Management of acute scrotum in children: a 25-year single center experience on 558 pediatric patients

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POGORELIC Z, MUSTAPIC K, JUKIC M, TODORIC J, MRKLIC I, MESTROVIC J, JURIC I, FURLAN D. Management of acute scrotum in children: a 25-year single center experience on 558 pediatric patients. *Can J Urol* 2016;23(6):8594-8601.

Introduction: *The aim of this study was to analyze management and outcomes of treatment in patients with acute scrotum.*

Material and methods: *From January 1990 until January 2015 case records of 558 patients who underwent surgery for acute scrotum were retrospectively reviewed. Mean age was 12 years old. Each patient was analyzed for following parameters: history data, localization of pain, physical examination, operating results and the results of follow up, age, etiology, and the time from initial symptoms to surgery.*

Results: *Scrotal explorations revealed 142 cases (25%) of spermatic cord torsion, 344 (62%) torsion of the testicular appendage, 54 (10%) epididymitis, 10 (2%) testicular trauma and 8 cases (1%) of other conditions. Two peaks of incidence of spermatic cord torsion were found, the first during first year of life and the second between 13 and 15 years of life. In patients with spermatic cord torsion, median duration of symptoms in the group of salvaged testes was 6 hours; while in the group of patients who underwent orchiectomy was 46 hours. Of the total number of patients with spermatic cord torsion 40 patients (28%) underwent orchiectomy while 102 testicles (72%) were saved. There were no major complications. Acute scrotum is significantly more common in the winter. Torsion of the testis has the highest incidence in January and August.*

Conclusion: *Early scrotal exploration based on careful physical examination decreases the risk of misdiagnosis of spermatic cord torsion. It is of great importance that the patient seeks immediate medical attention. If the patient arrived within 6 hours the testicle can be saved.*

Key Words: acute scrotum, spermatic cord torsion, children, testicular trauma

Introduction

Acute scrotal pain is a urological emergency requiring prompt assessment. Differential diagnoses include torsion of the testis, torsion of testicular appendages, epididymoorchitis, idiopathic scrotal oedema, hydrocele, trauma, testicular tumors, epididymal cysts and strangulated inguinal hernia.[1] The acute scrotum is a diagnostic dilemma because of its diverse etiologies and the extreme tenderness over the area that makes clinical examination difficult. Torsion of the spermatic cord is of major concern because it requires immediate surgical intervention.[2-6] Annual incidence of spermatic cord torsion is 4.5 in 100,000 males 1-25 years of age.[6] It can occur at any age but usually occurs in young males, with a bimodal incidence in the pediatric population: during the first year of life, and between the ages of 13 and 16 years.[1,4,6] An increased incidence of testicular torsion is seen with decreasing atmospheric temperature and humidity, suggesting a possible etiological role. On examination, the patient with spermatic cord torsion usually has a swollen tender testicle that is raised in a red scrotum and the testicle may be lying horizontally in the scrotum.

Accepted for publication September 2016

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Loss of the cremasteric reflex on the affected side and no pain relief when the testicle is elevated may also be noticed, and the patient may have a fever.[1,4-6] If this condition remains unrecognized, within the golden timeframe of 6 hours after initial pain, the testicle may be lost. Because spermatic cord torsion is a potentially reversible condition when diagnosed and treated early, the emphasis should be on prompt evaluation of children who present with acute scrotum or acute inguinal or abdominal pain.[1,3,7-9] Imaging studies have been devised for correct diagnosis and in order to overcome the problem of misdiagnosing testicular torsion as epididymitis and vice versa. Real-time ultrasound, Doppler ultrasound, testicular scintigraphy and magnetic resonance imaging are important modalities in confirming the clinical assessment.[2,3]

