Effect of peritoneal dialysis on malarial AKI children: a cross sectional study

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Abstract

Background: Peritoneal dialysis (PD) is the main stream of treatment as renal replacement therapy in pediatric patients with AKI in developing countries. Acute kidney injury (AKI) is a well-recognized complication of severe malaria in adults, but its incidence, prevalence and clinical importance in paediatric medicine not well documented.

Objectives: To find out the effect of peritoneal dialysis on outcome of malarial AKI children in a tertiary care centre.

Methods: A cross-sectional study done in under 14 children suffering from severe malaria (SM). Neonates, children with associated pre-existing renal disease or having chronic kidney disease (CKD) or acute on CKD and known hypertensives were excluded. All the enrolled children were screen for AKI as per KDIGO guidelines & categorised in two three stages. PD was done as per the predefined criteria& all relevant data were analysed with computer generated software.

Results: Out of 406 SM cases, AKI detected in 15% with female predominance Mortality among renal failure patients is 26.67%. PD required in 52.0% of patients & mortality rate of 25.0% in KDIGO stage I, II but 55.0% in KDIGO Stage III significance(p=0.000). There is a significant correlation between pre dialysis & post dialysis serum urea/ creatinine/ potassium/ TPC & urine output (p = 0.000).

Conclusion: AKI is an under-recognized complication in young kids with SM and is related to enhanced acute/ long-term morbidity & mortality. Its early detection & intervention by peritoneal dialysis improves the same.

Keywords: Severe malaria (SM), Acute Kidney Injury (AKI), Peritoneal dialysis(PD), KDIGO(Kidney Disease: Improving Global Outcome) guidelines, Chronic, Kidney Disease(CKD)

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Introduction

Malaria could be a major reason of mortality and morbidity within the tropical and subtropical regions[1] with overwhelming importance within the developing world like India these days with a calculable 300-500 million cases and > 1million deaths every year. Most complications & deaths from malaria are caused by plasmodium[2]. Of the 2.5 million according cases within South East Asia, India alone contributes about 70% of the total[3,4]. Presently Odisha contributes most burden attributable to malaria to the nation[3]. Nearly 22% cases and 20% deaths due to malaria in India were accorded from Odisha. This matter is severe in southern and western districts of Odisha with a predominant tribal population[5].

AKI (Formerly ARF) usually happens in Falciparum malaria[2,6]. Generally the prevalence of acute kidney injury in falciparum malaria varies in between 1% to 60% depending upon the severity of infection[7]. In India the number reported as 13% in North East India, 17.2% in Odisha and 17.8% in Delhi. Antecedentaly AKI was rare in kids; however currently has an increasing trend in older kids[8]. Presently there is an upsurge in the overall incidence from 13% to 17.8% of malarial patients of South East Asian regions[2]. Though it is known that children admitted to hospital with SM and AKI are at increased risk of death, renal injury is rare in children with SM and is often reversible in survivors[9].

Estimates of the incidence and prevalence of AKI in children with SM are restricted with prior studies victimisation either measurements of urine output, which can be insensitive in mild to moderate acute kidney injury, or single estimates of creatinine or BUN, which may not capture the extent of AKI over time in children with severe malaria (SM) and may miss little changes in renal function that are presently known to be related with less favourable outcomes. There is increasing proof that even little changes in kidney function are related to increased morbidity, mortality and an increased risk of developing CKD[10]. The Kidney Disease: Improving Global Outcomes (KDIGO) guidelines suggest broadening the definition of AKI[10] to comprehend acute changes in renal function & this guideline was accustomed outline AKI during this study.

In developed countries, the selection of modalities for renal replacement therapy (RRT) in pediatric AKI is broad and includes PD, intermittent haemodialysis (HD), and continuous renal replacement therapy[11]. In contrast, choice for RRT in pediatric AKI in several parts of developing country is limited[11,12,13,14]. Acute PD has been the renal replacement therapy of choice for many

years in most of the pediatric ICUs, partially due to its simplicity and safety and also the relative ease with that the procedure are often performed in terribly little patients[15]. So the present study is aimed to seek out the result of peritoneal dialysis on outcome of malarial AKI patients admitted to our hospital.

