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Study of the Incidence, Causes and Management of Fournier's Gangrene in a Tertiary Centre

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Abstract

Background-Fournier's gangrene is an uncommon and nasty condition characterized by a polymicrobial infection of the soft tissues of the perineum, external genitalia and peri-anal region.It is a form of necrotizing fasciitis.There is rapid onset of gangrene leading to exposure of the scrotal contents.

Objectives-1 To observe the patient with scrotal edema and inflammation for early detection and management of Fournier's gangrene.2.To prevent the spreading cellulitis.3.To improve prognosis.4.To decrease mortality and morbidity.

Place And Duration-Patients admitted in various surgical wards of Rajendra Institute of Medical Sciences, Ranchi having fournier's gangrene were included in our study.. The study was conducted during the period from August 2015 to August 2017.

Material and methods- Materials for this study consisted of 45 patients of scrotal gangrene admitted to Department of Surgery, Rajendra Institute of Medical Sciences, Ranchi during August 2015 to August 2017.Criteria for diagnosis of cases as Fournier's gangrene in this study were:A sudden onset of scrotal oedema in an apparently healthy person, progressing rapidly to gangrene.Involvement of part or whole of the scrotum and sometimes the undersurface of penis. Involvement of whole thickness of scrotal skin and subcutaneous tissue in gangrenous process.An associated systemic evidence of rapid and intense toxemia.Absence of any obvious cause of gangrene.A detailed clinical record sheet was prepared for all patients at the time of admission with particular reference to following points: Age, Sex, Case no. ,Religion ,Habitat, Occupation, Socio-economic status, Personal hygiene, Detailed enquiry was made for all patients with regard to: Onset of disease. Severity and duration of associated systemic symptoms, if any. Any predisposing factors. Any associated underlying disorders like – diabetes mellitus, general debilitating condition etc.During history taking, detailed enquiry were made about the presence or absence of systemic symptoms. Systemic symptoms were selected on the basis of various features mentioned in literature. The common features are fever, prostration, pallor, constitutional symptoms of infection like bodyache and malaise, haemodynamic instability and frank septicaemia**.**

Results- All the patients were male between the age group of 25-80 years. Most of patients were in their 5 and 6 decades. Two patients were died in our study. Out of these 36 patients were from rural population and only 9 patients were from urban population making rural to urban population ratio of 4:1. There is a definite relationship between Fournier's gangrene and socio-economic strata of a particular population(86.4% in a low socio-economic strata). The most common predisposing factor in our study was poor personal hygiene which was seen in 40 out of 45 cases studied.

Uncontrolled diabetes was found in 7 cases.20 patients were smokers and 13 were alcoholics. 3 of our patients were asthmatics who were on steroid. Few patients had more than one predisposing factors whereas two had none.

Conclusion- 45 male patients in our study were in the range of 25-80 years of age. Majority were in 5^{th} or 6^{th} decades of life. Most of them were from rural background from lower socioeconomic group and had poor personal hygiene. Quite a few of them were still idiopathic in that no definite cause could be found. In those in whom a definite cause could be found some form of trauma was present in most of them. Other conditions which were associated were anorectal abscess drainage and previous operation like Jaboulay's operation.

Keywords: Fournier's gangrene, polymicrobial infection,idiopathic aetiology,low socio-economic strata,poor personal hygiene.

Introduction

Fournier's gangrene is an uncommon and nasty condition Charactised by a polymicrobial infection of the soft tissues of the perineum,external genitalia and peri-anal region.It is a form of necrotizing fasciitis. It is characterised by sudden scrotal inflammation, with rapid onset of gangrene leading to exposure of the scrotal contents. Although it can occur in conjunction with sepsis of the testis, epididymis or perianal region, an obvious cause is absent in over half the cases. It canarise following minor injuries or procedures in the perineal area, such as a bruise, scratch, urethral dilatation, injection of haemorrhoids or opening of a periurethral abscess. Many patients have concurrent illnesses that diminish their defences,most notably diabetes mellitus and alcoholism. There is a mixed infection of aerobic and anaerobic bacteria in a fulminating inflammation of the subcutaneous tissues, which results in an obliterative arteritis of the arterioles to the scrotal skin which in turn results in gangrene.The condition can spread rapidly to involve the fascia and skin of the penis, perineum and abdominal wall.There is sudden pain in the scrotum associated with prostration,pallor and pyrexia. Cellulitis spreads rapidly (within hours) and progresses to necrosis until the entire scrotal and penile coverings slough, leaving the testes exposed but healthy.Treatment of a case of Fournier's gangrene is a surgical emergency.Urgent wide surgical excision of the dead and infected tissue is essential. This should be accompanied by intra venous antibiotics. Supportive care is essential, because the patients often become severely septic. Early review of the wounds is helpful to confirm that all dead tissue has been removed, and if the patient survives the acute episode, skin grafting is often necessary. Despite best therapy, mortality rates as high as 50 percent are often reported.

