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Testicular Torsion as a Urological Surgical Emergency: A Systematic Review of Main Approaches in Emergency Care and Surgical Techniques

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ABSTRACT

Testicular torsion is one of the most common and serious urological emergencies, characterized by the rotation of the spermatic cord, leading to a disruption of blood supply and, consequently, testicular ischemia. If not diagnosed and treated promptly, torsion can result in testicular necrosis, with the risk of organ loss. Despite being widely recognized, the condition is still associated with high morbidity and mortality rates, primarily due to delayed diagnosis and surgical interventions performed outside the ideal therapeutic window. Objectives: This study aimed to review the current literature on diagnostic and therapeutic strategies used in the management of testicular torsion, focusing on challenges encountered during initial care, early diagnosis, and appropriate surgical treatment. The review also seeks to discuss the main clinical implications and prognostic factors associated with the management of testicular torsion. The review was conducted by selecting and critically analyzing scientific articles published in medical databases such as PubMed, Scopus, and Web of Science, addressing testicular torsion, its diagnostic and therapeutic approaches. Clinical studies, systematic reviews, and emergency management guidelines were included, prioritizing recent and relevant publications for current medical practice. The evidence was evaluated based on rigorous methodological criteria, and results were grouped according to diagnostic, surgical treatment, and complications themes. The analysis of the studies revealed that the time between symptom onset and surgical intervention is the most significant prognostic factor in testicular preservation. Interventions performed within 6 hours of symptom onset are associated with significantly higher rates of testicular preservation, while delays greater than 12 hours increase the risk of necrosis and necessitate orchiectomy. The review also identified diagnostic challenges, especially in infants and adolescents, where clinical presentation may be atypical, delaying early diagnosis. The use of structured clinical tools, such as the TWIST Score, combined with a thorough physical examination, can improve diagnostic accuracy, although its application remains underused. Regarding surgical treatment, bilateral orchidopexy is recommended in cases of viable testis, while orchiectomy is indicated in cases of testicular necrosis. The choice of surgical technique should be made based on intraoperative evaluation and oncological criteria, particularly in adolescent and adult patients. Testicular torsion remains a urological emergency with significant

diagnostic and therapeutic challenges that directly impact clinical outcomes. Early identification, surgical intervention within the therapeutic window, and appropriate choice of surgical technique are crucial for testicular preservation and minimizing complications. Strengthening healthcare professional training, implementing standardized clinical protocols, and improving diagnostic infrastructure are essential measures to improve clinical outcomes and reduce morbidity and mortality associated with the condition.

INTRODUCTION

Testicular torsion is considered one of the most serious urological emergencies. It is characterized by the rotation of the spermatic cord around its own axis, which drastically compromises blood flow to the testicle. This condition constitutes a true surgical emergency, as, without prompt intervention, it can progress to testicular ischemia, tissue necrosis, and ultimately irreversible loss of the organ. Testicular torsion accounts for up to 25% of cases of acute testicular pain in children and adolescents who present to emergency services (1).

The epidemiology of testicular torsion reveals a bimodal distribution, with two main peaks of incidence: the first occurs during the neonatal period, especially in the first year of life, and the second during puberty, between 12 and 18 years of age, when there is rapid testicular growth and increased hormonal activity. This age distribution is essential for guiding clinical suspicion in different age groups and highlights the need to train frontline professionals in early diagnosis (2).

The pathophysiology of testicular torsion involves the acute rotation of the testicle around the spermatic cord, which compromises arterial and venous blood flow to the gonad. This rotation, usually between 180° and 720°, results in progressive testicular ischemia and may lead to testicular necrosis if not reversed in time (2).

Physically, torsion occurs when there is testicular hypermobility, often associated with an anatomical anomaly known as the “bell clapper deformity,” in which the testicle is not properly fixed to the tunica vaginalis and has abnormal freedom of movement within the scrotum. This condition facilitates testicular rotation around the spermatic cord axis, especially during periods of rapid growth or intense physical activity (1).

