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Comparison of Hydrocelectomy Techniques: A Retrospective Cohort Study on Surgical Outcomes, Complicatons and Recurrence Rates

Hidroselektomi Tekniklerinin Karşılaştırılması: Cerrahi Sonuçlar, Komplikasyonlar ve Tekrarlama Oranları Üzerine Retrospektif Bir Kohort Çalışması

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ABSTRACT Objective: The aim of this study was to compare the clinical success, complications, operative time, amount of bleeding, and aspirated hydrocele fluid rates of three different open surgical hydrocelectomy methods. **Material and Methods:** A total of 47 patients diagnosed with adult idiopathic hydrocele were retrospectively included in the study. Patients who underwent hydrocelectomy were divided into 3 groups. Group 1 underwent the Jaobulay or Wincklеman technique, Group 2 underwent the ONOL technique and Group 3 underwent the Eversion technique. The results of the patients were observed and recorded. The age of the patients, amount of aspirated hydrocele fluid, amount of bleeding, operation time were recorded and compared statistically. The 6th-month and 2nd-year postoperative hydrocele recurrence data of the patients were also statistically compared. **Results:** There was no difference between the groups in terms of age, amount of aspirated fluid and amount of bleeding ($p>0.05$). Among the operation times of the groups, Group 3 had a shorter operation time than the other 2 groups statistically. There was no difference between Group 3 and other groups in terms of Clavien-Dindo Grade 1 complication. No recurrent hydrocele was observed in any patient during follow-up. **Conclusion:** The eversion technique seems more advantageous in terms of duration, while both the eversion and ONOL techniques seem more advantageous in terms of complications.

Keywords: Hydrocelectomy; Jaobulay or Wincklеman technique; ONOL technique; eversion technique

ÖZET Amaç: Bu çalışmanın amacı, üç farklı açık cerrahi hidroselektomi yönteminin klinik başarısını, komplikasyonlarını, operasyon süresini, kanama miktarını ve aspire edilen hidrosel sıvı oranlarını karşılaştırmaktır. **Gereç ve Yöntemler:** Erişkin idiyopatik hidrosel tanısı almış toplam 47 hasta retrospektif olarak çalışmaya dâhil edildi. Hidroselektomi geçiren hastalar 3 gruba ayrıldı. Grup 1'e Jaobulay veya Wincklеman tekniği, Grup 2'ye ONOL tekniği ve Grup 3'e eversiyon tekniği uygulandı. Hastaların sonuçları gözlemlendi ve kaydedildi. Hastaların yaşı, aspire edilen hidrosel sıvı miktarı, kanama miktarı, operasyon süresi kaydedildi ve istatistiksel olarak karşılaştırıldı. Hastaların 6. ay ve 2. yıl postoperatif hidrosel nüks verileri de istatistiksel olarak karşılaştırıldı. **Bulgular:** Gruplar arasında yaş, aspire edilen sıvı miktarı ve kanama miktarı açısından fark yoktur ($p>0,05$). Grupların operasyon süreleri arasında, Grup 3 diğer 2 gruptan istatistiksel olarak daha kısa operasyon süresine sahiptir. Clavien-Dindo Grade 1 komplikasyonu açısından Grup 3 ile diğer gruplar arasında fark yoktur. Takip sırasında hiçbir hastada tekrarlayan hidrosel gözlenmedi. **Sonuç:** Eversiyon tekniği süre açısından daha avantajlı görünürken, eversiyon ve ONOL teknikleri komplikasyonlar açısından daha avantajlı görünmektedir.

