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Impact of COVID-19 on testicular torsion: A single-center retrospective study from a children's hospital

Kota Fujimoto[1,2], Beom Yong Rho[1,3], Si Wook Lee[4], Jae Ok Baek[4], Yong Seung Lee[1,4], Sang Woon Kim[1,4]

[1]Department of Urology, Urological Science Institute, Yonsei University College of Medicine, Seoul, Korea, [2]Department of Plastic and Reconstructive Surgery, Wakayama Medical University, Wakayama, Japan, [3]Department of Urology, Inha University College of Medicine, Incheon, [4]Department of Pediatric Urology, Severance Children's Hospital, Seoul, Korea

Purpose: Testicular torsion is a urological emergency necessitating immediate surgical intervention. However, the altered medical environment during the coronavirus disease 2019 (COVID-19) pandemic posed several challenges and the current study aimed to analyze its effects on the treatment of pediatric testicular torsion cases.

Materials and Methods: We retrospectively analyzed 47 pediatric patients diagnosed with testicular torsion at Severance Children's Hospital from 2009 to 2022. Patients were categorized into pre–COVID-19 (n=38) and COVID-19 (n=8) groups. Data were collected for each patient, and the differences between the two groups were statistically analyzed.

Results: The patients' median age was from 13 years (range, 1–19 years) to 13 years (range, 1–16 years) between the pre–COVID-19 and COVID-19 period (p=0.309). The analysis revealed a significant difference between the pre–COVID-19 and COVID-19 groups in the time from symptom onset to emergency department arrival (6.4 hours [0.7–120.0] vs. 20.0 hours [1.3–288.0], p=0.031) and the time from symptom onset to surgery start (19.5 hours [4.5–124.3] vs. 28.5 hours [6.1–293.4], p=0.047). The median postoperative size of the affected testis was 9.8 mL (range, 2.0–13.9 mL) during the COVID-19 period, compared to 1.6 mL (range, 0.1–7.3 mL) in pre–COVID-19 period (p=0.012). The testicular volume ratio (affected/unaffected) was used to evaluate outcomes across patients with varying ages and testicular sizes.

Conclusions: The current study shows that pandemic-related delays in treatment may worsen ischemic injury in testicular torsion, emphasizing the importance of timely intervention even during global crises.

Keywords: COVID-19; Testicular torsion; Testis

INTRODUCTION

Acute scrotum is a painful, acute scrotal swelling and is one of the most common causes of emergency room visits in boys. Acute scrotum has a broad differential diagnosis covering a wide range of possibilities. However, it is important to immediately rule out testicular torsion, which accounts for an estimated 25%–35% of all pediatric cases, making it one of the most common urological emergencies [1-3]. Testicular salvage rates in testicular torsion of 90%–100% are reported

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Corresponding Author: Sang Woon Kim https://orcid.org/0000-0002-5790-1948
Department of Urology, Urological Science Institute, Yonsei University College of Medicine, 50-1 Yonsei-ro, Seodaemun-gu, Seoul 03722, Korea
TEL: +82-2-2228-2310, E-mail: KHISIN@yuhs.ac

if surgery is performed within six hours of symptom onset, which decreases to 50% if symptoms last longer than 12 hours, and <10% if symptoms last 24 hours or longer. Hence, it is essential to recognize the characteristic symptoms in a timely manner through physical examination and imaging, in order to facilitate speedy diagnosis and intervention [4,5]. Coronavirus disease 2019 (COVID-19) was first diagnosed on December 8, 2019, in a patient in Wuhan, China [6], which was followed by a rapid spread of the outbreak around the world. The first case of COVID-19 in the Republic of Korea was reported in January 2020 [7]. More than 775.4 million COVID-19 infections and 7 million COVID-19 deaths had been reported worldwide by the end of May 2024 [8]. The pandemic resulted in public health measures to reduce viral spread, which ranged from complete lockdown to stay-at-home orders and social distancing measures. Such interventions, along with the public fear of COVID-19, may have contributed to the decrease in emergency department (ED) visits during the pandemic period [9]. Few studies have investigated the impact of COVID-19 on urologic diseases. Timely treatment of testicular torsion is critical to avoid poor outcomes such as testicular loss and infertility. Therefore, the purpose of this study was to assess how the altered healthcare circumstances during the COVID-19 pandemic affected the treatment of patients with testicular torsion.