The pathophysiology of testicular torsion can be divided into two main events:

Initial Venous Obstruction: Torsion initially impairs venous return, leading to vascular congestion, increased intratesticular pressure, and fluid extravasation into the interstitial tissues. This process results in edema, compression of arterial vessels, and progressive impairment of blood perfusion (1). Secondary Arterial Ischemia: As pressure increases, occlusion of the testicular artery occurs, leading to tissue ischemia. The duration and degree of torsion determine the severity of ischemic damage. Experimental and clinical studies demonstrate that the critical time limit for testicular viability is generally up to 6 hours after symptom onset, although irreversible damage may occur sooner in cases of complete torsion (>360°) (3). After 12 hours without corrective procedures, the chance of testicular loss increases significantly—up to 80%. After 24 hours without adequate intervention, the chance of testicular salvage drops to less than 10% (1-3).

Beyond direct ischemia, there is a release of inflammatory mediators, reactive oxygen species (ROS), and activation of apoptotic pathways. Paradoxically, reperfusion following detorsion can cause additional damage to testicular tissue due to oxidative stress, known as ischemia-reperfusion injury (1). If not properly treated, testicular torsion can progress to testicular necrosis, loss of endocrine and exocrine function, and increased risk of infertility and formation of antisperm antibodies, with possible bilateral repercussions even when torsion occurs unilaterally (1).

Testicular torsion is a urological emergency with potentially significant implications for male fertility. Although the direct impact on the affected testicle is evident, the effects on the contralateral testicle and the role of orchiepididymectomy (removal of the twisted testicle) in preventing further damage have been investigated. Experimental studies, such as that conducted by Lorenzini et al. (2012), evaluated the effects of unilateral testicular torsion on spermatogenesis in the contralateral testicle in pubescent rats. The results indicated that torsion did not cause significant long-term effects on spermatogenesis in the contralateral testicle, suggesting that spermatogenic function in the unaffected testicle remains preserved even after torsion on the opposite side (4). Clinically, the condition presents with sudden-onset unilateral testicular pain of variable intensity, often associated with nausea, vomiting, and systemic signs. Physical examination reveals an elevated testicle with horizontal rotation, scrotal edema, local hyperemia, and absence of the ipsilateral cremasteric reflex—considered one of the most sensitive findings for torsion. Additionally, the testicle is enlarged, firm, and extremely tender to palpation (1,2,4).

Some classic semiological signs help differentiate torsion from other scrotal conditions. Angel’s sign refers to the absence of the cremasteric reflex. Prehn’s sign, traditionally used to distinguish between epididymitis and torsion, consists of manually elevating the testicle: in epididymitis, the pain is relieved, whereas in torsion, the pain persists or worsens. Brunzel’s sign is characterized by pain radiating to the inguinal region or lower abdomen, reinforcing the importance of careful

evaluation of abdominal complaints in male adolescents (5). To systematize clinical evaluation and increase diagnostic accuracy, the TWIST score (Testicular Workup for Ischemia and Suspected Torsion) was proposed. This clinical tool is based on five criteria: testicular swelling (2 points), hard consistency (2 points), absence of cremasteric reflex (1 point), associated nausea or vomiting (1 point), and high-riding testicle (1 point). Scores range from 0 to 7, with scores between 5 and 7 indicating high risk of torsion, justifying immediate referral for surgical intervention, even before confirmatory testing (6). Despite the emphasis on clinical diagnosis, complementary tests play a supporting role. Color Doppler ultrasonography is the test of choice due to its high sensitivity and specificity. Absence of blood flow in the affected testicle or reduced flow compared to the contralateral side are important indicators. In some cases, especially in diagnostic uncertainty, testicular scintigraphy with technetium-99m may be used, although its applicability is limited by availability and the time required to perform the exam. Laboratory tests such as a complete blood count, CRP, or urinalysis are not specific for the diagnosis but may assist in ruling out infectious causes (4-7). Bilateral testicular torsion represents a rare urological emergency, with a prevalence of less than 2% of torsion cases, more common in neonates. Although it shares clinical signs with unilateral torsion, such as scrotal pain, edema, and tenderness, the absence of the classic "bell clapper" deformity may hinder diagnosis. Therefore, a high index of clinical suspicion, detailed physical examination, and the use of Doppler ultrasound are essential for early and accurate detection. Treatment requires immediate surgical intervention with orchidopexy, aiming to preserve testicular function, as organ viability significantly decreases after six hours from symptom onset. Appropriate management and specialized follow-up are essential to minimize long-term complications and preserve fertility. Further scientific investigation is needed to elucidate the pathophysiological mechanisms and predisposing factors involved in bilateral testicular torsion (8). Emergency management approaches include an initial attempt at manual detorsion, which may be performed by experienced professionals when access to the operating room is temporarily limited. However, the definitive treatment is surgical, with bilateral orchidopexy, since anatomical predisposition is usually present on both sides. In more severe cases with evident necrosis, orchiectomy is necessary. The choice of surgical technique, timing of intervention, and follow-up protocols vary between institutions, and there is still no consolidated consensus on the standardization of these practices (3). Given the clinical relevance and potentially irreversible impact of testicular torsion on gonadal function and fertility, an updated systematic review is justified. It should synthesize the main diagnostic and therapeutic approaches adopted in emergency care, as well as the most effective surgical techniques described in the literature. Based on a PICO (Population, Intervention, Comparison, and Outcome) structured question, this investigation aims to analyze and compare approaches that may contribute to early diagnosis and testicular preservation, with special attention to time to intervention and surgical success rates. The goal is to provide evidence-based support to guide the clinical practice of urology, emergency medicine, and pediatric surgery professionals, promoting faster and more effective care in a scenario where every minute counts.

