Original Article

# The 10-year priapism experience: identifying clearer targets for intervention

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**Background:** There is a paucity of data on the clinical experience of priapism. Moreover, little work has explored differences in practice patterns between urologists and emergency medicine (EM) physicians. Our primary objective was to understand the priapism patient population and identify targets that may guide clinical translational efforts.

**Methods:** A retrospective chart review was performed on two priapism datasets from June 2008–July 2018—one focused on patients managed by urology and another on patients managed exclusively by EM physicians. Primary areas of interest included the duration of priapism and acute interventions during the consultation. Time to presentation, prior interventions and evaluation was also documented.

**Results:** Over the course of 10 years, there were 396 encounters for priapism in 95 unique patients. Urology was consulted 199 times in 83 unique patients and EM physicians managed 197 encounters in 15 unique patients. In the urology cohort, median duration of priapism was 6 hours, and 72% of patients required further intervention. For the EM cohort, median duration of priapism was 4 hours and 89% of patients required further intervention. Amongst all patients, nine patients presented 4 or more times for a total of 294 encounters.

**Conclusions:** Urology and EM managed a similar number of encounters, but EM patients had a shorter duration of priapism. Understanding the role of the EM physician and the urologist can help tailor joint curriculum efforts for initial priapism management while focusing on more complex management for urology trainees. A small proportion of patients accounted for the majority of visits secondary to recurrent ischemic priapism indicating a need to target prevention of these episodes on an outpatient basis.

**Keywords:** Ischemic priapism; non-ischemic priapism; emergency medicine (EM); residency education

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## Introduction

The healthcare burden of priapism is poorly understood and largely abstracted. In contemporary data, the incidence of priapism has been reported to be as high as 5.3 per 100,000 patients and 8 encounters per 100,000 Emergency Department (ED) visits. Additionally, some studies have shown a trend towards an increasing incidence of priapism (1,2). Annual healthcare costs of priapism were estimated to be more than 120 million dollars. This may be an underestimate when considering the immeasurable costs such as impact on lost productivity and decreased quality of life, especially when about a quarter of patients who present for priapism will have a readmission within one year (1,3-5).

Despite the increasing incidence of priapism, there is still a paucity of data on this patient population. Burnett notes

 

that the healthcare consequences of priapism have received little awareness despite priapism being considered one of the worst complications of sickle cell disease (4). Some of the largest studies include 100–200 priapism patients that each illuminate an important clinical aspect of priapism (management, prevention, erectile dysfunction outcomes), however more studies are needed to be able to understand the heterogeneity of this patient population (6-8).

Therefore, our primary objective was to understand the priapism experience within our institution to determine targets that may guide clinical translational efforts. We further characterized the patient population to understand the differences in patients managed by urology compared to those managed by the emergency medicine (EM) physicians. We present the following article in accordance with the STROBE reporting checklist (available at https://tau.amegroups.com/article/view/10.21037/tau-22-180/rc).

## Methods

### *Dataset*

We explored two datasets to evaluate the institution's priapism experience. The initial focus was on patients managed by urology as a consult for priapism. The dataset comes from consults entered by the urology residents into a centralized database at our tertiary care referral center. The purpose of the database is to create a repository of information and data surrounding consults to the urology department. Information collected includes the date, time and location of the consult, the reason for the consult and need for procedural interventions. This dataset is used internally by residents and attendings and therefore does not include billing information. Subsequently, a separate dataset was created focusing on patients presenting with priapism that were managed exclusively by EM physicians. The EM dataset was produced from an internal data repository of clinical data utilizing diagnosis codes (ICD-10 codes included Priapism [N48.3], Priapism, unspecified [N48.30], Priapism due to disease classified elsewhere [N48.32], Priapism, drug-induced [N48.33], Other priapism [N48.39], Priapism due to trauma [N48.31], or Priapism [607.3]). The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the ethics board of the University of Michigan (Study HUM00169989). Informed consent was waived for this retrospective study.

### *Cohort*

The urology consult database was filtered by the reason for consult—"Priapism"—from July 2008 to June 2018. We identified all males 18 years and older that were seen at the University Hospital for priapism. The EM dataset included patients seen for priapism in the ED based on ICD-10 codes. This dataset included information only for the University Hospital and the same inclusion criteria was applied.

