

## Original Research Article

# Role of erythrocyte sedimentation rate and C-reactive protein as a predictor of severity of cellulitis and necrotising fasciitis

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### ABSTRACT

**Background:** Skin infections are major cause of morbidity and mortality worldwide, affecting more than one person/1000 person/year. Sepsis has a worldwide incidence of more than 20 million cases a year, with mortality due to septic shock reaching up to 50% even in industrialized countries. Acute phase reactants like erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) have been used traditionally as markers for inflammation and are readily available in most centres. Aim was to study the correlation between the values of ESR and CRP with severity of cellulitis and necrotising fasciitis (in term of hospital stay and disease outcome).

**Methods:** This was a prospective observational study conducted at Department of Surgery, GMC and Hamidia Hospital, Bhopal from a period of March 2016 to August 2018.

**Results:** Skin and soft tissue infections are most commonly affects male, diabetes mellitus most common co-morbid condition. Mean value of ESR and CRP in patients who could not survived was 64.44 and 145.92 respectively and value more than 54.95 and 93.41 requires longer hospital stay.

**Conclusions:** ESR and CRP are non-specific test but they are good predictors of severity of cellulitis and necrotising fasciitis not only in planning of management of these cases but also predicting outcome of the disease.

**Keywords:** C-reactive protein, Erythrocyte sedimentation rate, Cellulitis, Necrotising fasciitis

### INTRODUCTION

Skin and soft tissue infections have a deteriorating effect on a person's quality of life and especially seen in developing countries. Skin infections are major cause of morbidity and mortality worldwide, affecting more than one person/1000 person/year. Skin and soft tissue infections (SSTIs) include any infection that involves the skin, subcutaneous fascia and skin's appendages and these usually present with a wide spectrum, ranging from uncomplicated skin and soft tissue infection cellulitis to life threatening necrotizing fasciitis.

Cellulitis basically is the inflammation of the connective tissue of skin. It mainly is caused by bacterial infection,

commonly involved bacteria are staphylococci and streptococci. Necrotising soft tissue infection was first described by Hippocrates in the 5th century BC.<sup>1</sup> In 1952, Wilson coined the term Necrotising Fasciitis.<sup>2</sup> It is a much more progressed and advanced stage, where there is necrosis of the subcutaneous tissue and deeper fascia. It can affect any part of the body but mainly affects extremities, perineum and truncal areas of the body. The predisposing conditions are mainly Diabetes mellitus type II, alcoholism, chronic renal disease, chronic liver disease, under-nutrition, gout, corticosteroid use, trauma and malignancy.

Diagnosing the extent of the disease and its severity is critical for a successful management of a patient of skin

and soft tissue infection. Acute phase reactants are a heterogeneous group of plasma proteins that increases or decreases because of inflammatory stimuli. Currently in clinical practice, erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) are the most commonly used acute phase reactants. A better-defined role for biological markers, as an enhancement to clinical evaluation may lead to more judicious antibiotic prescriptions and it has the potential for long term favourable impact on antimicrobial stewardship and antibiotic resistant.

Acute phase reactants like ESR and CRP have been used traditionally as markers for inflammation and are readily available in most centres. Therefore, the present study was undertaken in Department of General Surgery, Gandhi Medical College and associated Hamidia hospital, Bhopal to study the predictive value of ESR and CRP in assessment of severity of the cellulitis and necrotising fasciitis and their outcome.

**METHODS**

This was a prospective observational study conducted at Department of Surgery, Gandhi Medical College and Hamidia Hospital Bhopal from a period of March 2016 to August 2018.

All patients above 12 years of age having cellulitis and necrotising fasciitis were included in the study. Paediatric age group (<12 years of age), cases of well-defined abscess, patients with known co-morbidity that are known causes of elevated ESR and CRP level like connective tissue disorders, autoimmune disorders and thyroid disease, patients with surgical site infection and all those patients who were operated for the same in other hospitals and transferred in for further management were excluded from the study.

ESR was measured by Wintrobe’s method and CRP was measured by semi quantitative slide test. Statistics analysis was done using Epi info version 7 and Unpaired T test is used for comparison of ESR and CRP. The study was approved by the Institutional Ethics Committee.