Fournier's gangrene, or variously known as "idiopathic gangrene of scrotum", "gangrenous erysipelas of scrotum", "spontaneous fulminating gangrene of scrotum" is among the rarity of surgical practice. The condition is an acute infectious process, which primarily involves either the scrotum or penis or both. This dramatic condition was first described as a separate disease entity by Fournier in 1883.

Cardinal points of the disease are:,Sudden onset in young person,Rapid progression to gangrene,Absence of a definite cause.The hallmark of Fournier's gangrene is

intense pain and tenderness in the genitalia. The clinical course usually progresses through the following phases.Prodromal symptoms of fever and lethargy, which may be present for 2-7 days.Intense genital pain and tenderness that is usually associated with edema of the overlying skin.Increasing genital pain and tenderness with progressive erythema of the overlying skin. Dusky appearance of the overlying skin; subcutaneous crepitation.

Obvious gangrene of a portion of genitalia purulent discharge from wounds.

Pathophysiology

Localized infection adjacent to a portal of entry is the inciting event in the development of Fournier's gangrene. Wound cultures from patients of Fournier's gangrene reveal that it is a polymicrobial infection with on average of four isolates per case. The bacteria involved at synergistically (via collagenases, hyaluronidases and other enzymes) invade and destroy fascial plane.

Ultimately, an obliterative endarteritis develops leading to thrombosis of subcutaneous vessels, fascial necrosis and leucocyte infiltration.

The spread of Fournier's gangrene is noted to be along the fascial layer and is determined by attachments of Colle's fascia of the perineum and abdominal wall. The dartos is a continuation of this layer over the scrotum and penis. Posteriorly the fascia is attached to the perineal body and urogenital diaphragm, laterally, it is attached to the pubic rami. These posterior and lateral attachments tend to limit the spread of infection in these directions. However, antero-posteriorly Colle's fascia merges with Scarpa's fascia of the anterior abdominal wall and therefore there is no barrier to spread in this direction, resulting in a widespread involvement.

Stages of inflammation of Fournier's gangrene were divided into 3 stages by R. B. Tan in 1964.

Ist Stage of Inflammation

It starts with a scratch which results into progressive oedema of the penis and scrotum. There is no fever but slight rise of temperature. The time extent is 4-15 days.

IInd Stage of Progressive Necrosis:

It starts with the onset of progressive gangrene which characterizes itself by sharp border with the lining tissue. Due to the dead tissue and the organisms the patient has offensive smell which can be smelt from a distance. There is slight rise of temperature. This period extends from 2-9days.

IIIrd Stage of Recovery

It starts with the hospital admission when extensive debridement commenced. This period depends upon the surgical therapy.

The scrotum and penis are richly supplied with blood from different sources and free anastomosis occurs between these arteries, making the scrotum an unlikely site of gangrene. It may be possible that in certain cases, these sources may be insufficient to the extent that gangrene may develop. It is also known that spread of infection in scrotum is facilitated by laxity of areolar tissue and inflammatory process will be manifested by severe oedema of scrotum which may precipitate gangrene by occluding the arteries.

Fournier's gangrene does occur in affluent as well as poor communities. Diabetes and chronic alcoholism are the most common associations observed with this disease. Immuno-suppression, either after organ transplantation or caused by chemotherapy for malignant disease, has also been associated with an increased risk. With the emergence of HIV, a new group of patients at risk has been recognized in both in Africa and the developed world and Fournier's gangrene has been reported as a presenting sign of undiagnosed HIV infection.

In spite of Fournier's having identified and described it about more than 100 years ago; its various aspects like

predisposing factors, causative organisms, management and prognosis needs further study. The present study has been done keeping in view the above mentioned facts so that early diagnosis and, prompt and better management of this emergency condition is undertaken so as to reduce the mortality and morbidity.

Campbell (1922) and Easu (1923) demonstrated the relationship of Fournier's gangrene to erysipelas and called it Erysipelas of scrotum or streptococcal gangrene of scrotum. Although streptococci are demonstrated in majority of cases, the condition is not erysipelas.

