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CONTENTS
İÇİNDEKİLER

Original Research
Özgün Araştırma

In Vivo Evaluation of the Chemical Composition of Urinary Stones Using Non-Contrast Helical Computerized Tomography 38-45
İdrar Taşlarının Kimyasal Bileşiminin Kontrastsız Helikal Bilgisayarlı Tomografi ile In Vivo Değerlendirilmesi
Osman Raif Karabacak, Fatih Sandıkçı, Hakan Saltas, Alper Dilli, Kürşad Zengin, Fatih Yalçınkaya, Ümit Yaşar Ayaz

The Influence of Pain and Anxiety on the Pain Perception and Outcome of Extracorporeal Shockwave Lithotripsy 46-51
Ağrı ve Anksiyetenin Ağrı Algısı ve Ekstrakorporeal Şok Dalgası Litotripsi Sonucu Üzerindeki Etkisi
Nihat Türkmen, Cemil Kutsal

Intraoperative Assessment of Stone Free Status for Percutaneous Nephrolithotomy Surgery: Surgeon's Eye 52-60
Perkütan Nefrolitotomi Ameliyatında Taşsızlığın İntraoperatif Değerlendirilmesi: Cerrahın Gözü
Mehmet Yiğit Yalçın, Batuhan Ergani, Taha Çetin, Mustafa Karabıçak, Mert Hamza Özbilen, Çağdaş Bildirici, Erkin Karaca, Mehmet Yoldaş, Erdem Kısa, Tufan Süelözgen, Gökhan Koç, Özgür Çakmak, Hayal Boyacıoğlu, Yusuf Özlem İlbey

Comparison of Open Radical Cystectomy vs Robot-Assisted Radical Cystectomy Perioperative Outcomes and Complications at a Single Center. An Analysis of Matched Pairs 61-68
Tek Merkezde Açık Radikal Sistektomi ile Robot Yardımlı Radikal Sistektominin Perioperatif Sonuçları ve Komplikasyonlarının Karşılaştırılması: Matched-pair Analiz
Harun Özdemir, Emin Taha Keskin, Merve Şam Özdemir, Metin Savun, Halil Lütfi Canat, Abdülmüttalip Şimşek

The Effects of Pelvimetric Measurements on the Operation Time of Open Retropubic Radical Prostatectomy 69-74
Pelvimetrik Ölçümlerin Açık Retropubik Radikal Prostatektomi Operasyon Süresi Üzerine Etkileri
Mustafa Aydın, Lokman İrkılata, Mustafa Koray Kırdağ, Uğur Öztürk, Mehmet Özen, Emrah Küçük, Hakan Yıldız, Reha Ordulu, Mustafa Kemal Atilla

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Original Article
Özgün Araştırma

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In Vivo Evaluation of The Chemical Composition of Urinary Stones Using Non-Contrast Helical Computerized Tomography

İdrar Taşlarının Kimyasal Bileşiminin Kontrastsız Helikal Bilgisayarlı Tomografi ile In Vivo Değerlendirilmesi

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ÖZET

Amaç: Düşük doz helikal bilgisayarlı tomografi kullanılarak böbrek taşlarının yoğunluğunun ve kimyasal yapısının belirlenmesi.

Gereç ve Yöntemler: Çalışmamıza; böbrek taşı nedeniyle ekstrakorporeal şok dalga litotripsisi (ESWL) yapılacak veya üriner sistem taş cerrahisi geçirmesi planlanan, böbrek veya üreter taşı olan 79 hasta dahil edildi. Tüm taş yoğunlukları, Hounsfield Ünite olarak düşük doz abdominal kontrastsız helikal bilgisayarlı tomografi incelemesi ile ölçüldü. Bilgisayarlı tomografi incelemesi için 4 dedektörlü Marconi MX 8000 sistemi kullanıldı. Tüm taşların analizlerinde X-Ray difraktometri kullanıldı.

Bulgular: Taş tipi 52 hastada tek tip ve 27 hastada mikst taş olarak bulundu. Karışık taşlar içinde en büyük grubu, 17 hasta ile kalsiyum oksalat monohidrat-dihidrat taşları oluşturdu. Ürik asit taşları en düşük, kalsiyum oksalat monohidrat taşları en yüksek yoğunluğa sahip olarak bulundu. Ürik asit ve sistin taşlarının dansite değerleri ile diğer taş çeşitleri arasındaki fark istatistiksel olarak anlamlıydı.

Sonuç: Teşhiste kullanılan kontrastsız helikal bilgisayarlı tomografi, taş kompozisyonunun in vivo tayininde de kullanılabilir. Uygun terapötik alternatifler sağlamak için görüntüleme çalışmaları ile taş kompozisyonlarını tanımlamak çok yardımcı olabilir.

Anahtar Kelimeler: *taş, yoğunluk, tomografi, sarmal, hounsfield ünitesi*

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This study was approved by the University of Health Sciences, Ankara Yıldırım Beyazıt Dışkapı Education and Research Hospital Ethical Committee (Approval Number: 34, Date: 2009-06-30). All research was performed in accordance with relevant guidelines/regulations, and informed consent was obtained from all participants.

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ABSTRACT

Objective: To determine the density and chemical structure of renal stones by using in vivo low dose helical computerized tomography (CT).

Material and Methods: 79 patients with urinary stones such as renal or uretheral stones were included in our study who were going to have extracorporeal shock wave lithotripsy (ESWL) or planned to go through urinary stone surgery due to renal stones. All stone densities were measured in Hounsfield Unit by low dose abdominal non-contrast helical computed tomography examination. Marconi MX 8000 CT system with 4 detectors was used for the CT examination. X-Ray diffractometry was used in the analyses of all stones.

Results: The stone type was found to be pure type in 52 patients, and mixed stone in 27 patients. The largest group among the mixed stones included whewellite stone with 17 patients. Uric acid stones had the smallest, whewellite stones had the highest density. The difference between the density values of uric acid and cystine stones and the other stone types were statistically significant.

Conclusion: Non-contrast helical computed tomography used in the diagnosis can also be used in the in vivo determination of the stone composition. It can be very helpful to define stone compositions by imaging studies to provide suitable therapeutic alternatives.

Keywords: *stone, density, tomography, helical, hounsfield unit*

INTRODUCTION

Urolithiasis is an important health problem that affects all societies. Its prevalence and incidence have been increasing worldwide (1). Thus, along with the diagnosis and treatment of urolithiasis, the prevention of recurrences should also be considered. One of the most important parameters in the assessment of the urolithiasis patients is the determination of the stone composition. Information about the chemical structure of the stone guides non-invasive, minimal treatment approaches. Stone analysis is generally performed after stone extraction. However, determination of in vivo stone composition is also important for some groups of patients, e.g. extracorporeal shock wave lithotripsy (ESWL), patient evaluation. In vivo stone composition determination has been a recent procedure, predominantly done using helical computed tomography (CT) (2). Several studies on in vitro and in vivo stone composition determination have reported that non-contrast helical CT (NCHCT), which is currently the mainstay of stone diagnosis, can be used to predict the mineral type of urinary stones on the basis of their attenuation coefficient (3). With this, it is possible to predict the stone type, and to direct the treatment to break the stone before ESWL, performing chemoprophylaxis, evaluating the patients, and managing diet. We aimed to determine in vivo chemical structure of urinary stones using NCHCT, and to correlate our results with x-ray diffractometry results.

MATERIAL AND METHODS

Between 2010 and 2013, 79 patients suffering from stone diseases with urinary stones such as renal or uretheral stones were included in the study conducted prospectively. First of all, patients were informed about the planned study. Afterwards, the study was initiated after "obtaining informed consent" from the patients. The study ethics approval was obtained from the ethics committee of the University of Health Sciences, Ankara Yıldırım Beyazıt Dışkapı Training and Research Hospital, "Ethics declarations date and number: 30.06.2009-34". The patients were planned to be treated with ESWL or percutaneous stone surgery at our clinic.

For all patients, pre-operative preparation was applied including blood count, and urine analysis, coagulation parameters, and biochemistry. Biochemistry included glucose, urea, creatinin, alanine aminotransferase, aspartate aminotransferase analyses. Metabolic evaluation was utilized in the stonelessness periods of the patients. Also, plain abdominal graphy, abdominal CT, and when necessary renal ultrasonography was performed preoperatively. Patients having renal stones of sizes ≥5 mm (5-37 mm) were included

in the study. Ultrasonography and/or plain abdominal graphy were applied for stone diagnosis. Philips MX 8000, 4-detector helical CT was used for stone localization and stone density determination. Technical parameters for enhanced abdominal scan were as follows: Pitch values 1.75/1, reference tube current 80 mA, tube voltage 120 kVp, slice thickness 1.6 mm, and acquisition slice thickness 3.2 mm. The dose used in stone protocol was 5.5 mGy which is 9.3 mGy in routine abdominal CT. For each stone, Hounsfield unit (HU) measurements were taken from the largest possible area for each stone determining a region of interest. Measurements were taken in bone window from three different regions from the stone center and the adjacent regions with the cross sections increased 4 times. The HU value which was the average of the three measurements was considered as base for the study. The impact of stone size on the accuracy of the measurement of stone density was evaluated using the largest sample group, calcium oxalate monohydrate (COM) stones (n=37) which were grouped into three as 5-14 mm, 15-25 mm, and >25 mm in diameters. Stone analysis was performed with Philips PW 3710/1830 X-Ray diffractometry device at 2.5-40°.

Inclusion and Exclusion Criterias

The treatment methods that we can obtain fragmented stones are ESWL and percutaneous nephrolithotomy (PCNL). Due to the necessity of stone analysis, patients who underwent ESWL and PCNL were included in our study. Stone fragments are difficult to obtain in patients undergoing RIRS, as the stone fragments are dusted. Therefore, these patients were not included in the study. Patients with contraindications for ESWL and PCNL treatment such as pregnancy, bleeding diathesis, skeletal deformity, arterial aneurysm in close proximity to the stone, and kidney tumor were excluded from the study. Stones smaller than 5 mm and bladder stones were also excluded from the study. After ESWL and PNL treatment, patients with stone analysis results were included in the study.

Statistical Analysis

Data was analyzed using SPSS 15.0 version. X-ray attenuation mean values of the stone types were compared in HU using Kruskal Wallis (test was applied due to lack of Normal distribution and common/same variance assumptions) and for comparsion aim of the results One-way ANOVA tests at 95% confidence level was also applied. And non-significant correlation between stone size and density in COM stones was found out by using Spearman test. The correlation between Maximum Density and Mean Density was evaluated using regression model.

RESULTS

Mean age of 79 patients was 44 (6-78), of whom 46 were male and 33 female, with stone diseases such as renal or ureteral stones. We classified the urinary stones obtained into two groups according to their chemical composition as pure and mixed stones (Table 1). Pure stone group included five types: COM, Calcium oxalate dihydrate (COD), cystine, struvite, and uric acid. Mixed stone group included four types: COM-CaP (COM-Calcium phosphate), COM-COD, and COM-whitlockite. In the evaluation of the stone densities, uric acid stone had the lowest density, whereas COM-whitlockite stone had the highest (Table 1).

The analysis of x-ray attenuation values revealed that the densities of cystine and uric acid stones were significantly different than the other stone types whereas there was no difference between the densities of cystine and uric acid stones. No statistically significant difference was observed between the densities of COM, COD, and struvite stones (Table 2). Since the components of the mixed stones may affect the density of the stone, they were not included in the comparison.

The effect of stone size on density was evaluated in the largest group COM stones, and no difference was found between the density values according to the stone size. There was not any significant correlation between stone size and stone density in the regression analysis. However, there was a linear correlation between maximum density and mean density which was %88.5 (Figure 1). The significance of the regression model was shown using ANOVA test (Table 3).

Table 1. Stone type and density

Pure Stone	n	Mean Density (HU)	Min.-Max. Density (HU)	Mixed Stone	Mean Density (HU)	n	Min.-Max. Density (HU)
COM	37	945	715-1420	**whewellite-Weddellite**	804	17	730-1339
COD	3	811	742-1210	**whewellite-Uric acid**	804	5	475-1117
Uric acid	5	414	359-645	**whewellite-Dahlite**	1068	3	1035-1285
Cystine	5	523	412-810	**whewellite-Whitlockite**	1247	2	830-1540
Struvite	2	915	840-1140				
Total	**52**					**27**	

HU; Hounsfield unit, ***COM;*** calcium oxalate monohydrate, ***COD;*** calcium oxalate dihydrate,

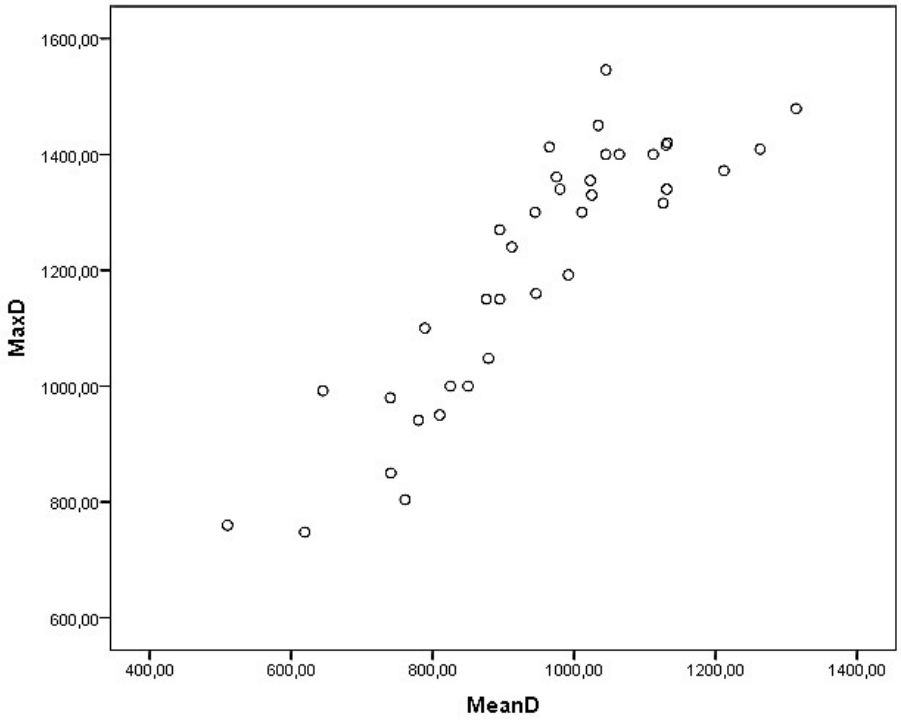
Table 2. Mean differences between stone types in Hounsfield Units

Stone Type	Stone Type Compared	Mean Difference	p
whewellite	Weddellite	134.86486	0.634
	Uric acid	531.86486	0.000
	Cystine	422.86486	0.000
	Struvite	30.86486	0.999
Weddellite	whewellite	-134.86486	0.634
	Uric acid	397.00000	0.012
	Cystine	288.00000	0.121
	Struvite	-104.00000	0.954
Uric acid	whewellite	-531.86486	0.000
	Weddellite	-397.00000	0.012
	Cystine	-109.00000	0.821
	Struvite	-501.00000	0.005
Cystine	whewellite	-422.86486	0.000
	Weddellite	-288.00000	0.121
	Uric acid	109.00000	0.821
	Struvite	-392.00000	0.042
Struvite	whewellite	-30.86486	0.999
	Weddellite	104.00000	0.954
	Uric acid	501.00000	0.005
	Cystine	392.00000	0.042

Table 3. HU density values of whewellite stones according to stone size.

Stone Size (mm)	n	Max. Density (HU)	Mean Density (HU)
5-14	16	1160.5	910.3
15-25	13	1175.8	913.1
>25	8	1353	1070
p		p=0.104	p=0.082
Total	37	1207	945.8

Figure 1. Linear correlation between maximum density and mean density values of whewellite stones



DISCUSSION

The chemical structure of the stone determines the stone fragmentation by different techniques such as ESWL and laser (4-6). COM and cystine stones are resistant to breakage whereas COD and uric acid can easily be fragmented. Until recently, the stone composition has been determined after the stone was extracted. However, knowing the stone composition before treatment would be to the benefit of both the patient (for preventing the suffering), and the clinic (for saving time and budget) (7). NCHCT has high sensitivity, it is performed in vivo with low dose radiation, and provides information about the chemical composition of the stone preoperatively (6,8). For these reasons, it replaced the excretory urography (9). It is seen in literature that the studies have been conducted both in vivo and in vitro. The studies conducted using NCHCT have continued with dual energy CT.

