



FOURNIER'S GANGRENE -CLINICAL REVIEW OF 50 PATIENTS

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Abstract

Background: Fournier's gangrene is a devastating necrotizing fasciitis of the genitalia and perineum which can lead to polymicrobial infection of the region and organ failure or death. The goal of this study was to identify the pre-presence systemic comorbid conditions, the local predisposing factors, metabolic issues, early diagnosis, management challenges, and outcomes in Kanyakumari District. Fournier gangrene is a surgical emergency that results in a high mortality rate if proper diagnosis and early management are done. This polymicrobial necrotizing fasciitis of the perineal, perianal, and genital regions has a mortality rate ranging from 15% to 50%.

Aims & Objectives: This study is intended to figure out the age and sex incidence, demographic pattern, predisposing etiological and risk factors, signs and symptoms, and the net result of patients, and to evaluate the optimal treatment modalities for Fournier's gangrene.

Methods: This study is carried out as an observational prospective study conducted in the Department of General Surgery Kanyakumari Government medical college from January 2021 to December 2022. A total of 50 cases of Fournier's gangrene fulfilling the inclusion criteria were included in the study. Demographic data including age, gender, etiology, risk factors, clinical features, presenting signs and symptoms site of involvement, microbial culture bacterial flora, treatment modality applied, duration of hospital stay, and mortality were studied.

Results: Total number of 50 patients with 46 males and 4 females were in the study. Males predominant were observed at 92 % with the ratio of male: female ratio of 11.5 :1. Females were presented with induration of the vulva, and abscess in the perineal or perianal area . On the basis of site, 31 (62%) had lesions in the scrotum, 8 patients (16%) in the perineum, 6 patients (12%) in the penis, 3 patients (6%) in the groin, and 2 patients (4%) in the vulva.

Eight in the research group suffered total scrotum loss. The presentation with symptoms to the hospital was delayed with a mean presentation of 6.8 days following disease onset. Patients who reported late to the hospital reported much more severe morbidity, late recovery, and needed multiple debridements and prolonged hospital stays.

Conclusions: This study suggests that if Fournier's Gangrene can be diagnosed early and the patients report to the hospital early, with prompt debridement, metabolic control, and appropriate antibiotics effective positive

outcome management can be done. Scrotum being a much elastic skin, primary closure and wound healing are possible even after much necrotic debridement. Patients having wider resulting soft tissue defects following debridement required surgical reconstruction, thus decreasing morbidity, hospital stay, and early return of patients to regular life. Strict metabolic control, proper hygiene, and early treatment are important tools to avoid this devastating disease.

Keywords: Fournier's gangrene, debridement, scrotum, morbidity

INTRODUCTION:

Fournier's gangrene is a variant of necrotizing fasciitis that commonly invade and affect the external genitalia and or perineum. Epidemiologically Fournier's gangrene affects adult Males much more than females and children. People who are Diabetic, immunocompromised, alcoholic, and decompensated conditions were more prone to the disease. It is reported one person out of 62,500 males are affected and males are affected 40 times more than females. (1)

Fournier gangrene was first described by Baurienne in 1764 and re-identified in 1883, by the French venereologist Jean Alfred Fournier who published a series in which 5 previously healthy young men suffered from rapidly progressive gangrene of the penis and scrotum without apparent cause and it is named as Fournier gangrene.

Fournier's gangrene is defined as polymicrobial necrotizing fasciitis of the perineal, perianal, or genital areas (2). The manuscript of Fournier's initial series of fulminant perineal gangrene exhibits a fascinating insight into both the social practices and the status of the practice of modern medicine at the time. As anecdotes, Fournier had described the recognized causes of perineal gangrene, with varied practices such as placement of a mistress' ring around the phallus, ligation of the prepuce which was used for controlling enuresis or as a birth control technique by an adulterous man to avoid pregnancy), placement of foreign bodies such as beans within the urethra, and excessive intercourse in diabetic and alcoholic persons. He invokes and cautioned physicians to be steadfast in getting a confession from patients of their "obscene practices."