Gibson (1930) related it to the extravasation of urine with or without rupture of periurethral abscess. But the line of involvement of tissue does not follow the line of extravasation of urine. Bertoglio and Ratlif (1943) recorded two cases due to clostridia and postulated that the condition is gas gangrene of scrotum. Meleny's concept (1931) of progressive synergistic bacterial gangrene was upheld by various authors for many years. Mansfield (1946) called it a vascular disaster of infective origin whereas Tehrani (1975) postulated that Fournier's gangrene is nothing but a necrotizing fasciitis involving scrotum.

More than 100 years after the first description of Fournier's gangrene as a separate disease entity, controversy still exist about the exact aetiopathogenic mechanism involved in the causation of this rare but disastrous condition. Every theories put forward by various authors from time to time find support from literature but none is capable of explaining the various aspect of disease like causation of infective thrombosis leading to extensive gangrene, rarity of the condition in spite of presence of large number of infective focus on or around the scrotum at any time, absence of typically similar condition elsewhere in the body.

Although, considered as an idiopathic condition for many years, recent study by various authors concludes that the condition is neither idiopathic nor spontaneous. A portal of entry for infective macro-organism can be found in every cases (Enriquez et al 1987), Fahal and Hassan (1988), Paty and Smith (1992), Kaulbar (1993). Traditionally the onset of disease has been described as sudden and explosive but course may be indolent and protracted (Paty and Smith 1992).

Idiopathic gangrene of scrotum traditionally described as condition affecting scrotum and under surface of penis in some cases has also been described in females affecting labia majora and perineal area. Although the extent of involvement is confined to scrotum in majority of cases, various authors recently described the involvement of perineal area, anterior abdominal wall, thigh and even hip joint and ureter in occasional cases. Females are also affected by Fournier's gangrene, although not as frequently as males. More recently Stephens et al (1993) in an extensive and exhaustive review of literature of more than 100 years that about 17% of affected individuals was female.

Various factors have been identified as risk factors for disease and are of prognostic significance. Age of the patient, presence or absence of associated underlying disorder, site of predisposing infective lesion, delay in initiation of treatment and treatment modality applied, all have its effect on outcome. In spite of availability of various specific potent antimicrobials, effective aggressive surgical approach and potent adjuvant therapy like hyperbaric oxygen therapy, the condition still carries significant high mortality and should always be considered as a potentially lethal condition.

The present study was planned in keeping in view the above mentioned fact and to identify possible aetiological factors in every cases and to have a detailed bacteriological study to make recommendations for early diagnosis and better management of this rare but disastrous condition of surgical practice.

Methodology

Materials for this study consisted of 45 patients of scrotal gangrene admitted to Department of Surgery, Rajendra Institute of Medical Sciences, Ranchi during July 2015 to October 2017.Criteria for diagnosis of cases as Fournier's gangrene in this study were:A sudden onset of scrotal oedema in an apparently healthy person, progressing rapidly to gangrene.Involvement of part or whole of the scrotum and sometimes the undersurface of penis. Involvement of whole thickness of scrotal skin and subcutaneous tissue in gangrenous process.An associated systemic evidence of rapid and intense toxemia.Absence of any obvious cause of gangrene.A detailed clinical record sheet was prepared for all patients at the time of admission with particular reference to following points: Age, Sex, Caseno, Religion, Habitat,Occupation,Socio-economic status,Personal hygiene.Detailed enquiry was made for all patients with regard to:Onset of disease,Severity and duration of associated systemic symptoms, if any,Any predisposing factors,Any associated underlying disorders like – diabetes mellitus, general debilitating condition etc.During history taking, detailed enquiry were made about the presence or absence of systemic symptoms. Systemic symptoms were selected on the basis of various features mentioned in literature. The common features are fever, prostration, pallor, constitutional symptoms of infection like bodyache and malaise, haemodynamic instability and frank septicaemia .

Results

There were 50 patients of Fournier's gangrene in our study which comprised of patients admitted in indoor wards of Department of Surgery of Rajendra Institute of Medical Sciences during the period of August 2015 to August 2017. The basis of diagnosing the patient as Fournier's gangrene was the one laid at the beginning of the study. All the patients were male between the age group of 25-80 years. Most of patients were in their 5 and 6 decades. Two patients were died in our study.

TABLE – 1 Age incidence of 45 cases of Fournier's gangrene.

Age group (years)	No. of patients	Percentage of Total
1-10	0	0
11-20	0	0
21-30	3	6.67
31-40	8	17.78
41-50	12	26.67
51-60	10	22.22
61-70	6	13.33
71-80	6	13.33

Out of these 36 patients were from rural population and only 9 patients were from urban population making rural to urban population ratio of 4:1.