Demirel and Suma applied NCHCT to 160 patients with acute flank pain to clarify the presence of urinary stone, and to determine the chemical composition of the stone (10). They reported that the highest density was seen in calcium oxalate (CaOx) stones which were followed by struvite and uric acid stones. Since there were not any cystine or brushite stones in their study, they did not comment on those. They concluded that the stone compositions could be distinguished on the basis of their HU densities. In our study, the highest density was found in COM-whitlockite, a mixed stone. The highest density in pure stones was measured in COM stone. The densities of pure stones were as COM>struvite>COD>cystine >uric acid.

El-Assmy et al. (11) scanned stones obtained from patients using 80 kV and 120 kV, determined the densities for chemical composition, and fragmented the stones in vitro by shock wave lithotripsy. They evaluated the correlations between HU density and fragmentation. They found statistically significant difference between uric acid and COM, struvite and mixed stones. They did not find any significant difference between struvite and COM, and mixed stone, and concluded that dual CT did not contribute to what have already been known. In our study with in vivo NCHCT, we did not find any statistically significant difference between the density values of uric acid and cystine stones and other stones which is consistent with the results of El-Assmy et al. The advantage of our study is that since it is in vivo, it can be used in the diagnosis and programming of the treatment.

In the stone composition determination with tomography, use of dual CT different from NCHCT is quite common with a considerably large literature. Hidas et al. (12) used in vivo dual CT in their study

in which they determined three pure stone types as uric acid, cystine, and CaOx. According to the x-ray diffractometry and tomography results, there was correlation in calcium and uric acid stones, whereas no correlation was found in the cystine stones. From this finding, it can be concluded that the accurate results obtained for the determination of CaOx and uric acid stones are not true for the determination of the cystine stone. Our study revealed that the densities of the uric acid and cystine stones were significantly different than the other stone types. When comparing the uric acid and cystine stones, no significant difference was found between their densities. We found the densities from the lowest to the highest HU value as uric acid<cystine<struvite<CaOx. This is similar to the results of Hidas et al. except that our method is more advantageous for the reasons that the patients are exposed to less radioactive beam, and the method has low cost because the evaluations are made using the CT which is originally used for diagnostic purposes.

Wisenbaugh et al. (13) evaluated the urinary stones using conventional and dual CT, and found that the HU values of the uric acid stones were significantly different than that of CaOx, and the HU values of cystine, struvite and CaOx stones overlapped. Thus, it could be suggested that the accurate determination of all urinary stones except uric acid may not be possible with dual CT similarly with the NCHCT used in our study. Unlike Wisenbaugh et al, Erdogan et al. (14), who also used dual-energy CT, for invivo analysis of urinary. Dual-energy CT analysis results are compared with in vitro stone analysis results, the stone types could be predictable correctly in 32 (91.4%) patients and detected incorrectly in 3 (8.6%) patients. Especially uric acid and cystine stones were predictable by 100% sensitivity, specificity, and diagnostic accuracy rate. Although it shows that dual CT is superior due to its high predictive rating, its excessive radioactive exposure and cost-effectiveness make it difficult to choose Dual CT.

Mostafavi et al. (15) reported that single-energy CT at 120 kV is efficient in differentiating the most common type of stones (struvite, cystine, and calcium oxalate) whereas dual-energy CT is needed to differentiate the stones with similar densities. They were able to determine the chemical composition of pure stones and found the attenuation values to range from 409 HU for uric acid and 1703 HU for brushite. In our study, the lowest density was 359 HU in uric acid stones, and the highest density was 1546 HU in a mixed stone composed of COM and whitlockite which is a phosphate stone. Similar to a number of studies, our study did not reveal any cystine stone with HU density value of 1000 or higher from which it could be concluded that during the evaluation of the cystine stone it should be kept in mind that its density does not exceed 1000 HU (16,17). In our study, 80% of uric acid stones and 60% of cystine stones had the attenuation values lower than 600 HU, and 20% of uric acid stones and 40% of cystine stones had the attenuation values between 600 and 900 HU.

Grosjean et al. (18) examined the attenuation values of 241 urinary stones in 4 different CT scanners and showed significant differences in CT attenuation values in different voltages in different scanners. Thus, it should be kept in mind that the data obtained at a particular center for the stone composition are the data obtained from that center's CT scanner and have similar collimation values. Our study was carried out using a single machine and same technical features (e.g. collimation and slice values), thus the HU values obtained could be considered as specific to our clinic.

Urinary stones with the same compositions may have different densities. The reason for this may be the use of different CT equipment, degree of collimation, energy setting, and stone size (4, 19). In the evaluation of stone densities using CT, stone composition and slice ranges are considered to be more important than the stone size (20). Stewart et al (21), in their study where they examined the relationship between the stone size and stone composition using HU, found that the stone size limits the determination of the stone composition. In our study, we kept the CT slice range constant, and evaluated Caox stone densities according to stone size only. We found that although there was an increase in the max and mean densities with the increase in stone sizes, the correlation between the densities of stones and stone sizes was statistically insignificant.

It is also difficult to do classification in mixed stones because of the probability of density overlap as the dominant component changes the density of the mixture. We found the density range of the mixed stones between 730 and 1546 HUs. COM-phosphate stone had the highest density, while COM-uric acid

stone had the lowest density due to the influence of uric acid. Thus, the identification of the stone types in mixed stones by tomography is difficult. In the present study, there was no statistically significant difference among the densities of the mixed stones.

In these studies, the most powerful decision can be made about the uric acid stones whereas it is difficult to differentiate the other stone types. In our study conducted in vivo using 120 kV, uric acid stones were successfully differentiated from the CaOx stones. We believe that the low dose helical CT is more feasible than dual CT for the prevention of patients from higher doses of radiation. Besides, helical CT has an advantage as it can be used in both diagnosis and the programming of the treatment.

Limitations

Stone analyzes are performed by patients at a different institution upon their own application. This limits the number of patients included in the study. It is known that CT attenuation values are different at different voltages with different devices. Therefore, different devices and larger number of patients may affect the results of our study. It is also difficult to classify mixed stones as the dominant component changes the density of the mixture. Therefore, it is difficult to determine the stone types by tomography in mixed stones. In such studies, the increase in mixed type stones affects the data of the study.

CONCLUSION

Our results suggest that the NCHCT performed for diagnostic purposes can also be used for the determination of the chemical composition of the stone. For some stone types, the limitations of both methods (dual CT and helical CT) are similar in the accurate determination of the stone composition. The NCHCT, which is used for diagnostic purposes, is more advantageous as it does not put an additional cost, produce similar results with other tomography methods such as dual CT, prevents higher doses of radiation exposure, and saves time.

Abbreviations:

CT : Computerized tomography
COM : Calcium oxakate monohydrate
COD : Calcium oxalate dihydrate
CaOx : Calcium Oxalate
CaP : Calcium phosphate
ESWL : Extracorporeal shock wave lithotripsy
HU : Hounsfield unit
NCHCT : Non contrast helical computerized tomography

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Ethical Approval: The study was approved by the Ethics Committee of University of Health Sciences, Ankara Yıldırım Beyazıt Dışkapı Education and Research Hospital (Approval Number: 34, Date: 2009-06-30). The study protocol conformed to the ethical guidelines of the Helsinki Declaration.

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Original Article
Özgün Araştırma

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The Influence of Pain and Anxiety on the Pain Perception and Outcome of Extracorporeal Shockwave Lithotripsy

Ağrı ve Anksiyetenin Ağrı Algısı ve Ekstrakorporeal Şok Dalgası Litotripsi Sonucu Üzerindeki Etkisi

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ÖZET

Amaç: Bu çalışmada ekstrakorporal şok dalgası litotripsi (ESWL) öncesi var olan depresyon ve anksiyetenin ESWL sırasında ağrı algısı üzerine etkisini araştırmayı amaçladık.

Gereç ve Yöntemler: Ekim 2019 ile Kasım 2020 tarihleri arasında ESWL uygulanan toplam 60 böbrek taşı hastası çalışmaya alındı. Hastaların yaşı, cinsiyeti, vücut kitle indeksi (VKİ) ve taş parametreleri kaydedildi. Hastanın anksiyete ve depresyon durumları ilk seans öncesi Hastane Anksiyete ve Depresyon Ölçeği (HADÖ) ile değerlendirildi. Ağrı düzeyi birinci seanstan sonra görsel analog skala (VAS) kullanılarak değerlendirildi.

Bulgular: Anksiyete, depresyon ve VAS puanları arasında istatistiksel olarak anlamlı fark yoktu (p>0,05). Anksiyete ve depresyon puanları ile işlem başarısı arasındaki ilişki de değerlendirildi ve anlamlı bir ilişki bulunmadı (p>0,05). Ayrıca VAS skoru ile hastanın yaşı, cinsiyeti, VKİ, deriden taşa uzaklığı ve taş boyutu arasında ilişki yoktu (p>0,05).

Sonuç: Sonuçlarımız, ESWL öncesi depresyon veya anksiyete ile işlem sonrası ölçülen VAS skoru arasında anlamlı bir ilişki göstermemektedir.

Anahtar Kelimeler: *anksiyete, ekstrakorporeal şok dalgası litotripsi, ağrı algısı, üriner taş hastalığı*

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This study was approved by the Ethics Committee of Health Sciences University Şişli Etfal Hospital, dated 10.01.2023 and number 3779. All research was performed in accordance with relevant guidelines/regulations, and informed consent was obtained from all participants.

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ABSTRACT

Objective: In this study, we aimed to investigate the effect of depression and anxiety presented before extracorporeal shockwave lithotripsy (ESWL) on pain perception during ESWL.

Material and Methods: A total of 60 kidney stone patients who underwent ESWL between October 2019 and November 2020 were enrolled in the study. Patients' age, sex, body mass index (BMI), and stone parameters were recorded. The patient's anxiety and depression states were evaluated using the Hospital Anxiety and Depression Scale (HADS) before the first session. The pain level was assessed by using the visual analog scale (VAS) after the first session.

Results: There was no statistically significant difference between the anxiety, depression, and VAS scores ($p>0.05$). The association between anxiety and depression scores and the procedure's success was also evaluated, and no significant association was found ($p>0.05$). Furthermore, there was no association between VAS score and patient's age, sex, BMI, the distance from skin to stone, and stone size ($p>0.05$).

Conclusion: Our results do not show a significant correlation between pre-ESWL depression or anxiety with the VAS score measured after the procedure.

Keywords: *anxiety, extracorporeal shockwave lithotripsy, pain perception, urinary stone disease*

INTRODUCTION

Extracorporeal shockwave lithotripsy (ESWL) was introduced in the early 1980s and became the first-line treatment for renal calculi less than 20 mm in diameter (1). The most significant advantage of the procedure can be applied without general anesthesia in an outpatient clinic. However, the success rate varies range from 33% to 91%. It depends on the stone size, location, and hardness as well as lithotripter, operator, and patient (2).

In the early years of ESWL, the procedure was needed general anesthesia to perform. Due to technical improvement, the pain levels were reduced. However, despite the improvement of the lithotripters, ESWL is still considered a painful procedure. Furthermore, many authors suggest that pain may affect the outcome of ESWL due to pain-induced movements and excessive respiratory excursions (3). Moreover, the unbearable pain levels can limit the optimal dose of energy (4).

The generally accepted opinion is that pain negatively affects the success of ESWL. It is thought that involuntary movements and irregular breathing caused by pain make it difficult for the operator to focus on the stone. Therefore, predicting the success of ESWL will prevent repetitive procedures and reduce hospital costs (5). However, there are no reliable data to confirm the direct effect of pain and anxiety on the success rate of ESWL. Therefore, we conducted a study to evaluate the impact of pain and anxiety on the stone-free rates of ESWL.

MATERIAL AND METHODS

Patient Selection Criteria

A total of 60 kidney stone patients who underwent ESWL between October 2019 and November 2020 were enrolled in the study. The sample size was calculated based on a previous study by assuming an error of 0.05, a 1-b error of 0.2 (power of 80%) (6). Informed consent was obtained from all patients, and the study was approved by the University of Health Sciences Ethical Committee with the reference number 3779. Patients' age, sex, body mass index (BMI), and stone parameters were recorded. The patients who cannot use non-steroidal anti-inflammatory drugs, have urinary tract infections, use psychiatric drugs, and have an absolute contraindication to ESWL were not included in the study. Furthermore, the patients with multiple or bilaterally stones were excluded from the study.

Extracorporeal Shockwave Lithotripsy

For pain control, all patients received diclofenac sodium 75mg SR (Dikloron, Deva; Istanbul, Turkey) 15

mins before the procedure, intramuscularly. The patient's anxiety and depression states were evaluated using the Hospital Anxiety and Depression Scale (HADS) before the first session. The pain level was assessed using the visual analog scale (VAS) after the first session (7). All patients received 1-3 sessions of ESWL according to their response to treatment. ELMED Multimed Classic lithotripter (ELMED, Ankara, Turkey) electrohydraulic system was used for the procedures. The initial energy level was determined as 7 KV, and it was adjusted according to the patient and increased up to a maximum of 21 KV. Each patient was administered 3000 shock waves, delivering 60 shock waves per minute at every session.

Statistical Analysis

Data were analyzed using software (SPSS, Version 23.0; IBM Corp, Armonk, NY). The Kolmogorov-Smirnov normality test was performed to determine the distribution. Afterward, Mann Whitney U test was used to evaluate the association between the success of the ESWL and the HADS scores. Furthermore, Kruskal -Wallis test was used to compare the anxiety, depression, and VAS scores, and the results were reported as the mean and the standard deviation (±SD). Spearman test was used to evaluate the correlation between VAS score, anxiety, and depression subgroups. The statistical significance was set at $P < 0.05$.

RESULTS

A total of 60 patients were included in the study. Patients' characteristics, stone parameters, VAS, anxiety, and depression scores were shown in Table 1.

The correlation between the severity of anxiety, depression, and VAS score was shown in Table 2. There was no significant correlation between the subgroups. Moreover, there was no statistically significant difference between the anxiety, depression, and VAS scores (p=0.069, p=0.802) (Table 3). The association between anxiety and depression scores and success of the procedure were also evaluated, and no significant association was found (p=0.127, p=0.809). Furthermore, there was no association between VAS score and patient's age (p=0.362), sex (p=0.201), BMI (p=0.437), the distance from skin to stone (p=0.98), and stone size (p=0.442).

Table 1. Patients and stone characteristics (n=60)

Age ± SD		44.5 ± 14.19
Sex (%)	Female	17 (28.3%)
	Male	43 (71.7%)
BMI ± SD		26.93 ± 5.37
Stone size (mm) ± SD		12.87 ± 5.71
Anxiety score ± SD		6.06 ± 4.03
Depression score ± SD		5.43 ± 3.12
VAS score ± SD		4.47 ± 2.91

SD: *standard deviation;* ***BMI:*** *body mass index;* ***VAS:*** *Visual Analogue Scale*

Table 2. Correlation between the severity of anxiety, depression, and VAS score

		Number (%)	VAS score ± SD	p-value	r value
All patients		60 (100%)	4.47 ± 2.91		
Anxiety	Mild	39 (65%)	3.90 ± 0.457	0.883	-0.024
	Moderate	11 (18.3%)	4.91 ± 0.899	0.519	0.218
	Severe	10 (16.7%)	6.20 ± 0.800	0.667	-0.156
Depression	Mild	47 (78.3%)	4.43 ± 0.430	0.66	0.112
	Moderate	10 (16.7%)	4.90 ± 0.994	0.452	0.627
	Severe	3 (5%)	3.67 ± 1.20	N/A	N/A

SD: *standard deviation;* ***VAS:*** *Visual Analogue Scale.*

Table 3. Comparison between the severity of anxiety, depression, and VAS score

		Number (%)	VAS score ± SD	p-value
All patients		60 (100%)	4.47 ± 2.91	
Anxiety	Mild	39 (65%)	3.90 ± 0.457	0.069
	Moderate	11 (18.3%)	4.91 ± 0.899	
	Severe	10 (16.7%)	6.20 ± 0.800	
Depression	Mild	47 (78.3%)	4.43 ± 0.430	0.802
	Moderate	10 (16.7%)	4.90 ± 0.994	
	Severe	3 (5%)	3.67 ± 1.20	

SD: *standard deviation;* ***VAS:*** *Visual Analogue Scale.*

DISCUSSION

Pain perception is an objective condition that depends on physiological as well as psychological factors (7,8). Therefore, some authors aimed to investigate the effects of anxiety and depression on pain perception in ESWL patients (4,9,10). However, these studies contradict each other. For example, Franceschi et al. (9) showed that anxiety does not affect pain perception. However, Vegnolles et al. (4) reported that patients who are more prone to depression and anxiety have lower pain thresholds. On the other hand, the results of our study showed that depression and anxiety, which were presented before ESWL, did not have a significant effect on the VAS score.