Fournier Gangrene will have initial symptoms like swelling or sudden pain in the scrotum, fever with or without chills, pallor, fatigue, and generalized weakness. (3). The gangrene is characterized by a characteristic foul odor and a purulent discharge from the infected region. Crepitus is also reported in these regions (3).

Fournier's gangrene is also known as "streptococcus gangrene", "synergistic necrotizing cellulitis" and "peri-urethral phlegmon", which are infective, destructive, and fatal. The infection is usually polymicrobial with Aerobic and Anaerobic bacteria. The predominant aerobe in this disease is Escherichia coli and is the predominant anaerobe is Bacteroides. Along with these the commonly isolated bacteria includes

- Proteus
- Staphylococcus
- Enterococcus
- Streptococcus (aerobic and anaerobic)
- Pseudomonas

- Klebsiella
- Clostridium

Polymicrobial involvement is necessary to create the synergy between the enzyme production that promotes rapid multiplication and enhances the spread of Fournier gangrene. When one microorganism produces the enzymes necessary to induce coagulation of the nutrient vessels, resulting in thrombosis of this nutrient vessel which reduces local blood supply and results in the fall of oxygen tension in the tissues. As this will produce hypoxia, the growth of facultative anaerobes and microaerophilic organisms will be enhanced. These anaerobic microorganisms, in turn, will produce enzymes (eg, lecithinase, collagenase), leading to the digestion of fascial barriers, thereby feeling the rapid extension of the infection ⁽⁴⁾.

The obliterative endarteritis of the subcutaneous arteries is the characteristic feature of Fournier's gangrene which ultimately leads to gangrene of the skin that covers the affected area. Early diagnosis of this is important or else it will lead to the rapid progression of gangrene and also the failure of multiple organs and ultimately death ^(5,6).

The infection starts with the infection of the superficial perineal fascia (Colles fascia), from there spread to the penis and scrotum via Buck and Dartos fascia, or to the anterior abdominal wall via Scarpa fascia, or vice versa. As Colles fascia is attached to the perineal body and urogenital diaphragm posteriorly and to the pubic rami laterally, thus limiting progression in these directions. Testicular involvement in the process is rare, as the testicular arteries originate directly from the aorta and thus have a blood supply separate from the affected region. Far advanced or fulminant Fournier gangrene can spread from the fascial envelopment of the genitalia throughout the perineum, along the torso, and, occasionally, into the thighs ⁽⁷⁾.

The pathognomonic findings of Fournier gangrene made out during the pathologic evaluation and examination of the involved tissues includes, ⁽⁸⁾

- Superficial and deep fascial planes necrosis
- Nutrient arterioles fibrinoid coagulation
- Infiltration of Polymorphonuclear cell
- Biofilm in involved tissues

Conditions that depress cellular immunity may predispose a patient to the development of Fournier gangrene. Examples include the following:

- Diabetes mellitus (present in as many as 60% of cases)
- Morbid obesity
- Alcoholism
- Cirrhosis
- Extremes of age
- Vascular disease of the pelvis
- Malignancy (eg, acute leukemia)
- Systemic lupus erythematosus
- Crohn disease

- HIV infection
- Malnutrition
- Iatrogenic immunosuppression (eg, from long-term corticosteroid therapy or chemotherapy)

The treatment for Fournier's gangrene consists of intensive and meticulous systematic management, empirical broad-spectrum antibiotic therapy, surgical debridement (the removal of necrotic tissues in the scrotum, penis, and inguinal areas), strict metabolic control and hyperbaric oxygen therapy, etc. Surgical debridement needs to be repeated and some may also need eventually reconstructive surgery.

With the advancement of new technology for wound care, diagnosing, assessing, and triaging to treat Fournier's gangrene with multiple options have made the treatment much more complex.