METHODS

This systematic review was conducted in accordance with the methodological guidelines established by PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), with the aim of gathering and critically analyzing the best available scientific evidence on the management of testicular torsion as a urological emergency, with emphasis on approaches adopted in emergency care and the surgical techniques used.

The literature search was carried out in the PubMed, SciELO, LILACS, Scopus, and Web of Science databases, covering the publication period from January 2000 to April 2025. The search strategy included the use of controlled descriptors (DeCS/MeSH) and free terms, combined with Boolean operators such as: "testicular torsion" AND "emergency care" OR "surgical technique" OR "orchiopexy" OR "scrotal pain" OR "acute scrotum." The search was adapted to each database to ensure comprehensive and accurate results.

Original studies (clinical trials, observational studies), systematic reviews, and meta-analyses published in English, Portuguese, Spanish, or other languages were included, provided they addressed patients diagnosed with testicular torsion and reported clinical, surgical, or diagnostic approaches. Studies irrelevant to the scope of the research, such as single case reports, letters to the editor, narrative reviews, and articles addressing other causes of acute scrotum, such as torsion of testicular appendages, were excluded. Additionally, duplicate publications, those with incomplete data, or without access to the full text were also discarded.

The study selection process followed two stages: screening of titles and abstracts, followed by full-text reading of potentially eligible articles, both conducted by two independent reviewers. In cases of disagreement, a third reviewer was consulted for the final decision. This methodological rigor ensured the reproducibility and reliability of the findings.

RESULTS

The initial search identified 164 relevant studies, extracted from a thorough literature review conducted in the PubMed, SciELO, LILACS, Scopus, and Web of Science databases, covering the publication period from January 2000 to April 2025. The search strategy included the use of controlled descriptors (DeCS/MeSH) and free terms, combined with Boolean operators such as: "testicular torsion" AND "emergency care" OR "surgical technique" OR "orchiopexy" OR "scrotal pain" OR "acute scrotum."

The selection of studies followed strict eligibility criteria, which included: the population of interest, consisting of males

of all age groups with a confirmed diagnosis of testicular torsion; the investigated interventions, which included emergency department approaches such as clinical evaluation, imaging, and manual detorsion, as well as surgical techniques such as orchiopexy and orchiectomy; and the comparators, which were different emergency/surgical approaches or absence of treatment.

The outcomes of interest were time to intervention, testicular preservation, complications, and long-term outcomes. Regarding study types, clinical trials, randomized clinical trials, cohort studies, case-control studies, case series, systematic reviews, and meta-analyses were considered. No restrictions were applied regarding the language of the selected articles.

After the initial search, to refine the results and ensure data quality, selective filters and exclusion criteria were applied, which eliminated reviews, editorials, letters to the editor, cohort studies, case-control studies, and case series that focused exclusively on neonatal torsion (which was not within the scope of this review), as well as studies lacking sufficient data on interventions or outcomes.

After applying the selection and exclusion criteria, the number of studies was reduced to 37, of which 16 were finally included in this systematic review, allowing for a robust and comprehensive analysis of emergency and surgical approaches to the management of testicular torsion.

