Case Presentation

Ranjita Pallavi

PGY -2

HPI

46 year old African American male, resident of Wards Island shelter was brought by EMS with altered mental status and fever.

He was a poor historian, uncooperative , confused and agitated so history was obtained from EMS sheet.

As per EMS, patient was found alert, mildly combative and aggressive, oriented x 2, somewhat improved after 25gDextrose: No Initial FS was documented on the EMS sheet: No documented hypoglycemia in the ER

He was combative in the ER , was given Ativan and haldol and put on 4 point restraints.

ROS: No further history was obtainable at this time

PMHx:Type 2 DM , Hypothyroidism as per EMS sheet

PSHx: Unable to obtain

Allergies: None

Family History: Unable to obtain

Social History: Resident of Wards Island shelter.Denied alcohol/smoking /drugs

Home Medications: unable to ascertain . EMS sheet mentioned Prednisone and levothyroxine . Not known why on Prednisone and what dose.

VS in the ER BP 124/54 **HR 110** RR24 **T100.7f O2SAT 93%** FS 165

Physical Exam:
Alert, oriented x2 to place and person, agitated, verbally abusive, uncooperative,
Right pupil dilated 3-4 mm and not reactive to light. Left pupil reactive.
EOMI, no nystagmus
Cranial Nerves Normal
Motor exam; Moving all 4 limbs , normal muscle tone, DTR2+ in all extremities
except absent Achilles tendon reflex bilaterally.
Sensory exam; intact light touch
No neck stiffness
Cerebella; not tested.

HEENT :L eye with mild conjunctival congestion. No cyanosis /icterus,No JVD
Chest -b/l equal air entry with diffuse wheezing and scattered crackles all over specially in L side
CVS-s1s2 normal, no added sounds
Abdomen-soft , nontender, nondistended, BS +
Extremities: No pedal edema

Initial Labs

CBC WBC 8.78 H/H **10.6/34.8** Baseline not known PLT 428

MCV 88.5 MCH 27 MCHC 30.5

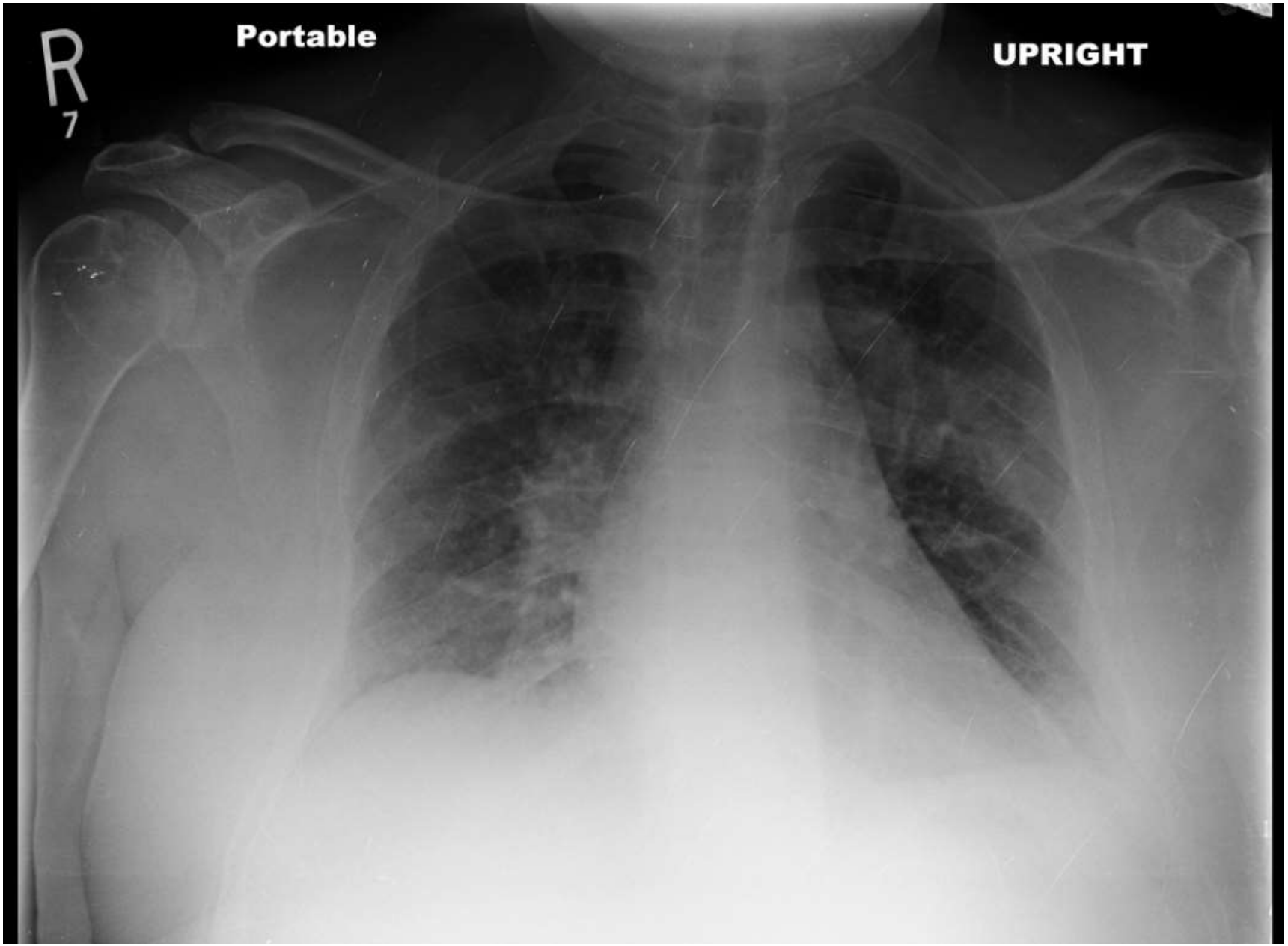
BMP **151**/4.2/113/**27** BUN /creatinine **20/2.6** glucose 86

Ca**10.6** **Corrected Calcium 11.6**
LDH 272
LFT 32/24/93/0.97/7.3 **ALB 2.9**
Mag 2.3
PTT wnl, INR 1.27
Serum Alcohol 0,
Serum salicylate and acetaminophen level negative
ABG: **7.32/50.4/60.2/25.3/89.2**
LACTATE 1.9

UA - 1+ protein , no RBCs , no WBCs , Bilirubin small , sp gravity - 1.012

Urine sodium - 20 , FenA - less than 1 %

Renal USG -
Right renal cyst. No hydronephrosis or renal calculus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Technician:
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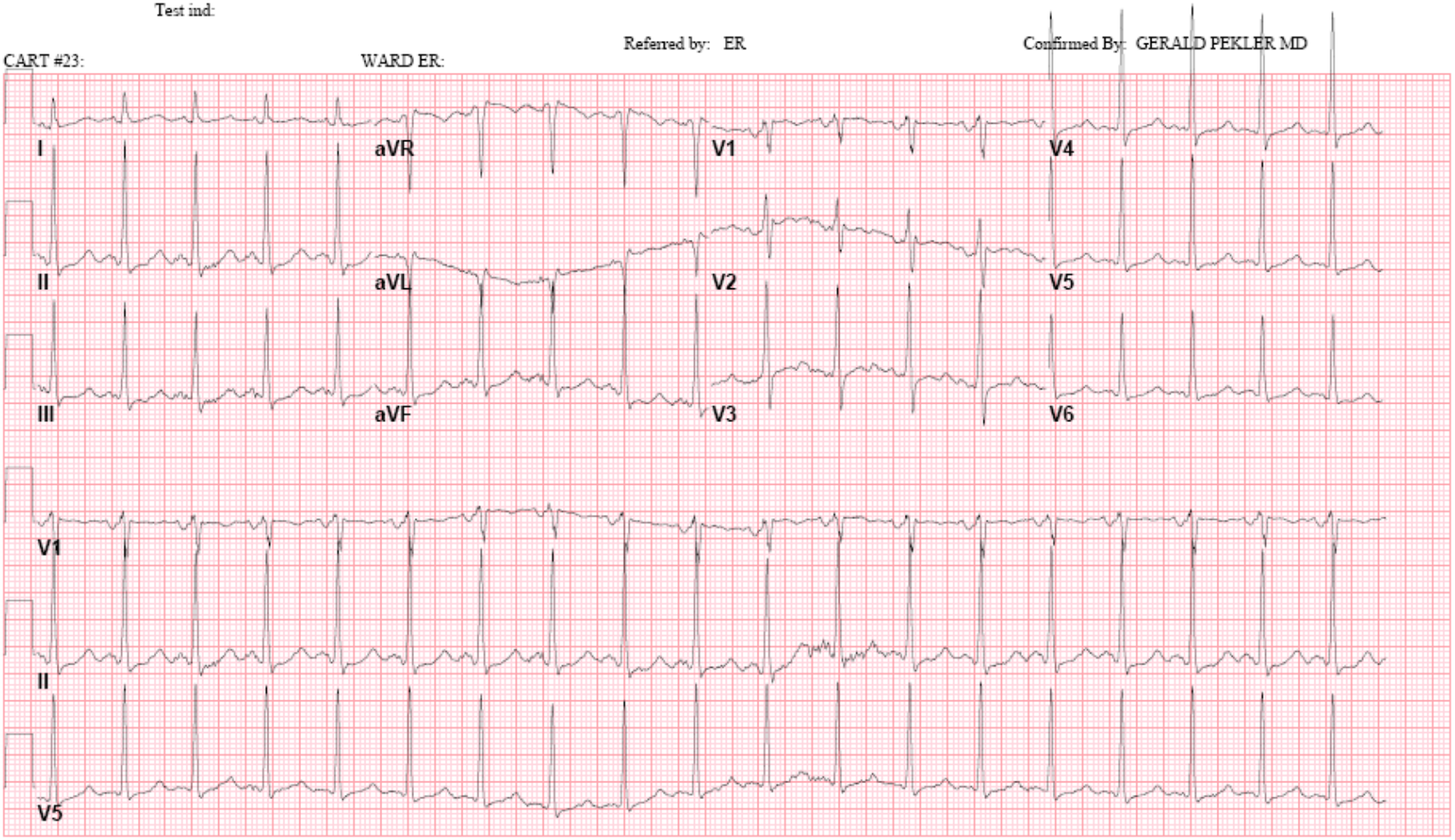
CART #23: WARD ER: Referred by: ER Confirmed By: GERALD PEKLER MD



25mm/s 10mm/mV 150Hz 7.1.1 12SL 235 CID: 23

EID:8 EDT: 08:59 10-JUL-2012 ORDER:

- Differential Diagnosis???

BMP

Date/Time	Na MH	K MH	Cl MH	CO2 MH	Glu MH	BUN MH	Creat MH
29Jun12 2143	151	4.2	113	27	86	20	2.6
30Jun12 0629	152	4.2	114	24	82	21	2.7
30Jun12 1441	149	5.3	113	24	96	19	1.9
30Jun12 1910	150	4.2	112	25	106	19	2.3
01Jul12 0803	153	4.3	118	22	95	14	1.8
01Jul12 1825	155	4.1	121	25	127	13	1.8
02Jul12 0119	154	3.3	119	25	163	10	1.8
02Jul12 0804	152	3.7	121	18	177	10	1.7
02Jul12 2034	152	3.6	117	23	152	8	1.8
03Jul12 0730	148	3.2	115	23	181	9	1.8
03Jul12 1335	149	3.1	115	24	183	9	1.8
03Jul12 2024	149	4.2	117	21	173	9	1.6
04Jul12 0311	144	3.2	111	22	263	9	1.6
04Jul12 1357	139	3.5	107	21	265	9	1.6
04Jul12 1958	141	3.9	109	19	128	8	1.4
05Jul12 1604	141	3.6	110	17	148	8	1.7
05Jul12 2004	138	4.3	110	17	207	8	1.4
06Jul12 1017	144	3.6	111	15	207	11	1.9
06Jul12 2004	143	3.7	114	17	222	15	1.5
07Jul12 1454	151	3.2	126	17	110	13	1.1
07Jul12 2313	145	3.8	117	17	118	16	1.3
08Jul12 0619	145	3.6	116	18	201	16	1.4
08Jul12 0953	136	3.2	109	16	424	15	1.3
08Jul12 1714	146	3.6	123	15	137	14	0.9
08Jul12 1955	142	5.1	115	17	135	18	1.2
09Jul12 1235	138	3.5	113	17	413	17	1.5
09Jul12 2008	143	4.7	116	18	143	17	1.3
14Jul12 1127	149	5.5	118	22	81	16	0.7
19Jul12 0905	144	4.1	104	29	114	21	1.3
24Jul12 0825	142	4.0	105	24	109	21	1.2

Serum and Urine Osmolality

Date/Time	Osmol MH
02Jul12 0119	326
02Jul12 2034	314
03Jul12 1335	306
03Jul12 2024	302
04Jul12 0311	305
04Jul12 1357	289
07Jul12 1558	305
07Jul12 1840	315
07Jul12 2313	299
08Jul12 0953	300

Date/Time	OsmoUr MH
30Jun12 0857	251
02Jul12 1923	61
03Jul12 1335	53
03Jul12 1841	55
04Jul12 0332	332
05Jul12 1604	336
07Jul12 1557	112
07Jul12 1840	513
08Jul12 0953	552