Further chart review of both cohorts was performed to identify patient factors and demographics. Primary areas of interest included the duration of the priapism (time from onset to evaluation) and acute interventions during the consultation. We also documented prior interventions for the specific episode and priapism evaluation (imaging, arterial blood gas). Interventions were divided into 'no intervention', 'bedside procedure', or 'led to formal urgent/emergent operating room (OR) procedure'. Time to presentation was obtained by chart review per patient history.

### *Statistical analysis*

Patient characteristics were described by priapism management group; EM managed, Urology Consult or both. Medians with interquartile range (IQR) were reported for age and number of encounters and Wilcoxon Rank-sum test compared them between Urology consult and EM managed. Categorical variables including race, etiology and frequency of encounters were presented with frequency and percentage and compared by management team using chi-square tests (Fisher's exact or Jonckheeere-Terpstra). Time to presentation was reported with median and IQR. A boxplot is presented by management group, and it was compared using the natural log transformation in a repeated measures linear mixed model accounting for clustering by patient using a compound symmetry covariance structure. Significance was determined with a type I error of 5%. All analyses were performed using SAS 9.4 (SAS Institute, Cary, NC).

## Results

Over the course of 10 years, there were 396 encounters for priapism in 95 unique patients managed by EM or urology. Of those, urology was consulted 199 times in 83 unique patients and EM managed 197 encounters in 15 unique patients. Assessing the data on a patient level, the median age of this population at their first encounter was

 

**Table 1** Patient characteristics

| Characteristics | All patients | Urology consults | EM physicians managed | Both | P value (compares Urology *vs.* EM) |
|---|---|---|---|---|---|
| Unique patients, n | 95 | 80 | 12 | 3 | |
| Race (by patient), n (%) | | | | | 0.56 |
| White or Caucasian | 58 (61.1) | 49 (61.3) | 7 (58.3) | 2 (66.7) | |
| Black or African American | 32 (33.7) | 27 (33.8) | 4 (33.3) | 1 (33.3) | |
| American Indian or Alaskan Native | 2 (2.1) | 2 (2.5) | 0 | 0 | |
| Hispanic | 1 (1.1) | 1 (1.3) | 0 | 0 | |
| Other/unknown | 2 (2.1) | 1 (1.3) | 1 (8.3) | 0 | |
| Median age (at first presentation), year | 42.7 | 46.1 | 36.1 | 27.1 | 0.22 |
| IQR, year | 28–54 | 31–55 | 23–51 | 22–37 | |
| Etiology by patient, n (%) | | | | | 0.0006 |
| Sickle cell | 13 (13.7) | 10 (12.5) | 2 (16.67) | 1 (33.3) | |
| Unknown | 29 (30.5) | 28 (35.0) | 0 | 1 (33.3) | |
| Erectogenic medication | 23 (24.2) | 20 (25.0) | 3 (25.0) | 0 | |
| Other medications (anti-psychotic) | 18 (18.9) | 16 (20.0) | 2 (16.7) | 0 | |
| Trauma | 6 (6.3) | 1 (1.3) | 4 (33.3) | 1 (33.3) | |
| Other (drug use, malignancy) | 6 (6.3) | 5 (6.3) | 1 (8.3) | 0 | |
| Median number of encounters ([IQR], Max) | 1 [1–1], 243 | 1 [1–1], 6 | 1 [1–1], 1 | 17 [3–243], 243 | 0.063 |
| Frequency of encounters, n (%) | | | | | 0.095 |
| 1 | 73 (76.8) | 61 (76.3) | 12 (100.0) | 0 | |
| 2 | 9 (9.5) | 9 (11.3) | 0 | 0 | |
| 3 | 4 (4.2) | 3 (3.8) | 0 | 1 (33.3) | |
| 4+ | 9 (9.5) | 7 (8.8) | 0 | 2 (66.7) | |

IQR, interquartile range; EM, emergency medicine.

43 years old (IQR, 28–54) (*Table 1*). The most common etiologies were unknown (29, 30.5%), followed by erectogenic medications (23, 24.2%), and other medications (18, 18.9%). However, sickle cell was the most common etiology in both groups when viewed at an encounter level. Sickle cell accounted for 178 (90%) visits for EM managed patients and 86 (43%) visits managed by urology. The median time to presentation was 4.5 hours (IQR, 4–7). The majority of patients were seen only once (74, 77%), but 9 patients (9%) presented 4 or more times. The breakdown of the types of priapism at the patient level are ischemic priapism (64, 67%), recurrent ischemic priapism (16, 17%), non-ischemic priapism (13, 14%), and unknown/other (2, 2%). Note that some patients may have presented with a different type of priapism at each encounter.

