

Original article:

Can ESR be a diagnostic marker for assessing the severity of malarial infection? A retrospective study

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Abstract:

Objective: This study aimed to investigate the variation of ESR in malarial infection and find out the variation of ESR in related to the degree of parasitemia. **Material and Methods:** A retrospective study with a duration of 6 months, on 385 randomly selected positive malaria cases. Their clinical record and lab records were analyzed for ESR level. **Result:** The sample of 385 positive malaria cases has included both males and females, ages ranged from 15-60 years old. A total number of *Plasmodium.falciparum* was 60 (uncomplicated & severe cases) and for *Plasmodiumvivax* was 325. In *P.vivax* infection the raised values were seen in 174 cases (53.5%) and in *P.falciparum* infection it was seen in 36 cases (60%). The degree of parasitemia did not show any significant rise in ESR in case of malarial infection. **Conclusion:** In our investigation, the degree of parasitemia did not show a significant rise in ESR except in the case of occasional parasitemia. We assume that the rise in ESR may be due to inflammatory process during infection or due to the presence of inclusion bodies

Keywords: Malaria; Parasitemia; ESR

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Introduction:

Malaria continues to be one of the critical public health problems. Udupi district is located on the western coast of Karnataka State in India. It was relatively free from malaria until early 1990 with only sporadic case reports. However, since 1990, with a sudden increase of industrialisation and construction activities, malaria has made a comeback¹. It is difficult to distinguish malaria from other infection like viral or bacterial based on the symptoms and signs². The malaria species that cause human infection are *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium malariae* and *Plasmodium ovale*. In India, most common are *Plasmodium falciparum* and *Plasmodium vivax*.

Hematological changes are some of the common complications in malaria, and they play a significant

role in malaria pathogenesis³. The patients suffering from malaria, there was high incidence of haematological disturbances, which was changing pattern⁴ and ESR is one of the haematological parameter elevated during malarial infection. Erythrocyte sedimentation rate (ESR) is one of the hematological test for prognosis and even for diagnosis of specific clinical conditions. Though it is a nonspecific hematological test, it is commonly used as an indicator of inflammation, infection, trauma, malignant disease, rheumatoid arthritis and systemic lupus erythematosus⁵. The merozoites of *Plasmodium* species invade the red cells and develop into trophozoites they may appear as cytoplasmic inclusion bodies within erythrocytes⁶. There has been no study of ESR role in acute malarial infection in the western coast of Karnataka. The study was

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undertaken to elucidate the association of ESR as a hematological index in malarial infection to explore whether this parameter is unique to disease or act as a potential diagnostic marker.

Materials and Methods: A retrospective study done in a tertiary care medical institute at Manipal, Karnataka, India. We conducted a study on 385 randomly selected positive malaria cases, in them the diagnosis of malaria established by Qualitative Buffy Coat (QBC) analysis method. The results of positive cases Plasmodium *falciparum* and Plasmodium *vivax*, the severity of the parasitemia noted. The results of ESR corresponding to those malaria positive cases and against parasitemia collected from the Hematology and Clinical Pathology Laboratory, Kasturba Hospital, Manipal. The data analyzed for the variation in erythrocyte sedimentation rate related to the degree of parasitemia.

Quantitation of parasite load grading parasite / QBC field: Occasional parasite / QBC field, (+) = <1 parasite / QBC field, (++) = 1-10 parasite / QBC field, (+++) = 11-100 parasite / QBC field.

Erythrocyte sedimentation rate (ESR) done by Ves-Matic Cube80⁷. Which is a benchtop automated instrument designed and programmed for the analysis of ESR test, according to the Westergren method. ESR is a common but nonspecific test that is often used as an indicator of active disease. It reflects the tendency of red blood cells to settle more rapidly in the face of some disease states. The ESR is directly proportional to the mass of RBC and inversely proportional to the viscosity of plasma. In normal whole blood, RBCs do not form rouleaux; the mass of RBC is small and therefore the ESR is decreased (cells settle out slowly). In abnormal conditions when RBCs can form rouleaux, the mass of the RBC is higher, thus increasing the ESR (cells settle out faster). Mean ESR range in healthy people <20 mm/hr.⁷

Statistical analysis: The collected data analyzed by percentage and standard deviation and presented by tables.