Anahtar Kelimeler: Hidroselektomi; Jaobulay veya Wincklеman tekniği; ONOL tekniği; eversiyon tekniği

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A hydrocele is an unusual collection of serous fluid between the two layers of the tunica vaginalis surrounding the testis.[1] Hydrocele is a common benign scrotal swelling, affecting approximately one percent of the adult male population.[2] Hydrocelectomy is considered the gold standard treatment for hydroceles.[3] Surgical intervention is recommended in the presence of functional issues such as pain, discomfort, or disability attributable to the size, rather than for purely aesthetic concerns.[3]

Lord plication and Jaboulay procedure techniques are the classical surgical approaches that have been successfully performed in all cases.[4,5] Hydrocele surgery has a long history spanning several centuries. However, the specific techniques of Jaboulay and Lord were only described in 1902 and 1964, respectively.[4,5] Various novel approaches have been explored in contemporary literature, including Outpatient novel "Out-leaf" (ONOL) procedure and new minimally access hydrocelectomy (eversion technique).[6,7] Hydrocelectomy procedures involving eversion for hydrocele may cause some postoperative discomfort such as haematoma, swelling, pain and restriction of movement.[6,8] There is a controversy surrounding the treatment of hydrocele. Minimally invasive techniques such as aspiration and sclerotherapy are available, but hydrocelectomy remains the treatment of choice.[9]

Numerous studies have compared various surgical techniques or fundamental new approaches and widely utilized surgical methods.[6,10-12] Nevertheless, despite a high global caseload, there are few studies in the literature comparing various hydrocelectomy techniques. In this study, we compared the 3 most common hydrocelectomy techniques. This study was performed to clarify some of the claims of the recently described less invasive techniques and to fill the existing gap in the literature. In this study, we compared the operation time, clinical success, bleeding amount, aspirated hydrocele fluid rates and complications of three different hydrocelectomy methods. The primary aim of the study was to evaluate complication rates and the secondary aim was to evaluate factors such as operation time and amount of bleeding.

MATERIAL AND METHODS

Hydrocelectomy techniques performed in Antalya Training and Research Hospital between March 2019 and April 2020 were compared. Our observational cohort study complies with the 1964 Declaration of Helsinki and ethical standards. All procedures performed in studies involving human participants are in accordance with ethical standards. After approval of the University of Health Science Antalya Training and Research Hospital Ethics Committee (date: February 14, 2019, no: 5/2), a total of 47 patients diagnosed with adult idiopathic hydrocele were retrospectively included in the study. Excluded patients were those who did not want to participate in the study, used immunosuppressive therapy, had dermatological disorders, and had a history of inguinal hernia or scrotal surgery. Scrotal ultrasonography was conducted to exclude any additional intrascrotal pathological conditions. Patients with bilateral hydrocele and testicular tumors detected on scrotal ultrasound were excluded from the study. Clinical assessment comprised a thorough examination of the medical history and physical condition, including scrotal transillumination. All patients provided written consent for participation in the study.

Patients who agreed to undergo surgery were given brief information about surgical techniques. Patients who underwent hydrocelectomy were divided into 3 groups. Group 1 underwent the Jaobulay or Winckleman technique, Group 2 underwent the ONOL technique and Group 3 underwent the Eversion technique. All operations were performed by the same surgeon.[5-7]

The Jaboulay or Winkleman Procedure is a surgical technique used to treat hydrocele. Following the extraction of the testis through a tunica incision, most of the hydrocele sac is removed, leaving a small amount of tissue around the borders of the testicle. The remaining sac is then everted, and haemostasis is achieved by applying a continuous suture to close the exposed edges around the cord structures. The sutures are placed in a loose configuration around the cord in order to avoid any disruption to the vascular supply to the testis.

The ONOL procedure is as follows: This innovative outpatient procedure permits the removal of large

hydroceles via a minor skin incision, thereby reducing the risk of complications. The procedure is conducted under light sedation and local anaesthesia. A small volume of fluid is aspirated through a 15 mm transverse incision to relieve scrotal tension. Subsequently, the tunica vaginalis is dissected from the dartos layer, and gentle traction is employed to facilitate the delivery of the sac. The tunica vaginalis is excised circumferentially at its base using electrocautery, with minimal postoperative discomfort and a rapid recovery period.

