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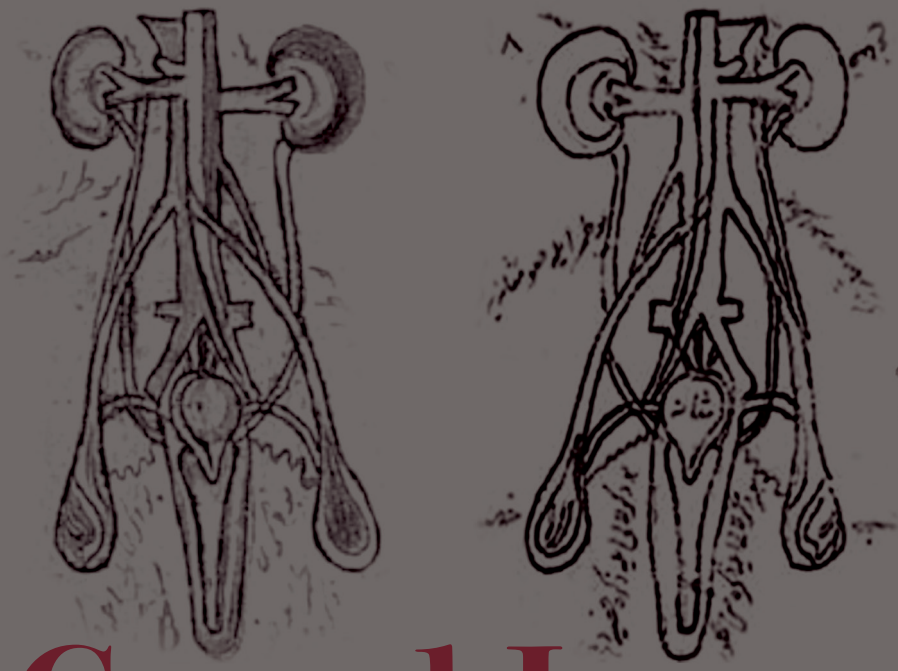

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Clinical Image	5	500	N/A	10	0	5
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[1], [3-5], [6,9], [8-12,16].

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[1] Guner E, Seker KG, Arikan Y, Huseynov C, Sam E, Ozdal OL. Aktuelle Urol. 2020; 51: 285-289. https://doi.org/10.1055/a-1117-2776.

- Article with more than six authors

[2] Karabulut D, Karabulut U, Caglar FN, Ekşi M, Yenice MG, Guner E, et al. The association between CHA2DS2-VASc score and erectile dysfunction: a cross-sectional study. Int Braz J Urol. 2019; 45: 1204-1208. https://doi.org/10.1590 / S1677-5538. IBJU.2019.0058.

- Book

[3] Sweetman SC. Martindale the Complete Drug Reference. 34th ed. London: Pharmaceutical Press; 2005.

- Book chapter

[4] McKenna K. Ejaculation. In: Knobil E, Neil J, editors. Encyclopedia of Reproduction, New York: Academic Press; 1999, p. 1002-8.

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We are applying the same steps to the double-blind peer-review process when we got the in-house submission.

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Contents

Editorial

Dear colleagues,

I am honored to share with you the second issue of 2025 (volume 5, issue 2) of the Grand Journal of Urology (Grand J Urol) with the contributions of many respected researchers and authors.

Grand Journal of Urology (GJU) aims to carry written and visualscientific urology studies to academic platforms and to make significant contributions to the science of urology. Our journal has been abstracted/indexed in Tubitak Ulakbim TR Index, EBSCOhost, J-Gate, SciLit, ResearchGate and Google Scholar international databases. As of these achievements, the Grand Journal of Urology (GJU) has taken its place among the journals indexed by national and international databases.

In this issue of our journal, there are many valuable articles under the subheadings of General Urology, Pediatric Urology, Reconstructive Urology and Urologic Oncology. I hope that these carefully prepared articles will make important contributions to valuable readers, researchers and the urology literature.

On this occasion, I would like to express my heartfelt gratitude to our authors who have contributed to our journal with their articles, to our reviewers who have meticulously evaluate the articles.

Respectfully yours

May 2025

Assoc. Prof. Ekrem GUNER, MD

Editor-in-Chief

Original Article – General Urology
Grand J Urol 2025;5(2):37-41
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AI-Assisted Cystoscopy Image Analysis for Detecting Urological Pathologies: A Novel Approach

Ürolojik Patolojilerin Tespitinde Yapay Zeka Destekli Sistoskopi Görüntü Analizi: Yeni Bir Yaklaşım

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Abstract

Objective: This study aims to develop and evaluate an AI-assisted system for detecting urological pathologies using cystoscopy images.
Materials and Methods: A dataset comprising 500 pathological and 500 healthy cystoscopy images was collected from the urology clinic of training and research hospital. Images were obtained using three different endovision systems (Karl Storz [Germany], Stryker [USA], Richard Wolf [Germany]). The dataset was preprocessed, augmented, and used to train a Convolutional Neural Network (CNN) model to classify images as either normal or pathological. The model's performance was evaluated on a test set comprising 100 pathological and 100 healthy images, using metrics such as accuracy, sensitivity, specificity, and F1-score. Statistical analyses were performed using IBM SPSS version 25.0, with a p-value of <0.05 considered significant.
Results: The model achieved a sensitivity of 94% for detecting pathological cases and a specificity of 58% for correctly identifying healthy cases. For pathological images, precision, recall, and F1-score were 0.69, 0.94, and 0.80, respectively, while for healthy images, these metrics were 0.91, 0.60, and 0.72. The overall accuracy of the model was recorded as 76%.
Conclusion: The AI-assisted cystoscopy image analysis system demonstrates high sensitivity in detecting urological pathologies but requires further improvements to enhance specificity. Future studies should focus on increasing dataset diversity and improving the model's ability to distinguish between benign and malignant features. The integration of higher-quality images and advanced AI techniques holds great potential for enhancing the model's success and improving diagnostic accuracy.

Keywords: artificial intelligence, cystoscopy, bladder cancer, deep learning, image analysis

Özet

Amaç: Bu çalışma, sistoskopi görüntülerini kullanarak ürolojik patolojilerin tespitine yönelik AI destekli bir sistem geliştirmeyi ve değerlendirmeyi amaçlamaktadır.
Gereçler ve Yöntemler: Eğitim ve Araştırma Hastanesi Üroloji Kliniğinde; 500 patolojik ve 500 sağlıklı sistoskopi görüntüsünden oluşan bir veri seti toplanmıştır. Görüntüler, üç farklı endovizyon sistemi (Karl Storz [Almanya], Stryker [ABD], Richard Wolf [Almanya]) kullanılarak elde edilmiştir. Veri seti ön işleme tabi tutulmuş, artırılmış ve bir Konvolüsyonel Sinir Ağı (CNN) modeli, görüntüleri normal veya patolojik olarak sınıflandırmak üzere eğitilmiştir. Modelin performansı, doğruluk, hassasiyet, özgüllük ve F1 skoru gibi metriklerle, 100 patolojik ve 100 sağlıklı görüntüden oluşan bir test setinde değerlendirilmiştir. İstatistiksel analizler IBM SPSS versiyon 25.0 ile yapılmış, p <0.05 anlamlı kabul edilmiştir.
Bulgular: Model, patolojik vakaların tespiti için %94 hassasiyet ve sağlıklı vakaların doğru sınıflandırılması için %58 özgüllük sağlamıştır. Patolojik görüntüler için kesinlik, geri çağırma ve F1 skoru sırasıyla 0.69, 0.94 ve 0.80 olarak bulunurken, sağlıklı görüntüler için bu değerler 0.91, 0.60 ve 0.72'dir. Modelin genel doğruluğu %76 olarak kaydedilmiştir.
Sonuç: AI destekli sistoskopi görüntü analiz sistemi, ürolojik patolojilerin tespitinde yüksek hassasiyet göstermektedir, ancak özgüllüğün artırılması için daha fazla iyileştirme gerekmektedir. Gelecek çalışmalarda, veri setinin çeşitliliğini artırmaya ve modelin benign ve malign özellikleri ayırt etme yeteneğini geliştirmeye odaklanılmalıdır. Daha kaliteli görüntülerin entegrasyonu ve ileri yapay zeka tekniklerinin kullanımı, modelin başarısını artırma ve tanısal doğruluğu iyileştirme açısından büyük bir potansiyel sunmaktadır.

Anahtar kelimeler: yapay zeka, sistoskopi, mesane kanseri, derin öğrenme, görüntü analizi

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Introduction

Artificial Intelligence (AI) and machine learning (ML) are rapidly advancing fields with the potential to revolutionize medical practice. AI refers to the ability of computer programs to learn and solve problems autonomously. Within AI, ML involves building mathematical models from input data to make decisions without human intervention. A subset of ML, known as deep learning (DL), uses multi-layered neural networks that mimic brain neurons' structure and activity, significantly enhances image recognition through neural networks [1].

One specific class of DL algorithms, the Convolutional Neural Network (CNN), is particularly well-suited for image recognition and analysis due to its architecture, which resembles the visual cortex. CNNs have driven substantial breakthroughs in medical image recognition, enabling AI to classify medical images with high accuracy. In the past, ML models relied on hand-crafted features such as color, intensity, and texture, but DL has surpassed these by automatically learning these features from vast amounts of data [2].

AI's progress in medical imaging spans radiology, ophthalmology, dermatology, pathology, neurology, and gastroenterology, where systems like computer-aided diagnosis (CADx) and detection (CADe) have addressed limitations in clinical practice [3,4]. Advances in computing power and big data analytics further facilitate AI integration into medical practice.

In urology, cystoscopy is a vital diagnostic tool for detecting urological pathologies. However, the interpretation of cystoscopy images relies heavily on the expertise and experience of clinicians, which can introduce variability and subjectivity into the diagnostic process. AI-supported systems can mitigate these issues by providing consistent and accurate image analysis, potentially enhancing diagnostic accuracy and efficiency [5].

This study develops and evaluates a CNN-based AI system for detecting urological pathologies from cystoscopy images. The system could be used both in clinical settings and at home, where patients might upload images captured using camera-equipped catheters for analysis, reducing the burden on healthcare professionals and offering a convenient monitoring tool for patients.

Developing such an AI system requires a multidisciplinary approach, combining expertise in urology, computer science, and data analytics. The involvement of clinical experts ensures that the system is clinically relevant and meets the practical needs of healthcare providers and patients. Additionally, the economic and societal benefits of such a system could be substantial, improving early detection rates and reducing healthcare costs through more efficient patient monitoring and follow-up.

AI-supported cystoscopy image analysis represents a promising advancement in urological diagnostics. This paper outlines the development of our AI system, details the methodology, and presents the results of our evaluations. By improving diagnostic accuracy and providing a scalable solution for patient monitoring, our system aims to enhance the overall quality of urological care.

Materials and Methods

Participants

This study was conducted at the Urology Clinic of Training and Research Hospital. The study included patients over 18 years of age who underwent cystoscopy between January 2018 and January 2024. Ethical approval for the study was obtained from the relevant institutional review board (08.07.2024-144011). All participants provided informed consent prior to inclusion in the study. A total of 500 pathological and 500 healthy cystoscopy images were collected for analysis.

The pathological images in this study were specifically from patients diagnosed with bladder cancer, including images from papillary or solid tumor formations observed during follow-up. These images were taken from atypical tissue areas, and no other pathologies were included in the evaluation beyond bladder cancer. The pathological images did not focus on a single bladder region but were representative of various areas. The decision to design the study this way was to avoid the complexity of interpreting fibrotic and hyperemic areas in previously resected regions, which can be challenging even for expert urologists. The healthy images were from patients with intact bladder tissue, with no recurrence observed post-endoscopic resection.

Imaging Systems

Cystoscopy images were acquired using three different endovision imaging systems: Karl Storz (Germany), Striker (USA), and Richard Wolf (Germany). Each system was equipped with different quality telescopes, including two "Karl Storz 30° Hopkins Telescope" and one "R. Wolf 30° 4.0 mm Telescope". This resulted in a varied dataset with differing image qualities and resolutions, which provided a comprehensive basis for training and evaluating the AI model.

Data Processing and Model Training

The collected cystoscopy images were classified into two categories: normal and pathological. Normal images were characterized by a smooth, cream-colored epithelial lining with non-prominent vasculature and minimal trabeculation. Pathological images were identified by the presence of raised, atypical structures such as tumors, which appeared distinct from the normal bladder lining.

To prepare the images for model training, they were resized to a consistent dimension of 224x224 pixels and normalized to a range of 0 to 1. Data augmentation techniques, including rotation, flipping, and brightness adjustments, were applied to increase the variability and robustness of the dataset.

A Convolutional Neural Network (CNN) was employed for image analysis and classification. The CNN architecture included multiple convolutional and pooling layers designed to extract relevant features from the images, followed by fully connected layers for classification. The model was implemented using the TensorFlow and Keras libraries in Python [6].

The model was trained using a supervised learning approach. During training, the CNN learned to distinguish between normal and pathological images by optimizing the weights of the network to minimize the binary cross-entropy loss function. The Adam optimizer was used to update the model parameters, and the training process was monitored using validation data to prevent overfitting [7].

Training and Validation

The dataset was split into training and testing sets, with 80% of the images used for training and 20% reserved for testing. The training process involved iterating over the training data for multiple epochs, with each epoch consisting of a forward pass to compute the output and a backward pass to update the model parameters based on the loss gradient.

To enhance the model's generalization capabilities, k-fold cross-validation was employed. This technique involves partitioning the training data into k subsets and training the model k times, each time using a different subset as the validation data and the remaining subsets as the training data. The final model performance was averaged across the k folds to obtain a robust estimate of its accuracy, sensitivity, and specificity [8].

Performance Metrics

The performance of the trained model was evaluated using the test set. Key metrics included accuracy, precision, recall (sensitivity), and specificity. The confusion matrix was used to compute these metrics, providing a detailed understanding of the model's performance in distinguishing between normal and pathological images.

Precision was calculated as the ratio of true positive predictions to the sum of true positive and false positive predictions. Recall (sensitivity) was determined as the ratio of true positive predictions to the sum of true positive and false negative predictions. Specificity was computed as the ratio of true negative predictions to the sum of true negative and false positive predictions [9].

Technical Considerations

While different imaging systems and optics provided diverse data, they also introduced challenges related to image homogeneity and consistency. Variations in resolution, contrast, and color profiles across the different systems potentially impacted the model's ability to generalize across all image types. This variability underscores the importance of incorporating a wide range of data augmentation techniques and rigorous cross-validation to ensure the robustness of the AI model.

Results

Model Performance

In our study, we developed an AI-assisted system to identify pathological and healthy bladder images from cystoscopy data. The model was trained on a dataset of 500 pathological and 500 healthy images and later tested on a separate set of 100 pathological and 100 healthy images. The initial testing within the controlled environment showed high accuracy, but real-world application yielded different results.

Confusion Matrix

The confusion matrix below illustrates the performance of our AI model on the test dataset. The matrix provides insights into true positive (TP), true negative (TN), false positive (FP), and false negative (FN) counts. While the AI model demonstrated high performance during initial testing, real-world application revealed significant challenges. The model achieved a sensitivity of 94%, indicating it could correctly identify 94 out of 100 pathological cases. However, the specificity was 58%, with 42 out of 100 healthy images incorrectly classified as pathological. This lower specificity suggests potential issues in distinguishing between certain benign structures (e.g., trabeculation, trigon area) and pathological ones (**Figure 1**).

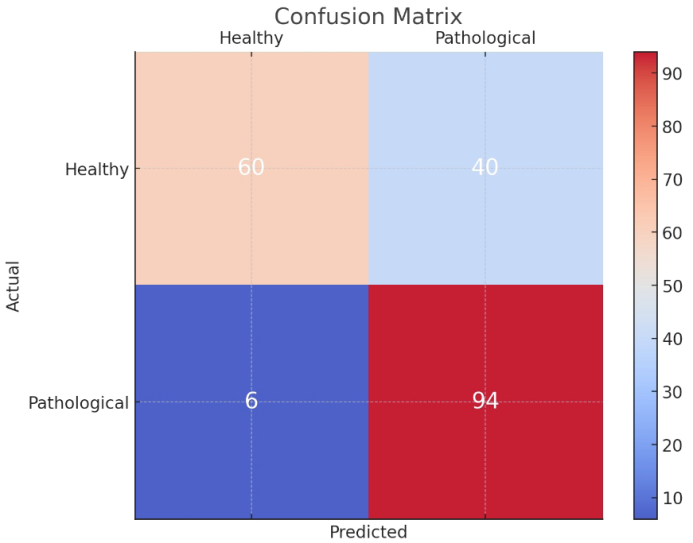

Figure 1. Illustrates the performance of our AI model on the test dataset. The matrix provides insights into true positive (TP), true negative (TN), false positive (FP), and false negative (FN) counts.

Table 1. The classification report provides additional metrics including precision, recall, and F1-score for both classes (healthy and pathological)

	Precision	Recall	F1-Score	Support
Healthy	0.91	0.60	0.72	100
Pathological	0.70	0.94	0.80	100
Accuracy			0.76	200
Macro Avg	0.80	0.77	0.76	200
Weighted Avg	0.80	0.77	0.76	200

The sensitivity and specificity of our model are key metrics that indicate its effectiveness: Sensitivity: 0.94 (94%); Specificity: 0.6 (60%)

Classification Report

The classification report provides additional metrics including precision, recall, and F1-score for both classes (healthy and pathological) (**Table 1**):

Precision: This metric indicates the accuracy of the model in predicting positive instances (i.e., how many of the instances predicted as pathological are actually pathological). The precision for healthy images is 0.91, meaning 91% of the images predicted as healthy are indeed healthy. The precision for pathological images is 0.69, indicating that 69% of the images predicted as pathological are truly pathological.

