Original Research Article

A comprehensive study of relation of Electrolyte disturabances with malarial infection

Ashish A Patel[1], Himanshu G Patel[1],*, Sandip R Patel[2]

[1]Dept. of Biochemistry, Banas Medical College and Research Institute, Palanpur, Gujarat, India
[2]Dept. of Biochemistry, Dr. N D Desai Faculty of Medical Science and Research, Nadiad, Gujarat, India

A R T I C L E I N F O

A B S T R A C T

Background: Malaria is most prevalent and fulminating disease in India. It is often seen that mortality and morbidity seen in malaria patients is mainly due to disturbances in electrolyte levels, especially that of Sodium and potassium, adversely affecting the hydration status of patient.

Materials and Methods: In the present study, sodium and potassium levels were measured from 100 confirmed cases of malaria, 100 apparently healthy, age-matched individuals were used as control subjects.

Result: A statistically significant ($p < 0.05$) changes were observed in sodium and potassium levels among the two groups.

Decrease in sodium and potassium levels are very frequent in Plasmodium falciparum cases and 11 to 20 year age group.

Conclusion: Hyponatremia and Hypokalemia represents the outcome of severity of disorder. So, all malaria patients should be monitored for electrolyte disturbances and effective treatment should be initiated soon to prevent complications.

1. Introduction

Malaria is the most prevalent, Life-threatening and fulminating disease of the world especially of the developing countries. Malaria is a parasitic disease caused by infection with female anopheles mosquito. Depending on type of malarial parasite, it can be differentiated into four different group i.e. Plasmodium falciparum, Plasmodium vivax, Plasmodium ovale and Plasmodium malaria. The characteristic manifestations of typical malaria are fever, headache, vomiting and other flu-like symptoms. If not treated urgently, malarial infection can lead rapidly to life-threatening complications. Plasmodium Falciparum infection is the most fulminating infection leading to kidney failure, Anemia, cerebral malaria, coma and death.[1]

Malaria is one of the most endemic diseases in India especially in Gujarat. Malaria is the vector borne disease transmitted by bite of anopheles mosquito. Plasmodium falciparum and Plasmodium vivax are most common species in India.[2] Severe complicated malaria is commonly associated with electrolyte disturbances.

The purpose of this study is to establish the correlation between electrolyte disturbances and malaria infections due to infection by plasmodium parasites. It has been said that high secretion of Antidiuretic Hormone (ADH), leads to pathophysiological effects of hyponatremia.[3] Normal range for sodium is 136-145 mEq/L, while normal range for potassium is 3.5-5.5 mEq/L.

2. Materials and Methods

Two groups were selected for this study, study group comprises 100 clinically suspected patients of malaria and later confirmed by microscopic detection of parasites on peripheral smear and detection of antigens of malaria by rapid diagnostic card tests. Control group comprises 100 apparently healthy, age and gender matched individuals. A complete history along with vital parameters, appropriate

* *Corresponding author.*
  E-mail address: himanshugptl76@gmail.com (H. G. Patel).

laboratory investigations was recorded. Sodium and potassium levels were measured with the help of Roche electrolyte analyzer AVL 9180 that utilizes direct ISE method for electrolyte measurement. The objectives of this study were to compare electrolyte level in both groups.

3. Result

Table 1 shows characteristics of study participants. Total 100 malaria cases and 100 age and gender matched healthy control were enrolled in this study. Mean age in the case group was comparable with control group (29.5 ± 5.5 v/s 28.9 ± 4.5, $p > 0.05$). In both groups, number of male and female subjects was similar. In case group, 57 patients had P. vivax infection and rest of subjects had P. falciparum infection.

Figures 1 and 2 shows the Na+ and K+ mean value of malaria case and healthy control groups. Both electrolytes in malaria patients were statistically significantly lower than control group (Case v/s control - Na+: 128.9 ± 4.45 v/s 138.7 ± 3.32, $p < 0.05$, K+ : 3.15 ± 0.78 v/s 4.3 ± 0.66, $p < 0.05$).