The studies confirm that, in the context of initial emergency care, clinical management must be immediate, based on a focused history, detailed physical examination, and, when available, color Doppler ultrasonography to assess scrotal blood flow. Although ultrasound is widely used, its sensitivity may be limited, especially in early or subacute presentations. Therefore, clinical judgment remains central to decision-making, with tools such as the TWIST score (Testicular Workup for Ischemia and Suspected Torsion) and classic clinical signs—such as absence of the cremasteric reflex, negative Prehn's sign, sudden and intense scrotal pain, and a high-riding horizontal testicle—being essential in initial assessment (1–3).

The ideal therapeutic window for surgical intervention is up to 6 hours after symptom onset, with time being the most important prognostic factor. After 12 hours without corrective procedures, the chances of testicular loss increase significantly, up to 80%. After 24 hours without appropriate intervention, the chance of testicular salvage is less than 10% (3–5).

A focused history and careful physical examination—including signs such as absence of the cremasteric reflex, sudden intense pain, elevated and horizontal testicle—combined with the TWIST score, aid in rapid decision-making and accurate diagnosis (1–3). Doppler ultrasound remains the imaging modality of choice, despite its sensitivity ranging from 63% to 100% and specificity from 97% to 100%, serving only as a complement in case of uncertainty in the physical exam (7–10).

Within the 6-hour therapeutic window, hospital transfer does not affect the orchiectomy rate. A 2021 meta-analysis published in the *Journal of Pediatric Urology* by Kwenda et al. reviewed 18 eligible studies, including 9 retrospective studies totaling 2,564 patients (532 transferred and 2,032 directly treated), which were suitable for quantitative analysis. The primary analysis showed that transfer status had no significant effect on torsion outcomes (RR 0.96 [95% CI 0.78–1.17]; I^2 = 44%). Subgroup analysis for patients who presented within 24 hours of symptom onset showed that transferred patients were more likely to undergo orchiectomy than those treated at the initial institution (RR 0.35 [95% CI 0.24–0.51]; I^2 = 4%) (9). This study demonstrates that hospital transfer does not affect the orchiectomy rate in pediatric patients with testicular torsion when including all presentation times. However, subgroup analysis of acute cases (<24 hours from symptom onset) suggests that transfer-associated delays negatively affect testicular viability (9).

Once testicular torsion is confirmed or even strongly suspected, surgical intervention must be immediate. In cases where the testicle remains viable after detorsion, bilateral orchidopexy is performed, fixing both testicles to the tunica albuginea of the scrotum, usually with nonabsorbable sutures, to prevent recurrence. However, when testicular necrosis is present—evidenced by dark coloration of the parenchyma, absence of Doppler pulsation, and lack of bleeding after tunica albuginea incision—orchiectomy becomes necessary. Two main surgical techniques are used for orchiectomy in testicular torsion: simple scrotal orchiectomy and inguinal orchiectomy with high ligation of the spermatic cord (1,2,10).

Simple scrotal orchiectomy is the most frequently employed technique in emergency settings. It involves a transverse incision in the scrotum, exposure of the torsed testicle, ligation of the spermatic cord near the external inguinal ring, and excision of the nonviable testicle. This technique is considered safe, quick, and efficient, particularly when urgent surgical intervention is needed to prevent infection and relieve the patient's pain. Its main limitation is the less extensive approach to the spermatic cord, which theoretically may leave residual tissue, though this usually has no significant clinical impact in most pediatric cases (10).

On the other hand, inguinal orchiectomy with high ligation of the spermatic cord is a more formal technique, especially used when malignancy is suspected or complete control of the spermatic cord is desired. The procedure is performed through an inguinal incision, similar to that used for herniorrhaphy, allowing mobilization of the cord up to the internal inguinal ring, high ligation, and removal of the testicle through the inguinal region. Although more time-consuming, this technique offers better oncologic safety, particularly in adolescents and adults, and reduces the risk of residual cysts in the cord. However, being a more invasive approach, it should be reserved for selected cases and is not the first choice for all pediatric testicular torsion cases (11).

Comparing both approaches, simple scrotal orchiectomy is more appropriate for acute situations where time is critical and there is no suspicion of malignancy, whereas inguinal orchiectomy is recommended for postpubertal patients with associated testicular masses or when complete spermatic cord excision is required. Both techniques aim to reduce morbidity but should be carefully selected according to the patient's profile and intraoperative findings (10).

