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RESEARCH ARTICLE

A STUDY OF CLINICAL PROFILE AND OUTCOME OF PATIENTS SUFFERING FROM NECROTIZING SOFT TISSUE INFECTION

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Abstract

Necrotizing fasciitis (NF) is a rare but dangerous soft tissue necrosis that frequently affects fascia and subcutaneous tissues and has a high hospital mortality rate. The term "necrotizing soft tissue infections" includes a wide variety of bacterial and fungal skin conditions. The location, depth, and extent of the infection are all considered when describing the condition. Necrotizing soft tissue infections can result in substantial local tissue loss, tissue necrosis, systemic toxicity, and even mortality, depending on the degree of invasion. Despite improvements in surgery and the development of antibiotics, necrotizing soft tissue infections are known to have fatality rates that range from 6 percent to up to 76 percent. The goals of the current study are to: Understand the clinical characteristics of patients who present with NSTI; early diagnosis by imaging; study the microbial flora, antibiotic therapy; and observe the clinical effects of the debridement.

Introduction:-

Hippocrates wrote that NSTI is a side effect of early streptococcal infection "When the exciting cause a minor mishap, many people were affected by erysipelas all over the body; enormous amounts of flesh, sinews, and bones broke away; there were many fatalities." Since Hippocrates, NF has been a recognised clinical entity, but during the past 30 years, its awareness and knowledge have progressively grown (1)(2). Leonard Gillespie, a British surgeon, Gilbert Blaine, a British doctor, and Thomas Trotter provided the first description of NSTIs in English in the late 18th century (3). In 1796, Baurienne was the first to describe a vaginal and perineal necrotizing infection (4)(5). After a series of five male victims were submitted to the French dermatologist and venereologist Jean Alfred Fournier in 1883 to 1884, it became known as Fournier's gangrene (4)(6). Brewer and Meleney documented an uncommon postoperative infection in 1926 that was superficial and gradually progressed into necrotizing symptoms, which they attributed to hemolytic staphylococcus aureus and microaerophilic, non-hemolytic Streptococcus (4). After that, in 1988, Davson et al claimed that skin-related amebiasis may be the contributing factor to the gangrene Brewer and Meleney's had described (4)(7).

Each class of NSTI has a unique microbiological flora, as well as significant potential variations in patient populations despite similar presentations. There are no discernible changes between patient groups in terms of hospitalization patterns, morbidity, or mortality (8)(9).

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Gram-positive cocci, gram-negative rods, and anaerobes, including clostridial species, are frequently isolated in polymicrobial or **Type-I infection**. The trunk and perineum are the anatomical regions that are most frequently visible. The majority of patients with type-I NSTIs are older and have more medical conditions, like diabetes (4)(8). In type-I NSTIs, gas gangrene, which is primarily caused by Clostridial infections, presumably represents the subtype of NSTI that was first reported and is most firmly linked to the antecedent disease (9)(10).

Two main toxins, α-toxin and Θ-toxin, are regarded to be most in charge of their fatal activity. α-Toxin works as a strong platelet agonist in the early stages, which causes platelet aggregation and thrombi development. This results in local ischemia circumstances at the infection site, which lower tissue Hand provide an environment that is conducive for bacterial growth (9)(10). Locally absorbed α-toxin, which also contributes to neutrophil dysfunction by interfering with diapedesis indirectly through platelet adhesion to neutrophils, causes neutrophil dysfunction. This causes the fluid recovered from clostridial wounds to have a paucity or complete lack of neutrophils on Gram-stain (9)(10). Both toxins are absorbed systemically as the infection progresses, impairing phagocytic function, causing intravascular hemolysis, decreasing endothelial cell integrity, stifling cardiac performance, and significantly lowering vascular tone. The quick onset of acute pain, often out of proportion to initial clinical evaluation, is a common symptom of clostridial infections (9)(10).

On drainage, there is the presence of a thin, pungent serosanguinous fluid. Although not always apparent, woody induration of adjacent tissue with accompanying tissue crepitus gas production is also typically described (9)(10). Sepsis and bacterial load often develop late and have poor prognosis with high mortality (9)(10).

Group A-hemolytic streptococci (GAS), either alone or in conjunction with staphylococcal species, are the most common cause of **type-II infections** (9)(10). Patients with type II infections are typically younger, healthier, and have a history of trauma, surgery, or IV medication use compared to those with type-I NSTIs. GAS infections become hazardous as a result of numerous microbial processes (9)(10). The catastrophic shock frequently observed with NSTIs caused by GAS is brought on by the activation of this inflammatory cascade. In addition to harming neutrophils, the GAS species also breaks down hyaluronic acid in connective tissues and prevents phagocytosis and bacterial reduction by fluid discharges (9)(10).