Electrolyte level of malaria patients was compared with different age groups in Table 2 (A) andTable 3 (B). Na^+ and K^+ level was significantly lower in the 11 to 20 years age groups as compared to other age groups. Table 4 shows any significant difference in level in male and female malaria patients (Male v/s Female - Na^+: 128.31 ± 3.50 v/s 129.82 ± 4.51, $p > 0.05$, K^+: 3.18 ± 0.88 v/s 2.99 ± 0.72, $p > 0.05$). Na^+ was significantly lower in P. falciparum infection (126.4 ± 4.00) than P. Vivax infection 129.9 ± 4.40, $p < 0.05$. Similarly K^+ was also lower in P. falciparum infection (2.91 ± 0.78) as compared to P. Vivax infection 3.30 ± 0.88, $p < 0.05$).

Table 1: Characteristics of study participants

Characteristics	Case	Control	p value
Age (year)	29.50 ± 5.51	28.90 ± 4.52	> 0.05
Gender (m/f)	50/50	50/50	> 0.05
PV/PF	57/43	NA	NA

Table 2: Age group wise comparison of electrolyte level in malaria subjects

Age group	N	Na^+ (mEq/L)	K^+ (mEq/L)
1 to 10	16	130.20 ± 3.40	3.12 ± 0.17
11 to 20	21	127.21 ± 2.30	2.91 ± 0.43
21 to 30	22	129.30 ± 4.21	2.92 ± 0.53
31 to 40	30	132.21 ± 2.92	3.11 ± 0.31
> 40	11	130.00 ± 3.61	3.11 ± 0.22

4. Discussion

In the tropical regions of world, malaria is one of the most common disorders that cause highest mortality and
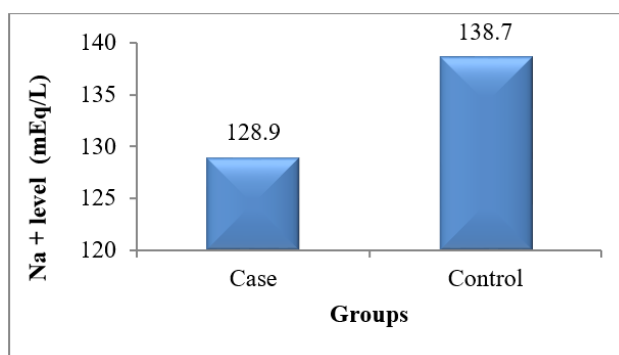

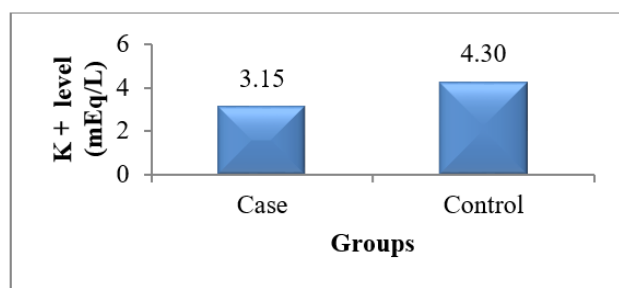**Fig. 1:** Comparison of Na$^+$ level between two groups

Fig. 2: Comparison of K$^+$ level between two groups

morbidity. Approximately, 300-500 millions individuals are affected by malarial parasitemia every year, out of which approximately 1 million patients die each year due to various complications.[4] In this study, we found that Na+ and K+ levels were decreased due to infection by malarial parasites. Dworak et al.,[5] Kakkilaya et al.,[6] and Ikekpeazu EJ et al.[7] also observed statistically significant low sodium and potassium levels in malaria cases. As per research results by Heindricks et al, various body cells loses 75 to 80 percent of their potassium content due to infestation by malarial parasites, which can lead to decrease in potassium values.[8]

