Comparison of Polypropylene Mesh and Primary Repair in the Treatment of Blunt Testicular Rupture

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Purpose: This study aimed to show the applicability of Polypropylene mesh (PM) grafting in blunt testicular ruptures.

Materials and Methods: Data of 16 patients treated for testicular rupture following blunt scrotal trauma between March 2007 and April 2015 were analyzed retrospectively. Eight primary repairs and eight PM graftings were performed to repair the tunica albuginea (TA). Postoperatively, patients underwent Doppler ultrasonography at 3 weeks and then at 3, 6, and 12 months, followed by annual scans. The measurement of plasma testosterone levels was performed 12 months after the surgery.

Results: The average follow-up time was 24.8 (range 12–48) and 42.8 (range 14–75) months for patients treated with PM grafting and primary repair, respectively. Differences in testicular size between treatment groups were only significant at 12 months postoperatively with the value of 26.5 mL (range 24–28) and 22.8 mL (range 13–27) in patients treated with a PM graft and primary repair, respectively (P = .045). There were no complications for those patients treated with the PM graft. Two patients who underwent primary repair developed testicular atrophy within 1 year postoperatively.

Conclusion: PM grafting is a safe alternative to primary closure of a TA defect following blunt testicular trauma.

Keywords: etiology; rupture; testis injuries; urogenital surgical procedures.

INTRODUCTION

Testicular rupture is a tear in the tunica albuginea (TA), and for this reason it is a surgical emergency. Scrotal trauma comprises less than 1% of all trauma-related injuries. The primary etiologies of scrotal trauma include blunt, penetrating, degloving, and electrical burn injuries to the scrotal contents[1,2]. Both penetrating and blunt traumas can cause testicular rupture[3,4]. Specifically, blunt trauma accounts for 75% of testicular injuries[5]. Individuals aged 10–30 years are the most vulnerable group to testicular trauma[6]. There are serious repercussions if a testicular rupture is missed. Although not life-threatening, loss of a testicle could impair future fertility, contribute to a hypogonadal state, and affect the psychosocial wellbeing of the patient[1]. The surgeon should attempt to salvage/preserve any viable tubules, as studies have revealed reduced endocrine abnormalities and improved semen quality when tubules are preserved, as compared to orchiectomy[6]. The standard treatment of testicular rupture is early exploration and debridement. If testicular rupture intervention occurs within the first 72 hours, the chance of saving the testes is 90%, whereas it drops to 30% after 72 hours[7,8]. In some cases, closure of the TA might not be possible if the seminiferous tubules are swollen or the tear in the tunica is large. In these cases, alternative closure methods are available. This study reports the results of treatment of testicular rupture with primary repair versus polypropylene mesh (PM) grafting. Long-term results were also evaluated.

MATERIALS AND METHODS

Data of 16 patients treated for testicular rupture following blunt scrotal trauma between March 2007 and April 2015 were analyzed retrospectively. Eight patients underwent PM grafting and eight underwent a primary repair. The study included 5 pediatric and 11 adult patients. The patients' age, cause of scrotal trauma, clinical findings, imaging results, time between trauma and hospital admission, operative findings, and postoperative outcomes were evaluated. Patients with penetrating or gunshot testicular trauma and those with an avulsion of the scrotum were excluded from this study.

Surgery Procedures

All patients were evaluated with Doppler ultrasound (US) and with preoperative and intraoperative physical examination. Following scrotal trauma, sufficient exposure was obtained via the injury or through a midline vertical incision, and the scrotal hematoma was evacuated (**Figure 1**). Nonviable and extruded seminiferous tubules were debrided. The rupture in the TA was then revealed. If the TA could be re-approximated, a primary repair was performed with 3-0 polydioxanone. If the tunica could not be re-approximated, or if a change in color of the testicular tissue was observed, a 1 mm thick PM graft was positioned and attached with 3-0polydioxanone sutures (**Figure 2**). A paratesticular penrose

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Table 1. Characteristics of patients who underwent primary repair and/or polypropyl mesh grafts on blunt type testicular rupture.

