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Testicular torsion during the COVID-19 pandemic: Results of a multicenter study in northern Italy

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Summary

Introduction
The literature reported an increased avoidance of the Emergency Department (ED) during COrona VIrus Disease 19 (COVID-19) pandemic, causing a subsequent increase of morbidity and mortality for acute conditions.

Testicular torsion is a surgical emergency, which can lead to the loss of the affected testicle if a delayed treatment occurs. As testicular loss is time-related, outcome was hypothesized to be negatively affected by the pandemic.

Objective
The aim is to investigate whether presentation, treatment and outcomes of children with testicular torsion were delayed during COVID-19.

Study design
Medical records of pediatric patients operated for testicular torsion of six Paediatric Surgical Units in Northern Italy between January 2019 and December 2020 were retrospectively reviewed.

Patients were divided as for ones treated during (dC) or before the pandemic (pC). To reflect possible seasonality, related to lockdown restrictions, winter and summer calendar blocks were also analysed.

For all cohorts, demographic data, pre-operative evaluation, operative notes and post-operative outcomes were reviewed. Primary outcomes were referral time, time from diagnosis to surgery and ischemic time, while secondary outcomes were orchiectomy and atrophy rates. Statistic was conducted as appropriate.

Results
A total of 188 patients with acute testicular torsion were included in the study period, 89 in the pre-COVID-19 (pC) period and 99 during COVID-19 (dC). Time from symptom onset to the access to the Emergency Department (T1) was not different among the two populations (pC: 5,5 h, dC: 6 h, p 0.374), and similarly time from diagnosis to surgery (pC: 2,5 h, dC: 2,5 h, p 0.970) and ischemic time (pC: 8,2 h, dC: 10 h, p 0.655). T1 was <6 h in 46/99 patients (46%) pC and 45/89 patients (51%) dC ($p = 0.88$, Fisher's exact test). Subgroup analysis accounting for different lockdown measures, confirm the absence of any difference.

Orchiectomies rate was 23% (23/99) dC and 21% (19/89) pC ($p = 0.861$, Fisher's exact test) and rate of post-operative atrophy was 9% dC (7/76) and 14% pC (10/70), $p = 0,44$, Fisher's exact test.

Discussion
Despite worldwide pediatric ED accesses reduction, we reported that neither ischemic time nor the long-term outcomes in children with testicular torsion increased during the COVID-19 pandemic.

In the available literature, few studies investigated the topic and are controversial on the results. Similarly to our findings, some studies found that timing and orchiectomy rates were not significantly different during the pandemic, while others reported a correlation to pandemic seasonality. Furthermore, in the recent pediatric literature it has been reported a delayed testicular torsion diagnosis due to shame in informing parents.

Strengths of this study are the large numerosity, its multicentric design and a long study period. Its main limitation is being retrospective.

Conclusions
We reported our large cohort from one of the most heavily COVID-19-affected regions, finding that referral, intra-hospital protocols and ischemic time in testicular torsion were not increased during to the pandemic, as well as orchiectomy rate and atrophy.

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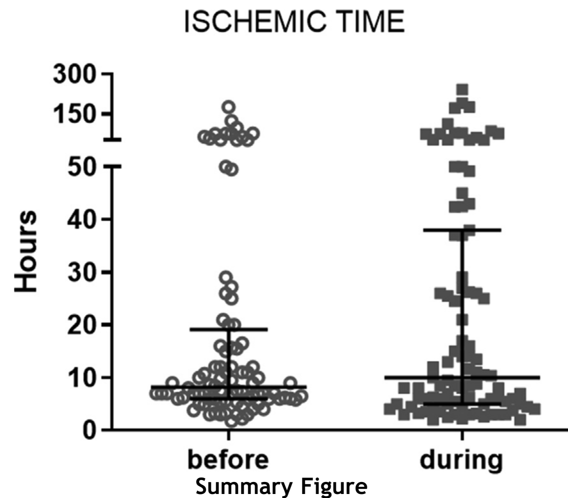

Summary Figure

Introduction

The spread of COronaVIrus Disease 19 (COVID-19) has begun as a geographically confined pneumonia of unclear etiology and rapidly reached a pandemic dimension, impacting all aspects of life across the world. Since the World Health Organization (WHO) confirmed COVID-19 as a global pandemic on March 11, 2020, the management of the disease has required a rapid remodulation of health systems and the global transmission of evidence-based information.

