

3. Title: Evaluation of renal function in normal Thai Children.

Principal Investigator: Channivat Kashemsant, M.D.

Associate Investigators: Craig J Canfield, Maj. MC  
Billy W. Evans, Maj. MC  
Sangchan Sangvichien, M.D.  
Philip Z. Sobocinski, Capt. MSC  
Aree Valyasevi, M.D.

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Objective - To define normal ranges of renal function in Thai children for anticipated studies of variety of disease processes. The study includes (a) Diurnal variation of serum electrolytes and nitrogenous substances. (b) Concentration and dilution abilities. (c) Inulin, PAH and creatinine clearance studies. (d) composition of sweat.

Procedure - 23 healthy children aged 6-12 years old were studied. Prior to study, all subjects had complete physical and laboratory work up and were put on hospital diet except on the day special tests were performed. The study included three consecutive days of diurnal collection of urine and blood, dilution and concentration tests and sweat test. During the last three month period, study of urinary excretion of calcium and phosphorus and clearance studies has been included.

So far completed data were obtained from 11 subjects. The other 12 are in the process of completion.

Result - Diurnal Rhythm: All children exhibited normal diurnal rhythm of creatinine clearance, electrolyte excretion and acidification of urine. The creatinine clearance were lower during the night in all except two in which technical error in collection of urine could not be excluded. The variation of day and night creatinine clearances were between 4.4 and 67%

Daily excretion of urinary metabolites and creatinine clearance: Nine subjects had 24 hour creatinine clearance within normal limits when expressed per  $1.73 M^2$  (85.1-112.8 ml/min). Two had creatinine clearances 76.7 and 77.9 ml/min/ $1.73 M^2$  which were interpreted as low-normal clearance rates.

The total 24 hour urine volume ranged from 1166-2235 ml/ $M^2$  which appeared to be higher than standard value (750-1500 ml/ $M^2$  24 hr.). This may have been explained by the ingestion of large amount of water due to the warm climate, since the solute excretions were 155-500 m) sm/L.

The daily total solute excretions were 308-634 mOsm/ $M^2$ /day which was markedly lower than average American (approx 750 mOsm/ $M^2$ /day). All children excreted low level of urea nitrogen (3.44-6.17 gm/day) but had normal excretion of creatinine and uric acid (creatinine 12-25 mg/Kg, Uric acid 5-12 mg./Kg.). These indicate a low protein diet in Thai children.

The excretion of Na and  $Cl_2$  appeared to be in normal ranges (Na 59.6-158.9 mEq/ $M^2$ , Cl 58.5-154 mEq/ $M^2$ ). The urinary potassium excretion was very low (12.5-24.2 mEq/ $M^2$ ) compared with average American (20-35 mEq/ $M^2$ /day). The low potassium excretion could not be accounted for just by low protein diet but means also a low potassium diet.

All children had normal serum osmolality, Na, K, Cl, uric acid Urea nitrogen, creatinine and protein.

Concentrating ability tests were performed by 22 hour water deprivation plus exogenous pitressin. Six children were able to concentrate urine maximally to 1279-1491 mOsm/L which was regarded as good concentrating ability. Five children had maximal concentrating ability between 970-1142 mOsm/L. The relationship between concentrating ability, solute excretion and prolonged administration of low protein diet in Thai people is a subject for further investigation.

The dilution test, which was performed by ingestion of large amounts of water plus alcohol, showed normal diluting capacity in all (Minimal osmolality 44.61 mOsm/L).

Clearance Studies: Inulin and PAH clearance were successfully performed in 9 subjects. Four children showed normal inulin clearance (93.7-145.4 ml/min/1.73M<sup>2</sup>), PAH clearance (338.7-583.3 ml/min/1.73 M<sup>2</sup>), and filtration fraction (0.20-0.30).

Sweat Test performed in 23 children with moderate sweating showed normal values.