**RESULTS**

Table 1 showed that out of 200 cases the majority of cases belongs to age group above 51 years (51-60 years), the mean age was 51.36. Table 2 showed in our group of 200 cases, 155 cases (77.5%) were male and 45 cases (22.5%) were female.

Table 3 showed most common co-morbid condition associated with cellulitis and necrotizing fasciitis was diabetes mellitus in 84 cases (42%).

Table 4 showed most common growth found on culture media were poly-microbial in 111 cases (55.5%), mono-

microbial growth was found in 79 cases (39.5%) and no organisms grown in 10 cases (5%).

**Table 1: Age distribution.**

Age group (in years)	Frequency	Percentage
12-20	4	2.0
21-30	18	9.0
31-40	25	12.5
41-50	36	18.0
51-60	54	27.0
61-70	43	21.5
>70	20	10.0

**Table 2: Sex distribution.**

Sex	Frequency	Percentage
Female	45	22.5
Male	155	77.5
Total	200	100.0

**Table 3: Co-morbid conditions associated with cellulites and necrotizing fasciitis.**

Co-morbid condition	Frequency	Percentage
Diabetes	84	42
Hypertension	20	10
Peripheral vascular disease	16	8
Chronic liver/renal diseases	16	8
Immunosuppression	8	4

**Table 4: Organisms associated with cellulites and necrotizing fasciitis.**

Organisms	Frequency	Percentage
Monomicrobial	79	39.5
Polymicrobial	111	55.5
No Growth	10	5

**Table 5: Value of ESR in cellulitis and necrotizing fasciitis.**

ESR (mm/hr)	Frequency	Percentage
0-10	8	4
11-20	14	7
21-30	10	5
31-40	29	14.5
41-50	37	18.5
51-60	32	16
61-70	40	20
71-80	16	8
81-90	8	4
>91	6	3
	200	100

Table 5 showed value of ESR in cellulitis and necrotizing fasciitis, maximum no. of patients 40 (20%) came in range between 61-70 mm/hr and more than 90 mm/hr value was found in 6 patients (3%).

**Table 6: Value of CRP in cellulitis and necrotizing fasciitis.**

CRP (microgram/ml)	Frequency	Percentage
12	24	12
24	34	17
48	76	38
96	48	24
192	18	9

Table 6 showed value of C-reactive protein, in 76 patients (38%) value was 48 microgram/ml, in 48 patients (24%) value was 96 microgram/ml, CRP value was 24 microgram/ml in 34 patients (17%), 12 microgram/ml was obtained in 24 patients (12%) and 192 microgram/ml was found in 18 patients (9%). Table 7 showed that less severe skin and soft infection, mean value of ESR and CRP was 35.65±18.496 and 39.36±22.281 respectively requires shorter duration of hospital stay (mean days of stay 16.31±9.417) while the mean ESR and CRP values for the group with more severe disease requiring longer hospitalization was 54.95±20.812 and 93.41±70.362 with mean days of hospital stay was 34.46±14.335 days. Table

8 showed mean value of ESR and CRP in patients who expired on duo course of treatment was 64.44±18.152 and 145.92±93.446. Patients who recovered from cellulitis and necrotising fasciitis were having the mean value of ESR and CRP 45.33±21.520 and 62.74±48.518.

**Table 7: Correlation of ESR and CRP with duration of hospital stay.**

Severity of disease	Markers	Mean	SD	Number
Less severe disease	ESR (mm/hr)	35.65	18.496	75
	CRP (microgram/ml)	39.36	22.281	75
	Duration of hospital stay (days)	16.31	9.417	75
Severe disease	ESR (mm/hr)	54.95	20.812	125
	CRP (microgram/ml)	93.41	70.362	125
	Duration of hospital stay (days)	34.46	14.335	125

**Table 8: Characteristic of mean value of ESR and CRP with respect to mortality.**

Group statistics	Outcome	N	Mean	Std Deviation	P value
ESR (mm/hr)	Recovered	175	45.33	21.520	<0.001
	Expired	25	64.44	18.152	
CRP (micro-gram/ml)	Recovered	175	62.74	49.518	<0.001
	Expired	25	145.92	93.446	

**Table 9: Different modalities of management.**

Management	Frequency	Percentage
Conservative	75	37.5
Release incision	54	27
Wide surgical debridement	49	24.5
Amputation	22	11
Total	200	100

Table 9 showed that patients presented with sign and symptoms of cellulitis and necrotizing fasciitis were managed by different modalities, most of them managed by conservative management (75 patients, 37.5%), 54 patients (27%) were managed by release incision, wide surgical debridement was done in 49 patients (24.5%) and amputation was required in 22 patients (11%). Table 10 showed that out of 200 cases 25 cases (12.5%) were

expired and 175 cases (87.5%) recovered from cellulitis and necrotizing fasciitis.

