

SERUM AND URINE SODIUM LEVELS IN DENGUE PATIENTS

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Abstract. We evaluated serum and urine sodium levels in children with dengue infections. Children with acute febrile illness admitted to Bhumibol Adulyadej Hospital in Bangkok from January 1999 to January 2000 were enrolled. Serum and urine sodium levels were measured before initiating intravenous fluid therapy. Two milliliters of blood were obtained on admission and before discharge to test for anti-dengue virus antibody using the enzyme-linked immunosorbent assay technique. Hyponatremia was defined as a serum sodium level <130 mEq/l and depletion of circulatory volume was defined as a urine sodium level ≤ 20 mEq/l. Out of 93 enrolled patients, 49 were categorized as dengue patients and 44 were as non-dengue patients. Six dengue patients developed shock whereas 43 patients did not. The mean serum sodium level was significantly lower in dengue patients compared to non-dengue patients (p -value < 0.0001). Hyponatremia was 9.7 times more common in dengue patients. Among dengue patients, the mean serum sodium level was significantly lower in shock patients compared to non-shock patients (p -value = 0.003). However, the prevalence of hyponatremia was not different between the two groups. The mean urine sodium level was significantly lower in dengue patients compared to non-dengue patients (p -value < 0.0001). A urine sodium level ≤ 20 mEq/l was 8.1 times more common in dengue patients. Among dengue patients, the mean urine sodium level was not significantly different between shock and non-shock patients. In shock patients, a urine sodium level ≤ 20 mEq/l was 7.6 times more common.

INTRODUCTION

Dengue infection is one of the most common public health problems affecting children in Southeast Asia and Western Pacific (Thisyakorn and Thisyakorn, 1994). The management of dengue infection depends on the staging and grading of the disease. Appropriate fluid replacement is the most important treatment for dengue infection (World Health Organization, 1997). Hyponatremia is commonly found in dengue patients (Varavithya *et al*, 1973) and reflects a depletion of the effective intravascular volume which can be confirmed by a urine sodium level ≤ 20 mEq/l (Bruton, 1994; Adelman and Solhaug, 2000). The purpose of this study was to measure serum and urine sodium levels in dengue patients and to compare the results to those with other febrile illnesses.

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MATERIALS AND METHODS

The study was conducted in the Department of Pediatrics at Bhumibol Adulyadej Hospital, which is a tertiary and large teaching hospital in Bangkok, Thailand. From January 1999 to January 2000, all hospitalized children aged 0-15 years with acute febrile illnesses who presented with a body temperature $\geq 37.8^\circ\text{C}$ for ≤ 3 days without specific cause of infection were enrolled. Dengue infection was diagnosed according to World Health Organization (WHO) criteria with serological confirmation. Children with dengue infection who developed hypotension or a pulse pressure < 20 mmHg were categorized as shock patients and the others as non-shock patients. Children diagnosed with other illnesses, malnutrition, chronic hepatic or renal diseases and those who had previously received treatment with antidiuretic drugs and intravascular fluid were excluded. Children with grade 4 dengue hemorrhagic fever were also excluded due to the need for emergent intravenous fluid.

Parents completed informed consent for the children. All patients received treatment as recommended by WHO guidelines. Serum and urine sodium levels were tested before initiating intravenous fluid. Two milliliters of blood were obtained on admission and before discharge from the hospital and the separated serum was stored at -20°C until tested for dengue virus antibody at the Armed Forces Research Institute of Medical Sciences (AFRIMS), Bangkok, Thailand. Demographic data and the clinical manifestations of all the patients were recorded. Hyponatremia was defined as a serum sodium level <130 mEq/l and depleted circulatory volume (ECV) was defined as a urine sodium level ≤ 20 mEq/l.

Statistics used for analysis included mean, range, and percentage in demographic data. The chi-square test was used to test for differences in population proportions. The Student's *t*-test was used to evaluate differences between population means. Odd ratios (OR) and 95% confidence intervals (95%CI) were used to test an association between populations.

RESULTS

Of 93 children, 49 were categorized as dengue patients and 44 as non-dengue patients. Out of 49 dengue patients, 28 were males and 21 were females, with a mean age of 8.8 ± 3.5 years. There were 43 non-shock patients and 6 shock patients.

The age and sex of the patients, days of fever, and clinical manifestations were not significantly different between the dengue and non-dengue patients. Hepatomegaly was more common in the dengue patients (49.0% vs 27.3%, p -value=0.03). Laboratory investigations showed that hematocrit levels in dengue patients were

significantly higher than those in non-dengue patients (p -value=0.01) whereas platelet counts in dengue patients were significantly lower than in non-dengue patients (p -value=0.04). The white blood cell counts and percentages of atypical lymphocytes were not significantly different between the two groups.

Serum sodium

The mean serum sodium levels were significantly lower among the dengue patients compared to the non-dengue patients (132.7 ± 3.5 vs 135.5 ± 3.3 mEq/l, p -value <0.0001). The prevalence of hyponatremia (serum Na <130 mEq/l) was 9.7 times more common in dengue patients than in non-dengue patients (18.4% vs 2.3%; OR=9.7; 95%CI=1.2, 76.9) (Table 1).