Treatment Technique	Patient	Age	Cause of Injury	Side Intervention	Time (hours)	Complications
Polypropylene mesh grafts	1	13	Fight	Right	36	-
	2	14	Fight	Left	12	-
	3	35	Occupational accident	Right	6	-
	4	34	Fight	Right	18	-
	5	23	Sports	Left	12	-
	6	26	Sports	Right	6	-
	7	16	Sports	Left	12	-
	8	49	Fight	Left	4	-
Primary repair	9	16	Fight	Right	12	Testicular atrophy
	10	28	Fall from height	Righ	t 24	-
	11	16	Sports	Left	6	-
	12	24	Fight	Left	8	Testicular atrophy
	13	19	Sports	Right	4	-
	14	21	Fight	Right	6	-
	15	18	Sports	Right	5	-
	16	24	Motorcycle accident	Right	8	-

drain was also placed, and removed within 24–48 hors. Immediately after the operation, the scrotum was elevated, iced, and anti-inflammatory therapy was started.

Follow-up

Postoperatively, patients underwent Doppler US once in 3 weeks and then once in 3, 6, and 12 months, followed by annual scans (**Figure 3**). The average follow-up period was 24.75 months (range 12–48) for patients who underwent PM grafting, and 42.75 months (range 14–75) for patients who underwent primary repair. Two of the patients, one from each group, moved to another city after one year. For this reason, one-year follow-up results of the patients were given in the study. Testicle size and echogenicity, as well as the state of the PM grafts, were assessed during follow-up. A normal testis is 4–5 cm long, 3 cm wide, and 2.5 cm thick, with a volume of 30 mL[9]. The postoperative testicular volume was calculated from US measurements using the empirical formula of Lambert (length × width × height × 0.71)[10]. The level of plasma testosterone was measured at 12 months postoperatively to evaluate hormonal status. Total testosterone was measured by electro-chemiluminescence immunoassay (ECLIA).

Statistical Analysis

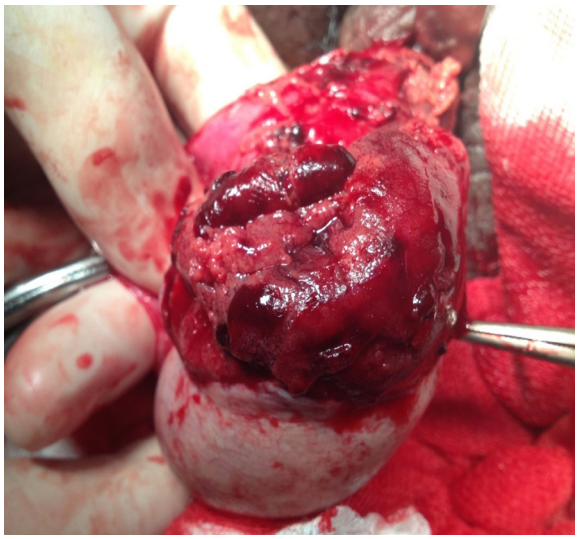

Figure 1. The testicular tissue extruded in scrotal exploration after blunt trauma.

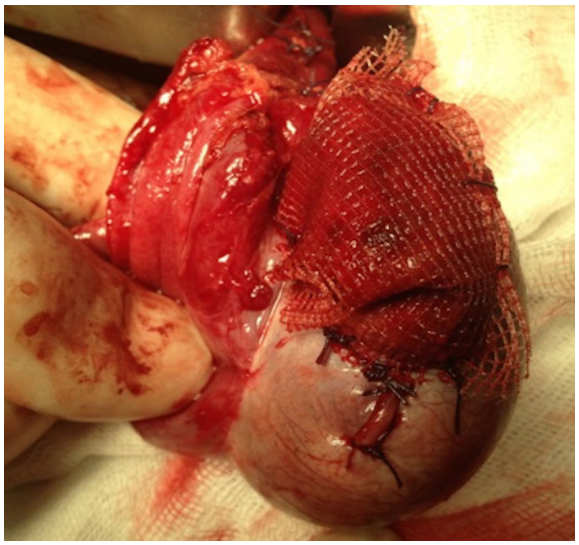

Figure 2. The polypropylene mesh graft in place.

Table 2. Testicular volume at follow-up.

Time of US	Primary Repair Group	Polypropylene Mesh Group	*P* Value
3 weeks	27.6 (25–30) mL	27.2 (25–30) mL	.667
3 months	24.4 (17–28) mL	27 (24–29) mL	.179
6 months	23.8 (16–26) mL	26.6 (24–28) mL	.060
1 year	22.8 (13–27) mL	26.5 (24–28) mL	.045

Abbreviation: US, ultrasonography.

