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A Case Series of Hyponatremia and Management in Hospitalized Patients

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Introduction

Hyponatremia is defined as serum sodium less than 135 mmol/L and manifestations can vary from asymptomatic to progressive neurologic sequelae from headache to altered mental status, seizure, coma and death from cerebral edema. Hyponatremia has been found to be an independent risk factor for increased mortality. This case series examines common etiologies of hyponatremia in the hospital (Table 1).

Case Series

Critical care was required for seizure, encephalopathy and hepatorenal syndrome. Treatment of acute, symptomatic hyponatremia included 3% NaCl IV (case 5,6) whereas treatment for subacute cases consisted of tolvaptan (case 1,6) and chronic hyponatremia due to hypothyroidism was treated with fluid restriction and levothyroxine (case 3,7).

Common causes included syndrome of inappropriate antidiuretic hormone, hypothyroidism, heart failure/diuretic use, polydipsia/beer potomania and cirrhosis.

Table 1: Hyponatremia Case Series	Serum Na ⁺ mmol/L	Creatinine mg/dL	Serum Osmol, mosm/kg	Urine Osmol, mosm/kg	Urine Na ⁺ , mmol/L	Special labs	Etiology	Treatment and Complications
Reference	136 - 145	0.6 - 1.30	275- 295	300 - 500	20 to 40			
Case 1: Male, age 50	118	0.40	256	270	92		Small Cell Lung Cancer, SIADH	Salt tablets 1 gm, Tolvaptan 15 mg, No fluid restriction
Case 2: Female, age 67	130	0.80	BNP 27500 pg/mL	n/a	n/a	Echo LVEF 20%	Heart failure, Diuretic use	Hold Lasix, Gentle hydration IVF
Case 3: Male, age 67	125	1.10	249	364	61	TSH 66 µIU/mL, Free T4 < 0.25 ng/dL	Severe Hypothyroid, Laryngeal cancer tonsillectomy	NS IV fluids, Levothyroxine dose doubled 250 mcg
Case 4: Male, age 39	125	0.80	n/a	n/a	n/a	Alcohol 16 mg/dL (ref. 0-50)	Polydipsia, Beer potomania	Restrict fluid, Librium 25 mg ICU: seizure, delirium tremens
Case 5: Female, age 58	107	0.90	233	82	<15	Alcohol 20 mg/dL (ref. 0-50) CPK > 3200 Unit/L (ref. 38-234)	Polydipsia, Beer potomania	3% saline IV, 0.9% NaCl IVF, Sodium rising rapidly from 107 mmol/L to 124 mmol/L due to polyuria: Desmopressin 1 mcg IV, stop 0.9% NaCl IVF, start D5W
Case 6: Male, age 71	116	0.70	248	394	123		SIADH secondary to COPD	3% saline, may use Tolvaptan if needed
Case 7: Male, age 87	123	1.00	254	471	40	TSH 114 µIU/mL, Free T4 < 0.07 ng/dL	Severe hypothyroid	Lasix IV, Hydrocortisone IV, Levothyroxine IV 200 mcg loading dose, Tolvaptan if no improvement, Levothyroxine 50 mcg PO
Case 8: Male, age 38	116	3.10	n/a	Ammonia 104 µmol/L (ref. 9-35)	Bilirubin 10.6 mg/dL (ref. 0.2-1.5)	INR 1.78 (ref. 0.8-1.1)	Hepatorenal syndrome, Cirrhosis	ICU: anuria, anasarca, hemodynamic instability IV fluid resuscitation, vasopressors MAP>60 Albumin 25gm BID, Lasix 40mg IV BID, dialysis if no improvement

Abbreviations: ref. (reference), SIADH (Syndrome of inappropriate antidiuretic hormone), TSH ref. (0.340 - 5.600) µIU/mL, LVEF (Left ventr. ejection fract.)