In this study, Decrease in levels of electrolytes is more common in 11 to 20 years age groups malaria patients. Ikekpeazu EJ et al.[7] also observed lower level of sodium and potassium level in 11 to 20 years age groups as compared to other age group. Electrolyte level was also significantly reduced in plasmodium falciparum infection as compared to P. Vivax infection. It may be due to those complicated, fulminating and severe types of malaria patients are mostly infected by plasmodium falciparum5. Jasani JH et al.[8] revealed that hyponatraemia and hypokalaemia were more common in P. falciparum than in P. vivax malaria.(PF v/s PV in male: 127.71 ± 1.68 v/s 132.25 ± 1.71, $p < 0.05$; PF v/s PV in female: 127.82 ± 1.26 v/s 132.48 ± 1.61, $p < 0.05$). Decreased sodium and potassium level in malaria patients indicate severity of infection, which needs to be monitored

Table 3: Age group wise pvalue of electrolyte comparison

Age group	1 to 10	11 to 20	21 to 30	31 to 40	> 40
1 to 10	NA	< **0.05**	> 0.05	> 0.05	> 0.05
11 to 20	< 0.05	NA	< 0.05	< 0.05	< 0.05
21 to 30	> 0.05	< 0.05	NA	< 0.05	> 0.05
31 to 40	> 0.05	< 0.05	< 0.05	NA	> 0.05
> 40	> 0.05	< 0.05	> 0.05	> 0.05	NA

Table 4: Comparison of electrolyte level in malaria subjects according to gender andtype of infection

Gender	Na^+ (mEq/L)	K^+ (mEq/L)
Male (n=50)	128.31 ± 3.50	3.18 ± 0.88
Female (n=50)	129.82 ± 4.51	2.99 ± 0.72
p value	> 0.05	> 0.05
Type of malaria		
P. falciparum (n=43)	126.41 ± 4.00	2.91 ± 0.78
P. vivax (n=57)	129.90 ± 4.40	3.30 ± 0.88
p value	< 0.05	< 0.05

carefully.

5. Conclusion

Decrease in sodium and potassium levels are very frequent in malaria patients, especially in Plasmodium falciparum cases and 11 to 20 year age group. Hyponatraemia and hypokalaemia represents the outcome of severity of disorder. Prognosis of malarial infections is solemnly dependent on the instant and prompt management of abnormalities of sodium and potassium levels.

6. Source of Funding

None.

7. Conflict of Interest

None.

References

1. Trampuz A, Jereb M, Muzlovic I, Prabhu RM. Clinical review: Severe malaria. *Crit Care*. 2003;7:315–23.
2. Park K. Malaria. In: Preventive and social medicine. Banarsidas Bhanot Publishers;. p. 231.
3. Sowunmi A, Newton C, Waruiru C, Lightman S, Dunger DB. Arginine vasopressin secretion in Kenyan children with severe malaria. *J Trop Pediatr*. 2000;46(4):195–9.
4. World Health Organization. Regional guidelines for the management of severe falciparum malaria in large hospitals. WHO Regional Office for South-East Asia. New Delhi; 2004.
5. Ebele JI, Emeka EN, Nnenna CA, Ignatius CM, Ebele AA. Malaria Parasitaemia: Effect on Serum Sodium and Potassium Levels. *Int J Trop Med*. 2010;5(2):46–9.
6. Heindricks RG, Hassan AH, Lo O, Akindkani A. Malaria in early childhood. *Ann Trop Med*. 1971;65:316–20.
7. Tayler TE, Stricklanad GT, Malaria. Hunter's tropical medicine and emerging infectious diseases. 8th ed. Strickland GT, editor. Philadelphia: W.B. Saunders Company; 2000.
8. Jasani JH, Sancheti SM, Gheewala BS, Bhuva KV, Doctor VS, Vacchani AB, et al. Association of the electrolyte disturbances (Na+, K+) with the type and severity of the malarial parasitic infection. *J Clin Diagn Res*. 2012;6(4):678–81.

Author biography

Ashish A Patel Assistant Professor

Himanshu G Patel Assistant Professor

Sandip R Patel Assistant Professor