Research Article

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EPIDEMIOLOGICAL REVIEW OF MALARIA WITH REFERENCE TO CAUSALITY ANALYSIS, TREATMENT MONITORING AND OUTCOME

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ABSTRACT
Primary objective of the study was to assess causality analysis by patient profile, clinical and laboratory assessment. Secondary objective was to assess the Treatment patterns, clinical outcome, and outcome determinants leading to mortality. 150 Patients, diagnosed as malaria and admitted in medicine ward at Tertiary Care Center were enrolled over a period of 8 months after written informed consent. Their demographics as age, sex, and habitat and blood Investigations, especially parasite index (PI), gametocyte study, hemoglobin, platelet count were noted. Treatment of patients and their progress and outcome was noted .Descriptive statistics was used for analysis. Out of 150 patients 127 (85 %) were males and 23 (15 %) were females. Young age and lower socio-economic class was more affected. 88 % patients showed typical symptoms. Artesunate (88 %) was most commonly used followed by Chloroquine (12 %). Cure rate was 93 %. Majority (73 %) patients had parasitic index up to 3 %. 40 (26.68 %) patients showed parasitic index between 4 – 14 %. 93 Patients (62 %) had platelet count up to one lakh. *P. Vivax* infection (64 %) was most common followed by *P. Falciparum* (29 %) and mixed infection (7 %). Young age, lower income group, and mobility are risk factor for malaria. Low Hb, thrombocytopenia, high parasite index, old age, co morbid conditions are poor prognostic factors.
Keywords: Malaria, Young age, Low Hb, Thrombocytopenia, Parasite index, Mobility

INTRODUCTION

Malaria, a disease of antiquity, has proved to be a formidable deterrent to the cultural and socioeconomic progress of man in the tropical, sub-tropical and monsoon prone zones of the world.[1] it is a major public health problem and more than 300 million cases are recorded every year around the globe. One to two million deaths are estimated every year, especially in Africa from where 90 % of cases are reported.[2]

Malaria is widely rampant in India. As per factsheet on the World Malaria Report 2012, in South East Asia, the second most affected region in the world, India has the highest malaria burden (with an estimated 24 million cases per year), followed by Indonesia and Myanmar. Of these about half are due to *P. Falciparum*.[3]

A recently published study from Orissa showed that the mortality in cases with severe malaria was 12 %.[4] Studies have shown that delayed diagnosis was one of the important factors associated with death and hence early identification of these risk factors may help in limiting the morbidity and mortality due to malaria.[5]

The disease manifests with sudden onset of high fever with rigors and sensation of extreme cold followed by feeling of burning heat, leading to profuse sweating and remission of fever by crisis thereafter. The febrile paroxysms occur every alternate day. Headache, body ache, nausea, etc. may be associated features. However in atypical cases, classical presentation may not manifest. Malaria transmission occurs in almost all areas of India except areas above 1800 meters of sea level. Country's 95 % population lives in malaria risk areas. In the Southeastern Asian Region of WHO, out of 1.4 billion people living in 11 countries (land area, 8,466,600 km^2; i.e., 6 % of global area), 1.2 billion are exposed to the risk of malaria, most of whom live in India; India alone contributed 76 % of the total cases.[7]

Case definition of malaria is as follows "Clinical case description: - Any patient of fever with any of the following symptoms: Chills, sweating, nausea, headache, vomiting, jaundice or splenomegaly." Convulsions, coma, shock, pulmonary edema and death may be associated in severe cases.[8]

Data from the 1990s suggested that as many as 90 % of all malarial cases and 90 % of deaths took place in sub-Saharan Africa, where levels of endemicity are high, and severe disease and mortality occur primarily during infancy and early childhood. More recent data-driven models indicate that up to one third of the global incidence may occur outside of Africa and that 25 % of the world's clinical cases in 2002 occurred in South and Southeast Asia, where passive reporting may significantly underestimate the disease burden. India is one of the major contributors to malarial morbidity and mortality in this part of the world.[9]