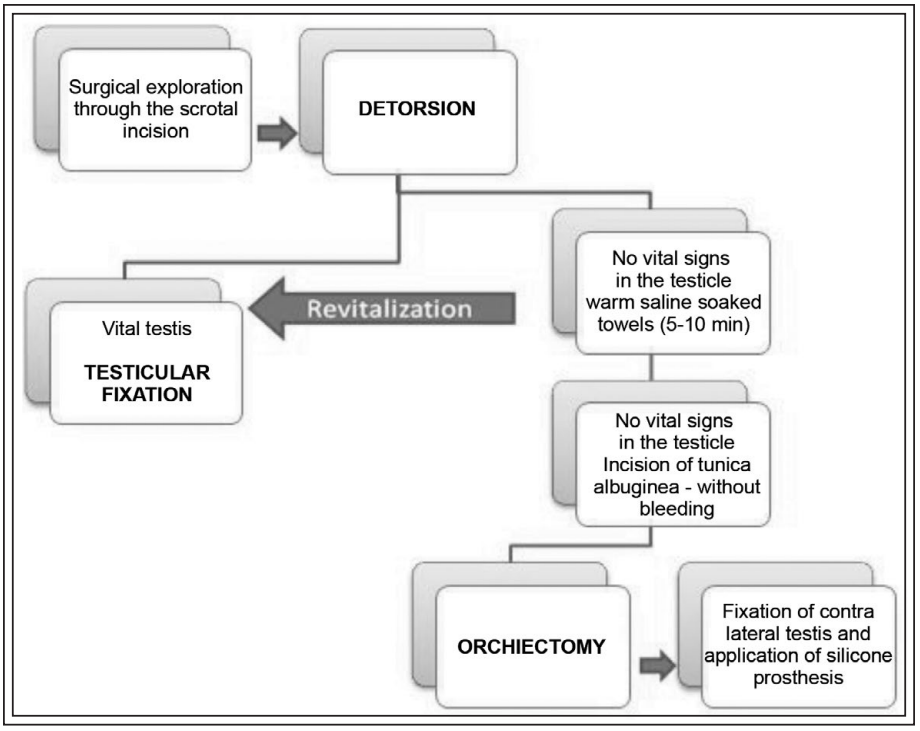

Figure 1. The algorithm of treatment in patients with spermatic cord torsion.

The aims of this study were to determine demographic data, clinical manifestations and surgical outcomes of all scrotal explorations performed on patients presenting with acute scrotal pain.

Materials and methods

A retrospective database analysis of medical records on all patients who underwent emergency surgery suffering from acute scrotum between January 1990 and January 2015 was performed. The diagnosis was made clinically and confirmed by scrotal exploration and a Doppler ultrasound. As Doppler ultrasound was used for diagnosis only during the last few years, the findings by this diagnostic method are not presented. The medical records included initial medical history, anamnestic data (age, duration of symptoms before surgery, history of fever and vomiting, history of trauma), physical examination findings (side of involved testis, presence of erythema, swelling, tenderness over the testis and epididymis), etiology, localization of pain, time of hospital admission, surgical findings and operating results. Correlation between the age of the patient and duration of the symptoms prior to admission was analyzed. Correlation between acute scrotum and seasons of the year was also analyzed. All patients presenting with scrotal symptoms and a clinical suspicion for spermatic cord torsion underwent surgical exploration. Algorithm of treatment of spermatic cord torsion is shown in Figure 1. Postoperatively, the patients received pain medication and, depending on the eventual diagnosis, antibiotic therapy. The patients were followed up at 14 days, 3 months and 12 months postoperatively, and then examined once a year.

Results

Over the study period a total number of 558 patients with acute scrotal pain and swelling were included in the study and operated on confirming the following diagnoses: spermatic cord torsion (TT) 142 (25.4%); torsion of the testicular appendage (AT) 344 (61.6%); epididymo-orchitis (EO) 54 (9.6%); testicular rupture 10 (1.7%); other reasons 8 (1.4%): idiopathic scrotal edema in one, testicular cancer in two, consecutive hydroceles in two and intravaginal abscess in three patients, Figure 2. The median duration of symptoms of patients with TT was 6 hours (1 h-120 h), in patients with AT median duration of symptoms was 24 hours (1 h-192 h) while in the patients with EO duration of symptoms was 12 hours (2 h-72 h). Of the total number of operated patients with