### *Urology consults cohort*

Most of the urology consults were seen in the ED (184, 93%), while the rest were seen inpatient. The median duration of priapism was 6.0 hours (IQR, 4.5–12). No intervention was required in 55 (27.6%) of the consults. The reasons included self-resolution, high-flow priapism, non-acute episodes, and for one consult, a misdiagnosis due to the presence of a malleable prosthesis. However, further intervention was required in the majority of the consults—bedside procedures for 128 (64.3%) consults and formal OR procedure in 16 (8%) consults. Of the formal/urgent ORs,

 

**Table 2** Interventions (all encounters)

| Interventions | Total (n=396) | Urology (n=199) | EM (n=197) |
|---|---|---|---|
| Transfers (percentage of encounters), n (%) | 51 (12.9) | 50 (25.1%) | 1 (0.5%) |
| Time to presentation, hour, median [IQR] | 4.5 [4–7] | 6.0 [4.5–12] | |
| Not transferred patients | 4 [4–5.5] | 5.5 [4–8] | 4 [3–4.5] |
| Transferred patients | 24 [10–48] | 26 [10–48] | 12 |
| Overall intervention, n (%) | | | |
| No intervention | 76 (19.2) | 55 (27.6) | 21 (10.7) |
| Bedside intervention | 304 (76.8) | 128 (64.3) | 176 (89.3) |
| Formal urgent/emergent OR | 16 (4.0) | 16 (8.0) | 0 |
| Bedside procedures | | | |
| Only irrigation | 9 (2.3) | 9 (7.0) | 0 |
| Only injection | 228 (75.0) | 56 (43.8) | 172 (97.7) |
| Irrigation and injection | 59 (19.4) | 55 (43.0) | 4 (2.3) |
| Irrigation, injection, distal shunt | 5 (1.6) | 5 (3.9) | 0 |
| Irrigation and distal shunt | 3 (1.0) | 3 (2.3) | 0 |
| OR procedures | | | |
| Proximal shunt | 4 (25.0) | | N/A |
| Distal shunt | 5 (31.3) | | N/A |
| Proximal and distal shunt | 3 (18.8) | | N/A |
| Irrigation only | 4 (25.0) | | N/A |

IQR, interquartile range; EM, emergency medicine; OR, operating room.

7 went on to get a proximal shunt (*Table 2*). Of note, though current American Urological Association (AUA) guidelines recommend against proximal shunt, this data was obtained prior to the change in guidelines.

Most patients were able to be discharged on the same day, but 69 consults (35%) required an admission. The median length of stay for patients who were admitted was 2 nights (IQR, 1–3, maximum =30), however the mode was one night. Those with a longer length of stay were admitted for other reasons, i.e., malignancy evaluation and management.

Transfers from an outside institution accounted for 25% (n=50) of the consults. Prior intervention was completed in 68% (n=34) of the transfers. Among those patients, 10 (29%) had a prior shunt completed. Consults who were transferred had an average duration of priapism of median 26 hours (IQR, 10–48) compared to consults who were not transferred [median 5.5 hours (IQR, 4–8)]. The majority of patients (75%) requiring an OR procedure were transferred patients.

Of the 83 unique patients, 22 patients (26%) were responsible for almost 70% of the consultations. In looking at the population of patients who have had multiple visits (>1 visit), 91% of those patients required a bedside procedure or formal OR procedure. Sickle cell was the etiology for about 25% of patients with multiple visits. In comparison, patients with only a single episode of priapism, 35% required an intervention and sickle cell was identified in 8% of patients.

### *EM cohort*

EM managed 197 visits in 15 unique patients with two of the patients accounting for 93% of the encounters (*Table 1*). The median duration of priapism was 4.0 hours (IQR, 3–4.5) in comparison to the urology cohort of 6.0 hours (IQR, 4.5–12), P=0.033 (*Figure 1*). Self-resolution without intervention occurred in 21 (11%) encounters (*Table 2*). Intervention occurred in most visits, with 172 (87%) patients

 

