

The Comparison of The Effects of The Anterior Preperitoneal Mesh Repair and Lichtenstein Procedure on Testicular Blood Flow and Volume in Patients with Inguinal Hernias

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ÖZET

Inguinal hernide anterior preperitoneal mesh tamiri ve Lichtenstein işleminin testiküler kan akımı ve testis hacmi üzerine etkilerinin karşılaştırılması

Amaç: Bu prospektif randomize çalışmada iki farklı inguinal herni tamir yöntemi olan anterior preperitoneal mesh tamiri ve Lichtenstein işleminin testiküler kan akımı ve hacmi üzerine etkileri araştırılmıştır.

Gereç ve Yöntem: Genel Cerrahi Kliniğine inguinal herni nedeniyle yatan ve ortalama yaşları 34.14 (20-45) olan 40 erkek hasta incelendi. Hastalar tamir yöntemlerine göre 1. Grup anterior preperitoneal mesh, 2. Grup Lichtenstein işlemi olmak üzere iki eşit gruba randomize olarak dağıtıldı. Tamir için her iki teknikte de polipropilen mesh (Prolene™ Mesh - Ethicon Inc) kullanıldı. Preoperatif dönem, postoperatif birinci ay ve altıncı ayda testis hacmi, testis kan akımı, pleksus pampiniformis venöz çapı, epididimal kanal çapı karşılaştırıldı.

Bulgular: Preoperatif ve postoperatif değerler arasında istatistiksel olarak anlamlı fark bulunmadı. Her iki teknikte de postoperatif benzer sonuçlar bulundu.

Sonuç: Herni tamirinde protez kullanımı ya da teknik spermatik kordun yapısal veya fonksiyonel bütünlüğüne etki göstermemektedir.

Anahtar kelimeler: inguinal herni, anterior preperitoneal mesh, Lichtenstein işlemi, testis kan akımı, testis hacmi

ABSTRACT

The comparison of the effects of the anterior preperitoneal mesh repair and lichtenstein procedure on testicular blood flow and volume in patients with inguinal hernias

Objective: In this prospective randomized study, the effects of two hernia repair techniques; anterior preperitoneal mesh repair and Lichtenstein procedure, on the testicular blood flow and testicular volume were compared.

Material and Methods: Forty male patients with the average age of 34.14 (range 20-45) who were admitted to the Clinics of General Surgery with inguinal hernia were evaluated. The patients were randomized, and divided into two equal groups; the 1st and the 2nd group had their hernia repair by anterior preperitoneal mesh repair technique, and Lichtenstein procedure, respectively. All of the prosthetic materials used for hernia repair were composed of polypropylene (Prolene™ Mesh - Ethicon Inc). Testicular volume, testicular blood flow, venous radius within the plexus pampiniformis, radius of epididymal duct, were considered to be the comparative criteria, and were measured in the pre-operative period, at the end of the 1st and 6th post-operative months.

Results: There were no statistically significant differences between pre-operative and post-operative values. Moreover, both surgical techniques were found to have similar post-operative results.

Conclusion: The utilization of prosthetic material or the technique used for hernia repair does not seem to interfere with the structural or functional integrity of the spermatic cord.

Key words: Inguinal hernia, anterior preperitoneal mesh, Lichtenstein repair, testicular blood flow, testicular volume

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INTRODUCTION

The reproductivity of men has been a major concern throughout the history of mankind; moreover, it is

accepted to be an important criteria of strength, and unfortunately, lack of reproductivity may result in an abrasive psychosocial pressure against the individuals in some communities. In such communities, the negative effects of groin hernia and its treatment on reproductive system may be the most important part of the conversation beyond the possible lethal complications, while the clinician is informing the patient about groin hernias and their treatment. A question arises at this point: is it more likely to have an impairment in reproductive functions with surgical treatment of a groin

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hernia than an untreated one? Therefore, the clinician should exactly know the short- and long-term results of the surgical procedure that is preferred in terms of informing the patient with evidence-based data. The utilization of prosthetic biomaterials for the surgical treatment of inguinal hernias, and the introduction of tension-free procedures are the mile stones of hernia surgery in the modern era (1). However, it is still unclear whether the prosthetic biomaterial leads to a structural or a functional insult to the anatomic structures within the spermatic cord such as neurovascular bundle, vas deferens, by the direct contact of the mesh or the mesh-induced fibrotic reaction in the inguinal region. In this prospective randomized study, we aimed to compare the effects of two hernia repair techniques both utilizing prosthetic biomaterial, the anterior preperitoneal mesh repair (APMR), and Lichtenstein procedure, on the testicular volume and blood flow.

