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Original Research Article

CLINICAL STUDY OF RISK FACTORS, CLINICAL PRESENTATION AND MANAGEMENT OF CELLULITIS LOWER LIMB

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Corresponding Author:
Dr. A.Mohan Kumar,
Email: mohankumar10386@gmail.com

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S. Senthur Pandian[1], A. Mohan Kumar[2]

[1]Assistant Professor, Department of Plastic and Reconstructive Surgery, Tirunelveli Medical College, Tamilnadu, India.
[2]Assistant Professor, Department of General Surgery, Tirunelveli Medical College, Tamilnadu, India.

Abstract

Background: Cellulitis, a soft tissue infection, is emerging as a major health issue in India. Identifying risk factors and timely intervention for lower limb cellulitis will reduce morbidity and mortality. This study investigated the risk factors, clinical presentation, and management of lower limb cellulitis. **Material and Methods:** A prospective study was conducted on 100 patients with lower limb cellulitis admitted to the General surgery OPD at Tirunelveli Medical College. We reviewed the patients' clinical records for data on patient demographics, risk factors, clinical presentation, management modality, and cellulitis outcome. **Results:** Most affected patients were elderly, which is explained by poor immune response and associated comorbidities. Males (85%) were affected more frequently than females were. Most of the patients had unilateral involvement (94%). Grade III cellulitis is present in most cases, and diabetes mellitus is a common risk factor. PUS culture showed that Staphylococcus aureus and Streptococcus species were the most common. In most cases, piperacillin, tazobactam, and imipenem were the most sensitive antibiotics. Doppler ultrasonography revealed no deep venous thrombosis. 13% of the patients managed conservatively, 75% of patients required wound debridement and fasciotomy and 12% required amputation. A total of 61% of the patients had a resultant wound that healed by secondary intention, and 1% of the population died because of septicaemia. **Conclusion:** This cellulitis lower-limb study found that diabetes mellitus was the most common risk factor. Hospital admission for severe cellulitis, appropriate and emergency surgical interventions as needed, employing culture-directed antibiotics, and managing comorbidities can save lives.

INTRODUCTION

The disease known as cellulitis is characterised by extensive involvement of the dermal and subcutaneous layers and connective tissue inflammation.[1] The organism, which can be either an external or natural skin flora, is mostly a bacterial infection. It mostly affects the skin, which is more vulnerable to fractures, cracks, blisters, ulcerations, cuts, bite wounds, and hospital injuries such as surgical or IV cannulae. The most frequently affected areas are the lower limbs since the skin there is more prone to the previously stated traumas.[1-2]

Its total frequency is approximately 199 per 100,000 person-years, and the rates in men and women are almost equal. The incidence rises by around 3.7% for every year of age or roughly 43.8% for every ten-year increase.3 Obesity is another systemic risk linked to lower limb cellulitis and age. Previous cellulitis in the region, venous insufficiency, oedema (particularly lymphedema), and a skin surface disturbed by trauma, ulceration, or dermatological disorders such as dermatitis are examples of local risk factors.4 Since the toe webs are frequently the reservoir for bacteria that cause cellulitis, other risk factors for the condition include colonisation of these regions by Staphylococcus aureus and b-haemolytic streptococci, tinea pedis, or inter-digital intertrigo (fissuring, scaling, and maceration). Cellulitis is more likely to occur after a prior saphenous venectomy and is frequently recurring.[4-7]

It is well known that patients with diabetes are the most vulnerable group in terms of lower limb cellulitis. This is mainly because of their weakened immune systems and the higher frequency of foot ulcers resulting from neuropathy and vasculopathy,

which cause sensory loss and poor distal circulation. Inadequate blood sugar management promotes the growth of the microorganism that causes ulcers and ultimately leads to cellulitis.[8] However, a significant proportion of the population is non-diabetic and is also more prone to the development of lower limb cellulitis and its complications. Early cellulitis can be managed in the outpatient unit with oral antibiotics and analgesics and by treating the primary cause. However, cellulitis of higher grades, with complications such as blisters, myositis, and fasciitis, requires hospital admission, parenteral antibiotics, and surgical management.

This study investigated the risk factors, clinical presentation, and management of lower limb cellulitis.

MATERIALS AND METHODS

This prospective study was conducted in the Department of General Surgery of Tirunelveli Medical College Hospital and included 100 patients admitted for lower limb cellulitis and its complications. Ethical committee approval and informed consent were obtained before the study started.

Inclusion Criteria

Patients who presented with acute swelling of the affected limb or a wound over the affected limb at >10 years of age were included.

