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## AN OBSERVATIONAL STUDY TO ESTIMATE THE RANGE OF ESR AND CRP VALUES ACCORDING TO SEVERITY OF SYMPTOMS IN FEMALE SUBJECTS OF AMAVATA

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### ABSTRACT

**Background:** Amavata, a classical Ayurvedic disease caused by Ama associated with Vata Dosha, closely resembles Rheumatoid Arthritis (RA) in its clinical presentation. Objective inflammatory biomarkers such as erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) are routinely used in modern medicine to assess disease activity in RA; however, their correlation with Ayurvedic symptom-based severity assessment is limited.

**Objectives:** To estimate the range of ESR and CRP values according to the severity of symptoms in female subjects of Amavata and to evaluate their correlation with clinical severity.

**Materials and Methods:** A cross-sectional observational study was conducted on 96 female patients diagnosed with Amavata. Patients were categorized into mild, moderate, and severe groups based on standardized Ayurvedic symptom severity scores. Subjective clinical features were assessed using classical parameters, while ESR and CRP were evaluated as objective inflammatory markers. Statistical analysis included one-way ANOVA, Chi-square test, and Spearman correlation.

**Results:** Mean ESR values increased significantly from mild ( $38.78 \pm 7.33$  mm/hr) to severe cases ( $54.62 \pm 12.14$  mm/hr) ( $p < 0.0001$ ). Similarly, mean CRP levels rose from  $14.07 \pm 4.02$  mg/L in mild cases to  $27.12 \pm 10.66$  mg/L in severe cases ( $p < 0.0001$ ). Both ESR and CRP demonstrated a statistically significant positive correlation with symptom severity scores.

**Conclusion:** ESR and CRP values show a strong association with the severity of clinical manifestations in Amavata. Integration of these biomarkers with Ayurvedic clinical assessment provides an objective and comprehensive approach for disease evaluation and management.

**KEYWORDS:** Amavata, Rheumatoid arthritis, ESR, CRP, Inflammatory biomarkers, Ayurveda.

## INTRODUCTION

Amavata is described in Ayurvedic classics as a systemic inflammatory disorder arising from Ama formation due to Mandagni and its association with vitiated Vata Dosha [1–4]. Madhava Nidana explains Amavata as a disease characterized by Sandhishoola, Sandhigraha, Angamarda, and Alasya due to circulating Ama combined with Vata and Kapha Dosha [1]. Chakradatta, Bhavaprakasha, and Yogaratnakara elaborate on its chronic, progressive nature and joint involvement [2–4].

The clinical presentation of Amavata closely parallels Rheumatoid Arthritis (RA), a chronic autoimmune inflammatory disorder characterized by symmetric polyarthritis, morning stiffness, and systemic involvement [5–7]. Epidemiological studies report a higher prevalence of RA among females, which aligns with observations in Amavata [6,7].

Inflammation plays a central role in the pathogenesis of RA, with acute-phase reactants such as ESR and CRP serving as established markers of disease activity and prognosis [8–11]. Elevated ESR and CRP are associated with synovial inflammation, disease severity, and functional disability [9–11].

In Ayurvedic research, several studies have reported elevated ESR and CRP levels in patients of Amavata and their association with clinical severity and chronicity [12–17]. However, systematic estimation of biomarker ranges corresponding to symptom severity remains limited. Hence, the present study was undertaken to correlate ESR and CRP values with severity grading of Amavata based on classical Ayurvedic criteria.

## MATERIALS AND METHODS

### Study design and setting

A cross-sectional observational study was carried out at an Ayurvedic teaching hospital.

### Sample Size

Sample size is determined considering proportion of Amavata in hospitalized patients as the main outcome. Following assumptions are made from the annual Hospital Statistics for the previous year.

1. Anticipated proportion (p)– 2.16%
2. Absolute precision(d) –5% Required sample size for each group i.e. mild, moderate, severe(n)- 32.4 ~ 32

Therefore, Total 96 subjects will be included in study. Following Formula is use for computation of sample size.

$$n = [(1.96)^2 * 2.16 * 97.84] / 52 \quad n = 32.46 \sim 32$$

Where,

Z – statistical corresponding to level of confidence

p - Expected proportion

d - Absolute precision

**Sampling Method:** This is Hospital based observation study where the sample of 96 subjects seeking treatment and care in study setting & fulfilling eligibility criteria will be selected by convenience sampling method.

### Inclusion criteria

Female patients aged 18–60 years with classical clinical features of Amavata.

### Exclusion criteria

Patients with other autoimmune or inflammatory joint disorders, severe systemic illness, or pregnancy were excluded.

