

HIV Induced Disorders of Electrolyte Balance

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HYPONATREMIA

Definition:

- Serum sodium concentration of less than **135** mEq./L is regarded as hyponatremia (Normal range being **135 – 149**)

Incidence of hyponatremia in hospital practice is 15 – 20%

Significant Hyponatremia of \leq **130** mEq/L has an incidence of 2 – 4% in hospital practice

HYPONATREMIA

- **Normal urine Na is 30 – 80 mEq/L and should be > 20 mEq/L**
- **If urine Na < 20 mEq/L**
 - **Very low Na intake**
 - **Low renal perfusion → kidney is Na avid**

HYPONATREMIA

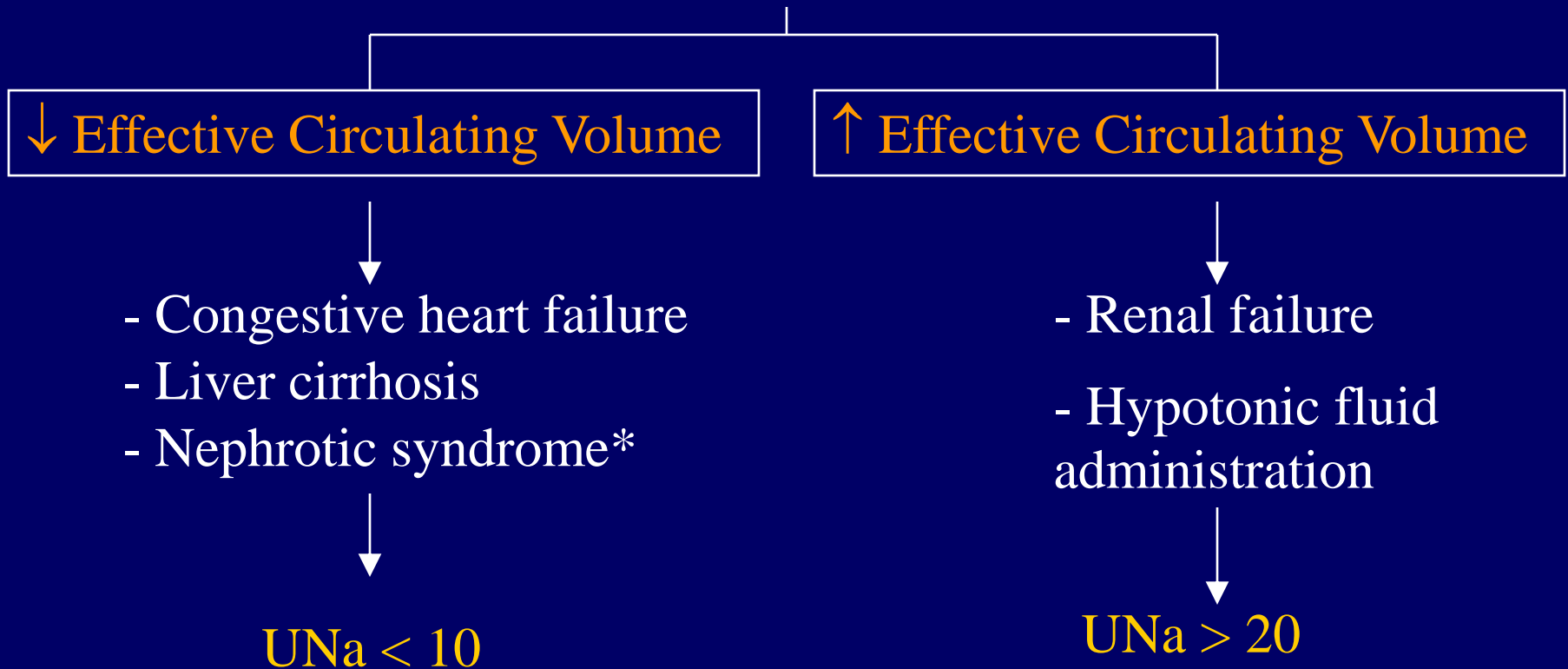
Introduction:

Hyponatremia usually results from

- Retention of water due to impairment of free water excretion or
- Sodium loss exceeding that of water loss e.g thiazide-induced hyponatremia. or
- From multiple factors, as is seen in HIV/AIDS

Hyponatremia With High ECF

Water Excess > Salt Excess



Hyponatremia With High ECF: Pathophysiology

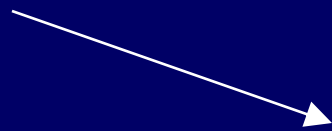
Low Vol States
(CHF, Liver, ? NS)



Activation of volume
regulatory mechanisms as
in low ECF states + Thirst



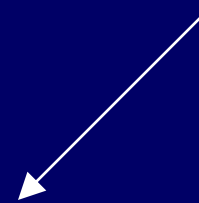
Water > Salt Retention



High Vol States
(Renal failure)



