Morbidity and Mortality of Malaria during Monsoon Flood of 2011: South East Asia Experience

*Muhammad Sadik MEMON [1], Shamsuddin SOLANGI [2], Shabana LAKHO [1], Zain Islam ARAIN [2], Farukh NAZ [2], Madiha ZAKI [2]

1. Dept. of Gastroenterology & Hepatology, Isra University Hospital, Hyderabad, Pakistan
2. Dept. of Medicine, Isra University Hospital, Hyderabad, Pakistan

*Corresponding Author: Email: drsadikmemon@hotmail.com

Abstract

Background: Malaria is the second most frequent clinically suspected disease entity after acute respiratory tract infection in developing countries. Active malarial transmission occurs throughout the year, while aggressive out bursts of disease are seen mainly during and after the 'monsoon' season. This study aimed to determine the morbidity and mortality associated with malaria during flood at Isra University Hospital, Hyderabad.

Methods: This prospective observational study was done at Isra University Hospital Hyderabad during monsoon flooding from July 2011 to October 2011. All 883 patients presented with symptoms of malaria (fever, headache, and vomiting) were evaluated and diagnostic tool ICT-MP was used for the detection of malaria parasite among them.

Results: Seventy four (8.38%) patients diagnosed for malaria. The mean age and SD was 30.11 ± 1.67 years. Overall mortality due to malaria observed (18.9%). Mortality rate significantly observed high in pregnant women (0.005) and in those patients who developed complications such as, pneumonia ($P = 0.04$), renal failure ($P = 0.04$), Unconsciousness ($P = 0.001$), and Septicemia ($P = 0.001$).

Conclusion: A Significant increase in the morbidity and mortality in patients with malaria after flood noticed. The probability of getting poor outcome is also associated when patient develop complications.

Keywords: Malaria, Monsoon, Flood, Disease burden

Introduction

Various epidemiological data suggests that malaria is still a major public health concern in an unindustrialized countries and is associated with high rates of morbidity and mortality throughout most of the tropics (1) and malaria also the second most frequent clinically suspected disease entity after acute respiratory tract infection (2). In Pakistan, with an estimated 1.5 million cases annually reported and according to W.H.O malaria has re-emerged as a major cause of morbidity in Pakistan (3). Review of previous literatures showed that approximately 3 billion people living in 108 countries who are exposed, approxi-mately 300 - 500 million people develop symptomatic malaria annually (4). In tropics *Plasmodium falciparum* is the major cause of malaria associated mortality, ranging from 65% - 95% (5) as compare to *P*. vivax and *P*. knowlesi (6,7).

Many risk factors are associated in the transmission of malaria among them, mass population movements within the country and across international borders with Iran and Afghanistan, unpredictable transmission patterns, low immune status of the population, climatic changes, poor socioeconomic conditions, declining health infrastructure, resource constraints, poor access

to preventive and curative services and mounting drug and insecticide resistance in parasites and vectors all contribute to this huge disease burden in Pakistan (8). Directorate of Malaria Control has reported that one person per thousand in the population is infected with malaria. Active malarial transmission happens throughout the year, while aggressive out bursts of disease are seen mainly during and after the 'monsoon' season. People residing in those areas are at an increased risk for malaria related mortality (9).

In Pakistan, severe flooding followed by heavy rains submerged approximately one - fifth of the total land area under water. This affects around 20 million people, mostly by destruction of property and with high death rates due to spread of diseases like dysentery and malaria.

Keeping in view the increased susceptibility of getting infected with malaria due to flood we aimed to conduct this study on determining the morbidity and mortality associated with malaria during monsoon flood at Isra University Hospital, Hyderabad.

Materials and Methods

Study design and setting

This prospective observational study was conducted from July 2011 to October 2011 at Isra University Hospital (IUH), Hyderabad, Pakistan. IUH is a 300 bedded private, tertiary care academic teaching hospital that largely serve the residents of Hyderabad (Population 2 million) and surrounding 6-8 districts of Sindh province.

Patient selection

Patients included in the study were adults (age ≥14 years) man and women diagnosed with malaria during the period of recent monsoon flood of 2011 (July 2011-October 2011). The study protocol was evaluated and approved by the hospital authorities, from where all the study participants were recruited and study was conducted in accordance with the declaration of Helsinki guidelines. All the individuals provided informed consent before their participation.

