Tunica Albuginea Decompression Fails to Alter the Injury of Prolonged Arterial Occlusion During Testicular Torsion

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Purpose: The correlation between intratesticular pressure during torsion/detorsion and subsequent testicular function and viability has been reported in several recent studies. We assessed the impact of tunica albuginea incision with tunica vaginalis flap coverage on intratesticular pressure and future histopathological parameters in a rat testicular torsion model.

Materials and Methods: A total of 21 rats were divided into 3 groups. Group 1 consisted of 7 controls undergoing a sham operation, group 2 consisted of 7 animals undergoing torsion-detorsion, and group 3 consisted of 7 animals undergoing testicular torsion-detorsion followed by tunica albuginea incision and tunica vaginalis flap coverage. Torsion was created by 720-degree counterclockwise rotation of the left testis for 2 hours. By using a compartment monitor, the intratesticular pressure of the torsed testes was measured before torsion (pretorsion), immediately before torsion repair (pre-detorsion), 5 minutes after detorsion (post-detorsion), and after tunical incision and tunica vaginalis flap application. The correlations between intratesticular pressure values and testicular weight, modified Johnsen score and mean seminiferous tubule diameter were evaluated 4 weeks postoperatively.

Results: Median pre-detorsion intratesticular pressure was significantly decreased after detorsion in group 2 (21 vs 7 mm Hg, p < 0.001) and group 3 (23 vs 7 mm Hg, p = 0.001). In addition, median intratesticular pressure after tunica albuginea incision and tunica vaginalis flap coverage in group 3 was significantly less compared to median post-detorsion intratesticular pressure in group 2 (5 vs 7 mm Hg, p = 0.025). Overall no significant difference was detected between groups 2 and 3 regarding median modified Johnsen score, mean seminiferous tubule diameter or median testicular weight. The significant reduction of intratesticular pressure in group 3 did not correlate with testicular weight (r = 0.500, p = 0.391), modified Johnsen score (r = −0.205, p = 0.741) or mean seminiferous tubule diameter (r = −0.200, p = 0.747).

Conclusions: Tunica albuginea decompression with tunica vaginalis flap coverage is an effective technique for decreasing intratesticular pressure in torsed testes. However, this technique failed to alter the injury of prolonged arterial occlusion in testicular torsion.

Key Words: disease models, animal; ischemia; spermatic cord torsion; surgical flaps; testis
of testicular damage and irreversible histological changes, early diagnosis and appropriate surgical intervention are necessary to restore testicular blood flow and prevent further damage. Immediate surgical detorsion is the standard of care, and orchiectomy is performed if the testis is infarcted in prolonged cases. Testicular salvage rates with appropriate diagnostic and surgical management reportedly range from 42% to 88%. However, whether testicular function is truly salvaged remains unknown. Currently testicular appearance during scrotal exploration is the major intraoperative criterion to judge testis viability. Therefore, reliable criteria to objectively evaluate testis viability intraoperatively are required to predict subsequent testicular function and prevent unnecessary orchiectomy in affected patients.

Experimental studies show that testis weight and sperm production are significantly decreased as the time and degree of torsion increase. In human studies ipsilateral testicular atrophy rates following torsion range from 33% to 68%. Since the main mechanism of injury in testicular torsion is thought to be ischemia/reperfusion, a limited number of recent clinical and experimental reports speculate that ITP is increased in torsed testes and reducing the pressure may help to predict future testicular function. In a series of patients with prolonged testicular torsion Kutikov et al reported that tunical incision after surgical detorsion made initially ischemic testicular tissue appear to be better perfused, and following closure of incision the testis again appeared to be ischemic. They also measured ITP which increased during torsion and fasciotomy, and decreased with the use of a tunica vaginalis flap. The relationship between ITP and subsequent spermatogenesis was recently investigated in an animal model, which revealed that ITP may be used as a predictive parameter for future testicular function. However, the effect of tunical incision and tunica vaginalis flap on ITP and subsequent testicular function has yet to be evaluated. We assessed the effect of tunica albuginea incision with tunica vaginalis flap coverage on ITP and its possible correlation with subsequent testicular function and histopathological findings in a rat testicular torsion model.