Current literature, supported by systematic reviews and international urological guidelines such as *Campbell-Walsh Urology*, emphasizes that the prognosis of testicular torsion essentially depends on time to intervention and the surgeon's experience. Thus, in-depth knowledge of surgical approaches and the ability to make rapid decisions in emergency settings are indispensable skills for the modern urologist (1–3,10).

This study observed that although testicular torsion is a well-recognized urological emergency, significant challenges remain in emergency settings that compromise the effectiveness of clinical and surgical management. Among the main difficulties encountered is variability in clinical presentation, especially in extreme age groups such as infants or adolescents, in whom symptoms may be atypical, hindering early diagnostic suspicion. The absence of classic signs such as the "bell clapper" deformity and absent cremasteric reflex may delay clinical suspicion, increasing the time between symptom onset and surgical intervention. Added to this is the limited access to Doppler imaging in a timely manner, particularly in low-complexity units or emergency services with limited human and technological resources (1,2,13).

Another commonly reported obstacle is delayed inter-hospital referral, which worsens testicular ischemia time and is directly related to increased orchiectomy rates, as demonstrated by studies analyzing the influence of inter-hospital transfer (9). The lack of standardized clinical protocols, along with hesitancy to perform manual detorsion—a technique potentially useful in resource-limited settings—also contributes to preventable testicular loss (1,2,13).

Complications include testicular atrophy, chronic pain, negative psychological impact in adolescents, and potential impairment of fertility, including evidence suggesting possible deleterious immunological effects on the contralateral testicle, even after appropriate treatment. These aspects reinforce the need for continued training of frontline professionals and investment in diagnostic infrastructure in emergency settings, in addition to developing effective clinical algorithms that prioritize rapid diagnosis and early intervention (1,2,13).

DISCUSSION

This systematic review, based on rigorous methodological criteria and a comprehensive bibliographic selection, synthesized current evidence regarding diagnostic and therapeutic strategies in the management of testicular torsion—one of the main urological emergencies in pediatric and young adult populations. The findings highlight that, despite diagnostic advances and consolidated knowledge about the pathophysiology of the condition, significant challenges persist in initial care that compromise clinical outcomes, particularly testicular viability (1–3).

The critical analysis of the selected studies revealed that the elapsed time between symptom onset and surgical intervention is the most impactful prognostic determinant. Robust evidence demonstrates that interventions performed within the 6-hour therapeutic window are associated with a high rate of testicular preservation, whereas delays exceeding 12 hours considerably increase the risk of necrosis and the need for orchiectomy. Nevertheless, systemic factors—such as failures in early clinical suspicion, limited access to scrotal Doppler imaging, and delays caused by inter-institutional transfers—undermine the timeliness of intervention, especially in low-complexity healthcare settings (1–3,9).

The heterogeneity in clinical presentation, particularly in infants and adolescents, represents a significant diagnostic barrier. In these age groups, the absence of classic clinical signs—such as an absent cremasteric reflex or typical scrotal deformity—may mask the diagnosis and delay surgical management. The use of structured clinical tools, such as the TWIST Score, combined with an accurate physical examination, stands out as a valuable strategy, although underutilized in many services (5,6).

Regarding surgical treatment, bilateral orchidopexy remains the standard approach in cases of viable testes, whereas orchiectomy is required in the presence of evidence of testicular necrosis. This analysis highlighted the advantages and limitations of scrotal and inguinal orchiectomy techniques, indicating that the surgical choice should be guided by intraoperative assessment and oncological criteria, particularly in adolescents and adults with suspicious testicular masses (11–16).

Complications arising from delayed or inadequate management include testicular atrophy, chronic pain, psychosocial dysfunctions, and impaired fertility. Additionally, evidence suggests potential immunological effects on the contralateral testis after unilateral torsion, which reinforces the importance of early intervention and prophylactic bilateral fixation (1,13).

CONCLUSION

The results of this systematic review demonstrate that testicular torsion, although widely recognized as a urological emergency, remains associated with high rates of testicular loss due to failures in early diagnosis and healthcare logistics. The identification of barriers in initial care—such as clinical variability, unavailability of immediate complementary exams, and the absence of standardized clinical protocols—reveals a scenario that demands continuous improvement.