In the literature, similar studies used various forms to evaluate depression and anxiety. Spielberger et al. (11) used the State-Trait Anxiety Inventory (STAI), Zigmond et al. (12) used Hospital Anxiety and Depression Scores (HADS), and Altok et al. (13) used Depression, Anxiety and Stress Scales (DASS-42) form. We used the HADS form in our study, which is a self-reported form and includes 14 questions. With this form, we could evaluate anxiety and depression simultaneously. It also has cut-off values to assess the severity of anxiety and depression. Therefore, we suggest that the HADS form is a convenient method to evaluate these subjects.

The feeling of pain that occurs during ESWL occurs in two ways. The first is due to the shock waves hitting the cutaneous and subcutaneous structures and generate pain. The second is due to distension of the kidney capsule or obstruction of the ureteropelvic junction by fragmented stones. Furthermore, the type of ESWL machine, shockwave voltage and number, stone size and location, age, sex, and BMI may affect the severity of the pain during ESWL (8,9). Moreover, anxiety and pain perception might increase with the number of ESWL sessions (10).

Therefore, in this study, we evaluated VAS and HADS scores based on the first session. However, literature has contradictory data about this topic. Vegnolles et al. (4), Tokgoz et al. (10), and Berwin et al. (14) reported that female patients felt more pain than male patients and therefore needed higher doses of analgesia. However, Salinas et al. (15) and Tailly et al. (16) did not find any significant relationship between sex and pain perception. Vegnolles et al. (4) and Tokgoz et al. (10) suggested no significant relationship between BMI and pain perception. However, Berwin et al. (14) reported that the higher the BMI value, the more pain the patients felt.

Moreover, while Berwin et al. (14) showed that the pain felt did not increase with increasing stone size, and number, Tailly et al. (16) suggested that these two variables significantly affected pain perception. In addition to all these findings, we found that VAS scores tend to increase with the BMI and stone size; however, there was no statistically significant correlation between VAS scores and these factors. Previous studies evaluated the correlation between the frequency, shock wave voltage, and pain perception (14,15). However, we did not investigate these factors because we use the same machine at the same frequencies and energy.

The study has several limitations that need to be addressed. First, VAS is a subjective method to assess pain perception. Therefore, reliability is low. The second is that the HADS scale, which is self-reported form and has low reliability. The last limitation is pain perception itself. Pain perception is highly subjective and depends on many independent factors (17). Therefore, the investigation of pain is exceptionally complicated.

CONCLUSION

Contrary to some studies in the literature, our results do not show a significant correlation between pre-ESWL depression or anxiety with the VAS score measured after the procedure. However, although there is no significant correlation, it is seen that there is an increase in the VAS score as anxiety and depression increase.

Conflict of Interest: The authors declare to have no conflicts of interest.

Financial Disclosure: The authors declared that this study has received no financial support.

Ethical Approval: The study was approved by the Ethics Committee of Health Sciences University Şişli Etfal Hospital, dated 10.01.2023 and number 3779. The study protocol conformed to the ethical guidelines of the Helsinki Declaration.

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Original Article
Özgün Araştırma

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Intraoperative Assessment of Stone Free Status for Percutaneous Nephrolithotomy Surgery: Surgeon's Eye

Perkütan Nefrolitotomi Ameliyatında Taşsızlığın İntraoperatif Değerlendirilmesi: Cerrahın Gözü

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ÖZET

Amaç: Perkütan nefrolitotomi (PNL) uygulanan hastalarda cerrahın intraoperatif taşsızlık kanısının doğruluğunu, bunu etkileyen faktörleri, yanlış tahminine sebep olan prediktörleri saptamak ve sonuç olarak "cerrah gözü"'nün güvenilirliğini değerlendirmek amaçlandı.

Gereç ve Yöntemler: PNL uygulanan ve dahil etme kriterlerine uyan 1025 hastanın verileri retrospektif olarak incelendi. Çalışmamızın temeli cerrahın taşşsızlığı değerlendirmesi üzerine olması sebebiyle, cerrahın intraoperatif rezidü taş (RT) kalmadığı kanaatini belirttiği ancak postoperatif bilgisayarlı tomografi görüntülemede RT olan ve olmayan hasta grupları değişkenlere göre karşılaştırıldı.

Bulgular: Cerrah gözü'nün sensitivitesi %67,87, spesifitesi %96,23, pozitif prediktif değeri %91,67 ve negatif prediktif değeri %83,04 bulundu. Çalışmamızda "cerrahın gözü"'nün %16,9 oranında yanlış taşsızlık tahmin ettiği saptandı. Her iki grup arasında cinsiyet, taşın tarafı, taşın yoğunluğu ve hemoglobin düşüşü arasında istatistiksel anlamlı ilişki saptanmadı. Taş boyutu, operasyon süresi, floroskopi süresi, taşın konumu, kaliks taşlarının sayısı ve GUY's nefrolitometri skoru (GSS) cerrahın gözü ile istatistiksel anlamlı ilişkili saptandı. Cerrahın gözü ile istatistiksel anlamlı ilişki saptanan parametrelerin çok değişkenli (multivariate) lojistik regresyon analizi sonucunda sırasıyla taş boyutu, kaliks taşlarının sayısı ve GSS anlamlı prediktörler olarak bulundu.

Sonuç: PNL' de "cerrah gözü" nün en önemli prediktörleri taş boyutu, kaliks taş sayısı ve GSS idi. Bu prediktörler taşsızlık öngörülen hastaların postoperatif görüntülemelerinde, radyasyon maruziyetini azaltacak yöntemlerin kullanılmasında etkili bir kriter olarak kullanılabilir.

Anahtar Kelimeler: *böbrek taşları, perkütan nefrolitotomi, taşsızlık durumu, intraoperatif değerlendirme, cerrahın gözü*

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This study was approved by the University of Health Sciences, İzmir Tepecik Education and Research Hospital Ethical Committee (Approval Number: 2019/14-14, Date: 2019-10-01). All research was performed in accordance with relevant guidelines/regulations, and informed consent was obtained from all participants.

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ABSTRACT

Objective: In patients who underwent percutaneous nephrolithotomy (PNL),it was aimed to determine the accuracy of the surgeon's intraoperative stone-free status (SFS) prediction, the factors affecting it, the predictors that cause incorrect estimation, and finally to evaluate the reliability of the "surgeon's eye".

Material and Methods: The data of 1025 patients who underwent PNL and met the inclusion criteria were evaluated retrospectively. Since the basis of our study was based on the evaluation of the surgeon's stone-free prediction, patients identified as "absence of residual stone fragment (RF)" by the surgeon were grouped and compared with postoperative computed tomography imaging according to the presence of RF.

Results: Sensitivity, specificity, positive predictive value and negative predictive value were calculated as 67.87%, 96.23%, 91.67% and 83.04%, respectively. In our study, it was found that the "surgeon's eye" predicted SFS incorrectly at a rate of 16.9%. There was no statistically significant relationship between gender,-stone side,stone density and hemoglobin decrease between the two groups. Stone size,operation time, fluoroscopy time, location of the stone,number of stones in the calyces and GUY's stone score (GSS) were found to be statistically significant in relation to the "surgeon's eye". As a result of multivariate logistic regression analysis stone size, number of stones in the calyces and GSS were significant predictors of the parameters that had a statistically significant relationship with the surgeon's eye.

Conclusion: The most important determinants of "surgeon's eye" in PNL were stone size,number of stones in the calyces and GSS. These predictors can be used as an effective criterion in the use of methods to reduce radiation exposure in postoperative imaging of patients who are predicted to be stone-free.

Keywords: *kidney stones, percutaneous nephrolithotomy, stone-free status, intraoperative evaluation, surgeon's eye*

INTRODUCTION

Kidney stones are a common health problem worldwide. Percutaneous nephrolithotomy (PNL) is accepted as the gold standard minimally invasive treatment method in the treatment of complex kidney stones larger than 2 cm (1). PNL gives satisfactory results with low morbidity, acceptable complication, and high success rates. Achieving stone- free status (SFS) or the presence of a residual stone fragment (RF) is an important factor in the success of PNL. Preoperative, and intraoperative estimation of the presence of RF influences the surgeon's decision to perform intraoperative procedures such as nephrostomy or ureteral stent placement.

Although GUY's stone score (GSS), Clinical Research Office of the Endourological Society (CROES) and "stone size, tract length, obstruction, number of involved calyces and essence" (S.T.O.N.E) nephrolithometry scoring systems are used to predict "preoperative" SFS in PNL, there is no scoring system for predicting "intraoperative" SFS yet (2,3).

Although the presence of RF is evaluated by the surgeon in the intraoperative period with fluoroscopy-guided radiological and endoscopic methods in PNL, the presence of RF is clarified with non-contrast computed tomography (CT), which is the gold standard imaging in the postoperative period. Today, the absence of RF is accepted as SFS. Millimeter-sized RFs can be easily missed intraoperatively. Therefore, SFS assessment may not always be accurate in the intraoperative period. There are few studies in the literature subjecting the sensitivity and reliability of the surgeon's assessment of the presence of intraoperative RF and its comparison with different postoperative imaging modalities. As a result, the "surgeon's eye" is an important method that can guide the operation in terms of the "intraoperative" SFS assessment and the necessity of different procedures such as nephrostomy and ureteral stent placement.

Unlike other studies, in this study, we aimed to evaluate the accuracy of the surgeon's intraoperative SFS prediction, the factors affecting it, the predictors that caused the wrong estimation, and finally, to evaluate the reliability of the "surgeon's eye".

MATERIAL AND METHODS

The study was carried out retrospectively after the approval of the local ethics committee, dated 09 October 2019, decision numbered 2019/14-14. The data of 1289 patients who underwent PNL in a single center due to kidney stones between November 2008 and July 2019 were collected. Patients who under the age of 18, underwent mini-PNL, had horseshoe kidney anomaly, had non-opaque stones, had missing preoperative/postoperative data, used flexible nephroscopy during the procedure, and had no CT scan for postoperative RF evaluation were excluded from the study. After the exclusion criteria, a total of 1025 patients were included in the study. An informed consent form was obtained from the patients before the procedure.

First of all, demographic data such as age and gender of all patients were recorded. Then, the location, side, number, size, and density (Hounsfield Unit (HU)) of the stones were recorded with the stone protocol CT in the preoperative period. Operation time and fluoroscopy time from the perioperative data, hemoglobin (Hgb) decrease from the postoperative data were collected. In addition, kidney stones of all patients were evaluated according to GSS. In GSS, conditions including the location of the stone, the presence of single or multiple stones, the presence of partial or complete staghorn stones, and the presence of anomaly in the kidney anatomy were evaluated and scored between 1-4 (2). "Calyx" localized stones were defined as stones other than isolated stones in the renal pelvis.

Approximately half of the patients (510 patients) included in the study were operated on by a single surgeon, while other surgeries were performed by different surgeons with at least 50 PNL experience. The operating surgeon performed all percutaneous renal accesses.The time from the beginning of the renal access to the placement of the malecot nephrostomy catheter was accepted as the operation time (min). Fluoroscopy time (sec) was defined as the total duration of exposure during the procedure. The largest stone diameter in the axial and coronal planes was used when calculating the size of the stones in CT The size was recorded in mm^2 by multiplying the lengths in both planes. In the presence of more than one stone, the size of each stone was measured and added separately. SFS was evaluated using non-contrast CT 1 month after surgery. The absence of RF of any size was considered as SFS.

The surgeon stated his opinion on obtaining SFS as " presence of RF" or "absence of RF" in the intraoperative period as a result of his evaluation made by considering both fluoroscopic and nephroscopic examinations. Since the basis of our study was based on the evaluation of the surgeon's stone-free prediction, patients defiined as "absence of RF" by the surgeon were grouped and compared with postoperative CT imaging according to the presence of RF.

Surgical Technique

After general anesthesia, PNL was started with cystoscopy in the lithotomy position. A 6F open-ended ureteral catheter was inserted up to the renal pelvis with the help of a C-arm fluoroscopy machine (Ziehm 8000, Ziehm Imaging GmbH. Nuremberg Germany). The pelvicalyceal system was evaluated by retrograde pyelography by administering contrast media through the ureteral catheter. After this stage, the patient was turned to the prone position. Under fluoroscopy, an 18G percutaneous access needle was inserted into the appropriate calyx using the triangulation technique. Dilatation was performed with a 30F amplatz dilator in accordance with the one-shot dilatation technique. The stones were fragmented with the aid of a 26F nephroscope (Karl Storz GmbH, Tuttlingen, Germany) and pneumatic and/or ultrasonic lithotripter by entering through the amplatz sheath. At the end of the operation, a 14 F malecot nephrostomy catheter was placed. The integrity of the collecting system and the presence of RF were checked with antegrade pyelography by giving contrast media through the catheter.

Statistical Analysis

SPSS 25.0 program (I.B.M. Corporation, Armonk, New York, United States) was used in the analysis of the variables. Compliance of the data with normal distribution was evaluated by Kappa analysis. Pearson's

Chi-Square and Fisher's Exact test were used to compare the distribution of categorical variables (gender, side of the stone, location of the stone, number of stones in the calyces, GSS) in the groups. Independent-Samples T-test with Bootstrap results were used to compare the surgeon's eye to RF on CT and fluoroscopy time. Mann-Whitney U test was used with the Monte Carlo simulation technique to compare the stone density (HU), stone size (mm^2), operation time (min), fluoroscopy time (sec), and hemoglobin decrease (g/dl). Multivariate logistic regression analysis was applied to the parameters that had a statistically significant relationship with the surgeon's eye. The sensitivity and specificity of the cut-off value calculated according to the stone size (mm^2), which showed statistical significance with the groups formed, were analyzed and expressed by ROC (Receiver Operating Curve). Quantitative variables were shown in the tables as mean ± std.(standard deviation)(Minimum/Maximum) and median (Minimum/Maximum), while categorical variables were shown as n(%). Variables were analyzed at a 95% confidence interval, and a p-value less than 0.05 was considered statistically significant.

RESULTS

Of 1025 patients included in the study, 627 (61%) were male, and 398 (39%) were female. The mean age was 49.59±13.64 years, and the mean body mass index (BMI) was 28.2 (18– 40.1). Single access was applied to 86.2%, and double access was applied to 11.6% of the patients. 85.5% of the patients had no previous history of stone surgery. History of PNL, open stone surgery, and both PNL and stone surgery were 5.7%, 7.6%, and 1.2%, respectively. The distribution of the presence/absence of RF according to the intraoperative surgeon's eye and postoperative CT is shown in Table 1.

While SFS was achieved in 636 (62.05%) patients, RF remained in 389 (37.95%) patients. 91.6% (264 patients) of the patients who were found to have RF by computed tomography were also considered to have RF by the surgeon's eye. One hundred and twenty- five (16.9%) of the patients with RF were those who were stated to have no RF by the surgeon. Accordingly, there were 264 true positives, 612 true negatives, 125 false negatives, and 24 false positive patients. Kappa analysis showed substantial agreement (κ: 0.675; $p< 0.05$). Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated as 67.87%, 96.23%, 91.67%, and 83.04%, respectively (Table 2).