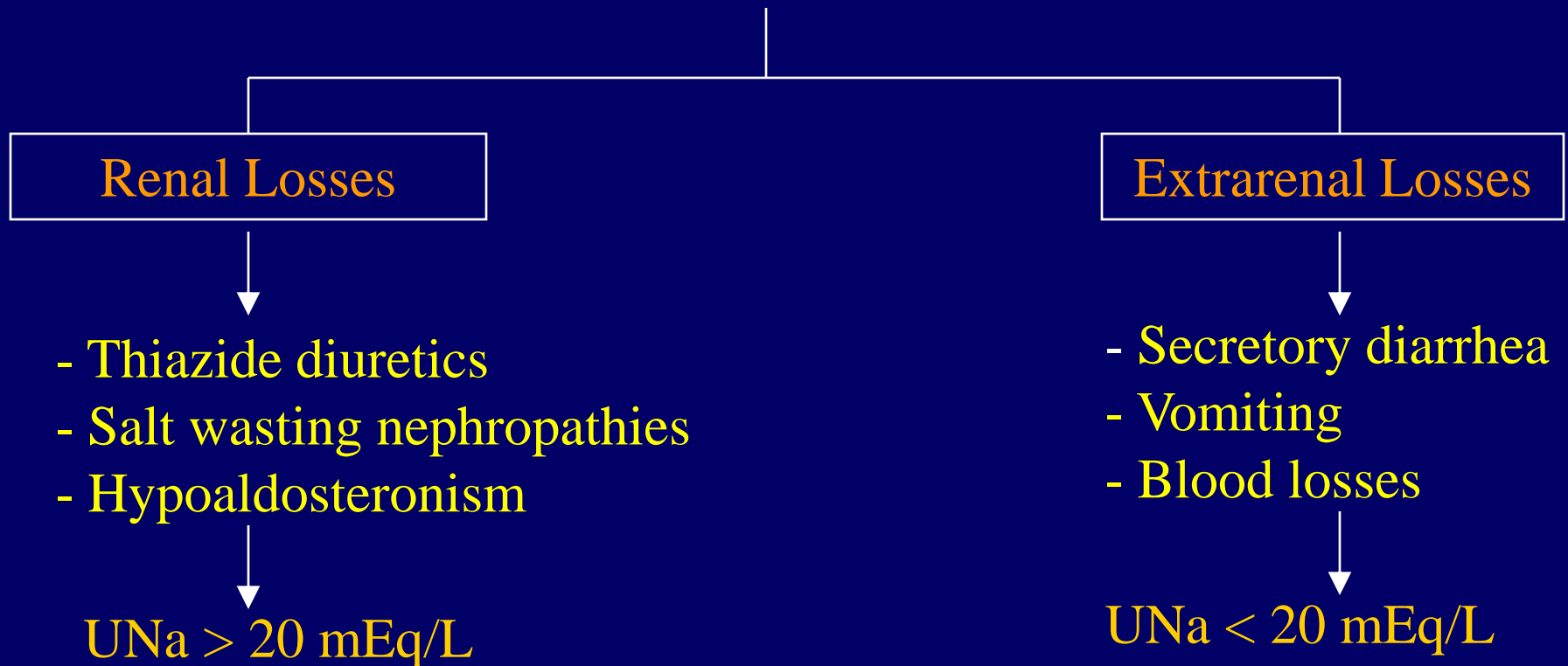
Inability to excrete a free
water load (Defective
dilution)