Recall (Sensitivity): Recall measures the model's ability to identify all relevant instances. The recall for healthy images is 0.58, meaning the model correctly identifies 58% of the healthy images. The recall for pathological images is 0.94, indicating that the model correctly identifies 94% of the pathological images.

F1-Score: The F1-score is the harmonic mean of precision and recall, providing a single metric that balances both concerns. The F1-score for healthy images is 0.71, and for pathological images, it is 0.80. These scores indicate the overall effectiveness of the model in classifying each category.

Support: Support refers to the number of actual occurrences of each class in the dataset. Both healthy and pathological categories have 100 images in the test set.

Accuracy: Overall, the model has an accuracy of 75%, meaning it correctly classified 75% of the images in the test set.

Macro Average: This average calculates the mean performance across all classes without taking class imbalance into account. The macro average for precision, recall, and F1-score is around 0.80, 0.76, and 0.75, respectively.

Weighted Average: This average takes class imbalance into account, providing a more realistic measure of the model's performance. The weighted averages for precision, recall, and F1-score are approximately 0.80, 0.76, and 0.75, respectively.

Overall, while the model shows high sensitivity in detecting pathological images, its specificity in correctly identifying healthy images is lower. This indicates a tendency to incorrectly classify healthy images as pathological, which is an important consideration for further improvements and refinements in the model.

Discussion

The performance of our AI model, while promising in controlled test environments, exhibited lower specificity in real-world applications. This discrepancy can be attributed to several factors related to the variability and complexity of medical imaging, particularly in cystoscopy.

One significant challenge we faced was the variability in imaging systems and optics used for data collection. The images were sourced from three different endovision systems (Storz, Striker, R. Wolf) and varied in resolution, contrast, and color profiles due to different optical qualities (two Storz and one R. Wolf). These differences introduced inconsistencies in the data, making it harder for the model to generalize across all image types. As a result, the model's specificity was affected, leading to a higher rate of false positives (42 out of 100 healthy images were misclassified as pathological) [10].

Our model was primarily trained to identify pathological structures based on their elevation and texture compared to the smooth, flat surface of healthy bladder tissue. However, certain benign anatomical features, such as trabeculation and the trigon area, were sometimes misclassified as pathological due to their elevated appearance. Additionally, areas with increased angiogenesis were often flagged as pathological. This indicates that while the model is effective in detecting deviations from the norm, it requires further refinement to differentiate between benign and malignant variations more accurately [3].

Due to recent advancements in AI and machine learning, AI-assisted diagnostics has become an intriguing, yet not fully explored field. In our opinion, we should view neural network and deep learning-based models as a form of 'expert opinion' rather than an entirely objective diagnostic test. Notably, cystoscopy performed by a urologist is also, in essence, a form of 'expert opinion'. This similarity in approach makes AI-assisted diagnostic methods a potentially suitable application for urological procedures like cystoscopy. While AI can aid in identifying abnormalities and augment a clinician's ability to detect disease, human oversight remains crucial for interpretation, especially in complex cases where benign and malignant features might overlap. Therefore, AI should complement, rather than replace, the expertise of the clinician in these scenarios.

To enhance the model's performance, several strategies can be considered:

Larger and More Homogeneous Dataset: Increasing the size of the dataset with more diverse images from a single, high-quality imaging system can help reduce variability. This would allow the model to learn more consistent features and improve generalization [7].

Regional Mapping of the Bladder: Dividing the bladder into specific regions (e.g., trigon, dome, lateral walls) and training the model to recognize patterns within these regions can improve accuracy. This approach ensures that the model considers the anatomical context when making predictions [6].

Data Augmentation and Preprocessing: Implementing advanced data augmentation techniques, such as varying lighting conditions, rotations, and translations, can help the model become more robust to variations. Preprocessing steps like normalization and contrast adjustment can also standardize the input data, reducing discrepancies between images [11].

Advanced AI Techniques: Utilizing more sophisticated AI architectures, such as transfer learning with pre-trained models like ResNet or VGG, can enhance the model's ability to learn complex patterns. Ensemble learning, combining multiple models, can also provide more reliable predictions by mitigating the weaknesses of individual models [4].

The AI-assisted cystoscopy image analysis system developed in this study demonstrated high sensitivity in detecting urological pathologies. However, further work is needed to improve specificity. Our study employed a Weakly Supervised Learning approach, where not all images were manually labeled. To achieve more accurate results, more complex and data-intensive methods, such as Fully Supervised Learning, may be required. This approach could enhance the model's performance, particularly in distinguishing between benign and malignant structures more effectively.

Artificial intelligence, particularly deep learning, relies on large datasets and high computational power to learn and generalize effectively. The advancements in computing power and the availability of big data have facilitated the integration of AI into clinical practice. However, the success of AI models in medical imaging heavily depends on the quality and consistency of the training data [12].

In the future, AI models could benefit from more sophisticated learning mechanisms, such as continual learning, where the model can adapt to new data incrementally without forgetting previously learned information. This approach could be particularly useful in medical imaging, where new data continuously becomes available [13].

Our study contributes to the growing body of literature on AI-assisted medical imaging by highlighting the challenges and potential solutions for improving model performance in real-world applications. The successful implementation of AI in cystoscopy could significantly reduce the workload of urologists and improve patient outcomes by enabling earlier and more accurate detection of bladder pathologies.

Future research should focus on developing standardized imaging protocols and larger, more diverse datasets to train AI models. Additionally, integrating AI with other diagnostic tools, such as MRI or CT scans, could provide a more comprehensive assessment of urological conditions, further enhancing diagnostic accuracy and patient care.

Conclusion

The developed AI model for cystoscopy image analysis shows promise but requires further refinement and testing with more diverse datasets to improve its specificity. Future work will focus on enhancing the model's ability to accurately classify benign anatomical variations and integrating higher-quality images from various endovision systems to improve overall performance.

Ethics Committee Approval: Ethical approval for this study was obtained from Kutahya Health Science University Clinical Research Ethics Committee (Approval number and date: 08.07.2024-144011).
Informed Consent: An informed consent was obtained from all the patients.
Publication: The results of the study were not published in full or in part in form of abstracts.
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References

[1] Mishra C, Gupta D. Deep machine learning and neural networks: an overview. IAES Int J Artif Intell 2017;6(2):66-73. https://doi.org/10.11591/ijai.v6.i2.pp66-73

[2] Yamashita R, Nishio M, Do RK, Togashi K. Convolutional neural networks: an overview and application in radiology. Insights Imaging 2018;9(4):611-29. https://doi.org/10.1007/s13244-018-0639-9

[3] Esteva A, Kuprel B, Novoa RA, Ko J, Swetter SM, Blau HM, et al. Dermatologist-level classification of skin cancer with deep neural networks. Nature 2017;542(7639):115-8. https://doi.org/10.1038/nature21056

[4] Gulshan V, Peng L, Coram M, Stumpe MC, Wu D, Narayanaswamy A, et al. Development and validation of a deep learning algorithm for detection of diabetic retinopathy in retinal fundus photographs. JAMA 2016;316(22):2402-10. https://doi.org/10.1001/jama.2016.17216

[5] Ferro M, Falagario UG, Barone B, Maggi M, Crocetto F, Busetto GM, et al. Artificial intelligence in the advanced diagnosis of bladder cancer: comprehensive literature review and future advancement. Diagnostics (Basel) 2023;13(13):2308. https://doi.org/10.3390/diagnostics13132308

[6] Krizhevsky A, Sutskever I, Hinton GE. Imagenet classification with deep convolutional neural networks. In: Advances in neural information processing systems. 2012; p. 1097-105.

[7] LeCun Y, Bengio Y, Hinton G. Deep learning. Nature 2015;521(7553):436-44. https://doi.org/10.1038/nature14539

[8] Kohavi R. A study of cross-validation and bootstrap for accuracy estimation and model selection. In: Proceedings of the 14th international joint conference on artificial intelligence-Volume 2. 1995; p. 1137-43.

[9] Brownlee J. Machine learning mastery with Python: understand your data, create accurate models, and work projects end-to-end. Machine Learning Mastery; 2016.

[10] Okagawa Y, Abe S, Yamada M, Oda I, Saito Y. Artificial intelligence in endoscopy. Dig Dis Sci 2022;67(5):1553-72. https://doi.org/10.1007/s10620-021-07086-z

[11] Shorten C, Khoshgoftaar TM. A survey on image data augmentation for deep learning. J Big Data 2019;6(1):60. https://doi.org/10.1186/s40537-019-0197-0

[12] Bibault JE, Giraud P, Burgun A. Big data and machine learning in radiation oncology: state of the art and future prospects. Cancer Lett 2016;382(1):110-7. https://doi.org/10.1016/j.canlet.2016.01.043

[13] Topol EJ. High-performance medicine: the convergence of human and artificial intelligence. Nat Med 2019;25(1):44-56. https://doi.org/10.1038/s41591-018-0300-7

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Prognostic Implications of Variant Urothelial Carcinoma: Survival Outcomes and Risk Factors from a Single-Center Experience

Varyant Ürotelyal Karsinomun Prognostik Göstergeleri: Tek Merkezli Bir Deneyimden Sağkalım Sonuçları ve Risk Faktörleri

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Abstract

Objective: Variant urothelial carcinoma (VUC) represents a diverse group of bladder cancer subtypes with distinct clinical behaviors and prognostic implications. This study aims to evaluate survival outcomes and prognostic factors in patients diagnosed with VUC.
Materials and Methods: A retrospective analysis was conducted on 1844 bladder cancer patients treated at our center between 2018 and 2022. Among them, 59 patients with histologically confirmed VUC were included. Survival outcomes were assessed using Kaplan–Meier analysis, and prognostic factors were evaluated via multivariable Cox regression models.
Results: The most common VUC subtypes were squamous (39%), micropapillary (23.7%), and sarcomatoid (6.8%). The median overall survival (OS) was 11 months, while cancer-specific survival (CSS) was 7 months. Micropapillary and sarcomatoid variants exhibited significantly poorer CSS, with an approximately 8-fold and 7-fold increased mortality risk compared to squamous subtype, respectively. Age and the presence of metastases were key predictors of worse CSS. While radical cystectomy was performed in 30.5% of patients, it did not significantly improve survival.
Conclusion: Our findings underscore the aggressive nature of micropapillary and sarcomatoid VUC subtypes, highlighting the need for individualized treatment approaches. Age and metastatic status were significant determinants of survival, emphasizing the necessity for early diagnosis and targeted therapeutic strategies. Future research should explore molecular profiling and novel treatment modalities, including immunotherapies, to improve patient outcomes.

Keywords: variant urothelial carcinoma, bladder cancer, survival, prognosis, histological variants

Özet

Amaç: Varyant ürotelyal karsinom (VUC), farklı klinik davranışlar ve prognostik sonuçlar gösteren mesane kanseri alt tiplerinden oluşan heterojen bir gruptur. Bu çalışmanın amacı, VUC tanısı almış hastalarda sağkalım sonuçlarını ve prognostik faktörleri değerlendirmektir.
Gereçler ve Yöntemler: 2018-2022 yılları arasında merkezimizde tedavi edilen 1844 mesane kanseri hastasının retrospektif analizi gerçekleştirildi. Bunlar arasından histolojik olarak doğrulanmış VUC tanısı alan 59 hasta çalışmaya dahil edildi. Sağkalım sonuçları Kaplan-Meier analizi ile değerlendirildi, prognostik faktörler ise çok değişkenli Cox regresyon modelleri kullanılarak analiz edildi.
Bulgular: En sık görülen VUC alt tipleri skuamöz (%39), mikropapiller (%23,7) ve sarkomatoid (%6,8) olarak tespit edildi. Ortanca genel sağkalım (OS) 11 ay, kanser spesifik sağkalım (CSS) ise 7 ay olarak bulundu. Mikropapiller ve sarkomatoid varyantlar, squamöz alt tipe göre sırasıyla yaklaşık 8 kat ve 7 kat artmış mortalite riski ile belirgin şekilde daha kötü CSS sergiledi. Yaş ve metastaz varlığı, daha kötü CSS'nin temel belirleyicileri olarak tespit edildi. Hastaların %30,5'ine radikal sistektomi uygulanmış olmasına rağmen, sağkalım üzerinde anlamlı bir iyileşme sağlamadı.
Sonuç: Bulgularımız, mikropapiller ve sarkomatoid VUC alt tiplerinin agresif doğasını vurgulayarak bireyselleştirilmiş tedavi yaklaşımlarının gerekliliğini ortaya koymaktadır. Yaş ve metastatik hastalık durumu, sağkalım üzerinde önemli belirleyiciler olup erken tanı ve hedefe yönelik tedavi stratejilerinin önemini göstermektedir. Gelecekteki araştırmalar, hastaların sonuçlarını iyileştirmek amacıyla moleküler profilleme ve immünoterapiler de dahil olmak üzere yeni tedavi yöntemlerini keşfetmelidir.

Anahtar kelimeler: varyant ürotelyal karsinom, mesane kanseri, sağkalım, prognoz, histolojik varyantlar

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Introduction

Bladder cancer ranks as the 10th most common malignancy worldwide, with an estimated 573,000 new cases and 213,000 deaths reported annually, according to recent global cancer statistics [1]. Approximately 90% of bladder cancers are classified as urothelial carcinoma (UC), yet a subset exhibits histological variants collectively referred to as "variant histologies (VH)." These include micropapillary, squamous differentiation, adenocarcinoma, and neuroendocrine carcinoma, which comprise approximately 5–25% of all bladder tumors depending on the studied population and diagnostic criteria [2]. These variants are often associated with advanced disease stages, aggressive clinical behavior, and distinct treatment responses.

Emerging evidence from international studies highlights significant heterogeneity in survival outcomes among patients with these VH. For instance, the five-year overall survival rates for patients with micropapillary and neuroendocrine variants are reported to be as low as 35% and 25%, respectively, compared to nearly 60% in those with pure UC [3,4]. This variation underscores the need for an in-depth understanding of the prognostic differences among these subtypes to inform clinical management strategies.

Despite these findings, much of the existing literature lacks direct comparative analyses of survival metrics across VH. Furthermore, factors such as cohort heterogeneity, variability in diagnostic practices, and limited representation of rare subtypes often impede the generalizability of results. This study aims to bridge these gaps and contribute to the literature to guide treatment approaches by systematically examining survival outcomes across variant bladder tumor histologies.

Our study aimed to determine the survival of patients with variant UC (VUC) and to analyze the factors affecting survival. Understanding these differences could yield critical insights into disease biology and improve prognostication and therapeutic decision-making.

Materials and Methods

After obtaining ethics committee approval from the institution where the study was conducted (protocol identification date and number: 26.01.2022/2011-KAEK-25 2022/01-19), the pathology results of 1844 patients who underwent transurethral resection or radical cystectomy for bladder tumor in our hospital between January 2018 and December 2022 were retrospectively analyzed. Of the 78 patients with VH other than pure UC, 19 were excluded from the study due to the unavailability of their radiological images. The remaining 59 patients were included in the study.

The specimens of patients diagnosed with VUC were independently confirmed by a pathologist, with patient information and original pathological diagnoses blinded. Demographic, radiological, and pathological characteristics of the patients were recorded. All patients with visceral metastasis identified on cross-sectional imaging also had lymph node metastasis. Patients with isolated lymph node metastasis were categorized into the "cN+" group, while those with both lymph node and visceral metastasis were included in the "cM+" group. Survival data were obtained using the records from the central population registry system.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, version 25.0. The data are expressed as mean ± standard deviation (SD). Differences in categorical variables were assessed with the Chi-square test, while Student's t-test was employed for continuous variables. Kaplan–Meier curves were utilized to estimate overall survival, and the log-rank test was applied to determine statistical significance. Binomial regression analysis was conducted to identify predictors of mortality. A p-value of less than 0.05 was deemed statistically significant.

Results

Of the patients with VH, 23 patients (39%) were diagnosed with squamous cell carcinoma, 14 patients (23.7%) with micropapillary carcinoma, and 4 patients (6.8%) with sarcomatoid tumors. Additionally, 3 patients each had a plasmacytoid, nested pattern, and clear cell carcinomas. Two patients each were diagnosed with adenocarcinoma and microcystic pattern tumors. Finally, single cases of lymphoepithelioma-like carcinoma, lipid cell variant, osteoclastic giant cell variant, glandular differentiation, and small cell carcinoma were identified. Microscopic images of some rare types of VH are shown in **Figure 1.** Of these patients, 53 were male (89.8%) and 6 were female (10.2%). The mean age at diagnosis was 72.1 ± 11.5 years. The baseline characteristics of patients with squamous, micropapillary, sarcomatoid, and other VH are summarized in **Table 1.** No statistically significant differences were observed between the groups in the evaluated parameters. However, subgroup analysis revealed that patients with tumors other than the three most common types had a statistically significantly higher likelihood of visceral metastasis compared to those with squamous differentiation (45% vs. 4%, p=0.003).

Radical cystectomy was performed in 18 (30.5%) patients after the initial diagnosis. Systemic chemotherapy was planned for 14 (23.7%) patients with lymph nodes and 13 (22.1%) patients with solid organ metastasis. 14 (23.7%) patients did not accept early radical cystectomy at the non-muscle invasive stage.