Majority of cases had systemic manifestations of infection which included fever, malaise, prostration, fever being the commonest. It was present in 36 out of 45 cases. All patients with fever complained of malaise and body ache. General feeling of ill health was present in all cases.Scrotal oedema was presenting feature in all patients. At the time of admission the skin was tense, markedly tender and shining in appearance.Nine cases presenting very late had extensive sloughing, and foetidodours. Two of the admitted patient was in shock and had to be resuscitated with IV fluids, blood transfusion and antibiotics.

TABLE – 2 Clinical and Laboratory findings

Clinical/Laboratory findings (n=45)	No. of patients	Percentage of total
Scrotal swelling	45	100
Leucocytosis	45	100
Malaise and body ache	34	75.55
Fever	36	80
Anaemia	30	66.67
Foul foetidodour	28	62.22
Extensive sloughing of scrotal skin	25	55.55
Shock	2	4.44

All the patients with Fournier's gangrene had leucocytosis, i.e. total leucocyte count greater than 11,000 per cmm. Majority of patients (30) were anaemic at the time of admission and 15 out of these required blood

transfusion.Very foul smelling foetidodour was noted in 28 out of 45 patients. Most of these patients of Fournier's gangrene besides being rural population were also from lower socio-economic group and only 13 percent of patients belonged to middle socio-economic group. At the onset of the disease the skin was hot, tense, tender and shining in appearance and in all these cases there was swelling of scrotum in association with p

Table – 3 Distributions Of Patients According To Socioeconomic Status

Socio-economic Group (n= 45)	No. patients	Percentage of total
Lower	39	86.7
Middle	06	13.3
Upper	--	--

This chart clearly demonstrates that there is a definite relationship between Fournier's gangrene and socio-economic strata of a particular population.

Various predisposing factors stated in literature were selected to find out their relationship to the occurrence of the Fournier's gangrene. These factors increase the likelihood of patient to get disease without directly causing the disease.The most common predisposing factor in our study was poor personal hygiene which was seen in 40 out of 45 cases studied Uncontrolled diabetes was found in 7 cases.20 patients were smokers and 13 were alcoholics. 3 of our patients were asthmatics who were on steroid. Few patients had more than one predisposing factors whereas two had none.

TABLE – 4 Predisposing factors in 45 cases of Fournier's gangrene.

Predisposing factors	No. of patients	Percentage of total
Poor personal hygiene	40	88.88
Smoking	20	44.44
Alcoholic	13	28.88
Steroid ingestion	03	06.66
Diabetes	07	15.55

Few patients have more than one predisposing factors.

In our study we also tried to pinpoint a cause for infection and initiation of gangrene. In some of the cases (12 out of 45 cases or in 26.66 percent of cases) no cause or source of infection immediately preceding gangrene was identified, while in vast majority of cases some cause of the gangrene could be identified.

It may be that minor trauma has been missed by the patients or that the patients considered them to be very trivial to report. In cases in which a definite cause could be identified majority 37 percent of cases were due to some sort of trauma- scratch cuts or puritusani with itching around the area. 8 of the cases were preceded by the drainage of anorectal abscess while 2 followed surgery for hydrocele.

TABLE – 5 Causes of Fournier's gangrene in 45 cases

Causes (n=45)	No. of patients	Percentage of total
Trauma (cuts, scratches)	17	37.77
Anorectal abscess drainage	08	17.77
Surgery (jaboulay)	02	4.44
Pruritus ani	05	11.11
Genitourinary	01	2.22
Unknown	12	26.66

There is wide variation in the duration between first symptom and the appearance of gangrene which is shown in the given table.

TABLE – 6 Duration between first symptom and the appearance of gangrene

Duration in days	No. of patients	Percentage of total
0 – 1	04	08.88
2 – 3	15	33.33
4 – 5	20	44.44
6 – 7	06	13.33

TABLE – 7 Bacteriological findings in cases of Fournier's gangrene

Organisms isolated	No. of cases
Streptococcus alone	20
Staphylococcus alone	07
Escherichia coli alone	03
Escherichia coli and streptococcus	06
Streptococcus and staphylococcus	04
No growth	05

Most common isolated organism was streptococcus either alone or in combination with staphylococcus. Other

organisms were E. coli either alone or in combination with streptococcus.

TABLE – 8 Involvement of scrotum in Fournier's gangrene.

Part involved	No. of cases
Most part of scrotum	25
Anterior part	08
Posterior part	05
Both testicles exposed	07

The extent of involvement of scrotum also varied to some extent. In no case were testes involved at any stage. Most commonly however major portion of the scrotum were involved in majority of cases. Nine cases of Fournier's gangrene presented extremely late with extensive sloughing out of scrotal skin two of the cases were in shock and were resuscitated with IV fluids and broad spectrum antibiotics.

