7 month old girl with hyponatremia

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HPI

- 7 month old girl born at 28 weeks, hydrocephalus s/p VP shunt at 6 months
- Admitted with vomiting, diarrhea, and fevers
- Na 128 upon presentation
- Has been as low as 122 since admission
- History of mild hyponatremia with nadir of 130 during last admission when shunt placed

HPI continued

- Endocrine consult on day 2 of admission
- Urine output 1.6-2 ml/kg/day
- Fluid intake ~800 ml formula/m2/d
- On NaPhos supplement for osteopenia of prematurity
  - Total Na intake 1.4 meq/kg/d
- Swelling around shunt tubing but no indication of shunt malfunction per neurosurgery

Past Medical History

- Birth history
  - 28 week twin born to 27 yo G7P6->8, csx due to fetal lie
  - Birth weight 1.2 kg (50%), birth length 37 cm (50%), birth HC 26 cm (50%)
- NICU Course
  - GBS bacteremia
  - Presumed NEC
  - Osteopenia of prematurity
- Hydrocephalus s/p VP shunt
  - Presented at 6 months with increased HC and MS changes, found to have ventriculomegaly
  - Head ultrasounds in NICU had showed only mild dilatation of lateral ventricles

Medications:

Prevacid

Calcium carbonate 225 mg po q8

(40 mg elemental Ca/kg/d)

Sodium phosphate 2.4 mmol BID

(1 meq Na/kg/d)

FeSO4

MVI with iron

Social History:

Lives with mother, father, 7 siblings ranging from twin brother to 10 year old sister

Social concerns about lack of visitation from parents

Family History:

Maternal grandparents with diabetes mellitus

Physical Exam

- Wt 6.6 kg (11%, 50% GA adjusted), Length 62 cm (<3%, 25% GA adjusted)
- Temp 36.3 (Tm 37.4), HR 156, RR 28, BP 100/71
- Constitutional: Well-nourished. Sleeping frequently but interactive when awake. No distress.
- Head: Macrocepahalic. Anterior fontanelle is flat and soft. Posterior right neck and occiput with swelling (4cm x 2cm x1cm), non-erythematous, fluid-filled feeling upon palpation
- Mouth/Throat: Mucous membranes are moist. Oropharynx is clear.
- Neck: No thyromegaly.
- Eyes: Tracks examiner, PEERL, Red reflex intact bilaterally.
- Cardiovascular: Regular rate and rhythm, S1 normal and S2 normal. No murmurs.
- Pulmonary/Chest: Effort normal and breath sounds normal.
- Abdominal: Soft. Bowel sounds are normal. No distension or tenderness. **+ VP shunt palpable, small reducible umbilical hernia**
- Musculoskeletal: Normal range of motion. She exhibits no deformity.
- Neurological: Alert. CNs intact. Truncal hypotonia, increased tone right arm. 2+ reflexes.
- Skin: Skin is warm. Normal turgor. Capillary refill <2 seconds.

Differential diagnosis

- Hypovolemic
  - Dehydration
  - Cerebral salt wasting
  - Diuretic use
  - Salt wasting nephropathy
- Hypervolemic
  - Congestive heart failure
  - Nephrotic syndrome
  - Liver failure
  - Renal failure
- Euvolemic
  - SIADH
  - Hypothyroidism
  - Adrenal insufficiency
  - Mineralocorticoid deficiency
  - Primary polydipsia
  - Excessive administration of hypotonic fluid

Laboratory evaluation

- Na 127, K 5.6, Cl 92, HCO3 21, BUN 3, Cr 0.2, Ca 9.6
- Serum osm 257
- Urine osm 535
- Urine Na 219
- TSH 1.88, free T4 1.54
- ACTH 14.4, cortisol 17.4
- Renin <0.6, aldosterone 17