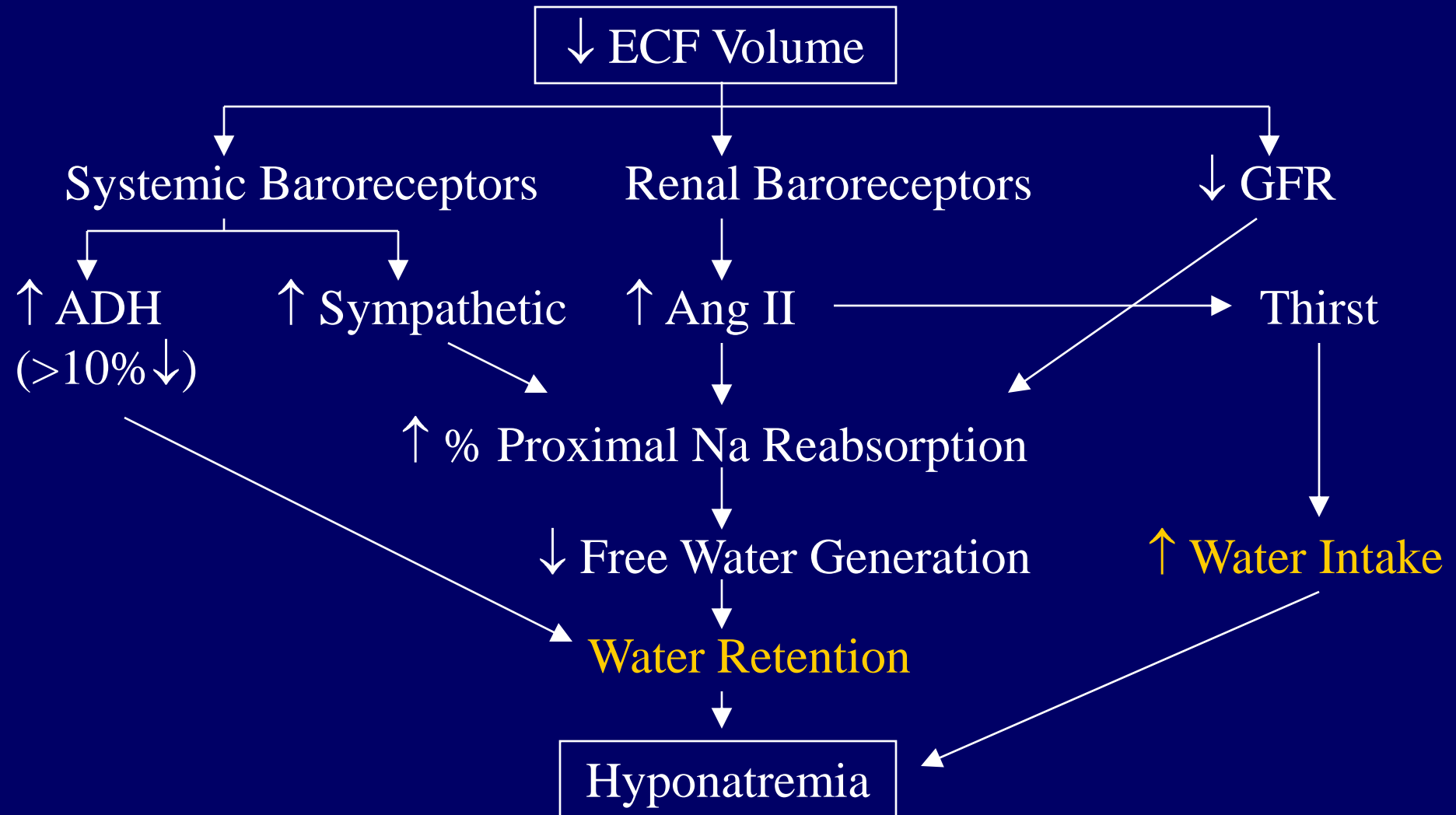
Hyponatremia

Hyponatremia With Low ECF

Salt Loss > Water Loss

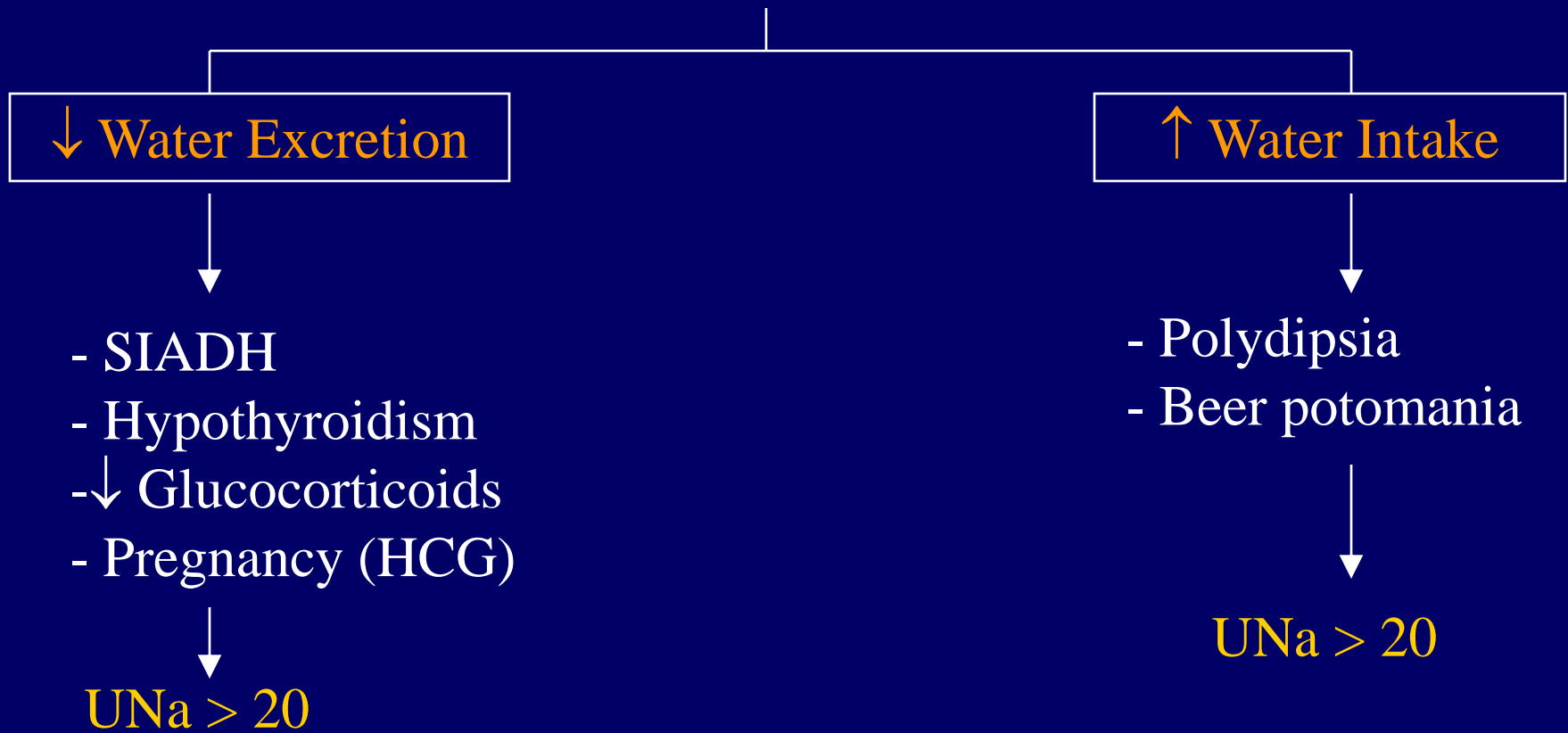


Hyponatremia With Low ECF: Pathophysiology

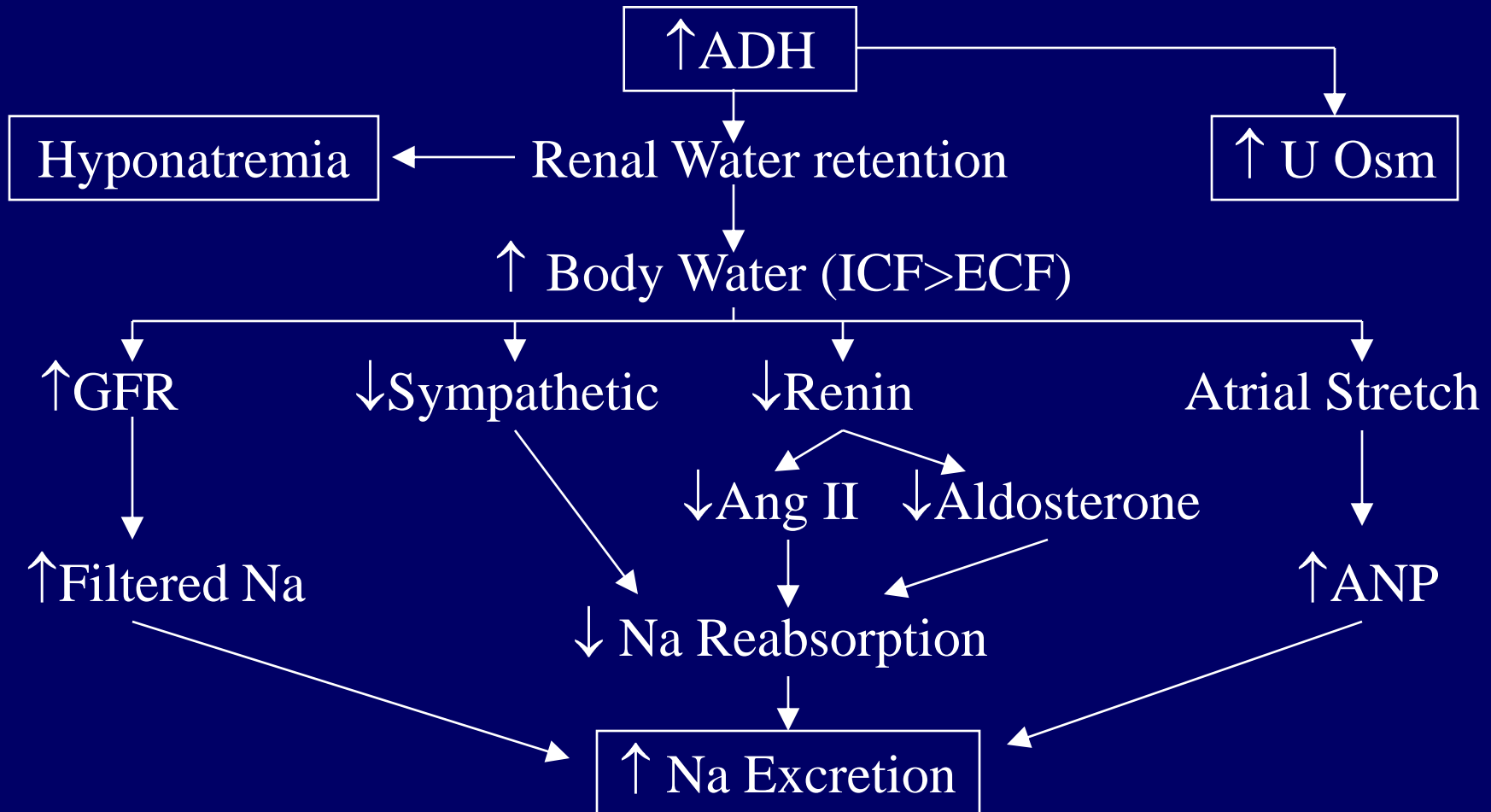


Hyponatremia With “Normal” ECF

Pure Water Excess



Hyponatremia With Normal ECF and \uparrow ADH: Pathophysiology



HYPONATREMIA

In HIV:

- Multiple factors are involved in the hyponatremia
- Duration of the disease, may determine severity
- Severity of the disease with $CD4 \leq 200$
- Co-morbid conditions, respiratory diseases. TB,
- Drug interactions, carbamazepine, amitriptyline
Amphoterecin B, omeprazole, tegretol and gabapentin
- Multi-organs hormonal involvement – adrenals
thyroid, gonadotrophins, pituitary

HYPONATREMIA

- Renal tubular defects resulting in mis-handling of electrolytes,
- Pituitary, thyroid, adrenal, and ovarian insufficiencies leading to altered hormonal balances.
- Thiazide and loop diuretics