There was good recovery in majority of patients admitted with Fournier's gangrene. Two patients were died due to spreading cellulitis of anterior abdominal wall and upper part of both thigh which causes septicemia and ultimately leads to death of patient despite of extensive debridement and aggressive resuscitation with IV fluids, blood transfusion and broad spectrum antibiotics. One of them was died after 5th day of admission whereas second patient was died after 7th day of admission.

TABLE – 9 Mortality in cases of Fournier's gangrene.

Status of patients	No. of patients	Percentage of total
Recovery	43	95.56
Death	02	04.44

Out of 45 patients 20 were recovered with conservative treatment. Secondary suturing was done in 12 patients. Partial thickness skin grafting was done in 08 patients, whereas in 03 patients both testicles were transposed in thigh after making pockets. 02 patients were died.

TABLE – 10 Treatment modalities in 43 cases of Fournier's gangrene

Treatment modalities	No. of patients	Percentage of total
Conservative with antibiotics and debridement	20	44.44
Secondary suturing	12	26.67
Partial thickness skin graft	08	17.78
Transposition of testicles in thigh	03	06.67

Two patients were died.

TABLE – 11 Time relationship of various events

Events	Range	Average duration
Appearance of gangrene after onset of illness	1-7 days	3.8 days
Disappearance of systemic symptoms after institution of treatment	2-8 days	3.4 days
Duration of hospital stay	16-30 days	22.6 days

Average duration of systemic toxic symptoms after primary wound excision and debridement was 3.4 days.

Patients were usually discharged within three weeks exception were 5 of which 3 took about a month to be discharged and 2 were died. None of the discharged patient has reported back with any sexual or functional problems.

Discussion

Since the first description of idiopathic gangrene of scrotum by John Adolf Fournier in 1883, as a separate disease entity, the disorder was considered as idiopathic for long. Many authors reporting the cases from time to time focused their attention to identification of a specific cause for lesion. But specific causes were identified in very less number of cases in early part of this century and number of idiopathic cases remained high (Table-A).

Table A:- Percentage of idiopathic cases of Fournier's Gangrene (1920-1960).

Author	Year	No. of cases	Idiopathic (%)	Cause known (%)
Randall	1920	16	10 (63%)	6 (37%)
Mair	1945	240	115 (48%)	125 (52%)
Thomas	1960	-	(66%)	(33%)

But the scenario changed gradually and gradually. More and more authors reporting the cases were able to identify a causative lesion in and around scrotum for initiation of rapidly progressing gangrenous process in majority of

cases. More recently Enriquez et al in 1987 found only 2 idiopathic cases out of their 2% cases whereas no idiopathic cases was found by Fahal and Hassan (1988) in a small series of 8 cases. Wolach et al found only 2 idiopathic cases in their series of 10 cases. During a 100 year period, only 26% cases were idiopathic as reported by Stephens et al in 1993. Similarly, in our present study only 12out of 45 cases were idiopathic i.e. no cause directly responsible for causation of gangrene were identified (Table-B).

Table - B

Author	Year	No. of cases	Idiopathic (%)	Cause known (%)
Enriquez et al	1987	28	2(7%)	26(93%)
Fahal & Hassan	1988	09	-	9(100%)
Wolach et al	1989	10	2(20%)	8(80%)
Stephens et al	1993	100 year review	(26%)	(74%)
Present study	2010	45	12(26.7%)	33(73.3%)

Fournier's gangrene was recognized as a separate disease entitled more than 100 years ago but exact etiology of disease is still unknown. Many theories were proposed but most were unable to explain the various clinical and laboratory aspect of disease.

Campbell (1922) after isolating streptococcus from four out of his five cases, concluded that Fournier's gangrene is a erysipelas of scrotum. But the observations of other authors and also ours in present study do not correlate with Campbell's conclusion. The gangrenous lesion neither have the raised spreading edge, characteristic of erysipelas nor the response to antibiotic treatment is dramatic as seen in erysipelas. The seven of our cases who were admitted before the occurrence of gangrene, the occurrence and extent of gangrene were not prevented in spite of broad spectrum antibiotic coverage.

Gibson (1930) postulated that the condition is a type of gas gangrene does not find support in literature. Most of the authors were unable to isolate gas forming organisms from the lesion. Although we observed systemic toxemia in at least 20 out of our 45 cases, the degree was not so severe as observed in gas gangrene. Only 5 of our patients experienced severe toxic symptoms leading to haemodynamic instability, that too responded favourably on usual line of management but unfortunately 2 patients were died later. Again, we were unable to detect presence of gas within scrotum in our case.

