Severe hyponatremia in a Dialysis Patient.
Case-based discussion

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A 70-year-old woman was hospitalized for treatment of endophthalmitis one week ago. She had received hemodialysis (HD) for 5years due to diabetic nephropathy. She was conscious and responsive but had headache, nausea and vomiting.

BP 191/73 HR90/min

delta BW 3.4 kg (twice the usual amount)

Before HD

Glu	**66 mg/dl**
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Q How would you treat this Patient？

1 3% Saline
2 Water restriction
3 Tolvaptan
4 Hemodialysis

Does this HD patient have severe hyponatremia ?

Severity	Symptom
Moderately severe	Nausea without vomiting Confusion Headache
Severe	Vomiting Cardiorespiratory distress Abnormal and deep Somnolence Seizures Coma (Glasgow Coma ≤ 8)

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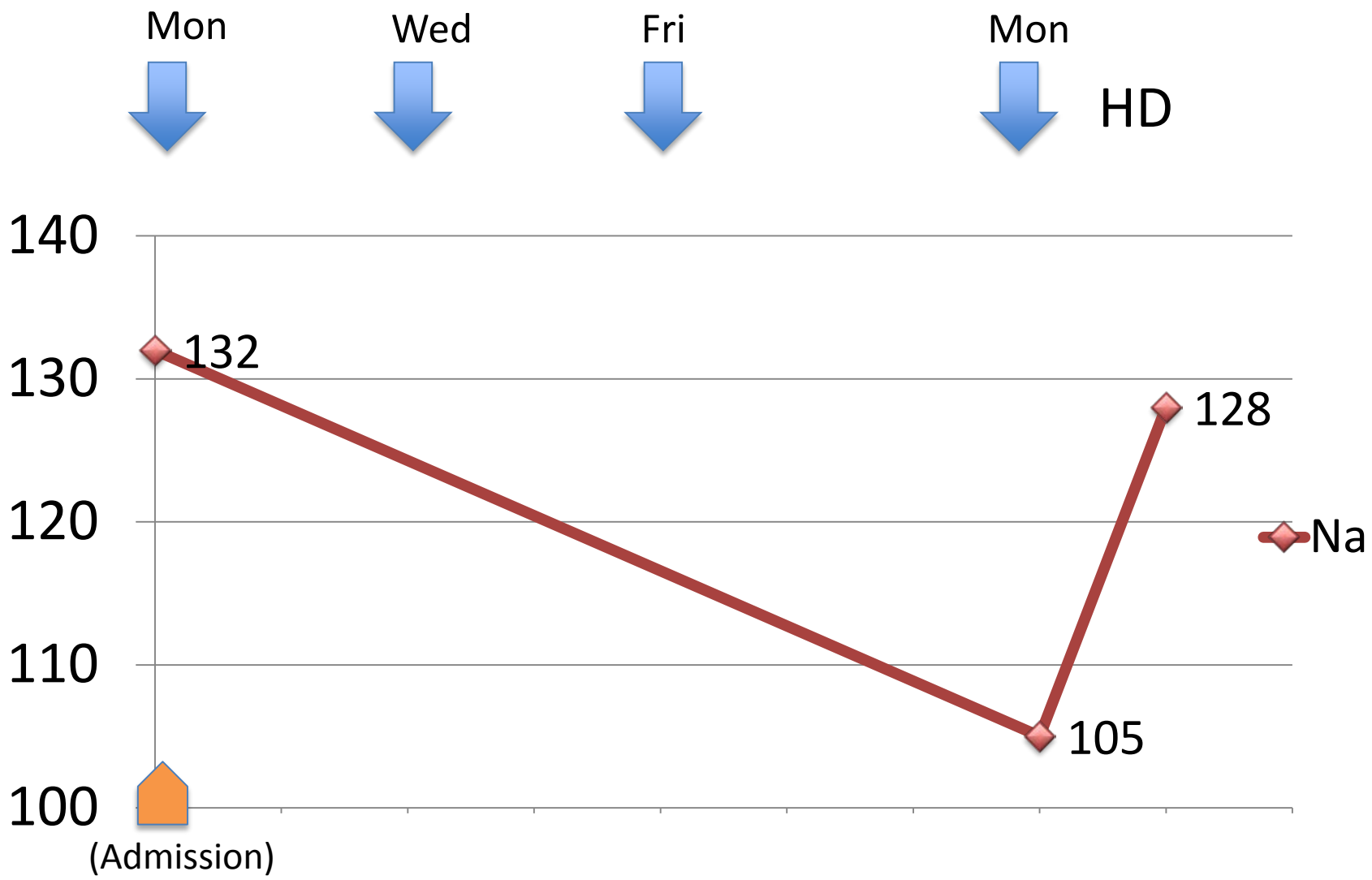
A 70-year-old woman. (continued) After 4 hours Hemodialysis.