MATERIALS AND METHODS

This experimental study was performed with 21 male Sprague-Dawley rats (6 weeks old) weighing 180 to 220 gm. The rats were divided into 3 groups. Group 1 (7 rats) underwent a sham operation, group 2 (7) underwent testicular torsion-detorsion, and group 3 (7) underwent testicular torsion-detorsion followed by tunica albuginea incision and tunica vaginalis flap coverage. The study received institutional ethical committee approval. Rats were anesthetized with 50 mg/kg pentobarbital sodium injected intraperitoneally. Torsion was created by 720-degree rotation of the left testis in a counterclockwise direction and maintained by fixation to the root of the tail with 5-zero polyglactin sutures. Testicular torsion was maintained for 2 hours in all rats. After 2 hours torsion was corrected by counter rotating the testis to its natural position and replacing it into the scrotum. Using a handheld compartment monitor (Stryker®) with a 27 gauge needle, the ITP of the torsed testes was measured before torsion (pre-torsion), just before torsion repair (pre-detorsion) and 5 minutes after detorsion (post-detorsion).

Sham operated rats were subjected to the same surgical procedure, except for testicular torsion. The steady state ITPs of the controls (accepted as the equivalent of pre-torsion ITP of groups 2 and 3) were measured after exposure. Additionally the rats in group 3 were subjected to anterior vertical tunica albuginea incision extending from the upper pole to the lower pole of the testis and tunica vaginalis flap coverage, followed by ITP measurement 5 minutes after detorsion. The tunica vaginalis flap, which was prepared from the parietal layer at an appropriate length for covering the defect, was placed over the exposed seminiferous tubules and sutured to the tunica albuginea with 7-zero polydioxanone sutures (see figure).

Two rats in group 3 died before completion of the study and were excluded. The rats were euthanized 4 weeks after the primary surgery, and the testes were removed. The testes were fixed in Bouin solution. Testicular tissue was examined under light microscopy after staining with hematoxylin and eosin. The germinal epithelium of at least 50 tubules was assessed using a micrometer eyepiece to calculate mean STD and modified Johnsen score. The spermatogenic maturation in seminiferous tubules was scored from 1 to 10, according to the modified Johnsen scoring system (10, full spermatogenesis with many spermatozoa, regular layers of germ cells; 9, many spermatozoa, irregular layers of germ cells, germ cells sloughed into the lumens; 8, few spermatozoa; 7, no spermatozoa, many spermatids; 6, no spermatozoa, few spermatids; 5, no spermatozoa or spermatids, many spermatocytes; 4, no spermatozoa or spermatids, few spermatocytes; 3, spermatogonia only; 2, no germ cells, Sertoli cells only; 1, no seminiferous epithelial cells, tubular hyaline degeneration).

Seminiferous tubule diameter has been reported to vary from 0.22 to 0.26 mm during different phases of spermatogenesis under normal conditions in rats, and decreased STD has been associated with pathological conditions such as hypospermatogenesis, varicocele,cryptorchidism and torsion in human and rat testes. We also examined the correlation between these histopathological parameters of testis and pre-detorsion ITP, post-detorsion ITP, and change in ITP in groups 2 and 3 at 4 weeks postoperatively.

The comparison of pre-torsion ITP and histopathological parameters of the 3 groups was analyzed using the Kruskal-Wallis test. Mann-Whitney U tests were used to compare ITP, testicular weight, modified Johnsen score and mean STD in groups 2 and 3. Correlation of ITP with testicular weight, modified Johnsen score and mean STD in groups 2 and 3 was evaluated using Spearman rank