Data collection

We recruited all patients with symptoms of malaria such as fever, vomiting, headache, and muscular pain etc. Diagnosis of malaria was made on the basis of careful history and complete clinical examination. Diagnosis was confirmed by performing rapid antigen testing i.e. Immuno-chromatographic Malaria Parasite test (ICT MP) and or identification of malaria parasite and its species on thick and thin film smear stained with Giemsa stain. During the four months period which constituted 883 numbers of patients among them malaria was diagnosed in 74 (8.38%) patients.

Once the diagnosis of malaria made, investigations were performed (complete blood count, estimated sedimentation rate, serum creatinine, random blood sugar level, liver functions test, and serum electrolytes) to further evaluate the patients for malaria related complications.

Questionnaires were used to collect the required data such as demographic details. Severity related variables such as degree of temperature, length of hospital stay, level of consciousness, associated complications such as pneumonia, seizures, and acute renal failure and associated co-morbid i.e. diabetes mellitus, hypertension, and pregnancy.

Diagnosed patients of malaria were treated with anti-malarial drugs, those who were able to took orally, given chloroquine, artemether, and quinine and those who were unable to take orally (unconscious patients or severely distressed) treated parentally. Patients were followed clinically as well as biochemically for clearance of parasite and complications during their hospital stay.

Statistical analysis

Data were recorded in standardized data sheet and analyzed in Statistical Package for Social Sciences 16.0 version. The descriptive analysis was done for demographic profile. Results are expressed as mean $\pm$ standard deviation for continuous variables and number (percentage) for categorical variables. Univariate analysis was performed by using the independent sample *t*-test corresponding to difference of means and Pearson Chi-square or Fisher's exact test corresponding to proportions whenever appropriate. Odds ratio (OR) and 95% CI (confidence interval) were estimated to identify the strength of association with independent factors. *P*-value < 0.05 was considered as statistically significant and all *P*-values are two sided.

Multivariate analysis was not done due to small total number of cases.

Results

We collected the information from 74 (8.38%) eligible respondents out of 883 patients presented with fever. We had slightly higher percentage of male subjects as compare to females, 55.4% and 44.6% respectively. Out of total, 51 (68.9%) were rural residents while 23 (31.1%) were urban residents. Overall, 71.6% of the respondents had positive *P. vivax* and 28.4% were *P. falciparum* positive.

There was no any significant association observed between patients' co-morbid with mortality except pregnancy (*P* – value 0.005) (Table1).

Among 74 patients, mortality rate was observed 18.9%. Relation of serum creatinine and duration of stay in hospital were significantly associated with patient's high mortality. Mean increase in the level of serum creatinine (4.12 ± 4.19 – mg/dl) was significantly associated with high mortality (*P* - value <0.001). Conversely, mean increase in the duration of hospital stay was significantly associated with lower mortality (*P* - value <0.01) (Table 2).

Table 1: Co-morbid and its relation with disease outcome

Variables	Improved & discharged (n=60)	Died (n=14)	Total (n=74)	P-Value	OR (95% C.I)
Pregnant					
Yes	3 (5)	5 (35.7)	8 (10.8)	0.005*	1.24(1.1 - 1.3)
No	57 (95)	9 (64.2)	66 (89.2)		
Diabetes Mellitus					
Yes	7(11.7)	1(7.1)	8(10.8)	0.62	1.71(0.1 – 15.2)
No	53(88.3)	13(92.9)	66(89.2)		
Hypertension					
Yes	3(5.0)	1(7.1)	4(5.4)	0.57	0.68(0.06 – 1.11)
No	57(95.0)	13(92.9)	70(94.6)		
IHD					
Yes	2(3.3)	0	2(2.7)	0.48	1.24(1.1 – 1.3)
No	58(96.7)	14(100)	72(97.3)		
HBsAg					
(+ve)	2(3.3)	0	2(2.7)	0.99	1.2(1.1 – 1.3)
(-ve)	58(96.7)	14(100)	72(97.3)		
Anti-HCV					
(+ve)	6(10)	1(7.1)	7(9.5)	0.74	1.4(0.1 – 13.0)
(-ve)	54(90)	13(92.9)	67(90.5)		
COPD					
Yes	2(3.3)	0	2(2.7)	0.98	1.24(1.1 – 1.3)
No	58(96.7)	14(100)	72(97.3)		