Before HD		After HD	
Glu	66 mg/dl	Glu	91 mg/dl
BUN	34.8	BUN	14.7
Cre	8.22	Cre	4.57
Na	105 mEq/l	Na	128 mEq/l
K	4.8	K	3.5
Cl	76	Cl	93

Clinical course



A 70-year-old woman. (continued) After 4 hr Hemodialysis.

Q2 What would be your next step?

1 3% Saline 2 Water restriction

3 Tolvaptan 4 Hemodialysis

5 Other treatment (eg : DIV water)

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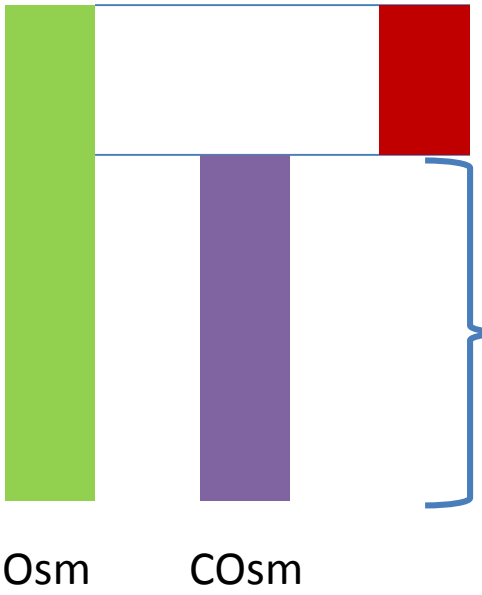
Serum Osm	323	Serum Osm	292
(Calculated)	226	(Calculated)	266
Osmolar Gap	97	Osmolar Gap	26