Exclusion Criteria

Patients who were terminally ill and had malignancy or polytrauma. Patients unwilling to participate in the study were excluded.

Methodology

A comprehensive clinical examination and a full patient history were obtained. Patients were examined for routine radiographic (chest X-ray, USG abdomen + pelvis, local USG with colour Doppler, X-ray of afflicted limb, CECT) and laboratory (CBC, BSL LFT, RFT, urine culture sensitivity, and pus culture sensitivity) tests. A history was obtained regarding the presenting ailment, discomfort, reddening of the area, swelling of the local area, ulcerations, and production of blisters or blebs. The patient's overall condition was assessed for anaemia and jaundice during clinical examination, and notes on hydration and nutrition were made. The respiratory and cardiac systems were thoroughly examined, and the results were noted. The central nervous system and abdomen were also examined. Every patient's vital signs were documented, including temperature, blood pressure, respiration rate, and pulse rate.

CREST standards for grading cellulitis were used to determine the degree of limb involvement. Parenteral antibiotics against Gram-positive, Gram-negative, and anaerobic organisms have been administered to all patients who arrive at the early stages of cellulitis. If the patient's condition improved, the antibiotic course lasted seven days while the response was tracked. When the patient failed to respond, or the condition progressed, an antibiotic was administered while the culture and sensitivity patterns were monitored. Blistering or bleb development may occur spontaneously. In these situations, proactive aseptic aspiration was performed with or without blister deroofing. Significant exudate loss and ulceration may occur because of tension and oedema at the site of cellulitis. Most patients lose their protective skin barrier, making them more dehydration-resistant. To prevent skin maceration, the wounds were dressed, and the patient's hydration status was corrected.

When a patient has advanced cellulitis, characterised by devitalised bronzy skin, underlying pus-pointing, and possible subcutaneous abscess, the skin is carefully debrided, and any underlying abscess is evacuated. The surgical protocol involves making incisions both within and outside the devitalised skin region until the area of newly viable tissue is reached. Any abscesses are then drained, and fasciotomy is performed when compartment syndrome poses a risk. Hemostasis was achieved, and the wounds were irrigated well. Adequate blood transfusions were used to treat blood loss during surgery.

Daily wound assessments were conducted, and further debridement was performed as necessary. To eliminate the persistent port of infection, amputation was performed when necessary in patients with vascular ulcers, cellulitis caused by snake bites, and a small number of trauma patients who displayed gangrenous alterations at the location, as well as skeletal damage. Patients were brought for amputation at the appropriate levels if they had necrotising cellulitis, which was potentially fatal, or if sepsis syndrome was imminent. Analyses and records of management outcomes were performed for every 100 patients have been made. It has been documented how the patient fared, including whether they recovered without incident or had tissue loss. This exposed region required care, whether they still had a deformity or whether they passed away from the illness.

Studies on the management of surgical wounds have also been conducted. Either the main closure was delayed, or we used the secondary intention to heal the wound. Split-thickness skin grafting has been used when it is doubtful that the wound margins and those that leave a raw region will mend.

RESULTS

One hundred patients with lower limb cellulitis were enrolled in the study. The majority were male (85%), aged 51–60 years (27%). The unilateral limb was involved in most of the patients (94%). The maximum number of patients was Grade III (67%), followed by Grade II (27%). Diabetes mellitus was the major cause of cellulitis (44%), followed by traumatic wounds (13%) (Table 1). In 47 patients,

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the infection was monomicrobial. In 22 patients, the infection was polymicrobial; in approximately 31 patients, no growth was observed. Staphylococcus aureus (37%) and Streptococcus SP (26%) were reported in most cultures. [Table 1, Figure 1]

Piperacillin – Tazobactum antibiotic was reported to be sensitive to the maximum number of patients (64%), followed by Imipenam in 54% of patients. Doppler study showed monophasic flow in the posterior tibial artery in 6% of all patients, followed by monophasic flow in the peroneal artery and venous insufficiency in 4% of patients. In cases of diabetes mellitus and bite injuries, especially in cases of snake bites at the site of the bite, the toes or metatarsals under the neath showed lytic changes or destruction due to gangrenous changes; otherwise, no other bony changes were noticed in the patients. [Table 1]