Italy was the first European country heavily affected by COVID-19, with a greater localization in the north of the country, where the healthcare system has rapidly been overwhelmed. As a way to contain the disease, the government established a stepwise strategy starting from the complete lockdown of initial foci in northern Italy on 20 February 2020 and subsequent adoption of progressively more stringent lockdown measures of the entire nation, as of 11 March. During that period of time, the medical literature reported an increased avoidance of the Emergency Department (ED) for non-COVID-19 illnesses during the pandemic [1—3]. Compared to the same period of past years, many Italian authors have reported a huge reduction of paediatric admissions to ED, ranging from 72% to 92% [4]. Also, during the COVID-19 pandemic in most of the centers elective surgical procedures were cancelled and surgery was limited to urgent surgical or trauma patients. These efforts to minimize unnecessary traffic through the healthcare facility resulted in a significant reduction in emergency department patient encounters, bringing to increase paediatric morbidity and mortality.

Testicular torsion is a common surgical emergency, since it can lead to the loss of the affected testicle, especially when a delayed diagnosis occurs. The reported annual incidence of testicular torsion is 1:4000 in males aged under 18 years old, which accounts for 5—25% of acute scrotum in children. Prompt diagnosis and surgical management with scrotal exploration and detorsion within the first 6—8 h following symptom onset are important to prevent testicular loss [5,6]. Given the difficulty and high testis loss rate even under optimal conditions, COVID-19 has been hypothesized to have a negative impact on acute scrotum management [7].

The aim of our study is to investigate whether children with testicular torsion had a delayed presentation and treatment during the pandemic period in a pool of centres highly affected by COVID-19, thus resulting in an increased rate of orchiectomy and testicular atrophy. The investigation was conducted comparing time from symptoms onset to ED access, ED-to-operating room (OR) time and total ischemic time during COVID-19 pandemic and compared it to the pre-pandemic period, as well as orchiectomy rate and testicular atrophy rate.

Materials and methods

A multicentric retrospective study was conducted in six Paediatric Urology and Pediatric Surgery Departments of Northern Italy, representative of the three most severely affected areas during COVID Pandemic that is Lombardy, Piedmont and Veneto. Included patients were referred to Torino, Vicenza, Brescia, Bergamo, Padova, Treviso Hospitals. The medical records of all consecutive patients evaluated at the Emergency Department for acute scrotum and operated for testicular torsion in the last 2 years were reviewed. We included in the study all male patients aged between one month and 18 years with a diagnosis of acute testicular torsion and who underwent emergency scrotal exploration plus detorsion orchiopexy or orchiectomy at the included institutions. Patients who were not confirmed to have testicular torsion on surgical exploration were excluded.

Patients were then divided in two cohorts: data from the pandemic period from March 2020 to January 2021 (COVID19 pandemic, dC) were compared with the pre-COVID period (pC), from January 2019 to February 2020, that served as control group for comparison. The timing of the pandemic cohort was determined based on the WHO declaration of a pandemic dated March 11, 2020. To account for possible correlation of the results to the lockdown restrictions, we also compared, within the COVID period,

outcomes during two different calendar blocks: the winter period with stricter lockdown (March—May 2020 and October 2020—January 2021, strict-lockdown) and the summer period with softer restraint policies (June—September 2020, soft-lockdown).

