A multicenter review of undescended testis torsion: A plea for early management

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Summary (400 words)

Introduction Torsion of an undescended testis (UT) is a surgical emergency, difficult to diagnose, whose prognosis depends on a quick management.

Aim of the Study To evaluate the management and outcome of these patients.

Study design We retrospectively analyzed all cases of UT torsion operated in nine French hospitals between 1997 and 2017. We divided patients in two groups: patients referred less than 6 hours after the onset of symptoms (group A) or more than six hours (group B).

Main results We collected 60 cases (17 in group A and 43 in group B). Median age was 2.2 years [IQR=0.7-7.8] (2.3y in group A and 2y in group B, p=0.76). Eleven patients (10 in group B) had neurological disorders (p=0.15). The main reason for absence of UT treatment was the absence of surgical consultation in a normal delay (n=44, 73%). Symptoms were pain (n=58, 97%), inguinal mass (n=55, 92%) and vomiting (n=16, 27%). An inguinal mass with no palpable testis in the ipsilateral hemiscrotum was seen in 55 patients (92%). An ultrasound scan performed in 27 patients led to the diagnosis in 16 patients (59%). At surgery, an orchiectomy was performed in 4 patients (23%) of group A and 24 patients (56%) of group B (p=0.04). After a median follow-up of 11 months [IQR=4-23], 11 patients of group A (65%) and 7 patients of group B (16%) had a clinically normal testis (p=0.03). The salvage rate among patients with conservative treatment was 85% for group A and 37% for group B (p=0.01).

Discussion Our study reveals that although UT torsion is an emergency, 72% of patients are referred more than 6 hours after the onset of symptoms. We mostly found classic clinical presentation of UT torsion: a painful inguinal mass with an empty ipsilateral scrotum. Ultrasound was performed in half cases, and even if the result was not significant, it still seemed to be associated with a higher rate of orchiectomy especially in group B because of

the delay in care. However, when ultrasound was realized early, it led to diagnosis in all cases. This dilemma poses the problem of the role of imaging in diagnostic management.

Conclusions Early clinical diagnosis in front of a painful inguinal mass with an empty scrotum is essential to improve the salvage rate of testis in UT torsion. Early management of UT should have avoided 68% of testis loss.

	Group A (n=17)	**Group B (n=43*)**	**TOTAL (n=60)**	***p-value***
Testis appearance, n (%)				
Ischemic	10 (59)	10 (23)	20 (33)	0.01
Necrotic	5 (30)	26 (61)	31 (52)	0.04
Vascularized	2 (11)	7 (16)	9 (15)	0.99
Orchiectomy, n (%)	4 (23)	24 (56)	28 (47)	0.04
Orchidopexy of the contralateral testis, n (%)	2 (12)	15 (35)	17 (28)	0.11
Testis atrophy at last follow-up, n (%)	2 (12)	8 (18)	10 (31)	0.05
Normal clinical testis at last follow-up, n (%)	11 (65)	7 (16)	18 (30)	0.03

Table. Operative findings and follow-up

*Four patients were lost to follow-up.

Introduction (176 words)

Spermatic cord torsion is a common surgical emergency with an estimated incidence of 1 in 1,500 males under the age of 18 years [1]. A quick management is needed to avoid necrosis that can occur six to 24 hours after pain onset [2] and a recent study suggests that the risk of having a nonviable testis increases by almost 5% every 10 minutes of delay [3]. Therefore, up to 42% of patients operated on for testicular torsion will have an orchiectomy [1]. Cryptorchidism or undescended testis (UT) is a common pathology of childhood, found in about 2 to 8% of boys [4]. UT torsion is rare, occurring in children at an unexpected age of testicular torsion making the diagnosis difficult and often delayed that differed treatment with low rates of testis salvage.

Only case reports, small size series or monocentric reviews have been published about UT torsion in the literature so far [5–11]. The aims of this multicenter retrospective study were to describe the management and to evaluate the outcome of these patients to determine the predictive factors that could help saving the testis.

Methods (216 words)

Patients' identification was carried out using diagnostic codes for testicular torsion and for UT in nine French children hospitals between 1997 and 2017. All the files associated with these codes were retrospectively reviewed and only those with a UT torsion confirmed during the operation were included. Collected data were: age at presentation, medical history, clinical examination, imaging, time between pain onset and surgery, operative findings and follow up. The diagnosis of UT torsion was suspected on the clinical data and confirmed by surgical exploration. The word 'pain' was quoted each time present in the records and for young infants, incessant crying was included as a sign of pain. Orchiectomy was performed when the

macroscopic appearance was in favor of necrosis. If not, the surviving testis was clinically evaluated at the end of follow-up.