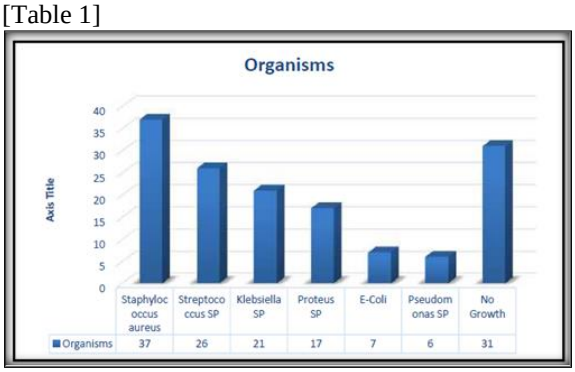

Figure 1: Observation of microorganisms cultured in patients

The treatment of individuals varied according to disease severity. The majority of patients required surgical wound debridement (48%) with or without decompression of the fascial compartment by fasciotomy. [Table 2, Figure 2] Very few patients required limb amputation. The study outcome showed that most patients required post-procedure wounds (61%), uneventful (27%), and disability in 11% of patients. Sixty-one patients in the study group with resultant wounds were ultimately managed with either a split thickness or allowed to heal by secondary intention. [Table 2]

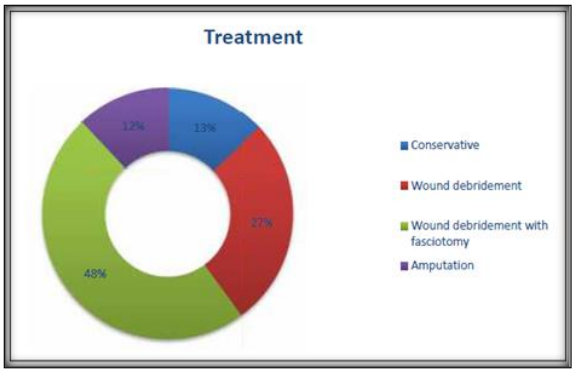

Figure 2: Observation of different treatment methods used in patients

Table 1: Observation of demographic and other evaluation parameters of patients

Parameters		Frequency (%)
Age group	<20 years	1 (1%)
	21 – 30 years	1 (1%)
	31- 40 years	5 (5%)
	41 -50 years	21 (21%)
	51-60 years	27 (27%)
	> 60 years	45 (45%)
Gender	Male	85(85%)
	Female	15(15%)
Limb Involved	Unilateral	94(94%)
	Bilateral	6(6%)
Grade of cellulitis	II	24(24%)
	III	67(67%)
	IV	9(9%)
Cause of cellulitis	Diabetes mellitus	44 (44%)
	Infected traumatic wounds	13 (13%)
	Chronic kidney disease	11 (11%)
	Bites	10 (10%)
	Web space infections	7(7%)
	Edema in cardiac failure	5 (5%)
	Lymphedema	3 (3%)
	Unknown	3 (3%)
Microorganisms cultured	Staphylococcus aureus	37 (37%)
	Streptococcus SP	26 (26%)
	Klebsiella SP	21 (21%)
	Proteus SP	17 (17%)
	E-Coli	7 (7%)
	Pseudomonas SP	6 (6%)
	No Growth	31 (31%)
Sensitive drugs	Piperacillin – Tazobactum	64 (64%)
	Cephalosporin group	39 (39%)
	Imipenem	54 (54%)
	Amikacin	18 (18%)
	Ciprofloxacin	18 (18%)

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	Cloxacillin	7 (7%)
	Ampicillin	6 (6%)
	Gentamycin	12 (12%)
Circulatory changes	No flow in calf vessels	1 (1%)
	Monophasic flow in a peroneal artery	4 (4%)
	Monophasic flow in the posterior tibial artery	6 (6%)
	Venous insufficiency	4 (4%)
	Deep vein thrombosis	0 (0%)

Table 2: Observation of treatment, Outcome and management of cellulitis in patients

Parameters		Frequency (%)
Treatment	Conservative	13 (13%)
	Wound debridement	27 (27%)
	Wound debridement with fasciotomy	48 (48%)
	Amputation	12 (12%)
Outcome	Uneventful	27 (27%)
	Post-procedure wound	61 (61%)
	Disability	11 (11%)
	Death	1 (1%)
Management	Split skin grafting	17 (28%)
	Healing by secondary intention	44 (72%)

DISCUSSION

In our study, for age distribution, it is evident that as age increased, the incidence of cellulitis and the severity of the disease also increased. Both inferences correlate with the literature.[9] This is explained by the comparatively poorer immune response and associated comorbidities in the elderly population. Among the 100 patients, 85% were male, and 15% were female; the literature supports this slightly increased male preponderance. Of the 100 patients studied, a maximum number of individuals (67 individuals) had grade III cellulitis, whereas 24 patients and nine patients had grade II and IV cellulitis, respectively. One consideration to be offered here is that the study is being conducted in inpatients of the surgical wards, and earliest forms of cellulitis are managed on an outpatient basis. Our study focused on the increased incidence of severe cellulitis.