Ethical Clearance: The ethics committee of the Kasturba Medical College and Hospital, Manipal approved the study.

Results: The sample of 385 positive malaria cases included both males and females, with the ages ranged from 15-60 years old; there was a male preponderance with a ratio 1.8:1.0. In the study, ESR

was raised in 210 cases (54.5%) and normal in 175 cases (45.5%). A total number of all Plasmodium. *Falciparum* was 60 (uncomplicated & severe cases), and for Plasmodium *vivax* was 325. In *P.vivax* infection raised values were seen in 174 cases (53.5%) and in *P.falciparum* infection it was seen in 36 cases (60%) (Table.1). The degree of parasitemia did not show any significant rise in ESR in case of malarial infection (Table.2).

Table no. 1: Variation of ESR in malarial infection

		ESR		TOTAL
		Normal result	Increased result	
Malaria species	<i>P.falciparum</i>	40%	60%	100%
	<i>P.vivax</i>	46.5%	53.5%	100%
TOTAL		45.5%	54.5%	100%

Table no.2: Degree of parasitemia did not show any significant rise in ESR in case of malarial infection. (Normal range 0-20mm/hr)

Degree of parasitemia	Mean ESR (mm/hr)	Number of cases	Standard deviation
Occasional	53.38	8	32.6
1+	22.88	16	26.0
2+	33.25	52	30.8
3+	27.14	79	22.1
4+	31.02	230	26.4
Total	30.65	385	26.5

N= number of cases SD=Standard deviation

Discussion:

Malarial infection is a mosquito-borne infectious disease, which is now common on the west coast of Karnataka, India. The hallmark of the disease is intra erythrocytic parasite infection. Erythrocyte is the primary target of the malarial parasite infection which leads to changes in the infected RBC's. Thus an investigation was conducted to demonstrate whether the ESR can be used as diagnostic blood marker to assess the severity of the malarial infection. A study conducted by Autaet al.,⁸ stated increased level of ESR in malarial infection (21.05mm/hr) In our study, also, we found an increase in ESR (30.65mm/hr) level in relation to malarial infection, but it was not significant. An investigation done by Oros Supcharoen et al.,⁹ demonstrated that ESR elevation during acute malarial infection and declined with

recovery. The elevated ESR level during acute illness may be due to the acute process of disease which is a non-specific change. However, change during the illness may be due to the inflammatory process by the host in response to the infection. This could be one reason-elevated level of ESR in malarial infection. Another reason for the insignificant elevation of ESR may be due to inclusion bodies. Studies conducted by Viroj Wiwanitkit^{10,11} reported RBC inclusion would increase erythrocyte sedimentation rate by adding additional mass to RBC's and this can reduce the time for sedimentation ESR. This may be another reason for the insignificant elevation of ESR in malarial infection.

In the present study conducted we could demonstrate only slightly raise in ESR from normal range in case of 2+ , 3+ and 4+ of *P. falciparum* parasitemia but in *P. vivax* we could find maximum ESR raised during 4+ parasitemia. Over all mean ESR was 30.65mm/hr, these shows raise but not significant raise. As discussed the elevation in ESR could be due to host response to malarial infection or malarial inclusion bodies

Conclusion:

In our investigation, the degree of parasitemia did not show a significant rise in ESR except in the case of occasional parasitemia. We assume that the rise in ESR may be due to inflammatory process during

infection or due to the presence of inclusion bodies. Considering ESR alone as a biomarker for assessing the severity of malarial infection may not be a good idea. Considering other blood parameter along with the ESR may give a better assessment of severity of parasitemia.

Limitations of the study

In the current study, only the role of ESR in malaria infection was undertaken. The study should have included other erythrocyte parameters and association of these with malarial parasitemia.

Conflict of interest: None of the researchers has a conflict of interest in the study conducted.