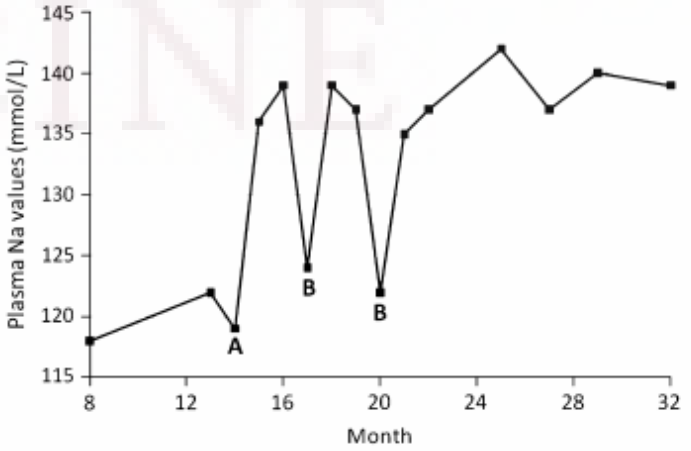
Initial Assessment/Plan

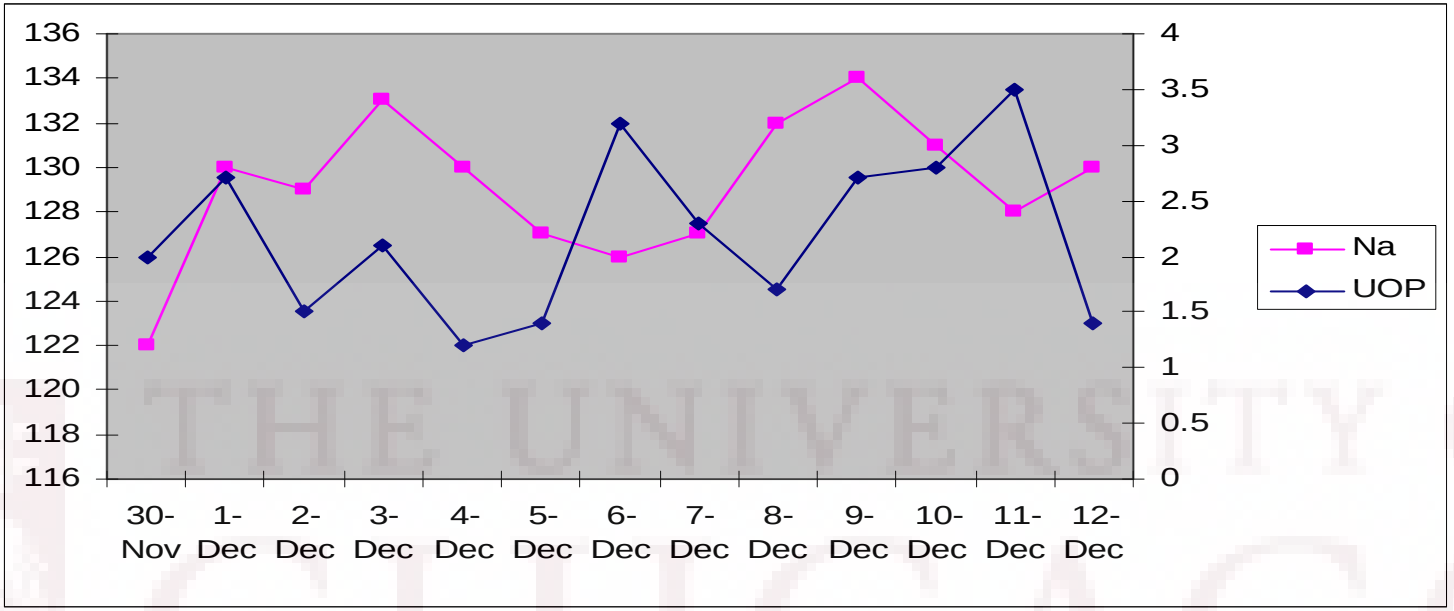
- Workup consistent with SIADH
  - Vomiting
  - Hydrocephalus
- NPO on D50.9NS
  - Fluid restriction to 1000 ml/m2/d
- Na rose to 130
- Gradually liberalize fluid restriction

Date	Na	Fluid allowance
11/30	122	1000 ml/m2 0.9NS
12/1	130	1200 ml/m2 0.9NS
12/2	129	1200 ml/m2 formula
12/3	133	1500 ml/m2 formula
12/4	130	1800 ml/m2 formula
12/5	127	1900 ml/m2 formula
12/6	126	1800 ml/m2 formula

The problem with fluid restriction

- Infant diet=fluid
- Other options:
  - Furosemide->hypokalemia, metabolic alkalosis, nephrocalcinosis
  - Lithium->hypothyroidism
  - Demecocycline->inhibition of bone growth
- Urea
  - Safe and well tolerated
  - Decreases natriuresis at low doses w/o affecting urine flow
  - Osmotic diuresis at higher doses