MATERIAL AND METHODS

Forty male patients with unilateral inguinal hernia were selected among the patients who have been admitted to our hospital between February 2007 and July 2008. The approval of the study for ethical issues was taken from the Local Ethics Committee of the hospital. All of the patients had a detailed information given by attending surgeon about the treatment, and the content of the study. An informed consent form was obtained from each patient. The criteria for the selection of patients were; between 20-45 years of age; no prior sexual dysfunction; unilateral inguinal hernia, no history of previous hernia or inguinal region surgery (appendectomy, varicocele etc.); no co-morbidities that may affect the testicular blood flow such as hypertension, diabetes, vasculitis, collagen tissue diseases, hematologic diseases, and bleeding disorders; ASA Class I and II in the pre-operative evaluation; no abnormality diagnosed in pre-operative scrotal Doppler scan; no history of steroids or non-steroidal antiinflammatory drugs for any medical purposes. The patients were randomized, and divided into two equal groups. The 1st group (n:20) had APMR, and the 2nd group (n: 20) had Lichtenstein procedure. All of the operations have been carried out by the same surgical team. A single dose of 1 gr cephazoline sodium was administered to each patient just before the induction of

anesthesia for prophylaxis. All of the patients had only 1 lt of ringer lactate solution with 5% dextrose during the peri-operative course. Diclophenac sodium, 75 mg every 12 hours, was administered parenterally for analgesy, and none of the patients experienced a severe pain that had to be managed by narcotic analgesics. The patients were fed via oral route, and were mobilized within the first 6 hours after operation. All of the patients were discharged on the 1st post-operative day.

Operative Techniques

All of the patients were operated under general anesthesia for standardization of the study. The following steps of operations were similar in both operative techniques: a classical Bassini incision was made on the hernia side; subcutaneous tissues, superficial fascial structures, and external oblique aponeurosis was separated by sharp dissection, and spermatic cord was freed by blunt dissection; peritoneal sac was found, dissected, obliterated by a purse string suture, and returned to the abdominal cavity in indirect hernias; peritoneal sac was inverted, and the fascial defect was plicated by a purse string suture in direct hernias. In Group I, the steps given above were followed by separation of the transversalis fascia, and the preperitoneal space was dissected to the femoral canal. A 6x11 cm polypropylene mesh (Prolene™ mesh - Ethicon Inc) was placed beneath the transversalis fascia. The fascia was approximated in a continuous fashion with 2:0 polypropylene suture, and bites were taken from the middle of the mesh in order to provide mesh fixation, and to avoid folding of the mesh. Since the only patient with femoral hernia was in Group I, no additional repair was done. In Group II, the proximal half of 6x11 cm polypropylene mesh (Prolene™ mesh - Ethicon Inc) was divided vertically to create a gap for spermatic cord. The mesh was applied to the base of inguinal canal, and was fixed to inguinal ligament and conjoint area in a continuous fashion with 2:0 polypropylene sutures. Finally, the tails of the mesh was approximated with 2:0 polypropylene sutures leaving an adequate space for spermatic cord. In both groups, operations were ended with the steps below: the external oblique aponeurosis and subcutaneous tissues were approximated with 2:0 polyglycolic acid after delicate hemostasis; skin was closed with separate 3:0 polypropylene sutures. Inferior

epigastric vessels, ilioinguinal nerve, iliohypogastric nerve, and genital branch of genitofemoral nerve was identified and preserved in all of the patients.

