sciendo

10.2478/AMB-2023-0006

ORIGINAL ARTICLE

THE IMPORTANCE OF MANUAL DETORSION IN INTRAVAGINAL TESTICULAR TORSION

M. Anastasakis[1], I. Gkalonaki[1], C. Doitsidis[1], P. Michou[2], I. Patoulias[1]

[1]First Department of Pediatric Surgery, Aristotle University of Thessaloniki Greece, General Hospital "G. Gennimatas" – Thessaloniki, Greece
[2]Department of Pediatrics, General Hospital "G. Gennimatas" – Thessaloniki, Greece

Abstract. Objective: *The aim of the present prospective clinical study was to highlight the importance of the proper application of the manual detorsion (MD) in cases of intravaginal testicular torsion. Major complications such as ischemia, reperfusion injury and testicular compartment syndrome could be avoided.* ***Materials and Methods:*** *From January 2017 to February 2018, 26 boys aged between 8 and 16 years underwent surgical treatment for intravaginal testicular torsion (ITT) (14 left- and 12 right-sided). Diagnosis was made upon clinical criteria (both symptoms and signs); sudden onset of scrotal pain (n = 26, 100%), nausea and vomiting (n = 25, 96,15%), abdominal pain (n = 3, 11,53%), high testicular position (n = 21, 80,77%), absence of the cremasteric reflex (n = 26, 100%), harshness of the twisted testicle (TT) (n = 24, 87.5%), alteration on axis or orientation of the TT (n = 24, 94,31%), and pain during palpation (n = 26, 100%). Two cases presented with neglected scrotum leading to inability to evaluate the intrascrotal structures. Major ultrasonographic findings were the following: absence of perfusion, heterogeneity of the parenchyma and identification of the Whirlpool sign. Therefore, our study group consisted of 15 out of the 26 cases, in which the initial assessment at the Emergency Department occurred within the first 3-7 hours after the onset of ITT.* ***Results:*** *Based on high clinical suspicion and ultrasonographic documentation of the ITT, MD was performed in all those cases. Pain alleviation followed immediately, while significant improvement of the clinical picture of the suffering scrotum was also observed. Successful detorsion was documented via ultrasonography. After completion of the preoperative assessment, bilateral orchidopexy was performed. All patients had an uneventful postoperative course and were discharged home on the second postoperative day.* ***Conclusion:*** *In conclusion, we hereby document that MD is a safe, non-invasive method, easy to learn for every clinician. It can be applied immediately after the diagnosis of the ITT, converting a highly urgent surgery into an elective one. Of course, surgical exploration of intrascrotal structures constitutes a crucial final step.*

Key words: *intravaginal testicular torsion, manual detorsion, ischemia, reperfusion injury, testicular compartment syndrome, male*

Corresponding author: *Anastasakis Michail, MD, Amalias 37, 54640 Tessaloniki, Greece, Phone: +30 6938130252, e-mail: mixalis.pao@windowslive.com*

Received: *16 May 2022;* ***Accepted:*** *11 August 2022*

INTRODUCTION

The annual incidence of testicular torsion in pre-adolescents and adolescents in the United States is estimated to be 3.8-4.5 cases/100,000/year [1].

Underlying causative factors for an intravaginal testicular torsion (ITT) include bell clapper deformity, broad mesorchium, sexual activity, physical exercise and especially cycling, overactive cremasteric reflex, cold weather resulting in asymmetric clamping of the cremasteric muscle, malignancy and finally rapid testicular development [2, 3, 4]. In 4-8% of ITT cases, traumatic injury of the affected scrotum is identified as the causative factor [6]. There are indications of a genetic background via the action of the insulin-like 3 hormone and its cell membrane receptor (Rx1f2) [6, 7].

DaJusta et al. and Sozubir et al. have also highlighted the high familiar predisposition to testicular torsion [6, 7]. Based on a report by Martin et al., bell clapper deformity is observed in 12% of the affected boys [8]. This anatomic variance has been recognized in up to 78% of all cases of ITT [1, 2, 3, 4].

Treatment of the testicular torsion is "a battle against time" as the anatomic alterations begin from the first few minutes after the onset of ischemia [9]. The basic parameters for the development of permanent alterations on the suffering testis are the duration and the degree of the torsion [10, 11, 12]. It has been now established that 4 to 6 hours after the onset of the TT, irreversible ischemic lesions develop [13, 14, 15]. Sharpet et al. referred to the correlation between survival of the twisted testis and testicular torsion duration, as shown in Table 1 [16].