The rapidity of onset and development of gangrene observed by various authors and by us can only be explained on the basis of vascular origin. Mansfield's hypothesis that the disease is a vascular disaster of infective origin, analogous to cavernous sinus thrombosis is able to explain the suddenness of onset of Fournier's gangrene. Mansfield again commented that the infection does not have any specificity other than existence of a pathogenic organism, which causes rapid thrombosis in vessels supplying scrotum. Various authors have supported this hypothesis. We visualized thrombosed vessels during primary wound debridement.

Various authors observed a constant pattern of involvement in Fournier's gangrene. We also observed three patterns of involvement. The fairly constant area of involvement in majority of cases reported by others and also observed by us can only be explained on basis of infective thrombosis of some or all vessels supplying the scrotum, namely the scrotal branches of internal pudendal artery and the superficial and deep external pudendal branches of femoral artery. Involvement of undersurface of penis reported by various authors, although not observed in our present series, can be explained by extension of thrombosis to scrotal branches of the internal pudendal artery which supply the undersurface of penis and anastomose with the dorsal arteries of penis. A characteristic feature of Fournier's gangrene is that testis is never involved in gangrenous process. This also supports the vascular theory because testis is supplied by separate artery.

The causation of thrombosis is somewhat more obscure. It is agreed that entry of microorganism is the initiation

point of the events leading to explosive gangrene. Organisms once within the fatty tissues, produce a violent inflammation and induce obliterativeendarteritis in a small vessels supplying the skin. Thrombosed vessels were clearly seen in most of our patients during initial wound excision. Looseness of scrotal tissue and decreased resistance of scrotal tissue to infection may account for rapid development of severe scrotal oedema. The rich blood supply of skin with very good collateral circulation allows preservation of skin even when gangrenous process has widely spread in the subcutaneous tissue. This was observed in five of our cases following an operation for hydrocoele. Clinically the gangrene was confined to a small area along suture line of scrotal incision but after opening the wound a large area of necrotic subcutaneous tissue was observed. Most of the authors focused their attention to identification of an infective lesion on or around the scrotum or a portal of entry for microorganism. The cases, in which such type of lesions was found, were described as cases with known specific cause. Percentage of cases with known specific cause is increasing day by day. We were able to find such a cause in 36 out of 45 cases. Most commonly identified causes are – anorectal infections, genitourinary lesions, surgery, trauma, immunosuppression, and diabetes mellitus. Among them the most common cause is anorectal infection responsible for 50% of case reported by Enriquez et al and Fahal and Hassan. 30% of cases of Wolach were also due to anorectal infections. But in our series anorectal infections were responsible for only 8 out of 45 cases. A urinary lesion is the second most common cause of Fournier's gangrene in most of the series and responsible for 1 case in our series. Most common cause identified in our series was minor trauma like cuts and scratch on scrotum which represent small number of cases in most of the series (Table-C).

Table-C

Author and Year	No. of Cases	Causes		
		Anorectal	Urinary	Others
Enriquez et al, 1987	28	14	10	02
Fahal and Hassan, 1988	09	05	03	01
Wolach et al, 1989	10	03	03	02
Stephens et al, 1993	100 year review	33%	21%	20%
Present study	45	08	01	12

Cases with unknown cause are not shown.

Surgery and trauma on or around scrotum provides a portal of entry for microorganisms. In addition surgery puts some degree of stress on patients. These factors predispose the person to infection. But it is unclear that in spite of having significant numbers of cases of wound infection in our practice, cases of Fournier's gangrene are reported rarely. Similarly we routinely encounter infective lesions like anorectal abscess, periurethral abscess, traumatic catheterization of urethra and many other described as causative factors for Fournier's gangrene, the disease is one of the rarity of surgical practice. In order to explain why some patients with source of infection around scrotum developed Fournier's gangrene, while majority does not, various author described various predisposing factors leading to decreased resistance of body to infection. Several of them were also identified by us in our study. But only few of them like poor general health can be directly held responsible for such degree of decreased resistance. Majority of our patient were in good health at time of appearance of gangrene.

Predisposing factors for Fournier's gangrene described in literature:

Lower socioeconomic group (Campbell, 1992),Generalized debilitating conditions,State of uncleanliness (Thomas, 1956),Diabetes mellitus,Immunosuppression by cytotoxic drugs,Alcohol abuse (Joo and Peter, 1985)

Campbell (1922) observed that the disease is only encountered in persons of lower socioeconomic group and with poor personal hygiene. Thomas (1956) observed a

relationship between uncleanliness and Fournier's gangrene. Our present observation supports this concept because about 70% of our patients were having poor personal hygiene. A state of uncleanliness may promote the colonization of pathogenic organism around scrotum. Presence of moisture along the crease of thigh and over the scrotum may be a contributing factor.

