

Gonococcal Infection of the Glans Skin, a Rare Local Complication of Gonorrhoea: A Clinical Study of 13 Cases

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Wenge Fan¹ , Qingsong Zhang², Mei Wei¹, Yuan Zhu¹,
Jing Zhang¹, Zhijiang Fan³, and Tingwang Jiang⁴

Abstract

The study aimed to understand the incidence, site, skin lesion manifestations, and treatment of gonococcal infection of the glans skin. We enrolled men with gonococcal infection of the glans skin and men with gonococcal urethritis from January 2014 to February 2020. Demographic data, site of onset, and skin lesion manifestations were recorded for all patients. Ceftriaxone (1 g) was injected intramuscularly once daily for 5 days in patients with lesions comprising abscesses or nodules. A single dose of ceftriaxone (1 g) was injected intramuscularly in patients with pustules. Incision and drainage were performed in patients with nonruptured abscesses. Thirteen patients had gonococcal infection of the glans skin (0.65%; 95% confidence interval = [0.30, 1.01]) among 1,989 patients with gonococcal urethritis. Mean age was 35.48 ± 2.37 (range = 26–45) years. Nonmarital sexual behavior patterns were genital–genital in eight patients (61.54%) and genital–oral in five patients (38.46%). All skin lesions occurred on the ventral side of the glans. Eleven patients (84.62%) had a single lesion and two (15.38%) had multiple lesions. The lesions manifested as abscesses in five patients (38.46%), nodules in five patients (38.46%), and pustules in three patients (23.08%). All lesions exhibited tenderness. All 13 patients were cured after treatment. The study shows that gonococcal infection of the glans skin is a rare local complication of gonorrhoea. Lesions often occur on the ventral side of the glans, presenting as abscesses, nodules, and pustules. Ceftriaxone treatment was effective for gonococcal infection of the glans skin.

Keywords

infection, *Neisseria gonorrhoeae*, skin, glans

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The penis consists of three portions: the root, the body, and the glans. The glans is the distal expansion of the corpus spongiosum. It is conical and normally ensheathed by the loose skin of the prepuce. In the uncircumcised male, five to six layers of stratified, nonkeratinizing squamous epithelium line the mucosal surface of the glans. These become keratinized after circumcision. The glans is composed of epithelium, lamina propria, corpus spongiosum, tunica albuginea, and corpora cavernosa. The lamina propria is 1–3 mm thick and consists of a layer of loose connective tissue containing small vessels, lymphatics, nerves, and occasional Vater-Pacini corpuscles (Ro et al., 2008). The male urethra (except where there is fossa navicularis), Littre's ducts, Tyson's ducts, paraurethral ducts, seminal vesicles, prostate, ampulla,

¹Department of Dermatology, First People's Hospital of Changshu City, Changshu Hospital Affiliated to Soochow University, Changshu, P. R. China

²Department of Dermatology, Affiliated Hospital of Nantong University, Nantong, P. R. China

³Department of Urinary Surgery, First People's Hospital of Changshu City, Changshu Hospital Affiliated to Soochow University, Changshu, P. R. China

⁴Department of Clinical Laboratory, First People's Hospital of Changshu City, Changshu Hospital Affiliated to Soochow University, Changshu, P. R. China

Corresponding Author:

Wenge Fan, Department of Dermatology, First People's Hospital of Changshu City, Changshu Hospital Affiliated to Soochow University, Changshu 215500, Jiangsu, China.
Email: fwgqh@sina.com



vas deferens, and epididymis are lined with columnar epithelium that is susceptible to gonococcal infections (Harkness, 1948; Subramanian, 1981). Urethral gonococcal infection may spread to these structures, leading to local complications of gonorrhea (Sherrard, 2014). The local complications of male gonorrhea include Tyson's gland infection, paraurethral duct infection, periurethral abscess, epididymitis, penile edema, and lymphangitis of the penis (Sherrard, 2014).