This study is carried out to identify the demographic profile of the people affected with this disease, etiological and risk factors, time delay in reporting to hospital clinical features, various surgical procedures for Fournier's gangrene, reconstructive procedures, and outcome of the disease.

Materials and Methodology:

Population of study: Patients of both gender with Fournier's gangrene admitted in General surgery department of Kanyakumari Govt Medical College

Study design: Prospective observational study.

Study period: January 2021 to December 2021

Place of study: Surgical wards of the Medical college.

Sample size: It is a hospital-based study of 50 cases that are fulfilling the Inclusion/Exclusion criteria.

Inclusion criteria:

- Patients with the signs and symptoms and the clinical diagnosis of Fournier's gangrene.
- consent for the study
- Patients above the age of 18

Exclusion criteria:

- Females with pregnancy
- Age less than 18.
- Patients not giving the consent for the study.

Methodology:

All Patients were subjected to structured history taking, appropriate clinical examination, study on the associated comorbid conditions and the metabolic status, radiological and blood investigations, aggressive surgical debridement, wound swab for culture and sensitivity and empirical antibiotic therapy.

Optimization of the general conditions using blood, IV fluids, Albumin and other nutrients therapy with insulin for metabolic control. Both swab and tissue culture reports were obtained, and specific antibiotics were started. The treatment procedures were tailor-made to each patient. Once they are admitted, all patients were followed up meticulously and outcomes were recorded using the proforma.

Statistical Assessment:

The collected data were entered in MS excel and using SPSS 22 version software, the data were analysed using descriptive statistics. Qualitative data were identified and expressed as frequency and proportion. Mean is

used to express the Quantitative data and mean is used to represent the Continuous measurement. The Categorical measurement were represented in number (%).

Management:

All patients admitted with Fournier's gangrene were triaged as per their clinical conditions and treatment modalities were started as per their needs either in the septic ward or in the ICU. The electrolytes imbalances and dehydration were corrected with aggressive fluid therapy and anaemia is corrected with components of blood.

The patients were subjected to early debridement with appropriate anaesthesia and broad-spectrum antibiotics with Amoxicillin with clavulanic acid or third generation cephalosporin, Aminoglycoside and metronidazole started empirically and once the culture report has come changed according to Culture and sensitivity report. Moist hygroscopic dressings were done, and debridement done whenever necessary.

Continuous debridement were done periodically as per the individual case till healthy granulation tissue was formed. The overall General condition of the patient was improved by correction of anaemia, hypoalbuminemia, and other nutritional support. Post debridement reconstruction were done depending upon the size of the raw area either as primary closure or with the availability of local tissue. Various methods used include, healing by secondary intention, split skin grafting, secondary suturing, flap cover. The stage of septicaemia sassed as SIRS, MODS, ARDS, and based on this critical care management were offered.

RESULTS:

The findings of various factors used in this prospected study conducted in the department of surgery on Fournier's gangrene patients from January 2021 to December 2022 were reported here . The patients age were in the range of 18 to 87 years with mean age being. $MEAN \pm SD=47.8 \pm 14.87$ years. Maximum cases are between 50-60 years of age group .The resulta are tabulated in Table 1.

Age in Years	No. of Cases	Percentage (%)
< 20	2	4
20-30	4	8
30-40	8	16
40-50	11	22
50-60	15	30
>60	10	20
TOTAL	50	100

Table 1: Age distribution

Males are affected more 46 patients (92%) and females only 4 patients (8%).The results are tabulated in Table 2.

Age in Years	Male		Female	
	No.	%	No.	%
<20	2	4	-	-
20-30	4	8	-	-
30-40	8	16	-	-

40-50	9	18	-	-
50-60	13	26	2	4
>60	8	16	2	4
TOTAL	46	92	4	8

Table 2: Incidence among Males and Females

Total of 46 male and 4 female patients were included in the study. Males are commonly affected 92%. M: F- 11.5:1. Females were presented with induration of the vulva, and abscess in the perineal or perianal area .The results are tabulated in Table 3.

