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SIGNIFICANCE OF SUBCUTANEOUS PRESSURE IN CELLULITIS OF LEG AND ITS IMPLICATION FOR EFFECTIVE MANAGEMENT AN OBSERVATIONAL STUDY

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ABSTRACT

BACKGROUND: Cellulitis is a non-necrotizing infection of the skin and subcutaneous tissue, hypodermis, and superficial fascia without muscular or deep fascia involvement. Lower limb cellulitis often results in prolonged hospital stay and long-term morbidity. Almost one-quarter of patients of lower limb cellulitis require hospitalization. The average duration of inpatient treatment for lower limb cellulitis is ten days. Long-term morbidity includes chronic Oedema and persistent leg ulceration and one-third will have a recurrence within three years. Cellulitis are mostly managed conservatively with limb elevation and antibiotics. Surgical intervention is required in case of local complications like abscess, necrotizing soft tissue infection, and systemic complications like severe sepsis with multi-organ affect. There is a lack of good evidence-based literature for the management of patient with lower limb cellulitis. It is an important healthcare issue due to the loss of work and economic burden for patients due to prolonged hospital stay and long-term morbidity. There are no standardized guidelines for the management of lower limb cellulitis. In clinical practice it depends on experience of treating physician. The hypothesis for the proposed observational study on the significance of subcutaneous pressure in leg cellulitis posits that alterations in subcutaneous pressure play a crucial role in the pathophysiology of cellulitis, impacting disease progression and response to treatment. Specifically, we hypothesize that increased subcutaneous pressure in the affected

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limb contributes to impaired lymphatic drainage and tissue oxygenation, creating a favourable environment for bacterial proliferation.

AIM AND OBJECTIVE:

❖ To measure subcutaneous pressure in cellulitic leg and compare it to normal leg.

❖ To correlate the increase in subcutaneous pressure with surgical intervention in cellulitis of leg.

PATIENTS AND METHODS: Patient admitted to General Surgery Department of MKCG Medical College & Hospital, Berhampur Diagnosed with cellulitis of lower limb and are being treated at our institute during the period of November 2023 to October 2024 and are willing to participate in the study by giving consent.

INCLUSION CRITERIA

- Cellulitis of unilateral leg only (below the knee joint).
- Adults, age >18 years.

EXCLUSION CRITERIA

❖ Bilateral pedal Oedema or Bilateral cellulites.

❖ Necrotising fasciitis.

❖ Lymphatic filariasis of leg.

❖ Deep Vein Thrombosis.

❖ Tibia/Fibula Fracture.

❖ Cellulitis already treated with antibiotics course.

❖ Pregnant and Children.

❖ Diabetic foot ulcers/skin necrosis.

RESULTS: The increase in subcutaneous pressure in the cellulitic leg in the group of patients who underwent surgery when compared to the group of patients who were managed conservatively was statistically significant.

CONCLUSION: From this study, it is proven that the subcutaneous pressure is increased in the cellulitic leg. The increase in subcutaneous pressure is associated with more local complications. The patients with high subcutaneous pressure were treated with surgical intervention on the same day of admission or later due to failure of conservative management. So, the surgical intervention in cellulitis of the leg is correlating with increased subcutaneous pressure in cellulitis of the leg.

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INTRODUCTION:

Cellulitis is a non-necrotizing infection of skin and subcutaneous tissue, hypodermis and superficial fascia without muscular or deep fascia involvement. The hypothesis for the proposed observational study on the significance of subcutaneous pressure in leg cellulitis posits that alterations in subcutaneous pressure play a crucial role in the pathophysiology of cellulitis, impacting disease progression and response to treatment. Specifically, we hypothesize that increased subcutaneous pressure in the affected limb contributes to impaired lymphatic drainage and tissue oxygenation, creating a favourable environment for bacterial proliferation. The normal subcutaneous pressure of the leg varies from -4 to +4 mmHg[1]. In chronic venous insufficiency, releasing the subcutaneous fluid by subcutaneous fasciotomy decreases the subcutaneous pressure[2]. The same principle is applied in the management of cellulitis. Early superficial subcutaneous fasciotomy in cellulitis can prevent the local complications like skin necrosis and progression to necrotizing soft tissue infection

AIM AND OBJECTIVE OF THE STUDY:

- ❖ To measure subcutaneous pressure in cellulitic leg and compare it to normal leg.
- ❖ To correlate the increase in subcutaneous pressure with surgical intervention in cellulitis of leg.