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Authors' contribution:

Data gathering and idea owner of this study: Patil A, Muduthan VR, Kunder G

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Writing and submitting manuscript: Patil A, Muduthan VR

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Reference:

1. Dayanand KK, Punnath K, Chandrashekar V, Achur RN, Kakkilaya SB, Ghosh SK, Kumari S, Gowda DC. Malaria prevalence in Mangaluru city area in the southwestern coastal region of India. *Malaria journal*. 2017 Dec;16(1):492. <https://malariajournal.biomedcentral.com/articles/10.1186/s12936-017-2141-0>
2. Lathia TB, Joshi R. Can hematological parameters discriminate malaria from nonmalarious acute febrile illness in the tropics?. *Indian Journal of Medical Sciences*. 2004 Jun 1;58(6): 239 <http://search.proquest.com/openview/af1062980dcb6f067eeace73c61c2847/1?pq-origsite=gscholar&cbl=46836>
3. Bakhubaira S. Hematological parameters in severe complicated Plasmodium falciparum malaria among adults in Aden. *Turkish Journal of Hematology*. 2013 Dec;30(4):394. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3874965/>
4. Mukherjee J, Chakrabarty P, Sinharoy U, Brojobasi B. Change in Hematological disturbances in Malaria in Eastern India: an observational study. *Bangladesh Journal of Medical Science*. 2016 Nov 3;15(3):403-8. <https://www.banglajol.info/index.php/BJMS/article/viewFile/19192/20255>
5. K.D.Chatterjee,:Text book of Parasitology, 13th edition.,CBS Pub.,90-95(2009).
6. Lynch E. C. Peripheral blood smear. In: Walker H. K., Hall W. D., Hurst J. W., editors. *Clinical Methods: The History, Physical, and Laboratory Examinations*. Boston, Mass, USA: Butterworths; 1990. <https://www.ncbi.nlm.nih.gov/books/NBK263/>
7. Happe MR, Battafarano DF, Dooley DP, Rennie TA, Murphy FT, Casey TJ, et al. Validation of the Dienes Mini-Ves Erythrocyte Sedimentation Rate (ESR) Analyzer Using the Westergren ESR Method in Patients With Systemic Inflammatory Conditions. *American Journal of Clinical Pathology*. 2002;118(1):14–17 <https://academic.oup.com/ajcp/article-pdf/118/1/14/4984451/ajcpath118-0014.pdf>
8. Auta T, Runka JY, Bawa JA, Sa'adatu SK. Haemoprevalence of malaria and haematological parameters of febrile patients in a hospital in Dutsin-Ma town, North Western Nigeria. *Biosciences Research in Today's World*. 2016;2: 8-14. https://www.researchgate.net/profile/Timothy_Auta/publication/305222335_Haemoprevalence_of_malaria_and_haematological_parameters_of_febrile_patients_in_a_hospital_in_DutsinMa_town_North-Western_Nigeria/links/5785560508ae36ad40a4c315/Haemoprevalence-of-malaria-and-haematological-parameters-of-febrile-patients-in-a-hospital-in-Dutsin-Ma-town-North-Western-Nigeria.pdf
9. Supcharoen O, Widjaja H, Ali KB, Kitayaporn D, Pukrittayakamee S, Wilairatana P et al. A study of erythrocyte sedimentation rate in malaria. *J Infect Dis Antimicrob Agents*.1992;4(9):193-99. <http://www.tm.mahidol.ac.th/social-environment/?q=publication2#1992>
10. Wiwanitkit V. Red blood cell inclusion will increase erythrocyte sedimentation rate. *Journal of Medical Hypotheses and Ideas*. 2008; 2:11. <http://ijmhi.tums.ac.ir/index.php/ijmhi/article/download/27/27>
11. Wiwanitkit V. Malarial parasite infection and increase of erythrocyte sedimentation rate. *Journal of Medical Hypotheses and Ideas*. 2008;2:20. <http://ijmhi.tums.ac.ir/index.php/ijmhi/article/download/36/36>