MRSA has apparently been identified as a single microbiological cause of NSTI for the previous ten years. This community associated MRSAcauses15% of NSTI in some communities (4)(7).

Type-III NSTIs are most frequently caused by the gram-negative marine bacterium Vibrio vulnificus. Type-III infections are more common in warm-water coastal regions of the Southeast United States, Central and South America, and Asia, while not being as well known as a class of NSTI as types-I and II (10).

Fungal NF cases are classified as **Type-IV**. Despite being the most common organism, Candida is none the less extremely uncommon. Patients with burns and traumatic wounds are especially at risk for fungal invasion, as are those with significant immunosuppression (9). Zygomycosis, more commonly known as mucormycosis, is a potentially fatal source of NSTI while being rarely observed. The ubiquitous zvgomycete fungus is primarily found in soil, manure, plants, and decomposing matter (9).

Since the more superficial layers (dermis and epidermis) are unaffected at first, NSTI starts in the hypodermis or superficial fascia (2)(11). The development of NF is thought to be caused by the interaction between the virulence factors of the bacteria and the unique components of the host (2)(12). Anaerobic bacteria can grow more readily in an anaerobic environment. Bacterial enzymes that break down the fascia and fat directly contribute to hypodermis and superficial fascia necrosis (2). The feeding vessels in the hypodermis get thrombosed as a result of invasive bacteria, which causes tissue ischemia that is made worse by edema. Tissue ischemia encourages the spread of pathogenic agents, which later results in skin necrosis. Additionally, it explains the phenomenon of extreme pain, particularly when the nerve branches are also impacted. Such instances also exhibit regional anesthesia or hypoesthesia. Due to vascular thrombosis, lymphangitis and lymphadenopathy are uncommon conditions. Crepitus can result from anaerobic bacterial gas (13)(14). An untrained surgeon may fail to make the proper diagnosis of the disease, which spreads beneath the skin and along the subcutaneous plane, due to the absence of changes over the skin that indicate the infection's extent. Within the first day following exposure, MODS might manifest in severe cases of fulminating Necrotizing Fasciitis (15).

NSTI is a hurdle for the surgeon. The clinical manifestations of tissue inflammation, such as "rubor, dolor, color, tumour, and loss of function," are absent in NSTI (2).

Urogenital, anorectal, and cutaneous disorders are catalysts for the development of Fournier's gangrene (2)(16)(17). Pain and/or itching of the perineum and/or scrotal skin are the primary initial symptoms of Fournier's gangrene (12)(14). Additionally, there is necrosis of the superficial fascia and fat, which results in crepitus and the formation of thin, watery, malodorous fluid. Crepitus is typically linked to polymicrobial infections, such as those caused by Enterobacteriaceae and Clostridiae spp. Systemic inflammatory response syndrome patients typically exhibit high temperature, stress, aberrant sensorium, leukocytosis, shock, and breathing difficulties. The LRINEC score is particularly helpful for diagnosis in all patients where soft tissue infections are suspected (2)(18).

Another crucial diagnostic indicator is the accumulation of gas in the soft tissue, which ispresentin50% of all NSTI cases. In most cases, an X-ray of the afflicted area is preferred. With ultrasound, CT scan, and MRI, additional primary examination results are also evident (2)(12).

Early detection is therefore crucial since it aids in wise decision-making. To quickly diagnose NSTI, cultures are required but take too long. Emergency surgical intervention is necessary in patients who present with septicemia and shock since their disease has already advanced in these cases (19).

The ideal treatment for NSTI is surgical debridement. To examine the fascia and see whether it is adherent to any other soft tissue layers in worrisome cases, a tiny incision is made over the skin and a blunt dissection is performed (9). Presently necrotizing soft tissue infections is still a complicated condition which may also need admission in the ICU (17).

These days the log used for care is: (a) In presence of shock: resuscitation; (b) Proper antimicrobial therapy according to culture. Adequate coverage to be given with antibiotics mainly for polymicrobial infection; (c) Plan for debridement of all necrotic tissue. Sometimes if there is a doubtful condition, diagnosis can be made using HPE analysis. Culture sensitivity of the wound should also be taken from the affected site; (d) If there is poor healing, patient should be planned for repeated debridement till the infection is controlled; (e)Usage of Hyperbaric Oxygen (HBO) therapy for treatment (18).