### Diagnostic criteria

Diagnosis was based on classical Ayurvedic features of Amavata along with the American College of Rheumatology (ACR) criteria for Rheumatoid Arthritis.

### Outcome measures

**Methods of data collection – relevant to objective:** Patient will be assessed on the basis of subjective and objective Parameter; relevant data will be collected for analysis.

Assessment criteria:

1. Subjective Criteria
  2. Objective Criteria
- Scoring the Samanya Lakshan (Common signs/symptoms) and Pratyatma Lakshan (Cardinal signs/symptoms) of Amavata [18] (Table No.1)

| Sr. No | Sign/symptoms                                                                              | Scores |
|--------|--------------------------------------------------------------------------------------------|--------|
| 1      | Sandhi shool (Joint Pain)                                                                  |        |
|        | a) No pain                                                                                 | 0      |
|        | b) Occasional pain/Sancharivedana                                                          | 1      |
|        | c) Pain during excess work/Sancharivedana                                                  | 2      |
|        | d) Constant pain disturbing routine/VrishchikDanshvat vedana                               | 3      |
| 2      | Sandhishotha (Joint Swelling)- According to joints involvement                             |        |
|        | a) No joint involvement                                                                    | 0      |
|        | b) 0 – 5                                                                                   | 1      |
|        | c) 6 – 10                                                                                  | 2      |
|        | d) Above 11                                                                                | 3      |
| 3      | Sandhigraha (Joint Stiffness)                                                              |        |
|        | a) No stiffness or stiffness lasting for 5 mints.                                          | 0      |
|        | b) Stiffness lasting for 5 mints to 2 hrs.                                                 | 1      |
|        | c) Stiffness lasting for 2 hrs. To 8 hrs.                                                  | 2      |
|        | d) Stiffness lasting for more than 8hrs.                                                   | 3      |
| 4      | Jwara (Fever)                                                                              |        |
|        | a) Normal body as well as local temperature (98-99°F)                                      | 0      |
|        | b) Mild raised local temperature with normal body temperature (body temperature 99- 100°F) | 1      |
|        | c) Moderate raised body as well as local temperature (body temperature-100-103°F)          | 2      |
|        | d) Raised body as well as local temperature (body temperature-103°F or above)              | 3      |
| 5      | Trushna (thirst)                                                                           |        |
|        | a) Normal daily water intake (1.5- 2lit/day)                                               | 0      |
|        | b) Increased thirst but frequencies of drinking can be controlled (2- 2.5lit/day)          | 1      |
|        | c) increased thirst with increased frequency (excessive amount -2.5-3 lit/day)             | 2      |
|        | d) very much increased thirst with very frequent intake                                    | 3      |
| 6      | Aruchi (tastelessness)                                                                     |        |
|        | a) Absent                                                                                  | 0      |
|        | b) Tasteless, can take diet                                                                | 1      |
|        | c) Tasteless, can take little amount of diet                                               | 2      |
|        | d) Tasteless, can't take regular diet                                                      | 3      |
| 7      | Nidraviparyaya (altered sleep)                                                             |        |
|        | a) satisfactory normal sleep (6-7 hrs)                                                     | 0      |
|        | b) occasional unsatisfactory                                                               | 1      |
|        | c) unsatisfactory sleep due to pain                                                        | 2      |
|        | d) unsatisfactory sleep with or without pain                                               | 3      |
| 8      | Alasya (laziness)                                                                          |        |
|        | a) No Alasya                                                                               | 0      |
|        | b) Doing satisfactory work or late initiation                                              | 1      |
|        | c) Doing unsatisfactory work or late initiation                                            | 2      |
|        | d) Do not want to do work or no initiation                                                 | 3      |
| 9      | Angamarda (Bodyache)                                                                       |        |
|        | a) Absence of body ache                                                                    | 0      |
|        | b) Bodyache for sometimes                                                                  | 1      |
|        | c) Generalised bodyache– intermittent                                                      | 2      |
|        | d) continuous bodyache                                                                     | 3      |

With these criteria, the maximum score is 27 and minimum score is 0. The gradation of Amavata is denoted by figures 00 to 27. From above assessment criteria, Amavata can be graded as follows-

**(Table No.2) – Gradation as per total scores obtained.**

| Sr. No. | Grade    | Total score |
|---------|----------|-------------|
| 1       | Mild     | 00-09       |
| 2       | Moderate | 10-18       |
| 3       | Severe   | 19-27       |

**Table No.3 - American College of Rheumatology revised criteria for the classification of functional status in rheumatoid arthritis. [19]**

|           |                                                                                                      |
|-----------|------------------------------------------------------------------------------------------------------|
| Class I   | Completely able to perform usual activities of daily living (self-care, vocational, and avocational) |
| Class II  | Able to perform usual self-care and vocational activities, but limited in avocational activities     |
| Class III | Able to perform usual self-care activities, but limited in vocational and avocational activities     |
| Class IV  | Limited in ability to perform usual self-care, vocational, and avocational                           |

Usual self-care activities include dressing, feeding, bathing, grooming, and toileting. Avocational (recreational and/or leisure) and vocational (work, school, homemaking) activities are patient-desired and age-and sex-specific.