Methods

The Veer Surendra Sai Institute of Medical Sciences and Research in eastern part of India is a thousand bed tertiary care hospital with one hundred pediatric beds. The hospital is located in Burla, Sambalpur district of western Odisha. The immediate geographical region of the hospital (10 districts of western Odisha & some part of Chhattisgarh state), has approx. 30 million inhabitants, 3 million of them being youngsters. Regarding 76% of the population live below the international poverty line[16]. The patients typically pay owed for medical treatment. The national health insurance scheme is not wide in use nevertheless and does not cowl fees for dialysis.

We performed a hospital-based prospective observational analytical cross-sectional study in our pediatric department from September 2012 to August 2014 (24 months). All children over one month of age and less than 14 years of age admitted to our indoor unit with signs and symptoms of SM[17] and demonstration of parasites in blood by various tests[18,19] were registered within the study. All the enrolled patients were screened for acute kidney injury by KDIGO guidelines and categorized in to three stages i.e., Stage I/ II/ III[10]. This guideline relies upon two criteria: shrivelled rate of glomerular filtration by calculating serum creatinine clearance[20] and/or the duration of oliguria or anuria[21]. Children who manifested proof of AKI throughout the hospital stay were conjointly enclosed. Children less than one month of age, not satisfying the SM criteria, associated congenital renal anomaly, having chronic kidney disease (CKD), acute on CKD and known hypertensives were excluded from our study.

Peritoneal dialysis was performed manually as per customary protocol (indications and procedures)[22] using commercially available continuous ambulatory PD solutions with 1.5% glucose (Global Medtronic, Mylapore, Chennai, India). The solutions were given freed from charge to our department by a benefactor and were administered at no value to the patients. We used stylet percutaneous PD catheters (Romsons Scientific & Surgical Pvt. Ltd., Agra, Uttar Pradesh, India).

406 cases were enrolled by simple consecutive sampling after proper consent given by the informant and ethical committee approval. A detailed history of illness, clinical examination, investigations, treatment and responses to therapy of each case was noted in the pre designed case pro forma and all the relevant data were noted on the excel sheet in a tabular form. Patients were followed from the day of admission to discharge & information on baseline demographics, types and stages of AKI, outcome of AKI & PD, comparison of various laboratory parameters before and after peritoneal dialysis were collected. Necessary statistical procedures were applied using SPSS v 20, Microsoft office student 2016 and Epi Info 7 software to observe the outcome variable in different domains.

Results

Sociodemographic profile of 406 SM patients was given with special reference to AKI parameters (Table 1). Prevalence is slightly more in under 5 age groups, male is affected more than female with M: F = 1.2:1, 39 patients died with mortality rate of approx. 10% (almost equal in all age groups and both sex). 15% develop AKI (26.67% oliguric, 73.33% non-oliguric variety) and 83.33% were under the age group of 10 years, female affected slightly more than male with mortality rate of 26.67%. Association of anemia with three different stages of AKI in children is significant (Pearson chi square = 18.67, p = 0.000) but association of level of creatinine with mortality was insignificant. There are 54% case in KDIGO stage II followed by 28% in stage I and 18% in stage III (Table 2). The staging was also affected by duration of illness prior to hospitalisation as is the requirement of PD (in 52% case). 93.33% of AKI children were having multiple organ involvement and this association is very significant (Pearson chi square = 19.12, p = 0.000)(Table 3) & mortality among them is 100.0%. Not a single renal failure patient died with single organ involvement. As per KDIGO criteria. Out of 31 dialysed patients (52%) 20 no of pts (65%) receive dialysis in KDIGO Stage I & II, out of which death occurred in 5 no of pts (25%); but out of 11 pts (35%) receiving dialysis in KDIGO Stage III death occurred in 6 no of pts (55%) & there is significant mortality difference between these two groups (Pearson's Chi-square = 20.00, p=0.001) (Table 4). There is no significant sex predisposition in effect of dialysis on mortality. A paired-samples t-test was conducted by Epi info 7 software to compare the serum urea (mg/dl), serum creatinine (mg/dl), urine output (ml per 24 hour), serum potassium (mg/dl) and TPC (lakhs/cmm) level before and after completion of peritoneal dialysis in children having malarial AKI. There was a significant difference in the mean serum urea level (mg/dl) before & after completion of P.D (M=9.33, SD=49.19) in children suffering from malarial AKI; t (30) =10.569, p = 0.000. There was a significant difference in the mean serum creatinine level (mg/dl) before & after completion of P.D (M=2.14, SD=0.87) in children suffering from malarial AKI; t (30) =13.682, p = 0.000. There was a significant difference in the mean urine output (ml/24 hour) before & after completion of P.D (M=2.981, SD=108.80) in children suffering from malarial AKI; t (30) = - 15.286, p = 0.000. There was a significant difference in the mean serum potassium level (mg/dl) before & after completion of P.D (M=1.44, SD=0.65) in children suffering from malarial AKI; t (30) =12.258, p