In dengue patients, the mean serum sodium levels were significantly lower in the shock patients compared to the non-shock patients (130.0 ± 1.6 vs 133.1 ± 3.6 mEq/l, p -value=0.003). The prevalence of hyponatremia was not different between the shock and non-shock patients (16.7% vs 18.6%; OR 0.9; 95% CI=0.1, 8.5) (Table 2).

Urine sodium

The mean urine sodium level was significantly lower in the dengue patients compared to the non-dengue patients (37.6 ± 38.2 vs 68.9 ± 43.9 mEq/l, p -value <0.0001). The prevalence of a urine sodium level ≤ 20 mEq/l was 8.1 times more common in dengue patients than in non-dengue patients (44.9% vs 9.1%; OR=8.1; 95%CI=2.5, 26.3) (Table 1).

In dengue patients, the mean urine sodium levels were not significantly different between the shock and non-shock patients (15.7 ± 15.8 vs 40.6 ± 39.5 mEq/l, p -value=0.14). The prevalence

Table 1
Serum and urine sodium levels in dengue and non-dengue patients.

Variables	Dengue N=49	Non-dengue N=44	p-value	OR	95% CI
Serum Na (mEq/l)	132.7 ± 3.5	135.5 ± 3.3	$<0.0001^a$	-	-
Serum Na <130 mEq/l	9 (18.4%)	1 (2.3%)	-	9.7 ^a	1.2, 76.9 ^a
Urine Na (mEq/l)	37.6 ± 38.2	68.9 ± 43.9	$<0.0001^a$	-	-
Urine Na ≤ 20 mEq/l	22 (44.9%)	4 (9.1%)	-	8.1 ^a	2.5, 26.3 ^a

^a = statistical significance

Table 2
Serum and urine sodium levels of dengue patients with and without shock.

Variables	Shock N=6	Non-shock N=43	p-value	OR	95% CI
Serum Na (mEq/l)	130±1.6	133.1±3.6	0.003 ^a	-	-
Serum Na <130 mEq/l	1 (16.7%)	8 (18.6%)	-	0.9	0.1, 8.5
Urine Na (mEq/l)	15.7±15.8	40.6±39.5	0.14	-	-
Urine Na ≤20 mEq/l	5 (83.3%)	17 (39.5%)	-	7.6 ^a	0.8, 71.4

^a = statistical significance

of a urine sodium level ≤20 mEq/l was 7.6 times more likely in the shock patients than in the non-shock patients (83.3% vs 39.5%; OR=7.6; 95%CI=0.8, 71.4) (Table 2).

DISCUSSION

Similar to previous studies, our data show that hyponatremia in dengue patients is commonly found and it is more common in shock patients (Varavithya *et al*, 1973). This finding may be the consequence of salt depletion, excess water from increased metabolism, decreased renal excretion, transient inappropriate antidiuretic hormone, the influx of sodium into cells as a result of dysfunction of the sodium-potassium pump, and the loss of sodium in the urine from acute tubular necrosis. We should be aware that hyponatremia in dengue patients may cause convulsions, especially in infants (Pancharoen and Thisyakorn, 2001a,b). Isotonic solution should be administered at the time of plasma leakage (Ngo *et al*, 2001).

A low urine sodium was commonly found in dengue patients, especially in shock patients. Similar to our study, a previous study demonstrated low 24-hour urine sodium levels in dengue patients with shock (Varavithya *et al*, 1973). This finding may be explained by the decreased renal blood flow, which is a consequence of the depletion of the ECV. Besides pulse rate, pulse pressure, urine output and hematocrit levels, a spot urine sodium is a simple method which may be helpful in monitoring the dynamic changes of fluid and electrolyte status in dengue patients.

In conclusion, hyponatremia and low urine sodium levels were frequently found in dengue patients. The serum sodium level of patients in

shock is lower, and the prevalence of a low urine sodium level is higher.

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REFERENCES

- Adelman RD, Solhaug MJ. Sodium. In: Behrman RE, Kliegman RM, Jenson HB, eds. Nelson textbook of pediatrics. 16th ed. Philadelphia: WB Saunders, 2000: 193-5.
- Bruton DR. Regulation of the effective circulating volume. In: Bruton DR, ed. Clinical physiology of acid-base and electrolyte disorders. 4th ed. Singapore: McGraw-Hill Book, 1994: 236-57.
- Ngo NT, Cao XT, Kneen R, *et al*. Acute management of dengue shock syndrome: a randomized double-blind comparison of 4 intravenous fluid regimens in the first hour. *Clin Infect Dis* 2001; 32: 204-13.
- Pancharoen C, Thisyakorn U. Dengue virus infection during infancy. *Trans R Soc Trop Med Hyg* 2001a; 95: 307-8.
- Pancharoen C, Thisyakorn U. Neurological manifestations in dengue patients. *Southeast Asian J Trop Med Public Health* 2001b; 32: 341-5.
- Thisyakorn U, Thisyakorn C. Diseases caused by arboviruses-dengue haemorrhagic fever and Japanese B encephalitis. *Med J Aust* 1994; 160: 22-6.
- Varavithya W, Manu P, Kittikool J, Phongbetchara P, Kashemsant C. Studies on dengue hemorrhagic fever. II: Electrolyte study. *J Med Assoc Thai* 1973; 56: 15-23.
- World Health Organization. Dengue haemorrhagic fever: diagnosis, treatment, prevention and control. 2nd ed. Geneva: WHO, 1997.