**Table 10: Disease outcome.**

Outcome	Frequency	Percentage
Recovered	175	87.5
Expired	25	12.5
Total	200	100

**DISCUSSION**

In the study, maximum no. of patients was in age group of 61-70 years (21.5%) with the mean age of 51.36. Nissar, et al reported mean age of the patient is 55 years.<sup>3</sup> The results of other studies are in compliance with the observations in our series.<sup>4,5</sup> In our study predominantly male were affected by skin and soft tissue infection

which were 77.5%, similar results were observed in other studies also.<sup>6-8</sup>

Trauma was the most common cause for the onset of disease (39%), and diabetes (42%) was the most common co-morbid condition associated with cellulitis and necrotising fasciitis. The results of our study are comparable and with diabetes mellitus being the most common co-morbidity associated with the cellulites and necrotizing fasciitis with other series also.<sup>3-5</sup>

55.5% cases had poly-microbial growth on culture media, whereas 39.5% had mono-microbial growth and 5% did not show any growth on culture media. Staph. Aureus was the most common gram-positive organism whereas pseudomonas was the most common gram-negative organism associated with cellulitis and necrotising fasciitis. In mono-microbial growth *S. aureus* and in poly-microbial growth pseudomonas and *E. coli* were most commonly isolated organism. In our study, the most common cause of infection was poly-microbial, which was comparable to other studies.<sup>4,9,10</sup> In some studies mono-microbial and poly-microbial organisms were different as a causative agent according to their environmental conditions.

Overall among 200 patients, 75 (37.5%) cases received conservative management whereas 22 (11%) patients had undergone for amputation. Out of 200 patients, during the course of treatment, 25 patients were could not survived. Mortality rate in our study is 12.5% which is different from the statistics of others' studies. However, this change can be attributed to the fact that mortality rates depend on early diagnosis and management.

In our study, out of 200 patients, 75 patients which was managed conservatively (less severe disease). For them mean value of ESR, CRP and hospital stay was 35.65 mm/hr, 39.36 microgram/ml and 16.31 days. Operative intervention was done in rest 125 patients. They have more severe disease and for them mean value of ESR, CRP and hospital stay was 54.95 mm/hr, 93.41 microgram/ml and 34.46 days. Pearson co-relation co-efficient were found to be positive while seeing association between ESR, CRP and hospital stay. After plotting receiver operating characteristic curve between mortality and ESR, CRP cut off value of ESR was 63.5 mm/hr with sensitivity 64% and specificity 78.3% and CRP was 72 microgram/ml with sensitivity 76% and specificity 72.6%. Wong et al concluded that the laboratory risk indicator for necrotizing fasciitis (LRINEC) is a laboratory-based scoring method that, reported a PPV of 92% and a negative predictive of 96% for necrotising skin and soft tissue infection for a LRINEC score of equal to or more than 6. A CRP level of more than 150 mg/L was assigned a score of 4 in this scoring system.<sup>11</sup> Kaori et al concluded that ESR and CRP can be complementary to good history taking and physical examination in the diagnosis and monitoring of inflammatory conditions.<sup>12</sup>

## CONCLUSION

ESR and CRP are non-specific test but they are good predictors of an inflammatory response in the body. These tests are not expensive and available at most of the places.

In our study they have turned out to be reasonably good predictors of severity of inflammatory response in cases of cellulitis and necrotising fasciitis. Their values can guide us in predicting the severity of the disease and its probable outcome with cut off value of ESR was 63.5 mm/hr with sensitivity 64% and specificity 78.3%, CRP was 72 microgram/ml with sensitivity 76% and specificity 72.6%. However, at places where the more sensitive and specific tests are not available these tests can be used as a useful tool in diagnosing the severity of cellulitis and necrotising fasciitis not only in planning of management of these cases but also predicting outcome of the disease.

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