Due to the young age of the patients, the precise time of onset of pain was frequently difficult to estimate. Considering that a delay of six hours is a well-known cut-off for testis' salvage after torsion starts, we divided patients into two groups: patients referred less than six hours after the onset of symptoms (group A) or more than six hours (group B). The time interval was measured between the first time parents became aware of a problem and the surgical exploration. This information was much more reliable and easier to found in medical record that the exact hour of the symptoms' onset.

Descriptive statistics were performed using Fisher's exact test for categorical variables, and the Mann-Whitney test for non-parametric continuous data (median and IQR), respectively. A p-value less than 0.05 was considered significant. All analyses were performed using GraphPad version 5.03 (GraphPad Software, San Diego, CA, USA).

Results (508 words)

We included 60 cases, 17 in group A and 43 in group B. Median age at diagnosis of UT torsion was 2.2 years [IQR=0.7-7.8] with 32 (45%) being less than two years old. The reasons for absence of UT surgery prior to UT torsion are described in Table 1. The main reason was the absence of surgical consultation in a normal delay to treat UT (n=44, 73%). Ten patients (17%) were younger than six months and 24 (40%) younger than 18 months. Six patients (10%) had an anesthetic contraindication due to neurological disorders. Overall, 11 patients had neurological disorders, one in group A (6%) and 10 in group B (23%) (p=0.15). Two other patients from group B had associated anomalies, one atrial septal defect and one

anorectal malformation. The median age at torsion was higher for patients with a neurological disorder (9,5 years vs. 1.7 years, p<0.01).

Both groups had similar clinical presentation (Table 2). The most common symptom was pain (n=58, 97%), more frequently localized in the inguinal area (n=56, 93%), rarely in the abdomen (n=2, 3%). The two patients who did not express pain were an 8-month-old child and a child with cerebral palsy.

An inguinal mass with no palpable testis in the ipsilateral hemiscrotum was present in 55 patients (92%). Other clinical symptoms were: local inflammation (n=22, 37%), vomiting (n=16, 27%) and fever (n=5, 8%). There were significantly more patients with local inflammation in group B (n=20, 46%) than in group A (n=2, 12%) (p<0.01).

In group A, color-Doppler ultrasound performed before surgery for six patients (35%) led to the correct diagnosis in all cases. In group B, 21 patients (49%) underwent a color-Doppler ultrasound but the diagnosis was only made in 10 cases (48%), which is lower than in group A (p=0.05).

Surgery was performed through an inguinal approach in 58 patients (97%) (Figure A). For the other two cases, the surgical approach was scrotal for one and inguinoscrotal for the other (Table 3). A necrotic testis was found in 5 patients in group A (30%) and 26 patients in group B (61%) (p=0.04) that led to 4 and 24 orchiectomies (p=0.04), respectively. In the absence of orchiectomy, a homolateral orchidopexy was performed for all testes in both groups. Contralateral orchidopexy was performed during the same surgery in two patients of group A (12%) and 15 patients of group B (35%) (p=0.11). Noteworthy, one patient of group B who underwent a right orchiectomy twisted his left intra-abdominal testis before the scheduled contralateral orchidopexy and became anorchid. In both groups, no postoperative complications were reported.

Median follow-up was 11 months [IQR=4-23], 8 months [IQR=4-27] in group A and 15 months [IQR=4-20] in group B respectively (p=0.92). Four patients from group B were lost to follow-up compared to none from group A. At the end of follow-up, two patients in group A (12%) and eight (18%) patients in group B had testicular atrophy, meaning that 15% of saved testis in group A and 42% in group B suffered from a secondary atrophy (p=0.055). The orchiectomy rate was 54% for the patients less than 18 months at diagnosis versus 42% above 18 months (p=0.43) (Table 4).

Discussion (1391 words)

Our study confirms that spermatic cord torsion in case of cryptorchidism is an emergency, needing a quick diagnosis and treatment to save the testis. Orchiectomy rate was twice as high in patients operated more than six hours after the onset of pain compared to patients operated beforewards. For intra-scrotal testes, it is well documented that surgery within the six first hours of symptoms onset is a significant predictor of testicular salvage [12, 13]. The salvage rate is about 40% while it is 30% in our series [1]. Gold *et al.* has recently studied the impact of in-hospital management duration time, defined as the time between the hospital entry at the emergency department and the surgical detorsion, and has showed that it is an independent factor influencing testicular survival. The risk of having a nonviable testis increases by almost 5% every 10 minutes of delay [3]. This finding is also true for patients with a long duration of symptoms before being referred to emergency departments. The authors suggest a probably exponential rate of testicular deterioration after torsion to explain this phenomenon. The last hours before detorsion are therefore the most important.