A retrospective, epidemiological study was carried out in Ahmadabad city, which has a population of about 3 million. Surveillance data for the years 1965-1998 showed a gradual resurgence of malaria between 1967 to 1976; followed by waves of low and high incidences. Major public and private health facilities in the city were

analyzed, for the period between 1991 and 1998, *P. vivax* was found to account for 69 % of all malaria cases and *P. falciparum* for the other 31 %. The annual numbers of malaria-attributable deaths were strongly correlated with the incidence of *P. falciparum* (r = 0.88). The malaria incidence detected 37,431 cases, *Plasmodium vivax* always predominated but the proportion of cases attributed to *P. falciparum* increased markedly from 1983. The surveillance data and health records representing a mean annual incidence of 12.2 cases/1000) was nine times greater than that officially reported (4119 cases, or 1.3 cases/1000 each year). Similarly, the annual malaria-attributable mortality detected (22 deaths/million) was far higher than that officially notified (0.3 death/million).[10]
The study performed on spatial malaria epidemiology in Bangladeshi highlands and was done to detect clusters of malaria and identify the geographic risk factors showed that average malaria prevalence was 15.47 % (n = 750). Malaria cases were significantly associated with proximity to water bodies and forests.[11]
Study of malaria in Lebanon in September 1994–August 1997, concluded that there was a high frequency of requests for malaria tests (smears), and mainly performed as a routine investigation for travelling purposes. A total of 228 malaria cases were detected during the study period (1.3 % of requested smears). *P. falciparum* proved to be the predominant type (88.9 %), while *P. vivax* was rarely identified (5.6 %). The laboratory investigations were not standardized over the country, nor were the case reporting technique. It was suggested that the resurgence of malaria in Lebanon in recent years could be attributed to emigrants from Africa due the high relative frequency of *P. falciparum* compared to *P. vivax*, the latter proved to be of an endogenous origin.[12]
The study done on tribal Malaria, an update on Changing Epidemiology by Neeru Singh in Madhya Pradesh, India observed that three districts (Mandla, Dindori, and Jhabua) contributed 57 % of state's malaria and 60 % *P. falciparum* infection while their population was only about 4.99 % of the state population. Similarly Betul (Population 1.4 million) was accounted for 10 % of all malaria cases in MP while it harbored less than 1 % of the state population. Consequently, a gradual decline in malaria prevalence rate was recorded from 1998 onwards. The lowest incidence was found in 2002, when overall 64 % and 61 % reduction was recorded in malaria and *P. falciparum* respectively. Later on this tempo could not be maintained and malaria and *P. falciparum* started increasing in the 2003 (11 and 22 %) and in 2004 (50 and 106 % respectively) followed by a marginal decline in 2005 (19 and 9 %) and in 2006 (36 and 21 %) respectively in number of malaria and *P. falciparum* cases.[13]
Ethnographic study carried out in Mumbai and Navi Mumbai, India on private general practitioners (GPs) and their role in the management of malaria at a time when these two neighboring cities were in the midst of the worst malaria epidemic in over 60 years. This study described the characteristics of a sample of 48 private practitioners from the two cities, and their clinics over a 9-month period. The findings of the study suggest that many practitioners in Mumbai and Navi Mumbai, India were poorly qualified and did not play a supportive role in the two cities' public health departments to bring the epidemic under control. The majority of the practitioners adopted diagnostic and treatment practices that were not consistent with the guidelines lay down by WHO and India's National Malaria Eradication Program. Very few practitioners, especially those practicing in low-income areas, relied on a peripheral blood-smear test to make a diagnosis. Practitioners whose clients were mostly the poor, commonly managed by giving one-day treatment to febrile patients that included injectable anti malarials and broad spectrum antibiotics. Such practitioners justified their mode of diagnosis and treatment by asserting that they were only responding to the demands placed on them by their patients who could not afford a blood-smear test or a full prescription.[14]

Objectives

Primary objective of the study was to assess causality analysis by complete patient profile and with clinical and laboratorial assessment. S
econdary objective was to assess the Treatment patterns, clinical outcome, and the outcome determinants leading to mortality.