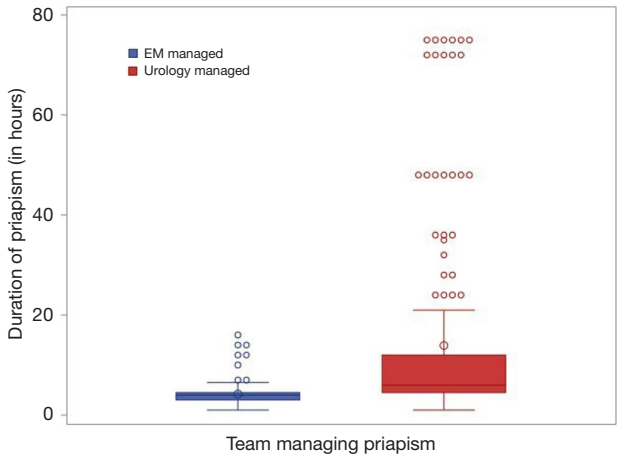


**Figure 1** Duration of priapism prior to presentation: urology and emergency medicine cohorts. EM, emergency medicine.

receiving an injection and 4 (2%) receiving both an injection and irrigation. Patients who presented to the ED multiple times accounted for the large majority of patients requiring an intervention (173, 98%). In contrast, only three of the 12 patients who presented once required an intervention.

Almost all patients were able to be discharged on the same day, but 4 encounters (2%) required an admission due to priapism in the setting of major trauma. Only one patient was a transfer from an outside institution. This patient had an injection at the outside institution and had full resolution of priapism at time of presentation. The median duration of priapism for patients who were not transferred was 4 (IQR, 3–4.5) compared to 12 hours for the patient who was transferred.

### *Multiple encounters*

In the total cohort, there were nine patients who presented 4 or more times (range, 4–243 visits) for a total of 293 visits. Urology managed 109 of these visits and EM managed 184 visits. Of these nine patients, two were managed by EM physicians, but only after they had been previously cared for by urology multiple times for priapism. The etiologies of the patients were unknown for 5 (56%), 3 (33%) had priapism due to sickle cell, and 1 (13%) had priapism secondary to trauma.

## Discussion

In older international studies, the incidence of priapism was estimated at 0.3–1.5 per 100,000 males per year (9-11). However, contemporary data in the United States suggests an increase in priapism incidence (1,3). This growth may represent a data collection limitation given that national databases are de-identified; therefore, the same patient may be counted more than once. Regardless, the incidence does not appear to be decreasing and given the impact on healthcare, we sought to better understand this patient population and potential targets of intervention.

### *Collaborative residency education*

Interestingly, urology and EM physicians managed a similar number of priapism encounters (199 *vs.* 197). However, 93% (n=184) of the EM managed encounters were with 2 people who had previously been evaluated by urology for recurrent ischemic priapism. Patients managed by the EM physician had a shorter duration of priapism (*Figure 1*). They were less likely to obtain a penile blood gas or imaging and higher likelihood to perform injection only as the management. Note that injection reflects phenylephrine, the alpha-adrenergic medication available at our institution. Patients who were managed by EM at the hospital were often seen by Urology as an outpatient. However, there are social determinants of health that make outpatient urologic care difficult to achieve and it is important that patients can receive necessary care from EM providers. In a survey of accredited EM residency programs, over 75% stated education on priapism management was essential or very important. However, 49% of EM residents had never managed a case of priapism in training and 17% of senior residents did not feel confident at all to manage priapism. This was despite having formal curriculum on priapism in most of the programs (12). The same group created a joint educational and simulation curriculum with Urology and EM and noted a simulation curriculum demonstrated an improvement in cognitive test scores and confidence level in managing priapism (13). In some cases, the EM physician may be the only available provider within the window of opportunity, but the treatment strategy may be dependent on provider's comfort level with management of priapism. A joint curriculum effort between EM and Urology may train future providers within the community to effectively manage priapism in a timely fashion.

This also further emphasizes the need to highlight management of refractory priapism in urology residency training. The majority of the urology cohort resolved with injection +/– irrigation, but 16 went on to receive

 

surgical intervention. In a recent survey of International Society for Sexual Medicine members, it was identified that the majority of respondents see at least one prolonged priapism (>36 hours) a year that requires surgical management (14). With the low incidence of operative intervention, there may be a lack of clinical exposure for trainees to understand the management of prolonged priapism. This includes shunts with or without tunneling and possibly a discussion of early *vs.* delayed implantation of a penile prosthesis (15).