Sex	Number of Cases	Percentage (%)
Males	46	92
Females	4	8

Table 3: Sex Distribution

On the basis of site, 31 (62%) had lesions in the scrotum, 8 patients (16%) in the perineum, 6 patients (12%) in the penis, 3 patients (6%) in the groin, and 2 patients (4%) in the vulva.

SITE	Number of Cases	Percentage (%)
Scrotum	31	62
Perineum	8	16
Penis	6	12
Groin	3	6
Vulva	2	4

Table 4: Site of involvement

Pain is the most significant symptom with all the patients were having pain followed by 35 patients had fever ,31 patients had scrotal swelling and 8 patients had discoloration of the perineum ,the data are tabulated in Table 5.

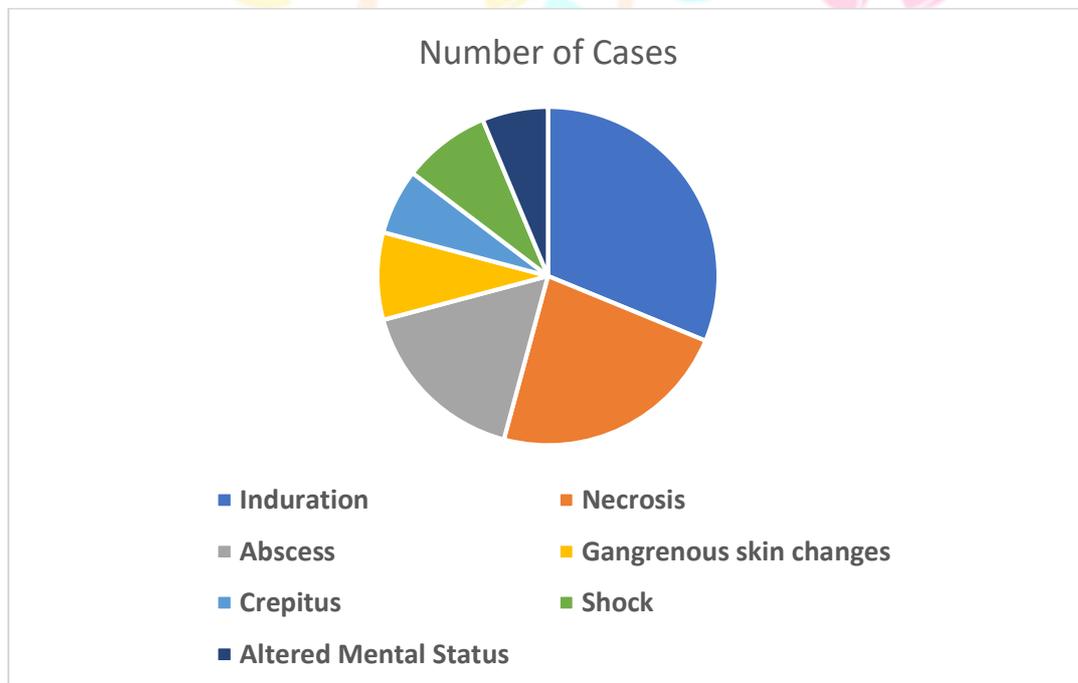
Symptoms	Number of cases	Percentage (%)
Pain	50	100
Erythema	50	100
Fever	37	74
Discharge from wound	20	40
Scrotal Swelling	31	62
Blisters/Skin vesicles	18	36
Discoloration of perineum	8	16

Table 5: Symptoms at Presentation

30 patients had induration in the involved region, 22 patients presented with necrosis and 16 patients with abscess, 8 patients with gangrenous skin changes. Crepitus, shock and altered Mental status were seen in 6 (12%);8 (16%), and 6 (12%) and values are tabulate in Table 6.