It was determined that gender, stone side, stone density, and Hgb decrease parameters did not affect the "surgeon's eye" statistically in groups with and without RF on CT. Stone size, operation time, fluoroscopy time, location of the stone, number of stones in the calyces, and GSS were statistically associated with the "surgeon's eye" (Table 3a and Table 3b).

Stone size (OR: 1.001; 95% [CI]: 1- 1.001; p=0.002), number of stones in the calyces (OR: 0.470; 95% [CI])]: 0.255-0.866; p=0.015) and GSS (OR: 0.416; 95% [CI]: 0.198-0.872; p=0.020) were found to be important predictors as a result of multivariate logistic regression analysis of the parameters that had a statistically significant relationship with the surgeon's eye. Stone location, operation time, and fluoroscopy time were not found to be significant predictors as a result of multivariate logistic regression analysis (Table 4).

As a result of the ROC analysis performed on the stone size parameter, which is one of the parameters affecting the surgeon's eye statistically, a threshold value of 540 mm^2 was found. True negativity (SFS) increased statistically for stones of this size and below (AUC 0.779; OR: 7.1; 95% [CI]: 4.7 - 10.9; $p <0.001$) (Figure 1). The sensitivity for stone size was 69.6%, and the specificity was 75.7%.

The overall complication rate was 11.9%. The ureteral catheter was inserted under local anesthesia in 9 patients due to severe colic pain in the early postoperative period (Clavien 3A). Ureterorenoscopy was performed in 26 patients (Clavien 3B).

Table 1. Residual fragment status of the patients according to the surgeon's eye and postoperative CT

		CT		
		Residual fragment (+)	Residual fragment (-)	Total
Surgeon's Eye	Residual fragment (+)	264	24	288
	Residual fragment (-)	125	612	737
	Total	389	636	1025

CT: Computed tomography

Table 2. Sensitivity, specificity, PPV and NPV of the surgeon's eye

		% 95 CI
Sensitivity	% 67.87	% 62.97 - % 72.48
Specificity	% 96.23	% 94.44 - % 97.57
PPV	% 91.67	% 88.07 - % 94.25
NPV	% 83.04	% 80.89 - % 84,99

CI: Confidence interval, *PPV:* Positive predictive value, *NPV:* Negative predictive value

Table 3a. Factors affecting the surgeon's eye

		Residual fragment status in CT		
		Absent	Present	P Value
		(n=612)	(n=125)	
		Mean±SD (Min./Max.)	Mean±SD (Min./Max.)	
Age		49.20 ± 14.22 (18 / 93)	51.34 ± 12.18 (22 / 78)	
		Mean (Min./Max.)	Mean (Min./Max.)	
Stone density (HU)		1084.82 (225 / 1626)	1092.43 (330 / 1609)	0.785¥
Stone size (mm²)		441.76 (102 / 4420)	831.35 (156 / 2820)	**<0.001**¥
Operation time (min)		63.89 (19 / 238)	77.41 (19 / 238)	**0.001**¥
Fluoroscopy time (sec)		122.68 (18 / 640)	149.29 (20 / 640)	**0.048**§
		Mean±SD	Mean±SD	
Hemoglobin decrease (g/dl)		1.46 ± 1.34	1.78 ± 1.63	0.231¥
		n (%)	n (%)	
Gender				
	Male	359 (81.6)	81 (18.4)	0.202*
	Female	253 (85.2)	44 (14.8)	
Side				
	Right	308 (81.3)	71 (18.7)	0.187*
	Left	304 (84.9)	54 (15.1)	
Location of the stone				
	Calyx	183 (80.6)	44 (19.4)	**<0.001***
	Renal pelvis	254 (92.7)	20 (7.3)	
	Calyx and renal pelvis	175 (74.2)	61 (25.8)	

CT: Computed tomography, *SD:* Standard Deviation, *HU:* Hounsfield Unit

**Chi-Square test, §:* Independent Samples T Test, *¥:* Mann-Whitney U test

Table 3b. Factors affecting the surgeon's eye

	Residual fragment status in CT		P Value
	Absent (n=612) n (%)	Present (n=125) n (%)	
Location of the stone			
Calyx and renal pelvis	175 (74.2)	61 (25.8)	
Calyx or renal pelvis	437 (87.2)	64 (12.8)	**<0.001***
Number of stones in the calyces			
1	236 (87.1)	35 (12.9)	**<0.001***
2	79 (66.9)	39 (33.1)	
3	27 (61.4)	17 (38.6)	
≥4	16 (53.3)	14 (46.7)	
Multiplicity of stone			
Single	236 (87.1)	35 (12.9)	**<0.001***
Multiple	122 (63.5)	70 (36.5)	
GSS			
1	354 (94.4)	21 (5.6)	**<0.001***
2	187 (78.2)	52 (21.8)	
3	54 (58.1)	39 (41.9)	
4	17 (56.7)	13 (43.3)	
GSS			
1 and 2	541 (88.1)	73 (11.9)	**<0.001***
3 and 4	71 (57.7)	52 (42.3)	

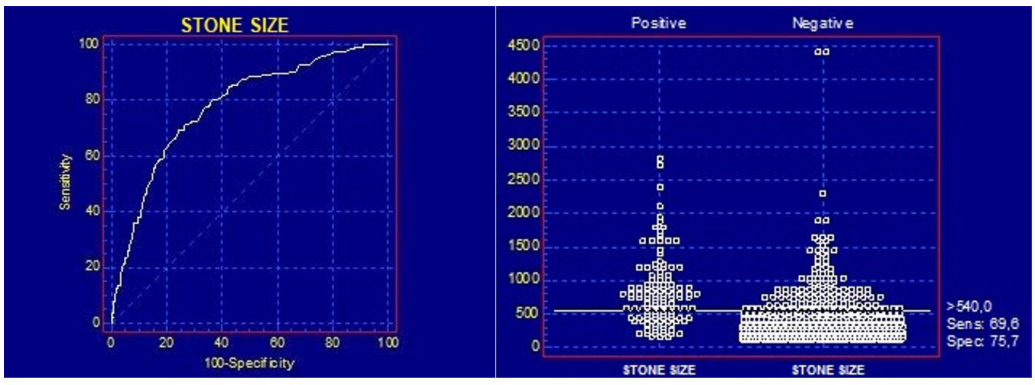
CT: Computed tomography, * Chi-Square test, ***GSS:*** GUY's stone score

Table 4. Multivariate analyzes of factors that significantly affect the surgeon's eye

	OR	%95 CI	*P* Value
Stone size (mm²)	1.001	1- 1.001	**0.002**
Operation time (min)	1.001	0.994- 1.008	0.822
Fluoroscopy time (sec)	1.002	1- 1.005	0.066
Location of the stone	1.84	0.959- 3.532	0.067
Number of stones in the calyces	0.47	0.255- 0.866	**0.015**
GSS	0.416	0.198- 0.872	**0.02**

OR: Odds Ratio, ***CI:*** Confidence Interval, ***GSS:*** GUY's stone score

Figure 1. Stone size (mm2) and ROC curve



DISCUSSION

PNL is currently accepted as the gold standard minimally invasive treatment method in the treatment of complex and large kidney stones (1). The main goal in the treatment of kidney stones is to ensure complete SFS by minimizing morbidity. CT scan taken in the postoperative period is superior to other imaging methods, with a sensitivity of up to 95% in the evaluation of SFS and the detection of millimeter-sized RFs (4). RF after PNL is important because it may cause new stone formation, symptoms, and additional surgery. Problems associated with RFs after PNL occur at rates of up to 31% and 46% (5-7). The "surgeon's eye" is a criterion that cannot be ignored, as intraoperative evaluation of SFS or RFs may require different types of additional interventions. In our study, based on CT results, the sensitivity, specificity, PPV, and NPV of RFs for the surgeon's eye were 67.87%, 96.2%, 91.67% and 83.04%, respectively. In other words, based on our results, the surgeon was only able to detect SFS in 83.04% of PNL compared to postoperative CT.

When we look at the literature, there are few studies investigating the role of the intraoperative surgeon's opinion in different operations. In a study involving 306 patients regarding the surgeon's intraoperative RF evaluation, it was considered that 236 (77%) procedures were achieved intraoperative SFS. In this study, the sensitivity, specificity, PPV, and NPV of intraoperative surgeon's opinions about SFS were 49.6%, 97.1%, 92.8%, and 72%, respectively (8). Although specificity and PPV were similar, sensitivity and NPV were found to be higher in our study. This may be because non-opaque stones were also included in this study. Portis et al. evaluated the surgeon's opinion about SFS using flexible nephroscopy in their study involving 39 renal units. In their study, SFS was obtained in 26 (66%) cases in PNL. Defining SFS as the absence of any RFs, they found a PPV of 67% and a NPV of 73% (9). They stated that the use of flexible nephroscopy in addition to fluoroscopy could significantly contribute to the accuracy of the surgeon's evaluation and thus reduce additional secondary interventions. However, in our study, although SFS was defined as the absence of RFs, it was shown that high NPV could be achieved without the use of flexible nephroscopy. In the study of Gökçe et al., which included 167 patients who underwent retrograde flexible nephroscopy simultaneously with PNL, the stone-free rate was found to be 92.7%. According to the surgeon's SFS opinion, PPV was 83.3%, and NPV was 96.2% (10). However, in order to perform retrograde flexible nephroscopy, the patient must be in the supine position. Since only prone PNL was performed on the patients in our study, we may not have been able to reach these rates.

The factors affecting SFS after PNL have been evaluated in various studies in the literature. In the study of Perez-Fentes et al., stone size and the presence of multiple stones were stated as the most important determinants of stone-free rate in PNL In addition, an increase in stone size and number was found to be associated with missing RFs (11). Also in the multivariate analyzes of Nevo et al.'s study, stone size (OR = 1.07, 95% CI: 1.03–1.11, p = 0,005) and presence of multiple stones (OR = 4.95, %95 CI: 2.52–9.71, p < 0,001) were found to be independent predictors for missing RFs (12). According to our results, stone size and the number of stones in the calyces, which are parameters affecting the surgeon's eye in PNL, were found to be statistically significant in multivariate analysis. In addition, a statistically significant difference was found when the number of stones was grouped as single and multiple. Thus, it was determined that the most important predictor of the surgeon's eye was the stone size and the number of stones in the calyces. An exact cut-off value that would make the surgeon's eye important for stone size, which is the strongest predictor, was an intriguing question. In our analysis for this question, the threshold value was 540 mm^2. True negativity (SFS) increases statistically significantly for stones of this size and smaller.

Another parameter that had a significant relationship with the surgeon's eye was GSS (p <0.001). As in our study, Noureldin et al. reported GSS as a predictor of SFS after PNL (13). Harraz et al. reported a 43% stone-free rate in GSS 4. They found only GSS as an independent predictor in the model 1 subgroup which they considered the absence of any residual fragments (8). Similarly, in another study, the stone-free rate was found to be 95.2% for GSS 1 and 40.7% for GSS 4, and GSS was found to be an independent predictor (p<0.001) (14). In our study, we found that GSS was an effective factor in predicting SFS, consistent with the literature. In addition, our stone-free rates in high GSS were found to be relatively high compared to

other studies. The presence of low GSS provides a better estimation of the surgeon's eye. In our multivariate analysis, larger stone size, increased number of stones in the calyces, and high GSS were found to be independent predictors of missing RFs. In addition to our predictors of stone size and the number of stones in the calyces, GSS should also be used as an effective parameter that can be evaluated in the "surgeon's eye".

The scarcity of similar studies and the fact that it has the highest number of patients compared to similar studies in the literature are the strengths of our study. The retrospective design of the study is one of the limitations. The fact that the operations were performed by more than one surgeon is another limitation as the "surgeon's eye" is a subjective assessment. In addition, our definition of SFS as the absence of RFs may have negatively affected our ratios between the surgeon's eye and CT. Failure to use a flexible nephroscope during the operation may also have affected the surgeon's eye.

CONCLUSION

According to our study, the most important determinants of the surgeon's eye in PNL were stone size, number of stones in the calyces, and GSS. It may be considered that additional intervention or the use of a drainage catheter may be required in patients who are predicted to have RF. It can be used as an effective criterion in the use of methods to reduce radiation exposure in postoperative imaging of patients who are predicted to be stone-free.

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Ethical Approval: The study was approved by the Ethics Committee of University of Health Sciences, İzmir Tepecik Training and Research Hospital (Approval No: 2019/14-14, Date: 2019/09/10). The study protocol conformed to the ethical guidelines of the Helsinki Declaration.

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Original Article
Özgün Araştırma

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Comparison of Open Radical Cystectomy vs Robot-Assisted Radical Cystectomy Perioperative Outcomes and Complications at a Single Center: An Analysis of Matched Pairs

Tek Merkezde Açık Radikal Sistektomi ile Robot Yardımlı Radikal Sistektominin Perioperatif Sonuçları ve Komplikasyonlarının Karşılaştırılması: Eşleştirilmiş Çift Analizi

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ÖZET

Amaç: Metastatik olmayan yüksek riskli kasa invazif olmayan ya da kasa invazif mesane kanserinde standart küratif tedavi yöntemi bölgesel pelvik lenfadenektomi (PLND) ile birlikte radikal sistektomidir. Açık radikal sistektomi (ARS), birincil tedavi şeklidir, fakat bu cerrahi yöntem önemli riskler taşımaktadır. Minimal invazif cerrahi tekniklerinden robotik cerrahinin uygulanmasıyla cerrahi morbiditeyi en aza indirmek ve daha hızlı iyileşme gösterilmiştir. Bu çalışmada amacımız kendi kliniğimizde mesane kanseri nedeniyle robot yardımlı radikal sistektomi (RYRS) ve ARS uygulanan hastaların eşleştirilmiş çift analizi kullanarak komplikasyonlar ve perioperatif sonuçlarını karşılaştırmaktır.

Gereç ve Yöntemler: Kliniğimizde Ocak 2021 - Şubat 2023 tarihleri arasında radikal sistektomi hastaların verileri retrospektif olarak elde edildi. RYRS uygulanan 20 hasta, aynı dönemde yaş (± 2 yaş), cinsiyet, klinik TNM evresi ve üriner diversiyon (ileal konduit veya ortotopik yeni mesane) açısından 1:2 oranında ARS uygulanan 40 hasta ile eşleştirildi. Perioperatif, postoperatif sonuçlar ve komplikasyonlar karşılaştırıldı.

Bulgular: Her iki grupta preoperatif veriler açısından fark yoktu. Ameliyat süresi RYRS grubunda anlamlı olarak daha uzundu (307,5'e karşılık 391,7 dakika; P=0.0001). RYRS'de önemli ölçüde daha düşük kanama miktarı (P=0.001) ve daha az intraoperatif kan transfüzyonu (P=0.023) izlendi. Yoğun bakımda kalış süreci ARS'de anlamlı olarak daha yüksek izlendi (P=0.047). Gruplar arasında 90 günlük minör (clavien 1-2) komplikasyon oranları benzer izlendi. Majör (clavien 3-5) komplikasyonlar açık cerrahide anlamlı şekilde daha fazla görüldü (P=0.042). 90 günlük mortalite oranı, RYRS ve ARS için sırasıyla %0'a karşılık %7.5 idi. Her iki grup arasında önemli patolojik sonuçlar açısından fark görülmedi.

Sonuç: RYRS ile ilk deneyimlerimiz, daha yüksek ARS deneyimiyle karşılaştırıldığında bile benzer patolojik sonuçlar, perioperatif kan kaybını önleme ve 90 günlük mortalite iyileştirmeleri ile güvenli ve uygulanabilir olduğunu göstermiştir.

Anahtar Kelimeler: *komplikasyon, mesane kanseri, robot yardımlı radikal sistektomi*

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This study was approved by the University of Health Sciences, Başakşehir Çam ve Sakura Health Research and Practice Center, Ethical Committee (Approval Number: 173, Date: 2023-04-19). All research was performed in accordance with relevant guidelines/regulations, and informed consent was obtained from all participants.