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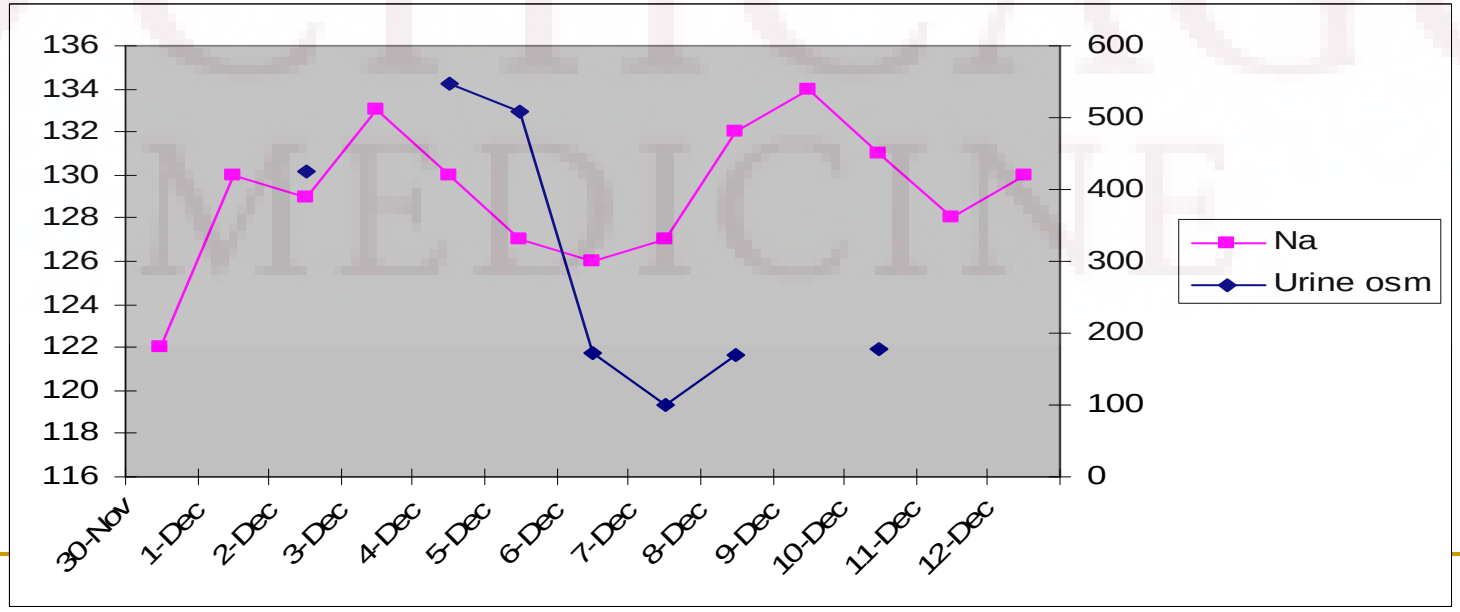
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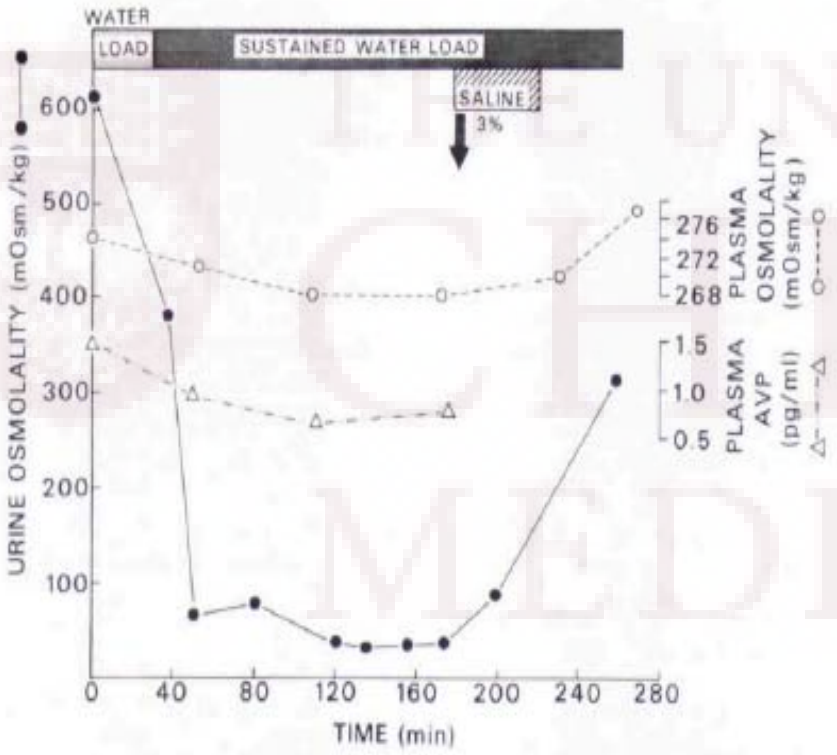
12-Dec
Na
Urine osm