= 0.000. There was a significant difference in the mean TPC level (lakhs/cmm) before & after completion of P.D (M= - 0.32, SD=0.21) in children suffering from malarial AKI; t (30) = - 8.68, p = 0.000.

Table 1

Severe Malarial (SM) children (n=406)		
Age wise distribution of severe malarial (SM)patients		
AGE GROUP IN YEARS	PERCENTAGES	
< 5	35.50%	
5 – 10	34.20%	
10 - 14	30.30%	
Sex Predisposition		
MALE	53.90%	
FEMALE	46.10%	
M: F	1.2:1	
Mortality		
OVERALL MORTALITY	10%	
M: F MORTALITY	1:1	
AGE WISE MORTALITY	AGE IN YEARS	PERCENTAGES
	< 5	3.70%
	5 – 10	2.60%
	10 - 14	3.70%
Acute Kidney Injury (AKI) (n = 60)		
TYPES OF AKI	PERCENTAGES	
Oliguric AKI	26.67%	
Non - Oliguric AKI	73.33%	
Age wise distribution of malarial AKI patients		
AGE GROUP IN YEARS	PERCENTAGES	
< 5	40%	
5 – 10	43%	More than 80% under 10 years of age
10 - 14	17%	
Sex Predisposition		
MALE	46.70%	
FEMALE	53.30%	
M: F	1:1.1	
Mortality		
OVERALL MORTALITY	26.67%	
M: F MORTALITY	1:1.3	
GENDER WISE MORTALITY	MALE	43.80%
	FEMALE	56.20%
AGE WISE MORTALITY	AGE IN YEARS	PERCENTAGES
	< 5	31.25%
	5 – 10	43.75%
	10 - 14	25%
% of AKI requiring Dialysis	52%	

Table 2

n = 60		
KDIGO Staging	**No of Patients**	**Duration of illness prior to hospitalization (in days)**
Stage I	17 (28%)	< 3
Stage II	32 (54%)	3 – 7
Stage III	11 (18%)	7 – 10

Table 3

n=60			
Organ Involvement	**No of AKI Cases**	**Mortality**	**p value**
SINGLE	4(6.67%)	0.0%	0.000
MULTIPLE	56(93.33%)	100.0%	

Table 4

	SEX	DEATH	RECOVERY	TOTAL
KDIGO Stage I & II	MALE	2	6	8
	FEMALE	3	9	12
KDIGO Stage III	MALE	4	2	6
	FEMALE	2	3	5
TOTAL		11	20	31

Discussion

The maximum prevalence of malaria in our study observed in age group of 1-5 years which is similar to the previous study[23] where maximum cases observed in age range from 0-5 years followed by 5-10 years. Our study reported a male predominance with male to female ratio 1.2:1 which is almost similar to different Indian studies[23,24,2,25] but differ from one study at Gujarat in 2010[26] which demonstrate an equal sex predisposition. This variation may be due to less no of samples in their study and/ or high educational status of Gujarat state. The high rate of malaria in male children in our area can be explained by the fact that more outdoor activity/ dominating society of males & better clothing in females due to social customs.

Our study shows a mortality rate of 10% which is more than the previous studies[25, 27] may be due to large sample size in these researches but less than a single study in Odisha[5] which may be explained by endemic nature of parasite in our state and we concentrate on a part of it. Mortality is almost equal in all age groups as evidenced by[25] and among both sex[26] which is consistent with our study.