Signs	Number of Cases	Percentage (%)
Induration	30	60
Necrosis	22	44
Abscess	16	32
Gangrenous skin changes	8	16
Crepitus	6	12
Shock	8	16
Altered Mental Status	6	12

Table 6: Clinical signs at presentation



The source of infection were traced and noted in 10 patients it is from Anorectal and 17 patients from Genitourinary . 10 patients had combination of both and 12 patients it was idiopathic and the results are tabulated in table 7

Source	No. of Patients	Percentage
Anorectal	10	20
Genitourinary	17	34
Combination of above	10	20
Idiopathic	12	24
Skin	6	12
Total	50	100

Table 7: Source of infection for Patients with Fournier's Gangrene (n=50)

Two patients presented within 24 hours, following RTA, with degloving injury to scrotum, penis and perineum. The presentation with symptoms to the hospital was delayed with a mean presentation of 6.8 days following disease onset. Patients who reported late to the hospital reported much more severe morbidity, late recovery, and needed multiple debridements and prolonged hospital stay. 11 Patients presented to the hospital only after a week to the hospital and the results are tabulated in Table 8

Time Interval	No. of Patients	Percentage
<48 hours	2	4
48hours-1week	37	74
≥1week	11	22

Table 8: Time interval between onset of symptoms and presentation at the hospital

Diabetes mellitus was the most common risk factor in majority of patients (72%). Uncontrolled blood sugars was associated with significant mortality and morbidity, later recovery and surgical site infections. Various associated symptoms noted were tabulated in Table 9.

Predisposing Risk Factors	Number of cases	Percentage (%)
Diabetes mellitus	38	72
Extremes of ages	4	8
Perianal abscess	10	20
Trauma	2	4
Alcohol	15	30
Steroids	4	8
Renal disease	12	24
Cirrhosis of liver	6	12

Table 9: Risk Factors and Etiology

The swab culture shows predominantly 66% Multi bacteria status. Klebsiella and E.coli are the most common organism isolated from wound swab cultures. The Bacteria isolated details are tabulated in table 10

Bacteria	Number of cases	Percentages (%)
Klebsiella	21	42
E. coli	20	40
Pseudomonas	13	26
Staph aureus	14	28
Proteus	10	20
Streptococcus pyogenes	6	12
Acinetobacter	2	4
Citrobacter	3	6

Table 10: Microbiology-Type of bacteria isolated from the wound

Patients were having the comorbidities and the associated findings are tabulated in Table 11.

Investigation	No. of Patients	Percentage
Anaemia	32	64
Leucocytosis	23	46
Hyponatremia	15	30
Increased Serum Creatinine	21	42
Hyperglycaemia	44	88
Glycosuria	46	92
Decreased Serum Albumin	12	24
Increased BT and CT	3	6
Hypocalcaemia	16	32

Table 11. Biochemical abnormalities in Fournier's Gangrene (n=50)

Three patients went against medical advice, after initial resuscitation due to lack of compliance. 6 patients died due to the late arrival to the hospital and advanced co morbid conditions. Data shown in table 12.

Outcome	Number of Cases	Percentages (%)
ALIVE	41	82
DEATH	6	12
DAMA	3	6

Table 12: Outcome of Patients

Discussion:

Most predominant critical issue in relation to the successful treatment of Fournier's gangrene and a positive prognosis is the early diagnosis and initiation of treatment. Fournier's gangrene, being a clinical diagnosis to start with, radiological techniques such as X-rays, ultrasonography, computed tomography, and magnetic resonance imaging and the advanced laboratory findings can be only secondary to start the treatment. The most common symptom will be pain associated with the signs of inflammation, edema, necrosis, and subcutaneous crepitation. Through clinical examinations should be done to assess the extension of the disease and the range of debridement.

Fournier's gangrene can affect both sexes, however as per the previous studies in our study 92 percent of the patients were belonging to the male sex and though it can occur in any age predominantly in our study elderly individuals are affected. It is less common in female due to the anatomical pattern of lymphatic drainage.