For both cohorts of patients, demographic data, ultrasonographic findings, recording of time and dates, information on COVID-19 swab results, operating theatre utilization were recorded. Few centers performed non-surgical manual detorsion at ED access, although all patients undergoing manual untwisting are still subject to emergent surgical exploration as per centres protocol. Orchiectomy versus detorsion orchiopexy was determined from the operative records. Post-operative atrophy, defined either clinically or based on ultrasonographic finding, was also recorded. Atrophy was defined as the difference in testicular volume >80% by ultrasound compared with the contralateral testis measured or as a reduction in 3 or more sizes at the orchidometer.

Primary outcomes were time from symptom onset to presentation to the ED (T1), time from diagnosis to surgery (T2) and ischemic time (T3), from symptom onset to surgical incision. Secondary outcomes were orchiectomy rate and rate of testicular atrophy at follow-up in preserved testes.

Statistical analysis was conducted as appropriate: dichotomic variables were expressed using rates and percentages while continuous variables as median and interquartile ranges (IQR), unless otherwise specified. D'Agostino-Pearson test for normal distribution was applied to all variables and parameters not showing a Gaussian distribution were analysed with non-parametric tests. Comparative analyses were therefore performed with either Mann Whitney or Kruskal—Wallis tests for continuous variables and Fisher's exact test for categorical variables. P values < 0.05 were considered significant. Statistical analyses were conducted using GraphPad Prism software (version 6, San Diego, CA), used as well for displaying the tables.

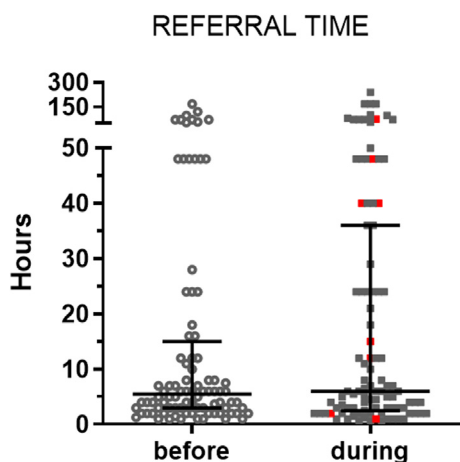

Fig. 1 Plot chart showing referral time, i.e. time in hours from symptom onset to the access to the Emergency Department (T1) before and during COVID 19 pandemic. Each dot plots a single patient value; red dots represent first lockdown month (March 2020); bars represent median and interquartile ranges. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article).

Results

During the study period, a total of 188 patients with acute testicular torsion were included. Of these, 89 occurred in the pre-COVID-19 period and 99 during COVID-19. Of this latter, we further divided the soft-lockdown period with 36 patients from the strict-lockdown period with 63 patients. Median age at presentation was 13 age (range 6 months—17 years).

Referral time (T1, time from symptom onset to the access to the Emergency Department) was not statistically different: pC 5,5 h (IQR 3—15) versus dC 6 h (IQR 2,5—36) p 0.374 (Mann Whitney test, see Fig. 1). Cases occurred in March 2020, during the first national lockdown weeks, were also analysed separately and showed a slight median increase, despite not significant (10 h, p = 0,36, Mann Whitney test, Fig. 1 red dots). The subgroup analysis of the patients presented within the pandemic period, comparing strict- and soft-lockdown months, still did not record any difference (p 0.772, Kruskal Wallis test). Also, T1 was <6 h in 46/99 patients (46%) pC and 45/89 patients (51%) dC (p = 0.88, Fisher's exact test).

Time from access to the ED to entry the operative room (T2, ED-to-OR) was identical in the two time-periods (Fig. 2). In fact, T2 dC was 2,5 h (IQR 2—3,5), same as pC 2,5 h (IQR 2—4), p 0.970, Mann Whitney test. Again, subgroup analysis accounting for lockdown variation, did not show any difference, with a p value of 0.268 (Kruskal—Wallis test).