Urine Electrolytes

Date/Time	UrNa MH	UrK MH	UrCl MH	Creat MH
29Jun12 2143				2.6
30Jun12 0629				2.7
30Jun12 0857	20	30.1	< 10	
30Jun12 1441				1.9
30Jun12 1910				2.3
01Jul12 0803				1.8
01Jul12 1825				1.8
02Jul12 0119				1.8
02Jul12 0804				1.7
02Jul12 2034				1.8
03Jul12 0730				1.8
03Jul12 1335	15	2.3	14	1.8
03Jul12 1841	14	2.5	12	
03Jul12 2024				1.6
04Jul12 0311				1.6
04Jul12 0332	77	17.5	98	
04Jul12 1357				1.6
04Jul12 1958				1.4
05Jul12 1604	89	22.7	115	1.7
05Jul12 2004				1.4
06Jul12 1017				1.9
06Jul12 2004				1.5
07Jul12 1454				1.1
07Jul12 1603	19	7.2	22	
07Jul12 1840	73	23.7	112	
07Jul12 2313				1.3
08Jul12 0619				1.4
08Jul12 0953	36	20.7	71	1.3
08Jul12 1714				0.9
08Jul12 1955				1.2
09Jul12 1235				1.5
09Jul12 2008				1.3
14Jul12 1127				0.7
19Jul12 0905				1.3
24Jul12 0825				1.2

Etiology of Hypernatremia

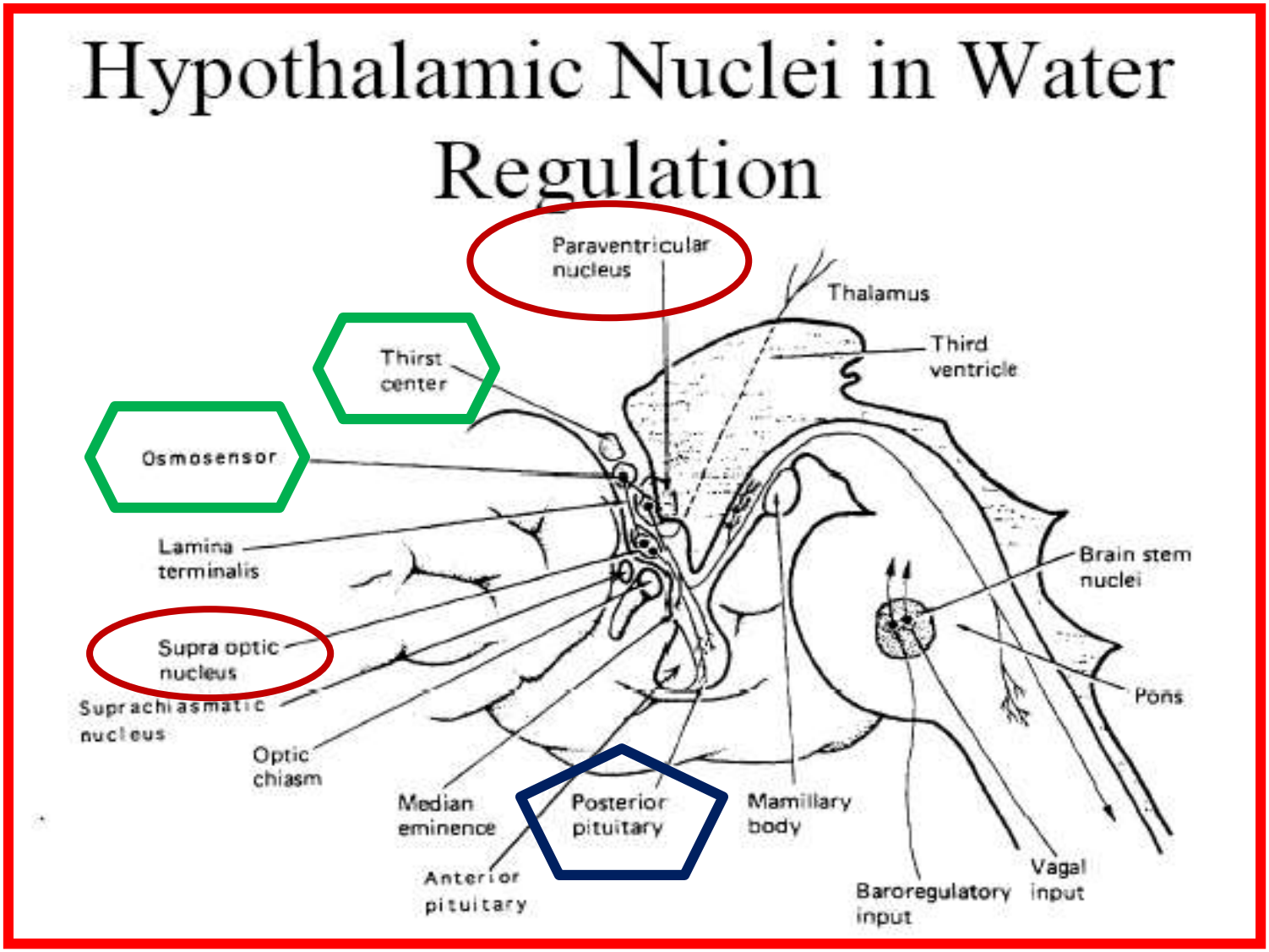
3 Main Mechanisms

- Unreplaced water loss: most common
- Water loss into cells
- Sodium overload

Unreplaced water loss

- Skin losses
- Gastrointestinal losses
- Urinary losses
- Central or nephrogenic diabetes insipidus
- Adipsic diabetes insipidus
- Osmotic diuresis

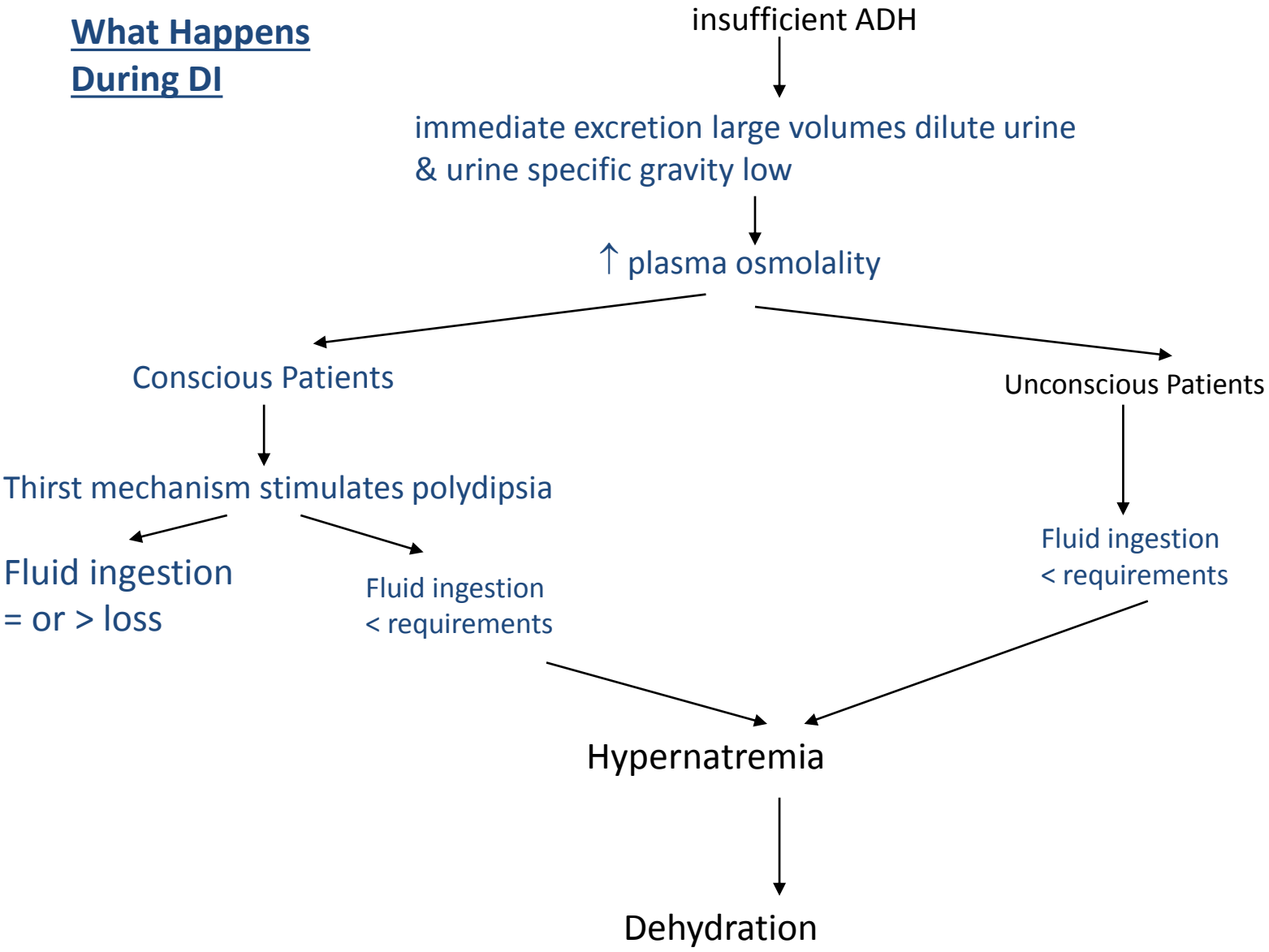
CENTRAL DIABETES INSIPIDUS

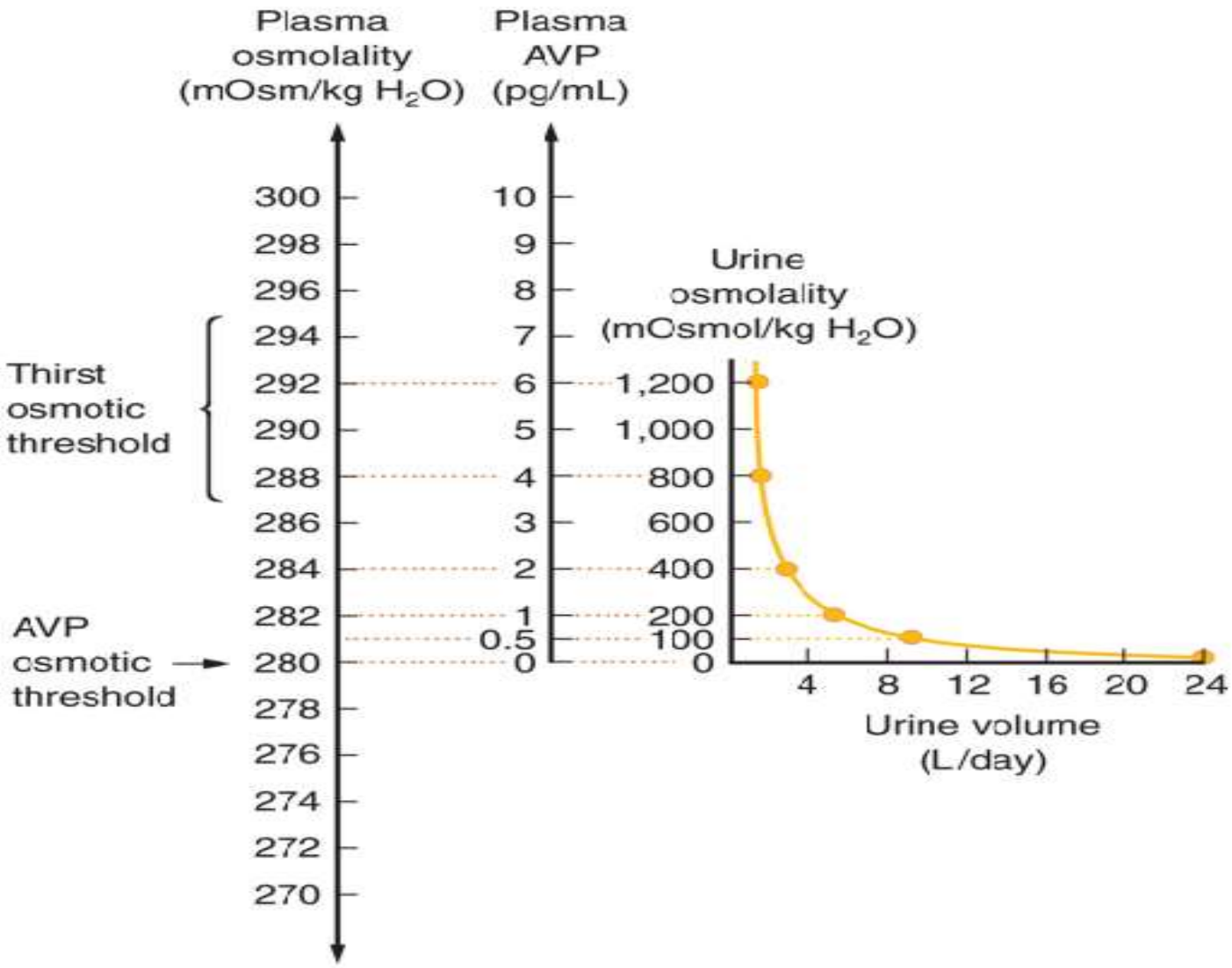


Adipsic Hypernatremia

- Absence of thirst
- Primary adipsia is rare
- Secondary adipsia from damage to hypothalamus
  - Trauma
  - Tumor
  - Hydrocephalus
  - Histiocytosis

What Happens During DI





Relationship of plasma osmolality, plasma AVP concentrations, urine osmolality, and urine volume in humans. Note that the osmotic threshold for AVP secretion defines the point at which urine concentration begins to increase, but the osmotic threshold for thirst is significantly higher and approximates the point at which maximal urine concentration has already been achieved. Note also that, because of the inverse relation between urine osmolality and urine volume, changes in plasma AVP concentrations have much larger effects on urine volume at low plasma AVP concentrations than at high plasma AVP concentrations. (Adapted from Robinson AG: Disorders of antidiuretic hormone secretion. J Clin Endocrinol Metab 14:55-88, 1985.)