The new minimal access hydrocelectomy (eversion technique) is as follows: A 2 cm incision is made in the scrotum, and the dartos muscle is incised with electrocautery. Then the parietal tunica vaginalis is grasped and blunt dissection is performed. A small incision is made to aspirate the hydrocele fluid, and a disk of tissue approximately twice the size of the incision is excised from the parietal tunica vaginalis. The edges of the tunica vaginalis are then sutured in an everted manner to the dartos. The visceral tunica is thus exposed towards the underlying scrotal skin.

All of the patients received spinal anesthesia. The procedure can be conducted under local anesthesia, necessitating concomitant pre-medication.[13] All surgeries were performed with 1 g cefazolin prophylaxis. The scrotum was meticulously cleaned with povidone-iodine with the patient in supine position. A transverse incision was then made in the scrotum with a scalpel. Following the appropriate operation, all tissues were submitted for pathological examination.

Penrose drains were placed in the lower poles of all patients except the ONOL technique (Group 2). A two-layer suture was applied, with the first layer involving the Dartos muscle and the next layer addressing the skin. Due to the demanding nature of the scrotum dressing, the dressings were secured with a standard bandage and pressure was applied. Oral analgesics were administered for several days.

Data such as age, aspirated hydrocele fluid volume, bleeding volume, and operative time were recorded. The 6th-month and 2nd-year postoperative hydrocele recurrence data of the patients were also statistically compared. Postoperative surgical complications were classified according to the Clavien-Dindo classification.

Drains were removed on postoperative day 1 in patients with drains. A dressing was applied to the wound, and the scrotum was dressed with a standard bandage for 5 days. Patients were discharged within 1-2 days and patients were not prescribed oral antibiotics. Patients were regularly monitored at 6-month intervals for a minimum of 24 months. We evaluated recurrence during follow-up by physical examination and scrotal ultrasound. Success is defined as the absence of scrotal fluid accumulation on palpation and scrotal ultrasound during the last follow-up. Failure defined as ipsilateral hydrocele recurrence diagnosed by physical examination and scrotal ultrasound.

STATISTICAL ANALYSIS

Statistical analyses were performed using SPSS 26.0 software (IBM, USA). A Pearson chi-square test (or Fisher's exact test when cell counts were low) was utilized to investigate the relationships between repair type and the categorical variables of interest. For assessing differences in continuous variables across the three repair types, a Kruskal-Wallis test was performed. A p-value below 0.05 was deemed statistically significant.

RESULTS

A total of 47 patients were included in the study. There were 19 patients in Group 1 (Jaobulay or Winckleman technique), 16 patients in Group 2 (ONOL technique) and 12 patients in Group 3 (Eversion technique) (Table 1). There was no difference between the groups in terms of age, amount of aspirated fluid and amount of bleeding ($p>0.05$). Among the operation times of the groups, Group 3 had a shorter operation time than the other 2 groups statistically. Group 2 also had a statistically shorter operation time than Group 1 ($p<0.05$). There was no complication other than Grade 1 complication according to the Clavien-Dindo classification. The most common Grade 1 complications in our study were pain, scrotal edema and hardening. A total of 23 patients had complications. Scrotal edema and hardening were observed in 10 patients in Group 1, 2 patients in Group 2 and 1 patient in Group 3. Other patients had only pain. In terms of Clavien-Dindo

TABLE 1: Comparison of preoperative, perioperative, and postoperative data of patients undergoing hydrocelectomy.