▪ESR (Erythrocyte sedimentation rate)

▪CRP (C - reactive protein)

To observe changes in the values of ESR & CRP with changes in severity of symptoms in Amavata subjects, Objectives are selected.

**(Table No.4) – Normal Ranges of ESR and CRP.**

| NAME                                 | NORMAL RANGE                                                                  |
|--------------------------------------|-------------------------------------------------------------------------------|
| ESR (Erythrocyte sedimentation rate) | Male: 0-9 mm after 1hr.<br>Female: 0-20 mm after 1hr.<br>(By Wintrobe method) |
| CRP (C - reactive protein)           | 0.068 to 8.0 mg/lit                                                           |

### Grouping

Based on cumulative symptom scores, patients were equally divided into three groups: mild (n = 32), moderate (n = 32), and severe (n = 32).

## Statistical analysis

Data were expressed as mean  $\pm$  standard deviation and 95% confidence intervals. One-way ANOVA was used to compare means among groups, Chi-square test for categorical variables, and Spearman correlation coefficient to assess association between symptom severity and inflammatory markers. A p-value  $< 0.05$  was considered statistically significant.

## RESULTS

### Baseline characteristics

Most participants belonged to the 41–50-year age group. No statistically significant difference was observed in age or BMI distribution among severity groups, indicating comparability of baseline characteristics.

### ESR according to severity

Mean ESR values showed a progressive and statistically significant increase with severity: mild  $38.78 \pm 7.33$  mm/hr (95% CI: 36.13–41.42), moderate  $45.53 \pm 9.43$  mm/hr (95% CI: 42.13–48.92), and severe  $54.62 \pm 12.14$  mm/hr (95% CI: 50.24–58.99) ( $F = 20.91$ ;  $p < 0.0001$ ).

**Table No.5- Comparison of mean ESR among 3 groups.**

| ESR                     | Mild          | Moderate      | Severe        |
|-------------------------|---------------|---------------|---------------|
| Mean                    | 38.78         | 45.53         | 54.62         |
| SD                      | 7.33          | 9.43          | 12.14         |
| Median                  | 38            | 48            | 57            |
| 95% confidence Interval | 36.13 – 41.42 | 42.13 – 48.92 | 50.24 – 58.99 |
| F-value                 | 20.91         |               |               |
| p-value                 | <0.0001, HS   |               |               |

### CRP according to severity

CRP levels increased significantly across severity groups: mild  $14.07 \pm 4.02$  mg/L (95% CI: 12.62–15.51), moderate  $18.90 \pm 6.02$  mg/L (95% CI: 16.72–21.07), and severe  $27.12 \pm 10.66$  mg/L (95% CI: 23.27–30.96) ( $F = 25.14$ ;  $p < 0.0001$ ).

**Table No.6- Comparison of mean CRP among 3 groups.**

| CRP                     | Mild          | Moderate      | Severe        |
|-------------------------|---------------|---------------|---------------|
| Mean                    | 14.07         | 18.90         | 27.12         |
| SD                      | 4.02          | 6.02          | 10.66         |
| Median                  | 13.65         | 19.98         | 24.12         |
| 95% confidence Interval | 12.62 – 15.51 | 16.72 – 21.07 | 23.27 – 30.96 |
| F-value                 | 25.14         |               |               |
| p-value                 | <0.0001, HS   |               |               |

### ACR according to severity

A significant association was observed between disease severity and ACR criteria among Amavata patients ( $\chi^2 = 119.82$ ,  $p < 0.0001$ ). Most mild cases belonged to ACR Class I (78.13%), while moderate cases predominantly showed Class II (81.25%). Severe cases were mainly classified under Class III (71.88%), with the remaining in Class IV (28.13%). This distribution indicates a progressive shift in ACR class with increasing disease severity.