None of the patients had a drainage catheter. Skin sutures were removed on the 7th post-operative day. All of the patients had scrotal Doppler scan in the pre-operative period, and were told to come back for control Doppler scan at the end of 10th, 30th, and 180th post-operative day. A detailed personal information has been obtained from each patient in order to make a regular surveillance. Scrotal Doppler scans of all patients in both pre- and post-operative periods were performed by the same radiologist. The parameters that have been investigated during scrotal Doppler scan were: the type and the content of hernia, testicular volume, testicular size, testicular echogenity, epididymal size, ductal radius, venous radius of plexus pampiniformis, functional or luminal abnormalities of plexus pampiniformis. Testicular blood flow was assessed by detailed investigation of testicular, epididymal, central, and capsular arteries. The parameters measured by scrotal Doppler scan for each artery were: peak end-systolic (Vmax) and end-diastolic (Vmin) arterial blood flow velocity ratio, resistivity index (RI), pulsatility index (PI), and S/D value. RI value, which is indirectly measured with the formula utilizing Vmax and Vmin [$RI = (Vmax - Vmin) / Vmin$], shows secondary response to vasodilatation, and has particular importance in compensation phase after a decrease in testicular blood flow. RI value is a functional result of Vmax and Vmin; it is affected by relatively less variables, and primarily shows the tissue response to testicular blood flow. Therefore, the sensivity of RI in assessing the testicular perfusion is higher than either Vmax or Vmin. RI and PI together help to measure quantitative value of distal resistance. All of the patients were evaluated for post-operative complications such as hematoma, seroma, surgical site infection, early recurrence, inguinal pain, and paresthesia in the end of post-operative 10th, 30th, and 180th days. The patients were advised to continue their daily physical activities without any restrictions unless they feel any pain or discomfort. Type of hernia, which was determined according to Nyhus Hernia Classification System, and the duration of operation of each patient was recorded. The mean follow-up period was 13.2 months (9-17). The incidence of early recurrence and long-term complications was recorded. NCSS 2007 & PASS 2008 Statistical Software

(Utah, USA) program was utilized to analyze the statistical data. In addition to defining statistical methods (median value, standard deviation), qualitative data of study groups that has normal distribution were compared by Student t Test. The comparison of parameters within each group was made with Paired Sample t Test. Quantitative data were compared by Chi-Square Test. $p < 0.05$ was considered to be statistically significant.

RESULTS

Group I includes 20 patients who had APMR, and Group II includes 20 patients who had Lichtenstein procedure. The median age in Group II was significantly higher than Group I ($p < 0.05$). The demographical data was given in Table 1. The hernia side was right-sided in 21 (52.5%) patients, and was left-sided in 19 (47.5%) patients. The distribution of hernia types were: 52.5% indirect, 42.5% direct, 2.5% pantaloon, and 2.5% indirect plus femoral (Table 1). There was no significant difference

Table 1: The demographical data of the patients.

	Group I Mean±SD	Group II Mean±SD	·p
Age (year)	31.40±7.78	36.76±6.91	0.025 *
Operative time (minute)	40.23±8.87	46.00±8.97	0.045 *
	n (%)	n (%)	†p
Hernia side			
left	9 (45.0%)	12 (60.0%)	0.342
right	11 (55.0%)	8 (40.0%)	
Hernia type (pre-operative)			
direct	6 (30.0%)	11 (55.0%)	0.122
indirect	13 (65.0%)	8 (40.0%)	
direct + indirect	0 (0.0%)	1 (5.0%)	
femoral + indirect	1 (5.0%)	0 (0.0%)	

SD: Standard deviation, ·: Student t test, †: Chi square test, * $p < 0.05$

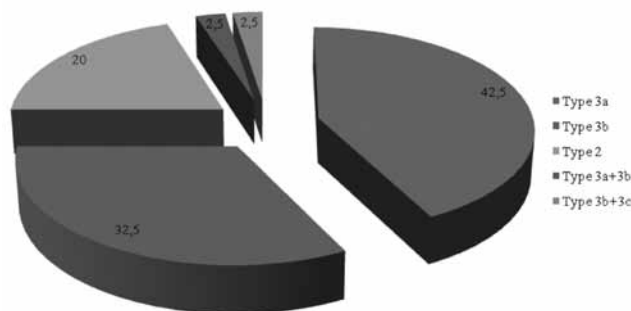


Figure 1: The distribution of hernias according to Nyhus Hernia Classification System.

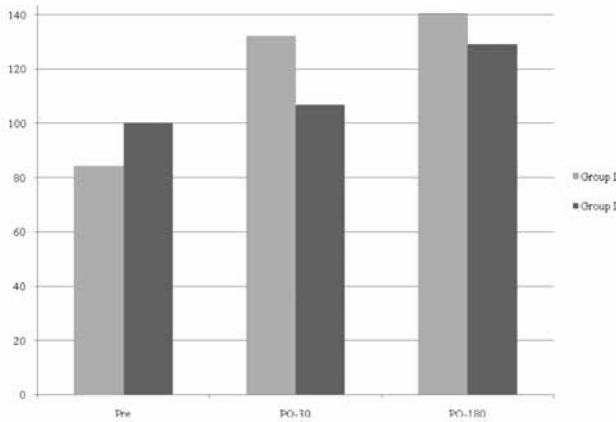


Figure 2: The comparison of testicular volumes.