Our study observed that 94% of patients had unilateral lower limb involvement, and 14% had bilateral lower limb involvement. The incidence of bilateral lower limb involvement is extremely rare.[10] In our study, cases involving both lower limbs included patients with oedema due to cellulitis, patients with chronic kidney disease and cardiac failure, patients with a history of barefoot walking with web space infections, and a few patients with unknown aetiology.

In our study, diabetes mellitus was responsible for most cases of cellulitis in the study group, followed by traumatic ulcers that had been infected and post-bite cellulitis. It is noted that cellulitis superimposing on lower limb oedema occurring in chronic kidney disease, lymphedema, and cardiac failure constitutes a considerable proportion of the aetiology of cellulitis in our study group. The exact cause of cellulitis is unknown. These findings in the present study are following earlier reported studies.[5]

Of the 100 patients studied in 47 patients, the infection was mono-microbial; in 22 patients, the infection was polymicrobial; in approximately 31 patients, no growth was observed. Staphylococcus SP and Streptococcus SP were the predominant organisms responsible for cellulitis in the study group, consistent with the literature. Other organisms observed in the study group included Klebsiella SP, Proteus SP, Pseudomonas SP, and E coli.[11] The sensitivity patterns of the cultured organisms showed piperacillin, tazobactam, and imipenem, which tended to have the maximum sensitivity for the common organisms causing cellulitis. The Cephalosporin group of antibiotics, amikacin, ciprofloxacin and gentamycin, are effective in many individuals.[12]

All 100 patients in the study group underwent a Doppler evaluation of the arterial and venous systems to study circulatory changes associated with lower limb cellulitis. We noticed that 4% of the patients showed monophasic flow in the peroneal artery, 6% had monophasic flow in the posterior tibial artery, and venous insufficiency was noticed in 4% of individuals. 1% of the patients had no flow in the calf vessels, and no patients were seen to have deep venous thrombosis.[15]

Bony changes were observed in 12% of the patients with cellulitis of the concerned limb in the phalanges or metatarsals in patients with diabetes mellitus. Regarding treatment, approximately 75 patients in the study group required surgical debridement and 48 required decompression of some muscular compartments using fasciotomy. 13% of patients with less severe forms of cellulitis were managed conservatively with parenteral antibiotics, anti-inflammatory agents, and limb elevation to reduce the associated oedema. In the study group, 12% required amputation because of the loss of almost all viable soft tissues and the possibility of sepsis syndrome due to the severely infected limb. Sharma et al. also reported similar findings in their investigation.[14]

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Regarding management outcomes, almost all patients who were managed conservatively recovered uneventfully. Approximately 61% of the patients had residual wounds that needed further attention, 11% of the patients remained with disability (amputation being done), and around 1% of the patients died because of comorbidities complicating the illness, especially diabetes mellitus.[15] In 28% of the patients, resultant wounds persisted as the raw area after preparing the same; they were managed with split skin grafting, and the remaining 72% were allowed to heal by secondary intention. These findings are following earlier reported studies.[16]

CONCLUSION

This study on lower-limb cellulitis found that diabetes mellitus was the most common cause. In addition to infected traumatic wounds, chronic kidney disease and post-bite cellulitis also contribute to infection. Early screening for diabetes mellitus and good glycaemic control prevent the incidence of cellulitis in the lower limbs. Staphylococcus SP and Streptococcus SP were the common organisms responsible for cellulitis in the study group, which correlates with the literature. Piperacillin, tazobactum, and imipenem are the most sensitive antibiotics in most cases, and this shows emerging resistance to commonly used antibiotics (ampicillin, cloxacillin, and cephalosporins). Educating people regarding proper foot care and footwear usage can prevent cellulitis due to web space infections, cracks in the sole, and trivial foot trauma. Hospital admission for severe forms of cellulitis, appropriate and emergency surgical intervention as needed, employing culture-directed antibiotics, and managing comorbidities can salvage the limbs and lives.

Limitations of the Study

As almost all patients with early forms of cellulitis (grade I) are managed with oral antibiotics and analgesics on an outpatient basis, and this study was conducted in hospitalised patients, this study did not include patients with milder grades of cellulitis. Our microbiology laboratory does not have facilities for anaerobic culture; therefore, the incidence of anaerobic infections could not be studied.

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