Osmolal gap

Osmolal Gap

Before 97.0 After 26.0

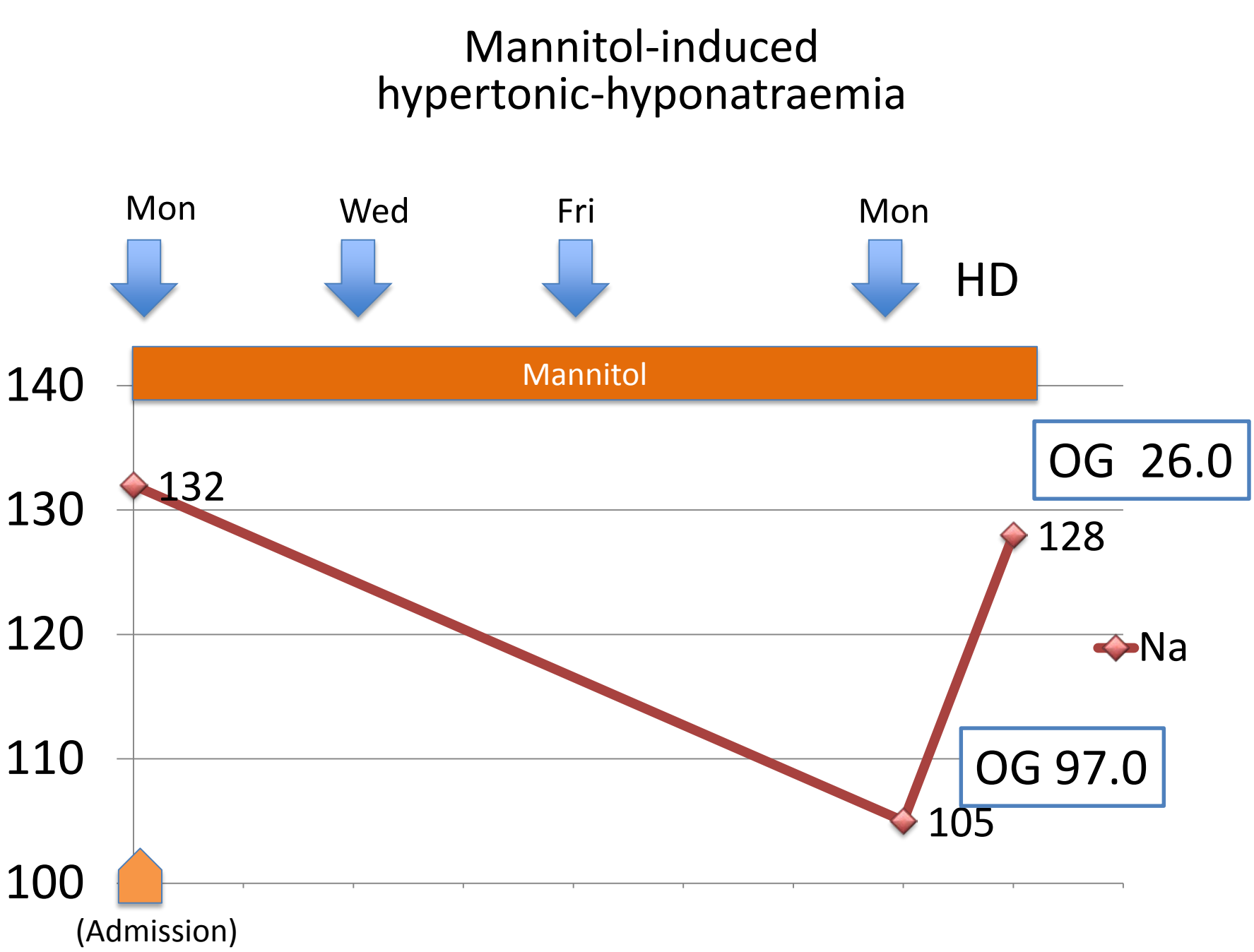
= measured serum osmolality − calculated serum osmolality



Osmolal gap

2 × [Na+] + Glu/18 + BUN/2.8

usually within 10 mOsm/L


Mannitol-induced
hypertonic-hyponatraemia
Mon
Wed
Fri
Mon
HD
Mannitol
140
130
120
110
100
132
128
105
Na
OG 26.0
OG 97.0
(Admission)

When should we check osmolar gap?

- Patients come to ER in a coma state without any history of toxic substance ingestion
- High anion gap Metabolic acidosis
  - Toxic alcohols and glycols

Mind the gap “MAE　DIE”

		Molecular Weight
M	Methanol	32
A	Acetone	58
E	Ethylene glycol	62
D	Diuretics, Dye	180 (Mannnitol)
I	Isopropanol	60
E	Ethanol	46