Table 1. Relationship between the duration of testicular torsion and survival rates of the twisted testicle

Duration of TT in hours	Survival rates of the twisted testicle (%)
24	10
12	50
4-8	90-100

The aim of the present clinical study was to highlight the importance of the timely application of manual detorsion (MD) in highly suspected cases of ITT, which represents a safe, non-invasive treatment approach, simplifying the subsequent surgical treatment and improving the overall prognosis for the patient, with the avoidance of major, related to ischemia complications.

MATERIALS AND METHODS

From January 2020 to February 2021, 26 boys aged between 8 and 16 years (mean: 11.5 years) underwent surgical treatment in the context of ITT. Fourteen cases were left- and 12 cases were right-sided. Diagnosis was based upon patient's reported symptoms and the findings of physical examination, as shown in Table 2.

Brunzel's sign, defined as the high and transverse position of the twisted testis, was identified in 21 cases. Two patients were admitted to the Emergency Department with a delay of 24 hours after the onset of the symptoms, resulting in the development of intense localized inflammation, leading to a clinical picture of a neglected acute scrotum and restricting our ability to evaluate adequately the intrascrotal structures.

Table 2. Signs and symptoms of the affected patients

Clinical sign or symptom	Number of patients
Sudden onset of pain	26
Nausea or/and vomiting	25
Abdominal pain	3
High position of the suffering testicle	21
Absence of cremasteric muscle reflex	26
Harshness of the affected testicle	24
Change in the axis or orientation of the affected testicle	24
Painful palpation of the affected testicle	26
Earlier episodes of testicular pain	8

In all cases, gray scale ultrasonography with the addition of Doppler color flow was performed, confirming the presence of testicular torsion. Major ultrasonographic findings are summarized in Table 3.

Table 3. Major ultrasonographic findings

Ultrasonographic finding	Result
Absence of perfusion of the affected testicle	Positive: 25/26 Doubted: 1/26
Loss of testicular homogeneity	Positive: 10/16 Negative: 15/16
Whirlpool sign (Figure 1)	Positive: 26/26

Our study group consisted of 15/26 cases of ITT (6 right- and 9 left-sided), which met the following prespecified criteria: a) pain duration less than 6 hours and b) homogeneous texture of the affected testicle

in ultrasonographic examination. It is obvious that our study group included reversible cases of ITT, regarding the effects of ischemic trauma and the subsequent reperfusion, including testicular compartment syndrome development.

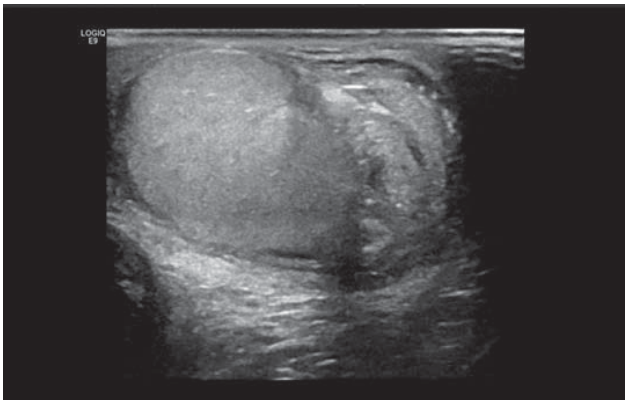

Fig. 1. Ultrasound image highlighting Whirlpool sign in ITT (5/6 patients)

The degree of the ITT ranged from 360-720° (Table 4).

Table 4. Degrees of ITT in each included case

Localization	Degree of ITT
Right (5/6)	360°
Right (1/6)	540°
Left (3/9)	540°
Left (2/9)	360°
Left (3/9)	720°
Left (1/9)	540°

Based on the high clinical suspicion of ITT and the subsequent ultrasonographic documentation, MD of the affected testicle was performed. The whole procedure was carried out without anesthesia requirement in the Emergency Department room.

Methodologically, the gradual detorsion of the affected testicle with each step of 180° was initially attempted, having as clinical criterion of the successful completion of the procedure the immediate pain relief as reported by the patient and the restoration of the normal (vertical) axis and the orientation of the testicle (the head of the epididymis located at the upper pole of the testis with epididymis body and tail being palpable on its posterior surface). A final clinical criterion for the successful detorsion was the palpation of the suffering testicle on the base of the ipsilateral hemiscrotum.