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ABSTRACT

Objective: The standard curative treatment for non-metastatic high-risk non-muscle-invasive and muscle-invasive bladder cancer is regional pelvic lymphadenectomy (PLND) combined with radical cystectomy. The most prefered surgical procedure is an open radical cystectomy (ORC). However, there are significant risks related to this surgical procedure. Robot-assisted radical cystectomy (RARC), one of the minimally invasive surgical procedures, has been demonstrated to reduce surgical morbidity and boost recovery. In this study, we examined the postoperative complications and outcomes of patients who underwent RARC and ORC for bladder cancer in our clinic using matched pair analysis.

Material and Methods: Between January 2021 and February 2023, datas of radical cystectomy patients were collected retrospectivelly at our clinic. Twenty patients who underwent RARC and forty patients who underwent ORC were matched at a ratio of 1:2 for age (± 2 years), gender, clinical TNM stage, and urinary diversion (ileal conduit or orthotopic neobladder) during the same period. The outcomes and complications of perioperative and postoperative procedures have been compared.

Results: There was no difference in preoperative data between the two groups. The RARC group had found significantly longer operative times (307.5 versus 391.7 minutes; P=0.001). Patients with RARC group had significantly lower bood-loss (P=0.001) and required less intraoperative blood transfusions (P=0.023). ICU stays were significantly longer in ORC (p =.047). The rates of mild Clavien complications were found to be similar between groups in the postoperative first 90 days. Open surgery was found to be associated with a significantly higher incidence of major (clavien 3-5) complications (p =.042). The 90-day mortality rates for RARC and ORC were found to be 0% and 7.5%, respectively. There was no difference in pathological outcomes between the two groups.

Conclusion: Our initial experience with RARC has demonstrated its safety and practicability, with comparable pathology outcomes, reduction of perioperative blood loss, and advances in 90-day mortality, when compared to ORCs with more years of experience.

Keywords: *bladder cancer, complication, robot-assisted radical cystectomy*

INTRODUCTION

Globally, bladder cancer (BC) is an important issue for public health (1). It is four times more prevalent among men compared to women. While BC is the seventh most frequently diagnosed cancer in men, it is the tenth most commonly diagnosed cancer overall (2). Typically, the elderly and smokers are affected (3). About three-quarters of patients have non-invasive disease, while one-quarter have invasive disease. The disease prognosis and life expectancy are getting worse as the disease advances through its stages. Consequently, the treatment strategy varies by stage. Regional pelvic lymphadenectomy (PLND) combined with radical cystectomy is the standard curative treatment for non-metastatic, high-risk, non-muscle-invasive, or muscle-invasive bladder cancer. The conventional method is open radical cystectomy (ORC). As technology advances, however, robotic surgery is becoming increasingly prevalent worldwide. It is gaining popularity, especially in the field of urology. Robot-assisted radical cystectomy (RARC) is one of these procedures. From 2004 to 2010, the proportion of RARCs increased from 0.6% to 12.8%, demonstrating this growing interest (4,5).

The comorbid elderly population and smoking exposure are significantly associated with bladder cancer. In this population, major pelvic surgery, such as radical cystectomy and urinary diversion, has significant risks. The open surgical technique results in major perioperative morbidity and prolongs the recovery period. Following radical cystectomy, many patients experience at least one complication. 20% to 30% of patients are readmitted following discharge, and approximately 20% require intervention (6,7). Complications extend the duration of recovery and increase mortality rates (8). As one of the minimally invasive surgical techniques, robotic surgery aims to reduce surgical morbidity and accelerate recovery. Numerous

studies have demonstrated lower complication rates, faster recoveries, and comparable oncologic outcomes (9–12).

In this study, we used matched pair analysis to investigate the complications and postoperative outcomes of patients who underwent RARC and ORC for bladder cancer in our clinic.

MATERIAL AND METHODS

Data from 113 patients who underwent radical cystectomy in our clinic between January 2021 and February 2023 were retrospectively analyzed after receiving the institutional review board's approval. 20 patients underwent RARC, and 93 patients underwent ORC. Twenty patients with RARC were paired with forty patients with ORC based on age (± 1 year), gender, clinical TNM stage, and urinary diversion (ileal conduit or orthotopic neobladder) during the same time period. Two experienced urology surgeons conducted ORC, and one urology surgeon performed RARC. Surgeons performing RARC have conducted at least 15 ORC procedures every year. The surgeon doing the RARC procedure also has a lot of experience with robotic-assisted radical prostatectomy (478 cases were handled by one surgeon).

Surgery, Preoperative Assessment and Postoperative Care

Preoperative CT scans of the thorax and abdomen were performed on all patients, and MRIs using the Vesical Imaging Reporting and Data System (VI-RADS) protocol were used for local staging. The enhanced recovery after surgery (ERAS) regimen was used with all patients during the preoperative, perioperative, and postoperative phases (7). ORC and pelvic lymphadenectomy (PLA) were performed as usual (13,14). In accordance with earlier descriptions (15,16), robotic RC with pelvic lymph node dissection was performed. The specimen was extracted via a 6 cm periumbilical incision following RARC. Robotic urine diversions (ileal loop, orthotopic neobladder) were performed totally intracorporeally.

Collection of Data

Patient demographics (age, gender, BMI), American Society of Anesthesiologists (ASA) score, preoperative therapy (intravesical chemotherapy or BCG), history of abdominal surgery, previous pelvic radiotherapy, neoadjuvant chemotherapy, VIRADS score, perioperative variables (duration of surgery, Estimated blood loss (EBL), blood transfusion, intraoperative complications), and pathological results (pathological stage, surgical margin status, number of lymph nodes) were evaluated. In addition, within 90 days of cystectomy, complications were grade according to Clavien (17). Minor issues were classified as Clavien grades 1-2, and serious issues as Clavien grades 3-5. The utilization of adjuvant therapy, disease recurrence, and hospital readmission were also noted. Patients with concurrent upper urinary tract tumor, salvage radical cystectomy, or radical cystectomy for other purposes (intestinal and gynecological cancers) were excluded from the study.

Statistical Evaluation

In this study, data obtained from personal information forms and scales were transferred to a computer by the SPSS (Statistical Package for Social Sciences 22.0) program, and the data were analyzed by this program. The data obtained were presented as arithmetic mean ± standard deviation, while quantitative data were presented as numbers and percentages. Each group was tested with the Kolmogorov–Smirnov test to investigate the normal distribution of the obtained data. Mann–Whitney U test was used for data because of gender, American Society of Anesthesiologist (ASA) scores (1-2 vs. 3-4), VI-RADS scores, operative time, estimated blood loss, clavien scores (1-2 vs. 3-5), length of the hospitalization, and length of the intensive care unit (ICU) were found without normal distribution. Data of readmission, reoperation, and interventional procedures were analyzed with chi-Square and Fisher's exact tests. In all statistical analyses, the p-value was accepted <0.05 at a 95% confidence interval.

RESULTS

Comparison of sex, age, pathological TNM, and clinical (VIRADS score) stage between groups were shown in Table 1. The mean patient age was 62.3 ± 6.3 (RARC) and 63.5 ± 6.3 (ORC), and 15% and 10% of patients in the RARC and ORC groups were found to be female, respectively. In each group, more than 50% of the patients had stage cT2 or advanced disease. Orthotopic neobladder was done in one patient per group. More than fifty percent of ORC patients had an ASA score between 3 and 4, and no clinically significant difference was observed.

The preoperative and postoperative outcomes are shown in Table 2. The RARC group had found significantly longer operative times (307.5 versus 391.7 minutes; P=0.001). Patients with RARC group had significantly lower bood-loss (P=0.001) and required less intraoperative blood transfusions (P=0.023). There was no significant difference in hospital stays between the two groups (RARC, 6.7 days; ORC, 7.2 days). The ORC group had significantly longer ICU stays (P=0.047). Within 90 days of surgery, clavien 1-2 complications were experienced by 70% and 77% of RARC and ORC patients, respectively (P=0.147). These were evaluated within the first 30 days and most of them were clavien 1 (antipretic, analgesic administration) complications. The incidence of major complications (clavien 3-5) was found significantly higher than open surgery (P=0.042). In ORC, seven patients had evisceration surgeries. The necessity for interventional procedures, going back to the operation room, and hospital readmission were comparable. While the ORC group experienced 90-day mortality at a rate of 7.5%, there was no mortality in the RARC group.

Table 3 shows that there was no difference in the two groups' serious pathological outcomes. Only the T0 stage was observed more frequently in the robotic group. In RARC and ORC, the average number of lymph nodes excised was similar (26 vs 20; P=0123). Positive surgical margins were 10% in both groups (P=0.99). There was no difference in adjuvant therapy (radiotherapy, chemotherapy) between the RARC and ORC groups.

Table 1. Demographics and preoperative variables comparing RARC with ORC

	RARC n:20	ORC n:40	P value
Age (y) (Mean ± SD)	62.3 ± 6.3	63.5 ± 6.2	0.485
Gender n(%)			
Male	17 (85)	36 (90)	0.573
Female	3 (15)	4 (10)	
BMI (kg/m2)(Mean ± SD)	27.9 ± 2.1	26.9 ± 4.1	0.281
ASA Score n(%)			
ASA 1-2	14 (70)	18 (45)	0.063
ASA 3-4	6 (30)	22 (55)	
VI-RADS Score(Mean ± SD)	3.6 ± 1.6	3.8 ± 1.1	0.902
Pathology of TUR-B n(%)			
Ta	2 (10)	5 (12.5)	N/A
Tis	5 (25)	15 (37.5)	
T1	5 (25)	14 (35)	
T2	13 (65)	21 (52.5)	
Concomitant Variant Pathology n(%)	4 (20)	14 (35)	N/A
Previous abdominal surgery n(%)	1 (5)	2 (5)	
Neoadjuvant chemotherapy n(%)	1 (5)	1 (2.5)	
Intravesical therapy n(%)	2 (10)	7 (17.5)	

***BMI:** Body mass index; **ASA:** American Society of Anesthesiologist; **VI-RADS:** Vesical Imaging-Reporting and Data System*
***TUR – B:** Transurethral Resection of the Bladder*

Table 2. Perioperative and Postoperative outcomes

	RARC n:20	ORC n:40	P value
Perioperative			
Operative time (min)(Mean ± SD)	391.7 ± 69.9	307.5 ± 49.5	0.001
Estimated Blood Loss (ml)(Mean ± SD)	187.5 ± 77.5	374.5 ± 229.9	0.001
Peroperative Transfusion n(%)	0 (0)	9 (22.5)	0.023
Type of the Urinary Diversion n(%)			
İleal Conduit	19 (95)	39 (97.5)	N/A
Orthotopic Neobladder	1 (5)	1 (2.5)	
Postoperative < 90 day Complicationsn(%)			
Clavien 1-2	14 (70)	31 (77)	0.147
Clavien 3-5	4 (20)	14 (35)	0.042
Re-admission	4 (20)	8 (20)	0.125
Re-operation	3 (15)	7 (17)	0.356
Interventional procedure	3 (15)	4 (10)	0.147
Lenght of day (Mean ± S.D.)			
ICU	0.3 ± 0.4	0.67 ± 0.5	0.047
Hospitalization	6.73 ± 1.6	7.5 ± 2.2	0.436
Mortalityn(%)			
<30- day	0 (0)	2 (5)	N/A
30-90 day	0 (0)	1 (2.5)	

ICU: *intensive care unit;* ***RC:*** *Radical Cystectomy*

Table 3: Pathologic and adjuvant treatment outcomes of RC

	RARC n:20	ORC n:40	P value
Pathologic Findings n(%)			
T0	3 (15)	1 (2.5)	0.041
Non-muscle invasive	7 (35)	15 (37.5)	0.254
Ta	1 (5)	2 (5)	
Tis	4 (20)	3 (7.5)	N/A
T1	2 (10)	10 (25)	
Muscle invasive	10 (50)	24 (60)	0.129
T2	3 (15)	11 (27.5)	
T3	3 (15)	7 (17.5)	N/A
T4	4 (20)	6 (15)	
Concomitant Variant Pathology	8 (40)	18 (45)	0.715
LVI	8 (40)	11 (27.5)	0.331
Lymph Node Status n(%)			
N0	18 (90)	30 (75)	0.175
N1-2	2 (10)	10 (25)	
Positive Surgical Margin n(%)	2 (10)	4 (10)	0.998
Adjuvant Chemotherapy n(%)	7 (35)	17 (42.5)	0.579
Adjuvant Radiotherapy n(%)	2 (10)	6 (15)	0.594
Recurrence n(%)			
Local	2 (10)	5 (12.5)	0.778
Metastatic	4 (20)	7 (17.5)	0.815

LVI: *Lymphovascular invasion* ***RC:*** *Radical Cystectomy*

DISCUSSION

Radical cystectomy and extended lymph node dissection are the gold standard treatment modalities for muscle invasive and non-muscle invasive bladder cancer with very-high risk. Bladder perforation should be avoided during the excision of the bladder, surrounding tissues, and neighboring organs for local curative therapy of bladder cancer with this approach. Surgical procedures have continually advanced over the years, but have made significant strides in the past decade. Despite all of this surgical advancement, there is still significant perioperative morbidity (18). In particular, minimally invasive surgical methods have been developed in the aim of improving complication management and recovery time. Smaller incisions can speed up recovery, lower morbidity, and decrease hospital stays. Radial cystectomy and urine diversion for bladder cancer are now frequently carried out around the world using robot-assisted minimally invasive surgical procedures.

It was noticed that RARC had a number of distinct benefits throughout the perioperative period. In 2015, Novara et al. demonstrated that RARC patients were less likely to require a transfusion and that blood loss was 521 mL less in RARC than in ORC (19). EBL was significantly lower in the RARC group, according to Bochner et al. (20). Less blood loss was seen in RARC in Riccardo Mastroiann's randomized controlled research, which was carried out in 2022. In fact, no patient was transfused perioperatively on the robot arm (21). In accordance with the literature, our study found that there was statistically significant less blood loss in robotic surgery than in open surgery. Additionally, while perioperative blood replacement was not conducted with the robotic arm, it was performed at a rate of 22.5% during open surgery and was observed significantly more frequently. In open surgery, cleaning the blood with the aid of suction gases and an aspirator may result in greater variability of blood loss and transfusion discrepancies. Additionally, because the abdomen is not opened during robotic surgery and because of the impact of gas pressure, the amount of bleeding may be reduced. Furthermore, dorsal vein ligation in robotic surgery is more easily observed and managed. This technical management may be why blood loss is low and less blood is needed to restore it.

There are a few perioperative concerns to consider along with the benefits of RARC. The lengthened operation time is one of these disadvantages. In the CORAL research, which evaluated open, laparoscopic, and robotic cystectomy, the mean difference in operating time between robotic and open surgery was found to be 96 minutes (22). A randomized prospective controlled research found that robotic surgery took significantly longer (23). However, Casey et al.'s study claimed that the robotic arm's time was only 18 minutes longer and that this difference was not clinically significant (24). In the results of our study, a robotic arm's operating time was shown to be 84 minutes longer on average. Due to surgical factors such as complex patient preparation and suturing ability, it is expected that robotic surgery will take a long time. However, we believe that this difference was the result of the learning process and that comparable operative times could be achieved over time. After the 15th case, the duration of robotic surgery reached open surgery.

Oncological results are one of the crucial findings in our comparison of RARC and ORC. Early oncological results were similar in the RARC and ORC groups despite minor variations in preoperative pathological and clinical stage (VIRADS score). More patients were tracked in the robotic arm at the T0 stage. In RARC, an average of 26 lymph node dissections were carried out as opposed to an average of 20 in open surgery. However, the positive surgical margin was comparable in both methods. Even though these are the first 20 robotic surgeries, it's crucial to be aware that the robotic surgeon specializes in urooncology and has extensive training in both open cystectomies and robotic pelvic surgery. All of these findings demonstrated that the RARC technique complies with the surgical principles.