『Step　Beyond Resident 2』

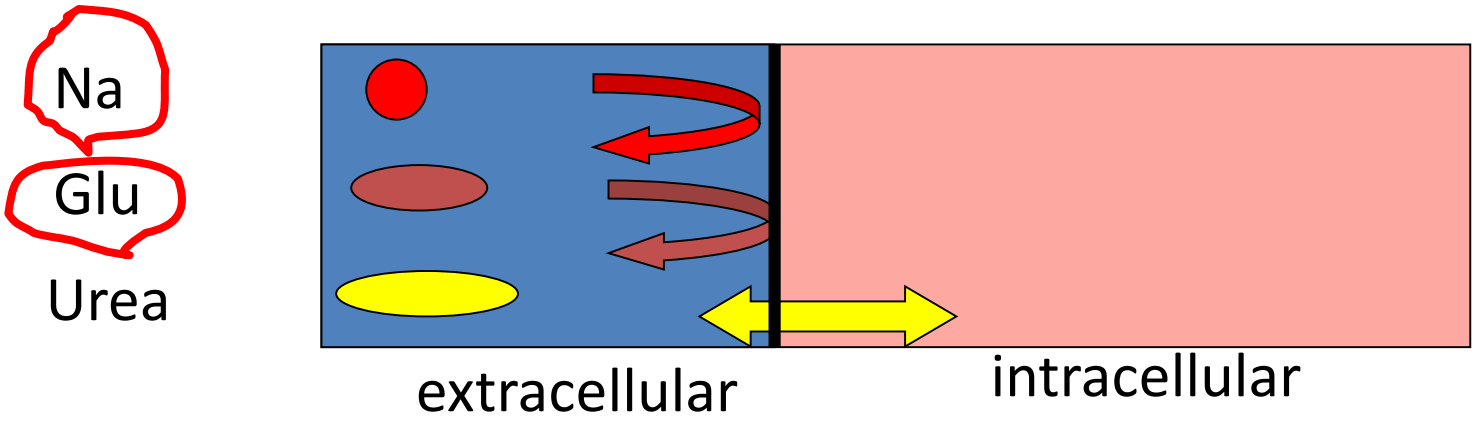
Effective and ineffective osmolality

Plasma osmolality=2 × Na＋
Glucose/18+BUN/2.8

(mEq/L) (mg/dL) (mg/dL)

Effective osmolality=2 × Na＋Glucose/18

Urea increased osmolality not an effective osmolyte
“ Effective” for Cell Volume



When should we check serum osmolality.

- Differential diagnosis Hyonatremia
  - Hypertonic Hyponatraemia
  - Isotonic Hyponatraemia (Pseudo hyponatrema)
- To rule out alcohol-related intoxications, other intoxications
  - Usually not present in the blood

orignated from Yugo Shibagaki : Medicina 44 no.3 2007-3

Mannitol Clinical Use

- Reduction of increased intracranial pressure associated with cerebral edema.
- Reduction of increased intraocular pressure
- Promoting urinary excretion of toxic substances.
- Genitourinary irrigant in transurethral prostatic resection or other transurethral surgical procedures.

Two types of Hypertonic Hyponatremia

	Mannitol intoxication	hyperglycaemia-induced
Hyponatremia	Hypertonic	Hypertonic
Molecular weight	182	180
Metabolism	Excretion: Urine (87 % unchanged drug)	Metabolize in the body
Treatment in renal impairment	Hemodialysis	Insulin
Osmolar Gap	Increase	No change

Cause of non-hypotonic hyponatremia

Table 10. Causes of non-hypotonic hyponatraemia.