Etiologies of Hypotonic Polyuria

Central (neurogenic) diabetes insipidus

- Congenital (congenital malformations, autosomal dominant, arginine vasopressin (AVP)–neurophysin gene mutations)
- Drug-/toxin-induced (ethanol, diphenylhydantoin, snake venom)
- Granulomatous (histiocytosis, sarcoidosis)
- Neoplastic (craniopharyngioma, germinoma, lymphoma, leukemia, meningioma, pituitary tumor; metastases)
- Infectious (meningitis, tuberculosis, encephalitis)
- Inflammatory/autoimmune (lymphocytic infundibuloneurohypophysitis)
- Trauma (neurosurgery, deceleration injury)
- Vascular (cerebral hemorrhage or infarction, brain death)
- Idiopathic

- Osmoreceptor dysfunction
- Granulomatous (histiocytosis, sarcoidosis)
- Neoplastic (craniopharyngioma, pinealoma, meningioma, metastases)
- Vascular (anterior communicating artery aneurysm/ligation, intrahypothalamic hemorrhage)
- Other (hydrocephalus, ventricular/suprasellar cyst, trauma, degenerative diseases)
- Idiopathic

Osmoreceptor dysfunction

- Granulomatous (histiocytosis, sarcoidosis)
- Neoplastic (craniopharyngioma, pinealoma, meningioma, metastases)
- Vascular (anterior communicating artery aneurysm/ligation, intrahypothalamic hemorrhage)
- Other (hydrocephalus, ventricular/suprasellar cyst, trauma, degenerative diseases)
- Idiopathic

Increased AVP metabolism

- Pregnancy

Increased AVP metabolism

Pregnancy

- **Nephrogenic diabetes insipidus**
- Congenital (X-linked recessive, AVP V_2 receptor gene mutations, autosomal recessive or dominant, aquaporin-2 water channel gene mutations)
- Drug-induced (demeclocycline, lithium, cisplatin, methoxyflurane)
- Hypercalcemia
- Hypokalemia
- Infiltrating lesions (sarcoidosis, amyloidosis)
- Vascular (sickle cell anemia)
- Mechanical (polycystic kidney disease, bilateral ureteral obstruction)
- Solute diuresis (glucose, mannitol, sodium, radiocontrast dyes)
- Idiopathic

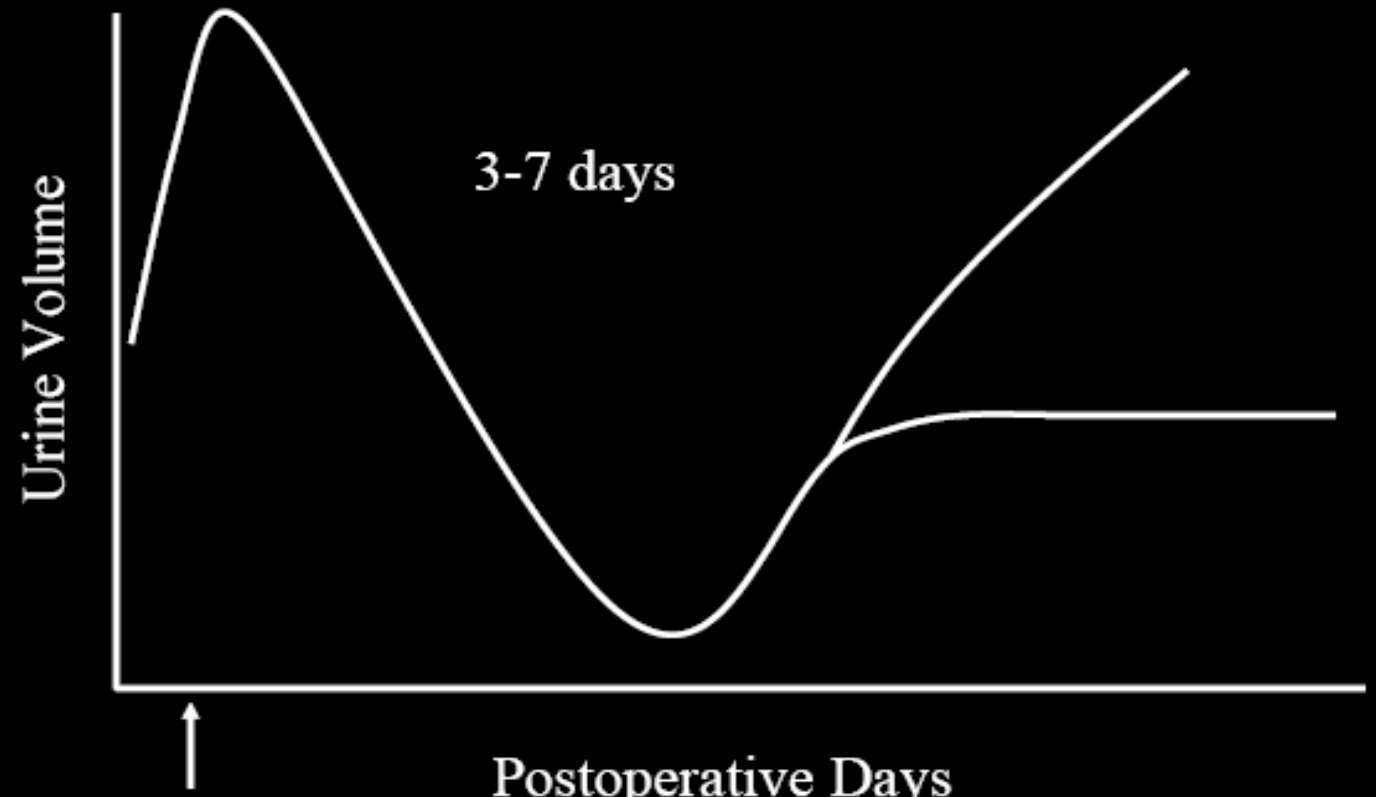
•Primary polydipsia

- Psychogenic (schizophrenia, obsessive-compulsive behaviors)

CENTRAL DIABETES INSIPIDUS

- Triphasic Response:
  - **Initial polyuria**
    - 1-5 days
    - Inhibition of ADH release due to hypothalamic dysfunction
  - **Antidiuretic phase**
    - 6^{th} to 11^{th} day
    - Slow release of stored hormone
  - **Permanent CDI**

Triphasic Response after Pituitary Stalk Damage



Symptoms

- The major symptoms of central DI are **polyuria** and **polydipsia**.
- Polyuria is defined as a urine output of over **3 L/day** in adults.
- Polyuria must be differentiated from frequency and nocturia, which are not associated with an increase in total urine output.
- The onset of polyuria is usually abrupt in CDI.
- This is in contrast to nephrogenic DI and primary polydipsia, in which onset of polyuria is almost always gradual.

Symptoms

- Nocturia is often the first sign of CDI.
- This is because urine is usually most concentrated in the morning due to lack of fluid ingestion overnight.
- As a result, nocturia is usually the first manifestation of a loss of concentrating ability.
- Thus, a relatively dilute urine is excreted, with a urine osmolality of less than 200 mOsmol/kg.
- Dry skin and constipation are other symptoms that may occur in CDI.

Diagnosis

- Most patients have a high-normal or only mildly elevated plasma sodium concentration, usually greater than 142 mEq/L.
- In addition, the plasma osmolality usually remains around values only slightly above 290 mOsm/kg (normal is 280-295 mOsm/kg).
- This occurs because the initial loss of water results in concurrent stimulation of thirst, which minimizes the degree of net water loss.

Diagnosis

- Stimulation of thirst does not occur, however, when CDI is due to a central lesion that impairs thirst causing hypodipsia or adipsia.
- In such cases, the plasma sodium concentration can exceed 160 meq/L and the plasma osmolality will rise significantly also.
- This also occurs if a patient has no access to water.
- Withholding water in patients with CDI can result in severe dehydration.

Diagnosis

- Water restriction test:
  - Not required for the diagnosis of DI, but is helpful in differentiating central DI from nephrogenic DI and primary polydipsia.
  - Recommended to confirm the diagnosis even if the history or plasma sodium concentration appear to be helpful.
  - Used to raise the plasma osmolality.
  - Hypertonic saline (0.05 mL/kg/min for less than 2 hrs) can be used if the water restriction test is inconclusive or cannot be done.

Fluid Deprivation Test for the Diagnosis of Diabetes Insipidus

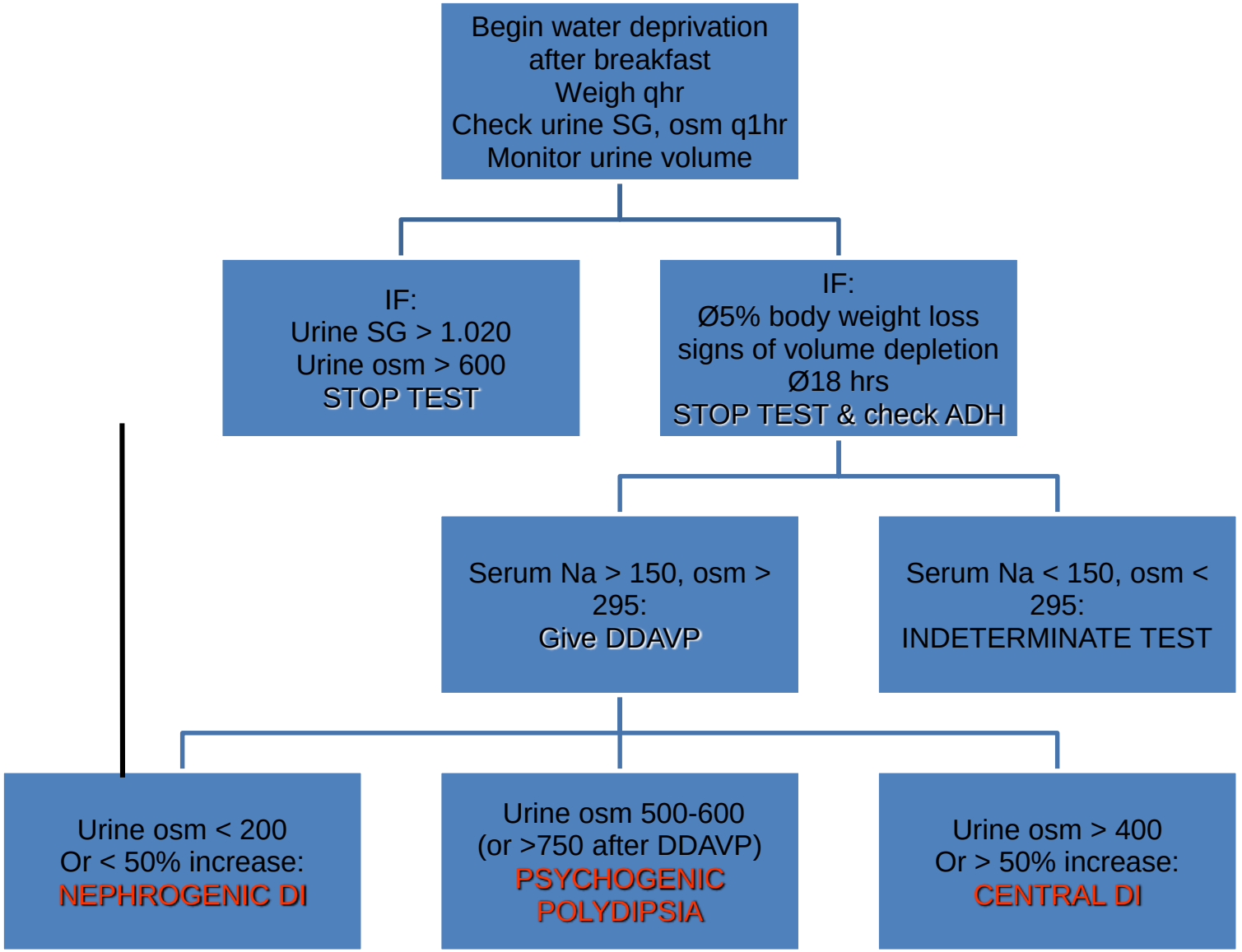
Procedure

- Initiation of the deprivation period depends on the severity of the DI; in routine cases, the patient should be made NPO after dinner, whereas in cases with more severe polyuria and polydipsia, this may be too long a period without fluids and the water deprivation should be begun early on the morning (e.g., 6 AM) of the test.
- Obtain plasma and urine osmolality, serum electrolytes and a plasma AVP level at the start of the test.
- Measure urine volume and osmolality hourly or with each voided urine.
- Stop the test when body weight decreases by ≥3%, the patient develops orthostatic blood pressure changes, the urine osmolality reaches a plateau (i.e., <10% change over two or three consecutive measurements), or the serum Na^+ >145 mmol/L.
- Obtain plasma and urine osmolality, serum electrolytes, and a plasma AVP level at the end of the test, when the plasma osmolality is elevated, preferably >300 mOsm/kg H_2O.
- If the serum Na^+ <146 mmol/L or the plasma osmolality <300 mOsm/kg H_2O when the test is stopped, then consider a short infusion of hypertonic saline (3% NaCl at a rate of 0.1 ml/kg/min for 1–2 hr) to reach these endpoints.
- If hypertonic saline infusion is not required to achieve hyperosmolality, administer AVP (5 U) or DDAVP (1 μg) SC and continue following urine osmolality and volume for an additional 2 hr.