MATERIALS:

Patient admitted to General Surgery Department of MKCG Medical College & Hospital, Berhampur Diagnosed with cellulitis of lower limb and are being treated at our institute during the period of November 2023 to October 2024 and are willing to participate in the study by giving consent. Materials needed are Inch tape, lignocaine gel, skin marker, Stryker intercompartmental pressure monitor- 18G side port needle, saline prefilled syringe, and pressure diaphragm.

INCLUSION CRITERIA

- Cellulites of unilateral leg only (below knee joint).
- Adults, age >18 years.

EXCLUSION CRITERIA

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- ❖ Pregnant and Children.
- ❖ Diabetic foot ulcers/skin necrosis.

METHODS:

An informed consent was obtained by the investigator with in 24 hrs of admission. The circumference of cellulitis at the point of maximum swelling was measured. A black skin marker was used to mark 4 points anterolateral, posterolateral, anteromedial, and posteromedial aspect at the same level. The distance of the point from the tibial tuberosity was measured. The circumference of the normal leg was measured at the same distance from tibial tuberosity and the anteromedial aspect of normal leg was marked with marker at the same level. Local anaesthetic gel was applied and 45 minutes later pressure was measured using the Stryker monitor.

Under all sterile & aseptic condition to prevent secondary infection. The subcutaneous pressure was measured in the normal leg with a Stryker intercompartmental pressure monitor at an angle of 45 degree between skin and the needle[3]. The needle is 5 cm in length. Only the 0.5 cm of tip of the needle with side port was inserted into the subcutaneous space. This will avoid needle from piercing the deep fascia and entering into muscular compartment. The needle was held in place for 10 second and 0.5 ml of normal saline was injected. The stable pressure value was noted. The subcutaneous pressure was noted in the cellulitic leg at 4 points at same level. The patient details and the pressure values were noted in Performa. The pressure values were not be revealed to the treating surgeon. The decision of conservative management with antibiotics or surgical intervention was made by treating surgeon from clinical assessment. The patients were followed up at the time of discharge and at the 14th day in the OPD or Clinic or contacted by phone number. The treatment given was documented. The clinical improvement with respect to symptoms and the wound following surgical intervention was assessed during the follow-up.

RESULTS AND DATA ANALYSIS:

The statistical significance of the data was analysed by paired t – test, Mann – Whitney U test, Levene's test of equality of variance and independent sample t- test. Paired t - test was used to analyse the significance of difference in the subcutaneous pressure at 2 different points in the cellulitic leg. Mann-Whitney st, a non-parametric version of sample t-test was used to analyse the significance of difference in pressure with respect to the distance from tibial tuberosity. Levene's test of equality of variance was used to rule out the variability between the patients treated conservatively and with surgery. Independent sample t- test was used to analyse the statistical significance of the change in subcutaneous pressure between the antibiotic group and surgery group.

A total 28 patients were recruited for this study. The mean age of the patients included in the study was 59 years. Majority of the patients were elderly more than 60 years of age[4,5]. 82% of the study group was males showing male predominance[6-9].

We found that most of the patients with cellulitis of the leg had medical comorbidities. Majority of the patients in the study group had Diabetes mellitus 64.3% (18).

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The signs documented were swelling, erythema, warmth, and tenderness. Erythema was present only in 78.6% of the study group but swelling, warmth, and tenderness were present in the entire study group. Symptoms and signs were used as the clinical indicators to assess the improvement during the treatment.