*Statistically significant *P* value <0.05/ IHD: Ischemic Heart Disease, COPD: Chronic obstructive pulmonary disease, OR: Odds Ratio, CI: Confidence interval

Table 2: Association of clinical and biochemical data with disease outcome

Variables	Improved & discharged Mean ± SD	Died Mean ± SD	Overall	P-Value
Temperature - ^{0}F	100.57 ± 2.09	100.9 ± 1.49	100.6 ± 1.99	0.55
Platelets-mm3	109.7 ± 91.22	104.2 ± 57.14	108.6 ± 85.50	0.83
Total Bilirubin-mg/dl	4.28 ± 7.70	7.14 ± 10.20	4.82 ± 8.23	0.24
RBS-mg/dl*	111.6 ± 68.07	126 ± 99.64	114.3 ± 74.47	0.51
Hemoglobin-g/dl	9.20 ± 2.97	8.04 ± 3.45	8.98 ± 3.08	0.2
WBC-mm3†	8.21 ± 7.80	9.64 ± 6.08	8.48 ± 7.49	0.52
SGPT‡	50.28 ± 74.66	56.78 ± 39.92	51.51 ± 69.25	0.75
Sodium	136.3 ± 6.50	139.2 ± 8.05	136.8 ± 6.85	0.15
Creatinine-mg/dl	1.33 ± 1.05	4.12 ± 4.19	1.86 ± 2.28	<0.001
Hospital-Days	4.9 ± 1.68	3.6 ± 1.69	4.6 ± 1.74	0.01*

*Statistically significant *P* value <0.05/ RBS: Random blood sugar, WBC: white blood cells, SGPT: Serum Glutamic pyruvic transaminase

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Table 3 shows high mortality rates among intubated and ventilated patients, 57.1% (*P* - value <0.001) and 57.1% (*P* - value <0.001) respectively. Results of the univariate analysis of complications in relation to mortality are shown in Table 4. Independent association of high mortality rate was observed in subjects who developed complications due to malaria. Among them, pneumonia (OR=0.12 CI 95% = 0.01 – 1.3; *P* = 0.04), renal failure (OR=0.2 CI 95% = 0.08 – 0.9; *P* = 0.04), Unconsciousness (OR=0.12 CI 95% = 0.03 – 0.4; *P*= 0.001), and Septicemia (OR=0.12 CI 95% [0.03 – 0.4; *P* = 0.001) were significantly associated complications (Table 4).

Table 3: Association of clinical manifestations with disease outcome

Variables	Improved & discharged (n=60)	Died (n=14)	Total (n=74)	P-Value	OR (95% C.I)
Bleeding					
Yes	14(23.3)	3(21.4)	17(23.0)	0.97	1.1(0.2 – 4.5)
No	46(76.7)	11(78.6)	57(77.0)		
Haematuria					
Yes	8(13.3)	2(14.3)	10(13.5)	0.99	0.9(0.1 – 4.9)
No	52(86.7)	12(85.7)	64(86.5)		
Hypoglycemia					
Yes	8(13.3)	5(35.7)	13(17.6)	0.05*	0.27(0.07 – 1.0)
No	52(86.7)	9(64.3)	61(82.4)		
Intubated					
Yes	2(3.3)	8(57.1)	10(13.5)	<0.001*	0.02(0.004 – 1.5)
No	58(96.7)	6(42.9)	64(86.5)		
Ventilated					
Yes	1(1.7)	8(57.1)	9(12.2)	<0.001*	0.01(0.001 – 0.1)
No	59(98.3)	6(42.9)	65(87.8)		

*Statistically significant *P* value <0.05/ OR: Odds Ratio, CI: Confidence interval