An experienced surgeon always takes care to make a proper incision. One study has stated that very small incision for debridement have bad results compared to large incision debridement. When extremities are involved and rapidly progressed, amputation may be needed and should be considered when the joint is involved or there is a rapid spread of infection. There is possibility of NSTI to progress rapidly inspite of debridement being done. Second planned surgery if needed should be done within 24 hours in patient. During surgery there are essential signs that are needed to be seen which involved grey color of deep fascia, decreased resistance of normal muscle to blunt dissection ("Finger test"), pale fascia with less blood loss and presence of a dish-water fluid (17)(20). Presently many studies have recommended initial debridement of most of the tissues that are involved and that can be easily raised with gentle pressure.

Materials and Method:-

Hospital based Observational study

Results:-

This is a prospective observational study conducted between 1st January 2021 to 30 June 2022 in the Department of Surgery, of Tertiary care center in Udaipur, Rajasthan. This study was done to study the clinic-pathological profile of patients suffering from NSTI, establish the diagnosis using imaging and further studies, plan and carry out the debridement, observe the patient's clinical progress, and research the microbiological flora and prudent antibiotic therapy.

All patients of all age groups who gave informed consent and came with NSTI or an infection that had characteristics of NSTI were included in the study and were examined. After receiving informed consent, patients were included in the study and the data collection form (and proforma) was filled up with demographic data. The patient's full medical

history was obtained, the management and NSTI outcome were documented, and patients were followed up both during their hospital stay and for three months after.

Table1:- Age wise distribution of patients.

Age (Years)	No. of Patients	Percentage
≤30	5	10.0%
31-40	12	24.0%
41-50	10	20.0%
51-60	10	20.0%
61-70	9	18.0%
>70	4	8.0%
Total	**50**	**100.0%**

Incidence was highest in age group 31-40 years; out of 50 patients 12 patients were present in this group. Overall incidence is noticed to be more in patients >30 years of age.

Table 2:- Gender Wise Distribution.

Gender	No. of Patients	Percentage
Male	43	86.0%
Female	7	14.0%
Total	**50**	**100.0%**

According to sex of the patients, male predominance was present.

Table 3:- Occupation of patients.

	No. of Patients	Percentage
Farmer	24	48.0%
Private Job	6	12.0%
Shopkeeper	6	12.0%
Housewife	5	10.0%
Labourer	5	10.0%
Student	2	4.0%
Vendor	2	4.0%
Total	**50**	**100.0%**

Out of 50 patients, most of the patients were farmers, which included 24 patients; followed by private job and shopkeeper.

Table 4:- History of Trauma.

History of Trauma	No. of Patients	Percentage
None	18	36.0%
Yes	32	64.0%
Total	**50**	**100.0%**

Out of 50, 32 patients had history of trauma.

Table 5:- Site of infection.

Site of infection	No. of Patients (n=50)	Percentage
Extremity	46	92.0%
Perineum	2	4.0%
Others	2	4.0%

Most of patients (46 patients) have infection over extremities (lower limb > upper limb). Only 2 patients had infection over perineum while out of rest 2 patients, 1 patient had infection over gluteal region alone while other had over chest.

Table 6:- History of Diabetes.

Known Diabetic	No. of Patients	Percentage
No	37	74.0%
Yes	13	26.0%

Total	**50**	**100.0%**

Out of 50, 13 patients were a known case of Diabetes Mellitus Type II. All of them were on long term medication. Only 2 patients were on irregular medication.

Table 7:- H/O long term medication and/or comorbidity (including diabetes).

	No. of Patients	Percentage
Co-Morbidity	26	52.0%
NoCo-morbidity	24	48.0%

Out of 50, 26 patients have co-morbid conditions and were on medication for the same. 24 patients did not have any other disease.

Table 8:- Types of Co-Morbidities.

	No. of Patients (n=26)	Percentage
Anti-Hypertensive	4	15.4%
Anti-Platelet	1	3.8%
ATT	3	11.5%
Dialysis	1	3.8%
Oral-Hypoglycemic	13	50.0%
Bronchodilators	1	3.8%
Thyroxine	3	11.5%
Total	26	100.0%

Of the 26 patients, 13 patients were on oral hypoglycaemic agents, followed by 4 patients on Anti-hypertensives. One of my patient had renal failure and was on dialysis.

Table 9:- Duration of Spread.

Duration of Spread	No. of Patients	Percentage
0-3Days	12	24.0%
4-7Days	19	38.0%
8-14Days	7	14.0%
>14Days	12	24.0%
Total	**50**	**100.0%**

Out of 50, most common duration of spread was 4-7 days, seen in 19 patients, followed by 0-3 days and >14 days in 12 and 12 patients respectively.

Table 10:- Organ failure assessment score.

qSOFA Score	No. of Patients	Percentage
0Score	46	92.0%
1Score	4	8.0%
Total	**50**	**100.0%**

Out of 50, 4 patients were in (developed) shock during the time of presentation, with sepsis and were admitted directly in the ICU.