MD of a right twisted testicle was performed like someone is scrolling from the beginning to the end pages of a book, while the reverse procedure was followed in those cases of left-sided ITT. However, if after the completion of the first phase of 180o detorsion there was difficulty in completing the procedure or the pain deteriorated, then the process was carried out on a reverse trend.

RESULTS

MD was successful in all cases. In the nine cases of the left-sided ITT the MD was performed in a clockwise direction, while in the six cases of the right-sided testicular torsion the MD was carried out in an anticlockwise direction. The successful and complete MD was confirmed by color Doppler ultrasonography, documenting the restoration of symmetric arterial blood supply to both testicles (Figures 2 and 3).

Surgical exploration of the scrotum was performed within the next day after the completion of the preoperative assessment, under general endotracheal anesthesia, with mid-scrotal incision. Initially, the previously twisted testicle was retracted into the surgical field.

In all cases, successful MD was confirmed. No biopsy or orchiectomy was required.

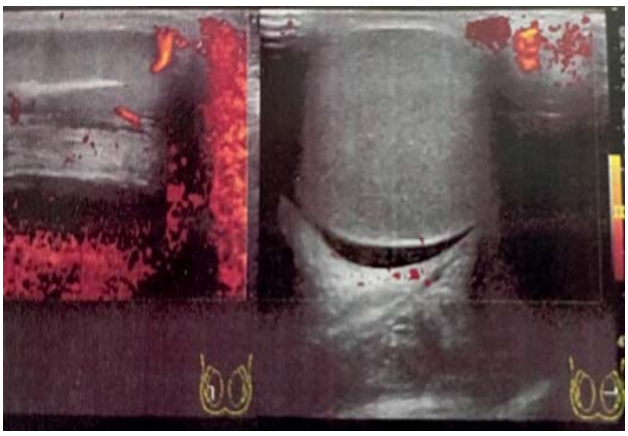

Fig. 2, 3. US confirmation of arterial blood disruption in the torsed testis (Fig. 1), and restoration of arterial supply after MD (Fig. 2)

In 12 out of 15 cases (80%), bell clapper deformity was identified (Figure 4).

In 7 out of 15 cases the macroscopic appearance of the detorsed testis was normal, while venous congestion of the spermatic cord was observed in the rest (8/15) cases (Figure 5).

The effects of mild to moderate ischemia were evident in 12/15 cases. In those cases, 2-3 elongated sections of the tunica albuginea of the affected testicle were overlapped with the parietal layer of the tunica vaginalis to prevent testicular compartment syndrome (Figure 6).

Testicular fixation was performed in a created subcutaneous pouch. Then the contralateral testis was retracted into the surgical field.

In 3 cases bell clapper deformity was identified bilaterally. The operation was completed with fixation of the contralateral testis in a dartos pouch. All patients received perioperatively chemoprophylaxis with second-generation cephalosporin in a therapeutic dose. All patients had an uneventful postoperative course and they were discharged home in good general condition within the first two postoperative days.

The postoperative follow-up schedule consisted of visits at six month intervals for one year. Follow-up consisted of clinic and ultrasonographic assessment.

Clinically, testicular size and turgidity were evaluated. The decrease in size and the harshness of the previously twisted testicle were considered as signs of permanent damage. By ultrasonographic evaluation, testicular dimensions and volume were evaluated along with the parenchyma echogenicity. We considered as criteria of irreversible testicular damage the smaller size of the previously affected testicle, at least 15%, compared to the contralateral and the heterogeneity of the testicular parenchyma (Table 5).

Fig. 4. Bell clapper deformity in the 2/15 study cases

Fig. 5. Remaining venous congestion of the spermatic cord after successful MD (3/15 cases)

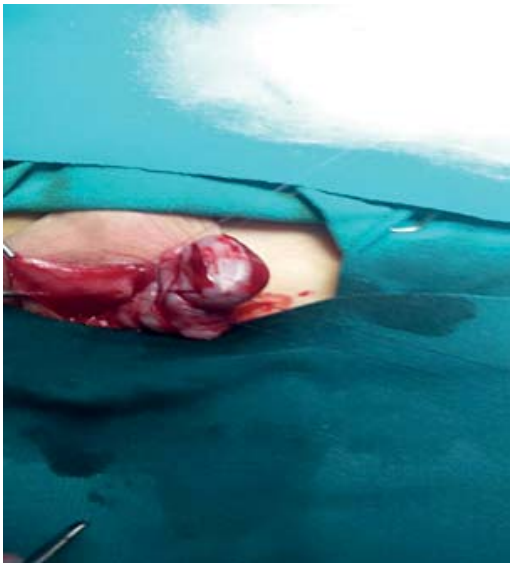

Fig. 6. Elongated sections on the tunica albuginea of the suffering testis (5/15 cases)