Diagnosis of UT torsion is often made too late. In our study, 72% of patients present to the emergency departments more than six hours after the onset of symptoms. The mean duration

of symptoms at time of surgery in literature varies from 19 to 40 hours [5, 8, 10, 14]. Zilberman *et al.* describes a series of 11 UT torsions with two patients referred more than three days after the beginning of initial symptoms, eight patients four to eight hours after and only one before four hours [15]. For Naouar *et al.*, only four of 13 patients (30.7%) have been admitted to the hospital within six hours after symptoms appearance with a mean of 19 hours for the others [9].

Clinical presentation of UT torsion can be classical: with a painful inguinal mass and an empty ipsilateral scrotum, like in 92% of our series. Clinicians should recognize this clinical presentation, which is also reported in other publications [7–10, 15]. Vomiting is present in 37% of our patients. Kargl *et al.* reports a vomiting rate of 9% [5], Naouar *et al.* of 23% [9] and Pogorelic *et al.* of 50% [10]. In intra-scrotal testicular torsions, the frequency of vomiting varies from 11% to 60% [16–18], nevertheless Beni-Israel *et al.* has showed that vomiting in an acute scrotum is associated with increased likelihood of testicular torsion with an odd ratio of 8,87 [19]. Absence of vomiting should therefore not rule out diagnosis of UT torsion but, when present, strongly reinforces clinical suspicion. However, atypical clinical signs can render the diagnosis difficult. In young children, UT torsion can be revealed by only inconsolable crying or poor nutritional intake [8–10, 15].

Because of the quite classical presentation of spermatic cord torsion (pain, vomiting) in this uncommon situation, parents and general practitioners or pediatricians' awareness must be improved, as well as the education for the recognition of signs of torsion must be part of the care of patients with UT and their parents.

Zao *et al.* has shown a bimodal age distribution for testicular torsion, with peaks in the first year of life and in early adolescence [1]. Our population’s characteristics confirm a peak of UT torsion during the first two years of life, half of our cohort being below the age of two years at UT torsion, which may prevent an accurate and prompt diagnosis. In the same way,

many patients (68%) have not been operated on for their UT because they were not referred for surgery at the recommended time. Parents and general practitioners or pediatricians' awareness must be improved. Indeed, even if international guidelines recommend surgical exploration and orchidopexy between 6 and 18 months at the latest [20, 21], many children are treated later on. Zvizdic *et al.* has shown in 2019 that the mean referral age of 324 patients with congenital cryptorchidism is 23 months [22]. For Jiang *et al.*, the median age is 44 months, and 64% of children have delay in referral [23] while median age at referral is 1.1 year for Nah *et al.*[24]. In our study, 36 patients (60%) are older than 18 months and should have already been treated. Among them, 15 will have an orchiectomy, which could therefore have been avoided. They represent more than half of our cohort's orchiectomies.

The most common past history includes neurological disorders. Among 11 cases of UT torsion reported by Ito *et al.* between 1991 and 2015, seven have cerebral palsy or neuromuscular disease [25]. These results were partially explained by a higher frequency of acquired UT in patients with cerebral palsy or neuromuscular disorders. Moreover, it has been proposed that disorderly contractions of the cremasteric muscles can cause acquired UT and torsion [26, 27]. However, Bingöl-Kologlu *et al.* shows that the frequency of cremasteric reflex increases during the first years of life, with a peak between 5 and 8 years [28]. This is consistent with our observations, where patients with neurological disorders presented UT torsion at a median age of 9,5 years. We can also suggest that the neurological disorders, as possible contraindication for surgical lowering of the testis, favor the over representation of UT torsion in our study. Neurological disorders often result in communication failures that may have delayed the identification of symptoms. We have also other associated anomalies like atrial septal defect and anorectal malformation. If these pathologies are not obstacles to the recognition of symptoms, they may have caused UT to pass to the background and thus delay its management.