Table 11:- Requirement of Surgery.

Required Surgery	No. of Patients	Percentage
No	11	22.0%
Yes	39	78.0%
Total	**50**	**100.0%**

Out of 50, 39 patients required surgery/debridement under Anaesthesia (General/regional). Although, all these 39 patients and 2 out of the rest 11 patients and had minor debridement (without anaesthesia during dressing) & daily dressings.

Rest 9 patients had only conservative management which included dressing and antibiotics (cellulitis cases).

Table 12:- Micro bacterial growth.

	No. of Patients	Percentage
Klebsiella	20	40.0%
E. Coli	20	40.0%
Pseudomonas	6	12.0%
No Growth	4	8.0%
Proteus Mirabilis	1	2.0%
Streptococcus	1	2.0%
MRSA	1	2.0%
Fungal Growth	1	2.0%
Citrobacter	1	2.0%
Sample not cultured/Inadequate for culture	2	4.0%

Amongst 50 patients, Klebsiella and E. coli was the most common. 9 out of 50 patients had mixed (polymicrobial growth).

Table 13:- Wound Culture.

Wound Culture Growth	No. of Patients (n=50)	Percentage
Monomicrobial	39	78.0%
Polymicrobial	9	18.0%
Nogrowth	2	4.0%

In this study, 39 cases out of 50 had monomicrobial growth on culture, 9 had polymicrobial while 2 had no growth.

Table 14:- Duration of Recovery.

Duration of Recovery	No. of Patients	Percentage
0-3Days	2	4.0%
4-7Days	21	42.0%
8-14Days	12	24.0%
>14Days	10	20.0%
Died	4	8.0%
LAMA	1	2.0%
Total	**50**	**100.0%**

Most of the patients recovered in 4-7 days (21 patients out of 50). Approximately 70% of patients recovered within 14 days.

Table 15:- Need for ICU.

Need For ICU	No. of Patients	Percentage
No	38	76.0%
Yes	12	24.0%
Total	**50**	**100.0%**

Amongst 50 patients, 12 patients needed ICU care during their hospital stay.

Table 16:- Need of Re-debridement.

Re-Debridement	No. of Patients	Percentage
No	40	80.0%
Multiple	10	20.0%
Total	**50**	**100.0%**

Out of 50 patients, multiple debridement (under general/regional anaesthesia) was done in 10 patients.

Table 17:- Need of Amputation.

Amputation	No. of Patients	Percentage
Yes	3	6.0%
No	47	94.0%
Total	**50**	**100.0%**

Amongst 50, only 3 patients required amputation.

Table 18:- Need of Coverage.

Need for Coverage	No. of Patients	Percentage
No	39	78.0%
Yes	11	22.0%
Total	**50**	**100.0%**

Total of 11 patients out of 50 patients required coverage of their debrided part.

Table 19:- Types of Coverage.

Coverage If Any	No. of Patients (n=11)	Percentage
SSG	5	45.5%
Fillet Flap + SSG	1	9.1%
Flap	1	9.1%
Multiple	3	27.3%
Sec. Suturing	1	9.1%

Of the total of 11 patients out of 50 patients who required coverage of their debrided part, coverage was done with SSG alone in 5 patients. One patient required flap and SSG both.3 patients out of 11 patients required multiple sittings for coverage due to graft loss. There was one patient in whom coverage was done with secondary suturing during follow up.

Table 20:- Duration of Hospital Stay.

Duration of Hospital Stay	No. of Patients	Percentage
1-10Days	32	64.0%
11-20Days	13	26.0%
21-30Days	4	8.0%
>30Days	1	2.0%
Total	**50**	**100.0%**

Most of the patients were discharged before 10 days (32 patients), while 13 patients had hospital stay of 11-20 days.

Table 21:- Anti Microbial Therapy of Patients.

Anti Microbial Therapy	No. of Patients	Percentage
Piperacillin and Tazobactam	35	70.0%
Amikacin	26	52.0%
Metronidazole	27	54.0%
Levofloxacin	13	26.0%
Clindamycin	12	24.0%
Meropenem	10	20.0%
Amoxiclav	4	8.0%
Feropenem	3	6.0%
Linezolid	2	4.0%
Gentamycin	2	4.0%
Fluconazole	2	4.0%
Colistin	1	2.0%
Ceftazidime	1	2.0%
Ceftriaxone	1	2.0%
Cefuroxime	1	2.0%
Tobramycin	1	2.0%
Ofloxacin	1	2.0%

Almost all of the patients were given polymicrobial therapy, with maximum number of patients being sensitive to Piperacillin and Tazobactam (35 patients). Broad spectrum antibiotics were preferred over narrow spectrum.

Table 22:- LRINEC score calculated on 1st day of hospital admission.