Methodology

Ethics Committee approval was taken from Committee for Academic Research Ethics, Seth, GS Medical College and KEM Hospital, Parel, Mumbai, India. The study was conducted in compliance with "ICH-GCP". This was a cross sectional study. 150 Patients, diagnosed as malaria and admitted in medicine ward at tertiary care center were enrolled over a period of 8 months after written informed consent. After inclusion of patients their demographics as age, sex, and habitat was noted. Blood Investigations, especially parasite index (PI), gametocyte study, hemoglobin, platelet count were noted. Patients were categorized according to their type and severity of infection. Patients were visited alternate day for their progress and their treatment was noted throughout hospitalization period.
The management given and outcome was assessed. The collected data was analyzed with regards to type of infection and severity of disease for causal analysis. Finally the clinical outcome for each patient was noted and outcome determinants were discussed with the help of collected data.

RESULTS

Gender and age wise distribution of Malaria cases

Out of 150 patients it was found 127 (85 %) were males; whereas 23 (15 %) were females. Patients in young age group (from age 18-38) were found to be affected most (55 %) (Table 1)
Most of the patients were infected with *P. vivax* (64 %) where as *P. falciparum* was found in 44 (29 %) patients. 10 (7 %) patients were infested with mixed malaria. 15 (10 %) patients were having recurrence of Malaria within period of last six months while 35 (90 %) patients did not have recurrence of Malaria for last 2 years.

Table 1: Gender Wise and Age Wise Distribution of Malaria Cases

Age	Gender		Total
	Male	Female	
18 - 28	43 (29 %)	2 (1 %)	45 (30 %)
28 - 38	33 (22 %)	5 (3 %)	38 (25 %)
38 - 48	21 (14 %)	4 (3 %)	25 (17 %)
48 - 58	10 (7 %)	8 (5 %)	18 (12 %)
58 - 65	20 (13 %)	4 (3 %)	24 (16 %)
total	127 (85 %)	23 (15 %)	150 (100 %)

Table 2: Occupation and Mobility Status of Malaria Patients

Occupation	Mobility		No of patients
	Yes	No	
Professionals	13	4	17 (11.33 %)
Skilled	26	2	28 (18.66 %)
Unskilled	37	3	40 (26.66 %)
Semiskilled	22	11	33 (22 %)
Unemployed / students	14	3	17 (11.33 %)
Housewives	00	15	15 (10 %)
Total	112	38	150 (100 %)

Table 3: No of Patients of Malaria Having Differential Parasitic Index

Parasite Index	Gender		Total no. of patients
	Male	Female	
1 %	59	9	68 (45.33 %)
2 %	18	5	23 (15.33 %)
3 %	16	3	19 (12.66 %)
4 %	16	2	18 (12 %)
5 %	4	1	5 (3.33 %)
6 %	1	0	1 (0.66 %)
7 %	1	0	1 (0.66 %)
8 %	3	1	4 (2.66 %)
9 %	2	1	3 (2 %)
10 %	2	0	2 (1.33 %)
12 %	1	0	1 (0.66 %)
13 %	2	1	3 (2 %)
14 %	2	0	2 (1.33 %)
Total	127	23	150 (100 %)

Table 4: Details about Sex, Gametocyte Type, and Therapy of Ten Patients Who Died

Parameter	No. of patients who died (%)
Males	7 (4.66 %)
Females	3 (2 %)
P. vivax gametocyte	7 (4.66 %)
P. falciparum gametocyte	3 (2 %)
Artesunate therapy	9 (6 %)
Chloroquine therapy	1 (0.66 %)

Table 5: Details about History of Illness in Ten Patients Who Died

History of illness (days)	No. of patients who died (%)
3	2 (1.33 %)
4	2 (1.33 %)
5	2 (1.33 %)
7	3 (2 %)
8	1 (0.66 %)

Table 6: Details about Hospitalization Period of Ten Patients Who Died

Hospitalization Period (Days)	No. of patients who died (%)
1	3 (2 %)
2	4 (2.66 %)
3	1 (0.66 %)
5	2 (1.33 %)