In our study with a mean follow-up period of 29 months, the median overall survival (OS) of the patients was 11 [interquartile

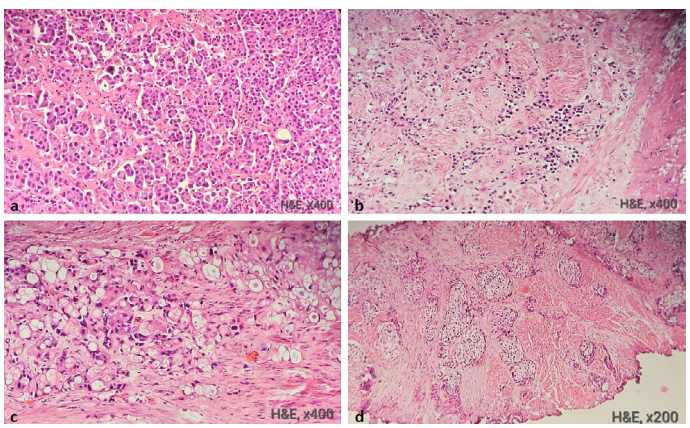

Figure 1. Microscopic specimen images of some variant histologies. (a): micropapillary variant (b): plasmacytoid variant (c): lipid cell variant (d): clear cell variant

Table 1. Baseline characteristic of patients according to type of variant histology

	Squamous (n=23)	Micropapillary (n=14)	Sarcomatoid (n=4)	Diğer VH (n=18)	P-value
Age	73.9±9	73.5±8.1	70±16.8	69.1±15.3	0.888
Gender n (%)					
Male	20 (87%)	13 (93%)	4 (100%)	16 (89%)	0.845
Female	3 (13%)	1 (7%)	-	2 (11%)	
Initial Surgery n (%)					
TUR-tm	23 (100%)	12 (86%)	4 (100%)	17 (94%)	0.179
Radical cystectomy	-	2 (14%)	-	1 (6%)	
Tumor size					
<3 cm	-	2 (14%)	-	-	0.084
≥3 cm	23 (100%)	12 (86%)	4 (100%)	18 (100%)	
Number of tumors					
Unifokal	7 (30%)	6 (42%)	3 (75%)	9 (50%)	0.319
Multifokal	16 (70%)	8 (58%)	1 (25%)	9 (50%)	
pT n (%)					
pT1	8 (35%)	2 (14%)	1 (25%)	3 (17%)	0.607
pT2	15 (65%)	10 (72%)	3 (75%)	14 (77%)	
pT3	-	1 (7%)	-	1 (6%)	
pT4	-	1 (7%)	-	-	
Presence of lymph node metastasis n (%)					
cN-	16 (70%)	11 (78%)	4 (100%)	14 (77%)	0.598
cN+	7 (30%)	3 (22%)	-	4 (23%)	
Presence of visceral organ metastases n (%)					
cM-	22 (96%)	13 (93%)	1 (25%)	10 (55%)	**0.003***
cM+	1 (4%)	1 (7%)	3 (75%)	8 (45%)	

VH: variant histology; TUR: transurethral resection; pT: pathological tumour stage; cN: clinically detected lymph node positivity; cM: clinically detected visceral organ metastasis positivity; *: indicates clinically significant

range (IQR):34, min-maximum (min-max):1-97] months. Cancer-specific survival (CSS) was 7 [IQR:10, min-max:1-65] months. Overall and cancer-specific survival graphs of variant subgroups are shown in **Figure 2**. The median OS (95% confidence interval) of squamous, micropapillary, sarcomatoid, and other variant subtypes were 13(9-19), 12(5-65), 3(2-3) and 10(3-20) months, respectively. Cancer-specific survival was 40(11-40), 12(5-65), 3(2-3), 14(4-54) months in the same order.

Age was a risk factor for cancer-specific survival (HR: 1.05; 95% CI 1.01-1.11; p= 0.045), but not for overall survival (HR: 1.03; 95% CI 0.98-1.07; p0.153). The cancer-specific mortality risk for the micropapillary variant was nearly eightfold higher compared to the squamous subtype. Cancer-related mortality was 7 times higher in the sarcomatoid variant and 5 times higher in the other variants. Detection of lymph node or solid organ metastasis on cross-sectional imaging did not affect overall survival but was found to affect cancer-specific survival **(Table 2).**

Discussion

The diverse histological variants of UC present significant challenges, as they exhibit differing clinical behaviors that can markedly affect patient outcomes and prognoses. Understanding these differences is crucial for effective diagnosis and treatment planning. Many VUCs may be muscle-invasive or even metastatic at diagnosis [5]. On the other hand, considering that in a study where 589 transurethral bladder resection (TURBT) specimens were re-evaluated by expert genitourinary pathologists, VH was not reported in 44% of cases, its detection becomes even more significant in terms of prognostic importance [6]. Many studies have shown that VUC is more aggressive and OS and CSS are shorter [7-9].

In this study, we evaluated the outcomes of patients diagnosed with VH of bladder cancer and showed that micropapillary and sarcomatoid types, in particular, had worse cancer-specific

Table 2. Multivariable Cox proportional hazards regression models testing the association between demographic, pathological features, and CSS, OS

	Overall Survival			Cancer-specific Survival		
	HR	**95% CI**	**p-value**	**HR**	**95% CI**	**P-value**
Age	1.03	0.98-1.07	0.153	1.05	1.01-1.11	**0.045***
Gender (male vs female)	1.28	0.48-3.4	0.611	0.89	0.22-3.6	0.881
Presence of muscle invasion at diagnosis	0.99	0.44-2.22	0.989	1.53	0.58-4.02	0.383
Radical cystectomy after diagnosis	1.41	0.62-3.22	0.406	1.15	0.36-3.65	0.811
Variant histology						
Squamous	Ref.			Ref.		
Micropapillary	0.8	0.36-1.77	0.582	7.73	2.16-27.6	**0.001***
Sarcomatoid	0.99	0.19-5.11	0.997	7.1	1.02-48	**0.047***
Other VH	1.52	0.67-3.42	0.312	5.46	1.31-22.8	**0.019***
Lymph node positivity at diagnosis	1.38	0.71-2.71	0.344	4.63	1.07-20	**0.039***
Visceral organ metastasis positivity at diagnosis	0.98	0.39-2.45	0.977	11.6	1.39-96	**0.023***

HR: hazard ratio; 95% CI: 95% confidence interval; VH: variant histologies; *: indicates clinically significant

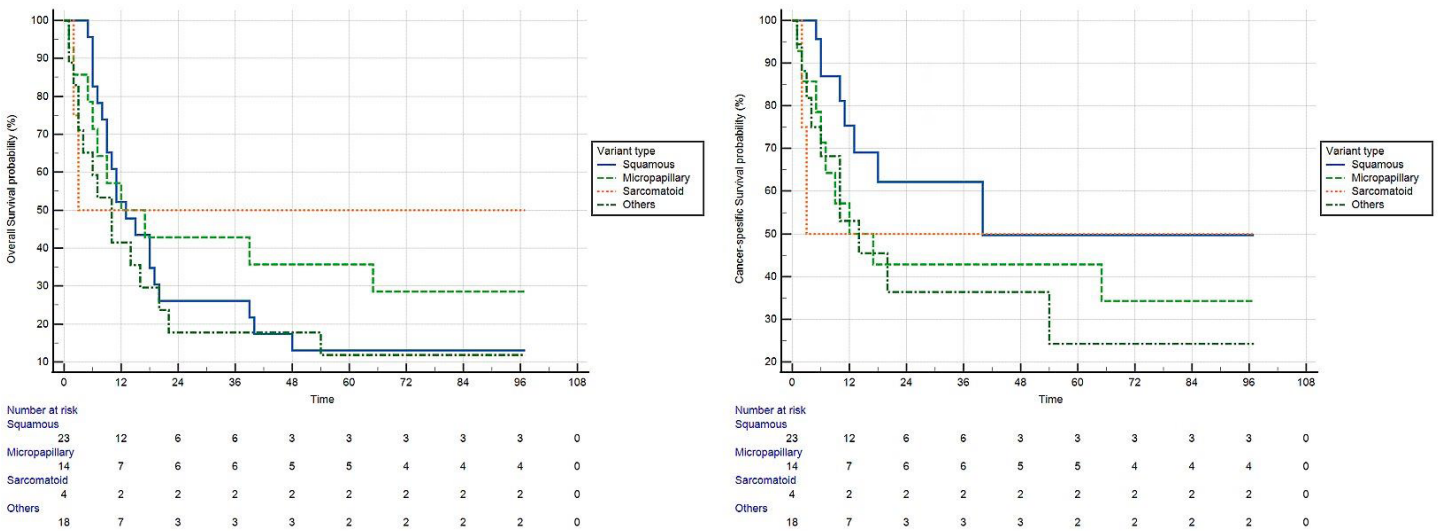

Figure 2. Kaplan-Meier plots stratified by histologic variants of urothelial carcinoma

survival than the most common squamous type. These findings are consistent with the existing literature, which highlights the prognostic importance of histological variants and their correlation with adverse pathological features. When evaluating VUC, it is necessary to consider that each variant may have a very different prognosis from each other as each variant has different dynamics.

The squamous variant of UC, while less aggressive than micropapillary or sarcomatoid types, presents a variable prognosis depending on the extent of the disease. In our study, the squamous variant accounted for 39% of all variant cases and was predominantly associated with localized disease at diagnosis. Cancer-specific survival for squamous variants in our cohort was similar to that reported in other studies, with 5-year survival rates ranging from 40% to 60%, depending on the stage at diagnosis [10]. The literature suggests that squamous differentiation frequently arises in response to chronic inflammation or infection, such as recurrent urinary tract infections or prolonged catheterization, which may explain its localized presentation in many cases [11]. However, conflicting data exist, with some studies indicating worse outcomes for higher-stage squamous variants, including a significant association with lymphovascular invasion and advanced pathological staging [12].

Micropapillary UC is a rare yet notably aggressive variant, constituting 0.6-2.2% of all UCs. This variant is characterized by early lymph node involvement and high-stage disease at diagnosis. In our cohort, micropapillary UC exhibited an approximately eight-fold higher cancer-specific mortality risk compared to squamous cell carcinoma (SCC). These results align with existing literature, which identifies micropapillary UC as having significantly worse survival outcomes than conventional UC, with five-year overall survival rates as low as 35% in some studies [13,14]. The clinical management of micropapillary UC remains a challenge. Radical cystectomy with pelvic lymphadenectomy is the cornerstone of treatment. However, the high propensity for early metastasis underscores the need for neoadjuvant chemotherapy. However, evidence supporting this approach is limited, and future prospective studies are needed to evaluate its efficacy [15,16] In our study, according to the literature, in 5 (35%) patients who could undergo radical cystectomy, the operation did not provide a statistically significant contribution in terms of OS or CSS.

The sarcomatoid variant of UC, as demonstrated in our study, represents one of the most aggressive histological subtypes. This variant accounted for 6.8% of all cases and was characterized by advanced pathological features, including a 75% rate of visceral metastasis at diagnosis. Multivariable analyses revealed that the sarcomatoid variant was associated with a seven-fold increased risk of cancer-specific mortality. In comparison, literature reports indicate a similarly poor prognosis, with 5-year survival rates often below 20% and a high likelihood of lymphovascular invasion and systemic spread [17]. Tumor size and unifocal presentation were notable features in our cohort, with all sarcomatoid tumors measuring ≥3 cm and 75% being unifocal, aligning with reports that highlight their rapid growth and localized dominance [18]. Sarcomatoid UC poses distinct challenges due to its aggressive nature and frequent metastasis at diagnosis. Standard therapies such as radical cystectomy are often inadequate due to the aggressive nature of the disease and its metastatic nature at the time of diagnosis. New therapies, including immune checkpoint inhibitors, show promise, especially given the high tumor mutation burden observed in upper urinary tract UC, especially in sarcomatoid variants. However, further research is needed to establish standardized treatment protocols and to evaluate the efficacy of new therapeutic approaches [19].

Other rare variants, including plasmacytoid, nested, and clear cell subtypes, were also analyzed. The plasmacytoid variant is associated with high metastatic potential, while the nested variant often poses diagnostic challenges due to its resemblance to benign lesions. In our study, patients with these subtypes showed varied survival outcomes, reflecting the heterogeneity of these entities. Nested UC, for instance, can mimic non-invasive UC, complicating early detection and treatment [18,20].

Our analysis identified age as a significant risk factor for cancer-specific survival but not for overall survival. This finding is consistent with studies suggesting that even elderly patients with pure UC have diminished physiological reserves to withstand aggressive disease and treatment regimens [21]. Additionally, the presence of lymph nodes or solid organ metastases at diagnosis adversely affected cancer-specific survival. Kim et al. analyzed 424 patients who underwent radical cystectomy+lymph node dissection for VUC and found that 92 patients (21.7%) had histological positive lymph node involvement. In the LN positive group, histological variants of UC were a significant independent prognostic factor of overall survival (hazard ratio (HR) 3.54; 95% confidence interval (CI) 1.77-7.08, $p < 0.001$) and cancer-specific survival (HR 3.66; 95% CI 1.69-7.90, $p = 0.001$) in both uni-variate and multivariate Cox regression analyses [22]. Our study is consistent with literature highlighting metastasis as a critical determinant of prognosis.

A key strength of our study lies in the detailed sub-analysis of variant UC subtypes, enabling a nuanced understanding of their prognostic implications. Furthermore, the confirmation of diagnoses by an independent pathologist enhances the reliability of our findings. However, the study's retrospective design and relatively small sample size, particularly for rare subtypes, limit the generalizability of the results. Larger multicenter studies are needed to validate our findings and explore potential therapeutic targets.

Conclusion

This study analyzed the effects of different subtypes of VUC on survival outcomes and showed that micropapillary and sarcomatoid variants in particular were associated with worse cancer-specific survival. Micropapillary and sarcomatoid variants were associated with an approximately eightfold and sevenfold increased risk of cancer-specific mortality, respectively. Our study revealed that age and the presence of metastases were the main factors affecting survival, while lymph node and visceral metastases significantly worsened cancer-specific survival. Our findings highlight the importance of molecular profiling and individualized therapeutic approaches in the management of these aggressive tumors, as each of these tumors behaves differently. Our findings emphasize the need for future research to assess the efficacy of immunotherapies and emerging treatment modalities.

Ethics Committee Approval: Ethical approval for this study was obtained from Bursa Yuksek Ihtisas Training and Research Hospital Clinical Research Ethics Committee (Ethics committee approval date and number: 26.01.2022/2011-KAEK-25 2022/01-19.
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References

[1] Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global cancer statistics 2020: GLOBOCAN estimates of ıncidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 2021;71(3):209-49.
https://doi.org/10.3322/caac.21660

[2] Alfred Witjes J, Lebret T, Compérat EM, Cowan NC, De Santis M, Bruins HM, et al. Updated 2016 EAU guidelines on muscle-invasive and metastatic bladder cancer. Eur Urol 2017;71(3):462-75.
https://doi.org/10.1016/j.eururo.2016.06.020

[3] Aron M. Variant histology in bladder cancer-current understanding of pathologic subtypes. Curr Urol Rep 2019;20(12):80.
https://doi.org/10.1007/s11934-019-0949-6

[4] Black AJ, Black PC. Variant histology in bladder cancer: diagnostic and clinical implications. Transl Cancer Res 2020;9(10):6565-75.
https://doi.org/10.21037/tcr-20-2169

[5] Lobo N, Shariat SF, Guo CC, Fernandez MI, Kassouf W, Choudhury A, et al. What is the significance of variant histology in urothelial carcinoma? Eur Urol Focus 2020;6(4):653-63.
https://doi.org/10.1016/j.euf.2019.09.003

[6] Shah RB, Montgomery JS, Montie JE, Kunju LP. Variant (divergent) histologic differentiation in urothelial carcinoma is under-recognized in community practice: impact of mandatory central pathology review at a large referral hospital. Urol Oncol 2013;31(8):1650-5.
https://doi.org/10.1016/j.urolonc.2012.04.009

[7] Dursun F, Elshabrawy A, Wang H, Wu S, Liss MA, Kaushik D, et al. Histological variants of non-muscle invasive bladder cancer: survival outcomes of radical cystectomy vs. bladder preservation therapy. Urol Oncol 2022;40(6):275.e1-275.e10.
https://doi.org/10.1016/j.urolonc.2022.02.004

[8] Monn MF, Kaimakliotis HZ, Pedrosa JA, Cary KC, Bihrle R, Cheng L, et al. Contemporary bladder cancer: variant histology may be a significant driver of disease. Urol Oncol 2015;33(1):18.e15-18.e20.
https://doi.org/10.1016/j.urolonc.2014.10.001

[9] Hsieh MC, Sung MT, Chiang PH, Huang CH, Tang Y, Su YL. The Prognostic impact of histopathological variants in patients with advanced urothelial carcinoma. PLoS One 2015;10(6):e0129268.
https://doi.org/10.1371/journal.pone.0129268

[10] Minato A, Noguchi H, Tomisaki I, Fukuda A, Kubo T, Nakayama T, et al. Clinical significance of squamous differentiation in urothelial carcinoma of the bladder. Cancer Control 2018;25(1):1073274818800269.
https://doi.org/10.1177/1073274818800269

[11] Tang Q, Xiong G, Li X, Fang D, Xi C, Zhang L, et al. The prognostic impact of squamous and glandular differentiation for upper tract urothelial carcinoma patients after radical nephroureterectomy. World J Urol 2016;34(6):871-7.
https://doi.org/10.1007/s00345-015-1715-0

[12] Elawdy MM, Taha DE, Elbaset MA, Abouelkheir RT, Osman Y. Histopathologic characteristics of upper tract urothelial carcinoma with an emphasis on their effect on cancer survival: a single-institute experience with 305 patients with long-term follow-up. Clin Genitourin Cancer 2016;14(6):e609-e615.
https://doi.org/10.1016/j.clgc.2016.04.017

[13] Cheng YT, Luo HL, Sung MT, Chiang PH. Micropapillary variant of urothelial carcinoma: a report of 4 cases and literature review. Chang Gung Med J 2010;33(4):461-5.
https://pubmed.ncbi.nlm.nih.gov/20804677/

[14] Amin MB. Histological variants of urothelial carcinoma: diagnostic, therapeutic and prognostic implications. Mod Pathol 2009;22 Suppl 2:S96-S118.
https://doi.org/10.1038/modpathol.2009.26