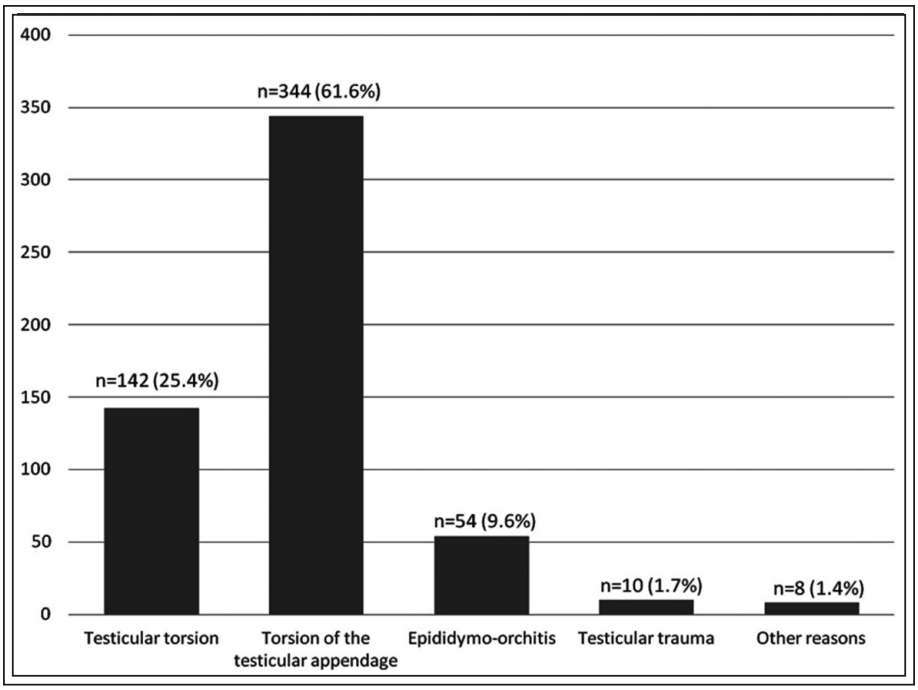

Figure 2. Distribution of the patients regarding the etiology of acute scrotum.

TT, 40 patients (28%) underwent orchiectomy while 102 testicles (72%) were saved. Median duration of symptoms in a group of patients with saved testicles was 6 hours (1 h-72 h), while in the group of patients who underwent orchiectomy was 46 hours (12 h-120 h). Rates of testicular salvage over time (hours) of onset of symptoms to surgery are presented in Figure 3. Patients were aged from several hours to 18 years, with median age of 12 years. Two peak incidences of TT were found, one during the first year of life, the other between ages of 13 and 15 years. Torsion of AT was encountered more frequently in boys between ages of 10 and 13 years, with peak incidence in 11 year of life. More than a half of the boys with EO were below the age of 1 year, Figure 4a. There were no major complications, only two patients were re-operated because of testicular atrophy and three wound infections were recorded. In all patients with acute scrotum the left testis was affected in 304 patients (54%), and right in 254 patients (46%). In patients with TT the left testicle was more frequently affected 82 (58%), in patients with AT the left testicle was affected in 183 boys (53%), while in patients with EO the left testicle was also more frequently affected 31 (57%). The median degree of torsion in 142 patients with TT was 360° (90°-1080°).

Rates of nausea/vomiting, groin pain, negative cremasteric reflex, a hard testis and a high position of the testicle are found to be much higher in patients with TT than in other etiologies of acute scrotum, Table 1.

Patient characteristics, demographic data, clinical manifestations and surgical outcomes are summarized in Table 1. A total number of nine children were operated following torsion of undescended testis. Mean age at the time of the surgery was 13.5 years (7 days-16 years). In four cases (44,5%) the testicle was preserved and orchiopexy was performed. In the other five cases (55.5%) orchiectomy was performed due to testicular gangrene. Mean duration of symptoms at time of surgery in the orchiopexy group was 6 h (4 h-10 h) and in the orchiectomy group was 50 h (range 36 h-50 h).