Penetration of the squamous epithelium by *Neisseria gonorrhoeae* is normally limited because of its histological and physiological structure. *N. gonorrhoeae* is a purulent pathogen that is considered a potential bacterium in any type of pyoderma (Scott et al., 1982). If the skin is injured, *N. gonorrhoeae* can infect the skin, causing primary skin gonorrheas (Ghosn & Kibbi, 2004) such as cutaneous gonococcal abscess of the abdomen (Dickson & Alter, 2011) and gonococcal cellulitis (Lal & Rapose, 2018). The glans can be infected by gonococci, but this is rarely seen in the clinic and the prevalence is unknown. We studied the incidence, clinical manifestations, and treatments of gonococcal infection of the glans skin in men in our clinic.

Method

Patients

We enrolled patients with gonococcal infection of the glans skin and patients with gonococcal urethritis who were treated at our hospital from January 2014 to February 2020. Patients with skin lesions on the glans and the presence of *N. gonorrhoeae* in skin lesion secretions were included. Those with other pathogens detected in skin lesions or paraurethral duct gonococcal infections were excluded.

Data Collection

The following clinical and demographic data for all included patients: age, occupation, marital status, non-marital sexual contact history, sexual orientation, sexual pattern, condom use, foreskin condition, interval from sexual exposure to onset of symptoms of gonococcal infection of the glans skin (incubation period), occurrence site, manifestations of cutaneous lesions, urinary pain, micturition frequency, urination urgency, and urethral orifice pyorrhea.

Laboratory Tests

To avoid contamination involving secretions from lesions of the glans skin and urethra and secretions from other parts of the penis, the penis was repeatedly rinsed with normal saline for 2 min. In patients without ruptured skin

lesions, local disinfection was performed and each cutaneous lesion was punctured with a syringe; purulent drainage or blood was then withdrawn. In patients with ruptured skin lesions, purulent drainage was directly removed using a sterile cotton swab. After the glans had been repeatedly washed with saline for the specified time, urethral secretions in all patients were collected with a small cotton swab. All specimens were subjected to Gram staining. Microscopic examination was then performed to detect Gram-negative intracellular diplococci (GNID) within phagocytes. All specimens were also cultured to detect general bacteria (excluding gonococcal species) and fungi. Genetic material from gonococcal species, *Chlamydia trachomatis*, *Ureaplasma urealyticum*, *Mycoplasma hominis*, *Mycoplasma genitalium*, and herpes simplex virus type 1 or 2 were detected using polymerase chain reaction (PCR). Dark-field microscopy was performed to detect *Treponema pallidum* in penile cutaneous lesion secretions from all 13 patients. Venous blood samples were collected from all patients and subjected to analysis using a rapid plasma reagin test, *T. pallidum* hemagglutination assay, and human immunodeficiency virus antibody assay.

Treatment

Patients with skin lesions presenting abscesses and nodules received intramuscular injection with ceftriaxone 1 g once a day for 5 days. Incision and drainage were performed in patients with a nonruptured abscess. Patients with pustules received intramuscular injection of a single dose of ceftriaxone 1 g.

To evaluate efficacy, the patient's condition was considered cured if the penile cutaneous lesions and symptoms had regressed by 1 month after treatment. The treatment was considered ineffective if the lesions did not regress or PCR testing of specimens from the cutaneous lesions was positive for *N. gonorrhoeae* DNA.

Statistical Analysis

SPSS13.0 software was used for statistical analysis. The $p < .05$ was considered statistically significant. Comparison of ratios was analyzed by chi-square test. The Shapiro-Wilk test was used to test the normality of the incubation periods of gonococcal urethritis and gonococcal infection of the glans skin and analyzed by paired *T* test.

Results

Prevalence of Gonococcal Infection of the Glans Skin

In total, 1,989 male patients with gonococcal urethritis were treated in our department from January 2014 to

February 2020. Of these, 13 (0.65%; 95% confidence interval 0.30–1.01) had accompanying *N. gonorrhoeae* infection of the glans skin.