Parameters	Group 1 (n=19)	Group 2 (n=16)	Group 3 (n=12)	p-value
Age ($\bar{X}$±SD)	59.78±18.34	65.12±11.12	58.83±14.79	
(med, min-max)	58, (21-85)	65, (34-80)	62.5, (25-83)	0.541
Aspirated hydrocele fluid (cc) (med, min-max)	170 (100-450)	275 (150-450)	190 (170-350)	0.137
Bleeding amount (cc) (med, min-max)	10 (5-20)	10 (10-15)	10 (10-15)	0.545
Operation duration Min ($\bar{X}$±SD)	38.63±2.45a	30.12±2.96b	22±1.75c	<0.01
Postoperative Clavien-I Rate (%)	14/19 (73.68)a	5/16 (31.25)b	4/12 (33.33)a,b	0.02
6-Month Recurrence (%)	0/19 (0)	0/16 (0)	0/12 (0)	-
24-Month Recurrence (%)	0/19 (0)	0/16 (0)	0/12 (0)	-

Different superscript letters (a, b, c) indicate significant differences between the groups. Group Distribution: Group 1: Jaobulay or Winckleman Group 2: ONOL technique Group 3: Eversion technique; SD: Standard deviation.

Grade 1 complication, Group 1 had more complications than Group 2. Again, there was no difference between Group 3 and other groups in terms of Clavien-Dindo Grade 1 complication. No recurrent hydrocele was observed in any patient during follow-up. Postoperatively, neither hematoma nor wound infection was evident in any case. Mild scrotal edema typically subsided within a few days after the procedure.

DISCUSSION

Modern surgical techniques for hydrocele can generally divided into three main categories: eversion of the sac posterior to the testicle, excision of the sac and plication of the tunica.[14] During the performance of a Jaboulay procedure, the hydrocele sac must be removed through the scrotal incision. This dissection within the dartos layer is thought to play a role in the increased incidence of hematoma.[4]

The study conducted by the authors did not show a significant advantage of one surgical approach over the other in terms of recurrence rate.[14] Recurrence rates are similar to those in other studies. Studies indicate that hydrocele fluid is primarily formed by the visceral portion of the tunica vaginalis. A hydrocele develops when the parietal tunica loses its reabsorption capability. Therefore, the ideal surgical operation should permanently expose the hydrocele fluid to an absorbing surface. The unnecessary excision of the non-absorbing parietal layer of the tunica significantly increases morbidity. This study highlights that techniques such as the Lord technique, which do not involve dissection or excision of the sac, are superior and cause far fewer postoperative complications. Rodríguez et al. observed that extensive dissection and removal of the vaginal tunic resulted in 91% edema formation, whereas edema developed in only 10% to 20% of cases without dissection and removal. They stated that the additional morbidity associated with dissection of the hydrocele sac is unnecessary.[14]

Even less invasive techniques alternatives to Lord's procedure have been tried. These typically involve needle drainage combined with sclerotherapy or a variation of the Lord's technique, which creates a small opening in the tunica vaginalis, facilitating fluid drainage into the Dartos without necessitating the delivery of the testicle external to the tunica. Although these techniques show lower complication rates, they also reveal an unacceptably high recurrence rate.[15-17]

No difference in recurrence rates was found among the three different techniques for treating idiopathic hydrocele include the Jaboulay bottleneck method, hydrocelectomy, and the Lord technique. But complication rates were higher with the Jaboulay stenosis technique.[10] In our study, no cases of recurrent hydrocele were found in any of the operation groups at 6 and 24 months.

In the ONOL procedure the enlarged hydrocele sac is delivered via a small scrotal incision with limited dissection and excised following complete extraction.[6] A new outpatient procedure makes it easier

to remove large hydroceles without complications through a small skin incision, minimizing the potential for complications. This approach is associated with decreased postoperative scrotal discomfort, accelerated recovery, and a low recurrence risk.[6] No cases of scrotal hematoma, wound infection or severe scrotal edema have been reported due to minimal dissection of the scrotal incision and hydrocele sac. Another notable advantage of this technique preserves the testis by avoiding any handling or extraction from the scrotum. This eliminates the risk of torsion of the testis or spermatic cord. Theoretically, the removal of the tunica vaginalis using an eversion or extrusion method procedure may lead to the potential occurrence of testicular and spermatic cord torsion.[6] A total of 38 consecutive adult patients were treated using this technique and no post-operative hematoma and wound infection was observed.[18]