Diabetes mellitus has long been recognized as predisposing factor. But it has been identified in very few cases by various authors. In general diabetes mellitus decreases the immunocompetence of the affected person, if poorly controlled. The incidence of infection is not more in diabetics in comparison to general population, but if it occurs, it tends to be more severe and extensive due to impaired leucocyte function (Forton, 1994). These factors may predispose a person for Fournier's gangrene. Gangrene is not uncommon in diabetes but it is usually due to microangiopathic atherosclerosis. It usually affects the foot and is usually not explosive. Because of these reasons, diabetes does not seem to be one of the important predisposing factors. This may account for lower percentage diabetes in most of the series including our present series.

Increasing reports of Fournier's gangrene occurring in patients with much diminished immunity due to debilitating conditions and cytotoxic therapy may support the hypothesis of decreased immunity responsible for rapid spread of infection in loose aereolar tissue of scrotum, leading to microthrombosis and gangrene.

The bacteriology of the condition reported in literature and observed by us in this study may throw some light on causation of thrombosis leading to vascular disaster of Fournier's gangrene. Most the authors have reported a mixed bacteriology. Fifteen cases of Gibson were due to streptococcus and one each to B. coli, B. fusiformis and Cl. Welchi. Campbell reported eleven different organisms in 56 cases of Fournier's gangrene reviewed by him (Table-D). Other authors reported even more varied pictures.

In our study, most common organism cultured was streptococcus either alone or in combination with other organisms. Pure culture of streptococcus was obtained in 11 cases. The bacteriological picture in our study is also similar to reported by others. But none of these organisms are capable of producing such extensive gangrene either alone or in different combinations.

Table–D: Bacteriological analyses in 56 cases of Fournier's gangrene.

Organisms Isolated	No. of cases
Streptococcus haemolyticus	32
Staph. aureus	02
Streptococcus + Staphylococcus	07
B. coli	01
Anaerobic streptococci	01
B. proteus	01
Unspecified Gram positive bacilli	01
Clostridium group	03
Cl. welchi + others	02
Others	06

Adopted from Campbell J.C, Fournier's gangrene in British Journal of surgery, 22; 106-113: 1955.

Meleny's (1931) concept of synergistic bacterial dermal gangrene may explain the pathogenesis of Fournier's gangrene in some respect. Meleny's postulation that gangrene of skin and subcutaneous tissue may occur following surgery or trauma, if the wound is colonized by staphylococci and an aerobic microaerophilic streptococci find some support. The most common combinations of organisms isolated by various authors like Campbell and in our present study is of streptococci and staphylococci. Although in majority of cases only streptococci has been isolated. This may be due to inadequate attention to isolation of organisms in mixed flora. A more detailed bacteriological study is required to settle this issue. Whether it is a specific combination of microorganisms or a combination of decreased host resistance and highly pathogenic microorganisms responsible for initiation of

gangrenous process is unclear at present. Bacteriological studies are insufficient to support or refute one or other hypothesis.

At our present state of knowledge, it is difficult to explain the rare occurrence of this infective type of gangrene, admits presence of so much infective foci in and around scrotum in general population.

Fournier's gangrene may be a variant of necrotizing fasciitis, which results in extensive destruction of soft tissue and is of infective origin. The condition is rapid in onset and is usually associated with severe systemic toxic symptoms. Necrotizing fasciitis is relatively rare despite of presence of so much infective soft tissue infections. Most common organisms responsible for necrotizing fasciitis are clostridium group and anaerobic bacteria but streptococcal necrotizing fasciitis do occur in fair number, although the incidence of such lesion is decreasing in recent past like Fournier's gangrene. Necrotizing fasciitis responds favourably with surgical wound debridement and supportive measures.

Korhaen et al (1998) have studied the role of hyperbaric oxygen therapy along with surgical debridement and broad spectrum antibiotics. This pointed out the role of hyperbaric oxygen therapy beneficial.

Campbell (1955) advocated that operation should be done earliest to provide relief of tension in the tissue space and to resume all sloughing tissue. Slough should be excised with a wide margin of inflamed tissue. The line of incision should pass through but not beyond the area of erythema.

Stevens (1998) reported role of clindamycin in the disease is fruitful.

Cawley (1999) reported the role of IVIG (immunoglobulin) in cases associated with sepsis syndrome.

Hejase et al (1996) reported the role of hydrogen peroxide as beneficial agent as it releases nascent oxygen which helps in destroying the anaerobic organisms.