Reset Osmostat

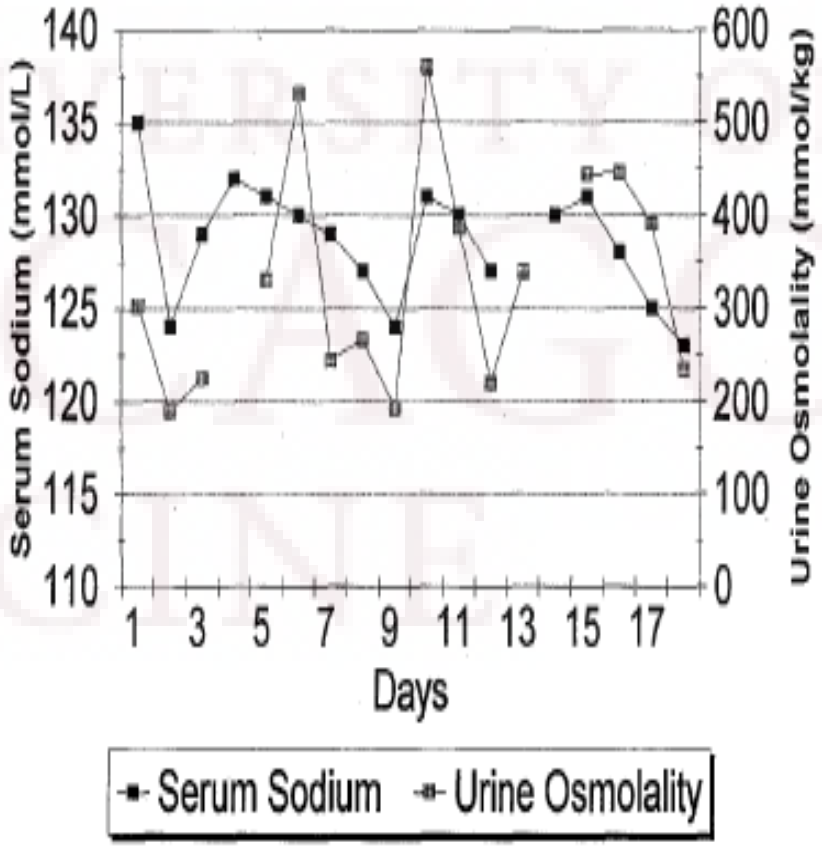


- 1976 study established 3 diagnostic criteria
  - Normal excretion of water load
  - Normal sodium balance w/o correction of hyponatremia during salt load
  - Urine concentration with increased serum tonicity

36% of cases of SIADH

Reset osmostat in pediatrics

- Case of infant with panhypopituitarism and cleft lip/palate
- Other pediatric cases:
  - Infant with cleft lip/palate and normal ant pit function
  - Adolescent with agenesis of corpus callosum and hypothalamic cyst



Is water loading really necessary for diagnosis of reset osmostat?

	Serum					Urine			
Pt	Age	Na	Osm	Creat	Urate	Osm	Na	FEurate	Ccr
	years	mmol/L	mOsm/kg	mg/dL	mg/dL	mOsm/kg	mmol/L	%	ml/min
1	83	124	262	0.4	2.8	336	43	9.6	
2	89	127	268	0.74	4.7	502	109	9.4	94.3
3	67	132	284	0.7	3.8	308	39	10.0	
4	61	131	282	0.6	3.6	452 (190)	73	8.0	
5	74	129	273	0.65	3.5	119	17	7.3	
6	74	131	267	0.77	3.6	463 (192)	69	8.3	
7	80	132	281	0.9	4.8	519	51	10.0	132
8	64	128	273	0.6	3.7	285	31	6.7	106.5
9	77	128	277	1.09	6.4	404	30	4.9	80
10	50	127	279	0.8	5.4	199	<10	8.9	
11	65	130	263	0.3	2.4	180	36	10.1	
12	68	129	272	0.68	4.5	199	33	7.48	
13	62	132	279	0.3	2.2	154	39	5.3	
14	65	131	280	0.68	3.8	652 (127)	69	8.7	

- 14 patients with non-edematous hyponatremia 0.5-14 years
- All demonstrated urine osm<200 on random urine collection or with water loading
- All had Fe urate 4-11% compared to Fe urate >12% which has been shown to have high sensitivity and specificity for SIADH

Back to our patient

- Transferred to La Rabida with stable Na 127-134
- Readmitted with mental status changes and emesis
- Found to have CONS shunt infection
- Shunt externalized and then replaced
- No further episodes of hyponatremia

References

- DeFronzo RA, Goldberg M, and Zalman SA. Normal diluting capacity in hyponatremic patients: reset osmostat or a variant of SIADH. *Ann Int Med* 84: 538-42.
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