CIRCUMFERENCE:

Measures	Circumference of the normal leg(cm)	Circumference of the Cellulitis leg(cm)	Distance from the tibial tuberosity(cm)
Mean	28.07	31.89	16.43
Minimum	11	13	4.00
Maximum	40	44	30.00
SD	6.27	7.11	5.43
25^{th} percentile	23.25	27.00	13.00
50^{th} percentile	29.00	32.00	15.00
75^{th} percentile	32.75	38.00	19.50

The mean circumference of the cellulitic leg was 31.89cm. There was increase in the circumference of the cellulitic leg when compared to the normal leg.

SUBCUTANEOUS PRESSURE:

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Measures	Normal leg pressure	Maximum pressure in cellulitic leg	Change in pressure
Mean	2.29	9.39	7.11
Minimum	-4	4	2
Maximum	6	16	16
SD	3.05	3.40	2.95
25^{th} percentile	-5.00	7.00	4.25
50^{th} percentile	3.00	9.00	7.50
75^{th} percentile	5.00	12.00	9.00

Normal distribution of subcutaneous pressure in the normal leg with the mean of 2.29mmHg as compared to 9.39 in cellulitic leg. The maximum subcutaneous pressure in the cellulitic leg corresponded to the area of cellulitis. There was an increase in subcutaneous pressure in the cellulitic leg when compared to the normal leg.

CORRELATION:

The subcutaneous pressure was correlated to the circumference of the leg and to the distance from the tibial tuberosity. This correlation was done as different patients had cellulitis at varying distance from the tibial tuberosity. These values were statistically analyzed to find out the significance. The correlation between the increase in the circumference of the cellulitic leg and the subcutaneous pressure was analyzed using a Scatter plot graph. There was no positive correlation as the plots were scattered probably due to small sample size as shown in Fig 1.

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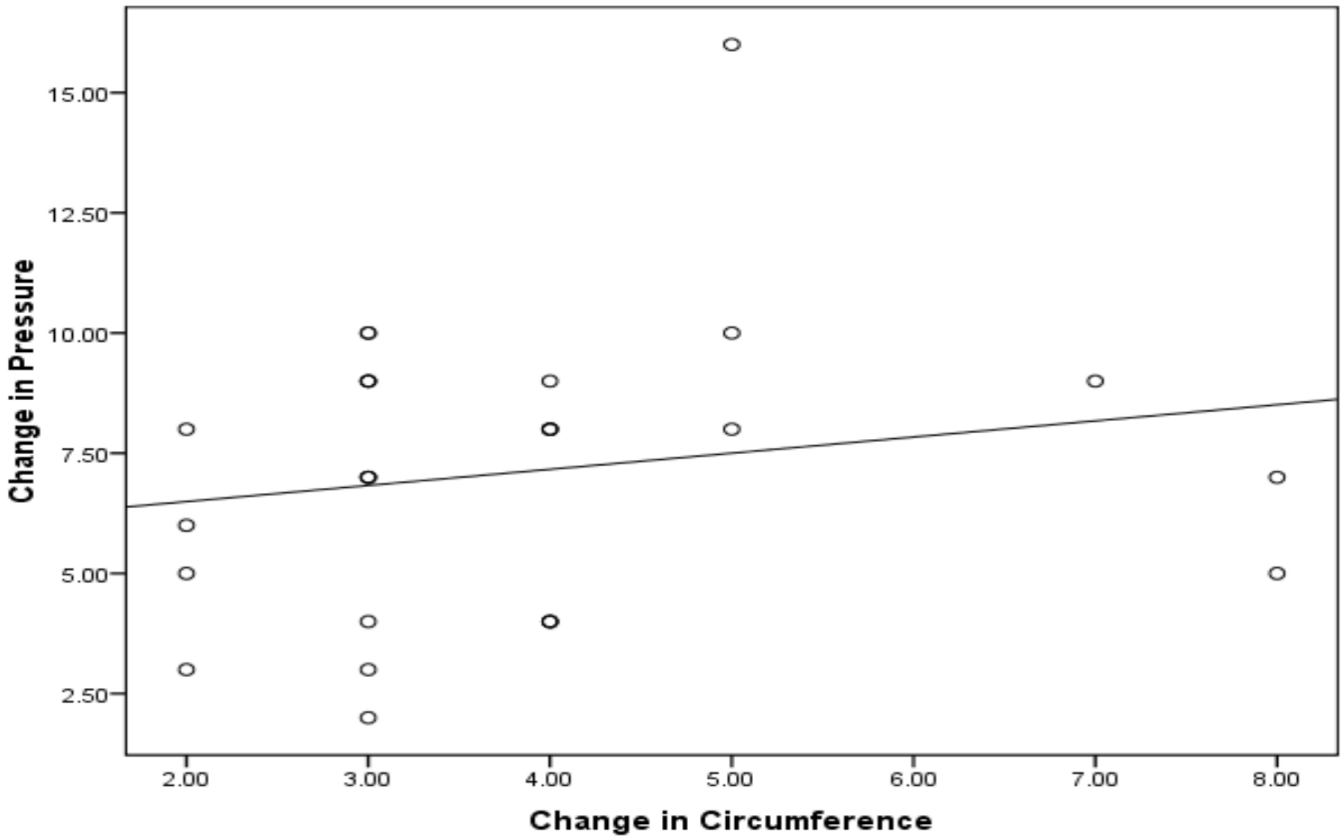