At 90 days, the rates of complications were comparable between the two surgical series. Additional minor issues were found. When compared to the overall complication rates, postoperative ileus represents a significant percentage in other series (25,26). But ileus was rare in both of our study's groups. due to the regular use of the ERAS protocol in both arms. We believe that using this technique lowers the incidence of ileus.

CONCLUSION

In one randomized experiment, rates of mild problems were 73% in RARC and 67% in ORC. Additionally, patients who underwent open surgery experienced wound-related complications more frequently (5.6% vs. 17.3%) (27). In our study, ORC showed greater clavien 3-5.

Conflict of Interest: The authors declare to have no conflicts of interest.

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Ethical Approval: The study was approved by the Ethics Committee of University of Health Sciences, Başakşehir Çam ve Sakura Health Research and Practice Center, Ethical Committee (Approval Number: 173, Date: 2023-04-19). The study protocol conformed to the ethical guidelines of the Helsinki Declaration.

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Original Article
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The Effects of Pelvimetric Measurements on the Operation Time of Open Retropubic Radical Prostatectomy

Pelvimetrik Ölçümlerin Açık Retropubik Radikal Prostatektomi Operasyon Süresi Üzerine Etkileri

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ÖZET

Amaç: Pelvimetrik ölçümlerin, prostat kanseri sebebiyle açık radikal retropubik prostatektomi olan hastalarda operasyon süreleri üzerine etkisini araştırmak.

Gereç ve Yöntemler: 2014-2022 yılları arasında açık radikal retropubikprostatektomi yapılan ve radyolojik görüntülerine ulaşılan 60 hasta çalışmaya dahil edildi. Hastaların demografik özellikleri, patoloji raporları ve ameliyat notları kaydedildi. Hastaların operasyon öncesi çekilen düz grafileri, pelvik manyetik rezonans ve bilgisayarlı tomografi görüntüleri incelendi. Anterior-superioriliak çıkıntılar arası uzunlık (ASİÇU), transvers pelvik girim çapı (TPGÇ), intertuberoz uzunluk (İTU), anteroposterior pelvik girim çapı (APGÇ), pubik yükseklik (PY), superior pubis-mid-tuberoz nokta uzunluğu (SPMNU) ve infrapubik açı (İA) ölçümleri yapıldı. Ölçümlerin operasyon süresi üzerine etkileri değerlendirildi.

Bulgular: Hastaların ortalama yaşları 63,21±15,12, ortalama vücut kitle indeksleri 25,95±5,45 olarak bulundu. Hastaların ortalama prostat volümleri 52,15±21,2 mL, prostat spesifik antijenleri (PSA) 20,48±5,34 ng/ml ve operasyon süreleri 137,36±30,2 dakika olarak ölçüldü, 24 (%40) hastanın Gleason skoru 7 ve üzerinde idi, 20 (%33) hastada parmakla rektal muayene bulgusu vardı ve hastaların 18'i (%30) pT3 evredeydi. Pelvimetrik ölçümlerin operasyon süresi üzerine etkisi incelendiğinde ise ölçümlerle operasyon süresi arasında bir korelasyon saptanmamıştır.

Sonuç: Hastaların anatomik özellikleri açık radikal retropubik prostatektomi operasyonu üzerine etkili olabilir fakat çalışmamız sonucunda pelvimetrik ölçümlerin operasyon süresi üzerine bir etkisi saptanmamıştır.

Anahtar Kelimeler: *prostat kanseri, radikal prostatektomi, pelvimetrik ölçümler*

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This study was approved by the Samsun University, Ethics Committee of Clinical Research (Approval Number: 2023/5/4, Date: 2023-03-15). All research was performed in accordance with relevant guidelines/regulations, and informed consent was obtained from all participants.

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ABSTRACT

Objective: To investigate the effect of pelvimetric measurements on the operative time of patients who underwent open radical retropubic prostatectomy for prostate cancer.

Material and Methods: Sixty patients who underwent open radical retropubic prostatectomy between 2014 and 2022 and who seradiological images were accessed were included in the study. Demographic characteristics, pathology reports and surgery notes of the patients were recorded. Preoperative X-rays, pelvic magnetic resonance and computed tomography images of the patients were examined. Inter-antero superior iliac spine distance (IASISD), Transverse pelvic brim distance (TPBD), Inter tuberous distance (ITD), Anteroposterior pelvic brim distance (APBD), Pubic height (PH), Superior pubis to mid-tuberous point (SPMP) and Infrapubic angle (IA) measurements were made.The effects of the measurements on the operation time were evaluated.

Results: The mean age of the patients was 63.21±15.12, and the mean body massindex was 25.95±5.45.The mean prostate volume of the patients was 52.15±21.2 mL, prostate specific antigen (PSA) was 20.48±5.34 ng/ml, and the operation time was 137.36±30.2 minutes. 24 (40%) patients had a Gleasonscore of 7 and above, 20 (33%) patients had digital rectal examination findings and 18 (30%) patients were in pT3 stage. When the effect of pelvimetric measurements on the operation time was examined, no correlation was found between the measurements and the operation time.

Conclusion: The anatomical features of the patients may have an effect on the open radical retropubic prostatectomy operation, but as a result of our study, we did not find any effect of pelvimetric measurements on the operation time.

Keywords: *prostate cancer, radical prostatectomy, pelvimetric measurements*

AMAÇ

Açık radikal retropubik prostatektomi (RRP) operasyonları sırasında dar ve derin pelvisi olan hastalarda dokuya ulaşım ve cerrahi diseksiyon zorluğu ve cerrahi süresinin uzun olabileceği düşünülse de bu konuyla ilgili literatürde az sayıda veri bulunmaktadır.

Pelvimetrik ölçümler pelvisin çap, uzunluk ve açılarının görüntüleme yöntemleri kullanılarak değerlendirmesine dayanır ve esas olarak kadın doğum pratiğinde sefalopelvik uyumsuzluğu ve sezaryen doğum gerekliliğini belirlemek için kullanılır (1,2). Pelvik bölge ile ilgili diğer cerrahi disiplinlerde ihtiyaç duyulduğunda bu ölçümlerden yararlanabilir. Kanada'da yapılan bir çalışmada dar pelvisin kan transfüzyon oranları, operasyon süresi ve patolojik sonuçlar üzerine etkisi değerlendirilmiş ve transvers çapın daralmasının transfüzyon oranları ve operasyon süresi üzerine herhangi etkisi bulunmazken patolojik sonuçları olumsuz etkilediği bulunmuştur (3).

Açık RRP sırasında pelvis özelliklerinin operasyonla ilgili parametreleri etkileyebileceği düşünülmektedir. Biz de bu çalışmamızda çeşitli pelvis çap, uzunluk ve açılarının açık RRP operasyon süresi üzerine etkilerini değerlendirmeyi amaçladık.

GEREÇ VE YÖNTEMLER

Çalışmamızda SÜKAEK-2023 5/4 sayılı etik kurul onayı alındıktan sonra kliniğimizde 2014-2022 yılları arasında radikal prostatektomi açısından tecrübeli aynı cerrah tarafından açık RRP yapılan ve radyolojik görüntülemelerine ulaşılan 60 hasta retrospektif olarak değerlendirildi. Hastaların demografik özellikleri, patoloji raporları ve ameliyat notları kaydedildi. Pelvik bölgede anatomik bozukluğu olan hastalar ve kemik pelvis cerrahisi geçiren hastalar çalışma dışı bırakıldı. Hastaların operasyon öncesi çekilen düz grafileri, pelvik manyetik rezonans ve bilgisayarlı tomografi görüntüleri incelendi ve anterior-superioriliak çıkıntılar arası uzunluk (ASİÇU), transvers pelvik girim çapı (TPGÇ),intertuberoz uzunluk (İTU), anteroposterior pelvik girim çapı (APGÇ), pubik yükseklik (PY), superior pubis-mid-tuberoz nokta uzunluğu (SPMNU), infrapubik

açı (İA) ölçümleri üroloji hekimi tarafından yapıldı. ASİÇU; anterior ve superioriliak çıkıntıların medial yönleri arasındaki en geniş mesafe, TPGÇ; pelvik kenarın medial yönleri arasındaki en geniş mesafe, İTU; iskial tüberküllerin inferomedial yönleri arasındaki en geniş mesafe, APGÇ; pelvik ağzın en içteki ön ve arka yönleri arasındaki en geniş mesafe, PY; simfizis pubisin üst ve alt yönleri arasındaki en büyük mesafe, SPMNU; simfizis pubisin üst yönü ile İTÜ çizgisinin ortasındaki bir nokta arasındaki en büyük mesafe, İA; inferiorpubik ramiler arası açı olacak şekilde ölçüldü (Figür 1). Ölçümlerin operasyon süresi üzerine etkileri değerlendirildi.

İstatistiksel analizler IBM SPSS V23 yazılımı kullanılarak gerçekleştirilmiştir. Shapiro-Wilk ile verilerin dağılımı incendi. Pearson korelasyon analizi yapıldı.

BULGULAR

Hastaların ortalama yaşları 63,21±15,12, ortalama vücut kitle indeksleri 25,95±5,45 olarak bulundu. Hastaların ortalama prostat volümleri 52,15±21,2 mL, prostat spesifik antijenleri (PSA) 20,48±5,34 ng/ml ve operasyon süreleri 137,36±30,2 dakika olarak ölçüldü.

24 (%40) hastanın Gleason skoru 7 ve üzerinde idi, 20 (%33) hastada parmakla rektal muayene bulgusu vardı ve hastaların 18'i (%30) pT3 evredeydi. Ortalama transver çap 13,52±0,9 cm, ortalama infrapubik açı 101,98±11,2° olarak ölçüldü. Diğer pelvimetrik ölçümler ve hasta özellikleri Tablo 1'de gösterilmiştir. Pelvimetrik ölçümlerin operasyon süresi üzerine etkisi incelendiğinde ise ölçümlerle operasyon süresi arasında bir korelasyon saptanmamıştır (Tablo 2).

Tablo 1. Ortalama pelvimetrik ölçümler ve hasta özellikleri

	Ortalama (SD)
VKİ (kg/m^2)	25,95±5,45
Prostat volümü (mL)	52,15±21,2
Yaş (yıl)	63,21±15,12
PSA (ng/ml)	20,48±5,34
Operasyon süresi (dk)	137,36±30,2
ASİÇU (cm)	33,4±3,2
TPGÇ (cm)	13,52±0,9
iTU(cm)	5,10±0,8
APGÇ (cm)	10,66±1
PY (cm)	3,12±0,4
SPMNU(cm)	4,89±0,6
iA (°)	101,98±11,2
	N(%)
Biyopsi Gleason≥7	24 (40)
Pozitif PRM	20 (33)
pT3	18 (30)

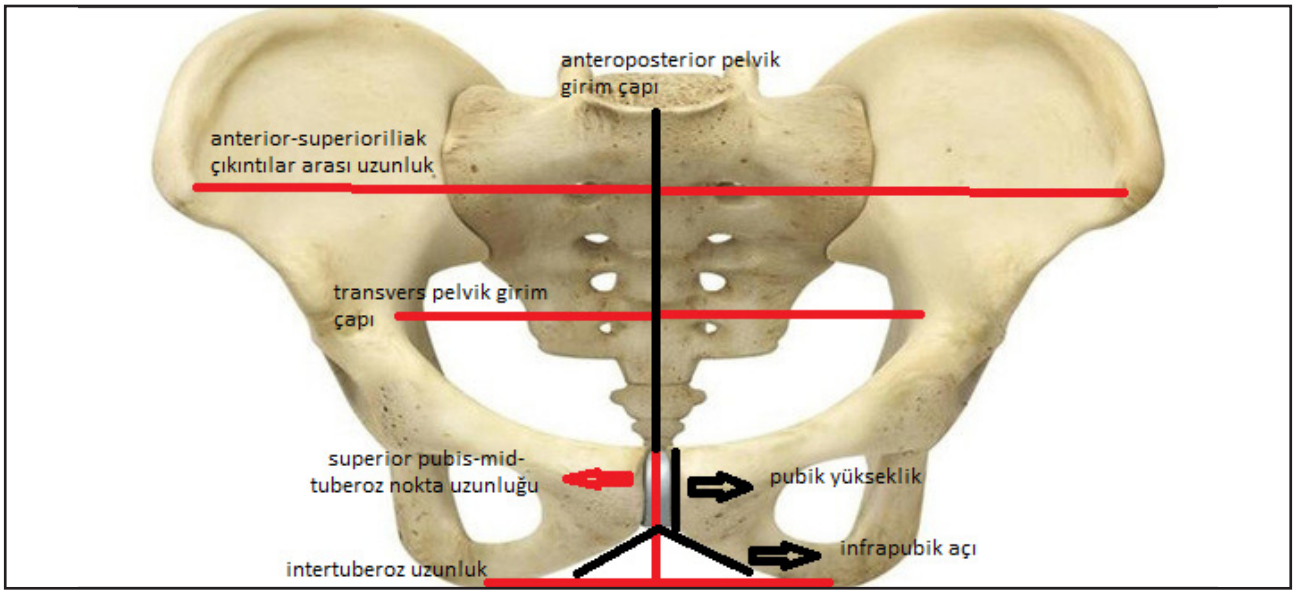
VKİ; *vücut kitle indeksi,* ***PSA;*** *prostat spesifik antijen,* ***ASİÇU;*** *anterior-superioriliak çıkıntılar arası uzunluk,* ***TPGÇ;*** *transvers pelvik girim çapı,* ***İTU;*** *intertuberoz uzunluk,* ***APGÇ;*** *anteroposterior pelvik girim çapı,* ***PY;*** *pubik yükseklik,* ***SPMNU;*** *superior pubis-mid-tuberoz nokta uzunluğu,* ***İA;*** *infrapubik açı*

Tablo 2. Pelvimetrik ölçümler ile operasyon süresinin korelasyon analizi

	ASİÇU	**TPGÇ**	**SPMNU**	**iTU**	**APGÇ**	**PY**	**İA**
CC	,195	,022	-,157	-,406	-,072	-,054	,222
p	,424	,928	,520	,085	,768	,827	,362

ASİÇU; *anterior-superioriliak çıkıntılar arası uzunluk,* ***TPGÇ;*** *transvers pelvik girim çapı,* ***İTU;*** *intertuberoz uzunluk,* ***APGÇ;*** *anteroposterior pelvik girim çapı,* ***PY;*** *pubik yükseklik,* ***SPMNU;*** *superior pubis-mid-tuberoz nokta uzunluğu,* ***İA;*** *infrapubik açı*

Figür 1. Pelvimetrik ölçümler



TARTIŞMA

Kemik pelvisin büyüklük ve şekli, özellikle kadın doğum pratiğinde önemli yeri olan ve travay ve doğumun gidişatını belirleyen önemli bir faktördür. Tarihsel süreçte çeşitli manuel yöntemlerle baş-pelvis uyumsuzluğu değerlendirilse de X-ray pelvimetrinin bulunması ile daha objektif ölçümler yapılmaya başlanmış ve uzun yıllar bu yöntem kullanılmıştır (4). Daha sonraki teknolojik ilerlemeler ile ultrasonografi, bilgisayarlı tomografi (BT) ve manyetik rezonans ile yapılan ölçümler ön plana çıkmıştır (5-7).

Pelvis anatomisinin açık RRP operasyonlarında önemli bir faktör olduğu belirtilse de bu konuda yapılan çalışmalar sınırlı sayıdadır. İlk olarak Wagner ve ark. external pelvimetrik ölçümlerin, RRP'de teknik zorluğu tahmin etmek için kullanılabileceğini belirtmiştir (8). Neill ve ark.'nın BT pelvimetrik ölçümlerin açık RRP üzerine etkilerini değerlendirdikleri 165 hastalık diğer bir çalışmada ise ölçümlerin operasyon süresi ve kan transfüzyonu ihtiyacını öngörmede herhangi bir etkisi olmadığı ortaya konmuştur (3). Bununla beraber transvers çapta her 8.6 mm azalmanın kapsül ihlaline bağlı oluşan pozitif cerrahi sınır olasılığını 5.3 kat artırdığı vurgulanmıştır. Japonya'dan yapılan bir çalışmada pelvik girim alanı ve prostat apex görünümünün kan kaybı üzerine etkileri operasyon öncesi görüntülemelerden elde edilen pelvimetrik ölçümlerle değerlendirilmiş ve geniş pelvik girim alanı olan, prostat apex görüş açısı iyi olan ve düşük VKİ olan hastalarda kan kaybı anlamlı olarak daha az bulunmuştur (9). Bizim çalışmamızda da Neill ve ark. nın çalışmasına benzer şekilde pelvimetrik ölçümlerle operasyon süresi arasında bir korelasyon saptanmamıştır.