MATERIALS AND METHODS

1. Data collection and study design

This study included patients diagnosed with testicular torsion at the Severance Children's Hospital. This study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by Institutional Review Board of Severance Hospital (approval number: 4-2024-1394) and individual consent for this retrospective analysis was waived. The participants were categorized into two groups based on the treatment period. The participants admitted during the COVID-19 period (March 1, 2020 to December 31, 2022) were allocated to the COVID-19 group, whereas the participants admitted during the pre–COVID-19 period (December 1, 2009 to February 29, 2020) formed the control group. A total of 61 patients were initially screened for this study. To clearly demonstrate the impact of COVID-19, we excluded patients with neurological disorders, including cerebral palsy and neonatal torsions. A total of 47 participants were eventually included. The scheme of the present study is illustrated in Fig. 1. Testicular torsion was diagnosed by physical examination and ultrasound, and the patients underwent surgery (orchiopexy or orchiectomy). A postoperative evaluation of the testis by ultrasound was performed to assess its position and size. The decision to perform orchiectomy or orchiopexy was made intraoperatively based on testicular color, turgor, and bleeding after detorsion. Testes that showed signs of necrosis (e.g., black discoloration and lack of bleeding upon incision) were removed, whereas those with partial viability were preserved.

2. Data and measurement variables

All clinical data were obtained from medical charts and analyzed retrospectively. The data included information on age, symptoms, time of disease onset, ED arrival and discharge, ultrasound examination, testicular procedures, and follow-up period. Based on the documented times of symptom onset, ED arrival, and surgery start, the time intervals

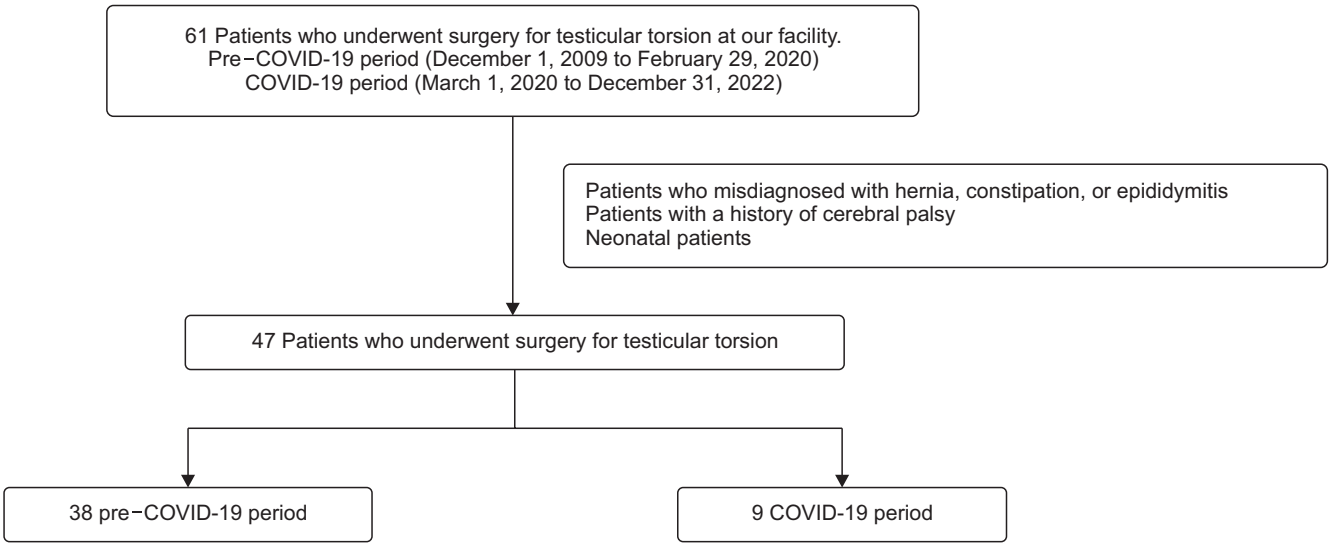

Fig. 1. Flow chart of the study participants. COVID-19, coronavirus disease 2019.