interpretation

- An unequivocal urine concentration after AVP/DDAVP (>50% increase) indicates CDI and an unequivocal absence of urine concentration (<10%) strongly suggests nephrogenic DI (NDI) or primary polydipsia (PP).
- Differentiating between NDI and PP, as well as for cases in which the increase in urine osmolality after AVP/DDAVP administration is more equivocal (e.g., 10%–50%), is best done using the relation between plasma AVP levels and plasma osmolality obtained at the end of the dehydration period and/or hypertonic saline infusion and the relation between plasma AVP levels and urine osmolality under basal conditions

DI: Water Deprivation Test



DI: Diagnosis

	Central	Nephrogenic	Psychogenic
Urine SG & Urine osm.	Low	Low	Low
Serum Na	*Normal to high	*Normal to high	***Normal to low**
Serum osmolality	*Normal to high	*Normal to high	***Low**
Symptom onset	Sudden	Varies	Varies
Urine volume	Large	Large	*Varies
Nocturia	Frequent	Frequent	Varies

* Results depend on access to free water.

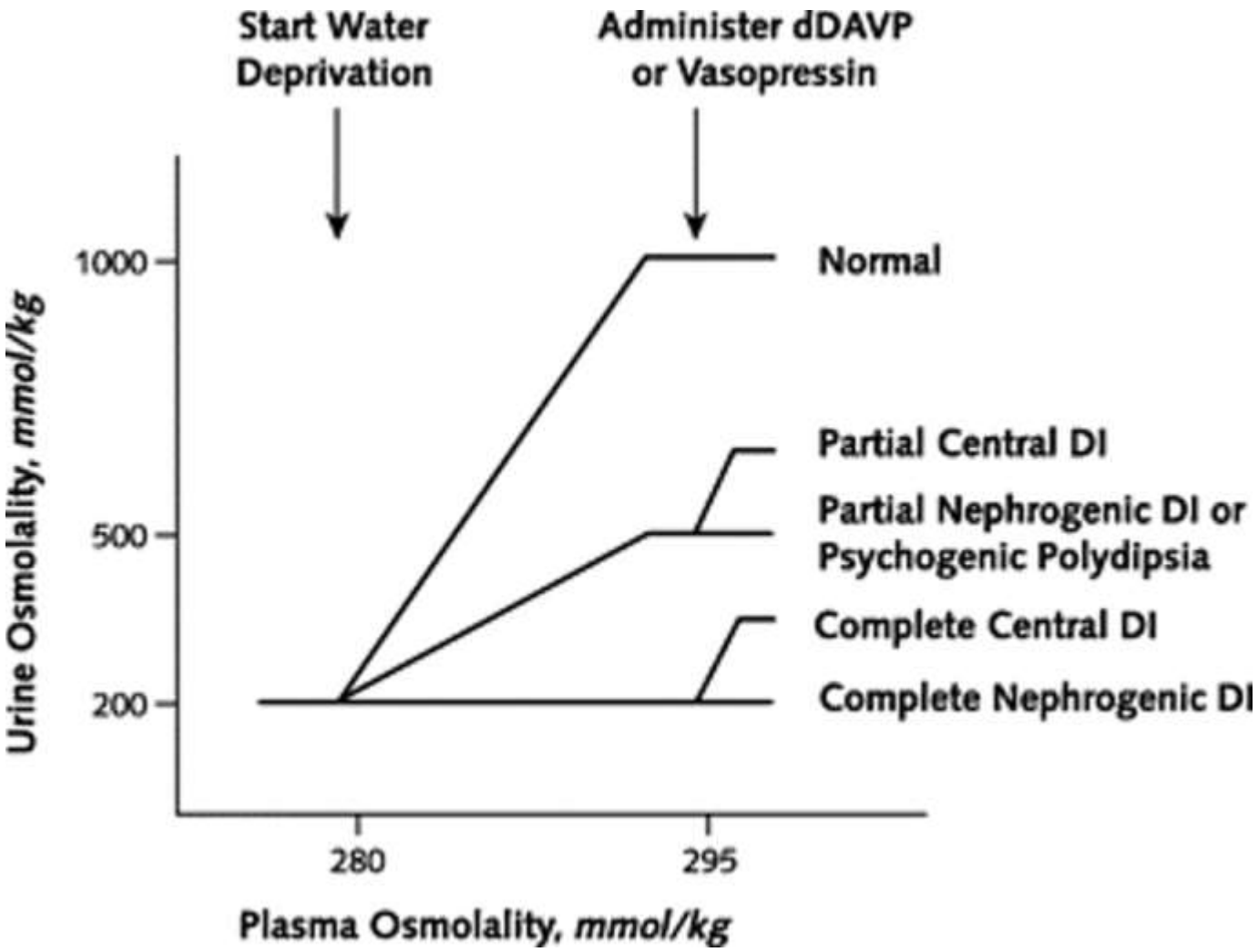
Water Restriction Tests

- Interpretation:
  - Normal subjects and primary polydipsia:
    - Urine osms are greater than plasma Osms after water restriction.
    - Urine osms increase minimally (<10%) after exogenous ADH.
  - Central Diabetes Insipidus:
    - Urine osms remain less than plasma osms after water restriction.
    - After ADH is given, urine osms increase 100% in complete CDI and over 50% in partial CDI.
  - Nephrogenic Diabetes Insipidus:
    - Urine osms remain less than plasma osms.
    - After ADH, urine osms increase by less than 50%.

Water Restriction Test

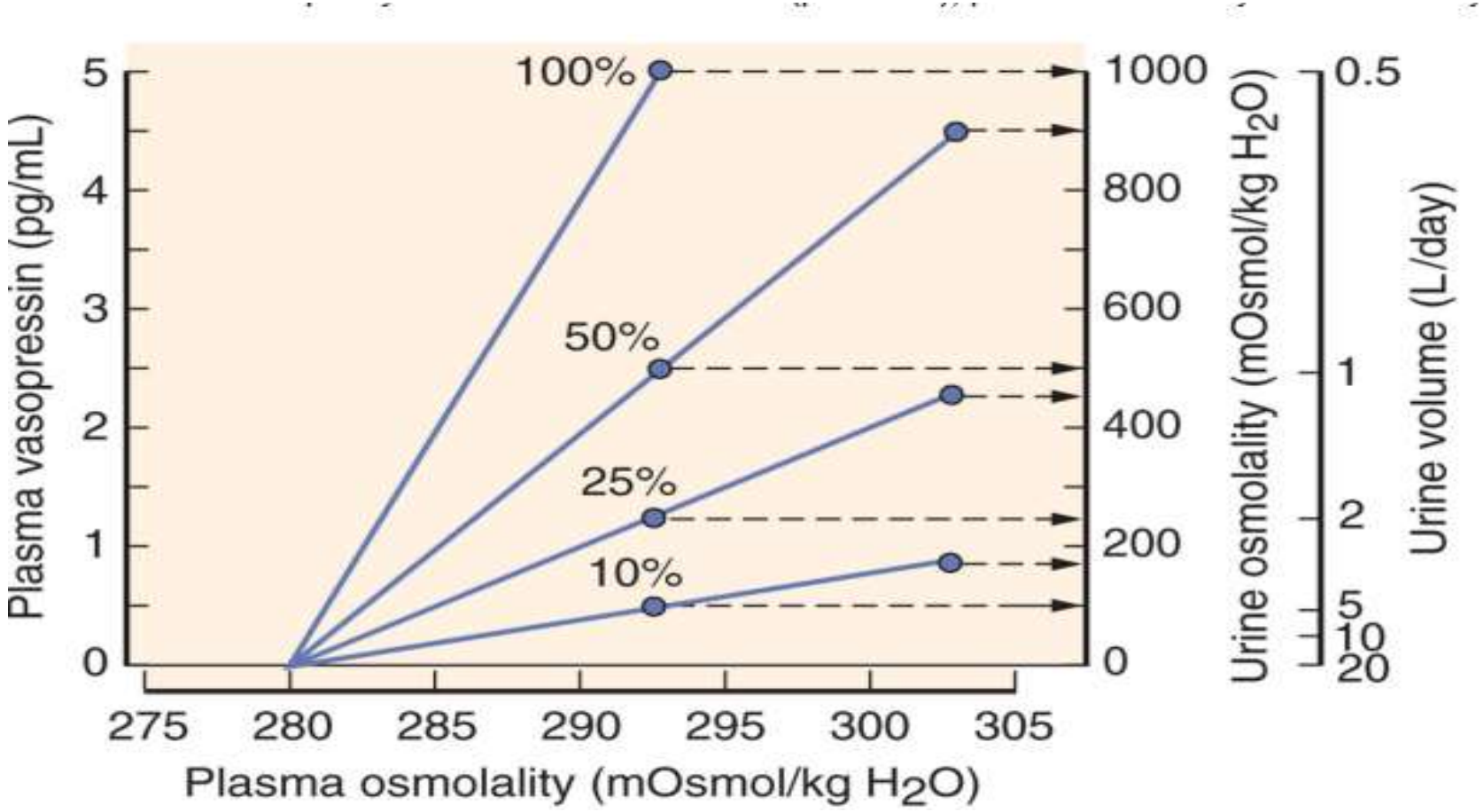
- Plasma ADH levels are measured at baseline and after water restriction in order to differential CDI, NDI, and primary polydipsia, in case the water restriction test is equivocal.
- If there is an appropriate rise in ADH in response to the rising plasma osmolality, central DI is excluded.
- If there is an appropriate elevation in urine osmolality as the plasma ADH rises, nephrogenic DI is excluded.
- Plasma ADH levels can be misleading in primary polydipsia since chronic over-hydration induces partial suppression of ADH release, mimicking the pattern in central DI.