Pelvis anatomisi etnik kökenlere göre de farklılık gösterebilmektedir (10). Bu anlamda Kafkasya ve Afikan-Amerikan kökenlilerin pelvimetrik ölçümleri ve bu ölçümlerin pozitif cerrahi sınır üzerine etkilerini araştıran bir çalışma sonucunda Afirikan-Amerikan erkeklerin daha küçük midpelvik alana ve daha dik simfizis açısına sahip olduğu belirtilmiş, buna bağlı olarak da derin pelvisi olan bu kökendeki erkeklerin apikal cerrahi sınır pozitiflik oranları daha yüksek bulunmuştur (11). Benzer şekilde Matikainen ve ark çalışmasında da apikal prostat derinliğinin cerrahi yöntemden (açık ya da laparoskopik) bağımsız olarakapikal cerrahi sınır pozitifliği için bağımsız bir prediktör olduğu ortaya konmuştur (12). Pelvik biometrik ölçümlerin yanında viseral yağ doku alanının kanser kontrolü, kontinans ve potens üzerine etkilerinin değerlendirildiği çalışmada simfizis açısının yanında viseral yağ doku alanının daha az olmasının da bu trifektayı olumlu etkilediği görülmüştür (13). vonBodman ve ark. da pelvimetrik ölçümlerin sinir koruyucu cerrahi ve erektil fonksiyonun düzelmesi üzerine herhangi bir etkisi olmadığını belirtmişlerdir (14).

Pelvimetrik ölçümler kadın doğum pratiğinde özellikle sefalopelvik uyumsuzluğu belirlemede sıklıkla kullanılsa da bu öçümlerinpelvik bölge ile ilgili diğer disiplinlerce de kullanılması cerrahi teknik açısından

faydalı olabilir. Açık RRP'de pelvisin anatomik özellikleri ile cerrahinin zorluğu arasındaki ilişki sıklıkla dile getirilse de bu konuda yapılan çalışmalar sınırlı sayıdadır. Biz de bu çalışmamızda pelvimetrik ölçümlerin açık RRP operasyon süresi üzerine etkilerini değerlendirmeye çalıştık. Retrospektif olması, hasta sayısı, hasta grubunun homojen olmaması ve pelvimetrik ölçümlerin etkileyebileceği diğer parametreleri değerlendirememiz çalışmamızın limitasyonları olarak gözükmektedir. Bu konuda yapılacak daha geniş çaplı çalışmalar bu ölçümlerin operasyon başarısı üzerine etkilerini daha ayırıntılı ortaya koyabilir.

SONUÇLAR

Pelvik alan ile ilgili cerrahilerde hastaların pelvislerinin anatomik özellikleri operasyonun teknik zorluğu ve başarısı açısından fikir verebilir fakat bizim çalışmamızda açık RRP olan hastalarda operasyon süresi açısından pelvimetrik ölçümlerin bir etkisi izlenmemiştir.

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Author Guidelines
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erginin editoryal ve yayın süreçleri, International Council of Medical Journal Editors (ICMJE http://www.icmje.org/recommendations/browse/publishing-and-editorial-issues/) yönergelerine göre şekillendirilmektedir.
Endoüroloji Bülteni yayıncılıkta şeffaflık ve en iyi uygulama ilkelerine uygundur (DOAJ https://doaj.org/apply/transparency/).
Bir yazının yayın için kabul edilmesinde en önemli kriterler özgünlük, yüksek bilimsel kalite ve alıntı potansiyelinin varlığıdır. Dergide yayınlanmak üzere gönderilen yazılar, daha önce başka bir yerde yayınlanmamış ve yayınlanmak üzere gönderilmemiş olmalıdır. Bir kongrede tebliğ edilmiş ve özeti yayınlanmış çalışmalar organizasyonun adı, yeri ve tarihi belirtilmek şartı ile kabul edilebilir.
Deneysel, klinik, ilaç çalışmalarının ve bazı vaka raporlarının araştırma protokollerinin Etik Kurul tarafından uluslararası sözleşmelere uygun olarak onaylanması (Dünya Tıp Birliği Helsinki Deklarasyonu "İnsan Denekleri ile İlgili Tıbbi Araştırmalar İçin Etik İlkeler" https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/) gereklidir. Gerekli görülmesi halinde yazarlardan etik kurul raporu veya bu rapora eşdeğer olan resmi bir yazı istenebilir.

- Üzerinde deneysel çalışma yapılan gönüllü kişilere ve hastalara uygulanan prosedürler ve sonuçları anlatıldıktan sonra onaylarının alındığını ifade eden bir açıklama yazının içinde bulunmalıdır.
- Hayvanlar üzerinde yapılan araştırmalarda acı ve rahatsızlık verilmemesi için yapılan uygulamalar ve alınan tedbirler açık olarak belirtilmelidir.
- Hasta onamı, etik kurulun adı, etik kurul toplantı tarihi ve onay numarası ile ilgili bilgiler makalenin "Gereç ve Yöntem" bölümünde de belirtilmelidir.
- Hastaların gizliliğini korumak, yazarların sorumluluğundadır. Hasta kimliğini ortaya çıkarabilecek fotoğraflar için, hasta ve/veya yasal temsilcileri tarafından imzalanan onayların alınması ve yazılı onay alındığının metin içerisinde belirtilmesi gereklidir.

Dergimize gönderilen tüm yazılar intihal tespit etme programı (iThenticate) ile değerlendirilmektedir. Benzerlik oranının %20 ve altı olması önerilmektedir.
Derginin Yayın Kurulu, tüm itirazları Yayın Etik Komitesi (COPE) kuralları çerçevesinde ele alır. Bu gibi durumlarda, yazarlar temyiz ve şikayetleri ile ilgili olarak yayın kuruluyla doğrudan iletişime geçmelidir. Gerektiğinde, dahili olarak çözülemeyen sorunları çözmek için bir ombudsman (bağımsız denetçi) atanabilir. Baş Editör, tüm temyiz ve şikayetler için karar verme sürecindeki nihai otoritedir.
Yazarlar, Endoüroloji Bülteni' ne bir makale gönderirken makalelerinin telif hakkını dergiye vermeyi kabul etmiş sayılır. Eğer yazarın çalışmasının basılması reddedilirse, yazının telif hakkı yazarlara geri verilir.
Endoüroloji Bülteni' ne gönderilen her makale, adı geçen yazarların tümünün imzaladığı yazar katkı ve yayın hakları devir formu ile birlikte gönderilmelidir. (https://dergipark.org.tr/tr/journal/3154/file-manager/17373/download)
Şekiller, tablolar veya hem basılı hem de elektronik formatlardaki diğer materyaller de dahil olmak üzere başka kaynaklardan alınan içeriği kullanan yazarların telif hakkı sahibinden izin almaları gerekir. Bu hususstaki hukuki, mali ve cezai sorumluluk yazarlara aittir.
Endoüroloji Bülteni'nde yayınlanan yazılarda belirtilen ifadeler veya görüşler yazarlara aittir. Editörler, editörler kurulu ve yayıncı, bu yazılar için herhangi bir sorumluluk kabul etmemektedir. Yayınlanan içerikle ilgili nihai sorumluluk yazarlara aittir.

Author Guidelines

Authors' credentials and e-mail addresses are not used for other purposes.

The submitted articles should be previously unpublished and should not be under consideration by any other journal.

If whole or a part of the submitted articles are presented in any congress, this should be noted in the submitted article.

The journal's Editorial Board handles all appeal and complaint cases within the scope of Committee on Publication Ethics (COPE) guidelines. In such cases, authors should contact the editorial office directly regarding their appeals and complaints. When needed, an ombudsperson may be assigned to resolve cases that cannot be resolved internally. The Editor in Chief is the final authority in the decision-making process for all appeals and complaints.

The editorial and publication processes of the journal are shaped following the guidelines of the International Council of Medical Journal Editors (ICMJE).

The journal conforms to the Principles of Transparency and Best Practice in Scholarly Publishing (DOAJ).

Originality, high scientific quality, and citation potential are the most important criteria for a manuscript to be accepted for publication. Manuscripts submitted for evaluation should not have been previously presented or already published in an electronic or printed medium. Manuscripts presented in a meeting should be submitted with detailed information on the organization, including the name, date, and location of the organization.

An approval of research protocols by the Ethics Committee following international agreements (World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects") is required for experimental, clinical, and drug studies and some case reports. If required, ethics committee reports or an equivalent official document will be requested from the authors.

- For manuscripts concerning experimental research on humans, a statement should be included that shows that written informed consent of patients and volunteers was obtained following a detailed explanation of the procedures they may undergo.
- For studies carried out on animals, the measures taken to prevent pain and suffering of the animals should be stated clearly.
- Information on patient consent, the name of the ethics committee, and the ethics committee approval number should also be stated in the Materials and Methods section of the manuscript.
- It is the authors' responsibility to protect the patients' anonymity carefully. For photographs that may reveal the identity of the patients, releases signed by the patient or their legal representative should be enclosed.

All submissions are screened by a similarity detection software (iThenticate), and the limitation without similarity is 20%.

When submitting a manuscript to Endourology Bulletin, authors accept to assign the copyright of their manuscript to the journal. If rejected for publication, the manuscript's copyright will be assigned back to the authors. Endourology Bulletin requires each submission to be accompanied by an Author Contribution&Copyright Transfer Form (available for download https://dergipark.org.tr/). Authors must obtain permission from the copyright holder when using previously published content, including figures, tables, or any other material in both print and electronic formats. In this regard, legal, financial, and criminal liabilities belong to the author (s).

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PREPARATION OF MANUSCRIPT
YAZININ GÖNDERİMİ

Makaleler yalnızca online olarak https://dergipark.org.tr/pub/endouroloji adresinden gönderilebilir. Başka bir yolla gönderilen yazılar değerlendirilmeye alınmayacaktır.
Dergiye gönderilen yazılar, öncelikle yazının dergi kurallarına uygun olarak hazırlanmasını ve sunulmasını sağlayacakları teknik değerlendirme sürecinden geçer. Derginin kurallarına uymayan yazılar, teknik düzeltme talepleri ile gönderen yazara iade edilir. Editör, ana metni değiştirmeden düzeltme yapabilir. Editör, yukarıda belirtilen şartlara uymayan makaleleri reddetme hakkını saklı tutar.
Yazarların aşağıdaki belgeleri göndermeleri gerekir:

- Yazar katkı ve Yayın Hakkı Devir Formu
- Bilgilendirilmiş Onam Formu
- ICMJE Çıkar Çatışması Formu
- Başlık Sayfası (Makale Başlığı, kısa başlık, yazarın adı, unvanı ve kurumu, sorumlu yazarın iletişim bilgileri, araştırmayı destekleyen kuruluş varsa kuruluşun adı)
- Ana belge (Tüm makalelerde, ana metinden önce de Özet bölümü yer almalıdır)
- Şekiller (JPEG formatı)
- Tablolar (en fazla 6 tablo)

Ana Belgenin Yayına Hazırlığı

Yazılar bilgisayar ile çift aralıklı olarak 12 punto büyüklüğünde ve Times New Roman karakteri ile yazılmalıdır. Her sayfanın bütün kenarlarında en az 2.5 cm boşluk bırakılmalıdır. Ana metin, yazarların adları ve kurulları hakkında hiçbir bilgi içermemelidir.
Yayın çeşitleri;

Araştırma Türü	Özet	Kelime Sayısı	Referans Sayısı	Tablo ve Figürler
Özgün Araştırma	250	4000	30	10
Derleme	250	5000	100	10
Olgu Sunumu	300	2000	20	10

Özgün makaleler yapılandırılmış bir Özet (abstract) (Giriş, Gereç ve yöntemler, Bulgular, Sonuçlar, Referanslar, Tartışma, gerekli ise Onam, Figürler; resim, grafik çizim, video, Tablolar) içermelidir.
Olgu sunumları için yapılandırılmış Özet gerekmez. Özet bölümü 300 sözcük ile sınırlandırılmalıdır. Özet de kaynaklar, tablolar ve atıflar kullanılamaz. Özün bittiği satırın altında sayısı 3-5 arasında olmak üzere anahtar kelimeler verilmelidir.
Türkiye dışındaki ülkelerden yazı gönderen yazarlar için Başlık, Özet, Anahtar Kelimeler ve yazıyla ilgili diğer bazı temel bölümlerin Türkçe olarak gönderilmesi zorunlu değildir. Bu bölümlerin çevirileri, yazarlar tarafından gönderilen özgün İngilizce metinler dikkate alınarak dergi editörlüğü tarafından yapılacaktır.
Makalede kullanılan tüm kısaltmalar, ilk kullanımda tanımlanmalıdır. Kısaltma, tanımı ardından parantez içinde verilmelidir.
Ana metinde bir ilaç, ürün, donanım veya yazılım programından bahsedildiğinde, ürünün adı, ürünün üreticisi, üretim şehri ve üreten şirketin ülkesi de dahil olmak üzere ürün bilgileri (ABD'de ise devlet dahil) parantez içinde verilmelidir.
Anahtar kelime seçimi için lütfen Index Medicus'un (MeSH) tıbbi konu başlıklarına bakınız: https://meshb.nlm.nih.gov/MeSHonDemand .
Tüm kaynaklara, tablolara ve şekillere ana metinde atıfta bulunulmalı ve kaynaklar, ana metinde geçen sıraya göre numaralandırılmalıdır. Kullanılan semboller, sembollerin standart kullanımlarına uygun olmalıdır.
Özgün Araştırma makaleleri klinik veya temel araştırma sonuçlarını içermeli, eleştirel okuyucular için kabul edilebilir olacak kadar iyi belgelenmelidir. En fazla 4000 kelime olmalı ve sırasıyla aşağıdaki başlıkları içermelidir;

- Başlık (hem Türkçe hem İngilizce)
- Özet (hem Türkçe hem İngilizce)
- Anahtar Kelimeler (hem Türkçe hem İngilizce)
- Giriş
- Gereç ve yöntemler
- Bulgular

- Tartışma
- Sonuçlar
- Şekillerin ve tabloların başlıkları (gerekirse)
- Kaynaklar

Olgu sunumları en fazla 2000 kelime olmalı ve sırasıyla aşağıdaki başlıkları içermelidir;

- Başlık (hem Türkçe hem İngilizce)
- Özet (hem Türkçe hem İngilizce)
- Anahtar Kelimeler (hem Türkçe hem İngilizce)
- Giriş
- Olgu sunumu
- Tartışma ve Sonuç
- Şekillerin ve tabloların başlıkları (gerekirse)
- Kaynaklar

Derlemeler yapılandırılmış olmalı, en fazla 5000 kelimeden oluşmalı ve sırasıyla aşağıdaki başlıkları içermelidir;

- Başlık (hem Türkçe hem İngilizce)
- Özet (hem Türkçe hem İngilizce)
- Anahtar Kelimeler (hem Türkçe hem İngilizce)
- Ana metin
- Sonuç
- Şekillerin ve tabloların başlıkları (gerekirse)
- Kaynaklar

Sistematik derlemeler için yazarla PRISMA yönergelerine uymalıdır; http://www.prisma-statement.org/documents/PRISMA%202009%20checklist.pdf

Editöre Mektuplar en fazla 1000 kelime olmalı ve aşağıdaki alt başlıkları içermelidir;

- Başlık
- Anahtar kelimeler
- Ana metin
- Şekillerin ve tabloların başlıkları (gerekirse)
- Kaynaklar

Şekillerin ve tabloların yayına hazırlığı

- Şekiller, grafikler ve fotoğraflar, makale yükleme sistemi aracılığıyla ayrı dosyalar (JPEG formatında) halinde sunulmalıdır.
- Dosyalar bir Word belgesine veya ana belgeye gömülmemelidir.
- Şeklin alt birimleri olduğunda; alt birimler tek bir görüntü oluşturmak için birleştirilmemelidir. Her alt birim, başvuru sistemi aracılığıyla ayrı ayrı sunulmalıdır.
- Şekil alt birimlerini belirtmek için görüntüler Arabik rakamlarla (1,2,3...) numaralandırılmalıdır.
- Gönderilen her bir şeklin en düşük çözünürlüğü 300 DPI olmalıdır.
- Şekillerin başlıkları ana belgenin sonunda listelenmelidir.
- Bilgi veya resimler hastaların tanımlanmasına izin vermemelidir. Kullanılan herhangi bir fotoğraf için hastadan ve/veya yasal temsilcisinden yazılı bilgilendirilmiş onam alınmalıdır.