Table 1. Baseline patient characteristics in the pre–COVID-19 and COVID-19 period

Characteristic	Pre–COVID-19 period	COVID-19 period	p-value
Number of patients	38	9	
Median age (y)	13 (1–19)	13 (1–16)	0.309
Side affected			0.236
Right	25 (65.8)	4 (44.4)	
Left	13 (34.2)	5 (55.6)	
Presenting symptoms			
Scrotal pain	33 (86.8)	9 (100.0)	0.249
Abdominal pain	16 (42.1)	2 (22.2)	0.332
Blood flow of testis			0.486
Absent	18 (47.4)	6 (66.7)	
Decreased	9 (23.7)	2 (22.2)	
Non-decreased	11 (28.9)	1 (11.1)	
Median preoperative testicular volume (mL)			
Affected	5.1 (1.0–11.4)	13.6 (6.1–31.4)	0.035*
Non-affected	5.2 (0.9–9.8)	9.0 (5.6–10.0)	0.097
Median preoperative testicular volume ratio (affected side/non-affected side)	1.19 (0.92–1.30)	1.49 (1.09–3.14)	0.106

Values are presented as number only, median (range), or number (%).
The median preoperative volume of the affected testis was significantly higher in the COVID-19 group, compared to the pre–COVID-19 group.
COVID-19, coronavirus disease 2019.
*p<0.05.

for the following were calculated: symptom onset to ED visit, symptom onset to surgery, and ED visit to surgery. Testicular size and the degree of blood flow (categorized as normal, decreased, or absent) were assessed during the ultrasound examination. The testicular ratio (affected side testis/non-affected side testis) was calculated based on the size of both testes. Each patient was followed-up at 7 days and 3 months postoperatively, with annual re-examinations if possible.

3. Statistical analysis

All statistical analyses were performed using R version 4.1.0 (R Foundation for Statistical Computing). Descriptive statistics, categorical variables, and continuous variables are expressed as number, percentage, and mean and standard deviation, or median (interquartile range), depending on whether the distributions were normal or not. The chi-squared test was used to compare categorical variables between groups. Continuous variables without normality were analyzed using the Mann–Whitney U test method between groups. Adjusted odds ratios and confidence intervals were calculated. $p<0.05$ indicates statistically significant differences.

RESULTS

1. Clinical characteristics

The current retrospective study included 47 children who had testicular torsion confirmed by surgical diagnosis. Of these, 38 patients were placed in the pre–COVID-19 group, and 9 in the COVID-19 group. The baseline clinical characteristics are described in Table 1. There was no significant difference in age and laterality between the two groups. Scrotal pain was reported by all 9 patients (100.0%) in the COVID-19 group, compared 33 with (86.8%) in the pre–COVID-19 group. Abdominal pain was observed in 16 patients (42.1%) of the pre–COVID-19 group, and in 2 patients (22.2%) of the COVID-19 group. Nausea and vomiting were present in 3 patients (7.9%) in the pre–COVID-19 group, and in 1 patient (11.1%) in the COVID-19 group. Doppler ultrasonography demonstrated absent blood flow in the affected testicle in 4 patients (44.4%) in the COVID-19 group, compared to 6 patients (15.8%) in the pre–COVID-19 group. Decreased (but not absent) flow was noted in 4 (44.4%) and 21 (55.3%) patients in the COVID-19 and pre–COVID-19 groups, respectively. Although these differences were not statistically significant ($p=0.061$), a higher proportion of absent flow was observed in the COVID-19 group, which may reflect more advanced ischemia at presentation. The testicular volume ratio (affected/unaffected side) was higher in the COVID-19 group (median, 1.49; range, 1.09–3.14) compared to the pre–COVID-19 group (median, 1.19; range, 0.92–1.30), but this difference was not statistically significant ($p=0.106$). This discrepancy—significant difference in testicular volume but not in the ratio—may be explained by variations in contralateral testicular