[15] Willis DL, Flaig TW, Hansel DE, Milowsky MI, Grubb RL, Al-Ahmadie HA, et al. Micropapillary bladder cancer: current treatment patterns and review of the literature. Urol Oncol 2014;32(6):826-32.
https://doi.org/10.1016/j.urolonc.2014.01.020

[16] Deuker M, Stolzenbach LF, Collà Ruvolo C, Nocera L, Mansour M, Tian Z, et al. Micropapillary versus urothelial carcinoma of the urinary bladder: stage at presentation and efficacy of chemotherapy across all stages-A seer-based study. Eur Urol Focus 2021;7(6):1332-8. https://doi.org/10.1016/j.euf.2020.08.010

[17] Lopez-Beltran A, Pacelli A, Rothenberg HJ, Wollan PC, Zincke H, Blute ML, et al. Carcinosarcoma and sarcomatoid carcinoma of the bladder: clinicopathological study of 41 cases. J Urol 1998;159(5):1497-503. https://doi.org/10.1097/00005392-199805000-00023

[18] Lopez-Beltran A, Cheng L, Raspollini MR, Canas-Marques R, Scarpelli M, Cimadamore A, et al. Variants of bladder cancer: the pathologist's point of view. European Urology Supplements 2017;16(12):210-22. https://doi.org/10.1016/j.eursup.2017.09.004

[19] Anraku T, Hashidate H, Nakahara A, Imai T, Kawakami Y. Sarcomatoid urothelial carcinoma of the renal pelvis treated with immunotherapy. BMC Urol 2023;23(1):38. https://doi.org/10.1186/s12894-023-01210-z

[20] Cox R, Epstein JI. Large nested variant of urothelial carcinoma: 23 cases mimicking von Brunn nests and inverted growth pattern of noninvasive papillary urothelial carcinoma. Am J Surg Pathol 2011;35(9):1337-42. https://doi.org/10.1097/PAS.0b013e318222a653

[21] Nielsen ME, Shariat SF, Karakiewicz PI, Lotan Y, Rogers CG, Amiel GE, et al. Advanced age is associated with poorer bladder cancer-specific survival in patients treated with radical cystectomy. Eur Urol 2007;51(3):699-708. https://doi.org/10.1016/j.eururo.2006.11.004

[22] Kim HS, Moon KC, Jeong CW, Kwak C, Kim HH, Ku JH. Histological variant as the significant predictor of survival in patients with lymph node positive urothelial carcinoma of the bladder. Sci Rep 2015;5:9626. https://doi.org/10.1038/srep09626

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Thermocautery-assisted Circumcision: A Single-center Experience from the First Two Years of Surgical Expertise

Termokoter Yardımlı Sünnet: Cerrahi Uzmanlığın İlk İki Yılından Tek Merkezli Bir Deneyim

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Abstract

Objective: Circumcision, the surgical removal of the foreskin covering the penile glans, is one of the oldest and most commonly performed surgical procedures worldwide. In recent years, thermocautery has gained popularity as a cost-effective and practical method. This study aims to present the results of the modified three-stage circumcision technique performed with the help of a thermocautery device in response to the intense demand for circumcision in our region and to contribute to the circumcision literature.
Materials and Methods: This retrospective study analyzed 604 circumcision patients operated on using the three-stage guillotine method with thermocautery while preserving the glans. These procedures were performed by a single surgeon in the first two years of his specialization at Siverek State Hospital between October 2022 and September 2024.
Results: The mean operative time was 12.5 ± 2.8 minutes (range: 8–25 minutes). The mean age of the patients was 7.04 ± 4.1 years (range: 0.33–15.7 years). Bleeding in the form of minor leakage was observed in 3 patients (0.52%). Complications such as infection, penile injury, meatal stenosis, or secondary phimosis were not encountered in any patient.
Conclusion: Thermocautery shortens the duration of the procedure, reducing the child's exposure to anesthesia and surgical stress, while also lowering the risk of bleeding. Circumcision performed with a thermocautery is practical and safe when conducted by trained doctors in an appropriate setting.

Keywords: circumcision, device, complication, thermocautery

Özet

Amaç: Sünnet, penis başını örten sünnet derisinin cerrahi olarak çıkarılması olup, dünya çapında en eski ve en sık uygulanan cerrahi prosedürlerden biridir. Son yıllarda, termokoterizasyon uygun maliyetli ve pratik bir yöntem olarak popülerlik kazanmıştır. Bu çalışmada, bölgemizde sünnete olan yoğun talep üzerine termokoterizasyon cihazı yardımıyla gerçekleştirilen modifiye üç aşamalı sünnet tekniğinin sonuçları sunularak sünnet literatürüne katkıda bulunulması amaçlanmıştır.
Gereçler ve Yöntemler: Bu retrospektif çalışmada, glans korunarak termokoterizasyon ile üç aşamalı giyotin yöntemi kullanılarak gerçekleştirilen 604 sünnet hastası analiz edilmiştir. Bu prosedürler, tek bir cerrah tarafından, uzmanlığının ilk iki yılında, Ekim 2022 ile Eylül 2024 tarihleri arasında Siverek Devlet Hastanesi'nde gerçekleştirilmiştir.
Bulgular: Ortalama ameliyat süresi 12,5 ± 2,8 dakikadır (aralığı: 8-25 dakika). Hastaların ortalama yaşı 7,04 ± 4,1 yıldı (aralığı: 0,33–15,7 yıl). 3 hastada (%0,52) küçük sızıntı şeklinde kanama gözlendi. Enfeksiyon, penis yaralanması, meatal stenoz veya sekonder fimozis gibi komplikasyonlar hiçbir hastada görülmedi.
Sonuç: Termokoterizasyon, çocuğun anesteziye ve cerrahi strese maruz kalmasını azaltırken, aynı zamanda kanama riskini de düşürür. Termokoterizasyon ile yapılan sünnet, uygun bir ortamda eğitimli doktorlar tarafından yapıldığında pratik ve güvenlidir.

Anahtar kelimeler: sünnet, cihaz, komplikasyon, termokoter

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Introduction

Circumcision, the surgical removal of the foreskin covering the penile glans, is one of the oldest and most commonly performed surgical procedures worldwide [1]. Its continued global practice, driven by religious, traditional, and medical reasons, sustains interest in this procedure. Despite ongoing debates regarding its psychological and ethical implications, circumcision remains one of the most frequently performed surgical interventions, carried out by physicians from various specialties in many societies today [2-4].

Nowadays, a number of methods are used for circumcision, such as the Shang Ring, PlastiBell, Gomco clamp, Mogen clamp, Smart clamp, Tara clamp, and thermocautery. The search for more practical, cost-effective, safe, and less complicated can be more suitable [5,6]. Healing period and the rate of complications can be affected by the surgical technique and energy source selected. Nonetheless, there are still disagreements on the best circumcision technique. Thermocautery has been more well-liked recently as an economical and useful technique. Thermocautery is a device that cuts tissue with a high-temperature metal tip while simultaneously providing coagulation. Unlike electrocautery, it uses a directly heated metal tip and does not transmit electric current directly to the tissue. The main advantages of this method include effective hemostasis during cutting, minimal bleeding, shorter procedure time compared to traditional surgery, and ease of use in field conditions due to its portability and low cost. However, thermocautery carries risks of thermal damage such as burns and delayed wound healing in surrounding tissues due to heat [7].

The aim of this study is to compare the modified three-stage circumcision technique performed with the aid of a thermocautery device (Electroteknik Medical, İzmir) **(Figure 1)** in response to the high demand for circumcision in our region, and to contribute to the circumcision literature.

Materials and Methods

After ethical approval (ethics committee approval date and number: 28.11.2022/ M5.TUT.019), this retrospective study analyzed 604 patients who underwent circumcision using the three-stage guillotine method with thermocautery while preserving the glans. These procedures were performed by a single surgeon in the first two years of his specialization at Siverek State Hospital between October 2022 and September 2024.

Figure 1. Thermocautery device

Patients who met the following exclusion criteria were excluded from the study: those individuals with penile anatomical anomalies (e.g., chordee, hypospadias, buried penis), patients undergoing additional perioperative surgical procedures, cases where thermocautery was not used, those requiring secondary surgeries, patients experiencing anesthesia-related complications, and individuals aged over 18 years.

Preoperative evaluations for all patients included physical examination in the outpatient clinic, complete blood count, bleeding parameters, and assessment by the anesthesia department. On the morning of the surgery, intravenous access was established after hospital admission. Before being taken to the operating room, patients received 0.1 mg/kg IV midazolam (Dormicum®) and were brought to the operating room accompanied by a nurse. Following induction of general anesthesia, dorsal penile block was applied with bupivacaine HCl (Marcaine 0.5%; AstraZeneca, Istanbul, Turkey) and prilocaine HCl (Citanest 2%; AstraZeneca, Istanbul, Turkey).

Surgical Technique

The settings of the thermocautery device were determined according to the age of the participant: 500°C was used for patients under 2 years of age, 550-650°C for patients between 2 and 10 years of age, and 700-750°C for patients over 10 years of age.

After local field preparation, the surgical site was draped under sterile conditions. In the first stage, the prepuce was completely retracted and the adhesions between the glans penis and the preputium were completely released. The prepuce was held with two clamps at the 6 and 12 o'clock positions, creating slight

Figure 2. A third straight clamp was placed under the clamps at the 6 and 12 o'clock positions and this was removed over the third clamp in a guillotine fashion with thermocautery, protecting the glans

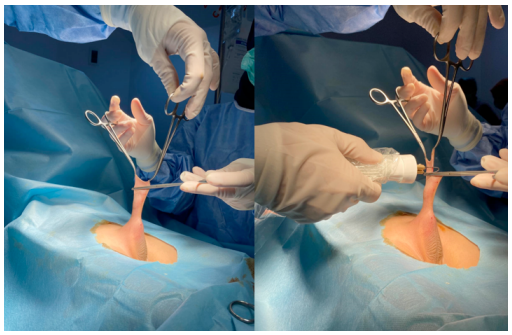

Figure 3. Only the outer preputial skin was clamped at the 12 and 6 o'clock positions, with the ventral aspect angled 15-20° upwards. After the tension was achieved, the outer prepuce was removed over the clamp in a guillotine fashion with thermocautery, again protecting the glans

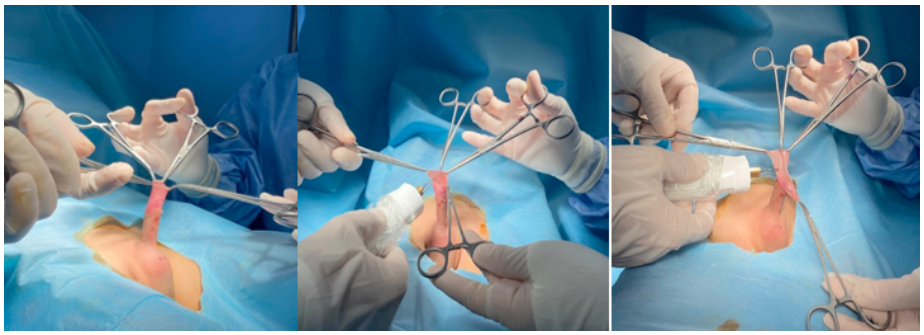

Figure 4. The mucosa (inner prepuce) was clamped only at the 12, 3, 6, and 9 o'clock positions and shortened using a thermocautery device

tension to adjust the length of the mucosa and foreskin. Then, a third straight clamp was placed under the clamps at the 6 and 12 o'clock positions and this was removed over the third clamp in a guillotine fashion with thermocautery, protecting the glans **(Figure 2).** In the second stage, only the outer preputial skin was clamped at the 12 and 6 o'clock positions, with the ventral aspect angled 15-20° upwards. After the tension was achieved, the outer prepuce was removed over the clamp in a guillotine fashion with thermocautery, again protecting the glans **(Figure 3).** In the third stage, the mucosa (inner prepuce) was clamped only at the 12, 3, 6, and 9 o'clock positions and shortened using a thermocautery device **(Figure 4).** The frenulum was preserved, leaving an average of 0.5–1 cm of mucosa intact. Active bleeding points were controlled by touching with the thermocautery **(Figure 5).**

To complete the procedure, 4/0–5/0 polyglactin 910 (VICRYL rapide®) sutures were typically placed at the 6–12, 2–10, and 4–8 o'clock positions, yielding a total of six sutures. Additional sutures were placed when necessary. The operative time was recorded as the time from the initial local site preparation to the placement of the final suture. After surgery, a topical antibiotic cream containing nitrofurazone was applied and the patient was transferred to the ward. Patients were usually discharged approximately six hours after the procedure. Follow-up assessments for complications were performed after one week, one month, and six months. Parents were informed of possible complications at discharge. Patients were evaluated in terms of operative time, bleeding, infection, urethral and penile injuries, secondary phimosis, meatal stenosis, urinary retention, and buried penis.

Statistical Analysis

The data was analyzed using SPSS 25.0 statistical software package. Number, percentage, mean ± standard deviation (minimum maximum) were used for descriptive statistics.

Results

A total of 573 patients who met the study criteria underwent circumcision for various reasons. The majority, 477 patients (83.2%), were circumcised for religious reasons. Physiologi-

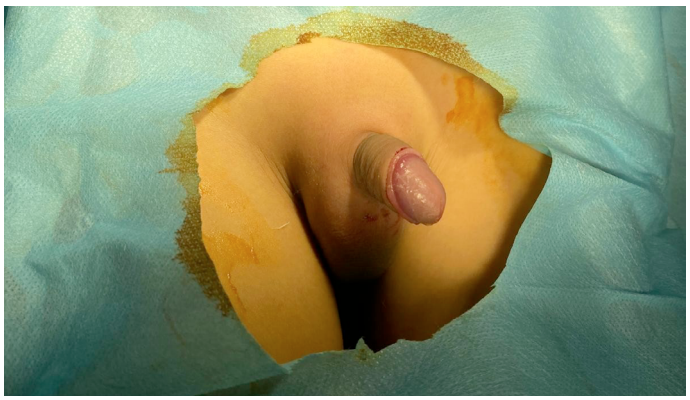

Figure 5. The frenulum was preserved, leaving an average of 0.5–1 cm of mucosa intact. Active bleeding points were controlled by touching with the thermocautery

Table 1. Patient age, operation time and complications

Number of patients (n, %)	**573 (100)**
Age (years, [mean±SD, (min.-max.)]	7.04±4.1 (0.33-15.7)
Operation duration (minute, [mean±SD, (min.-max.)])	12.5±2.8 (8-25)
Number of patients with complications (n, %)	3 (0.52)
Bleeding	3 (0.52)
Infection	0(0)
Secondary phimosis	0(0)
Meatal stenosis	0(0)
Circumcision reason (n, %)	
Religious reasons	477 (83.2)
Phimosis	47 (8.2)
Balanitis	23 (4.0)
Other reasons	26 (4.5)
Total	573 (100)

SD; standard deviation

cal phimosis was the indication in 47 patients (8.2%), while 23 patients (4.0%) underwent the procedure due to balanitis. The remaining 26 patients (4.5%) were circumcised for other medical or personal reasons **(Table 1).** The mean operative time was 12.5 ± 2.8 minutes (range: 8–25 minutes). The mean age of the patients was 7.04 ± 4.1 years (range: 0.33–15.7 years). Minor bleeding was observed in 3 patients (0.52%). Hemostasis was achieved in all cases with a 2-hour penile compression dressing. No cases of significant bleeding occurred, and none of the patients with bleeding had an underlying bleeding diathesis. Some patients developed varying degrees of edema, but this did not adversely affect the healing process. No postoperative infections related to circumcision were observed, and no systemic antibiotics were required. No complications such as infection, penile injury, meatal stenosis, or secondary phimosis were observed in any patient after a minimum of 6 months of follow-up **(Table 1).**

Discussion

Circumcision is one of the oldest and most frequently performed surgical procedures in human history [1]. In a study encompassing 237 countries, Morris et al. reported the global prevalence of male circumcision as 38%, while in Turkey, it was reported to be 98.6% [8]. Like any surgical procedure, circumcision carries a risk of complications. Given the high frequency of this procedure, a significant number of complications are observed [9,10]. In Şanlıurfa's Siverek district, which has a high birth rate, thermocautery has been preferred as a method for circumcision due to its speed, safety, reduced bleeding, and low incidence of severe complications. In our study, no major complications were observed in any patient.

Thermocautery has been found to be a safe method when performed by skilled practitioners [11]. However, relatively few studies have been conducted on the use of thermocautery in circumcision [12–14]. In general, the occurrence of complications is influenced by the surgeon's experience, the environment, and technical factors. These complications range from minor issues such as bleeding and simple infections to rare but serious outcomes such as glans amputation, thermal burns, poor wound healing, infection, meatal stenosis, necrosis, urethral fistula, or even death [10].

Previous literature has reported circumcision complication rates ranging from 0.1% to 35% [15]. In a study conducted in the United Kingdom involving 66,519 circumcisions, the complication rate was found to be 2%. Among the complications, bleeding occurred in 533 patients (0.8%), revision surgery was required in 303 patients (0.5%), and meatal stenosis was observed in 7 patients [16].

A meta-analysis examining thermocautery-assisted circumcisions in 32,000 patients from 17 countries reported a complication rate of 2.48%, with minor bleeding being the most common complication (2.2%). The most severe complications reported were entrapment of the penis due to secondary phimosis (0.078%) and meatal obstruction (0.018%) [17].