Study Population Characteristics and Manifestations

The mean age of the 13 patients was 35.48 ± 2.37 (range = 26–45) years. Occupation status included short-term employment (eight patients, 61.54%) and permanent employment (five patients, 38.46%). Three patients (23.08%) were unmarried and 10 (76.92%) were married. All patients reported a heterosexual orientation and mentioned a history of nonmarital sexual contact without the use of condoms. Nonmarital sexual behavior patterns were genital–genital in eight patients (61.54%) and genital–oral in five (38.46%). The prepuce was normal in 10 patients (76.92%) and redundant in three patients (23.08%). None had phimosis. No patients had congenital malformations involving the external reproductive organs and none reported prior lesions or abnormalities of the glans skin prior to becoming symptomatic with gonorrhea. Among the 1,976 gonococcal urethritis patients without gonococcal infection of the glans skin, nonmarital sexual behaviors were genital–genital in 1,928 patients (97.57%) and genital–oral in 48 patients (2.43%). The prepuce was normal in 1,664 patients (84.21%) and redundant in 305 patients (15.44%). Seven had phimosis (0.35%). There was a significant difference in nonmarital sexual patterns between the 13 patients with gonococcal infection of the glans skin and the 1,976 gonococcal urethritis patients without gonococcal infection of the glans skin ($\chi^2 = 65, p < .01$), but no significant difference in the prevalence of redundant prepuce ($\chi^2 = 0.61, p = .74$).

Among the 13 patients, the mean incubation period of gonococcal urethritis was 2.92 ± 1.32 (range = 1–5) days, complying with normal distribution ($W = 0.93, p = .33$). The mean incubation period of gonococcal infection of the glans skin was 8.00 ± 3.19 (range = 4–14) days, also complying with normal distribution ($W = 0.94, p = .42$). The difference was statistically significant ($t = 6.44, p < 0.01$). All skin lesions occurred on the ventral side of the glans. Eleven patients (84.62%) had a single lesion and two (15.38%) had multiple lesions. The lesions manifested as abscesses in five patients (38.46%), nodules in five patients (38.46%), and pustules in three patients (23.08%) (Figures 1–3). All lesions exhibited tenderness. Of the 13 patients, two cases (15.38%) were associated with gonococcal tysonitis. All 13 patients with gonococcal urethritis reported typical symptoms of urethritis, including urethral orifice pyorrhea, urinary pain, and frequent or urgent micturition.



Figure 1. Gonococcal Infection of the Glans

Note. Round nodules with sizes of 0.4 and 0.2 cm in diameter on the ventral side of the glans.



Figure 2. Gonococcal Infection of the Glans

Note. A 0.3-cm \times 0.4-cm abscess on the ventral side of the glans.

Laboratory Examination Results

Specimens of the cutaneous lesion secretions and urethral secretions of all 13 patients were collected separately for Gram staining. GNID within phagocytes were observed in all cutaneous lesion secretion and urethral secretion specimens. PCR confirmed the presence of *N. gonorrhoeae* in all specimens. All specimens were negative for general bacterial and fungal cultures. PCR was negative for *C. trachomatis*, *U. urealyticum*, *M. hominis*, *M. genitalium*, and herpes simplex virus types 1 and 2. Dark-field microscopy did not reveal *T. pallidum* in any penile cutaneous lesion secretions. Blood rapid plasma reagin test, *T. pallidum* hemagglutination assay, and human immunodeficiency virus antibody assay were negative in all patients.



Figure 3. Gonococcal Infection of the Glans Skin
Note. Ventral abscess of the glans, with pus overflow.

Treatment Results

All 13 cases were cured. Three patients with a nonruptured abscess were treated with incision, drainage, and ceftriaxone, and skin lesions subsided 7 to 14 ($M = 10.00 \pm 3.61$) days after treatment. Two patients with a ruptured abscess were treated with ceftriaxone, and skin lesions subsided 6 to 9 ($M = 7.50 \pm 2.12$) days after treatment. Five patients with nodules were treated with ceftriaxone, and skin lesions subsided 9 to 19 ($M = 12.80 \pm 3.77$) days after treatment. Three patients with a pustule were treated with ceftriaxone, and skin lesions subsided 5 to 6 ($M = 5.67 \pm 0.58$) days after treatment. The symptoms of gonococcal urethritis disappeared in all 13 patients, and GNID were not visible within phagocytes on a smear of urethral secretions.