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Table 2. Clinical presentation and management of patients in the pre–COVID-19 and COVID-19 period

Characteristic	Pre–COVID-19 period	COVID-19 period	p-value
Median time interval (h)			
Onset to ER arrival	6.4 (0.7–120.0)	20.0 (1.3–288.0)	0.031*
ER arrival to OR start	5.7 (2.9–50.9)	5.5 (2.7–8.5)	0.121
Onset to OR start	19.5 (4.5–124.3)	28.5 (6.1–293.4)	0.047*
Procedure			0.550
Orchiopexy	29 (76.3)	6 (66.7)	
Orchiectomy	9 (23.7)	3 (33.3)	
Median follow-up ultrasound (d)	190 (10–389)	92 (12–283)	0.157
Median postoperative testicular volume (mL)			
Affected	9.8 (2.0–13.9)	1.6 (0.1–7.3)	0.012*
Non-affected	10.6 (1.9–20.8)	7.6 (0.6–13.1)	0.073
Median postoperative testicular volume ratio (affected side/non-affected side)	0.77 (0.66–1.08)	0.61 (0.07–1.11)	0.088
Follow-up with ultrasound	10 (26.3)	5 (55.6)	0.122
Testicular atrophy in preserved cases	0/10 (0.0)	1/5 (20.0)	0.333

Values are presented as median (range) or number (%).
COVID-19, coronavirus disease 2019; ER, emergency room; OR, operation.
*p<0.05.

volume, particularly in adolescents with wide physiological growth differences. The median preoperative volume of the affected testis was significantly higher in the COVID-19 group, compared to the pre–COVID-19 group (13.6 mL [6.1–31.4] vs. 5.1 mL [1.0–11.4], p=0.035).

2. Time intervals and surgical outcomes

The time intervals and surgical outcomes are summarized in Table 2. The median time from symptom onset to ED arrival was significantly longer in the COVID-19 group compared to the pre–COVID-19 group (20.0 hours [1.3–288.0] vs. 6.4 hours [0.7–120.0], p=0.031). In addition, the time from symptom onset to the initiation of surgery was significantly prolonged in the COVID-19 group compared to the pre–COVID-19 group (28.5 hours [6.1–293.4] vs. 19.5 hours [4.5–124.3], p=0.047), whereas the time from ED arrival to surgery initiation did not differ significantly between the two groups (5.5 hours [2.7–8.5] vs. 5.7 hours [2.9–50.9], p=0.121). This suggests that the delay occurred primarily before hospital arrival, rather than during in-hospital management. Notably, despite potential logistical challenges related to viral screening and resource allocation during the pandemic, the comparable ED-to-surgery time suggests that institutional protocols and triage systems were effective in maintaining timely surgical intervention. The rate of orchiectomy was higher in the COVID-19 group (33.3%) compared to the pre–COVID-19 group (23.7%), although this difference was not statistically significant (p=0.550). The postoperative testicular volume ratio did not differ significantly between the two groups (p=0.088). The postoperative testicular volume ratio ranged from 0.66 to 1.08 (median, 0.77) in the pre–COVID-19 group and from 0.07 to 1.11 (median, 0.61) in the COVID-19 group, showing a trend toward greater atrophy in the latter group, although not statistically significant. However, a median postoperative volume of the affected testis was smaller than in the pre–COVID-19 group (1.6 mL [0.1–7.3] vs. 9.8 mL [2.0–13.9], p=0.012). This suggested a greater tendency toward postoperative testicular atrophy in the COVID-19 group. Supporting this, among the patients who underwent orchiopexy and were followed by ultrasound, testicular atrophy was observed in one of five cases (20.0%) in the COVID-19 group, whereas no cases of atrophy were noted in the pre–COVID-19 group (0/10). However, this difference was not statistically significant (p=0.333).