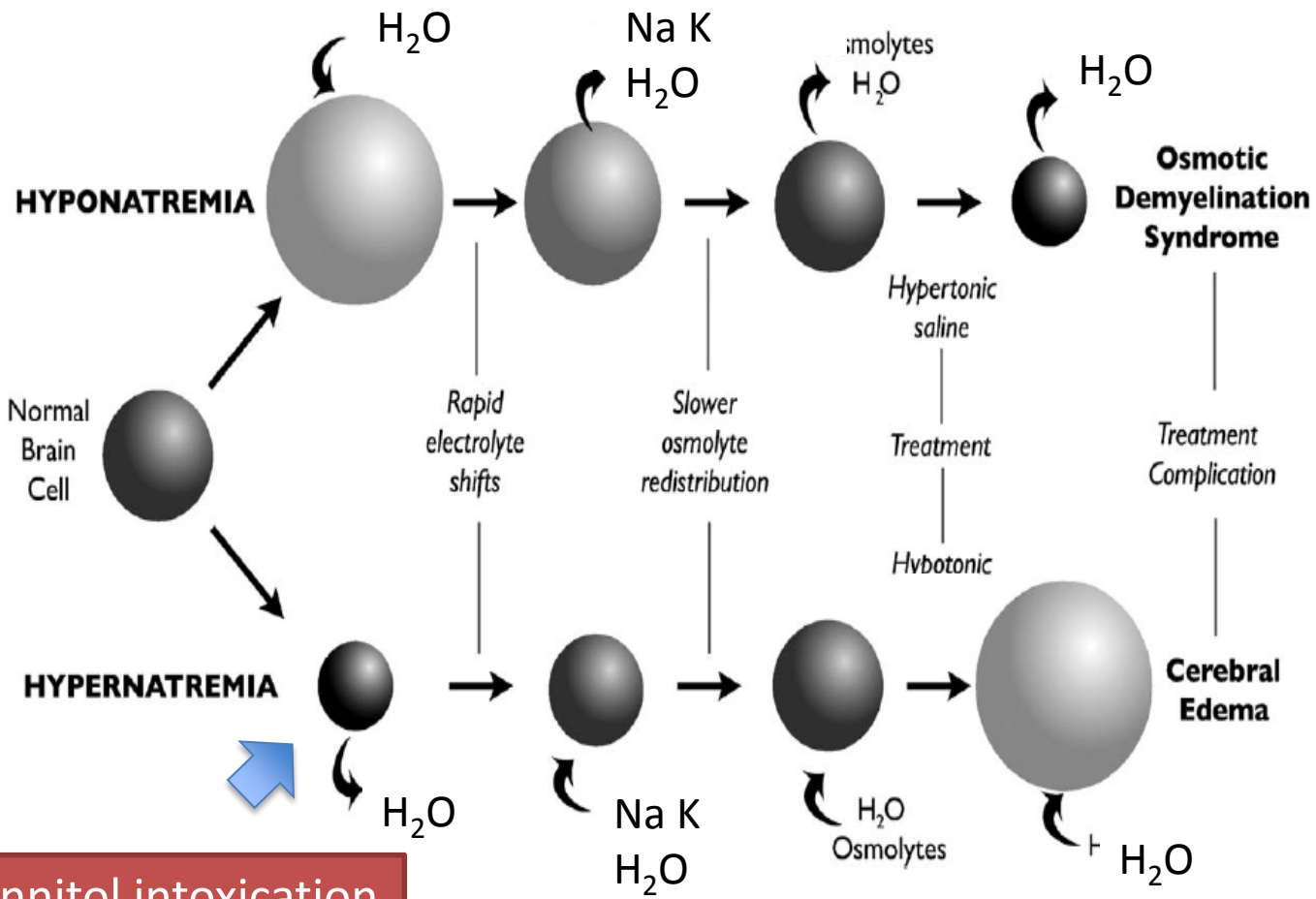
Setting	Serum osmolality	Examples
Presence of 'effective' osmoles that raise serum osmolality and can cause hyponatraemia	Isotonic or hypertonic	Glucose [31] Mannitol [32] Glycine [33] Histidine–tryptophan–ketoglutarate [243] Hyperosmolar radiocontrast media [244] Maltose [245]
Presence of 'ineffective' osmoles that raise serum osmolality but do not cause hyponatraemia	Isotonic or hyperosmolar	Urea [36] Alcohols [36] Ethylene glycol [36]
Presence of endogenous solutes that cause pseudohyponatraemia (laboratory artifact)	Isotonic	Triglycerides [97], cholesterol [97] and protein Intravenous immunoglobulins [96] Monoclonal gammapathies [246]

Renal failure combined with hyponateremia becomes hypotonic hyponatrema but with hyperosmolality.

Setting	Serum osmolality	Examples
Effective osmoles serum osmolality ↑ (cause hyponatreamia)	Isotonic or hypertonic	Glucose Mannnitol Glycine, Maltose Hyperosmolar radiocontrast media
Ineffective osmoles serum osmolality ↑ (not cause hyponatremia)	hypotonic and hyperosmolar	Urea, Alcohols, Ethylene glycol
Pseudohyponatremia (laboratory artifact)	Isotonic	Triglycerides, cholesterol, protein, ivIg, monoclonal gammapathies