Finally, no differences were found in the ischemic time (T3), time from symptom onset to entry to the operative room (Fig. 3): pC T2 was a median of 8,2 h (IQR 6—19) while in dC period it was 10 h (IQR 5—10), not statistically different (p = 0.655, Mann Whitney test).

Both during pC and dC there was a comparable rate of patients that had a pre-operative derotation in the ED, pre-

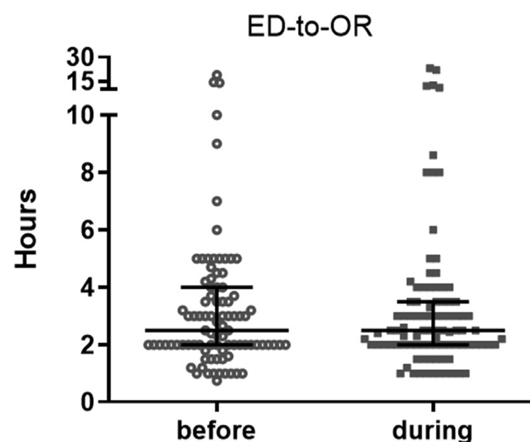

Fig. 2 Plot chart showing time in hours, from access to the Emergency Department to entry the Operative Room (T2, ED-to-OR) before and during COVID 19 pandemic. Each dot plots a single patient value; bars represent median and interquartile ranges.

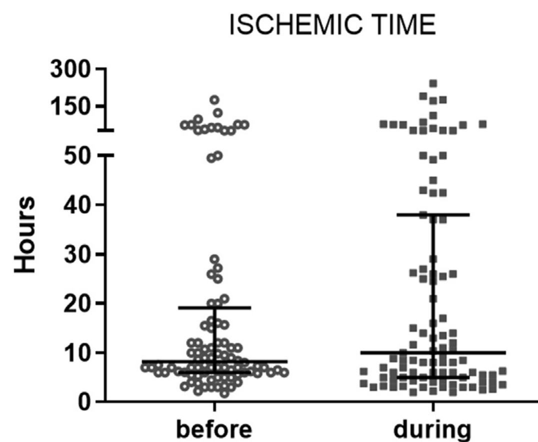

Fig. 3 Plot chart showing ischemic time in hours, from symptom onset to entry to the operative room (T3) before and during COVID 19 pandemic. Each dot plots a single patient value; bars represent median and interquartile ranges.

COVID 18% (16/89) and during pandemic 16% (16/99), p = 0.846 Fisher's exact test; despite similar untwisting outcomes, the procedure might have affected overall T2 values, and it might explain some high T2 values.

Of the patients operated during pandemic, 46/99 (47%) were operated in a dedicated COVID operating room; the remaining were operated in a non-COVID theatre because the swab was already proven to be negative.

Incidence of orchiectomy also was not significantly different between time periods, with 23% (23/99) undergoing orchiectomy dC and 21% (19/89) undergoing orchiectomy in pC period (p = 0.861, Fisher's exact test). Of the testicle that were preserved during the procedures, the rate of post-operative atrophy was 9% dC (7/76) and 14% in pC (10/70), p = 0,44, Fisher's exact test.

Moreover, even within COVID period, soft-lockdown months were comparable with strict-lockdown ones both for orchiectomy rate (8/36, 22% soft vs 15/63, 24% strict) and post-operative atrophies (4/28, 6% soft vs 3/48, 6% strict), with a p value of 1 and 0,41 respectively (Fisher's exact test).