TREATMENT:

All patients were treated with antibiotics, anti-inflammatory medications, limb elevation and magnesium sulphate paste local application. The antibiotics most commonly used were parenteral Penicillin and Cloxacillin. One patient was treated with Cefazolin and 3 patients who progressed to necrotizing soft tissue infection with systemic sepsis were treated with Piperacillin-Tazobactum,Clindamycin[6]. The antibiotic was chosen according to culture sensitivity and the treating surgeon decision.

GROUP STATISTICS:

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Group	N	Mean	Std Deviation	Std. Error Mean
Antibiotics & Surgery	14	8.2857	2.75761	0.73700
Antibiotics only	14	5.9286	2.73058	0.72978

The increase in subcutaneous pressure in the cellulitic leg when compared to the normal leg was correlated with the treatment given. One group of patients (N = 14) were managed conservatively with antibiotics. The other 14 patients underwent surgical intervention out of which 2 were operated on within 24 hours of admission and 12 were operated on later due to failure of conservative management.

The mean of change in pressure was 8.29 mmHg in the group of patients who had surgical intervention and it was 5.93 mmHg in the group treated with antibiotics. The mean increase in subcutaneous pressure in the cellulitic leg was more in the group treated with antibiotics and surgery. The change in subcutaneous pressure was statistically significant between the two groups with p value of 0.032.

DISCUSSION:

The attempt to measure the subcutaneous pressure and correlating to the surgical intervention was done mainly to define the criteria for surgical intervention. This study revealed that in the patients who had surgical intervention, the subcutaneous pressure in the cellulitic leg was significantly high when compared to the patients who were managed conservatively. The study population was similar to that described in literature with a predominance of older people and men[4,5]. The clinical presentations were also classical with diabetes mellitus as a major risk factor[6-9]. Most of the patients received Inj crystalline penicillin and cloxacillin for Streptococci and Staphylococci[6].

The measurement of subcutaneous pressure at the time of admission will be useful in deciding the treatment option. The patients who had high subcutaneous pressure at the time of admission ended up in surgery later due to failure of conservative management. In this group of patients, early surgical intervention can prevent ascending infection with systemic sepsis, extensive debridement due to progressing necrotizing soft tissue infection and avoid prolonged use of antibiotics and hospital stay.

CONCLUSION:

From this study, it is proven that the subcutaneous pressure is increased in the cellulitic leg. The increase in subcutaneous pressure is associated with more local complications. The patients with high subcutaneous pressure were treated with surgical intervention on the same day of admission or later due to failure of conservative management. So, the surgical intervention in cellulitis of the leg correlates with increased subcutaneous pressure in cellulitis of the leg.

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