Age distribution:

The patients in our study are from 18 to 87 years, with a mean age of presentation of 47.8 years. In studies done and reported by Kavut T⁽⁹⁾, Al-Abkari *et al.*⁽¹¹⁾, Laor *et al.*,⁽¹⁰⁾ and Alejandro *et al.*, Fournier's gangrene is

most common in the fifth and sixth decades of life. Similarly, Sockkalingam, V. S., *et al.*⁽⁶⁾, have reported low socioeconomic status contribute to the development of FG. Comparing all these studies the average age of patients are 50.01 years^(9, 10, 11, 6).

Sex distribution:

In our study predominantly female were the patients with the ratio of 11.5: 1. Our finding is consistent with the findings of other studies. The lower incidence in females may reflect better drainage of the perineal region through vaginal secretions. Homosexuals are at higher risk, especially for infections caused by community-associated methicillin-resistant *Staphylococcus aureus* (MRSA).

Predisposing risk factors:

Diabetes mellitus was the most common predisposing risk factor in our study (72%). Alcohol abuse was 30%, compared to 9-31% in previous studies. Others include steroid (3%), with no discernible risk factor in 10% of patients. In comparison to other studies, approximately 64% of patients had more than one risk factor. According to the Sockkalingam, V.S., *et al.*, study, the most common source of the disease⁽⁶⁾ was anorectal (35.3%), genitourinary (20.6%) and dermatological (14.7%). In 29.4% of cases, the cause was idiopathic. Diabetes (38.2%) was the most common co morbidity, followed by chronic alcoholism (20.6%), HIV (17.6%), chronic renal failure (8.9%), chicken pox (2.9%), and pulmonary tuberculosis (2.9%).

Site of involvement/ common presentation:

Scrotum was the most commonly involved region in our study. Females were presented with induration of the vulva, and abscess in the perineal or perianal area. The most common clinical presenting features were fever, pain, scrotal swelling, erythema, tenderness of the genitalia and perineum, and gangrene. The corresponding studies also give more or less similar findings.

In our study all patients with Fournier's gangrene came with pain (100%) and erythema (100%) and Lamb RC and Juler GL *et al.*⁽¹³⁾ and Clayton and Flower JE Jr *et al.*⁽¹⁴⁾ pain 100% and erythema 100%. However the incidence of altered mental state and shock are found less frequently comparing with the above studies.

As reported by Lamb RC and Juler GL *et al.*⁽¹³⁾ and Clayton and Flower JE Jr *et al.*⁽¹⁴⁾ anorectal (46%) site of origin was more common than genitourinary (33%). According to Ascii R and Sarikaya S *et al.*⁽¹⁵⁾ genitourinary (35.3%) site of origin was more common than anorectal (29.4%).

Microbiology-Organisms isolated:

Klebsiella and E. coli were the most common organism isolated. 66% of patients had polymicrobial culture isolates (more than one organism isolated), 30% had Monomicrobial cultures, and 4% did not grow in culture. According to the Sockkalingam, V. S., *et al.*, study, Escherichia coli was isolated in 47.0% of patients, followed by streptococci (41.1%) and klebsiella (35.3%). Bacteroides was the most frequently isolated anaerobe, found in 8.9% of patients the disease was limited to the genitalia in 18 of 34 cases (52.9%).

Mode of healing:

In our study comprising 50 patients, the average length of stay was 16.8 days. 17 individuals, had healed with secondary intention, 13 patients had undergone secondary suturing, SSG in 12 patients, and flap in 4 patients.

Mortality:

Six patients with advanced comorbid conditions and late admission to the hospital succumbed to the disease in our study. Early diagnosis, prompt aggressive and multiple sittings of surgical debridement, initial broad spectrum followed by accurate antibiotic therapy based on culture reports, and intensive care instituting fluid and nutritional support all contribute to reduced morbidity and mortality.