LRINEC Score	No. of Patients	Percentage
Low Risk (Score≤5)	45	90.0%

Intermediate Risk (Score6-7)	4	8.0%
High Risk (Score≥8)	1	2.0%
Total	**50**	**100.0%**

45 patients out of 50 had LRINEC score ≤5, thus vast majority of my patients were in low risk.
One patient who had LRINEC score >8, died within 5 days of hospital admission.

Table 23:- Final Diagnosis.

Final Diagnosis		**No. of Patients (n=50)**	**Percentage**
Cellulitis		12	24%
Necrotizing Soft Tissue	Necrotizing fasciitis	27	54%
	Gangrene +Necrotizing Fasciitis	5	10%
	Fournier Gangrene	2	4%
Cellulitis with Necrotizing fasciitis		4	8%
Total		**50**	**100%**

Amongst 50 patients, 38 patients had NSTI, with majority having necrotizing Fasciitis alone (27 patients), while 5 patients had NF along with gangrene. 2 patients had only Fournier's Gangrene.12 patients out of 50 had cellulitis alone. And 4 had severe proximal cellulitis with NF.

Table 24:- Follow up of 3 months.

Follow up	**No. of Patients (n=50)**	**Percentage**
No recurrence	39	78.0%
Lost of Follow-up/Died	8	16.0%
Required further treatment on follow up	3	6.0%
Total	**50**	**100.0%**

Apart from 4 patients who died and 4 patients who were lost to follow up, there were 39 patients who recovered well and had no recurrence in follow up period.
3 patients required treatment on follow up, 2 required debridement followed by coverage and one required secondary suturing.

Clinical Pictures

Figure 1:- Clinical pictures of patient having necrotizing fasciitis of right upper limb.

Necrotizing fasciitis of right upper limb

Figure 2:- Clinical pictures of patient having necrotizing fasciitis of gluteal region.

Pre- and Intra-Operative picture of NF of gluteal region

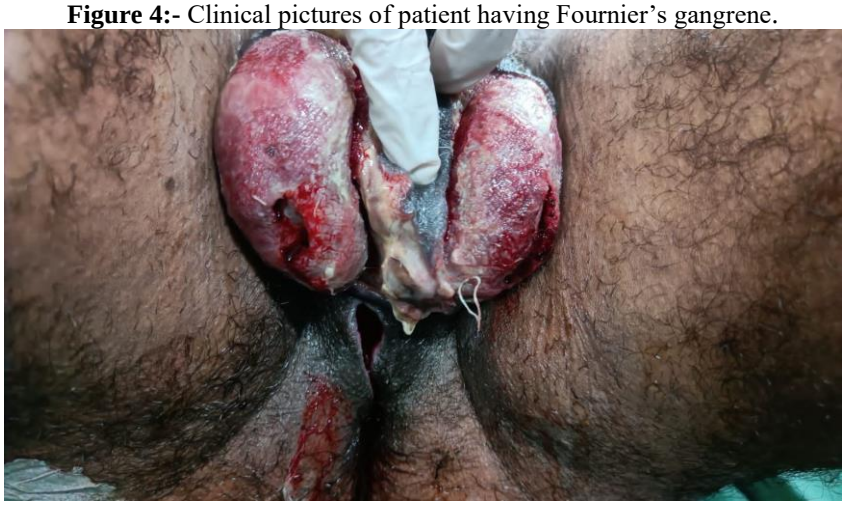
Post-operative day 4 and Follow-up picture on post-op day 30

Figure 3:- Clinical pictures of patient having necrotizing fasciitis of left lower limb.

Pre- and intra-operative pictures of NF of lower limb

NF of left foot

Figure 4:- Clinical pictures of patient having Fournier's gangrene.



Fournier's gangrene

Post-operative and follow up picture of Fournier's gangrene when secondary suturing was done.

Figure 5:- Clinical pictures of patient having lower limb cellulitis.

Lower limb cellulitis with blebs

SUMAG dressing for cellulitis

Figure 6:- Clinical pictures of patient having bilateral lower limb necrotizing fasciitis.

NF of bilateral lower limb with gangrenous toes

Post amputation and SSG grafting

VAC therapy

Regrafting of SSG at places of graft loss.

Discussion:-

This is a prospective observational study conducted between 1st January 2021 to 30th June 2022 in the Department of Surgery at Tertiary care center, Udaipur, Rajasthan. This study was done to study the clinico-pathological profile of patients presenting as NSTI or with infection similar to NSTI, and the confirmation of the diagnosis using imaging

and adjunct investigations was made. LRINEC and qSOFA score were calculated. We also assessed the microbiological flora, administered sensible antibiotic therapy, assessed the need for surgery and noted the patient's clinical progress.