Ultrasound has been performed in one out of two cases, and even if the result is not significant, it still seems to be associated with a higher rate of orchiectomy especially in group B because of the delay in the management. However, when the ultrasound is realized early, it leads to the correct diagnosis in all cases. This dilemma raises the issue of the role of imaging in diagnostic management. In Kargl's series, ultrasound examination with Doppler has led to the correct diagnosis in many cases but has corrected an initially clinical misdiagnosis in only one case [5]. Slijper *et al.* describes ultrasound with Doppler in three patients known for UT, who have been admitted with groin pain. In two patients incarcerated inguinal hernia has been diagnosed with ultrasound Doppler, while the surgery has revealed UT torsion. In the third patient, ultrasound with Doppler has diagnosed UT torsion, but surgery has diagnosed incarcerated inguinal hernia [29]. This highlights the variability of ultrasound results depending on the experience of radiologists and quality of the machine. *Kalfa et al.* has led a multicenter review of 919 patients from 11 European university hospitals [30]. The detection of the spermatic cord twist has a better sensitivity with high-resolution ultrasonography (Se=96%) than the intratesticular vascularization evaluation in color Doppler sonography (Se=76%). Other radiological exams as CT, scintigraphy or MRI, have been described to help with the diagnosis, but cannot be used routinely in children in the context of an emergency [6, 31, 32]. No additional examinations should delay surgical management. However, early ultrasound scan may be performed if the onset of symptoms can be accurately ruled out because the absence of edema at the first stage of UT torsion can greatly help the radiologic diagnosis and emergency management.

In most of series already published, the controlateral testis is fixed at the same time [6, 8, 9, 25]. We feel it is the right thing to do when it is technically possible even if there are no clear recommendations stated up to now. The case of the child who has twisted his second intra-abdominal testis before fixation goes strongly in this direction.

Our overall rate of secondary atrophy is 30%. Because of the retrospective nature of our study and the absence of ultrasound for systematic re-evaluation, the evaluation of the testicular atrophy was based on the comparative clinical examination. In the literature most studies do not provide follow-up [8, 11]. Zilberman, Pogorelic and Kargl *et al.* have reported atrophy rates varying from 25% to 80% based on clinical examination [5, 10, 15]. In the study by Naouar *et al.*, an ultrasound is systematic at 3 and 12 months. It reports 33% atrophy, 50% hypotrophy and only one in 6 patients with a normal testis [9].

The main strength of our study relies on the number of cases from several centers but the analysis leads to subgroups of sometimes less than 10 patients that weakens the statistical analyses. We can identify other bias due to the retrospective design of our study. The duration of symptoms is more difficult to assess in young children than in adults because their precise onset is uncertain. If we had a more precise duration, we could have tested the exact duration of symptoms that would lead to testis necrosis in children and compare it to the well-known cut-off of six hours we have empirically chosen from the adult urology practice. The exact position of the UT cannot be precisely determined to differentiate the congenital from the acquired form of UT. Finally, the evaluation of the surviving testis is only clinical with no systematic ultrasound scan, but the median follow-up is long enough to allow a good detection rate of testis atrophy, especially in group B.

Conclusion (103 words)

UT torsion can happen at any age but seems more frequent before two years. Early diagnosis in front of a painful inguinal mass with an empty scrotum with or - more frequently - without vomiting in relatively young, non-(pre)-pubertal children is essential to improve the salvage rate of UT torsion. When performed early, ultrasound scan may help the diagnosis, but a quick surgical management is the cornerstone treatment, with a recommended contralateral

fixation. Education for the recognition of signs of torsion must be part of the care of patients with UT and their parents. However, an early surgical management of UT at less than 18 months of age may drastically decrease the risk of UT torsion.

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Bibliography

[1] Zhao LC, Lautz TB, Meeks JJ, et al. 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: 2009–2013.

[2] Bayne CE, Villanueva J, Davis TD, et al. Factors Associated with Delayed Presentation and Misdiagnosis of Testicular Torsion: A Case-Control Study. *J Pediatr* 2017; 186: 200–204.

[3] Gold DD, Lorber A, Levine H, et al. Door To Detorsion Time Determines Testicular Survival. *Urology* 2019; 133: 211–215.

[4] Virtanen HE, Toppari J. Epidemiology and pathogenesis of cryptorchidism. *Hum Reprod Update* 2008; 14: 49–58.

[5] Kargl S, Haid B. Torsion of an Undescended Testis — A Surgical Pediatric Emergency. *J Pediatr Surg*. Epub ahead of print June 2019. DOI: 10.1016/j.jpedsurg.2019.06.018.

[6] Geng J-H, Huang C-N. Torsion of undescended testis: Clinical, imaging, and surgical findings. *Urol Sci* 2014; 25: 31–34.