Water deprivation test

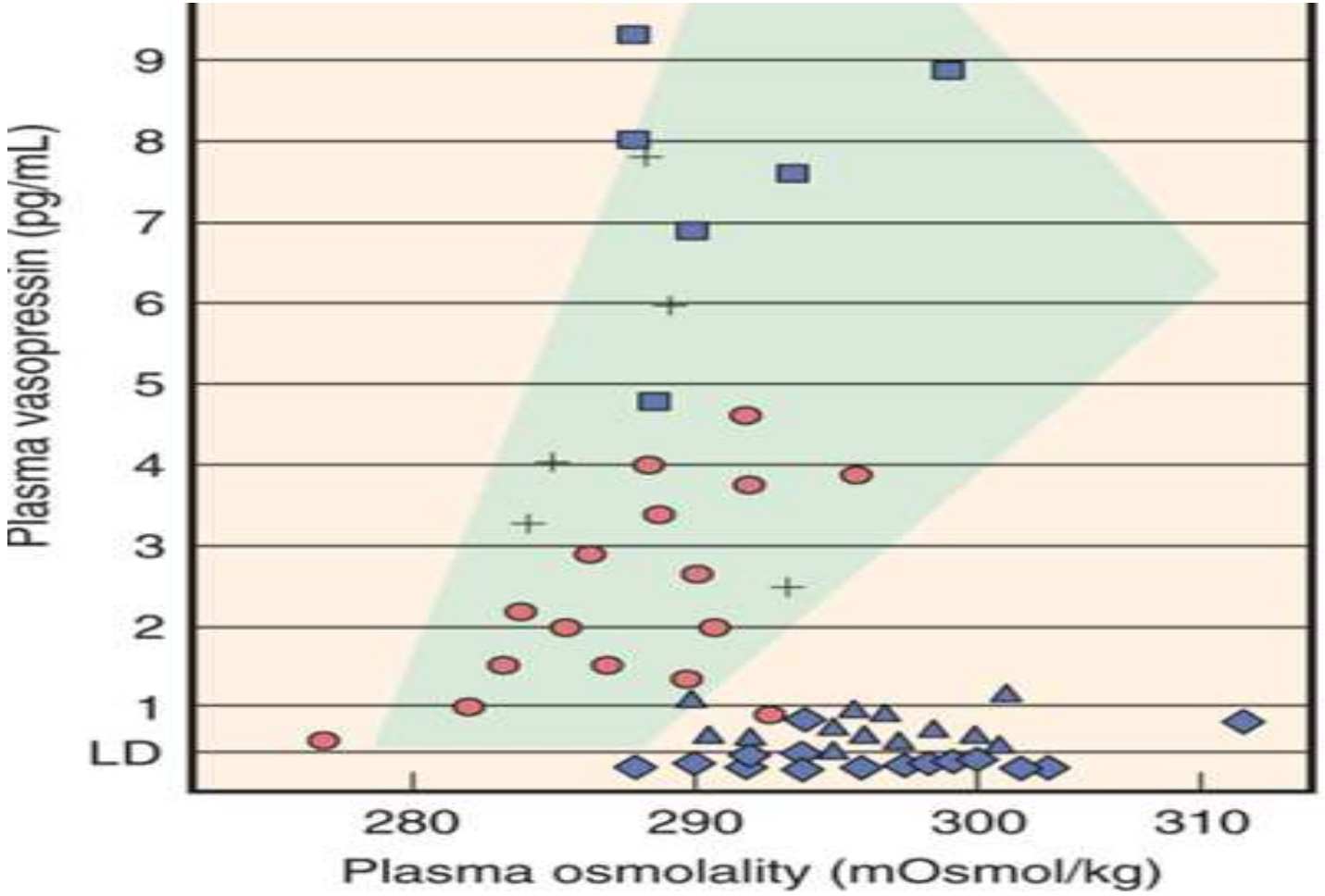


Sands, J. M. et. al. Ann Intern Med 2006;144:186-194

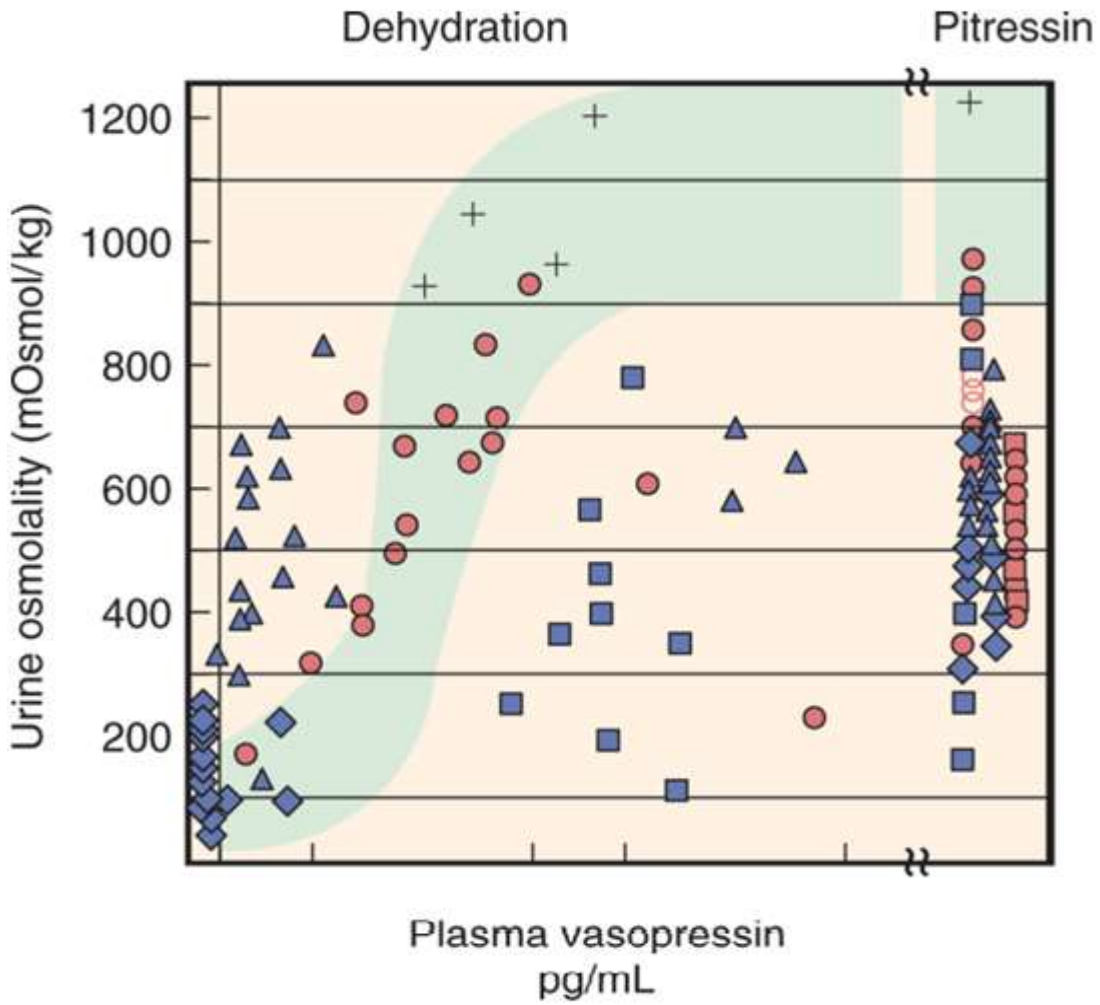
Annals of Internal Medicine



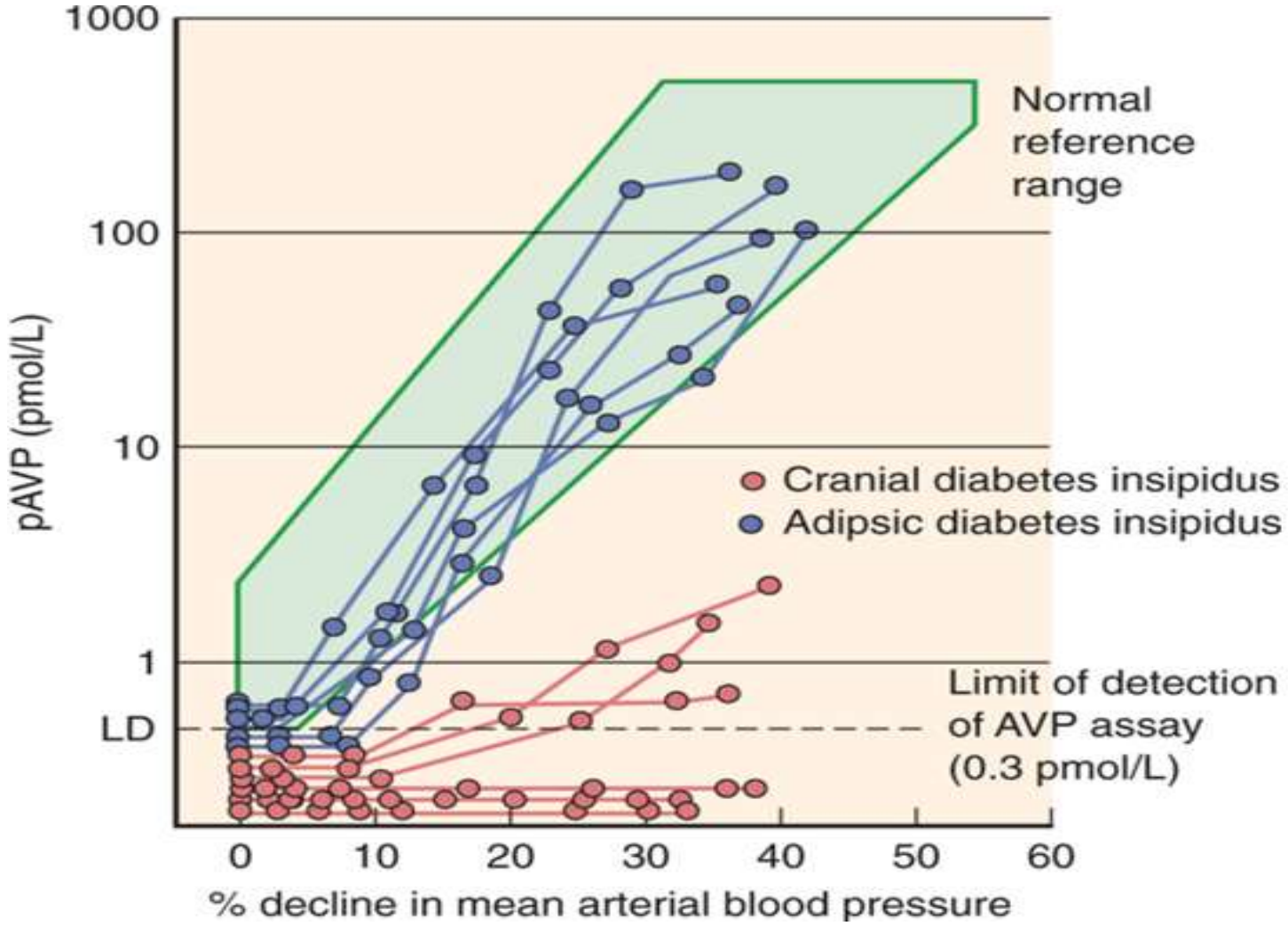
Relation between plasma AVP levels, urine osmolality, and plasma osmolality in subjects with normal posterior pituitary function (100%) compared with patients with graded reductions in AVP-secreting neurons (to 50%, 25%, and 10% of normal). Note that the patient with a 50% secretory capacity can achieve only half the plasma AVP level and half the urine osmolality of normal subjects at a plasma osmolality of 293 mOsm/kg H_2O, but with increasing plasma osmolality, this patient can nonetheless eventually stimulate sufficient AVP secretion to reach a near maximal urine osmolality. In contrast, patients with more severe degrees of AVP-secreting neuron deficits are unable to reach maximal urine osmolalities at any level of plasma osmolality. (Adapted from Robertson GL: Posterior pituitary. *In* Felig P, Baxter J, Frohman LA [eds]: Endocrinology and Metabolism. New York, McGraw Hill, 1986, pp 338-386.)



Relation between plasma AVP and concurrent plasma osmolality in patients with polyuria of diverse causes. All measurements were made at the end of a standard dehydration test. The *shaded area* represents the range of normal. In patients with severe (◆) or partial (▲) central DI, plasma AVP was almost always subnormal relative to plasma osmolality. In contrast, the values from patients with dipsogenic (○) or nephrogenic (▪) DI were consistently within or above the normal range. (From Robertson GL: Diagnosis of diabetes insipidus. *In* Czernichow AP, Robinson A [eds]: Diabetes Insipidus in Man: Frontiers of Hormone Research. Basel, S Karger, 1985, p 176.)



Relation between urine osmolality and concurrent plasma AVP in patients with polyuria of diverse causes. All measurements were made at the end of a standard dehydration test. The *shaded area* represents the range of normal. In patients with severe (◆) or partial (▲) central DI, urine osmolality is normal or supranormal relative to plasma AVP when the latter is submaximal. In patients with nephrogenic DI (▪), urine osmolality is always subnormal for plasma AVP. In patients with dipsogenic DI (○), the relation is normal at submaximal levels of plasma AVP but is usually subnormal when plasma AVP is high. (From Robertson GL: Diagnosis of diabetes insipidus. *In* Czernichow AP, Robinson A [eds]: Diabetes Insipidus in Man: Frontiers of Hormone Research. Basel, S Karger, 1985, p 176.)



Plasma AVP responses to arterial hypotension produced by infusion of trimethephan in patients with central DI ("cranial diabetes insipidus") and osmoreceptor dysfunction ("adipsic diabetes insipidus). Normal responses in healthy volunteers are shown by the *shaded area.* Note that despite absent or markedly blunted AVP responses to hyperosmolality, patients with osmoreceptor dysfunction respond normally to baroreceptor stimulation induced by hypotension. (From Baylis PH, Thompson CJ: Diabetes insipidus and hyperosmolar syndromes. *In* Becker KL [ed]: Principles and Practice of Endocrinology and Metabolism. Philadelphia, JB Lippincott, 1995, p 257.)

General Principles Of Treatment

- Estimate the magnitude of water deficit
- Rate of correction
- Appropriate fluid repletion regimen
- Concurrent volume or potassium deficit that needs correction

Step 1:Estimate the Water Deficit

- Water deficit= Current TBW x $\frac{\text{Serum [Na]}}{140}$ -1

TBW: Estimated total body water

60% LBW Young Men

50% LBW Young Women

50% LBW Elderly Men

45% LBW Elderly Women

Guides initial therapy

Step 2: Choose a rate of correction

- Maximum rate of correction of the serum sodium should be 10 meq/L per day in patients with hypernatremia for atleast 24 hours

Step 3: Design a fluid repletion regimen

- D5W
- Free Water
- Addition of free water to tube feedings
- 0.45% NaCl

- So let's do a sample calculation:
  - 60 kg woman with 168 mEq/L
  - How much water will it take to reduce her sodium to 140 mEq/L
- Water deficit = 0.4 x 60 ([168/140]-1) = 4.8 L
- But how fast should I correct it?
- Same as hyponatremia, sodium should not be lowered by more than 10-12 mEq/L in 24 hours
  - Overcorrection can lead to cerebral edema which can lead to encephalopathy, seizures or death
- So what does that mean for our patient?
  - The 4.8 L which will lower the sodium level by 28 should be given over 56-60 hours, or at a rate of 75-80 mL/hr
  - Typical fluids given in form of D5 water

- Obligate water losses from stool and skin: 30-40 ml/hour
- Urine electrolyte free water clearance =

$$UV \text{ (Urine Volume)} \times \left(1 - \frac{UNa + UK}{SNa}\right)$$

- If one half isotonic saline is given, each liter of IV fluid contains only 500 ml of free water

Desmopressin

- Desmopressin is a two-amino acid substitute of ADH that has potent antidiuretic activity but no vasopressor activity.
- It is also known as dDAVP, which stands for 1-deamino-8-D-arginine vasopressin.
- It is currently the drug of choice for long-term therapy of CDI to control polyuria.
- It is safe during pregnancy for both the mother and the fetus.