In a study by Akyüz et al., the incidence of trapped penis following thermocautery-assisted circumcision was reported as 0.38% [18]. Another study involving 2,973 thermocautery procedures reported a complication rate of 0.2%, with meatal stenosis and secondary phimosis each observed in 0.03% of cases [19]. Similarly, in a study of 1,011 children who underwent thermocautery circumcision, complications were observed in 4 patients (0.4%), including secondary phimosis in one child, meatal stenosis in another, bleeding in one, and infection in another [14]. The main approach to treating secondary phimosis is surgery; surgical revision may be required, especially in cases where scar tissue is evident. However, in some cases diagnosed early and with minimal scar tissue, topical corticosteroid therapy may be tried. According to the results of Yalçın's study, topical steroid treatment was largely ineffective in 54 cases of secondary phimosis that developed after circumcision with thermocautery, and all patients required surgical revision [20]. In our study, similar to the literature, minor bleeding was observed in 3 patients (0.52%), but no major complications were encountered. Bleeding, which is the most commonly reported complication in the literature (2–35%), is often caused by frenular or dorsal vessels [21]. In our patients, bleeding was controlled with postoperative compression dressings.

We believe that mucosal edema is a frequently encountered yet often overlooked complication in thermocautery-assisted circumcision. The literature reports varying rates of mucosal edema (20–30%), which are generally considered clinically insignificant [17]. In the study by Arslan et al., edema was observed in one-fifth of the patients and was deemed clinically irrelevant [12]. Ngcobo and colleagues reported that 20 to 30 percent of patients experienced penile swelling on the second day after surgery, although the surgical procedure was not clearly specified [22]. In our study, some children exhibited varying degrees of edema, but it had no adverse effect on the healing process. Concerns have been raised about thermocautery-related heat production causing damage to penile nerves, potentially reducing penile sensitivity and impacting tissue healing. Although few histopathological case studies exist, they have demonstrated that tissue damage caused by the high temperatures generated by the device is extremely limited [13,18,23].

Saracoğlu et al. reported that circumcisions performed with the thermocautery technique resulted in shorter operation times and less bleeding, contributing to reduced overall surgical duration [24]. Another study evaluating 2,973 children undergoing thermocautery-assisted circumcision reported an average procedure time of 6.5 minutes [19]. Meanwhile, another report indicated an average operation time of 17 ± 2.3 minutes (range 10–23 minutes) [18]. When we compare these times with other techniques, in the study of Tuncer et al., the classical surgical technique took 14.38 ± 2.91 minutes, the thermocautery technique 5.02 ± 1.32 minutes and the Alisklamp 4.05 ± 1.0 minutes, and all three techniques were found to be statistically different from each other in terms of surgery time [14]. In Yalçın's study of 5122 cases where the dorsal slit method was applied, the average procedure time was calculated as 11.74 ± 2.04 minutes [25]. In our study, the circumcision duration was recorded as 12.5 ± 2.8 minutes (range 8–25 minutes). Some centers use single- or two-stage guillotine techniques [14,17,19]. Although our circumcision duration was slightly longer due to the three-stage technique, our low complication rate, particularly the absence of major long-term complications such as meatal stenosis or secondary phimosis, can be attributed to the applied circumcision technique and the specialized training of the surgeon, who received extensive

education in a high-volume circumcision clinic.

Our study has certain limitations. Ideally, surgical techniques are best compared in prospective randomized trials; however, this is a retrospective study. Some minor complications may not have been noticed by the relatives of the patients or reported to the healthcare institution; this may have led to an underestimation of complication rates. The lack of a comparative control group in the study limits the ability to directly evaluate the efficacy and safety differences of the thermocautery technique compared to other methods. Long-term follow-up data are not available in our study; therefore, late complications, scar development or patient satisfaction could not be evaluated. Additionally, all circumcisions in this study were performed by a single surgeon.

Conclusion

In conclusion, reviewing the literature on circumcision suggests that such a frequently performed surgical procedure should be carried out by trained physicians under operating room conditions. There are various circumcision methods and specialized tools designed for this procedure. Thermocautery shortens the duration of the procedure, reducing the child's exposure to anesthesia and surgical stress, while also lowering the risk of bleeding. Circumcision performed with a thermocautery is practical and safe when conducted by trained doctors in an appropriate setting.

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References

[1] Dunsmuir W, Gordon E. The history of circumcision. BJU Int 1999;83(1):1-12. https://doi.org/10.1046/j.1464-410x.1999.0830s1001.x

[2] Tasci A, Danacioglu Y, Arikan Y, Colakoglu Y, Yapar B, Buyuk Y. Management of post-circumcision necrosis of the penis: the medicolegal aspect. Pediatr Surg Int 2020;36(4):523-8. https://doi.org/10.1007/s00383-020-04630-2

[3] Atikeler MK, Geçit I, Yüzgeç V, Yalçın O. Complications of circumcision performed within and outside the hospital. Int Urol Nephrol 2005;37(1):97-9. https://doi.org/10.1007/s11255-004-6077-2.

[4] Tokuc E, Yildiz N, Sertkaya Z, Ozsoy E, Kayar R, Ozkaya F. The relationship of urological and psychological problems with circumcision-a cross-sectional study. Grand J Urol. 2023;3(3):90-6. https://doi.org/10.5505/GJU.2023.40427

[5] Abdulwahab-Ahmed A, Mungadi IA. Techniques of male circumcision. J Surg Tech Case Rep 2013;5(1):1-7. https://doi.org/10.4103/2006-8808.118588

[6] Barone MA, Ndede F, Li PS, Masson P, Awori Q, Okech J, et al. The Shang Ring device for adult male circumcision: a proof of concept study in Kenya. J Acquir Immune Defic Syndr 2011;57(1):e7-e12. https://doi.org/10.1097/QAI.0b013e3182158967

[7] Tuncer AA, Deger M. Incidence of complications following thermocautery-assisted circumcisions. Urol J 2018;15(6):359-64. https://doi.org/10.22037/uj.v0i0.4296

[8] Morris BJ, Wamai RG, Henebeng EB, Tobian AA, Klausner JD, Banerjee J, et al. Estimation of country-specific and global prevalence of male circumcision. Popul Health Metr 2016;14:4. https://doi.org/10.1186/s12963-016-0073-5

[9] Weiss HA, Larke N, Halperin D, Schenker I. Complications of circumcision in male neonates, infants and children: a systematic review. BMC Urol 2010;10:2. https://doi.org/10.1186/1471-2490-10-2

[10] Şimşek A, Başer A. An examination of erroneous medical practices in circumcision surgery in light of supreme court decisions. Pediatr Surg Int 2024;40(1):157. https://doi.org/10.1007/s00383-024-05737-6

[11] Karaman MI, Zulfikar B, Özturk MI, Koca O, Akyüz M, Bezgal F. Circumcision in bleeding disorders: improvement of our cost effective method with diathermic knife. Urol J 2014;11(2):1406-10. https://doi.org/10.22037/uj.v11i2.1771

[12] Arslan D, Kalkan M, Yazgan H, Ünüvar U, Şahin C. Collective circumcision performed in Sudan: evaluation in terms of early complications and alternative practice. Urology 2013;81(4):864-8. https://doi.org/10.1016/j.urology.2012.11.070

[13] Tuncer AA, Bozkurt MF, Bayraktaroğlu A, Koca HB, Doğan I, Çetinkursun S, et al. Examination of histopathological changes of scalpel, monopolar, bipolar, and thermocautery applications in rat experimental circumcision model. Am J Transl Res 2017;9(5):2306-13. https://pubmed.ncbi.nlm.nih.gov/28559981/

[14] Tuncer AA, Erten EEA. Examination of short and long term complications of thermocautery, plastic clamping, and surgical circumcision techniques. Pak J Med Sci 2017;33(6):1418-23. https://doi.org/10.12669/pjms.336.13640

[15] Salle JLP, Jesus LE, Lorenzo AJ, Romão RL, Figueroa VH, Bägli DJ, et al. Glans amputation during routine neonatal circumcision: mechanism of injury and strategy for prevention. J Pediatr Urol 2013;9(6):763-8. https://doi.org/10.1016/j.jpurol.2012.09.012

[16] Cathcart P, Nuttall Mv, Van der Meulen J, Emberton M, Kenny S. Trends in paediatric circumcision and its complications in England between 1997 and 2003. Br J Surg 2006;93(7):885-90. https://doi.org/10.1002/bjs.5369

[17] Cakiroglu B, Gozukucuk A, Arda E, Tas T. Reliability of thermocautery-assisted circumcision: retrospective analysis of circumcision performed voluntarily in countries of low socioeconomic status. Ther Adv Urol 2019;11:1756287219882598. https://doi.org/10.1177/1756287219882598

[18] Akyüz O, Bodakçi M, Tefekli AH. Thermal cautery-assisted circumcision and principles of its use to decrease complication rates. J Pediatr Urol 2019;15(2):186.e1-186.e8. https://doi.org/10.1016/j.jpurol.2019.01.003

[19] Karakaya AE, Güler AG, Doğan AB. Hızlı sünnet: Bir epidemiyolojik ve teknik araştırma. Çocuk Cerrahisi Dergisi 2017;31(3):108-12. https://doi.org/10.5222/JTAPS.2017.108

[20] Yalçın, K. Termokoterle yapılan sünnet sonrası gelişen fimozisin tedavisinde topikal steroid kremlerin etkinliği var mı? Androl Bul 2023;25(2):67-72. https://doi.org/10.24898/tandro.2023.63496

[21] Polat F, Tuncel A, Balci M, Aslan Y, Sacan O, Kisa C, et al. Comparison of local anesthetic effects of lidocaine versus tramadol and effect of child anxiety on pain level in circumcision procedure. J Pediatr Urol 2013;9(5):670-4. https://doi.org/10.1016/j.jpurol.2012.07.022

[22] Ngcobo S, Wolvaardt JE, Bac M, Webb E. The quality of voluntary medical male circumcision done by mid-level workers in Tshwane District, South Africa: A retrospective analysis. PloS One 2018;13(1):e0190795. https://doi.org/10.1371/journal.pone.0190795

[23] Hay SA. The use of thermal cautery for male circumcision. JKAU Med Sci 2009;16(1):89-93. https://doi.org/10.4197/Med. 16-1.8

[24] Saracoglu M, Ozturk H, Zengin T, Kerman HS. Comparison of thermal cautery-assisted circumcision with the conventional technique. Human Andrology 2014;4(2):34-7. https://doi.org/10.1097/01.XHA.0000439147.28288.fe

[25] Yalçın, K. Sünnet uygulanan çocuklarda dorsal slit yöntemi sonuçlarımız. Androl Bul 2023;25(1):1-5. https://doi.org/10.24898/tandro.2023.34445

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Urological Complications in Gynecological Oncology Surgeries: A Tertiary Center Experience

Jinekolojik Onkoloji Cerrahisinde Ürolojik Komplikasyonlar: Tersiyer Merkez Deneyimi

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Abstract

Objective: The close proximity of the female genital system and the urinary system predisposes both systems to operative complications. We examined the causes and management of these complications, which are even more prevalent in oncological surgeries.
Materials and Methods: In total, 135 malignant cases operated on in the Gynecological Oncology clinic of Çam and Sakura City Hospital between December 2022 and April 2024 were retrospectively examined. Management of urological complications was carried out together with the urology clinic.
Results: A total of 10 urological complications developed in nine patients during the 16-month period. All of them were seen in surgeries performed by laparotomy. Four of the patients who underwent major oncological surgery had bladder damage, and the other four had ureter damage. In one patient, both bladder and ureter damage were observed. Eighty percent of complications were diagnosed intraoperatively. Bladder injuries developed during dissection and ureter injuries, which generally occurred during energy use and ligation. While damage to the bladder and mid-ureter was primarily repaired, a more difficult procedure such as ureteroneocystostomy was performed for distal ureter injuries. Defects in the bladder trigone were also difficult to treat.
Conclusion: The female genital and urinary systems, which are in close proximity to each other, make them prone to urinary complications during gynecological surgeries. Due to the nature of oncological surgery, the disrupted anatomy and the different biology of tumor cells may increase these complication rates. Therefore, every surgeon dealing with gynecological oncology must be familiar with urological anatomy and master the management of complications.

Keywords: urinary injury, gynecological oncologic surgery, urological complications, ureteral injury, bladder injury

Özet

Amaç: Kadın genital sistemi ile üriner sistemin yakın komşuluğu her iki sistem içinde operatif komplikasyonlara yatkınlık gösterir. Onkolojik ameliyatlarda daha da artan bu komplikasyonların sebeplerini ve yönetimini inceledik.
Gereçler ve Yöntemler: Çalışmaya Aralık 2022 ve Nisan 2024 ayları arasında Çam ve Sakura Şehir Hastanesi Jinekolojik Onkoloji kliniğinde opere edilen 135 malign vaka retrospektif olarak incelendi. Ameliyat esnasında gelişen ürolojik komplikasyonların yönetimi üroloji kliniği ile beraber yapıldı.
Bulgular: 16 aylık dönemde toplamda 9 hastada 10 ürolojik komplikasyon gelişti. Bu komplikasyonların hepsi laparotomi ile yapılan ameliyatlarda görüldü. Majör onkolojik cerrahi uygulanan 4 hastada izole mesane yaralanması, 4 hastada izole üreter yaralanması ve 1 hastada üreter ve mesane birlikte yaralanması görüldü. Üriner sistem hasarlarının %80'i intraoperatif olarak tanı alırken, mesane hasarları diseksiyon esnasında, üreter hasarları ise genelde enerji kullanımı ve ligasyon esnasında gelişti. Mesane ve mid-üreterdeki hasar primer olarak onarılırken, distal üreter yaralanmaları için üreteroneosistostomi gibi daha zor bir prosedür uygulandı. Mesane trigonundaki defektlerin tedavisi de zordu.
Sonuç: Birbiri ile yakın komşuluk içinde olan kadın genital ve üriner sistemi, jinekolojik ameliyatlar esnasında üriner komplikasyon oluşmasına yatkınlık sağlar. Onkolojik cerrahinin doğası gereği bozulan anatomi ve tümör hücresinin farklı biyolojisi bu komplikasyon oranlarını artırabilmektedir. Bu yüzden jinekolojik onkoloji ile uğraşan her cerrahın ürolojik anatomiye aşina olması ve komplikasyonların yönetimine hakim olması gerekmektedir.

Anahtar kelimeler: üriner hasar, jinekolojik onkolojik cerrahi, ürolojik komplikasyon, üreter hasarı, mesane hasarı

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Introduction

Due to the nature of oncological cases, morbidity and mortality in gynecological oncological surgeries are higher than in gynecological surgeries performed for benign reasons. In gynecological oncology surgeries, the gastrointestinal, urinary, and vascular systems can also be a part of the surgery. The close proximity of the genital and urinary systems increases the possibility of injury in these areas. Iatrogenic injuries may occur for reasons such as tumor tissue disrupting the nutrition in that area, changes to the anatomical structure, the radiotherapy used in adjuvant treatment destroying the tissues, and larger resections being made to perform maximal surgery. The incidence of urinary system complications in benign gynecological surgeries is reported as 0.3%-1.8% [1]. While most of the studies published in the literature describe the results of benign gynecological operations, very few of them belong to gynecological oncology cases [2]. Bladder and ureter injury rates in gynecological oncological cases range from 1.1% in simple hysterectomies performed for uterine cancers to 5.3% in radical hysterectomies [3]. Although it is difficult to determine the exact incidence because symptomatic cases are generally published, developing technology and increased surgical experience have led to a decrease in urological complications. In this study, we identified iatrogenically developing urological complications in gynecological oncological surgeries in our clinic and evaluated them in light of the literature.

Materials and Methods

In our study, patients who were operated on in our gynecological oncology clinic between December 2022 and April 2024 were retrospectively scanned. One hundred thirty-five oncology surgeries performed by the same gynecological oncologic surgeon between these dates were examined. One hundred ten surgeries were performed by laparotomy and the twenty five surgeries were performed by laparoscopy. No urological complications were seen in the laparoscopy group and all the urological complications were seen in laparotomy group. Ten urological complications that developed in 9 patients were examined. The patients' demographic data and disease findings were evaluated by scanning the files, archive records, and hospital operating system (HBYS). Intraoperative consultation was requested from the urology clinic in the management of complications. The age, previous surgeries, tumor type, surgery performed, and pathology reports of all patients were examined. Urological complications and their occurrence were analyzed **(Table 1).** The complications we encountered during surgeries

Table 1. Age, previous surgery, diagnosis, surgery type, urological complication and the way of occurence of the cases

	Age	Previous surgery	Diagnosis	Surgery	Urological complication	Way of occurence
Case 1	57	-	Adnexal mass (Clear cell CA)	Debulking (TAH BSO PPLND)	Bladder 3 cm full thickness incision	During bladder peritonectomy
Case 2	72	S/C Umblical herni	Adnexal mass (Endometrioid CA)	Debulking (TAH BSO PPLND) LAR Implant excison on liver	Ureter LigaSure injury	During LAR (left ureteral tumor invasion)
Case3	64	Gastric operation	Recurrent ovarian CA	Debulking total colectomy ileal resection	Bladder 2-4 cm. full thickness incision, Ureter LigaSure injury	During mass excision and bladder peritonectomy
Case 4	38	S/C	Endometrium CA	Debulking (TAH BSO PPLND)	Bladder serosal injury	Bladder is extended towards the fundus due to previous surgery
Case 5	60	Cholecystectomy Umblical herni	Endometrium CA	Debulking (TAH BSO PPLND)	Ureter ligation	During uterin artery ligation
Case 6	43	-	Cervix CA	Meigs operation	Ureter ligation	During vaginal cuff ligation
Case 7	51	-	Recurrent Cervix CA	Type1 hysterectomy	Bladder 2 cm full thickness incision	Due to adhesions related to radiotherapy
Case 8	61	S/C	Recurrent Cervix CA	Anterior exenteration	Shortening of the ureters, Ileal conduit and ureterocutanostomy couldn't be performed	Right ureter totally excised due to tumor invasion. Left ureter remained very short after releasing from the tumor
Case 9	51	Strassmann TAH BSO	Vaginal agenesis Uterin anomaly	Cervical stumph excision	Bladder 2 cm full thickness incision	During mass excision (dens adhesions due to previous surgery of rectum, bladder and sigmoid colon)

CA: carcinoma; LAR: low anterior resection; S/C: sectio cesarean; TAH BSO: Total abdominal hysterectomy bilateral salpingooopherectomy; PPLND: pelvic paraaortic lymph node dissection

Table 2. Distribution of urinary injuries according to the types of surgery performed in our clinic

Type of surgery	Number of surgery	Ureter injury	Bladder injury	Total injury
Debulking	56	3 (5.3%)	4 (7.1%)	7 (12.5%)
Interval debulking	19	-	-	0
Meigs radical hysterectomy	3	1 (33.3%)	-	1 (33.3%)
Exenteration	1	1 (100%)	-	1 (100%)
Diagnostic L/T	1	-	-	0
TAH BSO	23	-	-	0
USO/cystectomy	6	-	-	0
Stumph excision	1	-	1 (100%)	1 (100%)
L/T total	110	5 (4.5%)	5 (4.5%)	10 (9%)
L/S USO/cystectomy	3	-	-	-
TLH + LND	22	-	-	-
L/S total	25	0	0	0
Total	135	5	5	10

L/T: laparotomy; TAH BSO: total abdominal hysterectomy bilateral salpingooopherectomy; USO: unilateral salpingooopherectomy; L/S: laparoscopy; TLH: total laparoscopic hysterectomy; LND: lymph node dissection

were compared with general literature information, and similar and different features were evaluated. Ethical approval for the study was received from our hospital's Clinical Research Ethics Committee with decision number KAEK/27.12.2023-578.