Numerous reports have supported the minimal access hydrocelectomy approach.[7] In addition, fenestration of the tunica has been completed, allowing the sac to engage with the lymphatic-rich subcutaneous tissue.[19] The new minimally access hydrocelectomy (eversion technique) involves minimal dissection and manipulation. It has led to no recurrence and very few complications, requiring a brief operative duration.[7] The average duration of this operative procedure was 15 minutes.[7] The average operative time for the ONOL technique was 27.3 minutes.[6] Jabouley's technique took longer due to the partial removal of the sac and the need to ensure hemostasis.[6] As in previous studies in our study, similar operation times were obtained and the shortest surgery time was 22 minutes in the group that used the eversion technique.

Saber performed a study comparing the clinical outcomes of Jaboulay's technique to his novel minimal-access method (the eversion technique).[11] The minimal-access group showed a more favourable complications, faster return to normal life, and enhanced cosmetic results compared to the traditional Jaboulay technique.[11] Minimally invasive maneuvers offer superior operative outcomes in terms of scrotal edema, patient satisfaction and hardening compared to standard eversion-excision hydrocelectomies.[11] The most common complications following scrotal surgery for hydrocele often include persistent swelling and hardening of the scrotum.[8] However, in the minimally invasive techniques observed in this study, scrotal swelling, hardening and the overall complications rate are significantly reduced compared to eversion-excision hydrocelectomy.[11] In our study in accordance with literature, scrotal edema and hardening were observed in 10 patients in Group 1, 2 patients in Group 2 and 1 patient in Group 3.

The rate of postoperative complications was 13.5%, including persistent edema, scrotal hardening, and wound infection.[7] The ONOL technique, considered a more minimally invasive approach to hydrocelectomy, resulted in scrotal hardening and persistent edema in over 9% of patients. This was attributed to the excision of the entire hydrocele sac.[6] A study examining all scrotal surgeries for benign conditions revealed an overall complication rate of 20%.[20] The overall complication rate in the eversion technique was lower compared to the Jaboulay procedure.[11] In less invasive techniques including the eversion technique and ONOL technique, the overall complication rate was less than that observed in eversion-excision hydrocelectomy.[8,20] In our study, the complication rates were higher in patients who underwent the Jaboulay procedure.

One of the recent studies compared sac excision hydrocelectomy using a vessel-sealing device with Jaboulay's technique.[12] Better patient satisfaction, shorter hospital stays and reduced postoperative edema were seen in the sac excision hydrocelectomy group.

No Clavien-Dindo Grade 2 and higher complications were observed in our study Patients reported that the most common problem after surgery was edema, which affected their recovery process.

The shortcomings of our study are that the groups did not consist of equal numbers of patients, patients could not be randomized, and power analysis could not be performed. One limitation of this study is the retrospective nature, which may introduce selection bias. Future prospective, randomized controlled trials with larger sample sizes are needed to validate these findings.

CONCLUSION

To our knowledge, this study represents the first comparison of these three hydrocelectomy techniques. The eversion technique seems more advantageous in terms of duration, while both the eversion and ONOL techniques seem more advantageous in terms of complications. Randomized controlled trials with more extensive participant groups are recommended to obtain more accurate results.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Yasin Aktaş, Mahmut Taha Ölçücü;* ***Design:*** *Mahmut Taha Ölçücü, Kayhan Yılmaz;* ***Control/Supervision:*** *Kaan Karamık, Mutlu Ateş;* ***Data Collection and/or Processing:*** *Şahin Kılıç, Murat Şambel;* ***Analysis and/or Interpretation:*** *Yasin Aktaş, Kaan Karamık;* ***Literature Review:*** *Yasin Aktaş, Kaan Karamık;* ***Writing the Article:*** *Yasin Aktaş;* ***Critical Review:*** *Kayhan Yılmaz, Murat Şambel, Şahin Kılıç;* ***References and Fundings:*** *Mahmut Taha Ölçücü;* ***Materials:*** *Yasin Aktaş, Mahmut Taha Ölçücü.*

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