Table 7: Details about Parasite Index of Ten Patients Who Died

Parasite Index (%)	No. of patients who died (%)
2	3 (2 %)
3	1 (0.66 %)
4	6 (4 %)

Table 8: Details about Hemoglobin Levels in Ten Patients Who Died

Hemoglobin level (g%)	No. of patients who died (%)
7 - 8.9	3 (2 %)
9 - 10.9	5 (3.33 %)
11 and above	2 (1.33 %)

62 % patients platelet counts were below 100000 and platelet count below 50000 was found in 21 % patients.
Out of 150 patients, 110 patients were earning income. Almost half of the patients (52 %) were earning income less than six thousand rupees.

Occupation and mobility status of Malaria patients
Majority of patients (48 %) were unskilled and semiskilled and were found to be revolving in and around city for the daily employment reasons. (Table 2)

No of patients of Malaria having differential Parasitic Index (P.I.)
About 73 % patients had parasitic index up to 3 %. 40 (26.68 %) patients showed parasitic index between 4-14 %. 50 (33 %) patients took treatment from private practitioners before coming to hospital. Most of these patients (74 %) were having P.I. of 1 %. 37 patients were treated symptomatically and not given any anti-malarial therapy. 13 patients were treated with chloroquine but they discontinued the treatment. Three patients died in hospital and 47 patients's recovered following treatment in hospital. Majority of patients (88 %) were given inj. Artesunate while 12 % patients were given oral Chloroquine. Average recovery period was 3.44 days. Cure rate was 93 %. 10 patients i.e. 7 % died. (Table 3)

Details about sex, gametocyte type, and therapy of ten patients who died
P. vivax caused 7 deaths and 3 deaths occurred due to *P. falciparum*. (Table 4)

Details about history of illness in ten patients who died
All of these patients were having history of illness from last 3-8 days (Table 5)

Details about hospitalization period of ten patients who died
Most of the patients were hospitalized up to 2 days before death. (Table 6)

Details about Parasite Index of ten patients who died
Most of deaths occurred in patients who were having parasite index 4 %. (Table 7)

Details about Hemoglobin levels in ten patients who died
Hb% was between 7 - 11 g% in 8 patients who died. All dead patients were having platelet count below 90000. Age of seven patients was between 50-65 years. The main causes of deaths were revealed to be metabolic acidosis, severe hepatic, cerebral and renal involvement, respiratory and cardiac involvement. (Table 8)

DISCUSSION

Sex and Age Distribution
The study was conducted in 150 patients. It revealed that 85 % patients were males where as 15 % patients were females. The reason for incidence of disease more in males may be related with their daily ambulation at different places. The incidence of malaria was found more in young age group. 55 % of cases were found in 18-38 age groups. This is the age group which is constantly mobile. Seven out of ten patients who died belonged to age group 50 to 65 years indicating old age as poor prognostic factor.

Incidence and Recurrence
The incidence of *Plasmodium vivax* (64 %) found to be more in this study. The number of deaths due to *P. vivax* was also more due to high incidence. Previous studies conducted also showed same inferences about the incidence.[10,12] 10 % of patients got recurrence of malaria within last six months of period. This definitely rings alarm for their locality which has turned more disease prone.

Income status
Almost half of the patients (52 %) were earning income less than six thousand rupees. The likely reason for incidence of malaria more in lower income group is that they had unprotected shelter, less facilities and limited access for sanitation.

Investigational findings
Most of deaths occurred in patients who were having parasite index 4 %, platelet count below 90000 and Hb between 7-11 g%. This indicated high parasite index thrombocytopenia and low Hb as poor prognostic factors.

Treatment observations
Majority of patients (88 %) were given inj. Artesunate while 12 % patients were given Chloroquine. The average time required for patient's recovery was 3.44 days. But as *Vivax* affected patients took more time for recovery (avg. 4 days) it can be assumed that *vivax* is less responsive to Artesunate. It was found that, 90 % of patients were suffering from symptoms since 2 days before they were admitted to hospital. These two days worsened the clinical condition and increased the time for treatment. Combination treatment of Artesunate and Primaquine can help reduce the symptoms effectively. Most of patients were given Primaquine on discharge. This underlines the need for proper implementation of ideal drug regimen for treatment of malaria.