Table 5. Clinical and ultrasonographic criteria assessed during the follow-up period

Rating Criterion	Finding (patients)
Turgidity of the twisted testis	Normal (n = 15)
Comparative testicular size estimation	Normal (n = 14), almost normal (n = 1)
Volume of the twisted testis	Normal (n = 14), testicular volume < 20% compared to the contralateral (n = 1)
Echogenicity of the twisted testis	Normal (n = 15)

DISCUSSION

In the initial phase of TT, testicular vascular congestion and worsening of intercellular edema developed. However, no change in cellular morphology was established. These alterations are considered as reversible and are not detected by the performed ultrasonography. Beyazal et al. depicted these initial and reversible ischemic changes by performing Diffusion-weighted imaging (DWI) sequence – a specialized magnetic resonance imaging (MRI) technique [17].

Successful detorsion is followed by apoptosis of the spermatogenic cells, accumulation of neutrophils and oxidative stress development. Neutrophils chemotaxis is induced by the increased expression of testicular vascular E-selectin [18]. Because of the pathophysiological effects of ischemia and the subsequent reperfusion of the twisted testicle, intercellular edema and increased intra-testicular pressure is developed. After these alterations, reduced capillary pressure is exerted, with simultaneous exacerbation of those ischemic effects. All those events constitute the so-called testicular compartment syndrome [19]. Along with the blood-testis barrier and the extended release of cytokines, ischemia induces several alterations in the contralateral testicle, including extensive cell apoptosis of the seminal epithelium, Leydig cells atrophy, dysplasia of the spermatozoa, as well as alterations in the Sertoli cells [20].

Nash was the first to apply and describe MD, in order to rapidly restore the arterial blood supply to the affected testicle [21, 22]. Later, Van der Poel described another case of a young man, being a doctor himself, who suffered from recurrent episodes of TT; he was applying MD to himself [23].

Urgent surgical treatment is the basic therapeutic approach to restore blood flow, so as to rescue the testicle from ischemia and prevent recurrent torsion of both testicles. Unfortunately, patients most times visit the hospital with a delay, after the first, critical 6 hours from the onset of TT. According to Demirbas et al., vital time equal to 80-90 minutes is usually spent from the initial patient's examination until the beginning of the surgery [24].

MD is apparently not indicated in an extra-vaginal testicular torsion, observed mainly during the perinatal period and in patients with cryptorchidism. Dewan et al. demonstrated that MD is not widely accepted by both urologists and young surgeons, who consider this technique as ineffective [25]. This perception was in fact the motive for this study.

No anesthesia induction was required for the performance of MD in any of our patients. The recession of pain occurred quickly after the successful and complete detorsion, representing a significant clinical criterion for the evaluation of the method [24].

Cattolica describes the application of MD in 35 out of a total of 104 cases of testicular torsion over a decade [26]. No analgesia or anesthesia was required in any of the above-mentioned cases. On the contrary, Gatti et al. considers analgesia as necessary in order to reassure the cooperation of the pediatric patient, while maximizing the effects of MD with the relaxation of the cremasteric muscle, as well [27]. Another clinical criterion that could be utilized for the assessment of a successful MD is the palpation of the suffering testicle on the base of the ipsilateral scrotum [28].

The TT can be lateral, outward, median or inward [28, 29, 30]. There are no established parameters to determine the direction of TT [31]. In 60-70% of cases, torsion occurs in the midline and in 30% in the lateral line [32, 33, 34]. Yecies et al. in their study including 104 boys with ITT that underwent surgical treatment, found that ITT was lateral in 38 cases (46%) [35]. In our study, in four out of five cases the ITT was left-sided and thus the MD was performed in a clockwise direction, while in the right-sided case the detorsion was carried out in an anti-clockwise direction. The overall rotation can usually range from 180º-1080º [24, 35]. In our study it ranged from 360-720º.

Beyazal et al. carried out the surgical exploration of the scrotum by an intrascrotal approach, which constitutes the typical methodology, which we also followed [17]. Demirbas et al. performed a complete and successful MD in 20 cases out of a total of 26 patients with ITT (76.92%) [24]. Cornel and Karthaus described successful MD in 14 out of the 17 patients experiencing an ITT [36]. Similar results were also demonstrated by Cattolica et al. [26] and Kiesling et al [37].