The study included and examined all patients of all age groups who were diagnosed with NSTI or an infection that was comparable to NSTI and provided written informed permission. After receiving informed consent, the demographic data was entered on to the proforma and data collecting form. A thorough history was gathered, and during the patient's hospital stay and for up to three months later, the management and NSTI outcome were documented and followed up on.

In our study, 12 patients (24%) who were in the age range of 31 to 40 years made up the majority of the patients, overall approximately 90% of patients presenting with NSTI and related infections were >30 years old. However, Incidence was less in patients in the age range of less than 30 years (10%) and more than 70 years (8%). Mean age in my study group is 48.84 (~49) years. According to the sex of the patients, male predominance was seen with 86% cases. In a study by Hari Krishnan CP, In this study, 75 participants with NSTIs were enrolled, with the age range of the majority being between 41 and 60. More than 50% of patients were between the ages of 40 and 60, and both the lower and upper age groups of this range are equally affected by the disease. Patients are 55 years old on average (21). In another study by M Nischal, significant incidental age of the disease was48 years and was seen mainly in farmers (22). In a study by Nissar Sheikh, the whole sample size was of three hundred and thirty-one cases of necrotizing fasciitis, with significant age of 51 ± 15 and ratio between males and females was 3:1 which was suggestive of a possibility of a more male involvement (74.3%) that was similar to our study (23). In another study by Liao et al, the average age was 61.2 years which is higher compared to other study, but male predominance was present which is similar to our study (24). In study by Pauline Kha, where it was noticed in forty-six males and twenty-one females with a significant age of 54 years (range 44-70 years) (25). Study done by Christopher Mc Henry, a total of thirty-two women and thirty-three men had an age ranging from 15-87 years and the mean age found was fifty years. A study done by Kao LS et al. median age was found to be fifty years in a total of 296 cases (26).

When looking at the patients' occupations, the majority of them (48% of them) were farmers (connected to agriculture), followed by an equal frequency of private job and shops (12%), as well as housewife and labourer (also 10%). According to a research by Nischal et al, almost 66.6% of patients were professionals in agriculture (22). About 64% of the individuals in our study had a history of trauma.

Diabetes, which was present in 36% of patients and was most frequently associated with co-morbidities, was followed by hypertension. Two of these patients had inconsistent medical therapy. According to a study by Hari Krishnan CP, diabetes mellitus, followed by hypertension and peripheral vascular disease, is the most frequent co-morbidity associated with necrotizing soft tissue infections (27). In the current study, trauma was found to be the primary risk factor for NSTI in 26 out of 24 patients, followed by bites in 24 cases, poorly treated pre-existing lesions in 13 cases, and idiopathic in 9 cases (21). In a study done by LS Kao et al. in 50% of the patients no apparent cause of necrotizing soft tissue infection was recognized. In study by Sheikh et al, 43 (13%) cases presented with a previous history of trauma. A total of 5 (1.5%) cases gave a history of administration of IM injection use. Although most of the cases (85.5%) did not give a positive history or any occurrence that would point towards development of necrotizing fasciitis. Very commonly encountered comorbid conditions were diabetes mellitus (51.7%), hypertension (35.6%) and kidney disease (15%) (92). In study by Nischal et al, most commonly encountered threat was diabetes mellitus (type 2) and was reported in twenty-one patients (70%). A total of eight (26.6%) cases had HTN, three (10%) had kidney failure and 2(6.6%) cases had human immunodeficiency virus infection (22). A study by Pauline Kha, pointed out the predisposition of patients who have immunosuppressive therapy to necrotizing infections (n=20, 30%); illnesses leading to immunosuppression (n=33, 49%) which includes T2DM (n=24), malignancy (n=6), and CLD (n=3); and peripheral vascular diseases (n=19;28%). An overall of thirty-five (52%) cases had no comorbidity and eleven (16%) cases had more than one comorbidity (25). In our study, around 48% cases did not have any co-morbidity. Increased age and the diabetic status has been commonly seen as a predisposing condition. Prevalence of diabetes is comparatively more in developing nations due to poor hygienic conditions and low socio-economic status. Due to immunosuppression of the person along with frailty and delaying treatment results in increased severity of the illness. Raised glucose levels in the blood lead to decreased oxygen tension, which ultimately lead to bacteraemia.

In our study, the spread lasted between 4 and 7 days in 38% of the cases, between 0 and 3 days in 24% of the cases, and lasting more than 14 days in 24% of the cases. The average spread lasts 9.12 (~9) days. In a study by Hari Krishnan

et al., 80 patients presented with an intervention delay of greater than three days. Only 2 patients went above the intervention's one-month limit by more than a week or two, or a duration of 4–7 days. The typical patient intervention delay is 10 days (21).