Discussion

We emphasize that in our study the skin of the glans was the focus because there is also a paraurethral duct in the glans that is parallel to the end of the urethra and opens at the external urethra (Fan, Zhang, & Ye, 2016; King & Nicol, 1969). The paraurethral duct is a vestige of embryonic development that cannot be seen by the naked eye (Gilhooly & Hensle, 1984). *N. gonorrhoeae* can invade the paraurethral duct through its orifice, causing gonococcal

inflammation of paraurethral glands (Fan, 2010; Fan et al., 2012, 2014; Fan, Zhang, & Ye, 2016). In this study, the prevalence of gonococcal urethritis with concurrent gonococcal infection of the glans skin was 0.65%, which is considerably lower than the reported incidence of gonococcal urethritis with concurrent gonococcal paraurethral duct infection (1.5%; Fan, Zhang et al., 2016), but higher than that of gonococcal urethritis with gonococcal epididymitis (0.41%; Chen et al., 2017). The difference between the incubation period of gonococcal urethritis and gonococcal infection of the glans skin was statistically significant in the 13 patients in our study. These results suggest that gonococcal infection of the glans skin is a rare local complication of gonococcal urethritis. Although the outermost layer of the glans is composed of squamous epithelium, the skin is thin and tender and the glans is close to the cervix during intercourse. Sexual intercourse can cause minor trauma to the glans, while oral sex is more likely to cause damage to the glans skin. In this study, the incidence of oral sex was as high as 38.46%. Therefore, gonococcal infection of the glans skin may be caused by direct skin inoculation. Whether the high-risk factor of gonococcal urethritis complicated by gonococcal infection of the glans skin is related to gonococcus genotype, nonmarital sexual patterns, course of infection, and underlying diseases needs further investigation.

In our study, the glans skin lesions caused by gonococcal infection were on the ventral side of the glans. The dorsal side from the ventral side of the glans was only involved in one patient. There was a significant difference between skin lesions occurring on the ventral side of the glans and those on the dorsal side of the glans. A possible reason for this is a gravity effect where by the purulent secretions from the urethral orifice are more likely to contaminate the ventral side of the glans. It may also be related to the relatively weak barrier function on the ventral side of the glans skin compared with the dorsal side. The dorsal side of the glans is more vulnerable to friction and keratinization than the ventral side, and the local environment on the ventral side is more humid than the dorsal side. We found that gonococcal infection of the glans skin lesions manifested as abscesses, nodules, and pustules. This pleomorphism of skin lesions is essentially the result of pathological manifestations of glans skin inflammation being at different stages. Gonococcal infections of the glans skin are easily diagnosed by inspection of the specific site and laboratory examination. Because of limited conditions, we did not detect *T. pallidum* in skin secretions by PCR (Centurion-Lara et al., 1997; Wicher et al., 1998), but all skin secretions were negative for dark-field detection of this organism.

Ceftriaxone is the first choice for treatment of gonococcal infection. New guidelines for the treatment of uncomplicated gonorrhea were released by the United States Centers for Disease Control and Prevention in 2020. For treatment of uncomplicated urogenital, rectal, or pharyngeal gonorrhea, the guidelines recommend a single 500-mg intramuscular dose of ceftriaxone. For those weighing ≥ 150 kg (300 lbs), a single 1-g intramuscular dose of ceftriaxone should be administered. If chlamydial infection has not been excluded, oral administration of 100 mg doxycycline twice daily for 7 days is recommended (Cyr et al., 2020). However, there are no evidence-based guidelines for the treatment of gonococcal infection of the glans skin. In our study, patients were treated with different total ceftriaxone doses according to the severity of glans skin lesions, and all were cured.

This study showed that gonococcal infection of the glans skin is a rare local complication of gonorrhea. The lesions were often found on the ventral side of the glans, presenting abscesses, nodules, and pustules. Ceftriaxone was an effective treatment. However, our conclusions are limited by the small sample size, and will require further verification in multi-center studies with larger samples.

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Declaration of Conflicting Interests

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Ethics and Consent

This study was approved by the Ethics Committee of Changshu First People's Hospital (Approval No. 2013-csyy-05). All participants provided written informed consent prior to enrolment in the study.

ORCID iD

Wenge Fan  <https://orcid.org/0000-0001-5597-4417>

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