DISCUSSION

The altered healthcare environment during the COVID-19 pandemic had a profound impact on healthcare delivery worldwide. With no definitive end in sight during the initial phases, concerns arose regarding the anxiety experienced by patients in accessing medical care. Public advisories to refrain from venturing outside resulted in people avoiding unnecessary medical visits to prevent inadvertent infections and minimize the burden on the health care system [7,9-11]. Confronted with an unprecedented medical environment, the diagnosis and treatment of non–COVID-19 conditions varied, depending on the situation prevailing at the medical institutions in that region. Several studies have reported a significant decrease in ED visits during the COV-

ID-19 pandemic across various medical fields, raising concerns about delayed access to urgent care. This trend may have also affected timely presentation in cases of testicular torsion, where early intervention is critical for testicular salvage [12-17]. The extent of the impact of COVID-19 on the field of urology is unclear. The current study aimed to evaluate the impact of the pandemic specifically on patients with testicular torsion. Acute scrotum is relatively common in EDs and accounts for approximately 0.5% of all ED visits. Testicular torsion exhibits a bimodal age distribution and accounts for up to 26% of all acute scrotal cases. Extravaginal torsion is more common in the neonatal period, while intravaginal torsion occurs more frequently during adolescence, with peak incidence reported at 13–14 years of age. Prolonged ischemia due to torsion may cause irreversible damage to the testis. Therefore, prompt diagnosis and treatment is critical for salvaging the affected testis. The testicular salvage rate is 80%–100% if surgery is performed within 6 hours, but drops to below 20% if surgery is delayed beyond 12 hours. Patients typically present with a sudden onset of diffuse scrotal pain, often accompanied by nausea, vomiting, and abdominal pain [1,18,19]. In the current study, social factors related to COVID-19 did not influence the incidence, age distribution, laterality, or symptoms of testicular torsion. However, preoperative ultrasound examination in the COVID-19 group showed greater enlargement of testis than in pre–COVID-19 group. In the current study, social factors related to COVID-19 did not influence the incidence, age distribution, laterality, or symptoms of testicular torsion. However, preoperative ultrasound examination in the COVID-19 group showed greater enlargement of the testis than in the pre–COVID-19 group. Furthermore, the time from symptom onset to ED visit, as well as the time to surgery, were significantly prolonged in the COVID-19 group. This suggests a delay in seeking medical care during the pandemic, which likely contributed to ischemic progression of the affected testis. The cause of this delay could be multifactorial. Several studies have investigated the impact of COVID-19 on testicular torsion. Some have shown no significant difference in outcomes between the pre-pandemic and pandemic periods [20], while others found delays in presentation and increased rates of orchiectomy during the pandemic [21]. Our findings align more closely with the latter, suggesting that the delays in seeking care during the pandemic contributed to worsened outcomes, including increased testicular atrophy. In South Korea, public messaging encouraged people to stay home and avoid hospitals unless absolutely necessary, which may have led to hesitation among patients or their guardians. In addition, heightened fear of COVID-19 exposure in hospitals, confusion regarding hospital entry policies, and misinterpretation of initial symptoms may have also played a role. As this was a retrospective study, we could not conduct structured interviews with guardians to clarify the reasons for the delay. Future prospective studies should include surveys or interviews to investigate whether delays were primarily due to EMS system factors (e.g., ambulance response time, access to care) or patient-related factors (e.g., fear, uncertainty, misjudgment). Understanding these factors is essential for preparing effective healthcare delivery strategies in future public health emergencies. In Korea, the fatality rate of patients with cardiovascular diseases, including acute myocardial infarction (AMI), who had visited the ED increased during the COVID-19 pandemic [7]. During this period, most AMI patients presenting to the ED had clinical symptoms similar to those of COVID-19 infection, which may have prolonged the time from the ED to catheterization laboratory [10,22]. In addition, the medical staff participating in primary percutaneous coronary intervention required sufficient time to wear personal protective equipment while responding to patients with suspected COVID-19. In the current study, most patients presenting to the ED were also screened for COVID-19 infection, which included questionnaire-based and thermal screening. However, patients presenting with scrotal pain during the pandemic likely did not raise suspicion for COVID-19 as their symptoms were not typical of the infection. As a result, the time from ER visit to surgery during the COVID-19 period may not differ from that in the pre–COVID-19 period, since additional precautions for suspected COVID-19 cases were unnecessary. Only a quick test for COVID-19 screening was performed at the time of emergency surgery. Despite concerns about the risk of infection and the delays in starting surgery during the pandemic, our clinical research showed no significant difference between the two groups in terms of treatment. Although the COVID-19 group exhibited more severe preoperative edema, there was no significant difference in the rate of orchidectomy between the two groups. In our institution, the decision to remove or preserve the testis was made intraoperatively by evaluating testicular viability following detorsion. Even in cases with prolonged ischemia, if the testis showed partial reperfusion or bleeding, orchiopexy was preferred to preserve potential function, especially in pediatric patients. However, the increase in preoperative testicular volume in the COVID-19 group suggested that the prolonged time from symptom onset to ED visit during the pandemic may have contributed to the increase in edema. Although the testicular volume ratio (affected/unaffected) was not significantly different between groups, this may be attributed to variations in the