Statistical analyses were performed using the Statistical Package for the Social Science (SPSS Inc, Chicago, Illinois, USA) version 13.0. The Mann–Whitney U-test, the nonparametric equivalent of Student's t-test, was used to compare differences between the independent groups. As the sample size was less than 10, the use of a non-parametric test was more suitable. A P value less than .05 was considered statistically significant.

RESULTS

Overall, the mean interval between injury and surgery was 11.2 hours (range 4–36). When evaluating the group-specific time interval, it was 9.1 hours (range 4–24) for primary repair and 13.25 hours (4–36) for PM repair. This difference was not significant (P = .286). The cause of testicular rupture was a fight with blunt trauma in seven patients (43%) and sports injuries in six patients (37.5%), primarily being struck by a ball or a foot during a football match. Of the remaining three patients, one was injured in an occupational accident (6%), one was injured in a fall (6%), and one was injured in a motorcycle accident (6%). None of the patients suffered additional organ trauma (**Table 1**). Patients who underwent PM grafting had an average age of 26.25 years (range 13–49) and were followed for an average of 24.75 months (range 12–48), postoperatively. Four PM graft patients had a right testicular rupture and four had a left testicular rupture. The average hospital stay for a PM graft patient was 3.37 days (range 2–5). Patients who underwent primary repair had an average age of 20.75 years (range 16–28) and were followed for an average of 42.5 months (range 14–75), postoperatively. Six (75%) primary repair patients had a right testis rupture and two had a left rupture. The hospital stay for primary repair patients averaged 3.25 days (range 2–5). The average testis sizes on follow-up Doppler US for patients who underwent PM grafting were 27.2 (range 25–30), 27 (range 24–29), 26.6 (range 24–28), and 26.5 (range 24–28) mL at 3 weeks and 3, 6, and 12 months after operation, respectively (**Table 2**). For patients who underwent primary repair, the average sizes were 27.6 (range 25–30), 24.4 (range 17–28), 23.8 (range 16–26), and 22.8 (range 13–27) mL at 3 weeks and 3, 6, and 12 months after operation, respectively. Differences in testicular size between treatment groups were only significant at 12 months postoperatively (P = .045). Two of the patients who underwent primary repair developed testicular atrophy. The testicular volumes for these two patients 12 months after surgery were 13 and 15 mL. The interval between testicular trauma and hospital admission was 8–12 hours, and there was no relationship between the timing of surgical intervention and the development of atrophy. There were no significant differences in the time interval between admission and surgery for the two treatment groups (P = .238). Plasma testosterone levels were measured after 12 months postoperatively to evaluate hormonal status. The mean testosterone level was 492.5 ng/dL (range 320–750) in patients who underwent PM grafting and 478 ng/dL (range 280–780) in patients who underwent primary repair. No significant difference was found in the testosterone levels of the two treatment groups (P = .527).

Figure 3. The Doppler ultrasonography photograph, taken six months after treatment of a patient who was treated with polypropylene mesh for blunt testicular trauma.

DISCUSSION

Blunt scrotal trauma can result in a variety of injuries including testicular rupture, torsion, dislocation, hematoma, or contusion, as well as epididymal, scrotal, and urethral injuries. If not diagnosed aggressively and repaired surgically, testicular rupture can lead to testicular atrophy and loss[11]. The maximum preservation of viable testicular tissue is essential, because subfertility is a late complication of testicular trauma[12]. To avoid debriding viable testicular tissue, a graft can be used to cover the defect[13]. The standard treatment of testicular rupture is early surgical exploration and an attempt to save the testis[1]. The hematoma is evacuated intraoperatively, extruded seminiferous tubules are debrided, and the TA is closed pri-