An essential risk of MD is the incomplete detorsion, which could be easily mistaken as successful. Sessions et al. reported that in 32% of all the cases they managed, MD was incomplete [29]. We believe that by selecting the patients with specific and strict criteria, by applying the technique appropriately and by evaluating the outcome objectively, the potential risk of unsuccessful detorsion is diminished.

In the context of the surgical investigation, immediately after completion of the preoperative assessment of the patient, it is essential to perform longitudinal incisions in the tunica albuginea of the suffering testicle to minimize the potential risk development of testicular compartment syndrome. The development of intercellular edema within the testicular parenchyma due to ischemia, restoration of arterial blood

supply, and the rigidity of testicular fibroids leads to increased intra-cortical pressure and restriction of microcirculation, resulting in the exacerbation of ischemia [38]. Figueroa et al. found that treatment success, simultaneously with the rescue of the affected testicle increased from 64% to 85% by performing longitudinal incisions in the tunica albuginea [39]. However, a delayed surgical exploration of the scrotum is not indicated, as it endangers the development of compartment testicular syndrome. We believe that the surgical investigation should be performed as early as possible, immediately after the completion of a meticulous preoperative evaluation of the patient.

CONCLUSION

In conclusion, MD is a safe and non-invasive method, easy to learn for every physician.

It can be applied immediately after the diagnosis of the ITT, with high success rates, aiming to the restoration of arterial blood supply of the affected testicle.

After the performance of a successful MD, an extremely urgent surgical exploration of the intrascrotal structures is converted into an elective one.

Emergent surgical intervention is required when MD fails, according to specific clinical and ultrasonographic criteria.

Surgical exploration of the scrotum is absolutely the necessary final step for the correction of a potentially incomplete detorsion, the prevention of reperfusion complications and mainly of the testicular compartment syndrome, along with future episodes of TT affecting either the same or the contralateral testicle.

Disclosure Summary: *The authors have nothing to disclose.*

REFERENCES

1. Williamson RC. Torsion of the testis and allied conditions. Br J Surg 1976; 63(6): 465-76.
2. Zhao LC, Lautz TB, Meeks JJ, Maizels M. Pediatric testicular torsion epidemiology using a national database: incidence, risk of orchiectomy and possible measures toward improving the quality of care. J Urol 2011; 186(5): 2009-13.
3. Feher Miklos A, Bajory Z. A review of main controversial aspects of acute testicular torsion. J Acute Disease 2016; 5(1): 1-8.
4. Leibovitch I, Mor Y. The vicious cycling: bicycling related urogenital disorders. Eur. Urol 2005; 47(3): 277-86.
5. Seng YJ, Moissinac K. Trauma induced testicular torsion: a reminder for the unwary. J Accid Emerg Med 2000; 17(5): 381-2.
6. DaJusta DG, Granberg CF, Villanueva C, Baker LA. Contemporary review of testicular torsion: new concepts, emerging technologies and potential therapeutics. J Pediatr Urol 2013; 9(6 Pt A): 723-30.
7. Sozubir S, Barber T, Wang Y et al. Loss of Insl3: a potential predisposing factor for testicular torsion. J Urol 2010; 183(6): 2373-9.
8. Martin AD, Rushton HG. The prevalence of bell clapper anomaly in the solitary testis in cases of prior perinatal torsion. J Urol 2014; 191(5 Suppl): 1573-7.
9. Kapoor S. Testicular torsion: a race against time. Int J Clin Pract. 2008; 62:821-7.
10. Barthold JS. Abnormalities of the testes and scrotum and their surgical management. In: Wein AJ, editor. Campbell-Walsh urology.10th ed. Philadelphia, Pa: Saunders Elsevier; 2011. p.3587-92.
11. Castaneda-Sanchez I, Tully B, Shipman M, Hoeft A et al. Testicular torsion: A retrospective investigation of predictors of surgical outcomes and of remaining cotroversies. J Pediatr Urol. 2017 Oct;13(5): 516.e1-516.e4.
12. Visser AJ, Heyns CF. Testicular function after torsion of the spermatic cord. BJU Int. 2003; 92:200-3.
13. Tryfonas G, Violaki A, Tsikopoulos G, et al. Late postoperative results in males treated for testicular torsion during childhood. J Pediatr Surg. 1994; 29:553-6.
14. Yang C, Song B, Tan J et al. Testicular torsion in children: a 20-year retrospective study in a single institution. ScientificWorld Journal 2011; 11: 362-8.
15. Drlik M, Kocvara R. Torsion of spermatic cord in children: a review. J Pediatr Urol 2013; 9(3): 259-66.
16. Sharp VJ, Kieran K, Arlen AM. Testicular torsion: diagnosis, evaluation and management. Am Fam Physician 2013; 88(12): 835-40.
17. Beyazal M, Celiker FB, Inecikli MF et al. The monitoring of preoperative external detorsion with diffusion-weighted imaging in a patient with acute testicular torsion. Hindawi Case Reports in radiology vol. 2017, article ID 3702873, 3 pages.
18. Turner TT, Bang HJ, Lysiak JL. The molecular pathology of experimental testicular torsion suggest adjunct therapy to surgical repair. J Urol 2004,176 (6 Pt 2): 2574-8.
19. Paddy D, Bhavish K, John L. Survey of manual detorsion of the testicle Mini review. 2016;1(2) JO Uro & Nephron, 555556.
20. Hadziselimovic F, Geneto R, Emmons LR. Increase apoptosis in the contralateral testes of patients with testicular torsion as a factor for infertility. J Urol 1998;160(3Pt 2):1158-60.
21. Nash WG. Acute torsion of the spermatic cord: reduction: immediate relief. Br Med J. 1893; 1:742.
22. Lee LM, Wright JE, McLoughlin MG. Testicular torsion in the adult. J Urol. 1983; 130:93-4.
23. Van der Poel J. Strangulation of the testis and epididymis from the torsion of the spermatic cord. Medical Records, 1895,47:737.
24. Demirbas A, Demir D, Ersoy E et al. Should manual detorsion be a routine part of treatment in testicular torsion? BMC Urol 2017,17:84.
25. Dewan P, Kowlessur B, Lazarus J. A Survey of Manual Detorsion of The Testicle Mini Review 2016; 1(2): 555556. JO Uro & Nephron.
26. Cattolica EV. Preoperative manual detorsion of the torsed spermatic cord. J Urol. 1985 May;133(5):803-5.
27. Gatti JM, Patrick Murphy J. Current management of the acute scrotum. Semin Pediatr Surg 2007; 16(1): 58-63.
28. Siu Uribe A, Garrido Perez JI, Vazquez Rueda F et al. Manual detorsion and elective orchiopexy as an alternative treatment for acute testicular torsion in children. Cir Pediatr. 2019 Jan 21;32(1):17-21.