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size of the contralateral (unaffected) testis, particularly in adolescents whose testicular volume changes substantially with age. These physiological variations may have masked the statistical significance in ratio-based comparisons. In addition, the decrease in postoperative testicular volume in the COVID-19 group suggested that the significant delays in surgery during the pandemic may have exacerbated the ischemic injury. Among patients who underwent orchiopexy and received ultrasound follow-up, testicular atrophy was observed in 1 of 5 cases (20.0%) in the COVID-19 group, while no atrophy was noted in the pre–COVID-19 group (0/10). Although the difference was not statistically significant, this suggests that delayed intervention during the pandemic may have contributed to ischemic damage even in testes that were preserved. However, the interpretation of this finding should be made with caution due to the small number of follow-up cases and potential selection bias. Similar delays in other emergency conditions, such as pediatric poisoning, were also associated with poorer clinical outcomes during the pandemic [23]. Since testicular torsion is a condition requiring urgent attention, these findings emphasize the importance of timely intervention. The current study showed essential implications of public health messaging and health system preparedness during a pandemic. However, this study had several limitations. The single-center retrospective study may limit generalizability. In addition, the small sample size is likely to reduce statistical power. Furthermore, the lack of detailed information on Emergency Management Services (EMS) response times prevented us from considering the impact of pre-hospital delays due to EMS-related factors. One limitation of the current study is the potential interobserver variability in ultrasound-based testicular volume measurements, which may affect the accuracy of size comparisons. Hence, larger multicenter studies with longer follow-up are required to investigate the long-term effects of delays in treatment of testicular torsion. Public health measures aimed at limiting the spread of infection, such as social distancing and movement restrictions, have inadvertently contributed to delays in seeking medical care for non–COVID-19 emergencies, including testicular torsion. These delays may result in worse outcomes, as demonstrated in the current clinical study, which showed significant shrinkage of the affected testis. While our findings suggest that the delays likely occurred before hospital arrival, the specific causes remain unclear due to the retrospective nature of this study. Future pandemic preparation plans must ensure not only the capacity for infection control but also the ability to maintain prompt access to emergency care, through both public education and support for EMS systems. This study underscores the critical role of maintaining access to emergency care during global crises.

CONCLUSIONS

The COVID-19 pandemic significantly delayed the treatment of pediatric testicular torsion, leading to worse outcomes, including increased testicular atrophy. Our findings emphasize the need for timely medical intervention, even during global crises, and highlight the importance of maintaining access to emergency care in future healthcare strategies.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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AUTHORS' CONTRIBUTIONS

Research conception and design: Kota Fujimoto, Beom Yong Rho, Si Wook Lee, Jae Ok Baek, and Sang Woon Kim. Data acquisition: Kota Fujimoto and Si Wook Lee. Statistical analysis: Kota Fujimoto and Si Wook Lee. Data analysis and interpretation: Kota Fujimoto, Si Wook Lee, and Sang Woon Kim. Drafting of the manuscript: Kota Fujimoto and Sang Woon Kim. Critical revision of the manuscript: Sang Woon Kim. Administrative, technical, or material support: Jae Ok Baek and Yong Seung Lee. Supervision: Kota Fujimoto, Beom Yong Rho, and Sang Woon Kim. Approval of the final manuscript: all authors.

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