marily. If the completion of these steps is not possible, alternative methods include using a free graft of tunica vaginalis or a vascularized tunica vaginalis graft[8,14]. For adolescent patients with testicular rupture due to blunt trauma, Cubillos and colleagues found that rest, antibiotic treatment, and a conservative approach with serial US follow-ups is suitable if no atrophy develops[4]. Chandra and colleagues reported that patients with blunt scrotal trauma should undergo scrotal exploration, without US, if there is a hematocele, and that the maximum tissue is saved if exploration is performed within 72 hours[7]. Although successful, non-operative management has recently been reported. This approach is traditionally thought to be associated with a greater risk of infection, testicular atrophy, and resulting orchiectomy. The standard treatment for testicular rupture remains early exploration and debridement to attempt testicular salvage[4,5]. Polypropylene meshes are a type of non-absorbable mesh[15]. The use of synthetic meshes as a means of strengthening the abdominal wall was popularized after the work by Usher and Gannon in a canine model. Usher subsequently reported the clinical usefulness of synthetic mesh in the repair of abdominal and thoracic defects[16]; however, the wide acceptance of PM took place in 80's following Lichtenstein's report[17]. The use of PM in hernia surgery has become increasingly popular. The use of synthetic mesh for achieving a tension free repair has resulted in a significant reduction in postoperative recurrences[18]. Polypropylene meshes have a mild reactivity upon implantation and in-growth, with low susceptibility to mesh infection. Furthermore, they have a tensile strength that is retained for indefinite periods of time[19]. However, these meshes can induce adhesion of viscera when placed intraperitoneally[20].

Polypropylene mesh has been widely used in the treatment of urinary incontinence in urological surgery since 1980s.Suburethral slings have become the preferred technique for the treatment of stress urinary incontinence[21]. Studies confirm that the choice of a tension free PM allow high success rates and the transvaginal taps (TVT)® simplified the stress urinary incontinence therapy, becoming one of the most common options for the treatment of this disease[22,23]. Ferguson et al. initially used Polytetrafluoroethylene Grafts in two patients with testicular rupture as a result of gunshot trauma. However, orchiectomies were performed because of severe epididymo-orchitis, a common occurrence for ruptures caused by gunshot trauma. Typically Polytetrafluoroethylene graft infections are caused by a foreign body and are resistant to antibiotic treatment. Ferguson and colleagues also used free tunica vaginalis grafts in seven patients with gunshot wounds, and the results proved satisfactory[14] .All of the patients in the present study had blunt scrotal trauma, and none developed epididymo-orchitis. Grigoryuk and colleagues found that Polytetrafluoroethylene stimulated the local production of pro-inflammatory cytokines when compared with polypropylene in their study. Polytetrafluoroethylene is a more reactogenic material than polypropylene; it mainly stimulates the local production of pro-inflammatory cytokines. The local anti-inflammatory effect of polypropylene was less pronounced, but persisted for longer time[24]. We performed scrotal exploration 12 hours after a sports-related accident, resulting in testicular rupture. Despite the debridement of the testicular tissue that was extruded, we were not able to do primary repair of the TA. We did not use a free graft of tunica vaginalis or a vascularized tunica vaginalis graft as there was edema and fragmentation of the TA. Instead of performing an orchiectomy, we repaired the rupture using PM. Thus, as the results were encouraging, we used it as an alternative technique in traumas. To treat testicular rupture, Jian et al. used vascularized tunica vaginalis grafts and suggested this method as an alternative treatment when the TA cannot be reapproximated[8]. Kuritov and colleagues used tunica vaginalis grafts after performing a testicular fasciotomy in three patients to prevent compartment syndrome[25]. However, in blunt scrotal testicular ruptures, it is often difficult to obtain a vascularized graft due to the presence of a hematoma in the scrotal layers or edema in the tunica vaginalis. Therefore, tunica vaginalis grafts were not used in the present study. To the best of our knowledge, this study is the first to demonstrate that a PM graft can be used to successfully close a TA defect during testicular rupture repair following blunt trauma. There were several limitations to this study, including the retrospective design and small cohort. In the present study, semen analyses were not carried out during the postoperative period, although one patient treated with PM became a father after the operation, and another is expecting his second child. In both groups, plasma testosterone levels 12 months postoperatively were normal, and no statistical difference was found between the treatment groups. Measuring the testicular pressure with a handheld compartment monitor could have prevented the development of compartment syndrome after primary closure. Lastly, one of the limitations of this study was not having measured the devitalized tissue amount that was debrided in patients with testicular rupture.

CONCLUSIONS

In conclusion, following testicular rupture due to blunt trauma, there might be insufficient tissue with which to close the TA because of aggressive seminiferous tubule debridement. Aggressive seminiferous tubule excision in an attempt to close the TA can lead to significant loss of testicular parenchyma, and the forced closure of the free ends of the TA with the application of tension can cause testicular atrophy via compartment syndrome. In such cases, PM is a safe synthetic material that should be used to close the defect and should serve as an alternative to primary repair of the TA with aggressive debridement or use of tension.

CONFLICT OF INTEREST

None.

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