Delay in reporting to hospital:

Stamenkovic I and Lew PD et al ⁽¹⁶⁾ 53% reported to hospital with in 48 hrs to 1 week and 47% reported with in 48 hours, however in our study it was only 8% of patients reported with in 48 hours, 72% patients came with in 48 hours and one week and 10 % patients after one week.

A Study by Miller JD et al ⁽¹⁷⁾ leukocytosis was 93% and hyperglycemia 82% are biochemical abnormalities. In our study 88 % of patients had hyper glycemia.

The data of the present study are compared with the other published studies and they are tabulated in Table 13.

Criteria	Study factor	Present study Jayalal et al	Kavat T ^[6]	AL-Abkari HA. et al., ^[7]	Laor E et al., ^[8]	Alejandro et al., ^[11]
AGE	Mean AGE	47.8	47.4	54.7	53	47.5
SEX	Male %	92	86	82	78	96
	Female %	8	13	18	22	4
Predisposing factors	Diabetes Mellitus (%)	72	66	60	45	51
	Alcohol (%)	30	30	25	22	24
	Steroids (%)	6	3	2	1	3
Site of involvement	Scrotum (%)	65	90	70	85	52
	Perineum (%)	20	23	33	35	38
	Penis (%)	12.5	13	9	11	10
Organism Isolated	Klebsiella (%)	42	40	18	21	25
	E. coli (%)	40	33	9	13	11
	Pseudomonas (%)	26	26	38	35	30
	Staph aureus (%)	28	16	5	6	7
	Proteus (%)	20	10	2	4	3
Mode of healing	Healing by secondary intention (%)	34	43	69	60	63
	Secondary suturing (%)	26	33	20	18	19
	SSG (%)	24	16	5	4	3
	Flap (%)	8	6	2	3	4
Mortality	Mortality (%)	12	3	27	15	12

Table 13: The comparison of the results

Conclusion:

This study suggests that if Fournier's Gangrene can be diagnosed early and the patients report to the hospital early, with prompt debridement, metabolic control, and appropriate antibiotics effective positive outcome management can be done. Scrotum being a much elastic skin, primary closure and wound healing are possible even after much necrotic debridement. Patients having wider resulting soft tissue defects following debridement required surgical reconstruction, thus decreasing morbidity, hospital stay, and early return of patients to regular life. Strict metabolic control, proper hygiene, and early treatment are important tools to avoid this devastating disease. Alcoholism and Diabetes and were major risk factors in many of the patients. Klebsiella and E.coli are the commonest organism . Hyperglycaemia is the commonest co morbidity and strict metabolic control of Diabetics can reduce the incidents.

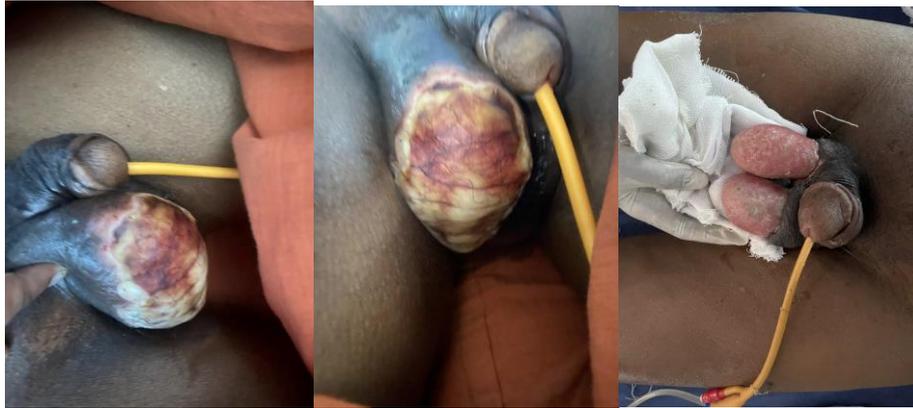


FIG1: FOURNIER'S GANGRENE

After debridement



FIG : 2: Healing by secondary intention



FIG : 3: Healing by Secondary Suturing



FIG : 3: Healing by SSG

References:

1. Kostovski O, Spasovska O, Trajkovski G, Antovic S, Kostovska I, Tosheska-Trajkovska K, *et al.* Challenging Treatment of a Female Patient with Extensive Fournier's Gangrene- Case Report. *Prague Medical Report.* 2021;122(1):39-44.
2. Perneti R, Palmieri F, Sagrini E, Negri M, Morisi C, Carbone A, *et al.* Fournier's gangrene: Clinical case and review of the literature. *Arch Ital Urol Androl.* 2016 Oct 5. 88 (3):237-238.
3. Zuhour M, Dadacı M, Baycar Z, İnce B, Soylu A. Fournier's Gangrene as a Possible Surgical Complication of COVID-19: Two Case Reports and Literature Review. *Turkish Journal of Plastic Surgery,* 2022, 17-20.
4. Mergenhagen SE, Thonard JC, Scherp HW. Studies on synergistic infections. I. Experimental infections with anaerobic streptococci. *J Infect Dis.* 1958 Jul-Aug. 103(1):33-44.
5. Simsek ARİFE, Dirican A, Gecit I. The predictors of mortality in patients with anogenitalnecrotizing fasciitis (Fournier's gangrene). *Archives of Hellenic Medicine/Arheia Ellenikes Iatrikes.* 2020;37(5):650-655.
6. Sockkalingam VS, Subburayan E, Velu E, Rajashekar ST, Swamy AM. Fournier's gangrene: prospective study of 34 patients in South Indian population and treatment strategies. *Pan African medical journal,* 2018, 31(1)
7. Koukouras D, Kallidonis P, Panagopoulos C, Al-Aown A, Athanasopoulos A, Rigopoulos C, *et al.* Fournier 's gangrene, a urologic and surgical emergency:presentation of a multi-institutional experience with 45 cases. *Urol Int.* 2011;86(2):167–172. doi:10.1159/000321691. [PubMed]
8. Huang CS. Fournier's Gangrene. *N Engl J Med.* 2017 Mar 23. 376 (12):1158. [[QxMD MEDLINE Link](#)]. [[Full Text](#)].
9. Kavati T A clinical study of Fournier's gangrene and its management. Dissertation M.S., Rajiv Gandhi University of Health Sciences, Karnataka, Bengaluru, 2019.
10. AL-Abkari HA. Fournier's gangrene: report of 22 cases at Dammam Medical Complex. *Gulf Medical Journal.* 2017;6(1):27-32.
11. Laor E, Palmer LS, Tolia BM, Reid RE, Winter HI. Outcome prediction in patients with Fournier's gangrene. *The Journal of urology.* 1995;154(1):89-92.
12. Morua AG, Lopez JA, Garcia JD, Montelongo RM, Guerra LS. Fournier's gangrene: our experience in 5 years, bibliographic review and assessment of the Fournier's gangrene severity index. *Arch Esp. Urol.* 2009;62(7):532-40
13. Juler GL; Fournier's gangrene of the scrotum: A poorly defined syndrome or a misnomer. *Arch Surg.,* 1983; 118: 38 – 40.

14. Clayton MD, Flower JE Jr, Sharifi R; Causes, Presentation, Survival of 57 patients with Necrotizing fasciitis of the male genitalia. Surg Gynecol Obstet., 1990; 170: 49 – 55.
15. Asci R, Sarikaya S, Buyukalpalli R, Yilmaz AF, Yildiz S; Fournier’s gangrene: Risk assessment and enzymatic debridement with lyophilized collagenase application. Eur Uro., 1998
16. Stamenkovic I, Lew PD; Early recognition of potentially fatal necrotizing fasciitis: The role of frozen section biopsy. N Engl J Med., 1984; 310:1689 –1693
17. Miller JD; The importance of early diagnosis and surgical treatment of Necrotizing fasciitis. Surg Gynecol Obstet., 1983; 157: 197 – 200