[7] Hajji F, Janane A. Images in clinical medicine. Torsion of undescended testis. *N Engl J Med* 2012; 366: 1625.

[8] Singal AK, Jain V, Dubey M, et al. Undescended testis and torsion: is the risk understated? *Arch Dis Child* 2013; 98: 77–79.

[9] Naouar S, Braiek S, El Kamel R. Testicular torsion in undescended testis: A persistent challenge. *Asian J Urol* 2017; 4: 111–115.

[10] Pogorelić Z, Mrklić I, Jurić I, et al. Testicular torsion in the inguinal canal in children. *J Pediatr Urol* 2013; 9: 793–797.

[11] Weiss AP, Van Heukelom J. Torsion of an Undescended Testis Located in the Inguinal Canal. *J Emerg Med* 2012; 42: 538–539.

[12] Mansbach JM, Forbes P, Peters C. Testicular torsion and risk factors for orchiectomy. *Arch Pediatr Adolesc Med* 2005; 159: 1167–1171.

[13] Ramachandra P, Palazzi KL, Holmes NM, et al. Factors influencing rate of testicular salvage in acute testicular torsion at a tertiary pediatric center. *West J Emerg Med* 2015; 16: 190–194.

[14] Deng T, Zhang X, Wang G, et al. Children with Cryptorchidism Complicated by Testicular Torsion: A Case Series. *Urol Int* 2019; 102: 113–117.

[15] Zilberman D, Inbar Y, Heyman Z, et al. Torsion of the cryptorchid testis--can it be salvaged? *J Urol* 2006; 175: 2287–2289; discussion 2289.

[16] Abbas TO, Abdelkareem M, Alhadi A, et al. Suspected testicular torsion in children: diagnostic dilemma and recommendation for a lower threshold for initiation of surgical exploration. *Res Rep Urol* 2018; Volume 10: 241–249.

[17] Tu L, Zhao Y-W, He J. [Diagnosis and treatment of 109 cases of testicular torsion in children and adolescents]. *Zhonghua Nan Ke Xue Natl J Androl* 2019; 25: 46–49.

[18] Jefferson RH, Pérez LM, Joseph DB. Critical analysis of the clinical presentation of acute scrotum: a 9-year experience at a single institution. *J Urol* 1997; 158: 1198–1200.

[19] Beni-Israel T, Goldman M, Bar Chaim S, et al. Clinical predictors for testicular torsion as seen in the pediatric ED. *Am J Emerg Med* 2010; 28: 786–789.

[20] Radmayr C. Management of undescended testes: European Association of Urology/European Society for Paediatric Urology guidelines. *J Pediatr Urol* 2017; 13: 550.

[21] Kolon TF, Herndon CDA, Baker LA, et al. Evaluation and treatment of cryptorchidism: AUA guideline. *J Urol* 2014; 192: 337–345.

[22] Zvizdic Z, Islamovic B, Milisic E, et al. Changing Trends in the Referral and Timing of Treatment for Congenital Cryptorchidism: A Single-Center Experience from Bosnia and Herzegovina. *J Pediatr Surg*. Epub ahead of print August 2019. DOI: 10.1016/j.jpedsurg.2019.08.013.

[23] Jiang DD, Acevedo AM, Bayne A, et al. Factors associated with delay in undescended testis referral. *J Pediatr Urol* 2019; 15: 380.e1-380.e6.

[24] Nah SA, Yeo CSW, How GY, et al. Undescended testis: 513 patients' characteristics, age at orchidopexy and patterns of referral. *Arch Dis Child* 2014; 99: 401–406.

[25] Ito T, Matsui F, Fujimoto K, et al. Acquired undescended testis and possibly associated testicular torsion in children with cerebral palsy or neuromuscular disease. *J Pediatr Urol* 2018; 14: 402–406.

[26] Candocia FJ, Sack-Solomon K. An infant with testicular torsion in the inguinal canal. *Pediatr Radiol* 2003; 33: 722–724.

[27] Phillips NB, Holmes TW. Torsion infarction in ectopic cryptorchidism: a rare entity occurring most commonly with spastic neuromuscular disease. *Surgery* 1972; 71: 335–338.

[28] Bingöl-Koloğlu M, Tanyel FC, Anlar B, et al. Cremasteric reflex and retraction of a testis. *J Pediatr Surg* 2001; 36: 863–867.