29. Sessions AE, Rabinowitz R, Hulbert WC, et al. Testicular torsion: direction, degree, duration and disinformation. J Urol. 2003;169:663-5.
30. Gunes M, Umul M, Altok M. Atypical testicular torsion: We must be cautious in the course of manual detorsion. Pediatr Emerg Care. 2016 Oct;32(10):691-692.
31. Cannon ML, Finger MJ, Bulas DI. Manual testicular detorsion aided by color doppler ultrasonography. J Ultrasound Med. 1995 May. 14(5):407-9.
32. Estremadoyro V, Meyrat BJ, Birraux J et al. Diagnosis and management of testicular torsion in children. Rev Med Suisse. 2017,13(550):406-410.
33. Gunes M, Umul M, Celik AO et al. A novel approach for the manual de- torsion of an atypical (outward) testicular torsion with bedside doppler ultrasonography guidance. Can Urol Assoc J. 2015 Sep-Oct. 9 (9-10):E676-8.
34. Saxena AK, Castellani C, Ruttenstock EM, Hollwarth ME. Testicular torsion: a 15-year single-center clinical and histological analysis. Acta Paediatr. 2012 Jul. 101(7): e282-6.
35. Yecies T, Bandari J, Schneck F, Cannon G. Direction of rotation in testicular torsion and identification of predictors of testicular salvage. Urology. 2018 Apr;114: 163-166.
36. Cornel E, Karthaus H. Manual derotation of the twisted spermatic cord. Br J Urol, 1999. 83 (6):672-4.
37. Kiesling V, Schroeder D, Pauljev P, Hull J. Spermatic cord block and manual reduction: primary treatment for spermatic cord torsion. J Urol, 1984 132(5):921-3.
38. Kutikov A, Casale P, White MA, Meyer WA, et al. Testicular compartment syndrome: a new approach to conceptualizing and managing testicular torsion. Urology 2008; 72(4):786-9
39. Figueroa V, Pippi Salle JL, Braga LH et al. Comparative analysis of detorsion alone versus detorsion and tunica albuginea decompression (fasciotomy) with tunica vaginalis flap coverage in the surgical management of prolonged testicular ischemia. J Urol 2012; 188(4 suppl):1417-22.