Discussion

Since the declaration of the COVID-19 pandemic, a large number of countries in the world have applied severe restrictive measures to prevent viral spread and overwhelming national health systems. The aim of these measures was to reduce social contacts by closing school, suspending non-essential productive activities, stopping of mass gatherings and events and individual movement restrictions [8]. Italy was the first country outside Asia to experience a widespread epidemic and also to impose a generalized lockdown on March 11, 2020 allowing its citizens to leave their homes only for medical needs or grocery shopping, converting non-essential work in smart working and traditional face to face lessons to distance learning. Again in Italy, the need of postponing non-urgent ED access for both adult and paediatric population has been advocated by the press. As a consequence of these drastic measures and fear of contagion, it has been reported a substantial decrease in paediatric ED visits and a considerable reduction in clinical visits by family pediatricians [9]. In recent paediatric literature, these daily-life limitations have been a point of discussion due to the increased risk of delaying diagnosis of potentially serious clinical conditions. An e-survey conducted in the United Kingdom and Ireland found that 32% of pediatric consultants had seen children with delayed presentations of potentially life-threatening conditions such as diabetic ketoacidosis, sepsis, and malignancy [10]. In the surgical practice, several recent studies regarding the management of acute appendicitis during COVID-19 pandemic clearly showed that staying at home, due to public health safety orders, negatively impacted on children who developed appendicitis. The highest level of evidence about this topic is reported by a recent meta-analysis which emphasizes a significantly higher incidence of complicated appendicitis in children during the COVID-19 period than in pre-COVID-19 period [11]. For instance, during the pandemic, an increased rate of perforated appendicitis in pediatric patients, compared to pre-COVID-19 period, has been reported [11–13].

Multiple factors have been hypothesized to be responsible for this increased complicated appendicitis as delayed presentation of pediatric patients, socioeconomic factors or delay in time to surgery for restricted pandemic protocols [11]. Starting from these assumptions we compared presentation trends and outcomes among paediatric patients with testicular torsion before and during the COVID-19 period in several centers highly affected by the pandemic. Contrary to our expectations, we demonstrated that neither the time periods from symptoms onset to ED referral and intervention nor the long-term outcomes, such as orchiectomy and post-operative atrophy rate were statistically increased during the COVID-19 pandemic.

In the available literature, only six studies investigated whether the COVID-19 pandemic caused increased of number of orchiectomies as a consequence of delayed presentation and diagnosis of acute testicular torsion in paediatric patients (Table 1). A recent meta-analysis compared all these studies focusing on the impact of the COVID-19 pandemic on pediatric testicular torsion in terms of duration of symptoms, proportion of children with delayed presentation (>24 h) and orchiectomy rate. Pogorelic et al. hypothesize that no significant difference in the outcomes existed between pre- and COVID-19 period [14]. Similar to our findings, studies from Nelson et al. and Littman et al. found that time from onset of symptoms to ED presentation, ischemic times, and orchiectomy rates for testicular torsion at their center were not significantly different during the COVID-19 pandemic period compared to pre-COVID period [15,16]. Shields et al. reported the same results but with a statistically significant increase in testicular torsion cases during the COVID-19 pandemic period [17]. However, unlike these above-mentioned studies, we decided in the presented study to extend the collection of data until January 2021, including the two major peaks of infection and the different grades of restriction measures. Our subgroup-analysis on the two time periods, namely the high-COVID19 incidence period during winter months, reflecting strict-lockdown measure, and the low-COVID-19 incidence period during summer, did not

Table 1 Published series of testicular torsion in pre-COVID-19 e during COVID-19 period. T1 = referral time, T2 = time from diagnosis to surgery, T3 = ischemic time, pC = ,pre-COVID pandemic, dC = during COVID pandemic, SSD = statistically significant difference, NSSD = not statistically significant difference.