### *Hospital transfers*

We identified 25% of the urology consults were transfers from an outside institution. Of those transferred, the majority had a prior intervention (irrigation, injection, or shunt) and were more likely to go to the OR (24% *vs.* 3% non-transfers). Almost 40% of the transfers did not require any further intervention because many of them had either converted to non-ischemic priapism or had self-resolution. It is unclear whether these patients were initially misdiagnosed or if they truly converted as there was not access to outside medical records. The other patients who did not receive intervention either refused treatment options, were past the opportunity for intervention, or later required embolization. The median duration of priapism for patients who were transferred was 26 hours compared to non-transfers that had a median duration of 5.5 hours. This is undoubtedly influenced by time to travel but represents a stark difference in duration of priapism. Changes of hypoxia and acidosis are noted even within 6 hours of a priapism and at 24 hours there are pathologic features of smooth muscle necrosis and fibrosis along with a decrease in viable tissue (16,17). As more time passes, the success of an intervention decreases and the risk of erectile dysfunction increases.

In a study looking at emergency room transfers, 500 patients were transferred for specialized care, however 54% of the transfers were identified to be unnecessary (18). Our tertiary care referral center is uniquely positioned adjacent to a metropolitan area but also serves a tri-state area with surrounding rural areas. With a varied healthcare landscape of both metropolitan and rural areas, it is important to determine the factors that may avoid unnecessary transfers while expediting the management of patients who require further specialized needs.

### *Management of recurrent ischemic priapism*

A small percentage of patients (9%) were responsible for an overwhelming majority of the overall encounters (74%). A large majority of visits were the result of recurrent ischemic priapism (93% of EM managed patients and 69% of the urology consults). Recurrent ischemic priapism is not unique in our patient population, as other patient level studies have shown up to 50% of the priapism patients having multiple visits for priapism (6,19). Recurrent ischemic priapism is described as painful and multiple transient episodes of priapism that can progress into an acute ischemic episode. Guidelines state that the acute episode should be managed as ischemic priapism, but future management centers around prevention (20).

There have been many suggested medical treatment options for recurrent ischemic priapism, including hormonal analogues, adrenergic agonist (pseudoephedrine), PDE5 inhibitors and hydroxyurea. However, there is a paucity of studies demonstrating efficacy and some treatments have unwanted side effects (21). Though advances in the understanding of the pathophysiology of recurrent ischemic priapism have been made in recent years, outpatient management and prevention of episodes have still been suboptimal. This is an area that can potentially have the greatest impact on patients and the healthcare system, but also the most difficult as further robust data and clinical trials will be needed to determine the best agent for prevention of priapism. Promising targets have been identified through basic science research looking at the nitric oxide pathway, adenosine signaling pathway, the RhoA/Rho Kinase pathway and the roles of oxidative stress, opiorphins, testosterone and P-selectin on the mediation of priapism in sickle cell patients (22). The continued efforts in both clinical and basic science arenas are needed to find the optimal way to prevent recurrent ischemic priapism.

### *Limitations*

Our findings should be considered in the context of several limitations. This is a single institution study with a population that may not be generalizable to different institutions based on a variety of factors including geographic location and population demographics. Some institutions may pursue penile prosthesis immediately in the setting of ischemic priapism, but this was not captured

 

in our data as it represents the acute period. This highlights the importance of understanding regional differences in patient populations. For instance, in a recent study looking at the hemodynamic effects of phenylephrine in the treatment of ischemic priapism, a group identified drug induced priapism to be the leading cause of priapism, of which a majority of that was secondary to penile injection therapy (6). For our institution, erectogenic medications accounted for 24% of patients presenting with priapism, but sickle cell anemia accounted for the majority of the visits. Also, as with any retrospective review, there may be inherent biases.

## Conclusions

Priapism is a urologic emergency that can lead to irreversible erectile dysfunction and negative psychologic impact. Joint education in priapism may help train future providers to manage priapism in an effective and timely fashion. Urologists are more likely to be responsible for managing patients with longer duration of priapism, requiring escalated interventions emphasizing the need to highlight management of refractory priapism in urology residency training. In addition, 40% of transfers required no interventions calling attention to the need to understand how to prevent unnecessary transfers. Lastly, a minority of patients accounted for the majority of consultations indicating a major need to improve outpatient management of recurrent ischemic priapism.