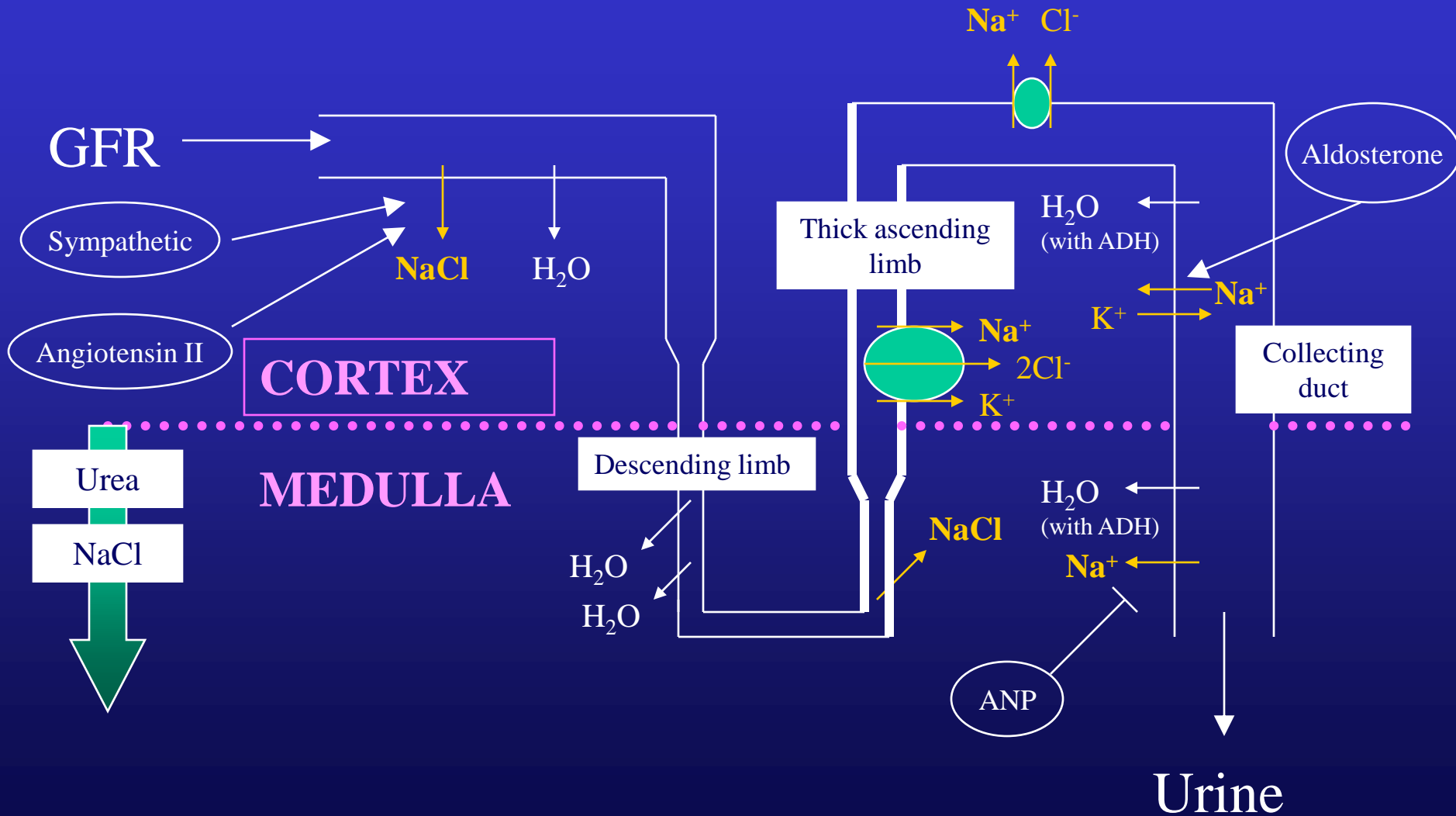
SIADH

- **Causes:** CNS or pulmonary diseases, post-op, pain, nausea, drugs (cyclophosphamide, vincristine, carbamazepine, chlorpropamide, NSAIDS)
- **Diagnosis:**
 - “Normal” or slightly expanded ECF
 - $U_{Na} > 20$ mEq/L
 - U_{osm} inappropriately high for P_{osm}
 - Normal thyroid and adrenal function
 - Low uric acid and BUN