The overall prevalence of AKI in falciparum malaria is less than one percent, but could be go up to 60% in severe infection[6]. The report from India included: 17.2% in Odisha, 13% in North East India, 17.8% in Delhi[28]. The decline renal involvement (15%) in our study may be due to early & timely interventions of malarial patients following the implementations of different national health policies by state Govt. NRHM to decrease the death due to malaria. 83.33% cases were under 10 years of age(older children) which is consistent with previous studies[29,30] but against another study[31] which shows no age group predisposition in malarial AKI patients. This variation may be due to inclusion of wide age group range in the old study. In AKI female is affected slightly more than male with M: F ratio of 1:1.1 which is contradictory to the findings of other study (male affected more than female)[2]. It may be due to late reporting at the hospital for female patients because of negligence of the parents due to existing discrimination in different sex in tribal & rural belt. Mortality of malarial AKI in our study was 26.67% with 68.75% in older children (5-14 yrs) which is more or less consistent with previous studies[30,32,33]. Mortality of malarial AKI was more in female than male with M: F ratio of 1: 1.3 which was same as that of old research[2] but differ from a study in 2008 at Nigeria[33] which may be due to local cultural and social conduits.

PD was done in 52% cases in our study as opposed by 78% in other[2] This decrease percentages of patients requiring PD in our study may be due to widely use of newer antimalarial drugs like artemisin derivatives as well as available of pediatric nephrologists & other trained medical staffs. One study[34] found that the renal involvement is associated with moderate reduction of haemoglobin level, similar to our study (82%). Oliguria was detected in 26.67% cases in our study as opposed by 69% in other[6]. This decrease incidence of oliguria detection in our study may be due to the lack of knowledge on significance of urine output in malarial patients as well as their ignorance & awareness about the early symptoms of renal involvement.

We found maximum no of renal failure cases were presented with in 3-7days of onset of symptoms. In comparison of patients with short duration of illness (<3days), with those of prolonged duration (>7days)

were more likely to have higher degree of AKI and also mortality[2] which is consistent with our study. In comparison to AKI with single organ involvement, AKI with multiple organ involvement results in more deaths[29]. Our study also coincides with the previous study. Using the KDIGO guidelines to define and stage AKI in our cross sectional study, 15% of malarial children had AKI with 28% stage I, 54% stage II, and 18% stage III. There was a significant association between the severity of AKI and mortality. The other studies[35-39] also coincides with our study. There is a significant correlation between pre dialysis & post dialysis serum urea (mg/dl)/ serum creatinine (mg/dl)/ serum potassium (meq/L)/ TPC (lakhs/cmm), urine output (ml/24 hr). The serum urea/ creatinine/ potassium level is decreasing after dialysis which coincides with previous studies[40,41] but TPC level are increasing after dialysis as per past research[42].

Conclusions

AKI is multifactorial and carries a significant mortality & morbidity particularly in late referral or if renal replacement therapy is not available. Peritoneal dialysis (PD) is a simple technique as it does not need extremely trained personnel, does not require complicated equipment, does not require systemic anticoagulation and in dearly-own. Further, thanks to gradual removal of fluid and solutes, PD ends up in higher hemodynamic stability. Temporary replacement of renal function by dialysis or hemofiltration can stop death and facilitate complete recovery once applied early. So timely detection of renal impairment is important and renal function ought to be assessed altogether patients in falciparum malaria. AKI could be a common complication in childhood severe malaria that develops or worsens in children following admission lightness the importance of serial creatinine assessments in kids admitted with severe malaria. Further, AKI was related to accrued risk of acute and future mortality, suggesting that children who survive their initial infection and are discharged with recovering renal function stay at higher risk of succeeding death and will need more clinical follow up.

As this is a cross sectional study it's some limitations. We could not estimate incidence rate and long term follow up. Additional studies are needed to outline the long-term risk of chronic kidney disease and mortality in children extant severe malaria with AKI receiving PD.

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Contributors

NRM and PCP were responsible for data collection, data interpretation, and study design. NRM, PCP & SRN responsible for manuscript writing, review and approval.

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