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## Footnote

*Reporting Checklist:* The authors have completed the STROBE reporting checklist. Available at https://tau.amegroups.com/article/view/10.21037/tau-22-180/rc

*Data Sharing Statement:* Available at https://tau.amegroups.com/article/view/10.21037/tau-22-180/dss

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*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at https://tau.amegroups.com/article/view/10.21037/tau-22-180/coif). The authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the ethics board of the University of Michigan (Study HUM00169989). Informed consent was waived for this retrospective study.



## References

1. Stein DM, Flum AS, Cashy J, et al. Nationwide emergency department visits for priapism in the United States. J Sex Med 2013;10:2418-22.
2. Chrouser KL, Ajiboye OB, Oyetunji TA, et al. Priapism in the United States: the changing role of sickle cell disease. Am J Surg 2011;201:468-74.
3. Roghmann F, Becker A, Sammon JD, et al. Incidence of priapism in emergency departments in the United States. J Urol 2013;190:1275-80.
4. Burnett AL. Sexual health outcomes improvement in sickle cell disease: a matter of health policy? J Sex Med 2012;9:104-13.
5. Michael P, Tran VT, Hopkins M, et al. Comparison of Urologic Transfers to Academic Medical Centers: A Multi-institutional Perspective. Urology 2020;136:100-4.
6. Sidhu AS, Wayne GF, Kim BJ, et al. The Hemodynamic Effects of Intracavernosal Phenylephrine for the Treatment of Ischemic Priapism. J Sex Med 2018;15:990-6.
7. Dutta R, Matz EL, Overholt TL, et al. Patient Education Is Associated With Reduced Delay to Presentation for Management of Ischemic Priapism: A Retrospective Review of 123 Men. J Sex Med 2021;18:385-90.
8. Johnson MJ, McNeillis V, Chiriaco G, et al. Rare

 

Disorders of Painful Erection: A Cohort Study of the Investigation and Management of Stuttering Priapism and Sleep-Related Painful Erection. J Sex Med 2021;18:376-84.
9. Earle CM, Stuckey BG, Ching HL, et al. The incidence and management of priapism in Western Australia: a 16 year audit. Int J Impot Res 2003;15:272-6.
10. Kulmala RV, Lehtonen TA, Tammela TL. Priapism, its incidence and seasonal distribution in Finland. Scand J Urol Nephrol 1995;29:93-6.
11. Eland IA, van der Lei J, Stricker BH, et al. Incidence of priapism in the general population. Urology 2001;57:970-2.
12. Dai JC, Franzen DS, Lendvay TS, et al. Perspectives on Priapism Education in Emergency Medicine. J Sex Med 2020;17:159-62.
13. Dai JC, Ahn JS, Cannon ST, et al. Acute Ischemic Priapism Management: An Educational and Simulation Curriculum. MedEdPORTAL 2018;14:10731.
14. Butaney M, Thirumavalavan N, Rodriguez D, et al. Current practice in the management of ischemic priapism: an anonymous survey of ISSM members. Int J Impot Res 2019;31:404-9.
15. Bivalacqua TJ, Allen BK, Brock G, et al. Acute Ischemic Priapism: An AUA/SMSNA Guideline. J Urol 2021;206:1114-21.
16. Broderick GA, Harkaway R. Pharmacologic erection: time-dependent changes in the corporal environment. Int J Impot Res 1994;6:9-16.
17. Zacharakis E, Raheem AA, Freeman A, et al. The efficacy of the T-shunt procedure and intracavernous tunneling (snake maneuver) for refractory ischemic priapism. J Urol 2014;191:164-8.
18. Bertazzoni G, Cristofani M, Ponzanetti A, et al. Scant justification for interhospital transfers: a cause of reduced efficiency in the emergency department. Emerg Med J 2008;25:558-61.
19. Masterson TA, Parmar M, Tradewell MB, et al. Using Artificial Intelligence to Predict Surgical Shunts in Men with Ischemic Priapism. J Urol 2020;204:1033-8.
20. Montague D, Jarow J, Broderick G, et al. AUA guideline on the management of priapism: AUA clinical guidelines. J Urology 2003;170:1318-24.
21. Morrison BF, Burnett AL. Stuttering priapism: insights into pathogenesis and management. Curr Urol Rep 2012;13:268-76.
22. Musicki B, Burnett AL. Mechanisms underlying priapism in sickle cell disease: targeting and key innovations on the preclinical landscape. Expert Opin Ther Targets 2020;24:439-50.

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