Tablolar ana belgeye gömülmeli veya ayrı dosyalar halinde sunulmalıdır. Tablo sayısı altı adet ile sınırlandırılmalıdır. Tüm tablolar, ana metinde kullanıldığı sırayla art arda numaralandırılmalıdır. Tablo başlıkları ve açıklamaları ana belgenin sonunda listelenmelidir.

Kaynaklar

Kaynaklar yazıda kullanılan kaynaklar cümlenin sonunda parantez içinde belirtilmelidir. Kaynaklar makalenin sonunda yer almalı ve makalede geçiş sırasına göre sıralanmalıdır. Kaynaklar yazarların soyadlarını ve adlarının baş harflerini, makalenin başlığını, derginin adını, basım yılını, sayısını, başlangıç ve bitiş sayfalarını belirtmelidir. Altı ve daha fazla yazarı olan makalelerde ilk 3 yazardan sonrası için 'et al.' veya 've ark.' ifadesi kullanılmalıdır. Kısaltmalar Index Medicus' a uygun olmalıdır.
Kaynakların sonuna alıntı yapılan makalelerin doi linki eklenmelidir.

Örnekler

Makaleler için:

1. Tasci A, Tugcu V, Ozbay B, Mutlu B, Cicekler O. Stone formation in prostatic urethra after potassium-titanyl-phosphate laser ablation of the prostate for benign prostatic hyperplasia. J Endourol 2009;23:1879-81. https://doi.org/10.1089/end.2008.0596

Kitap için:

1.Günalp İ: Modern Üroloji. Ankara: Yargıçoğlu matbaası, 1975. Kitap bölümleri için: Anderson JL, Muhlestein JB. Extra corporeal ureteric stenting during laparoscopic pyeloplasty. Philadelphia: W.B. Saunders; 2003. p. 288-307

Web sitesi için;

Gaudin S. How moon landing changed technology history [Internet]. Computerworld UK. 2009 [cited 15 June 2014]. Available from: http://www.computerworlduk.com/in-depth/it-business/2387/how-moon-landing-changed-technology-history/

Bildiriler için;

Proceedings of the Symposium on Robotics, Mechatronics and Animatronics in the Creative and Entertainment Industries and Arts. SSAISB 2005 Convention. University of Hertfordshire, Hatfield, UK; 2005.

Tez için;

Ercan S. Venöz yetmezlikli hastalarda kalf kası egzersizlerinin venöz fonksiyona ve kas gücüne etkisi. Süleyman Demirel Üniversitesi Tıp Fakültesi Spor Hekimliği Anabilim Dalı Uzmanlık Tezi. Isparta: Süleyman Demirel Üniversitesi. 2016.

Geri Çekme veya Reddetme

Yazıyı Geri Çekme: Gönderilen yazının değerlendirme sürecinde gecikme olması vb. gibi gerekçelerle yazıyı geri çekmek ve başka bir yerde yayınlatmak isteyen yazarlar yazılı bir başvuru ile yazılarını dergiden geri çekebilirler.

Yazı Reddi: Yayınlanması kabul edilmeyen yazılar, gerekçesi ile geri gönderilir.

Kabul sonrası

Makalenin kabul edilmesi durumunda, kabul mektubu iki hafta içinde sorumlu yazara gönderilir. Makalenin baskıdan önceki son hali yazarın son kontrolüne sunulur. Dergi sahibi ve yayın kurulu, kabul edilen makalenin derginin hangi sayısında basılacağına karar vermeye yetkilidir.

Yazarlar, makalelerini kişisel veya kurumsal web sitelerinde, uygun alıntı ve kütüphane kurallarına bağlı kalarak yayınlayabilirler.

PREPARATION OF MANUSCRIPT

Manuscripts can only be submitted through the journal's online manuscript submission and evaluation system, available at https://dergipark.org.tr/ Manuscripts submitted via any other medium will not be evaluated.

Manuscripts submitted to the journal will first go through a technical evaluation process where the editorial office staff will ensure that the manuscript has been prepared and submitted following the journal's guidelines. Submissions that do not conform to the journal's guidelines will be returned to the submitting author with technical correction requests. The editor reserves the right to reject manuscripts that do not comply with the aforementioned requirements. Corrections may be done without changing the main text.

Authors are required to submit the following:

- Author Contribution&Copyright Transfer Form,
- Informed Consent Form
- ICMJE Disclosure of Interest Form
- Title Page (including Title of Manuscript, Running title, author (s) 's name, title, and institution, corresponding author's contact information, Name of the organization supporting the research)
- Main document (All articles should have an abstract before the main text).
- Figures (Jpeg format)
- Tables (max 6 tables)

Preparation of the Main Document

The articles should be written double-spaced in 12 pt, Times New Roman character and at least 2.5 cm from all edges of each page. The main text should not contain any information about the authors' names and affiliations.

Publication Types;

Type of Article	Abstract	Text (Word)	References	Table&Figures
Original Article	250	4000	30	10
Review Article	250	5000	100	10
Case Reports	300	2000	20	10

Original articles should have a structured abstract. (Aim, Material and Methods, Results, Conclusion). For case reports, the structured abstract is not used. Limit the abstract to 300 words. References, tables, and citations should not be used in an abstract. Authors must include relevant keywords (3-5) on the line following the end of the abstract. The Turkish title, abstracts, and Turkish keywords are not required for the international authors. The editorial office will provide these.
All acronyms and abbreviations used in the manuscript should be defined first, both in the abstract and in the main text. The abbreviation should be provided in parentheses following the definition.
When a drug, product, hardware, or software program is mentioned within the main text, product information, including the name of the product, the producer of the product, and city and the country of the company (including the state if in the USA), should be provided in parentheses.
All references, tables, and figures should be referred to within the main text, and they should be numbered consecutively in the order they are referred to within the main text. The symbols used must be nomenclature used standards.
Original Research Articles should be maximum of 4000 words and include subheadings below;

- Title (both in Turkish and English)
- Abstract (both in Turkish and English)
- Keywords (both in Turkish and English)
- Introduction
- Material and Methods
- Results
- Discussion
- Conclusions
- Figures and Tables Legend (if necessary)
- References

Case Reports should be maximum of 2000 words and include subheadings below;

- Title (both in Turkish and English)
- Abstract (both in Turkish and English)
- Keywords (both in Turkish and English)
- Introduction
- Case Presentation
- Discussion and Conclusion
- Figures and Tables Legend (if necessary)
- References

Literature Reviews should be maximum of 5000 words and include subheadings below;

- Title (both in Turkish and English)
- Abstract (both in Turkish and English)
- Keywords (both in Turkish and English)
- Main text
- Conclusion
- Figures and Tables Legend (if necessary)
- References

Letters to the editor should be maximum of 1000 words and should include subheadings below;

- Title
- Keywords
- Main text

- Figures and Tables Legend (if necessary)
- References

Preparation of the Figures and Tables

The submission system should submit figures, graphics, and photographs as separate files (in JPEG format).

- The files should not be embedded in a Word document or the main document.
- When there are figure subunits, the subunits should not be merged to form a single image. Each subunit should be submitted separately through the submission system.
- Arabic numbers should number images to indicate figure subunits.
- The minimum resolution of each submitted figure should be 300 DPI.
- Figure legends should be listed at the end of the main document.
- Information or illustrations must not permit the identification of patients, and written informed consent for publication must be sought for any photograph.

Tables should be embedded in the main document or submitted as separate files, but if tables are submitted separately, please note where it is suitable in the main text. Tables are limited to six tables. All tables should be numbered consecutively in the order they are used to within the main text. Tables legends should be listed at the end of the main document.

References

The references used in the article must be written in parenthesis at the end of the sentences. References should be numbered in the order they appear in the text and placed at the end of the article. References must contain surnames and initials of all authors, article title, name of the journal, the year, and the first and last page numbers. Articles with 6 or more authors 'et al.' are mixed with the first three authors. Abbreviations should be according to index Medicus.
Authors must add the DOI (Digital object identifier) at the end of each reference.

For Examples;
Article in journal: 1. Tasci A, Tugcu V, Ozbay B, Mutlu B, Cicekler O. Stone formation in prostatic urethra after potassium-titanyl-phosphate laser ablation of the prostate for benign prostatic hyperplasia. J Endourol 2009;23:1879-81. https://doi.org/10.1089/end.2008.0596
For Books: 1.Günalp İ: Modern Üroloji. Ankara: Yargıçoğlu matbaası, 1975. Chapters in books: Anderson JL, Muhlestein JB. Extra corporeal ureteric stenting during laparoscopic pyeloplasty. Philadelphia: W.B. Saunders; 2003. p. 288-307
For website; Gaudin S. How moon landing changed technology history [Internet]. Computerworld UK. 2009 [cited 15 June 2014]. Available from: http://www.computerworlduk.com/in-depth/it-business/2387/how-moon-landing-changed-technology-history/
For conference proceeding; Proceedings of the Symposium on Robotics, Mechatronics and Animatronics in the Creative and Entertainment Industries and Arts. SSAISB 2005 Convention. University of Hertfordshire, Hatfield, UK; 2005.
For Thesis; Ercan S. Venöz yetmezlikli hastalarda kalf kası egzersizlerinin venöz fonksiyona ve kas gücüne etkisi. Suleyman Demirel University Faculty of Medicine Sports Medicine Department Thesis. Isparta: Suleyman Demirel University. 2016.
Retraction or Reject; Manuscript Retraction: For other reasons, authors may withdraw their manuscript from the journal with a written declaration.

Manuscript Reject

The manuscripts which are not accepted to be published are rejected with explanations.

AFTER ACCEPTANCE

If the manuscript is accepted, the acceptance letter is sent within two weeks, the last version of the manuscript is sent to the author for the last corresponding. The journal owner and the editorial board are authorized to decide which volume of the accepted article will be printed.
Authors may publish their articles on their personal or corporate websites by linking them to the appropriate cite and library rules.

Peer Review Process
Yayın Değerlendirme Süreci

Çift-Kör Değerlendirme Süreci

1. Makale Başvurusu

İlgili yazar, makalesini Dergipark çevrimiçi sistemi aracılığıyla dergiye gönderir.

2. Editöryal Değerlendirme

Editörlük, ilgili makalenin derginin yazım kurallarına göre düzenlenip düzenlenmediğini kontrol eder. Bilimsel içeriği bu aşamada değerlendirmez.

3. Editör tarafından değerlendirme

Editör, makalenin orijinal olup olmadığını denetler. Değilse, makale ret edilerek süreç tamamlanır.

4. Hakem Daveti

Editör, makalenin bilimsel içeriğinin değerlendirilmesi için konu ile ilgili hakemlere davet gönderir. Genellikle 2 hakeme davet gönderilir. İlgili yazıyı hakemlerden birisi ret diğeri kabul ettiği takdirde, bölüm editörü uygun görürse üçüncü bir hakemin incelemesi için davetiye gönderebilir.

5. Davete Yanıt

Seçilen hakemler, daveti gönderilen yazıyı kendi uzmanlıklarına, çıkar çatışmalarına ve kullanılabilirlik durumlarına karşı gizli olarak değerlendirir. Daha sonra kabul veya reddetmektedirler.

6. İnceleme Süreci

Hakem, makaleyi çeşitli açılardan değerlendirdikten sonra (15 gün içerisinde) eleştiri ve önerilerini içeren hakem değerlendirme formunu editöre gönderir. Major veya minör revizyonlar sonrasında hakem yazıyı tekrar değerlendirmek istemiş ise öneri ve eleştiriler yazarlara iletilerek düzeltilmiş yazıyı tekrar sisteme yüklemeleri istenir. Bu süreç hakemin kabul veya ret cevabı verene kadar devam eder.

7. Derginin Değerlendirme Süreci

Bölüm Editörü, genel bir karar vermeden önce geri gönderilen tüm değerlendirmeleri dikkate alır. Hakem değerlendirme sonuçları çok farklıysa, editör bir karar almadan önce fazladan bir fikir edinmek için ek bir inceleme isteyebilir.

8. Kararın İletilmesi

Bölüm Editörü, yazı hakkındaki son kararına hakem isimleri gizlenerek hakem raporlarını da ekler ve yazara çevrimiçi sistem ve e-mail aracılığı ile gönderir.

9. Sonraki Adımlar

Makale kabul edilirse, dil editörüne gönderilir. Bu aşamalardan sonraki adımlar;

- Son kopya gönderisi
- Mizanpaj
- Düzeltmeler
- Yayınlanacak gönderilerin erken baskı olarak web sayfasına yerleştirilmesi
- Sayı oluşturulması
- İçindekiler sayfası düzenlenmesi
- Web sitesinde sayı olarak yayınlanması ve baskı

**Kurum içi değerlendirme sürecinde; çift kör değerlendirme sürecindeki adımlar izlenmektedir.*

The Double-Blind Peer Review Process

1. Submission of Paper

The corresponding author submits the paper via Dergipark online system to the journal.new

2. Editorial Office Assessment

Editorial Office checks the paper's composition and arrangement against the journal's Author Guidelines to make sure it includes the required sections and stylizations. The quality of the paper is not assessed at this point.

3. Appraisal by the Editor

Editor checks that the paper is appropriate for the journal and is sufficiently original and interesting. If not, the paper may be rejected without being reviewed any further.

4. Invitation to Reviewers

Editor sends invitations to individuals he or she believes would be appropriate reviewers. As responses are received, further invitations are issued, if necessary, until the required number of acceptances is obtained – commonly this is 2.

5. Response to Invitations

Potential reviewers consider the invitation as anonymous against their own expertise, conflicts of interest and availability. They then accept or decline. If possible, when declining, they might also suggest alternative reviewers.

6. Review is Conducted

The reviewer sets time aside to read the paper several times. The first read is used to form an initial impression of the work. If major problems are found at this stage, the reviewer may feel comfortable rejecting the paper without further work. Otherwise they will read the paper several more times, taking notes so as to build a detailed point-by-point review. The review is then submitted to the journal, with a recommendation to accept or reject it – or else with a request for revision (usually flagged as either major or minor) before it is reconsidered.

7. Journal Evaluates the Reviews

The Section Editor considers all the returned reviews before making an overall decision. If the reviews differ widely, the editor may invite an additional reviewer so as to get an extra opinion before making a decision.

8. The Decision is Communicated

The Section Editor sends a decision email to the author including any relevant reviewer comments as anonymous.

9. Next Steps

If accepted, the paper is sent to language Editor. If the article is rejected or sent back for either major or minor revision, the Section Editor should include constructive comments from the reviewers to help the author improve the article. At this point, reviewers should also be sent an email or letter letting them know the outcome of their review. If the paper was sent back for revision, the reviewers should expect to receive a new version, unless they have opted out of further participation. However, where only minor changes were requested this follow-up review might be done by the Section Editor. After these;

- Copyedit submission
- Layout
- Corrections
- Publishing the submissions on the web page as early print
- Creating issues
- Organize Table of Contents
- Publishing the issue on the web page and printing hardcopy

**We are applying the same steps on The Double-Blind Peer Review Process when we got the in-house submission.*

Prof.Nurettin Oktel St
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