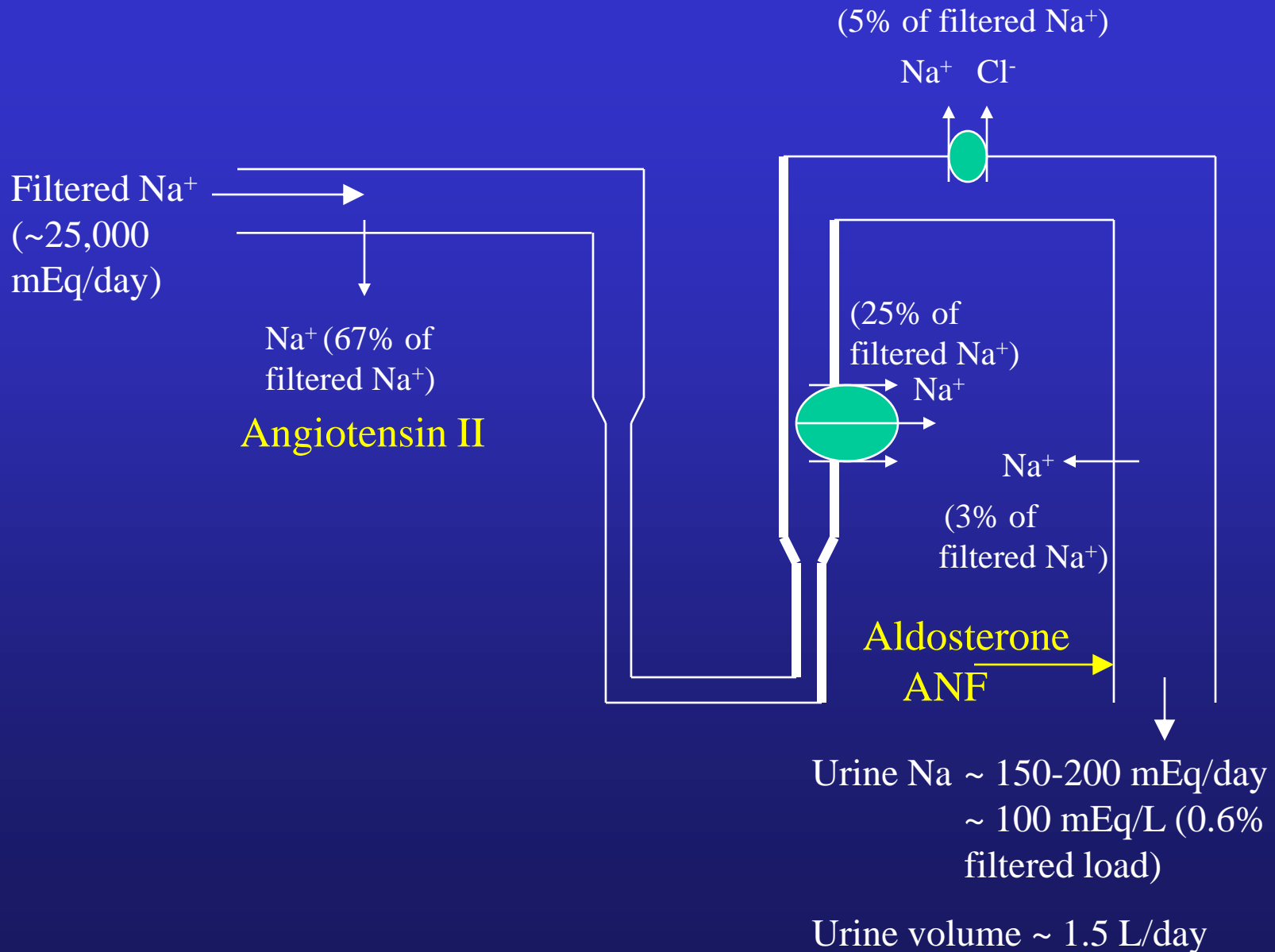
SALT AND VOLUME REGULATION

Proximal convoluted tubule

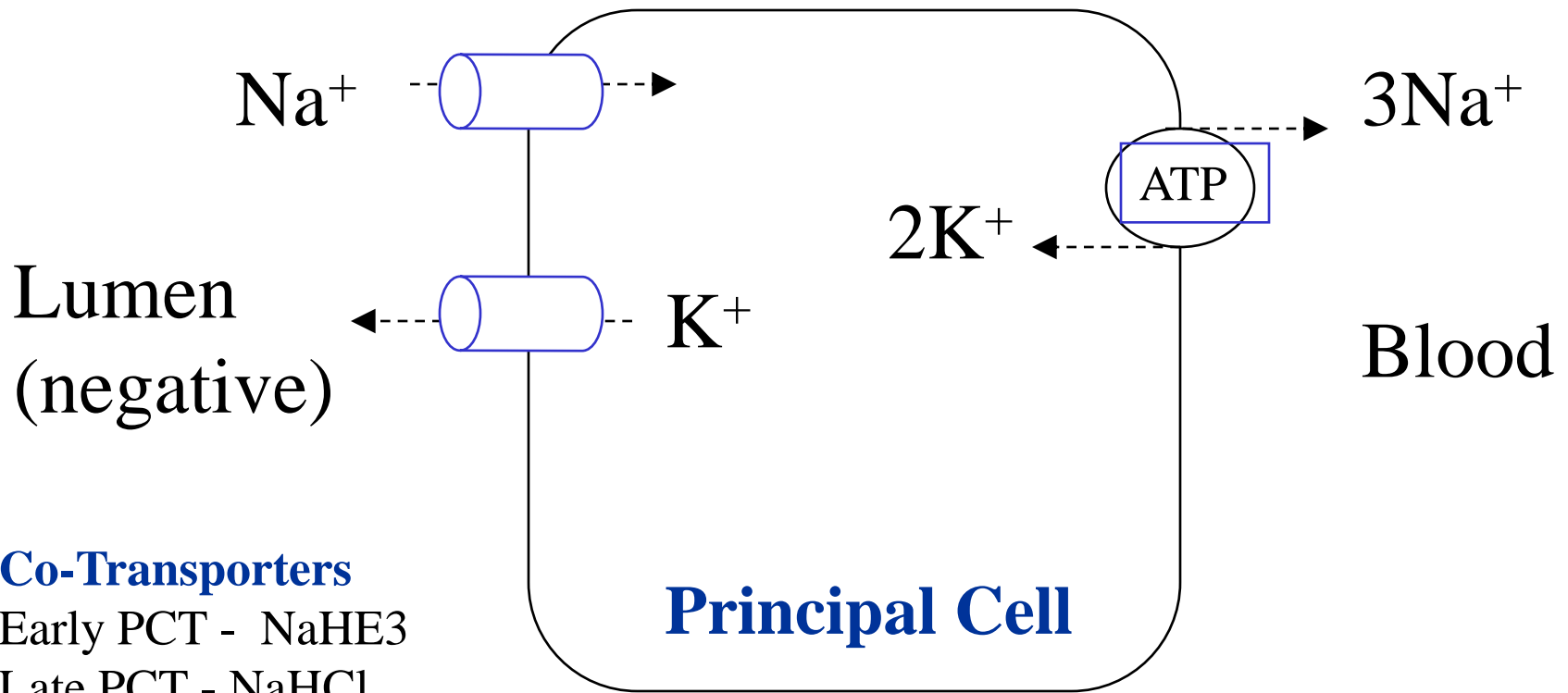
Distal convoluted tubule



RENAL HANDLING OF SODIUM IN TUBULES



Na and K Transport



Co-Transporters

Early PCT - NaHE3

Late PCT - NaHCl

Thick Asc Loop NKCC2 → Frusemide sensitive

Distal DCT - NaCCT → Thiazide sensitive

Collect. Duct - ENaC → Amiloride sensitive

HYPONATREMIA

In AKUHN

- We noted hyponatremia and or hypernatruria in a number of patients with advanced HIV/AIDS. (CD4 \leq 100)
- A total of 20 cases out of 162 patients with HIV infection reviewed between Oct 2004 – Sept 05
- They all had varying degrees of hyponatremia
- Majority had excess sodium excretion in the urine, despite hyponatraemia.
- The literature is rather scanty as to the causes of excess sodium loss in urine in HIV/AIDS

HYPONATREMIA

- This observation led us to further review several possible causes
- We are studying different stages of HIV/AIDS
- Duration and stage of HIV,
- Types and severity of co – morbid conditions,
- Drugs interactions.

HYPONATREMIA

- **An observational cross-sectional study over a one year period,**
- **Looking at electrolyte imbalances in patients with HIV/AIDS**
- **Records of all patients admitted with HIV/AIDS between October 2004 and September 2005 were reviewed and all those with hyponatraemia and or hypernatruria were included in the study.**