Desmopressin

- The initial aim of therapy is to reduce nocturia, in order to provide adequate sleep.
- Thus, the first dose is usually given in the late evening to control nocturia.
- After that is achieved, control of daily diuresis is the goal.
- The size of and necessity for a daytime dose is determined by the effectiveness of the evening dose and any recurrence of polyuria during the day.

Desmopressin

- It comes in a liquid form that is usually administered intranasally.
- The intranasal preparation can be delievered with a rhinal catheter or a metered nasal spray bottle.
- A initial dose of 10 micrograms of the intranasal form is given at bedtime.
- This dose is titrated up in 5 microgram increments as needed depending on the response of the nocturia.
- The typical daily maintenance dose is 10 to 20 micrograms once or twice daily.

Desmopressin

- An oral tablet preparation is also available.
- Absorption of the oral form is decreased 40-50% when taken with meals.
- The oral form has about 1/10 to 1/20 the potency of the nasal form because only about 5% is absorbed from the gut.
- It is recommended to start with the nasal form before attempting a trial of oral therapy in order to ensure that the patient understands what constitutes a good antidiuretic response.

Risks of Desmopressin

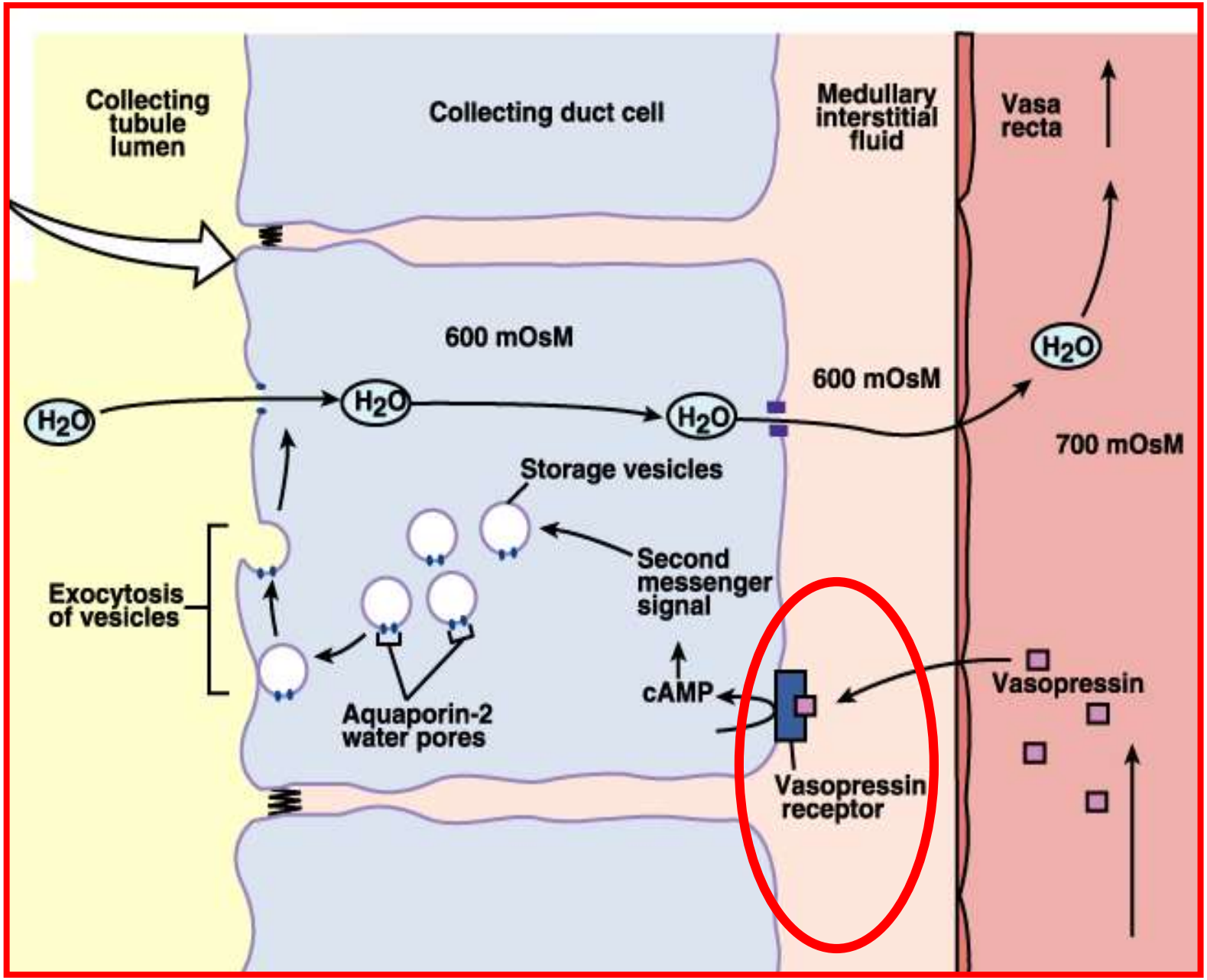
- Potential risks of desmopressin include water retention and the development of hyponatremia.
- This may occur because once dDAVP is given, the patient has nonsuppressible ADH activity and may be unable to excrete ingested water normally.
- This can be avoided by giving the minimum daily dose required to control the polyuria.

Other Drugs

- For the vast majority of patients with CDI, dDAVP is readily available, safe, and effective.
- Therefore, it is rarely necessary to add other drugs to the regimen.
- The other agents available are less effective and associated with more adverse effects than desmopressin.
- Chlorpropamide, carbamazepine, and clofibrate can be used in cases of partial CDI and can lower the urine output by as much as 50%.
- NSAIDS and Thiazide Diuretics

NEPHROGENIC DIABETES INSIPIDUS

- Congenital or acquired
- Normal hypothalamic function and ADH release
- ***Diminished or absent renal responsiveness to ADH***


Collecting tubule lumen
Collecting duct cell
Medullary interstitial fluid
Vasa recta
600 mOsM
600 mOsM
700 mOsM
H2O
H2O
H2O
H2O
Storage vesicles
Second messenger signal
Exocytosis of vesicles
Aquaporin-2 water pores
cAMP
Vasopressin
Vasopressin receptor

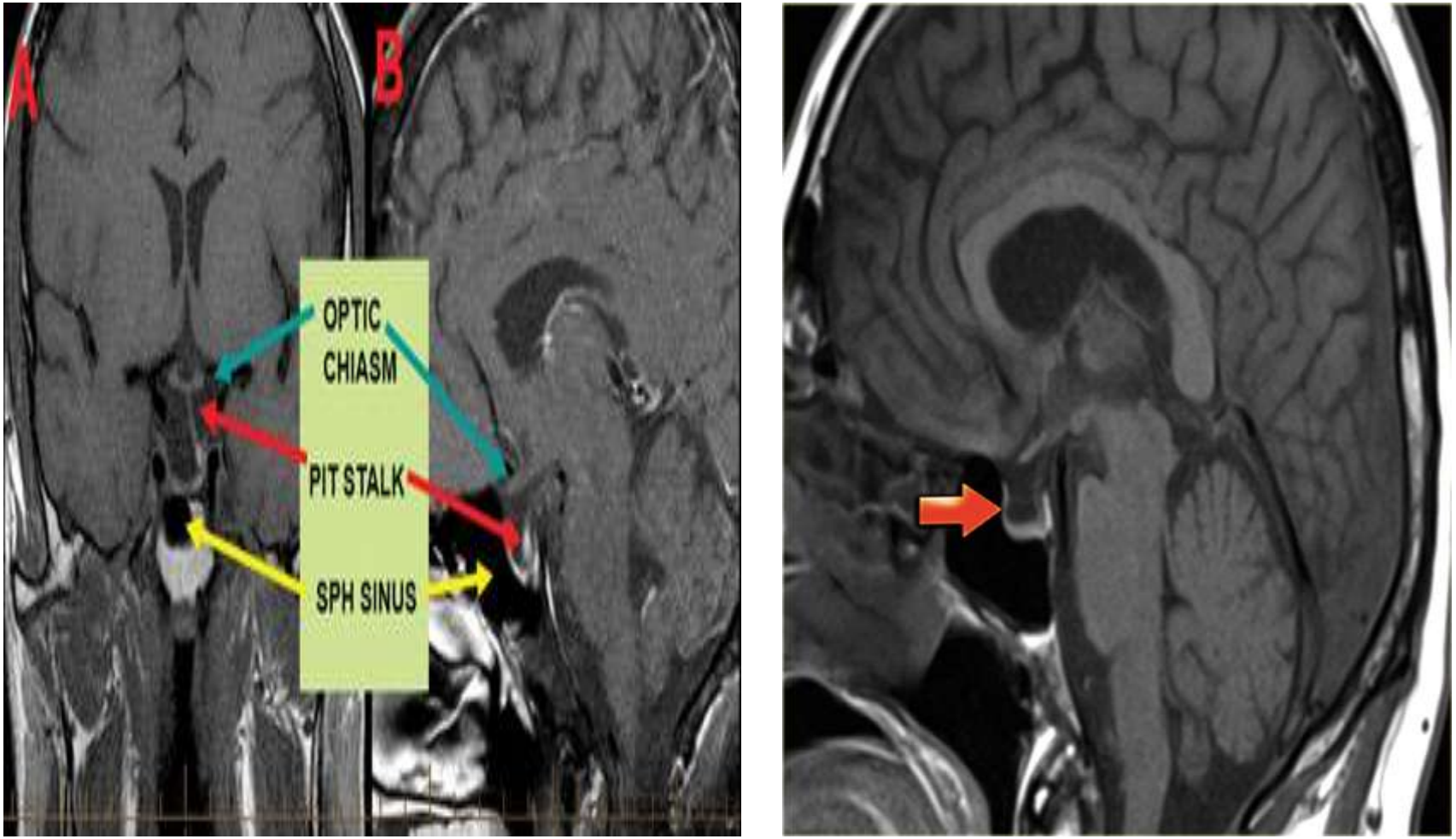
NEPHROGENIC DIABETES INSIPIDUS

- Congenital
- Hypercalcemia
- Hypokalemia
- Drugs:
  - Lithium
  - Demeclocycline
- Sjogren's syndrome
- Amyloidosis
- Osmotic diuresis
  - Glucose, mannitol, urea
- Loop diuretics
- Acute & chronic renal failure
- Sickle cell anemia
- Pregnancy

Therapy in Nephrogenic Diabetes Insipidus

- Low salt low protein diet
- Thiazide diuretics
- Amiloride
- NSAIDS like Indomethacin

Empty Sella Syndrome: MRI



Empty Sella Syndrome

- Empty sella refers to an enlarged sella turcica that is not entirely filled with pituitary tissue
- Radiologic description not a clinical condition
- 2 Types:
- **Primary**:

  Defect in the diaphragm sella that is thought to allow CSF pressure to enlarge the sella
- **Secondary:**