First author	Year	Study	Country	COVID period	Groups pC/dC	T1 pC/dC	T2 pC/dC	T3 pC/dC	Orchiectomy rate pC/dC	Atrophy rate pC/dC
Nelson et al.	2020	Single-center retrospective	USA	March–May 2020	77/17	NSSD ($p = 0.476$)	–	NSSD ($p = 0.694$)	NSSD ($p = 0.397$)	–
Holzman et al.	2021	Multicenter prospective	USA	March–July 2020	137/84	SSD ($p = 0.04$)	NSSD	–	NSSD ($p = 0.06$)	–
Pogorelic et al.	2021	Multicenter retrospective	Croatia	March–December 2020	68/51	SSD ($p = 0.007$)	NSSD	–	SSD ($p = 0.001$)	–
Littman et al.	2021	Single-center retrospective	USA	March–May 2020	57/21	NSSD ($p < 0.37$)	–	–	NSSD ($p < 0.17$)	–
Shields et al.	2021	Single-center retrospective	USA	March–December 2020	79/38	NSSD ($p = 0.86$)	–	–	NSSD ($p = 0.27$)	–
Lee et al.	2021	Single-center retrospective	USA	March–October 2020	55/27	SSD ($p = 0.003$)	NSSD	SSD ($p = 0.001$)	NSSD	–
Our series	2021	Multicenter retrospective	Italy	March 2020–January 2021	89/99	NSSD ($p = 0.374$)	NSSD ($p = 0.970$)	NSSD ($P = 0.655$)	NSSD ($p = 0.861$)	NSSD ($p = 0.44$)

highlight any statistical difference. This finding is in contrast with results from Holzman et al. that reported a difference in the two different analysed pandemic periods, but in this study the periods analysed were limited to summer and spring months, both characterized by softening of the lockdown measures.

Moreover, in recent paediatric literature it has been reported a 13% rate of delayed testicular torsion diagnosis due to shame and fear in informing parents [18]. We acknowledge that our study is in contrast to previously published ones that reported a longest time to presentation and highest orchiectomy rates as effect of observed delay in seeking emergency care during COVID-19 period [7–19]. We explained these apparently abnormal finding with a longer lockdown period compared with other countries that has facilitated interaction between children, at home after school closed, and parents, at home for smart working or temporary unemployment. These changes have increased parental awareness of their child's physical condition and ability to respond in a timely manner to any acute symptoms, despite the pandemic restrictions. This hypothesis could support also the results reported by Lee et al. which referred a significantly fewer delayed presentation of testicular torsion and shorter ischemia time on presentation during COIVD-19 period [20].

Interestingly in our follow up time, we did not record an increase in the rate of testicular atrophy during COVID-19 period.

Finally, the need to avoid intra-hospital spread of contagion and to ensure healthcare workers protection, were necessarily linked with the availability of rapid and sensitive testing for positive patients undergoing surgery or the presence of a COVID-19 dedicated operating room. These aspects and new protocols were supposed to have lengthened some diagnostic and therapeutic paths. However, to whom it may concern testicular torsion, we found that this time interval was not different between the COVID-19 cohort and pre-pandemic controls. We could postulate that limiting the number of family members allowed to enter the ED, having effective and rapid COVID-19 testing, dedicated operating rooms and a reduction in overall elective surgery cases to prioritize the treatment for emergency may be some of the key points to maintain a timely surgical exploration and therefore not influencing long term outcomes on testicular preservation.

Our study has several important features such as the large number of patients, a multicenter design including the most affected Italian regions and a longer pandemic period than the remaining available literature, but also it has a main limitation due to its retrospective character to which we have tried to obviate through an in-depth statistical analysis.

The presence of a large multicentric groups, despite giving a wide overview of the situation during the pandemic, it is affected by some limitation as the variability among the different centers in the management of this condition and in the organization during the pandemic, such as the possibility to directly access the OR in a dedicated pediatric fast-track service or depending on presence of other specialties within the Hospital; the different local guidelines for the pandemic restrain.

Conclusions

Management of testicular torsion from diagnosis in ED to arrive in OR should be very fast for staying in testicle-save-time window. We report that in a large cohort in one of the most heavily COVID-19 affected regions, referral, intra-hospital protocols and thus total ischemic time due to testicular torsion were not increased due to the pandemic. As a consequence, orchiectomy rate and post-operative atrophy were also substantially not increased. Parent's awareness and the develop of appropriate protocols may lead to a maintenance of the standard-of-care for emergent surgery even during a worldwide pandemic.

Acknowledgements

None

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