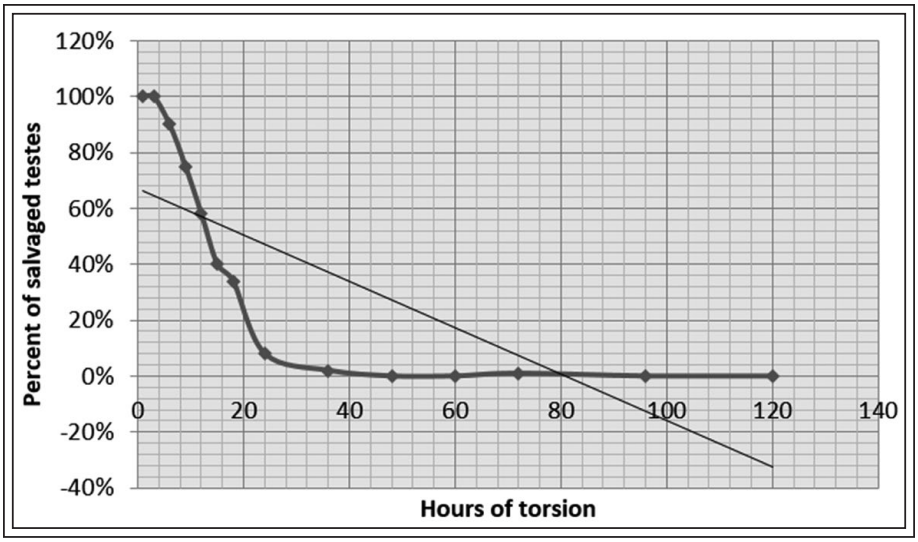

Figure 3. Rates of testicular salvage over time (hours) of onset of symptoms to surgery.