Outcome
Out of 150 patients, 93 % patients were cured but 7 % patients died. It was observed that 18 patients presented atypical symptoms, out of which 7 patients died. They had co-morbid conditions which deteriorated the overall clinical picture.
Most of deaths occurred in patients who had parasitic index up to 4 %, low Hb, infection with *P. vivax*, platelet count below 90000, and old age (between 50-65 years) and co-morbid conditions. These patients had history of illness since last three to eight days and most of them required hospitalization for up to two days before death. Most of the deaths occurred due to cardio respiratory arrest and serious hepatic and renal involvement.

CONCLUSION
This study concludes that the young age group, lower income group, and mobility are risk factor for malaria. Referred patients had more severe presentation of disease than those who directly visited the tertiary care center. Low Hb, thrombocytopenia, high parasite index, old age, and co morbid conditions are poor prognostic factors.

REFERENCES

1. Lal S, Sonal GS, Phukan PS. Status of Malaria in India. J Ind academics for clinical medicine 1998; 5: 20-23.
2. Gupta R, Gupta R. Malaria millennium development goals, treatment costs and generics. Current science 2005; 89(5): 730.
3. World Health Organization. Factsheet on the World Malaria Report Available from: http://www.who.int/malaria/media/world_malaria_report_2012_facts/en/; 2012.
4. Tripathy R, Parida S, Das L, *et al*. Clinical Manifestations and predictors of Severe Malaria in Indian Children. Pediatrics. 2007; 120: 454-460. http://dx.doi.org/10.1542/peds.2006-3171 PMid:17766489
5. Kumar A, Valencha N, Jain T, Dash A. Burden of Malaria in India: Retrospective and Prospective and View. Am J Trop Med Hyg 2007; 77(6): 69-78. PMid:18165477
6. World Health Organization. The World Health Report: Reducing Risks, Promoting Healthy Life. Geneva, Switzerland: World Health Organization, Available from: http://www.who.int/whr/2002/en/whr02_en.pdf; 2002.
7. Ringwald P. Resistant malaria in children. Indian Pediatrics 2001; 38(1): 9-14. PMid:11175928
8. IDSP case definition: medicos11.com Available from: http://whoindia.healthrepository.org/bitstream/123456789/195/5/IDSP_Ch2_case_Definitions.pdf; 2013.
9. World Health Organization. Severe *falciparum* malaria. World Health Organization, communicable diseases cluster. Trans R Soc Trop Med Hyg 2000; 94(supply): S1S90. [Web of Science][Medline]
10. Yadav RS, Bhatt RM, Kohli VK, Sharma VP. The burden of malaria in Ahmadabad city, India: a retrospective analysis of reported cases and deaths. Annals of Tropical Medicine and Parasitology 2003; 97(8): 793-802. http://dx.doi.org/10.1179/000349803225002642 PMid:14754491
11. Haque U, Huda M, Hossain A, Ahmed SM, Moniruzzaman M, Haque R. Spatial malaria epidemiology in Bangladeshi highlands, Malaria Journal 2009, 8: 185. http://dx.doi.org/10.1186/1475-2875-8-185 PMid:19653914 PMCid:PMC2732922
12. Ghassa AI Awar. Malaria in Lebanon: the current state, September 1994 – August 1997 Available from: http://applications.emro.who.int/dsaf/dsa519.pdf
13. Neeru Singh. Tribal Malaria, an Update on Changing Epidemiology. State wise malaria situation during 1997-2006. National Vector Borne Disease Control Programme. Available from:

http://www.rmrct.org/files_rmrc_web/centre%27s_publications/NSTH_06/NSTH06_6.N.Singh.pdf
14. Kamat VR. Private practitioners and their role in the resurgence of malaria in Mumbai and Navi Mumbai, India: serving the affected or aiding an epidemic? Soc. Sci. Med 2001; 52: 885-909. http://dx.doi.org/10.1016/S0277-9536(00)00191-X

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