  Associated with an identifiable disease of the pituitary gland

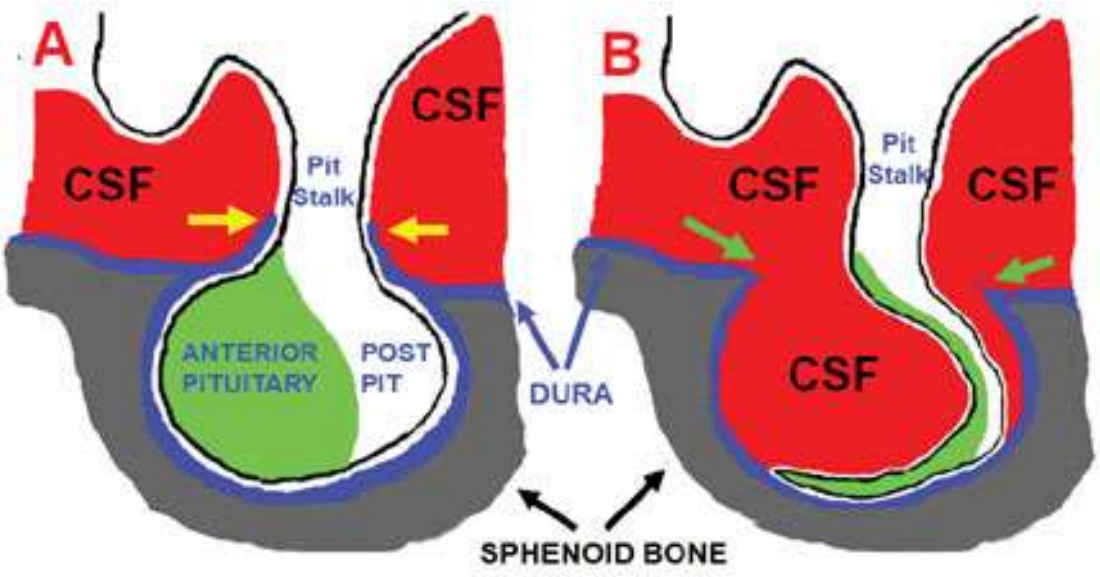
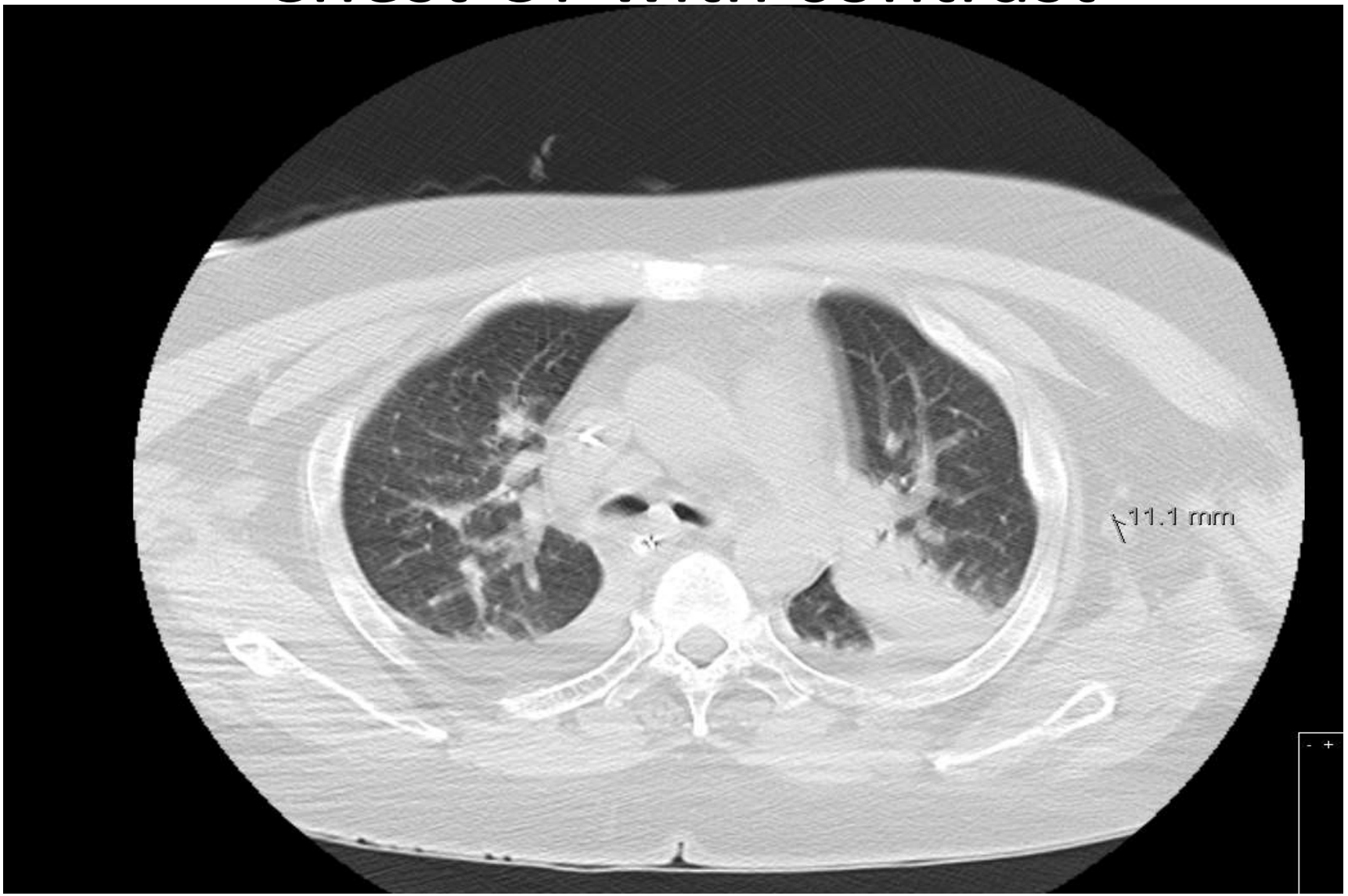


Illustration of the contents of the normal sella (A) and partially empty sella (B).

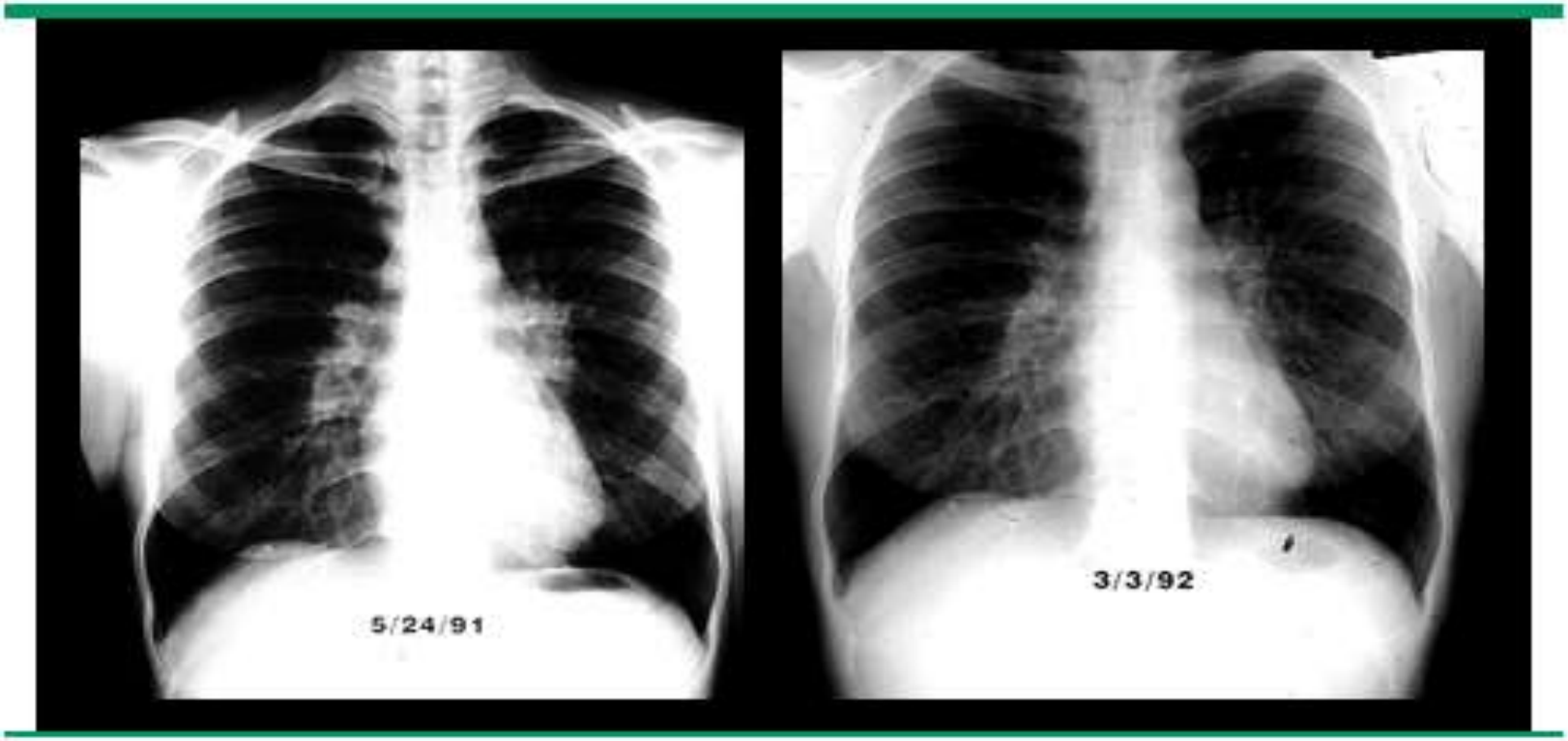
Chest CT with contrast



Pulmonary Sarcoidosis: Stages

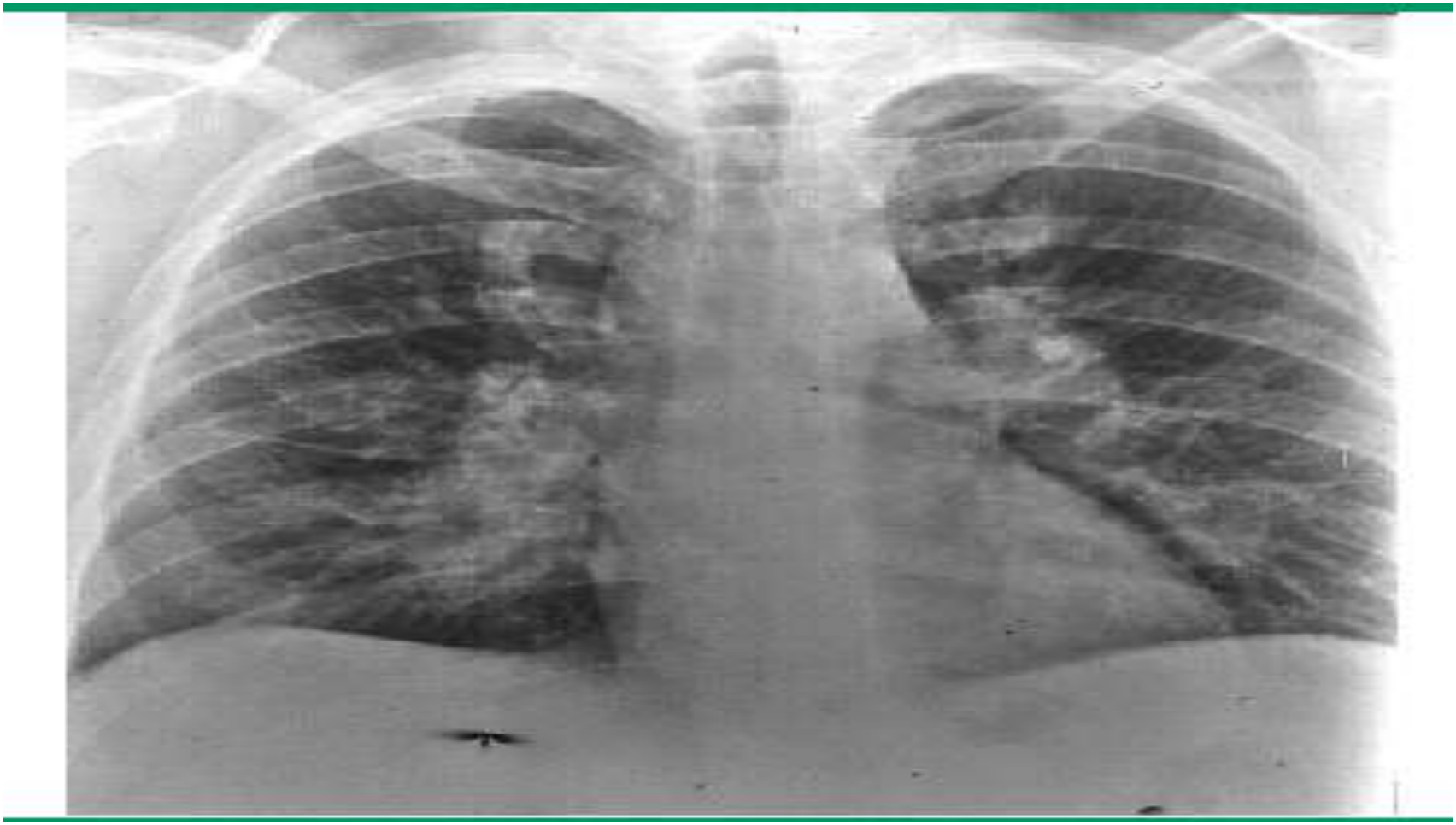
- Stage I — Stage I is defined by the presence of bilateral hilar adenopathy, which is often accompanied by right paratracheal node enlargement.
- Fifty percent of affected patients exhibit bilateral hilar adenopathy as the first expression of sarcoidosis.
- Regression of hilar nodes within one to three years occurs in 75 percent of such patients, while 10 percent develop chronic enlargement that can persist for 10 years or more.