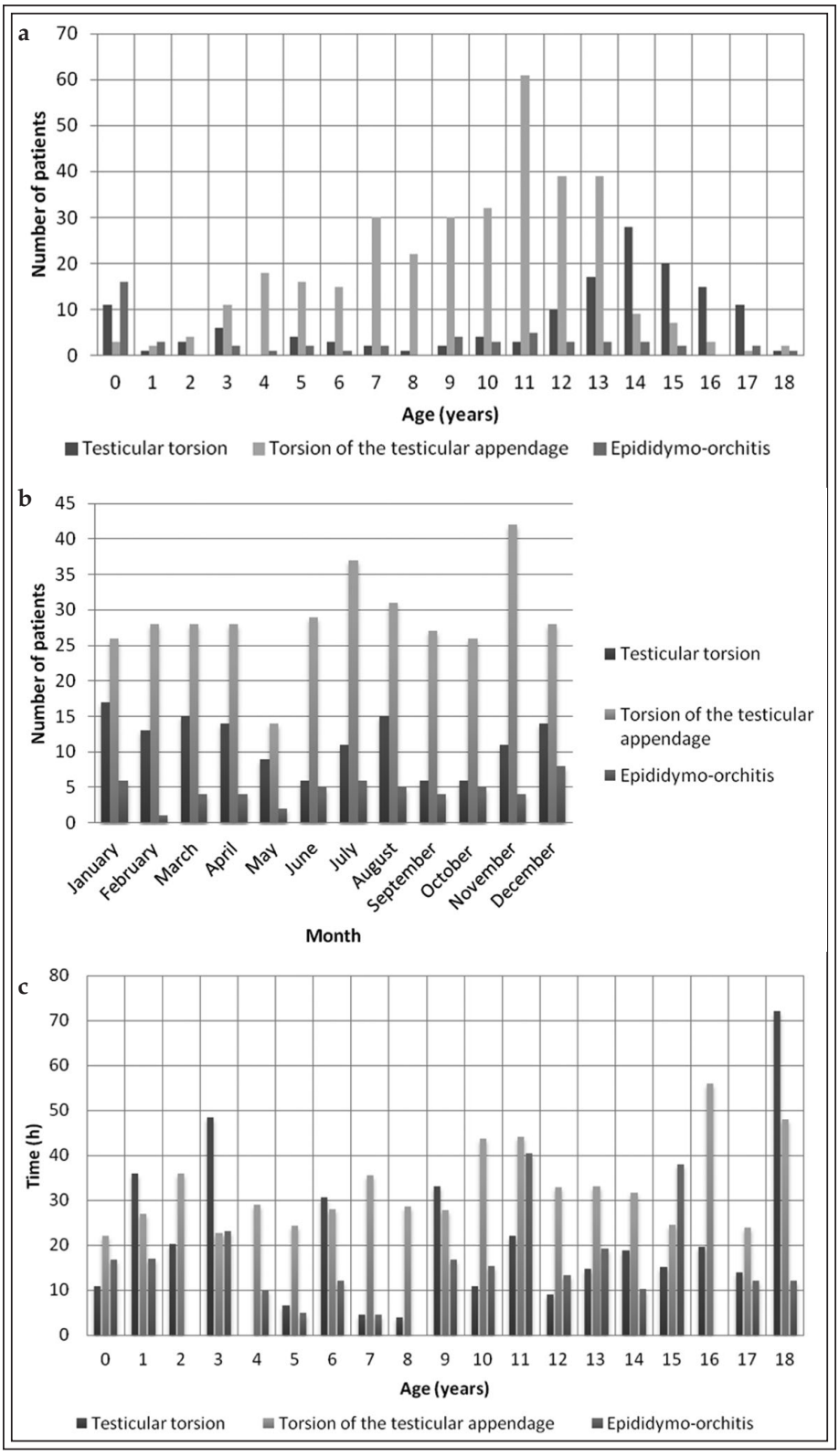

Figure 4. Distribution of the patients regarding: **a)** age and etiology of acute scrotum; **b)** frequency of acute scrotum and the months of the year; **c)** the average duration of symptoms and patients age.

The left testis was affected in three cases (33.3%), while the right was affected in six cases (66.7%), Table 2.

Ten patients have been operated due to testicular trauma. The average time after admission of the trauma was 35 h (6 h-72 h). In seven (70%) patients the right testicle was injured. The leading cause of injury was a blow to the scrotum during sports (8 patients); one patient received a blow to the scrotum during a physical attack, and in one patient injury was a result of a fall from a motor vehicle. The mean size of the rupture was 2.85 cm in diameter (2 cm-4 cm). Two boys developed testicular atrophy during follow up, Table 2. Patients with testicular rupture without extrusion of the testicular content or patients presented later than 72 h were treated conservatively. There were 13 patients treated conservatively. In 12 of them testicles were salvaged without signs of testicular atrophy during follow up, and one patient (presented 6 days after trauma) developed testicular atrophy.

Pain and edema of the hemiscrotum were the most common findings in the patients suffering from TT, while in patients with EO 50 (92%) edema was major symptom, Table 1. The frequency of presentation of patients with TT by month over the study period was analyzed to determine association between cold weather and the incidence of TT, it was most common in January. Significantly more boys underwent surgery in the winter and summer months, and the lowest in autumn. In

TABLE 1. **Patient characteristics, demographic data, clinical manifestations and surgical outcomes of the patients operated on because of acute scrotum (n = 558)**