Pre: Pre-operative period, PO-30: Post-operative 30th day
PO-180: Post-operative 180th day

epididimis measured in the post-operative 180th day was significantly higher than those measured pre-operatively ($p < 0.05$). In both groups, the ductal radii in the post-operative 30th day were found to be significantly higher than those in the pre-operative period ($p < 0.05$). In Group II, the radii of plexus pampiniformis veins in the post-operative 180th day were found to be significantly lower than those of pre-operative period ($p < 0.05$). There were no significant differences between the pre-operative and post-operative RI values of testicular and capsular arteries in both groups ($p > 0.05$). In Group I, however, we demonstrated a statistically significant increase between RI values of epididimal arteries ($p < 0.05$), and a statistically significant decrease between RI values of central arteries ($p < 0.05$) in the post-operative 30th and

Table 2: The comparison of pre- and post-operative data of 2 groups.

	TV		SE		DR		RPPV	
• p								
Pre	0.790	0.084	0.803	0.118				
PO-30	0.622	0.358	0.994	0.855				
PO-180	0.571	0.670	0.594	0.403				
• • p	I	II	I	II	I	II	I	II
Pre & PO-30	0.670	0.964	0.050*	0.500	0.010*	0.014*	0.017*	0.472
Pre & PO-180	0.044*	0.226	0.020*	0.010*	0.137	0.131	0.023*	0.015*
PO-30 & PO-180	0.066	0.242	0.319	0.029*	0.531	0.230	0.529	0.020

Pre: Pre-operative period, PO-30: Post-operative 30th day, PO-180: Post-operative 180th day, TV: testicular volume, SE: The size of the epididimis, DR: Ductal radii, RPPV: The radii of plexus pampiniformis veins

between the locations and the distribution of types of hernias between 2 groups ($p > 0.05$). All of the hernias were classified according to Nyhus Hernia Classification System in the peri-operative course (Figure 1). According to pre-operative data, there was no significant difference between the testicular volumes of the patients in Group I ($p > 0.05$). While the comparison of testicular volumes measured in the pre-operative period and the post-operative 30th day was found to be similar ($p > 0.05$), as was the comparison of the post-operative 30th and 180th days ($p > 0.05$), testicular volumes measured in the post-operative 180th day were significantly higher than those measured in the pre-operative period ($p < 0.05$). In Group II, testicular volumes were demonstrated to be similar in the pre-operative and all of the post-operative controls ($p > 0.05$) (Figure 2). There was no significant difference between the size of epididimis of patients in both groups measured in the pre- and post-operative evaluations ($p > 0.05$). In both groups, however, the size of

180th days. The comparison of these data is summarized in Table 2. The overall complication rate was 12.5%, and the mortality rate was 0% for totally 40 inguinal hernia repair procedures. To date, seroma in 4 patients, scrotal edema in 1 patient was observed. Of 4 patients who developed seroma, 3 of them which is statistically insignificant ($p > 0.05$) were in Group II. The patient who had post-operative scrotal edema was in Group II, and scrotal edema was successfully managed with anti-inflammatory drugs and scrotal elevation. None of the patients had ischemic orchitis, testicular atrophy, urinary retention, urinary tract infection, and hemorrhage due to vascular injury in the post-operative period.

DISCUSSION

In the late 1980s, tension-free procedures with prosthetic biomaterials has gradually gained popularity; since then, the clinicians were encouraged to find out

an ideal method that would minimize the recurrence rates, shorten the hospital stay, and minimize or put away the post-operative pain. Mesh repair offers not only a tension-free repair but also the reinforcement of the base of inguinal canal by creating a new internal ring and posterior wall (2). However, there is an important question about the mesh repairs that has to be enlightened: does the utilization of prosthetic biomaterials have any negative effects on structural or functional integrity of the neurovascular structures and vas deferens within the inguinal canal by direct contact or fibrotic reaction of the prosthetic biomaterial? In this prospective randomized study, we aimed to compare the effects of APMR and Lichtenstein procedure, both utilizing polypropylene mesh, on testicular volume and blood flow in inguinal hernia surgery. In contrast to Lichtenstein procedure, the mesh is applied posteriorly to the transversalis fascia within the preperitoneal space in APMR; therefore, we have an optimistic expectation that APMR may have some advantages such as the preservation of natural anatomy in the inguinal canal, and the minimalization of adverse effects of mesh on spermatic cord structures due to direct contact or peri-mesh fibrotic reaction by means of preperitoneal placement of the mesh.