- **Full medical history and physical examination were obtained**
- **Clinical features of electrolyte disturbance were specifically sought for**
- **Clinical co-morbid conditions were looked for**
- **Full drug history was also reviewed to highlight any drug interactions.**
- **Routine tests as in standard of care were performed,**
- **In addition timed urine was collected from all these patients and urinary sodium and potassium were estimated.**

HYPONATREMIA

Results:

- 165 patients admitted with HIV/AIDS,
- 20 patients were found with abnormalities of either serum or urinary sodium.
- 12 had mild to moderate hyponatraemia
- 8 had compensated hypernatruria (UNa >180 mmol) with normal serum sodium levels
- This is a 12% incidence of sodium derangement
- Fourteen (70%) of the patients had CD4 counts less than 200 and 11 of them had counts less than 100 cells/cmm

HYPONATREMIA

No. of Cases N = 20	Normal Na [>135] K+ [>3,5] Cl ⁻ [> 95]	Mild Na [125-135] K+ [3.2-3.4] Cl ⁻ [90 – 94]	Moderate Na [115-125] K+ [3.0 – 3.2] Cl ⁻ [85 – 89]	Severe Na [<115] K+ [< 3.0] Cl ⁻ [< 84]
Sodium	8cases (40%)	9 cases (45%)	3 cases (15%)	Nil
Potassium	15 cases (75%)	3 cases (15%)	2 cases (10%)	Nil
Chloride	14 cases (70%)	5 cases (25%)	1 case (5%)	Nil

Table 1. The serum levels of sodium, potassium and chloride for the 20 patients studied.