Stage 1



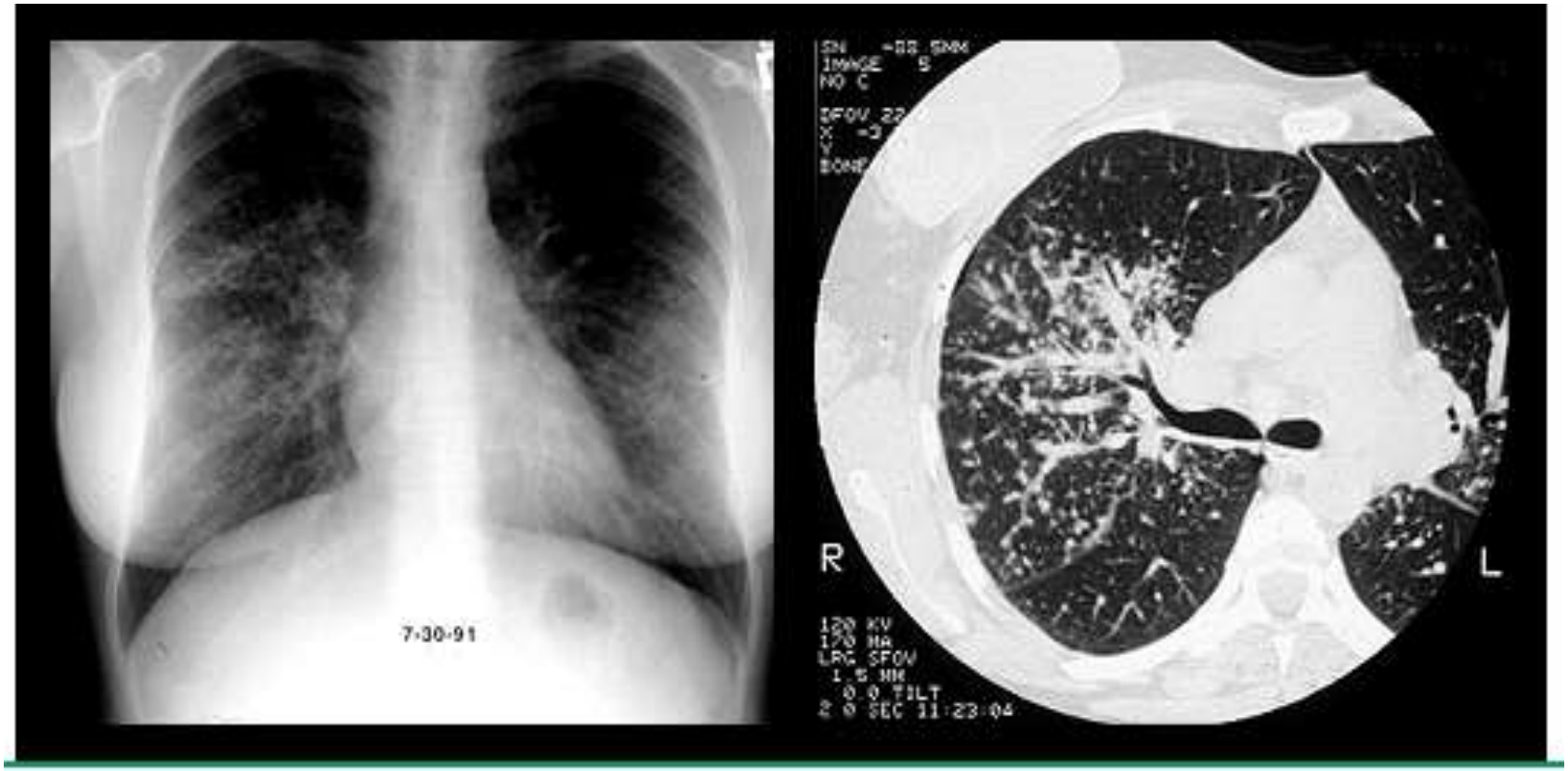
- Stage II — Stage II consists of bilateral hilar adenopathy and reticular opacities (the latter occurring in the upper more than the lower lung zones).
- These findings are present at initial diagnosis in 25 percent of patients.
- Two-thirds of such patients undergo spontaneous resolution, while the remainder either have progressive disease or display little change over time. Patients with stage II disease usually have mild to moderate symptoms, most commonly cough, dyspnea, fever, and/or easy fatigue.

Stage 2



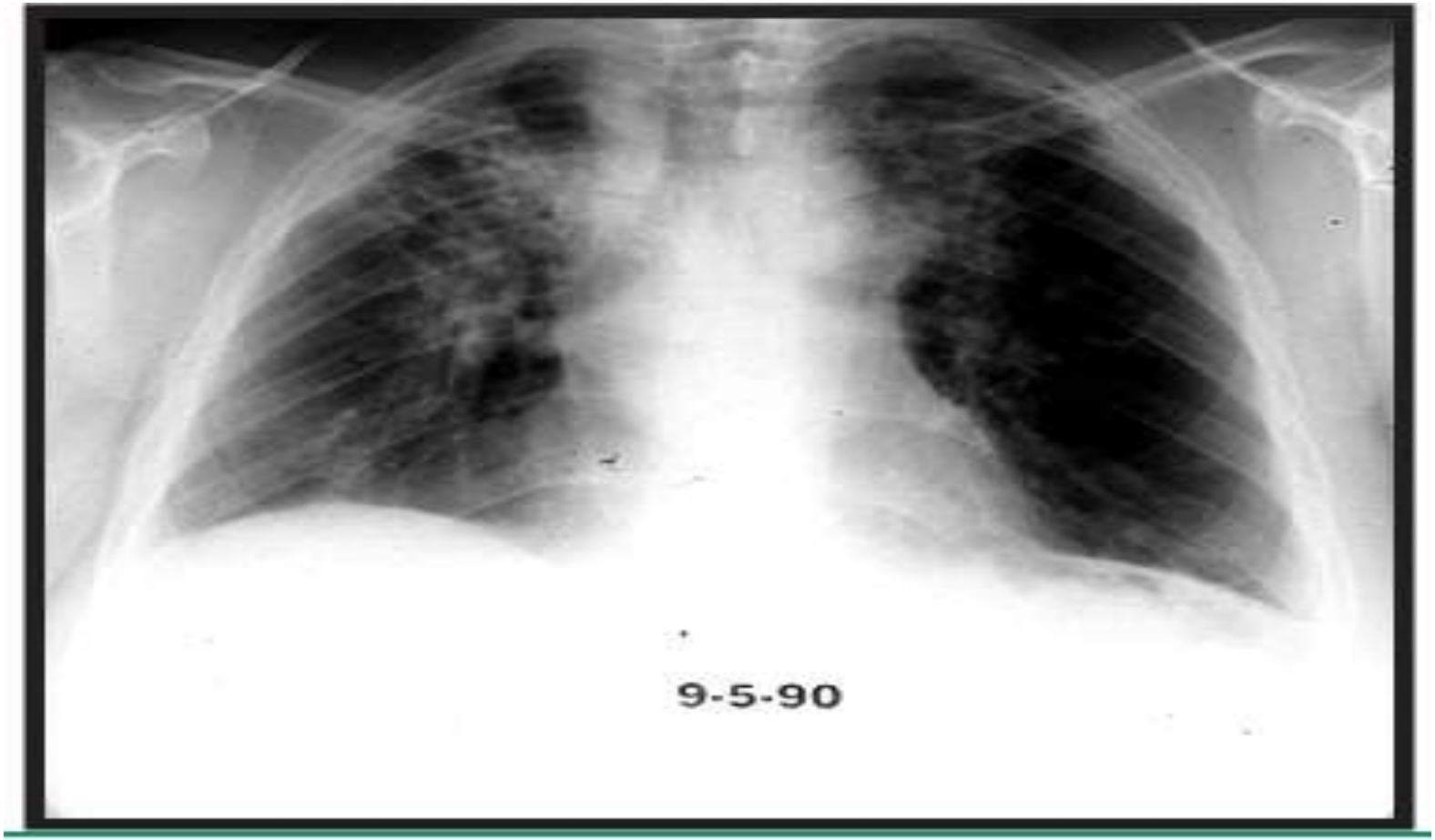
- Stage III — Stage III consists of reticular opacities with shrinking hilar nodes.
- Reticular opacities are predominantly distributed in the upper lung zones.

Stage 3



- Stage IV — Stage IV disease is characterized by reticular opacities with evidence of volume loss, predominantly distributed in the upper lung zones .
- Conglomerated masses with marked traction bronchiectasis may also be seen. Extensive calcification and cavitation or cyst formation may also be seen.

Stage 4



Central Hypothyroidism

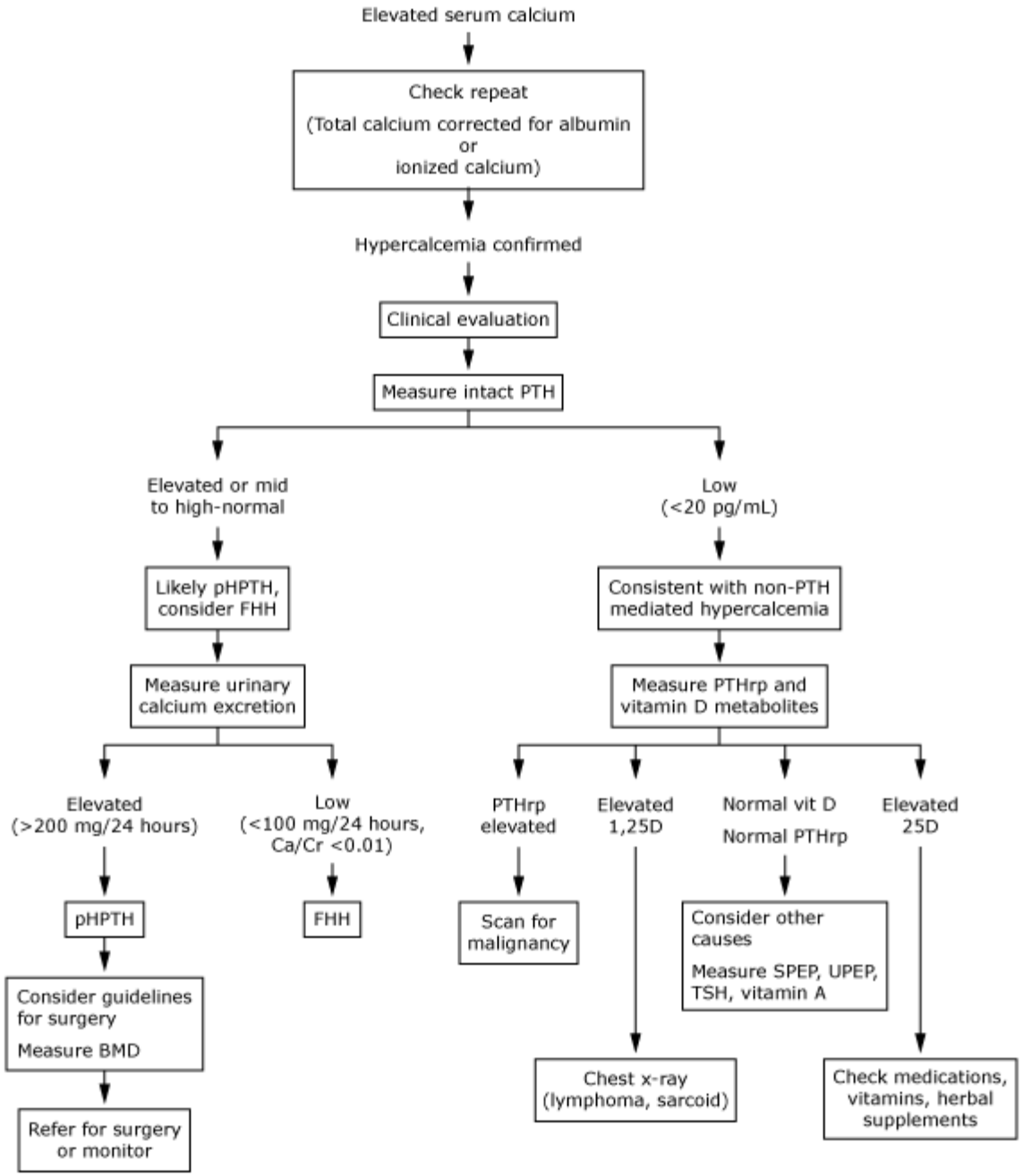
Thyroid Function Tests

Date/Time	TSH BH
30Jun12 0156	0.015
06Jul12 2004	<0.008
08Jul12 1955	<0.008

Date/Time	FT4 BH
30Jun12 0750	1.32
06Jul12 2004	0.78
08Jul12 1955	0.44

Date/Time	FT3 BH
30Jun12 0750	3.3
06Jul12 2004	1.6
08Jul12 1955	1.4

Diagnostic approach to hypercalcemia



Hypercalcemia workup

- PTH <3.00 pg/ml
- Corrected Ca 11.6 mg/dl
- PTH rP 17 pg/ml(14-21)
- 1.25 Vit D 41 pg/ml(18-72)
- 25-(OH) vitamin D 27 ng/ml(30-100)
- Phosphate 4 mg/dl(2.7-4.5)
- SPEP: No abnormal bands seen
- UPEP: No proteins observed
- Cortisol on admission 25.2 ug/dl(6-21)

Treatment of hypercalcemia

Intervention	Mode of action	Onset of action	Duration of action
Isotonic saline hydration	Restoration of intravascular volume Increases urinary calcium excretion	Hours	During infusion
Calcitonin	Inhibits bone resorption via interference with osteoclast maturation Promotes urinary calcium excretion	4 to 6 hours	48 hours
Bisphosphonates	Inhibit bone resorption via interference with osteoclast recruitment and function	24 to 72 hours	2 to 4 weeks
Loop diuretics*	Increase urinary calcium excretion via inhibition of calcium reabsorption in the loop of Henle	Hours	During therapy
Glucocorticoids	Decrease intestinal calcium absorption Decrease 1,25-dihydroxyvitamin D production by activated mononuclear cells in patients with granulomatous diseases or lymphoma	2 to 5 days	Days to weeks
Gallium nitrate	Inhibits osteoclast-mediated bone resorption	3 to 5 days	2 weeks
Calcimimetics	Calcium sensing receptor agonist, reduces PTH (parathyroid carcinoma, secondary hyperparathyroidism in CKD)	2 to 3 days	During therapy
Dialysis	Low or no calcium dialysate	Hours	During treatment