Results

A total of 135 oncological surgeries were performed by the same surgeon in the 16 months between December 2022 and April 2024. Urological complications developed in a total of 9 (6.6%) patients, all of which were seen in laparotomy surgeries (9/110 = 8.1%). Of these 9 patients, 3 (5%) were among the 60 patients operated on due to adnexal mass/ovarian cancer, 2 (7.4%) were among the 27 patients operated on due to endometrial cancer, and 3 (42%) were among the 7 patients operated on due to cervical cancer, and one patient operated on due to a cervical mass.

A total of 10 urological complications were detected in 9 of 110 patients operated on via laparotomy. Bladder damage occurred in 5 (4.5%) of these operations, and ureter damage occurred in 5 cases (4.5%). While there is usually single-organ damage, in one case, both bladder and ureter damage occurred simultaneously. No urological complications were observed in 25 cases who underwent laparoscopic USO and hysterectomy due to endometrial hyperplasia, adnexal mass, and endometrial cancer. The distribution of cases with urological complications according to the type of surgery performed is shown in **(Table 2).**

While 1 of the bladder injuries developed only in the serosal layer, full-thickness damage occurred in the other 4 cases, including the serosal, muscular, and mucosal layers. While 4 of them were diagnosed intraoperatively, 1 could be diagnosed on the 5th postoperative day. The serosal damage occurred during the blunt dissection of the 11-cm mass sitting on the bladder due to adhesions from previous cesarean sections. It was sutured superficially with a 3/0 polyglactin suture. The first of the full-thickness injuries occurred during bladder peritonectomy after the resection of the tumor sitting on the bladder, and the other occurred during adhesiolysis in the stump excision of the patient who had previously undergone Strassman and hysterectomy surgery.

The patient diagnosed postoperatively was a patient with recurrent cervical cancer who had previously received chemoradiotherapy and undergone type 1 hysterectomy. Because of the left ureteral hydronefrosis CT scan was performed. We performed cytoscopy because of the urinary extravasation seen in tomography. A 2-cm defect in the posterior trigone was observed during cystoscopy in the bladder, which was thought to have been damaged during the excision of the abscess and tumoral tissue between the bladder and the uterus. Although the bladder and ureter were checked intraoperatively by the urology clinic, the diagnosis could only be made postoperatively. It was diagnosed by cystoscopy after extravasation developed on the 3rd day. This patient, who later developed renal failure, died due to septic shock on the 70th day. The last patient with bladder damage also developed ureter damage. During the excision of the 4-cm recurrent mass in the cuff, 2 separate incisions of 2 and 4 cm were made. During colectomy, the right mid-ureter damage caused by LigaSure was repaired primarily with 4/0 Vicryl. All full-thickness bladder defects were sutured in 2 layers with 2/0 and 3/0 polyglactin sutures.

Of the 5 patients with ureteral damage, 2 underwent primary ureter repair (ureteroureterostomy), 2 underwent ureteroneocystostomy (UNC), and 1 underwent permanent bilateral nephrostomy. While 4 of them were diagnosed intraoperatively, 1 was diagnosed with CT urography after hydronephrosis developed on the 6th postoperative day. The other primary ureter repair was performed during the surgery for the ovary, which was completely attached to the rectum and uterus during the colectomy. During low anterior resection, a full-thickness incision was made in the ureter at the point where it crosses the left iliac artery. In the mid-ureter damage caused by LigaSure during both colectomies, the damaged ureter ends were excised and anastomosed with polyglactin sutures under the guidance of a double J guide, and ureteroureterostomy was performed.

Ureteroneocystostomy was performed in both patients who underwent ligation of the right distal ureter. In the first patient, in whom polar artery variation was observed in the right kidney, the ureter, which was ligated during uterine artery ligation, was understood to have dilated during retroperitoneal lymph dissection. In the other patient who underwent UNC, the diagnosis was made on the 6th day. The diagnosis was made by CT urography due to the discharge of clear fluid (700-1000 cc per day from drain), hydronephrosis in the kidney, and an increase in the creatinine value in the drain. It was understood that the ureter was ligated while closing the vaginal cuff during radical hysterectomy. In the postoperative follow-up of the patientkidney loss developed, with the right kidney function decreasing to 7% in the 8th month although she had undergone nephrostomy.

The last patient is a patient with recurrent cervical cancer who underwent anterior exenteration for central recurrence. In this patient, the right ureter was completely excised due to tumor invasion, and the remaining ureter tissue after the tumor tissue was excised on the left, again due to tumor invasion. It was not long enough for ureterocutanostomy, so the patient underwent bilateral permanent nephrostomy.

The location of damage, type of damage, time of diagnosis, and treatment according to the complication that occurred are shown in **(Table 3).**

The average length of hospitalization was found to be 11 days (4-29). Patients who underwent ureteral repair were followed for at least 1 month with a double J stent catheter. The average follow-up period was 11 months (3-19). One of the patients died in the 2nd month after surgery due to complications related to cervical cancer. The patient with cervical cancer who underwent UNC developed renal failure in the 8th month after the surgery, while no complications related to the urological operation were observed in the other patients. The patients' hospitalization periods, postoperative follow-up, and prognoses are shown in **(Table 4).**

Discussion

Gynecological malignancy surgeries involving the pelvic, abdominal, and retroperitoneal regions are operations that may be complicated by iatrogenic urological injuries. In cancer surgeries, urological complications are the second most common type after bowel injuries [4]. Reasons such as anatomical proximity, the tumor distorting the anatomy or invading the tissue itself, the need for a larger resection to remove the entire tumor, and tissue adhesion due to radiotherapy may cause iatrogenic injury anywhere in the urinary tract extending from the kidney to the urethra. The type of gynecological tumor most frequently associated with urological damage was cervical cancer (42.8%) and ovarian cancer the least (5%), as in the literature. Costantini et al. experienced urological damage at a rate of 12.9%-48.5% in cervical cancer and 1.7%-25.4% in ovarian cancer, with a higher incidence of recurrences [5].

The most frequently damaged organ in iatrogenic urinary system injuries is the bladder [6]. The incidence is 0.2-1.8% in female pelvic surgery, 2.3% in radical hysterectomy, and 4.5% in cytoreductive surgery. Likewise, it is 4.5% in oncological laparoscopic and robotic surgeries [1]. In our cases, no urinary injury was observed in those surgeries performed by laparoscopy. In those performed by laparotomy, bladder and ureter injuries were seen at equal rates (4.5%). One of the patients had both bladder and ureter injuries in the same surgery.

The way the damage occurs, to which layer of the bladder it extends, its location, and most importantly the time of diagnosis completely affect the treatment.

Unlike ureteral injuries, iatrogenic bladder injuries are frequently diagnosed intraoperatively (80% of cases). Bladder injuries can be diagnosed by directly observing the incision, urine extravasation, the visibility of the catheter, or demonstration of leakage with saline/methylene blue [7]. In the postoperative period, diagnosis is made by imaging. In our cases, all but one bladder injury was diagnosed and treated intraoperatively. The bladder injury we noticed in the postoperative period was our most serious case in this group, a patient with recurrent cervical cancer. A defect in the posterior trigone was observed in the cystoscopy performed after postoperative renal pelvicaliectasis. Bladder repair was performed by relaparotomy, but healing of the edematous, fibrotic, and malnourished tissue led the patient to acute renal failure. Although the major factor in the poor prognosis of the patient, who died from septic shock after 2 months, is considered to be adhesions and tissue nutrition deterioration due to previously applied radiotherapy, the

Table 3. Type and location of the damage, time of diagnosis and treatment

	Location	Type of damage	Time of diagnosis	Treatment
Bladder	Bladder dome, full thickness 3 cm.	Sharp dissection	Intraoperative	Double layer primary suture
Bladder	Bladder dome, full thickness 2 and 4 cm.	Sharp dissection	Intraoperatifve	Double layer primary suture
Bladder	Bladder dome serosa	Blunt dissection	Intraoperative	Single layer primary suture
Bladder	Bladder trigon posterior 2 cm.	Dissection	Postoperative 3rd day	Double layer primary suture
Bladder	Bladder dome full thickness 2 cm.	Sharp dissection	Intraoperative	Double layer primary suture
Ureter	Left mid ureter	LigaSure injury	Intraoperative	Ureteroureterostomy
Ureter	Right mid ureter	LigaSure injury	Intraoperative	Ureteroureterostomy
Ureter	Right distal ureter	Ligation	Intraoperatif	UNC
Ureter	Right distal ureter	Ligation	Postoperative 6th day	UNC
Ureter	Bilateral ureters are short	Dissection	Intraoperative	Bilateral permanent nephrostomy

UNC: ureteroneocystostomy

Table 4. Hospitalization and follow-up process of urological complications according to surgical indications

Indication	Surgery	Urinary injury	Treatment	Hospitalisation	DJ stent time	Follow up time	Follow up result
Ovarian CA	Debulking	Bladder	Double layer primary suture	4 days	-	8 months	No complication
Ovarian CA	Debulking	Ureter	Ureteroureterostomy	8 days	6 weeks	3 months	No complication
Recurrent ovarian CA	Debulking	Ureter Bladder	Ureteroureterostomy Double layer primary suture	13 days	6 weeks	14 months	No complication
Endometrium CA	Debulking	Bladder	Single layer primary suture	5 days	-	10 months	No complication
Endometrium CA	Debulking	Ureter	UNC	7 days	4 weeks	15 months	No complication
Cervix CA	Meigs radical hysterectomy	Ureter	UNC	14 days	12 weeks	19 months	Right kidney postoperative 8th month 7% functional
Recurrent Cervix CA	Anterior pelvic exenteration	Ureter	Bilateral permanent nephostomy	13 days	-	11 months	Recurrency
Recurrent Cervix CA	Debulking (type 1 hysterectomy, recurrent mass excision)	Bladder	Double layer primary suture	29 days	-	2 months	Postoperative 70th day ex
Vaginal agenesis	Stumph excision	Bladder	Double layer primary suture	6 days	-	14 months	No complication

BOT: borderline ovarian tumor; TAH BSO: total abdominal hysterectomy bilateral salpingooopherectomy; LAR: low anterior resection; CA: carcinoma; DJ: double J stent

localization of the damage also appears as a negative factor in tissue healing.

In trigonal or infratrigonal injuries, the involvement of the ureter and urethra makes repair difficult [8]. In this case, the healing of the damage close to the trigone was delayed due to the effect of the patient's additional complications. Bladder injuries in other cases were close to the bladder dome and were treated at the time of surgery.

It is also important whether the damage is limited to the serosa, extends to the full thickness, or was caused by energy. Although it is more common in ureter damage than in the bladder due to energy use, the use of cautery in areas close to the bladder wall may cause fistula formation as a late complication [6]. Primary sutures can be applied in serosal injuries, and small lesions can also be treated conservatively with a Foley catheter. However, in cases of full-thickness damage, surgical intervention is necessary. No thermal damage to the bladder was observed in our cases. Generally, damage occurred during blunt and sharp dissection. While serosa damage was repaired with simple sutures, cases with full-thickness damage were sutured separately in 2 layers with polyglactin sutures in cooperation with the urology clinic. The mucosa and detrusor muscle were repaired with 3/0, and the serosa was repaired with 2/0 Vicryl. Bladder catheterization was performed after 1 week of cystogram control.

Conditions in which the normal anatomy is disrupted, such as previous abdominal surgery, radiotherapy, endometriosis, and large tumoral mass, are risk factors for ureteral damage [7]. Ureteral dilatation detected intraoperatively may be an indication that the ureter is ligated. In the postoperative period, pain, nausea/vomiting, and ileus may be the result of ureteral damage. Ureteral damage develops in 5% of cases undergoing oncological surgery [9]. The widespread use of laparoscopic interventions in gynecology has caused the emphasis on iatrogenic ureteric injuries to shift from urology to gynecology. While 64% of ureteral injuries are seen in laparoscopic gynecological cases, 11% are seen in urological cases, and the rest are seen in other open surgical procedures [10]. The risk is higher especially in laparoscopic radical hysterectomies. Hwang et al. found that the odds ratio of urological complication risk is 1.97 [11]. In our experience, no ureteral damage was observed in laparoscopic cases. The surgeon's experience in this regard is the most important factor. Ureter damage occurred in 4.5% of the patients who underwent laparotomy. Three of these cases were seen in debulking surgeries with widespread tumor burden, and 2 were seen in surgeries of patients with cervical cancer, which has a very close relationship with the ureter.

While most bladder injuries are intraoperative, only one-third of ureter injuries are recognized intraoperatively [12]. These injuries occur during dissection adjacent to the uterine artery, at the level of the uterovesical junction or infundibulopelvic ligament, and sometimes within or adjacent to the tumor tissue [8,13]. However, the most common injury is seen in the lower third. Especially, 63% of the ureteric injuries are seen in the distal 5 cm of the ureter [14]. While ureteroureterostomy is performed through end-to-end anastomosis in upper and middle

ureter injuries, UNC is performed in distal-end injuries. In our cases, ureteroureterostomy was performed in 2 cases with mid-ureteral damage, and UNC was performed in 2 cases with distal ureteral damage. In the last ureteric injury, since both ureters were quite short, we couldn't perform an ileal pouch, which is the safest procedure of pelvic exenteration. Such a continent urinary diversion improves quality of life if the ureteric length is sufficient [15]. While one patient who underwent UNC was diagnosed on the 6th postoperative day, the others were diagnosed intraoperatively and operated on.

There are more urological complications in radical hysterectomies than in other surgeries. The Meigs operation was performed in a late-diagnosed UNC patient with cervical cancer, and relaparotomy was performed on the 6th postoperative day. It was observed that the ureter was ligated at the bladder level during cuff suturing. If the diagnosis is made within 1-2 weeks postoperatively, it can be operated again [11]. In cases diagnosed after 1 week, if the injury is incomplete, it is more appropriate to postpone the operation for 6-8 weeks to ensure stent application or tissue healing [10].

The way the damage occurs and the degree of damage (whether it is complete or partial) are also important in the treatment [6]. Since there may be more damage than is visible in energy-related damage, how much damaged tissue should be excised is important. While surgical intervention is required for full-thickness damage, the patient can be followed with a stent for partial damage. In our patients, the damage to the mid-ureter was a full-thickness incision with ligation, and the damage to the distal ureter was a partial injury caused by suture ligation. We think that injuries caused by ligation are mostly due to rapid intervention during bleeding from the bone.

Since ureteral injuries progress more silently, symptoms may occur later. While treatment success is better in bladder injuries, post-treatment follow-up is important in ureter injuries. Regular follow-up is essential to ensure the continuity of the passage and to prevent late complications that may occur. However, we currently lack sufficient data regarding postoperative follow-up after ureteral injury repair [9]. While no problems were observed in the follow-up of the patients in whom we performed ureteroureterostomy, loss of kidney function developed in the cervical cancer patient in whom we performed UNC in the 8th postoperative month.

While this type of surgical approach may be effective in bladder and ureter injuries, the major risk factors are the presence of an oncological case and the surgeon's experience. Previous surgeries, radiotherapy, and distortion of anatomy also increase the risk of complications. The most important factor for ureteric damage, which has recently tended to increase in laparoscopic surgeries, is surgical experience. To reduce the risk of complications during the learning phase, it may be beneficial to undertake endoscopic surgery with an experienced team, especially in oncological cases. It is very important to detect complications early because, while injuries detected intraoperatively have the chance to be treated in the same surgery, morbidity and permanent damage may be greater in cases detected late. Careful intraoperative exploration and dissection, ectasias in the kidneys in the postoperative period, the quality and amount of drain fluid, deterioration of renal functions, chemical peritonitis, or ileus should be warnings for us.

Conclusion

Gynecological oncological surgeries and urological complications are closely related. Every surgeon dealing with gynecological oncology must be familiar with urological anatomy and master the management of complications. Preoperative multidisciplinary evaluation should be carried out thoroughly, and even the tumor-ureter relationship should be determined by radiology. If major surgery is to be performed, ureterolysis should be performed by monitoring the ureteral traces. Since it is not possible to completely eliminate complications, it is important to diagnose them early and manage them appropriately. Since there is no direct symptom that indicates urinary damage at an early stage, diagnosis is made when a complication is suspected. Careful dissection and vigilance can reduce urological complications in oncological cases.