Patient characteristics	Spermatic cord torsion (n = 142)	Torsion of testicular appendage (n = 344)	Epididymo-orchitis (n = 54)	Testicular rupture (n = 10)	Other reasons (n = 8)
Demographic data					
Age, median (range)	14 (0-18)	10 (0-18)	9 (0-18)	14 (11-17)	4 (0-14)
Lateralization					
Left n (%)	82 (58%)	183 (53%)	31 (57%)	3 (30%)	5 (63%)
Right n (%)	60 (42%)	161 (47%)	23 (43%)	7 (70%)	3 (37%)
Clinical manifestations					
Duration of symptoms (h) median (range)	6 (1-120)	24 (1-192)	12 (2-72)	35 (6-72)	12 (8-72)
< 6 h (n)	72	28	14	1	0
6 h-12 h (n)	22	62	15	4	2
12 h-24 h (n)	14	131	20	4	5
24 h-72 h (n)	30	72	5	1	1
> 72 h (n)	4	50	0	0	0
Pain, tenderness n (%)	135 (95%)	305 (88.6%)	42 (77.7%)	10 (100%)	6 (75%)
Edema of testis, n (%)	104 (73.1%)	299 (86.9%)	50 (92.5%)	6 (60%)	7 (87%)
Scrotal erythema, n (%)	78 (54.9%)	233 (76.7%)	37 (68.5%)	7 (70%)	6 (75%)
Nausea or vomiting n (%)	34 (23.9%)	13 (3.7%)	1 (1.8%)	0 (0%)	0 (0%)
Groin pain, n (%)	36 (25.3%)	3 (0.8 %)	0 (0%)	1 (10%)	0 (0%)
Negative cremasteric reflex, n (%)	87 (61%)	7 (2%)	0 (0%)	-	-
Hard testis, n (%)	90 (63.3%)	13 (3.8%)	0 (0%)	-	-
High position of the testicle, n (%)	96 (67.6%)	1 (0.2%)	0 (0%)	-	-
Degree of torsion, median (range)	360° (90°-1080°)	-	-	-	-
Recent trauma, n (%)	3 (2.1%)	19 (5.5%)	0 (0%)	10 (100%)	0 (0%)
Surgical outcomes					
Surgical procedure					
Detorsion and fixation, n (%)	102 (71.83%)	-	-	-	-
Orchiectomy n (%)	40 (28.16%)	-	-	-	-
Complications, n (%)	3 (2.1%)	1 (0.2%)	0 (0%)	1 (10%)	1 (12.5%)
Length of hospital stay days; median (range)	3 (2-5)	3 (2-7)	4 (2-8)	2 (1-3)	3 (2-3)

patients with AT relatively equal proportion of patients in relation to the months of the year was found. Patients with EO were usually equally distributed in relation to the seasons with a note that is somewhat larger number of EO was recorded in winter, Figure 4b. The average duration of symptoms prior to arrival at hospital compared to the years of the patients was observed. In TT patients the most time needed to admission to hospital were boys of 18 years, in patients with AT longest duration of symptoms was observed in patients with 16 years while in patients with EO longest time recorded was in patients with 11 years, Figure 4c.

Discussion

Spermatic cord torsion is a true urologic emergency and must be differentiated from other complaints of testicular pain because a delay in diagnosis and management can lead to loss of the testicle.[1,3,6-9] Time becomes an important factor when evaluating these

TABLE 2. **Characteristics, operative findings and outcome of patients presenting with rare causes of acute scrotum**

Characteristics, operative findings and outcome of patients presenting with spermatic cord torsion in inguinal canal (n = 9)

Patient no.	Age (yrs)	Side	Duration of symptoms (h)	Symptoms	Operative findings	Outcome
1	14	Left	56	testicular pain, edema, nausea	gangrene of testis	orchiectomy
2	13	Right	5	testicular pain, edema	testicular torsion	orchiopexy
3	15	Left	60	testicular pain, edema, vomiting	gangrene of testis	orchiectomy
4	16	Right	4	testicular pain, edema	testicular torsion	orchiopexy
5	15	Right	6	testicular pain, edema	testicular torsion	orchiopexy
6	1	Left	36	testicular pain, crying	gangrene of testis	orchiectomy
7	0	Right	10	testicular pain, edema, crying	testicular torsion	orchiopexy
8	9	Right	48	testicular pain, edema, erythema	gangrene of testis	orchiectomy
9	1	Left	48	testicular pain, edema, crying	gangrene of testis	orchiectomy

Characteristics, operative findings and outcome of patients presenting with testicular rupture (n = 10)