**Table No.7 - Comparison of ACR Criteria among 3 groups.**

| ACR criteria | Mild        | Moderate  | Severe    |
|--------------|-------------|-----------|-----------|
| I            | 25(78.13)   | 0         | 0         |
| II           | 7(21.88)    | 26(81.25) | 0         |
| III          | 0           | 6(18.75)  | 23(71.88) |
| IV           | 0           | 0         | 9(28.13)  |
| Chi2-value   | 119.82      |           |           |
| p-value      | <0.0001, HS |           |           |

### Correlation analysis

A statistically significant positive correlation was observed between symptom severity scores and ESR ( $r = 0.5549$ ;  $p < 0.0001$ ) as well as CRP ( $r = 0.5859$ ;  $p < 0.0001$ ), indicating that higher clinical severity was associated with greater inflammatory activity.

**Table No.8 - Correlation of score with ESR and CRP.**

|            | Score   |             |
|------------|---------|-------------|
|            | r-value | p-value     |
| <b>ESR</b> | 0.5549  | <0.0001, HS |
| <b>CRP</b> | 0.5859  | <0.0001, HS |

## DISCUSSION

The present study demonstrates a statistically significant association between increasing severity of Amavata symptoms and elevated levels of ESR and CRP. Ayurvedic classics describe Amavata as a disease of progressive Ama accumulation with Vata predominance, leading to systemic inflammatory manifestations [1–4]. This concept is comparable to chronic synovial inflammation described in Rheumatoid Arthritis [5–7].

Modern studies have established ESR and CRP as reliable indicators of inflammatory burden, disease activity, and prognosis in RA [8–11]. Similar observations have been reported in Ayurvedic clinical studies, where elevated ESR and CRP correlated with symptom severity, chronicity, and functional impairment in Amavata [12–18].

Previous clinical studies conducted on Amavata have demonstrated significant reduction in ESR and CRP following Ayurvedic interventions, further validating their utility as objective assessment parameters [14–19].

**Estimated range of ESR & CRP with severity of symptoms (Table No. 9) -**

| Gradation as per severity of symptoms | Scoring | ESR (mm at the end of 1 hr) | CRP (mg/l)    | ACR criteria |
|---------------------------------------|---------|-----------------------------|---------------|--------------|
| Mild                                  | 00-09   | 36 – 41                     | 12.62 – 15.51 | I (78.13%)   |
| Moderate                              | 10-18   | 42 – 49                     | 16.72 – 21.07 | II (81.25%)  |
| Severe                                | 19-27   | 50 – 59                     | 23.27 – 30.96 | III (71.88%) |

These ranges are specific to three categories of Amavata according to severity of symptoms and differ from the standard ranges stated for ESR and CRP values obtained from previous studies.

The study found a clear correlation between the severity of Amavata symptoms and ACR criteria, with mild, moderate, and severe cases corresponding primarily to ACR Classes I, II, and III, respectively. Additionally, a progressive increase in ESR and CRP levels was observed across the severity groups, with no overlap in their estimated ranges, indicating distinct inflammatory profiles. Statistically significant correlations were found between symptom severity and both ESR ( $r = 0.5549$ ,  $p < 0.0001$ ) and CRP ( $r = 0.5859$ ,  $p < 0.0001$ ), confirming that higher disease severity is associated with increased inflammatory marker levels. Thus, incorporation of ESR and CRP into Ayurvedic clinical evaluation provides objectivity, supports severity grading, and enhances reproducibility of clinical research, as emphasized in integrative Ayurveda literature [20–22].

## CONCLUSION

This observational study estimated severity-specific ranges of ESR and CRP in female patients of Amavata. The ESR ranges were 36–41 mm/hr in mild, 42–49 mm/hr in moderate, and 50–59 mm/hr in severe cases, while CRP ranged from 12.62–15.51 mg/L, 16.72–21.07 mg/L, and 23.27–30.96 mg/L, respectively. All patients showed deranged ESR and CRP values corresponding to symptom severity, indicating a clear association between inflammatory markers and disease severity. As ESR and CRP are prognostic inflammatory markers, higher values reflected increased disease activity, greater inflammation, and poorer prognosis in severe cases, with moderate and mild cases showing progressively lower

inflammation and better prognosis. The study thus supports the alternative hypotheses that ESR and CRP ranges are significantly associated with severity grades of Amavata symptoms and with ACR criteria.

The study suggests further scope for evaluating these associations in male patients and for examining the relationship between symptom severity and ACR criteria across genders. Interventional studies focusing on specific severity grades using ESR and CRP as prognostic parameters are also recommended. Additionally, studies with larger sample sizes may help establish more precise and widely acceptable disease-specific reference ranges for ESR and CRP in Amavata.

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### **Conflicts of interest**

None declared.

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