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References

[1] Naser O, O'Connor E, Greenwell TJ. Urological complications following gynaecological surgery. Obstetrics, Gynaecology & Reproductive Medicine 2022;32(12):272-81. https://doi.org/10.1016/j.ogrm.2022.09.002

[2] Cunningham KG, Karam JA. Management of Urologic Complications in Gynecologic Oncology Surgery. In: Ramirez PT, Frumovitz M, Abu-Rustum NR, editors. Principles of Gynecologic Oncology Surgery, Philadelphia: Elsevier; 2018, p.259-71.

[3] Mendez LE. Iatrogenic injuries in gynecologic cancer surgery. Surg Clin North Am 2001;81(4):897-923. https://doi.org/10.1016/s0039-6109(05)70173-0

[4] Purwoto G, Dalimunthe BE, Kekalih A, Aditianingsih D, Mazni Y, Wahyudi I, et al. Complications of ovarian cancer surgery in Dr. Cipto Mangunkusumo National Referral Hospital, Jakarta: A cross-sectional study. Ann Med Surg (Lond) 2022;77:103581.
https://doi.org/10.1016/j.amsu.2022.103581

[5] Costantini B, Vizzielli G, Fanfani F, D'Addessi A, Ercoli A, Avenia N, et al. Urologic surgery in gynecologic oncology: a large single-institution experience. Eur J Surg Oncol 2014;40(6):756-61.
https://doi.org/10.1016/j.ejso.2014.01.020

[6] Vorobev V, Beloborodov V, Golub I, Frolov A, Kelchevskaya E, Tsoktoev D, et al. Urinary system ıatrogenic ınjuries: problem review. Urol Int 2021;105(5-6):460-69.
https://doi.org/10.1159/000512882

[7] Esparaz AM, Pearl JA, Herts BR, LeBlanc J, Kapoor B. Iatrogenic urinary tract injuries: etiology, diagnosis, and management. Semin Intervent Radiol 2015;32(2):195-208.
https://doi.org/10.1055/s-0035-1549378

[8] Ziogou A, Giannakodimos A, Giannakodimos I, Manikas A, Ziogos E. Urological injuries following gynecologic surgery: clinical manifestations, diagnosis and management. HJOG 2024;23(1):1-13.
https://doi.org/10.33574/hjog.0545

[9] Lecointre L, Buttignol M, Faller E, Boisrame T, Martel C, Host A, et al. Urological procedures performed by gynecologists: Activity profile in a gynecological surgery department, 10-year observation cohort. Eur J Obstet Gynecol Reprod Biol 2023;288:204-10.
https://doi.org/10.1016/j.ejogrb.2023.07.015

[10] Abboudi H, Ahmed K, Royle J, Khan MS, Dasgupta P, N'Dow J. Ureteric injury: a challenging condition to diagnose and manage. Nat Rev Urol 2013;10(2):108-15.
https://doi.org/10.1038/nrurol.2012.254

[11] Hwang JH. Urologic complication in laparoscopic radical hysterectomy: meta-analysis of 20 studies. Eur J Cancer 2012;48(17):3177-85.
https://doi.org/10.1016/j.ejca.2012.06.006

[12] Lee JS, Choe JH, Lee HS, Seo JT. Urologic complications following obstetric and gynecologic surgery. Korean J Urol 2012;53(11):795-9.
https://doi.org/10.4111/kju.2012.53.11.795

[13] Capozzi VA, Monfardini L, Scarpelli E, Barresi G, Rotondella I, De Finis A, et al. Urologic complication after laparoscopic hysterectomy in gynecology oncology: a single-center analysis and narrative review of the literature. Medicina (Kaunas) 2022;58(12):1869.
https://doi.org/10.3390/medicina58121869

[14] Martin A, Wells A, Anderson ML, Chern JY, Rutherford TJ, Shahzad MM, et al. Trends in ureteral surgery on an academic gynecologic oncology service. Gynecol Oncol 2021;163(3):552-6.
https://doi.org/10.1016/j.ygyno.2021.10.009

[15] Houvenaeghel G, Moutardier V, Karsenty G, Bladou F, Lelong B, Buttarelli M, et al. Major complications of urinary diversion after pelvic exenteration for gynecologic malignancies: a 23-year mono-institutional experience in 124 patients. Gynecol Oncol 2004;92(2):680-3.
https://doi.org/10.1016/j.ygyno.2003.11.003

Case Report – Reconstructive Urology
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A Rare Case Report of Infertility Due to a Giant Hair-bearing Urethral Stone in a Urethral Diverticulum

Üretral Divertikülde Saçlı Dev Üretral Taşa Bağlı Nadir Bir İnfertilite Olgu Sunumu

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Abstract

Urethral stones are rare, accounting for less than 1% of all urinary system stones. These stones may present with obstructive symptoms or remain asymptomatic. Hair-bearing urethral diverticula, which can form after surgical interventions such as hypospadias repair, are an uncommon cause of urethral stone formation. However, urethral stones leading to infertility are extremely rare.

A 38-year-old male patient presented to the urology outpatient clinic with complaints of infertility. Physical examination revealed a palpable mass in the penoscrotal region. Further evaluations and imaging identified this mass as a urethral stone within a hair-bearing urethral diverticulum. The patient's history revealed a childhood hypospadias repair. Open surgery was performed for stone removal and diverticulectomy. Semen analysis at the six-month postoperative follow-up showed an improvement in semen volume from 1 ml preoperatively to 2.5 ml, reaching normal levels. Additionally, nine months after the procedure, the patient's spouse was confirmed to be pregnant. Long-term follow-up revealed no postoperative complications.

This case highlights the importance of considering urethral pathologies in infertile patients with a history of urethral surgery. Such conditions can be effectively treated with open surgery, potentially restoring fertility.

Keywords: urethral stone, urethral diverticulum, hairy urethra, case report

Özet

Üretra taşları, üriner sistem taşlarının %1'inden azını oluşturan nadir taşlardır. Bu taşlar obstrüktif semptomlarla ortaya çıkabileceği gibi asemptomatik de kalabilir. Hipospadias onarımı gibi cerrahi müdahaleler sonrasında oluşan saçlı üretra divertikülleri üretra taşı oluşumuna neden olabilecek nadir sebeplerdendir. Üretra taşlarının infertiliteye neden olması ise oldukça nadirdir.

İnfertilite şikayeti ile üroloji polikliniğine başvuran 38 yaşında erkek hastanın muayenesinde penoskrotal bölgede ele gelen oluşum tespit edildi. İleri değerlendirmeler ve görüntülemerle bu oluşumun üretra divertikülü içindeki saçlı üretra taşından kaynaklandığı tespit edildi. Hastanın hikayesinden çocukluk döneminde hipospadias onarımı operasyonu geçirdiği anlaşıldı. Taşın çıkarılması ve divertikülün eksizyonu için açık cerrahi yapıldı. Operasyon öncesi 1 ml olan semen hacminin, operasyon sonrası altıncı ay takibinde yapılan semen analizinde normale döndüğü (2,5 ml) görüldü. Operasyondan dokuz ay sonra ise hastanın eşinin gebe kaldığı öğrenildi. Uzun dönem takipte hastada herhangi bir komplikasyon görülmedi.

Bu olgu, üretral cerrahi öyküsü olan infertil hastalarda üretral patolojilerin dikkate alınmasının önemini vurgulamaktadır. Bu durum açık cerrahi ile etkili bir şekilde tedavi edebilir ve potansiyel olarak fertiliteyi geri kazandırabilir.

Anahtar kelimeler: üretra taşı, üretra divertikülü, saçlı üretra, olgu sunumu

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Introduction

Urethra is a rare location for urinary system stones, accounting for less than 1% of all cases [1]. The majority of urethral stones are found in the posterior urethra [2]. These stones can be asymptomatic, but they may also present with obstructive symptoms, recurrent urinary tract infections, and even acute renal failure [3, 4]. One of the rare causes of urethral stones is urethral diverticula, which can occur as long-term complications after hypospadias repair [4]. While hypospadias surgery is the most common cause of acquired diverticulum in children, it is not the leading cause in adults [5]. Diverticula that develop following hypospadias repair, especially when flaps from the scrotum or penile skin are used, may contain hair-bearing urethra. The stones found in these hair-bearing urethral diverticula can grow to very large sizes and may be asymptomatic. In the existing literature, there have been no reports of urethral stones causing infertility. Additionally, only one documented case of infertility caused by a urethral diverticulum has been reported, and that involved a congenital diverticulum. Our case, involving a secondary diverticulum with a giant urethral stone leading to infertility, presents a unique scenario that has not been previously described. To our knowledge, this is the first case report of urethral stone in a urethral diverticulum causing infertility. We present the following case in accordance with the CARE reporting checklist.

Case

A 38-year-old male patient presented to the clinic with complaints of infertility. He reported that despite engaging in unprotected intercourse for two years, he had not been able to have a child. The patient's medical history revealed that he had undergone right orchiopexy and hypospadias repair surgery at the age of five. Physical examination revealed a subglandular urethral meatus and a significant reduction in the volume of the right testis. Additionally, a palpable formation of approximately 4 cm was detected in the midline at the junction of the scrotum and the penile shaft. Upon further questioning, the patient indicated that this mass had been present for years, but he had never sought medical attention for it. Aside from post-micturition dribbling, the patient reported no other lower urinary tract symptoms. Semen analysis revealed low sperm volume (1 ml). Ultrasound targeting the midline formation revealed a calcified lesion approximately 3 cm in diameter, located extratesticularly near the base of the penis, casting a posterior shadow. Magnetic resonance imaging at the level of the penile root showed a well-defined lesion measuring 30x36 mm, hypointense on T1 and T2-weighted images, non-enhancing on post-contrast sequences, and hypointense on fat-suppressed sequences. Retrograde urethrography revealed a well-defined opacity of approximately 4 cm at the level of the penile root, with contrast material surrounding the opacity **(Figure 1a).** Urethroscopy confirmed the presence of a hairy urethral diverticulum with a stone inside **(Figure 1b).** However, no urethral stricture was observed distally to the diverticulum. It was understood that the patient had undergone hypospadias repair at the age of five using an onlay flap from scrotal skin. Open surgery was planned to remove the stone and repair the diverticulum. The operation began with a vertical incision at the penoscrotal junction. The diverticulum was accessed, and the stone, covered with hair, was removed through a vertical incision **(Figure 1c).** The excess tissue in the diverticulum was excised, and the urethral lumen was restored to its normal calibration **(Figure 1d).** The remaining hair follicles in the urethral tissue were ablated using a holmium laser. The urethra was closed in a single layer over a 20 fr urethral catheter using 4-0 Vicryl sutures **(Figure 1e).** The urethral catheter was removed on the

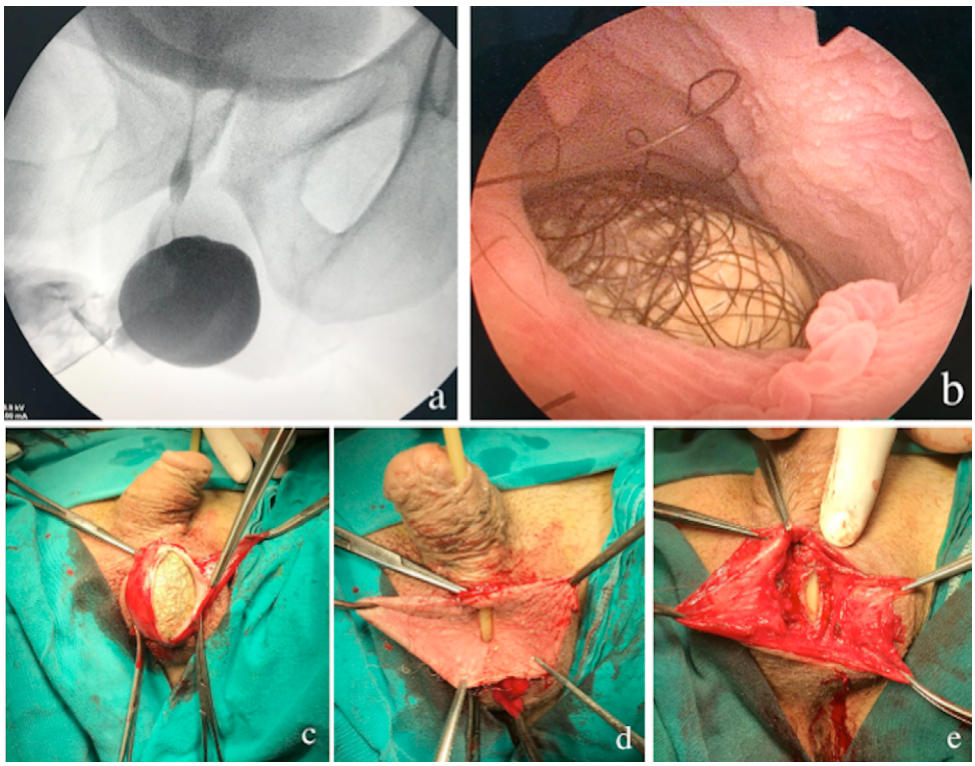

Figure 1. (a): retrograde urethrogram showing a urethral diverticulum and an intradiverticular stone (b): urethroscopy image displaying the hair-bearing urethral stone (c): urethral diverticulum containing the stone in open surgery (d): view of the urethral diverticulum before excision of the excess tissue (e): image after excision of excess tissue, showing the urethra restored to normal calibration

21st postoperative day. After the catheter removal, the patient was instructed to support the surgical site with his finger during urination for three months. At the 6-month follow-up, the patient's semen analysis showed normal sperm parameters and a semen volume of 2.5 ml. The patient experienced no lower urinary tract symptoms, and by the 9th month post-surgery, his wife had become pregnant, indicating the restoration of fertility. Four years after the operation, the patient continues to remain free of any urinary symptoms.

Discussion

The urethra is the least common region for stones within the urinary system. Due to its longer length and anatomical narrowings, urethral stones are more often seen in males. Most urethral stones originate from the kidneys and bladder; however, they can also develop secondary to urethral pathologies like strictures and diverticula [1, 2, 4]. Since the urethra is the terminal part of the urinary system, stones in this region often cause symptomatic obstruction, making large urethral stones relatively rare. Urethral stones generally present with lower urinary tract symptoms such as obstructive complaints, hematuria, recurrent urinary tract infections, and post-void dribbling. However, in cases of stones associated with hairy urethral diverticulum, the situation may differ; these stones can grow significantly over time while remaining asymptomatic. The asymptomatic nature of these stones may be due to the gradual development over the years, leading patients to perceive the minor changes as normal.

Male urethral diverticula are quite rare, with 90% being secondary diverticula [6]. Both primary and secondary types are most commonly found in the penoscrotal region, as in our case [7]. Secondary urethral diverticula are mainly caused by factors that increase intraurethral pressure and lead to fibrosis, scar formation, and necrosis, such as previous surgeries, strictures, infections, and trauma [8]. One significant type of surgery that may result in diverticula is hypospadias repair, where 10–15% of cases develop diverticula as complications, and up to 8% present with a hairy urethra when skin flaps are used [9,10]. In hairy urethral diverticula, stones can grow significantly without causing symptoms [4]. Turbulent flow within the diverticulum leading to stasis and hair within the diverticulum acting as a nidus might play a role in stone development [5].

In the literature, there is only one reported case of a urethral diverticulum causing infertility, and in that case, the diverticulum was congenital [11]. What makes our case even more unique is that the diverticulum in our patient is secondary and, despite containing a giant stone, did not cause any lower urinary tract symptoms that would prompt a urological consultation. Instead, it presented solely as infertility, making this case highly unusual and noteworthy. It was thought that during the expulsion phase of ejaculation, the entire ejaculate could not pass through the diverticulum and the associated stone. The absence of a urethral stricture and an increase in ejaculate volume from 1 ml pre-treatment to 2.5 ml post-treatment supports this hypothesis.

The treatment of urethral stones depends on their size, shape, location, and underlying cause. Small urethral stones are mostly treated using minimally invasive methods like milking, forceps extraction, urethral lithotripsy, or push-back with lithotripsy in the bladder. However, in the case of a urethral diverticulum and associated hairy urethral stone, the treatment becomes more complex. These stones can grow to significant sizes, making endoscopic treatment insufficient. Xie et al. demonstrated successful treatment in 16 patients with hairy urethral stones secondary to hypospadias repair. Their approach included open surgery for stone removal, excision of the excess diverticular tissue, laser epilation of the remaining hairy urethral area, and repair with a buccal mucosal graft if a stricture was present. Additionally, to prevent postoperative fistula formation at the surgical site, they used a technique where the skin incision was made lateral to the stone while the diverticulum containing the stone was incised at the midline [4]. Similarly, we performed an open repair in our patient. However, since there was no stricture, we did not use a buccal mucosal graft, and both the skin incision and diverticulum incision were made at the midline. Moreover, no fistula development was observed in our patient at the 4-year postoperative follow-up.

Hairy urethral diverticula with stone formation is a rare condition, particularly following hypospadias repair. Our case highlights that such stones can be asymptomatic yet cause complications like infertility. Due to the size and complexity of these stones, open surgical intervention is often required. In our patient, successful treatment without postoperative complications, such as fistula formation, was achieved with a tailored surgical approach. This case underscores the importance of considering urethral stones in patients with a history of urethral surgery and atypical symptoms, and it demonstrates the potential for positive outcomes with individualized treatment and follow-up.