Efess (1993) and Dunford (2000) reported about use of natural unprocessed honey. It has an impressive acceleration of healing process. In our study, our institution do not have facility of hyperbaric oxygen therapy, hence no trail has been done on this regard.

In spite of so much controversy over aetiopathogenetic mechanism of disease, there is little controversy over management. Surgery is still the mainstay of treatment as was the days of Fournier. All necrotic tissue should be excised deliberately to get patient rid of part irreversibly lost. Excision should provide free possible drainage. We found irrigation of wound with hydrogen peroxide very useful. Toileting with normal saline, application of EC or oxum or papain urea or ampicure (a natural product) has definite role. Antibiotics should be given as per the culture report.

Rapid regeneration of skin and subcutaneous tissue after sloughing of the gangrenous part is not specific to the disease process. This is general regenerative response of tissue after any trauma. Spontaneous closure of wound may occur but it may produce immobility of testis. Campbell suggested that secondary suture is the best method of closure of wound. We were able to provide adequate coverage to raw area and testicle by secondary suture in 12 out of 45 cases.

Split thickness skin grafting is the usual method recommended in cases where there is extensive loss of skin. We have done skin grafting in 8 out of 45 cases. We decided transpose both testicles in thigh in 3 out of 45 cases. Rest 20 patients improved conservatively with antibiotic therapy and antiseptic dressing. Unfortunately 2 patients were died.

Only occasionally complex plastic operations are needed the facility of which is not available at our institution.

Conclusion

50 cases of Fournier's gangrene were admitted in indoor surgical ward of Department of Surgery in Rajendra

Institute of Medical Sciences, Ranchi were studied regarding their clinical feature, duration, onset, course, pathogenesis, management and final outcome.

The study was carried out between July 2010 to October 2012. 45 male patients in our study were in the range of 25-80 years of age. Majority were in 5^{th} or 6^{th} decades of life. Most of them were from rural background from lower socioeconomic group and had poor personal hygiene. Quite a few of them were still idiopathic in that no definite cause could be found. In those in whom a definite cause could be found some form of trauma was present in most of them. Other conditions which were associated were anorectal abscess drainage and previous operation like Jaboulay's operation. The onset was sudden in almost all cases and rapid progression to gangrene varied in different cases. Involvement of tissue were limited to skin and subcutaneous tissue, although involvement varied from small area over anterior aspect of scrotum to whole of the scrotal skin and subcutaneous tissue.

Clinical findings were common which were anaemia, leucocytosis, foetidodour, malaise, body ache.

Surgical and other valuable measure undertaken in our study have been discussed in detail. 2 of the 45 patients were died.

From extensive review of literature and observation made in the present study it can be concluded that:

Fournier's gangrene is a vascular disaster of infective origin, leading to rapid and extensive gangrene of scrotum, undersurface of penis and neighbouring area sometimes.

The disaster is results of thrombosis of vessels supplying the skin and subcutaneous tissue.

Thrombosis is caused by infective organisms in the tissue, leading to obliterative endarteritis of vessels supplying the skin and subcutaneous tissue.

Bacteriological picture is varied and inconclusive. Streptococci are isolated in majority of cases either alone or in various combinations. All the organisms isolated from lesion are incapable of producing an extensive lesion on its own.

Exact bacteriological event leading to thrombosis and rarity of disease, in spite of various infective lesions present on or around scrotum at any time is difficult to explain.

Hypothesis of progressive synergistic bacterial gangrene (Meleny, 1931) may explain the causation of lesion.

The gangrene process may be a variant of Necrotizing fasciitis, in which there is extensive necrosis of skin and subcutaneous tissue up to deep fascia, usually following infection (Tehrani, 1975).

Looseness of scrotal skin and low resistance of scrotal tissue to infection is responsible for rapid and extensive involvement of tissue in gangrenous process.

The so called 'Idiopathic' condition is no longer idiopathic. A predisposing factor and portal of entry of microorganism is always present, although it may be undetectable in some cases.

Surgical excision and debridement of wound with adjuvant therapy with antibiotics is mainstay of treatment. Specialised procedures like urinary and faecal diversion and hyperbaric oxygen therapy may be of value in some selected cases. Primary excision and suture is also really valuable in some cases.

Early recognition of condition and aggressive surgical and medical approach is recommended to improve the outcome in this rare but serious disorder.

We are unable to put forward any hypothesis from our own observations, which may explain every aspect of causation of thrombosis leading to gangrene. But the concept of progressive synergistic bacterial gangrene of Meleny (1931) and its similarity to necrotising fasciitis appears to explain most of the aspect of this rare disease entity. The subject needs further observation and evaluation.

Death may occur in cases of Fournier's gangrene if patient is neglected and presents very late for the treatment.

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