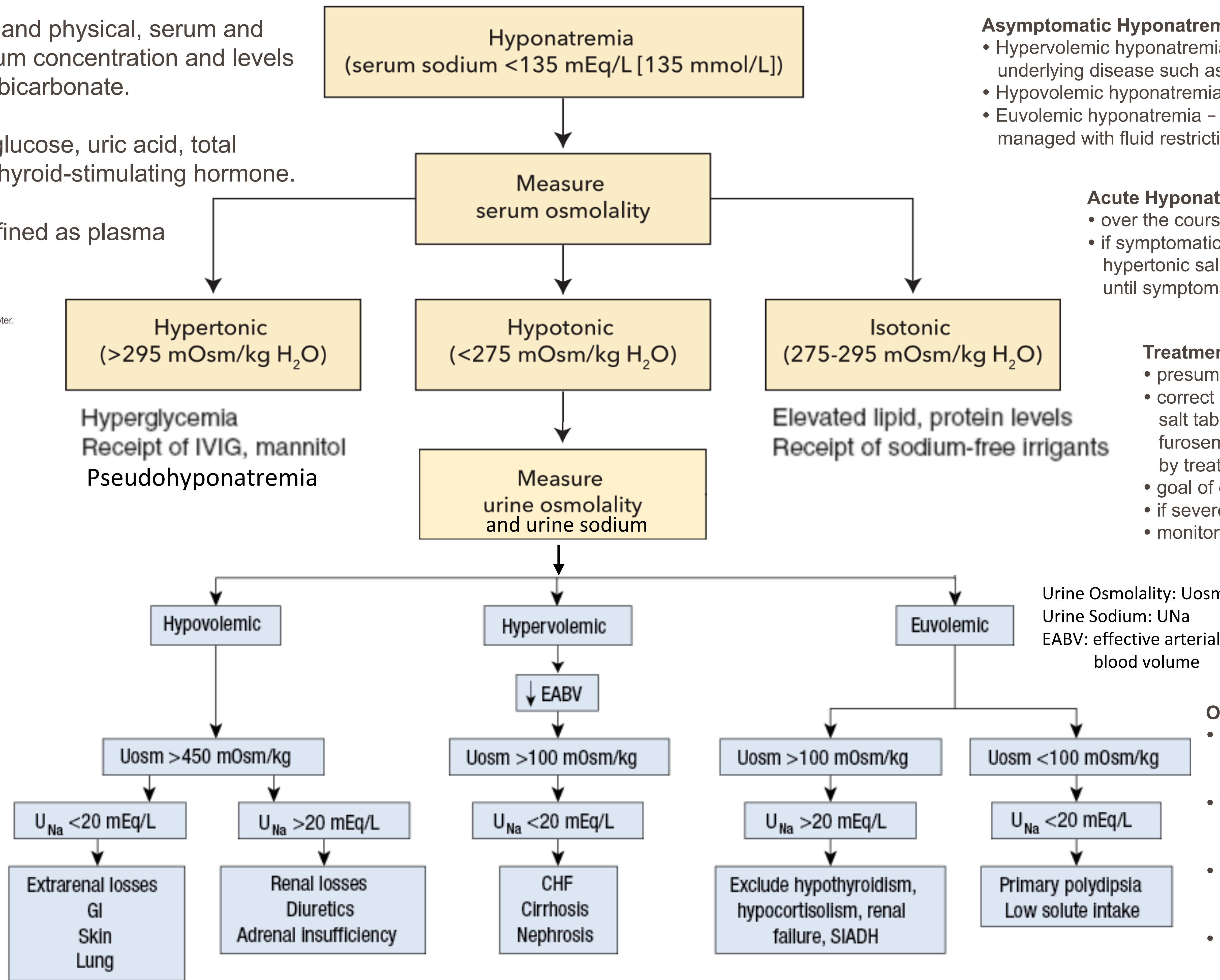
Evaluation

Evaluation includes history and physical, serum and urine osmolality, urine sodium concentration and levels of potassium, chloride and bicarbonate.

Special labs include urea, glucose, uric acid, total proteins, triglycerides and thyroid-stimulating hormone.

Severe hyponatremia is defined as plasma sodium < 120 mmol/L.

Figures adapted from:
 1. Wells BG, DiPiro JT, Schwinghammer TL, et al. Hyponatremia Chapter. Pharmacotherapy Handbook, 8th ed. New York: McGraw-Hill, 2012.
 2. American College of Physicians. MKSAP 18: Medical Knowledge Self-Assessment Program: Nephrology Page 12. Philadelphia, PA American College of Physicians, 2018/2019.



Asymptomatic Hyponatremia:

- Hypervolemic hyponatremia - management of the underlying disease such as heart failure or cirrhosis.
- Hypovolemic hyponatremia - fluid resuscitation.
- Euvolemic hyponatremia - if asymptomatic, can be managed with fluid restriction such as in SIADH.

Acute Hyponatremia:

- over the course of 24 to 48 hours
- if symptomatic such as seizures, can use hypertonic saline (3% NaCl) in boluses (100 cc) until symptoms resolve or up to 3 doses.