In an experimental study, Uzzo et al. found no significant difference between testicular volumes, testicular temperatures, testicular blood flows, and vasograms of the subjects which had Lichtenstein and Shouldice procedures (3). In the histopathological examination, however, it was demonstrated that spermatogenesis in testicles was not affected, and the intraluminal radius of vas deferens decreased considerably due to the thickening of muscular layer, while there was no erosion or stenosis at the anatomic structures within the spermatic cord including vas deferens. Peiper et al. compared Lichtenstein and Shouldice procedures in order to investigate the effects of polypropylene mesh on anatomic structures of inguinal canal in 2 different experimental studies (4,5). In contrast with Uzzo et al, they observed that there was a significant decrease in arterial perfusion of testicles, testicular temperature, and Johnsen scores (a qualitative scoring system for spermatogenesis) in subjects which had Lichtenstein procedure when compared with the subjects in control and Shouldice procedure groups. However, testicular volume was found to be increased in both treatment

groups. They concluded that polypropylene mesh could have negative effects on anatomic structures within the inguinal canal, and therefore, could be used in selected cases with caution. In literature, there are numerous experimental studies investigating the effects of prosthetic biomaterials on hormonal and histological responses of anatomic structures such as testicular vessels, testicles, epididymis, and vas deferens within the inguinal canal (6- 10). Turgut et al. evaluated 48 patients with unilateral groin hernia by scrotal Doppler scan in the pre-operative period (11). Both testicles were evaluated in the study, and testicular volume and RI of intratesticular arteries were found to be significantly higher at the hernia side. According to the data, they suggested that, this difference could be the result of intermittent mechanical compression of spermatic cord within the inguinal canal. Shin et al. built a comprehensive multicentric study lasting 4 years, and including 8 medical institutes in USA (12). The characteristics and the operative findings of the patients were reviewed retrospectively. The study was based on 14 patients who had a tension-free repair for inguinal hernia with polypropylene mesh, and developed azoospermia due to inguinal vasal obstruction after surgery. Of these 14 patients, 10 had conventional, 2 had laparoscopic, and 2 had conventional plus laparoscopic repair. Surgical reconstruction of vas deferens was performed to 8 of 14 patients. Of note, surgical treatment of male infertility due to mechanical vasal obstruction by fibrotic reaction is a difficult procedure, and usually have upsetting outcomes. Therefore, the authors concluded that the young patients who would have inguinal hernia surgery, particularly with mesh, should be given a detailed information prior to surgery about the risk of developing infertility secondary to vasal obstruction. Of note, the actual anatomopathological mechanism of inguinal vasal obstruction still continues to be a mystery. Durmus et al. compared 3 hernia repair procedures, namely posterior wall darn, Lichtenstein procedure, mesh plug repair, in their prospective randomized study including 30 patients (13). The patients were divided into three equal groups, and end-systolic and end-diastolic testicular blood flow velocity (V_{max} , V_{min}), testicular volume, and RI of all patients was measured in the pre-operative period, and the post-operative 5. and 180. days. They found no significant difference between pre- and post-operative investigations. Similar results were reported in various

studies (14-22). Beddy et al. suggested that inguinal hernias could lead to an alteration in testicular blood flow which could result in decreased fertility (22,23). Moreover, Yavetz et al. reviewed 8500 infertile patients with or without testicular atrophy, and demonstrated that 565 of 8500 (6.65%) had a previous groin hernia surgery (24).

According to data of the present study, the parameters assessed by scrotal Doppler scan in patients who had Lichtenstein procedure are consistent with those in literature. The APMR was found to have similar results with Lichtenstein procedure; however, APMR was demonstrated to have positive effects such as an increase in testicular volume on the postoperative 180th day without arterial or venous stasis, a decrease

in RI values of central arteries, and a decrease in radii of pampiniform plexus veins in early post-operative period. These findings suggest that both procedures do not have a negative effect on the physiological and the anatomic integrity of structures within the inguinal canal, and furthermore, APMR seems to lead to an improvement in those mentioned. However, long-term surveillance of such patients is necessary to get more precise conclusions.

Tension-free repair of inguinal hernia by the anterior preperitoneal mesh repair, in which a polypropylene mesh is applied posteriorly to the transversalis fascia, is a perfect alternative to Lichtenstein procedure in terms of protection, or perhaps improvement, of physiological and anatomic aspects of reproductive system.

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