Table I  
Outline of laboratory studies

Laboratory Studies	Hospital Day					Remarks
	1	2	3	4	5	
CBC and parasite density	X	X	X	X	X	(1)
Urinalysis	X	X		X		
Electrolytes and Osmolality	X	X	X	X	X	(1)
24 hr. Urine Electrolytes	X	X	X	X	X	
BUN and Creatinine	X	X	X	X	X	(1)
Liver function tests	X					(1)
Total Protein and electrophoresis	X					(1)
Inulin, - PAH clearance		X				(1)
Water Load test			X			
Body Space measurements	X					(2)
Blood pH	X					
Viral and leptospirosis serology	X					(1)

(1) Repeated on day prior to discharge

(2) Repeated on day of discharge

Table II  
Relation of maximum parasitemia to weight loss, febrile course  
and admission sodium and creatinine.

	Asexual Parasites/mm <sup>3</sup>			
	1,000	1,000-10,000	10,000-100,000	100,000
Number of patients	8	4	10	3
Weight loss (Kg) in hospital	0.69	0.80	2.21	2.97
Fever (days after Rx)	0.93	0.63	2.51	3.20
Admission serum sodium	136	134	131.4	128
Admission serum creatinine	2.02	1.13	1.13	1.50

Table 3: Summary of admission & discharge laboratory data.

	Admission	Discharge
<b>Hematology</b>		
Hematocrit (%)	36.8	33.5
Leukopenia* (< 5000/mm <sup>3</sup> )	24%	0
Leukocytosis* (> 10,000/mm <sup>3</sup> )	4%	4%
Rising Eosinophils*	52%	
<b>Urine</b>		
Protein* (≥ tr)	32	
RBC* (≥ 1/HPF)	28	
Granular casts (> 0)	28	
<b>Chemistries</b>		
Sodium (meq/L)	132.4	136.8
Potassium (meq/L)	3.96	4.26
Chloride (meq/L)	96.9	103.5
CO <sub>2</sub> (meq/L)	20.8	21.7
Osmolality (mOsm/Kg H <sub>2</sub> O)	275	280
Creatinine (mg%)	1.14	1.02
BUN (mg%)	18	8.5
Total bilirubin* (> 1 mg%)	32	4
Direct bilirubin* (> .7 mg%)	16	4
Thymal turbidity* (> 5 units)	60	50
Alkaline phosphatase* (2.3 Sigma)	40	16
SGOT* (> 50 units)	28	4
SGPT* (> .45 units)	16	4

\*Reported as % of patients abnormal, limit of normal value given in parenthesis.

Table 4. Relation between admission serum sodium & selected clinical aspects.

		Serum Sod. 134 <sup>+</sup>	Serum Sod. 135 <sup>+</sup>
Age (years)		29.5	23.6
No previous malaria attacks*		81%	22%
Maximum parasitemia (/mm <sup>3</sup> )		55,200	9,100
Days of fever after treatment		2.45	0.61
Weight loss after treatment (Kg)		1.8	0.9
Proteinuria*		48	11
Granular urinary casts*		34	0
Potassium (meq/L)	Adm.	3.9	4.04
	Disch.	4.3	4.15
Chloride (meq/L)	Adm.	93.9	102
	Disch.	103.6	103.4
CO <sub>2</sub> content (meq/L)	Adm.	20.4	21.5
	Disch.	21.6	22.0
Osmolality (mOsm/kg.H <sub>2</sub> O)	Adm.	270	283.9
	Disch.	279.5	283.3
Creatinine (mg/100 ml)	Adm.	1.21	1.01
	Disch.	1.01	1.04
BUN (mg/100 ml)	Adm.	20.6	13.4
	Disch.	8.5	8.5
First 24 hour urine Na <sup>+</sup> excret (meq)		39	111
First 24 hour uring K <sup>+</sup> excret (meq)		25	16
Abnormal water load test*		31	0
Plasma volume (cc/Kg)	Adm.	55.6	59.7
	Disch.	58.0	58.8
Blood volume (cc/Kg)	Adm.	83.0	86.4
	Disch.	82.1	85.8

\* Expressed as % of patients in this category.