In our study, associated organ failure was in 8% cases (renal failure) and patients were in shock due to sepsis. In study by N sheikh et al, shock due to sepsis was reported in 76(27.8%) cases during hospitalization. Calculated median time for stay in hospital was 16and in ICU was 5.5 (1-75) days. The seriousness of the illness was seen more in men rather than women, though the laboratory parameters were quite similar. Although there was not a huge contrast present in hospital stay, ICU or presence of shock in both the sexes (23).

In our study, 45 patients out of 50 (90% cases) had LRINEC score ≤5, thus vast majorityofmypatientswereinlowriskandhadgoodprognosiswithgoodrecoveryonfollow-up. One patient who had LRINEC score >8, died within 5 days of hospital admission.

In our study, approximately 78% cases required surgery. Patients required various forms of procedures along with debridement, like coverage was required in 22% cases (SSG alone in 45.5% cases, flap + SSG in 9.1% cases, flap alone in 9.1% cases, secondary suturing (2% cases) and Amputations (were required in 6% cases. Around 20% patients required multiple debridement. Of the 3 cases (6%) which had undergone amputation in the study, only one of them was diabetic. One of them had undergone bilateral fore-foot amputation which was followed by SSG and VAC therapy. On follow-up this patient had10% graft loss and regrafting with SSG was done. A study by Nischal et al. found that surgical intervention had a significant figure of 2.5. One above knee and two below-knee amputations were performed in three cases (10%), and diabetes was present in all three patients (22)(27). In a study by HariKrishnan CP, in 93 patients debridement was performed, followed by 14 disarticulations, 10 amputations, and 33 fasciotomies. Out of 75patients, 10 had passed away. 10.3% of men and 28.6% of women experienced it. The 66patients that survived were given a variety of secondary managements, including skin grafts and secondary suturing (21). In a study by Pauline Kha, patients who survived experienced a mean of 5.6 surgical intervention (ranging 2-10 intervention). To control increasing sepsis, amputation was performed on 4 (6%) cases. The hospitalization time and surgery performed was not linked with the risk of amputation (25).

In our investigation, when we evaluated the microbiological flora, we discovered that Klebsiella and E. coli had the highest incidence (40% of both). In18%ofthecases,mixed(polymicrobial) development was seen. In 4% of cases, there was no growth. While a fungus had grown in one case. In our investigation, monomicrobial growth was discovered in 41 patients overall. Escherichia coli (n=21) was a common member of the microbiological flora in the study by Harikrishnan CP. It was either monomicrobial or coupled with other infections, frequently affecting the lower extremity. Pathogens like Escherichia coli were frequently found in both mono-microbial and poly-microbial instances. The majority of Klebsiella isolates are multi-microbial. Reasonably, both mono-microbial and poly-microbial instances involve Staphylococcus aureus (21).

In study by Nischal et al., culture was positive in fifty percent of the cases and were mainly polymicrobial. Commonest pathogens that were isolated are: Pseudomonas (pseudomonas aeruginosa) followed by Staphylococcal species (Staph aureus) and Klebsiella. Increased single organism (mono-microbial) infection was associated with Streptococcus (beta-hemolytic) and Escherichia coli (22).

Depending on the type of treatment received and the surgical operations carried out, about 21 individuals in our study had a recovery duration of 4–7 days, 12 patients had a recovery period of 8–14 days, and approximately 10 patients had a recovery in more than 14 days. Around 24% patients required ICU stay in our study. Average (mean) recovery time in this study was 10.11 (~10) days. In a research by CP Harikrishnan, the average hospital stay (recovery time) was 10 days if symptom onset intervention time was under 3 days, and 1 month if it was between 4 and 7 days. For patients who experienced an intervention delay of 8–14 days, an average hospital stay of 2-4 weeks was required, while 33% required a stay of 1–2 months. Hospital stays for healed patients were 11.55 (~11) days on average (mean). The average hospital stay for recovery was 29–56 days if the usual intervention delay was 15–28 days. The average hospital stay was too long for patients who had amputations, with a wide range for each patient and a minimum in situations of death. In comparison to non-morbid instances, toe disarticulation cases required an additional 6days, while large ulcer cases required an additional 15 days. Due to two early deaths brought on by missed diagnoses of cellulitis rather than life-threatening necrotizing soft tissue infections and the improper selection of narrow spectrum

antibiotics rather than broad spectrum antibiotics, the average recovery period during hospital stays for patients in case of death patients is shorter (21).