Table 4: Complications and its association with disease outcome

Variables	Improved & discharged (n=60)	Died (n=14)	Total (n=74)	P-Value	OR (95% C.I)
Drowsiness	n (%)	n (%)	n (%)		
Yes	19(31.7)	7(50.0)	26(35.1)	0.22	0.46(0.1 – 1.5)
No	41(68.3)	7(50.0)	48(64.9)		
Jaundice					
Yes	17(28.3)	7(50.0)	24(32.4)	0.2	0.39(0.1 – 1.2)
No	43(71.7)	7(50.0)	50(67.6)		
Seizures					
Yes	4(6.7)	3(21.4)	7(9.5)	0.12	0.26(0.05 – 1.3)
No	56(93.3)	11(78.6)	67(90.5)		
Pneumonia					
Yes	2(3.3)	3(21.4)	5(6.8)	0.04*	0.12(0.01 – 1.3)
No	58(96.7)	11(78.6)	69(93.2)		
Renal failure					
Yes	13(21.7)	7(50.0)	20(27.0)	0.04*	0.2(0.08 – 0.9)
No	47(78.3)	7(50.0)	54(73.0)		
Unconscious					
Yes	14(23.3)	10(71.4)	24(32.4)	0.001*	0.12(0.03 – 0.4)
No	46(76.7)	4(28.6)	50(67.6)		
Septicemia					
Yes	11(18.3)	9(64.3)	20(27.0)	0.001*	0.12(0.03 – 0.4)
No	49(81.7)	5(35.7)	54(73.0)		

*Statistically significant *P* value <0.05/ OR: Odds Ratio, CI: Confidence interval

Discussion

Inter-annual climate variability has been reported to be an important determinant of epidemics, and climate forecasts can be used as early warning of changes of risk in epidemic-prone regions (10).

The morbidity and mortality rate of malaria vary in Pakistan from one area with other and from one season to other season. We observed in this study the morbidity and mortality of malaria, as 8.38% and 18.91% respectively, which is relatively far higher than the previously conducted studies (2, 11, 12). The overall mortality is six folds higher in our study as shown in previously published data (13). One of the explanations is that, change in the world climate is associated with an increased incidence of rain fall and flooding which in turn causes increase risk of vector - borne infections, one of the most common amongst is an upsurge of malaria in malaria endemic areas (14).

In this study we correlated the clinical manifestations, complications and laboratory findings with disease outcome. This study demonstrates that there is no any significant change occurs in the disease outcome with the presence or absence of underlying co-morbid except pregnancy.

Another strong determinant which can be considered an underlying independent factor in poor outcome in patients with malaria is presence of hypoglycemia. Our study shows significant number of deaths (35.7%, $P = 0.05$) associated with poor outcome of disease in hypoglycemic patients. Statistically, the same findings were also observed in previously conducted study (15).

Malaria is also responsible for causing renal derangements and can lead to acute renal failure if not treated, which in turn can affect overall prognosis of the patients with mortality rate can reach up to 75% in severe form of malaria (16). However, various published data have different findings regarding association of malaria with mortality. Some studies are in favor (17) while some studies reject this association (18). This study shows poor outcome ($P<0.001$) of the patient if mean serum creatinine > 4 - mg/dl. The poor outcome with raised serum creatinine level were also observed in a previously conducted study (19). Malaria during pregnancy is a major contributor in increasing rate of mortality ranging from 0.5% - 23% (20, 21). In our study, there is an upward trend noticed with a very high percentage (35%) and significant ($P = 0.005$) relation between pregnancy and death due to malaria. Malaria associated maternal death rate in an international data represent comparatively low percentage (8.5%) than ours (22). This low percentage in their setup could be because of early detection of the disease and start of empiric treatment on time.

Patients who develop complications due to malaria are at very high risk of having treatment failure and increase susceptibility of death. A substantial proportion in our study who develop septicemia, acute renal failure, and pneumonia, (64.3%, $P = 0.001$), (50%, $P = 0.04$), and (21.4%, $P = 0.04$) showed significant association between mortality due to complications of malaria

These findings can be approved by the data published in the past as acute renal failure (23;24) septicemia, and pneumonia (25) are associated with poor outcome of the disease.

There are certain limitations of this study. Most important limitations which can cause bias in this study are smaller sample size and hospital based study which may be unable to reflect actual incidence and mortality of malaria. Since IUH is a private tertiary care hospital, strata belonging to lower socioeconomic could not have an easy access due to the cost factor.

Conclusion

This study shows a significant increase in the morbidity and mortality in patients with malaria after flood. The probability of getting poor outcome is also associated when patient develop complications and patients with pregnancy. The data on malaria morbidity and mortality after flood on larger sample size is needed to validate the results of this study.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission,

redundancy, etc.) have been completely observed by the authors.

Acknowledgements

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