Patient no.	Age (yrs)	Side	Time from trauma to surgery (h)	Mechanism of injury	Associated injuries	Size of rupture (cm)	Outcome
1	16	Right	24	combat sport	-	4	normal testicle
2	17	Right	6	fall from a motor vehicle	fracture of the forearm	2	normal testicle
3	14	Right	48	combat sport	laceration of penis	3.5	normal testicle
4	15	Right	24	combat sport	-	2	normal testicle
5	16	Left	24	physical attack	-	3	normal testicle
6	11	Left	72	combat sport	-	3	normal testicle
7	16	Right	48	combat sport	-	2.5	normal testicle
8	15	Right	8	combat sport	-	2.5	atrophy
9	14	Left	12	football	-	3	normal testicle
10	16	Right	8	combat sport	-	2	atrophy

patients; a prompt and accurate diagnosis can be essential to the preservation of testicular viability.[9] The incidence of spermatic cord torsion among patients with acute scrotum varies from 16% to 45% depending on the age of the patient, but in most of the reposts is about 25%.[3,10-14] In our study incidence of spermatic cord torsion of 25% among 558 patients operated on because of acute scrotum was found. It can occur at any age but usually occurs in young males, with a bimodal incidence in the pediatric population: during the first year of life, and between the ages of 13 and 16 years.[6] Similar findings were found in our study. As many as 50% of boys with spermatic cord torsion have had a prior episode of testicular pain.[15] The left testis is more frequently involved. Bilateral cases account for 2% of all torsions.[6-9] In our study left testicle was affected in 58% of the patients with spermatic cord torsion. Because spermatic cord torsion is a potentially reversible condition when diagnosed and treated early, the emphasis should be on prompt evaluation of children who present with acute scrotum or acute inguinal or abdominal pain.[6,9,16] If treated within 6 hours of the presenting pain, there is a good chance of saving the affected testicle, as 90%-100% testicles will be saved. If treated within 6 h-12 h, depending on degree of the torsion, 20%-50% testicles will be saved and if treated within 12 h-24 h 0%-10% testicles will be saved.[1-3,6,9] In our study percent of salvaged testes in patients treated within 6 h from onset of symptoms was 90%-100%, in patients treated within 6 h-12 h 25%-65%,

and in patients treated within 12 h-24 h 0%-24%. In this study overall incidence of salvaged testes was 72%, similar to the most reports from literature, although there are reports on very low percent of salvaged testes.[17] The success of salvaging testis greatly depends on the duration of pain, and in our study an average duration was 6 hours in group of salvaged testicles and 46 hours in group of orchiectomies. Testicular atrophy is inevitable when pain is presented over 8 h-12 h and when pain is presented more than 24 hours the success of the salvage is very low.[8,16,17]

Not all spermatic cord torsion cases present as acute onset severe scrotal pain. Some patients initially present only with lower abdominal or inguinal pain, and the pain moves to the scrotum a few hours later after the initial abdominal presentation. If this condition remains unrecognized, within the golden timeframe of 6 hours after initial pain, the testicle may be lost.[6,16] This is the reason why any male patient presenting with lower abdominal pain should have their testicles checked to make sure that they do not have torsion.[6] This condition, unfortunately, often remains unrecognized even by physicians, and some children are even operated with suspicion of appendicitis, and the real cause of the disease is determined only after appendectomy.[18,19]

Torsion of the spermatic cord also may be complication of the cryptorchidism. Torsion of TT in the setting of cryptorchidism is rarely reported and usually involves patients suffering from cerebral palsy and spastic neuromuscular disease.[9] Torsion of the cryptorchid testis can also occur intra-abdominally. Literature is very limited on this topic and incidence of orchiectomies is very high. Only a few cases of torsion within the inguinal canal have been reported in the current literature and are mostly limited to case reports.[9] Torsion of an undescended testis can be difficult to diagnose because it can mimic other emergencies such as acute abdomen or incarcerated hernia. This case emphasizes the need for a proper abdominal, inguinal and genitourinary examination of a patient presenting with groin pain, especially for a patient who is unable to communicate well with the emergency physician. In our study 9 patients had torsion of testis in the inguinal canal, in this group of patients there was a greater rate of orchiectomy (55%) compared to the patients with TT of descended testis.