Piperacillin-Tazobactam was the most prevalent anti-microbiological medication in our study, according to the culture sensitivity, followed by Metronidazole and Amikacin in54% and 52% of cases, respectively and others drugs like Levofloxacin, Clindamycin, Meropenem, Amoxi-Clav, Feropenem, Linezolid, Gentamycin, Colistin, Tobramycin, Ceftazidime, Ceftriaxone, Cefuroxime, Ofloxacin etc. We preferred giving polymicrobial therapy rather than mono-microbial. Two patients were given anti-fungal Fluconazole as culture was positive for fungal growth. In a study by YHT sai, the initial antibiotic regimen for treating necrotizing fasciitis calls for the use of Clindamycin in conjunction with Imipenem, Meropenem, Ampicillin/Sulbactam, Tigecycline, and Piperacillin/Tazobactam (27).

Outof50,9caseshadtype-I NSTI (18%), 35 cases (70%) had type-II NSTI and 4 patients had type-IV NSTI (including 3 cases of ENT department). None of the case had type-IIINSTI in my study. 35 participants in a research by Kurian GP had type I infection, 37patients had type II infection, and the other patients had no growth on cultures sent for microbiology. Studies on the microbiological aetiology of NSTIs from the Indian subcontinent and the West have produced wildly disparate results (2).

Conclusion:-

This research work is carried out over a period of one and half year prospectively. A total of 50patients were taken in the study. Finally, we state:

1. Males in the middle-aged and senior age groups, particularly those between the ages of 31 and 40, 41 to 50, and 51 to 60, were most frequently affected. Incidence was uncommon inpeopleunder30 and over 70.
2. Most of the patients were those who were in contact with soil, like farmers, and majority had history of trauma.
3. Co-morbidities including diabetes mellitus and hypertension both play a significant effect.
4. It is a terrible surgical emergency that typically lasts nine days, and making the diagnosis is one of the trickiest parts of patient care because it calls for a high degree of suspicion.
5. Renal organ failure is also frequent; if not correctly treated, a patient's admission in the intensive care unit is unavoidable.
6. In our investigation, Klebsiella and E. coli were the most prevalent microbiological flora.
7. In most of the cases, hospital stay was upto10 days, but based on the types of procedures performed, hospital stay was lengthened.
8. The common antibiotics used are Piperacillin-Tazobactam, Metronidazole, Amikacin and if necrotizing soft tissue was in mind and antimicrobial therapy inadequate to stop the disease then urgent surgical intervention was done. Polymicrobial antibiotic therapy was preferred.
9. Patients belonging to low-risk group according to LRINEC scoring have comparatively shorter duration of hospital stay and good recovery as compared to those belonging to intermediate and high-risk group.
10. Type-II NSTI was more common followed by type-I and type-III in my study.
11. The fatality rate in cases with NSTI has been significantly reduced by timely administration of antibiotics, surgical intervention, and adequate lesion care.

Mucormycosis cases

During my study duration we had a pandemic COVID-19 due to which steroids were prescribed to many patients, and this was found to be associated with increased incidence of mucormycosis infection which otherwise is rare. To complete my study objective of various types of NSTI inter-departmental cases were studied which had undergone surgical intervention and records were obtained from hospital medical records and wards. There were 3 cases reported in ENT department of mucormycosis who required surgical intervention (debridement). With permission from ENT department and ethical committee these cases were added apart from my original case study to make it comprehensive. An invasive, opportunistic fungal disease called mucormycosis is most frequently diagnosed in people who have other medical conditions including diabetes mellitus or long-term steroid use. Diabetes patients' diet and lifestyles, as well as their access to medication and routine medical care, are disturbed during this COVID-19 epidemic (28) (29).

Discussion:-

All 3 cases of mucormycosis were male in age group 40-50 year. One of them was diabetic and didn’t have any history of being COVID-19 positive. Other 2 of them had history of COVID-19 infection but didn’t have any other comorbidity. All three of them had history of steroid intake. Average duration of spread of infection was 18.66 days.

Most common area involved being face. LRINEC score was <5 in all with qSOFA score=0. Debridement was done in all 3 of them. Diagnosed to be cases of sinusitis. Average duration of recovery was 19.33 days. Amphotericin-B was the most prescribed anti-fungal. Multimodal treatment, in the opinion of Ahamed and Al Thobaiti, entails surgical care as the most significant component, as well as the treatment of antecedent morbidity disorders and extensive antifungal therapy (30). Mucormycosis has traditionally been treated with amphotericin-B. According to a newly published article, Muthu et al. stressed the significance of liposomal Amp-B administered at 3mg/kg/day having equivalent efficacy and being safer than the drug's 10mg/kg/day dose due to its vaso-occlusive nature (30)(31). In the ENT OPD, patients were followed up with no recurrence.

Conflicts Of Interest:
None.

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