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References

[1] Verit A, Savas M, Ciftci H, Unal D, Yeni E, Kaya M. Outcomes of urethral calculi patients in an endemic region and an undiagnosed primary fossa navicularis calculus. Urol Res 2006;34(1):37-40. https://doi.org/10.1007/s00240-005-0008-2

[2] Kamal BA, Anikwe RM, Darawani H, Hashish M, Taha SA. Urethral calculi: presentation and management. BJU Int 2004;93(4):549-52. https://doi.org/10.1111/j.1464-410x.2003.04660.x

[3] Bielawska H, Epstein NL. A stone down below: a urethral stone causing acute urinary retention and renal failure. CJEM 2010;12(4):377-80. https://doi.org/10.1017/s1481803500012501

[4] Xie L, Li S, Li Q. Surgical treatment and prevention of recurrence of urethral calculi associated with hairballs after urethroplasty. Urol Int 2013;91(3):256-60. https://doi.org/10.1159/000353101

[5] Snyder CL, Evangelidis A, Snyder RP, Ostlie DJ, Gatti JM, Murphy JP. Management of urethral diverticulum complicating hypospadias repair. J Pediatr Urol 2005;1(2):81-3. https://doi.org/10.1016/j.jpurol.2004.10.001

[6] Griggs-Demmin A, Patel S, Faisal F, Saoud C, Salimian K, Cohen A. Acquired male urethral diverticulum complicated by calculi: a case report. Urol Case Rep 2021;39:101837. https://doi.org/10.1016/j.eucr.2021.101837

[7] Allen D, Mishra V, Pepper W, Shah S, Motiwala H. A single-center experience of symptomatic male urethral diverticula. Urology 2007;70(4):650-3. https://doi.org/10.1016/j.urology.2007.06.1111

[8] Thakur N, Sabale VP, Mane D, Mullay A. Male urethral diverticulum uncommon entity: our experience. Urol Ann 2016;8(4):478-482. https://doi.org/10.4103/0974-7796.192094

[9] Bhat A, Mandal AK. Acute postoperative complications of hypospadias repair. Indian J Urol 2008;24(2):241-8. https://doi.org/10.4103/0970-1591.40622

[10] Crain DS, Miller OF, Smith L, Roberts JL, Ross EV. Transcutaneous laser hair ablation for management of intraurethral hair after hypospadias repair: initial experience. J Urol 2003;170(5):1948-9. https://doi.org/10.1097/01.ju.0000091657.32531.69

[11] Shuzhu C, Min W, Weijing Y, Yidong L. Congenital urethral diverticulum with infertility in an adult man and review of the literature. Springerplus 2016;5(1):1867. https://doi.org/10.1186/s40064-016-3545-y

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Detection of an Adrenal Adenoma on 18F-Fluorocholine PET/CT in a Patient with Prostate Cancer

Prostat Kanserli Bir Hastada 18F-Florokolin PET/BT'de Adrenal Adenom Tespiti

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Abstract

18F-Fluorocholine PET/CT is a valuable imaging tool in prostate cancer evaluation, especially for detecting biochemical recurrence. However, false-positive results, including benign adrenal adenomas, may occur. We present a case of a 62-year-old male with treated prostate cancer, who underwent 18F-FCH PET/CT due to biochemical recurrence. The scan showed focal uptake in the prostatic bed but also unexpectedly identified a 13x14 mm hypodense mass in the left adrenal gland. MRI suggested an adrenocortical adenoma, which was confirmed histologically. While adrenal radiotracer uptake is well-documented with other radiotracers, 18F-FCH role in characterizing adrenal lesions remains underexplored. This case raises the potential for 18F-FCH PET/CT to help distinguish benign from malignant adrenal tumors, warranting further investigation.

Keywords: adrenal adenoma, 18F-Fluorocholine, PET/CT, prostate cancer

Özet

18F-Florokolin PET/BT prostat kanserinin değerlendirilmesinde, özellikle biyokimyasal nüksün saptanmasında değerli bir görüntüleme aracıdır. Ancak, benign adrenal adenomlar da dahil olmak üzere yanlış pozitif sonuçlar ortaya çıkabilir. Bu yazıda, tedavi edilmiş prostat kanseri olan ve biyokimyasal nüks nedeniyle 18F-FCH PET/BT uygulanan 62 yaşında bir erkek olgu sunulmuştur. Tarama prostatik yatakta fokal tutulum gösterdi, ancak beklenmedik bir şekilde sol adrenal bezde 13x14 mm hipodens bir kitle tespit edildi. MRG, histolojik olarak doğrulanan bir adrenokortikal adenomu düşündürmüştür. Adrenal radyotracer tutulumu diğer radyotracerlerle iyi belgelenmiş olsa da, 18F-FCH'nin adrenal lezyonları karakterize etmedeki rolü yeterince araştırılmamıştır. Bu vaka, 18F-FCH PET/BT'nin benign ve malign adrenal tümörlerin ayırt edilmesine yardımcı olma potansiyelini ortaya koymaktadır ve daha fazla araştırmayı gerektirmektedir.

Anahtar kelimeler: adrenal adenom, 18F-Fluorocholine, PET/BT, prostat kanseri

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Introduction

Prostate cancer (PC) is among the most common malignancies in men, underscoring the importance of early detection and surveillance for effective management. Imaging plays a pivotal role in diagnosing, staging, and monitoring PC, particularly in identifying recurrence post-treatment. 18F-Fluorocholine (18F-FCH) PET/CT has emerged as a key modality in this context, leveraging the heightened choline metabolism characteristic of prostate cancer cells. This metabolic shift, driven by upregulated choline transporters and increased choline kinase activity, leads to the accumulation of radiolabeled choline in malignant tissue [1].

18F-FCH PET/CT demonstrates high diagnostic accuracy in detecting local recurrences and distant metastases, especially in patients with rising prostate-specific antigen (PSA) levels, thereby guiding therapeutic decisions [2]. Its superiority over conventional imaging is evident in cases where other modalities fail to identify recurrence [3]. However, false-positive results remain a challenge, as non-malignant conditions such as benign adrenal adenomas can mimic malignancy.

Adrenal incidentalomas, asymptomatic adrenal masses discovered incidentally, are increasingly identified due to widespread cross-sectional imaging use. These lesions occur in up to 10% of the general population, with benign adenomas comprising 50-70% of cases [4]. In PC patients, distinguishing adrenal adenomas from rare metastases is critical, as management differs markedly: benign lesions typically require no intervention, whereas malignancies may necessitate surgery or systemic therapy [5].

Case

A 62-year-old male with a history of prostate cancer was referred to our department for evaluation of biochemical recurrence following a progressive rise in PSA to 2.53 ng/mL. The patient had undergone radical prostatectomy in 2015, with a pathological staging of pT2cN0M0 and a Gleason score of 7 (3+4). His preoperative PSA was 14 ng/mL. The initial postoperative PSA was undetectable. However, in 2016, a biochemical recurrence was detected, prompting treatment with adjuvant external beam radiation therapy. Following this intervention, PSA levels remained stable and undetectable until 2023, when a new elevation was observed, suggestive of recurrent disease. The patient had no significant comorbidities and no clinical signs of metastatic spread. In this context, an FCH PET/CT was performed due to its local availability and the patient's PSA level being above 2 ng/mL, a threshold at which FCH PET/CT has demonstrated good sensitivity for the detection of recurrent prostate cancer. After intravenous administration of 240 MBq of 18F-FCH and a 60-minute uptake period, imaging from the skull base to mid-thigh revealed a focal area of increased radiotracer uptake in the prostatic bed (SUVmax:8.2), consistent with local recurrence. No evidence of distant metastases was observed in typical sites (lymph nodes, bones), suggesting localized disease amenable to targeted therapy.

Notably, the scan also identified an incidental 13×14 mm hypodense mass in the left adrenal gland with moderate 18F-FCH uptake (SUVmax:5.1) **(Figure 1).** While this finding raised suspicion for malignancy, adrenal metastases from

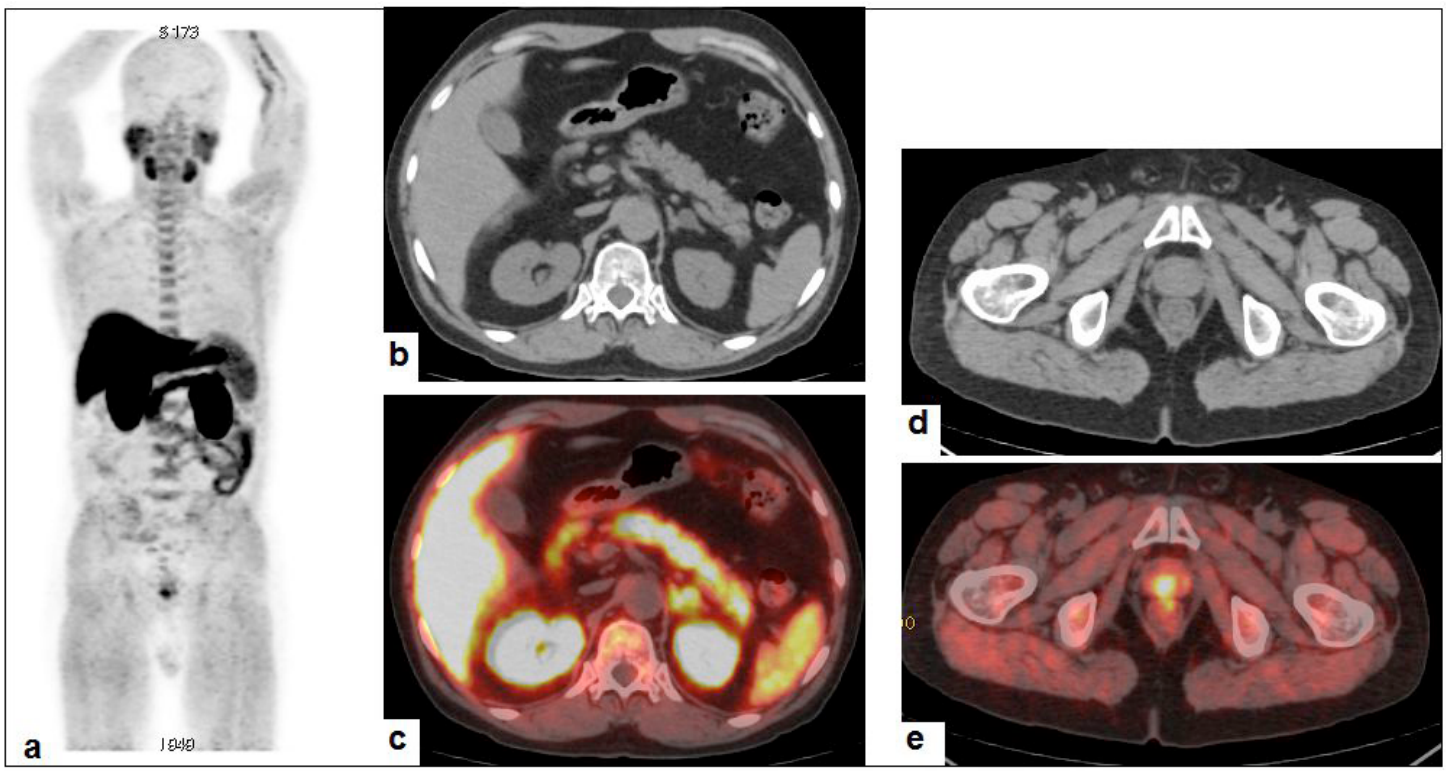

Figure 1. An incidental hypodense mass measuring 13×14 mm in the left adrenal gland

prostate cancer are rare, and 18F-FCH uptake in adrenal lesions is nonspecific. Further evaluation with contrast-enhanced MRI demonstrated a classic washout pattern (50% delayed-phase washout), favoring a benign adrenocortical adenoma. Percutaneous biopsy confirmed the lesion as a benign adrenal adenoma, characterized histologically by well-differentiated cortical cells without malignant features.

Discussion

Adrenal incidentalomas are increasingly encountered in clinical practice due to the widespread use of advanced modalities like PET/CT, CT, and MRI. These lesions pose a significant diagnostic challenge, particularly in patients with a history of malignancy, as they necessitate differentiation between benign entities and rare malignancies. This diagnostic dilemma is exemplified in the case of a PC patient undergoing 18F-FCH PET/CT for biochemical recurrence, where a metabolically active adrenal adenoma initially raised suspicion for metastasis. Adrenal incidentalomas occur in up to 10% of the general population [4], with benign adenomas comprising 50-80% of cases [6]. However, in cancer patients, their discovery demands careful evaluation to exclude metastasis. In PC, adrenal metastases are rare compared to bone or lymph node involvement, yet their possibility in advanced disease underscores the need for thorough characterization [7]. While 18F-FCH PET/CT is highly sensitive for detecting PC recurrence (leveraging cancer cells' upregulated choline metabolism via choline kinase/transporters), its specificity for adrenal lesions is limited. Benign adenomas may exhibit radiotracer uptake due to metabolic activity linked to lipid turnover or membrane synthesis, creating overlap with malignancy. This ambiguity necessitates a multimodal approach: CT and MRI provide critical anatomical and functional data, while biopsy remains definitive for inconclusive cases [8].

Imaging features help distinguish benign from malignant lesions. Benign adenomas typically appear well-circumscribed and homogeneous on CT, with rapid contrast washout, whereas malignancies often display irregular margins, heterogeneous enhancement, and delayed washout [9]. Despite moderate 18F-FCH uptake in the presented case, the adrenal mass's hypodense CT appearance and 50% MRI washout favored a benign adenoma, later confirmed histologically. Management of adrenal incidentalomas in cancer patients hinges on lesion size, functionality, and imaging characteristics. Small (<4 cm), non-functional lesions with benign features can be monitored, while suspicious lesions may require resection [10]. In this case, conservative management sufficed, avoiding unnecessary surgery. The growing role of 18F-FCH PET/CT in oncology highlights its dual utility and limitations: while invaluable for detecting PC recurrence, its nonspecific adrenal uptake underscores the need for complementary techniques. Future research should prioritize integrating advanced MRI with PET/CT and elucidating molecular mechanisms of radiotracer uptake in adenomas to refine diagnostic specificity. Such advances could mitigate diagnostic uncertainty and optimize patient outcomes in this evolving clinical landscape.

Conclusion

This case highlights the necessity of a multimodal diagnostic approach for evaluating adrenal incidentalomas, particularly in oncology patients. While 18F-FCH PET/CT is highly sensitive for detecting recurrent prostate cancer, its specificity in characterizing adrenal lesions remains limited, with inherent risks of false-positive interpretations. Accurate diagnosis requires integrating functional imaging with anatomical modalities such as contrast-enhanced CT and MRI, alongside histopathological confirmation when ambiguity persists.

In prostate cancer patients, adrenal masses demand meticulous clinical and imaging evaluation to distinguish metastatic disease from benign etiologies like adenomas, a critical step to avoid unnecessary interventions. Multidisciplinary collaboration, guided by evidence-based protocols, ensures balanced decision-making, optimizes patient outcomes, and minimizes risks of misdiagnosis or overtreatment.

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References

[1] Vali R, Loidl W, Pirich C, Langesteger W, Beheshti M. Imaging of prostate cancer with PET/CT using (18)F-Fluorocholine. Am J Nucl Med Mol Imaging 2015;5(2):96-108. https://pubmed.ncbi.nlm.nih.gov/25973332/

[2] Kim DY, Lee WW, Song YS, Hong SK, Byun SS, Kim JS. Detection of recurrence sites using 18F-fluorocholine PET/CT in prostate cancer patients with PSA failure. Prostate Int 2023;11(2):69-75. https://doi.org/10.1016/j.prnil.2022.11.001

[3] Paymani Z, Rohringer T, Vali R, Loidl W, Alemohammad N, Geinitz H, et al. Diagnostic performance of [18F] Fluorocholine and [68Ga] Ga-PSMA PET/CT in prostate cancer: a comparative study. J Clin Med 2020;9(7):2308. https://doi.org/10.3390/jcm9072308

[4] Sherlock M, Scarsbrook A, Abbas A, Fraser S, Limumpornpetch P, Dineen R, et al. Adrenal Incidentaloma. Endocr Rev. 2020;41(6):775–820. https://doi.org/10.1210/endrev/bnaa008

[5] Chatzellis E, Kaltsas G. Adrenal Incidentaloma. [Updated 2024 May 28]. In: Feingold KR, Anawalt B, Blackman MR, et al., editors. Endotext [Internet]. South Dartmouth (MA): MDText.com, Inc.; 2000-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK279021/

[6] Bracci B, De Santis D, Del Gaudio A, Faugno MC, Romano A, Tarallo M, et al. Adrenal lesions: a review of imaging. diagnostics (Basel) 2022;12(9):2171. https://doi.org/10.3390/diagnostics12092171

[7] Sakellakis MJ, Hahn AW, Ramachandran S, Zhang M, Hoang A, Song JH, et al. Characterization of prostate cancer adrenal metastases: dependence upon androgen receptor signaling and steroid hormones. Prostate Cancer Prostatic Dis 2023;26(4):751-8. https://doi.org/10.1038/s41391-022-00590-x

[8] Calabria F, Chiaravalloti A, Schillaci O. (18)F-choline PET/CT pitfalls in image interpretation: an update on 300 examined patients with prostate cancer. Clin Nucl Med 2014;39(2):122-30. https://doi.org/10.1097/RLU.0000000000000303

[9] Korobkin M, Brodeur FJ, Francis IR, Quint LE, Dunnick NR, Londy F. CT time-attenuation washout curves of adrenal adenomas and nonadenomas. AJR Am J Roentgenol 1998;170(3):747-52. https://doi.org/10.2214/ajr.170.3.9490968

[10] Fassnacht M, Tsagarakis S, Terzolo M, Tabarin A, Sahdev A, Newell-Price J, et al. European Society of Endocrinology clinical practice guidelines on the management of adrenal incidentalomas, in collaboration with the European Network for the Study of Adrenal Tumors. Eur J Endocrinol 2023;189(1):G1-G42. https://doi.org/10.1093/ejendo/lvad066