had pathological diagnoses available with which clinical and radiological findings were correlated. Second, not all patients with PU and AVW masses were captured in this study, as we needed to include patients with confirmatory pathology diagnoses. Third, results must be interpreted cautiously as a selection bias may have been introduced when the surgeon selected imaging modality, potentially favoring MRI and increasing its diagnostic accuracy. Fourth, as imaging may be necessary for surgical planning and may significantly impact management by changing the diagnosis, we have not included a stratified analysis by modality and diagnosis. It will be something worth exploring in a future study. Lastly, the patients represented in this study were treated by a single surgeon, which can limit the generalizability of our findings. More powered prospective studies should be performed to evaluate MRI and TV US diagnostic accuracies head-to-head for higher-quality evidence.

### Table 3  Imaging modalities diagnostic accuracies.

|                                | MRI (n = 82) | TV US (n = 22) | VCUG (n = 6) | DBU (n = 6) |
|--------------------------------|-------------|---------------|-------------|------------|
| Agreement with pathological diagnosis n (%) | 46 (56.1)   | 10 (45.5)     | 1 (16.7)    | 3 (50)     |
| Agreement with a group of pathological diagnoses n (%) | 62 (75.6)   | 18 (81.8)     | 4 (66.7)    | 3 (50)     |
| Number of clinical diagnoses corrected by imaging n (%) | 5 (6.1)     | 2 (9.1)       | 0           | 0          |
| Number of pathological diagnoses corrected by imaging n (%) | 8 (9.8)     | 4 (18.2)      | 0           | 0          |

Abbreviations: DBU, double balloon urethrography; MRI, magnetic resonance imaging; TV US, transvaginal ultrasound; VCUG, voiding cystourethrography.

### Conclusion

Clinical diagnosis of periurethral and anterior vaginal wall masses based on pelvic and cystoscopy examinations by an experienced surgeon predicted the group of pathological diagnoses in most cases. Imaging may be helpful in surgical planning and patient counseling in selected cases.
AUTHOR CONTRIBUTIONS
Study conception and design: Nawar Touma, Henry H. Yao, Kevin V. Carlson, and Richard J. Baverstock. Data collection: Samer Shamout, Henry H. Yao, Kevin V. Carlson, and Richard J. Baverstock. Analysis and interpretation of results: Henry H. Yao, Nawar Touma, and Jordyn Shaw. Draft manuscript preparation: Nawar Touma, Jordyn Shaw, and Samer Shamout. All authors reviewed the results and approved the final version of the manuscript.

CONFLICT OF INTEREST STATEMENT
The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT
The data that support the findings of this study are available from author, H. H. Y., upon request.

ETHICS STATEMENT
Ethics approval was granted by the Conjoint Health Research Ethics Board at the University of Calgary.

ORCID
Henry H. Yao  http://orcid.org/0000-0003-1955-6992
Samer Shamout  http://orcid.org/0000-0003-4018-5858
Jordyn Shaw  http://orcid.org/0000-0002-4096-1696
Richard J. Baverstock  http://orcid.org/0000-0002-5839-4909
Kevin V. Carlson  http://orcid.org/0000-0002-6071-6110

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