[29] Slijper N, Sukhotnik I, Toubi A, et al. Critical validation of ultrasound Doppler in the diagnosis of torsion of undescended testis. *Isr Med Assoc J IMAJ* 2007; 9: 99–101.

[30] Kalfa N, Veyrac C, Lopez M, et al. Multicenter assessment of ultrasound of the spermatic cord in children with acute scrotum. *J Urol* 2007; 177: 297–301; discussion 301.

[31] Abd-ElGawad EA, Abdel-Gawad EA, Magdi M, et al. Magnetic resonance imaging for detection of non palpable undescended testes: Diagnostic accuracy of diffusion-weighted MRI in comparison with laparoscopic findings. *Egypt J Radiol Nucl Med* 2015; 46: 205–210.

[32] Vijayaraghavan SB. Sonographic differential diagnosis of acute scrotum: real-time whirlpool sign, a key sign of torsion. *J Ultrasound Med Off J Am Inst Ultrasound Med* 2006; 25: 563–574.

Tables and figures legend:

Table 1. Patients' characteristics

Table 2. Clinical presentation

Table 3. Operative findings and follow-up

Table 4. Orchiectomy rate by age

Figure A. Operative findings of an undescended testis torsion by inguinal approach. After detorsion, the testis was saved and an orchidopexy was performed.

Figure A.

	Group A (n=17)	Group B (n=43)	TOTAL (n=60)	*p-value*
Median age (Year + IQR)	2.3 (1.1-6.5)	2 (0.6-9)	2.2 (0.7-7.8)	0.76
Neurological disorders, n (%)	1 (6)	10 (23)	11 (18)	0.15
Disorders of sex development, n (%)	0 (0)	1 (2)	1 (2)	1
UT side, n (%)				
Right	6 (35)	19 (44)	25 (42)	0.57
Left	9 (53)	14 (33)	23 (38)	0.23
Bilateral	2 (12)	10 (23)	12 (20)	0.47
Type of UT, n (%)				
Palpable	9 (53)	32 (74)	41 (68)	0.13
Unpalpable	8 (47)	11 (26)	19 (32)	
Reasons for the absence of UT surgical treatment, n (%)				
Age<6months	1 (6)	9 (21)	10 (17)	0.25
No surgical consultation	16 (94)	28 (65)	44 (73)	0.02
Anesthetic contraindication	0 (0)	6 (14)	6 (10)	0.17

Table 1. Patients' characteristics

UT: Undescended testis

	Group A (n=17)	**Group B (n=43)**	**TOTAL (n=60)**	***p-value***
Fever, n (%)	0 (0)	5 (12)	5 (8)	0.31
Vomiting, n (%)	3 (18)	13 (30)	16 (27)	0.51
Local inflammation, n (%)	2 (12)	20 (46)	22 (37)	<0.01
Pain location, n (%)				
Inguinal	17 (100)	39 (90)	56 (93)	
Abdominal	0 (0)	2 (5)	2 (3)	0.56
No pain	0 (0)	2 (5)	2 (3)	
Preoperative CDU, n (%)	6 (35)	21 (49)	27 (45)	0.39
Correct diagnosis on CDU, n (%)	6 (100)	10 (48)	16 (59)	0.05

Table 2. Clinical presentation

CDU: color Doppler ultrasound

	Group A (n=17)	Group B (n=43*)	TOTAL (n=60)	*p-value*
Testis appearance, n (%)				
Ischemic	10 (59)	10 (23)	20 (33)	0.01
Necrotic	5 (30)	26 (61)	31 (52)	0.04
Vascularized	2 (11)	7 (16)	9 (15)	0.99
Orchiectomy, n (%)	4 (23)	24 (56)	28 (47)	0.04
Orchidopexy of the contralateral testis, n (%)	2 (12)	15 (35)	17 (28)	0.11
Testis atrophy at last follow-up, n (%)	2 (12)	8 (18)	10 (31)	0.05
Normal clinical testis at last follow-up, n (%)	11 (65)	7 (16)	18 (30)	0.03

Table 3. Operative findings and follow-up

*Four patients were lost to follow-up.

	Age		*p-value*
	<6 months (n=10)	**>6 months (n=50)**	
Orchiectomy, n (%)	4 (40)	24 (48)	0.737
	<1 year (n=21)	**>1 year (n=39)**	
Orchiectomy, n (%)	11 (52)	17 (44)	0.59
	<18 months (n=24)	**>18 months (n=36)**	
Orchiectomy, n (%)	13 (54)	15 (42)	0.43

Table 4. Orchiectomy rate by age