Mellick reported that TT is the third most common cause of a malpractice lawsuit in adolescent males.[5] Stimson et al performed a review of claims and indemnity payments for urologists by an insurance company in New York State, and found that TT was tied as the fourth most commonly misdiagnosed condition.[20]

Torsion of AT is one of the most common causes of acute scrotum, incidence in our study was 62%. Although it is a benign condition the necrotic tissue can be gradually absorbed without any consequences in almost all cases. The tip of the incidence of AT torsion is in prepuberty age while the peak of incidence of torsion of testis is at adolescent age.[3,7-10] Similar findings were found in our study. The exact incidence of epididymitis is unknown. Large pediatric centers reported rate of epididymitis from 5-40 cases per year.[21-23] Our study has recorded 54 cases of epididymitis that underwent surgery for a clinical presentation of an acute scrotum and form up 10% of all cases of acute scrotum.

Scrotal trauma accounts for less than 1% of all trauma related injuries, because of the anatomic location and mobility of the scrotum. The peak incidence of scrotal trauma is in the age range of 15–40 years.[24] Blunt trauma is the most commonly occurring form and usually results from sport injury, motor vehicle collision or assault.[24] The right testis is injured more often than the left one, because of its greater propensity to be trapped against the pubis or inner thigh.[24] Testicular rupture is a rip or tears in the tunica albuginea resulting in extrusion of the testicular contents. Prompt surgical intervention is crucial. Ruptured testis can be salvaged, with a high success rate, if surgical repair is performed within 72 hours of testicular injury.[24] In our study mean time between surgery and the initial trauma was 35 hours, sports injuries were the most common causes of significant testicular injury. All testes were salvaged, although two boys developed testicular atrophy during follow up.

Imaging studies have been devised for correct diagnosis and in order to overcome the problem of misdiagnosing TT as epididymitis and vice versa.[2,25] In the diagnosis of testis torsion the combination of standard and Doppler ultrasound achieves specificity of 80%-100%, and the sensitivity of 85%-100%.[2,25] Acute-phase proteins can be helpful in the differentiation of acute epididymitis from other non-inflammatory causes of acute scrotum.[2] Sometimes despite mentioned diagnostic procedures it is not possible to distinguish between TT or some other conditions that mimics clinical presentation of TT. Thus, for the certain patients a surgical intervention is actually a diagnostic procedure and is always justified in any doubt or dilemma for the accuracy of diagnosis. The previous articles on the subject of incidence of TT in relation to the seasons of the year have shown a positive correlation between low air temperature and TT.[26,27] In our study, TT also most commonly occurred in January. Significantly higher number of boys underwent surgery in winter

and summer, and the lowest number in autumn. This is attributed to the relative contraction of cremasteric muscle in winter and increased physical activity in summer, primarily water sports.

Conclusion

Early scrotal exploration based on careful physical examination decreases the risk of misdiagnosis of TT. Regarding the etiology of scrotal pain it is of great importance that the patient seeks immediate medical attention. Reduction in delays to patient presentation by increasing public awareness will decrease testicular loss due to torsion. A certain percentage of children with acute scrotal pain and swelling will be difficult to diagnose because of the overlap of signs and symptoms among TT, torsion of the AT and EO. If the patient arrived on time, within 6 hours, the testicle can be saved. Torsion of an undescended testis is a relatively rare phenomenon that should be suspected, diagnosed and treated without delay to prevent testicular infarction. Considering the fact that abdominal pain can be the only presenting symptom of testicular torsion, any male patient presenting with lower abdominal pain should have their testicles checked to make sure that they do not have torsion. Scrotal trauma calls for careful physical and imaging evaluations to determine the appropriate management of injuries. Testicular rupture, the most severe testicular injury, requires immediate surgical intervention. Ruptured testis can be salvaged, with a high success rate, if surgical repair is performed within 72 hours of testicular injury. □

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