Treatment of Chronic Hyponatremia:

- presumed to be chronic when duration unclear
- correct gradually with the use of fluid restriction, salt tablets, slow infusions of 3% saline, furosemide, urea, or vasopressin antagonists, or by treatment of the underlying cause.
- goal of correction up to 8 mmol/L in first 24 hours
- if severe, raise sodium up to 6 mmol/L
- monitor serum sodium every 2 to 4 hours

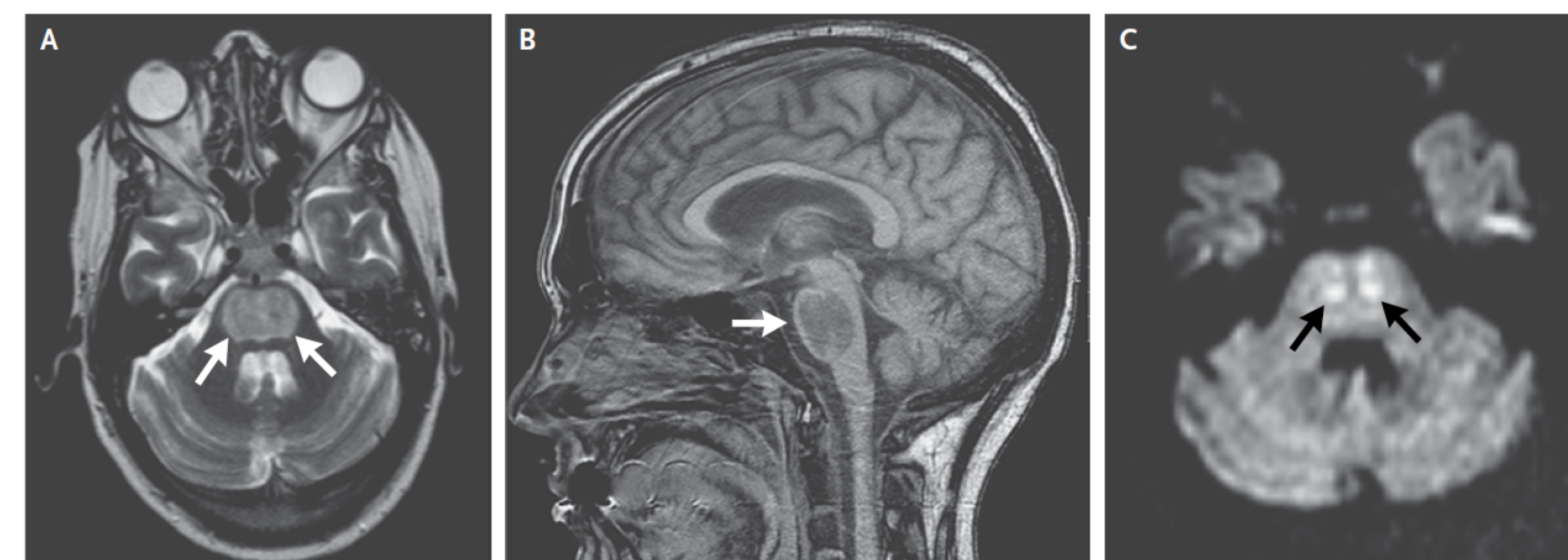
Urine Osmolality: Uosm
 Urine Sodium: UNa
 EABV: effective arterial blood volume

Overly Rapid Correction of Hyponatremia:

- If correction is exceeded, the serum sodium should be brought back down.

- This can be accomplished with free water (D5W) and/or ADH analogs (Desmopressin).
- This can happen during spontaneous urinary losses of water.
- Not to restrict oral fluid in the first 24 to 48 hours of treatment

Osmotic demyelination syndrome (ODS)



MRI brain shows high T2 (Panel A, arrows) and low T1 (Panel B, arrow) in the pons, with restricted diffusion (Panel C, arrows).
 Figure adapted from Baden 2016.

ODS, formerly called **Central Pontine Myelinolysis**, symptoms are frequently irreversible:

- Dysarthria, dysphagia, paraparesis or quadriparesis, behavioral disturbances, movement disorders, seizures, lethargy, confusion, disorientation, obtundation, and coma.

- Severely affected patients may become "locked in", they are awake but are unable to move or verbally communicate.
- Risk for ODS includes rapid overcorrection in the setting of chronic hyponatremia which can occur in hypokalemia, alcoholism, malnutrition and liver disease or Sodium < 105 mmol/L
- Rapid correction is a hypertonic stress to astrocytes that are depleted of osmolytes, triggering apoptosis, disruption of the blood brain barrier, and, eventually, brain demyelination.

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 Lee JY, Kilonzo K, Nistico A, Yeates K. (2014) Management of hyponatremia. Canadian Medical Association. CMAJ May 13, 2014, 186(8). E281-E286.