The adoption of standardized clinical tools, frontline professional training, and investments in emergency diagnostic infrastructure are essential measures to optimize diagnostic accuracy and reduce the time to surgical intervention. Moreover, the appropriate choice of surgical technique, guided by clinical and oncological criteria, helps minimize sequelae and preserve reproductive function.

In summary, the success in managing testicular torsion depends on the integration of prompt clinical recognition, effective diagnostic support, and immediate surgical intervention. Strengthening these stages is imperative for improving functional outcomes and reducing morbidity and mortality associated with this condition.

REFERENCES

1. Wein AJ, Kavoussi LR, Partin AW, Peters CA, eds. Campbell-Walsh-Wein Urology. 12th ed. Philadelphia: Elsevier; 2021.
2. Mellick LB. Torsion of the testicle: it's time to stop tossing the dice. Pediatr Emerg Care. 2012 Mar;28(3):80–6. doi:10.1097/PEC.0b013e3182442b6b.
3. Pogorelić Z, Mustapić K, Jukić M, et al. Management of acute scrotum in children: a 25-year single center experience on 558 pediatric patients. Can J Urol. 2016;23(6):8594–8601.
4. Lorenzini F, Tambara Filho R, Gomes RPX, et al. Efeitos tardios da torção testicular sobre a espermatogênese do testículo contralateral e o valor preventivo da orquiepididimectomia do testículo torcido. Acta Cir Bras. 2012;27(6):388-395. doi:10.1590/S0102-86502012000600006.
5. Qin KR, Tong L, Law TN, et al. Commentary on "Unjumbling the TWIST score for testicular torsion: systematic review and meta analysis". Pediatr Surg Int. 2023;39(1):170. doi:10.1007/s00383-023-05460-8.
6. Qin KR, Qu LG. Diagnosing with a TWIST: Systematic review and meta-analysis of a testicular torsion risk score. J Urol. 2022;208(1):62–70. doi:10.1097/JU.0000000000002496.
7. McLaren PSM. A systematic review on the utility of ultrasonography in the diagnosis of testicular torsion in acute scrotum patients. Radiography. 2021;27(3):943–949. doi:10.1016/j.radi.2020.12.012.
8. Bokhari A, Aldarwish H, Alharbi T, et al. Bilateral testicular torsion: A systematic review of case reports. Cureus. 2023;15(5):e38861. doi:10.7759/cureus.38861.
9. Kwenda EP, Locke RA, DeMarco RT, Bayne CE. Impact of hospital transfer on testicular torsion outcomes: A systematic review and meta-analysis. J Pediatr Urol. 2021;17(3):293.e1–293.e8. doi:10.1016/j.jpurol.2021.01.038.
10. Moore SL, Chebbout R, Cumberbatch M, et al. Orchidopexy for testicular torsion: A systematic review of surgical technique. Eur Urol Focus. 2021;7(6):1493–1503. doi:10.1016/j.euf.2020.07.006.
11. Koschel SG, Wong LM. Radical inguinal orchidectomy: the gold standard for initial management of testicular cancer. Transl Androl Urol. 2020;9(6):3094–3102. doi:10.21037/tau.2019.12.20.
12. Monteilh C, Calixte R, Burjonrappa S. Controversies in the management of neonatal testicular torsion: A meta-analysis. J Pediatr Surg. 2019;54(4):815–819. doi:10.1016/j.jpedsurg.2018.07.006.
13. Laher AE, Ragavan S, Mehta P, Adam A. Testicular torsion in the emergency room: a review of detection and management strategies. Open Access Emerg Med. 2020;12:237–246.
14. Van Welie M, Qu LG, Adam A, et al. Recurrent testicular torsion post orchidopexy - an occult emergency: A systematic review. ANZ J Surg. 2022;92(9):2043–2052. doi:10.1111/ans.17592.
15. Laher A, Swart M, Honiball J, et al. Near-infrared spectroscopy in the diagnosis of testicular torsion: Valuable modality or waste of valuable time? A systematic review. ANZ J Surg. 2020;90(5):708–714. doi:10.1111/ans.15402.
16. Mellick LB, Sinex JE, Gibson RW, Mears K. A systematic review of testicle survival time after a torsion event. Pediatr Emerg Care. 2019;35(12):821–825. doi:10.1097/PEC.0000000000001287.