HYPONATREMIA

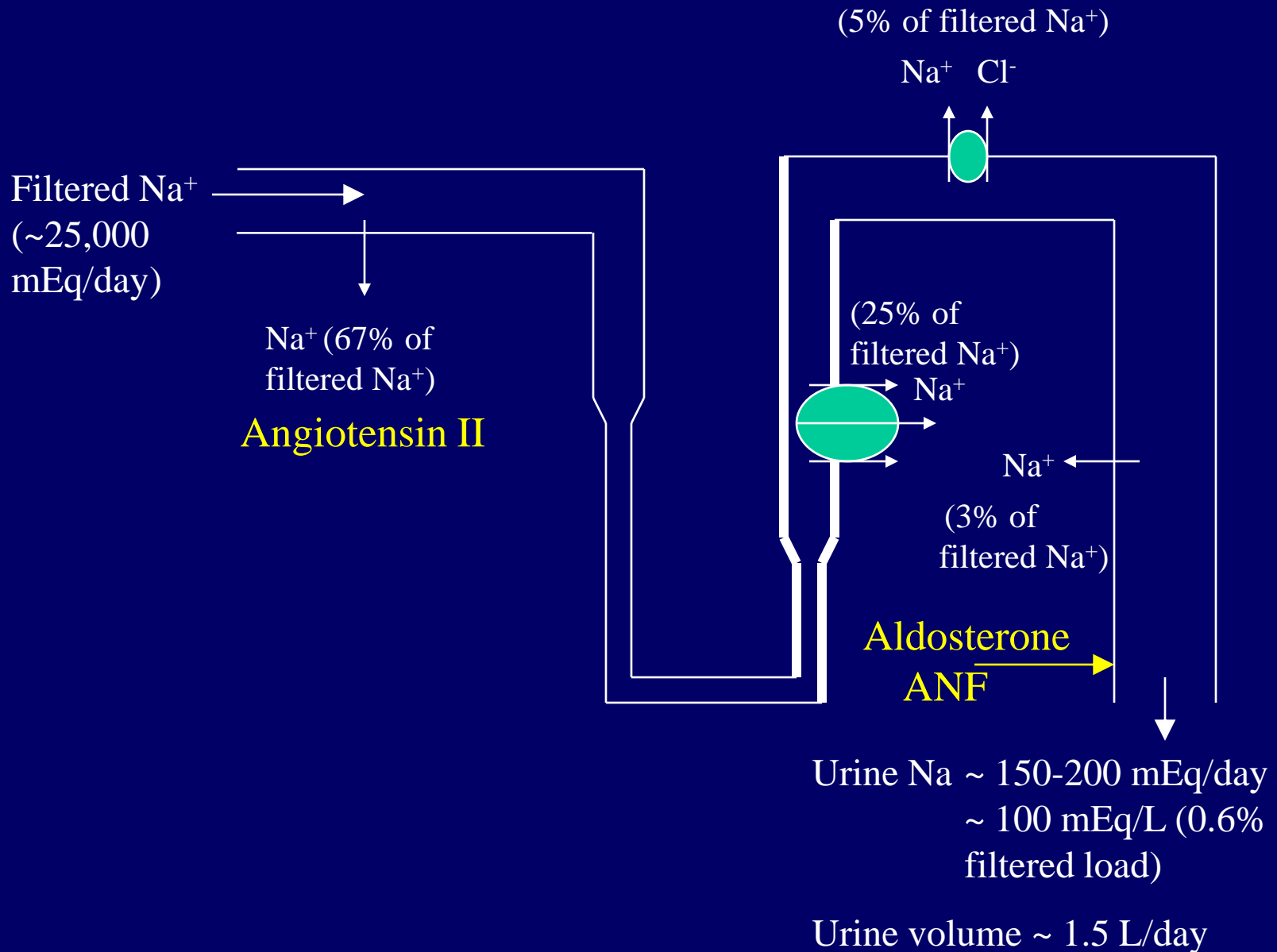
	Normal Urinary Na [80-180]	Increased Urinary Na [>180]	Low Urinary Na <80
PTB [11]		8	3
ARVs [7]	1	6	
Non- ARVs [13]	4	6	3
CNS [4]		3	1
Drugs[3]		3	

HYPONATREMIA

Discussion:

- HIV Nephropathy is usually characterised by collapsing focal segmental glomerulosclerosis, with marked podocyte proliferation, hypertrophy and hyperplasia of the overlying visceral epithelial cells. Microcystic dilatation of the tubules Prominent lymphocytic interstitial nephritis
- It was initially described in 1984 by Rao et al.,
- Bruggeman LA, et al. demonstrated that the renal tubular epithelium is a site of HIV-1 infection

RENAL HANDLING OF SODIUM IN TUBULES



HYPONATREMIA

Discussion:

At What Stage Does the problem start

- All our patients had advanced HIV disease.
- It is not clear at what stage abnormalities in renal handling of electrolytes developed.
- Need to look further into the possible time at which this defect begins,
- studying subjects with varying degrees of HIV/AIDS

HYPONATREMIA

Factors Contributing to the process

- possible correlation between various factors such as duration of the condition, severity of the disease,
- contribution of co-morbid conditions,
- drugs interplay in such cases. It is our hope to shed further light in the forthcoming studies.

HYPONATREMIA

What Treatment Modalities:

- Treatment of hyponatremia, though necessary, needs to be cautious
- Rapid correction has been shown to cause central pontine osmotic demyelination.
- It is important to consider whether correction is necessary,
- and if so what is to be done at short term and long term if the problem is chronic.

HYPONATREMIA

Discussion

- Hyponatremia causes varying symptoms depending on the degree and duration of hyponatremia,
- **Early features:** muscle cramps, anorexia, nausea and vomiting, difficulty concentrating,
- **Late features:** confusion, lethargy, agitation, headache, seizures, or status epilepticus, or the patient may present with obtundation, and or coma, suggesting brain stem herniation.

Thank You