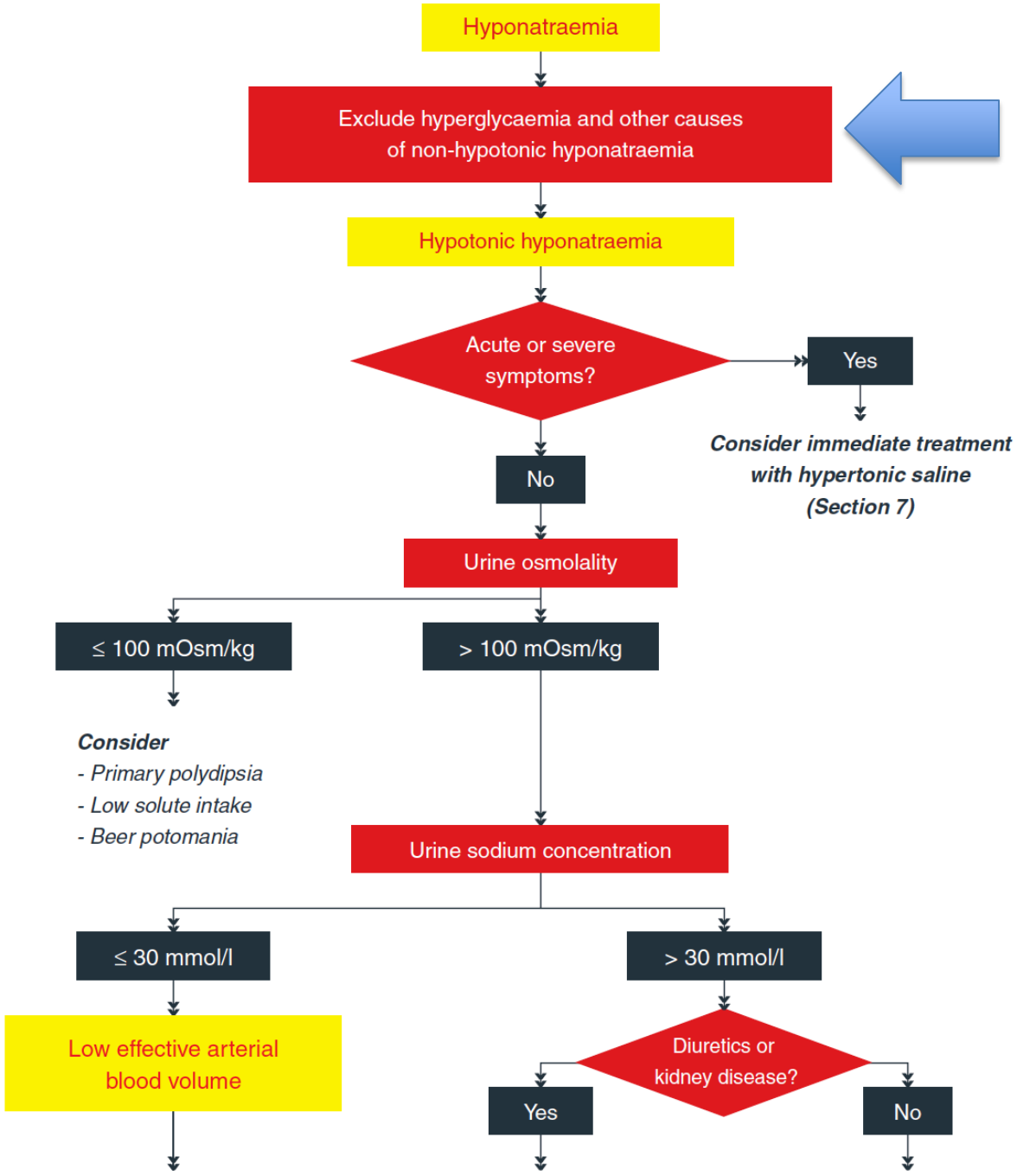
Modified by Clinical practice guideline on diagnosis and treatment of hyponatraemia

Brain cell pathophysiology in hyponatremia



Mannitol intoxication

Emerg Med Clin N Am 23 (2005) 749–770



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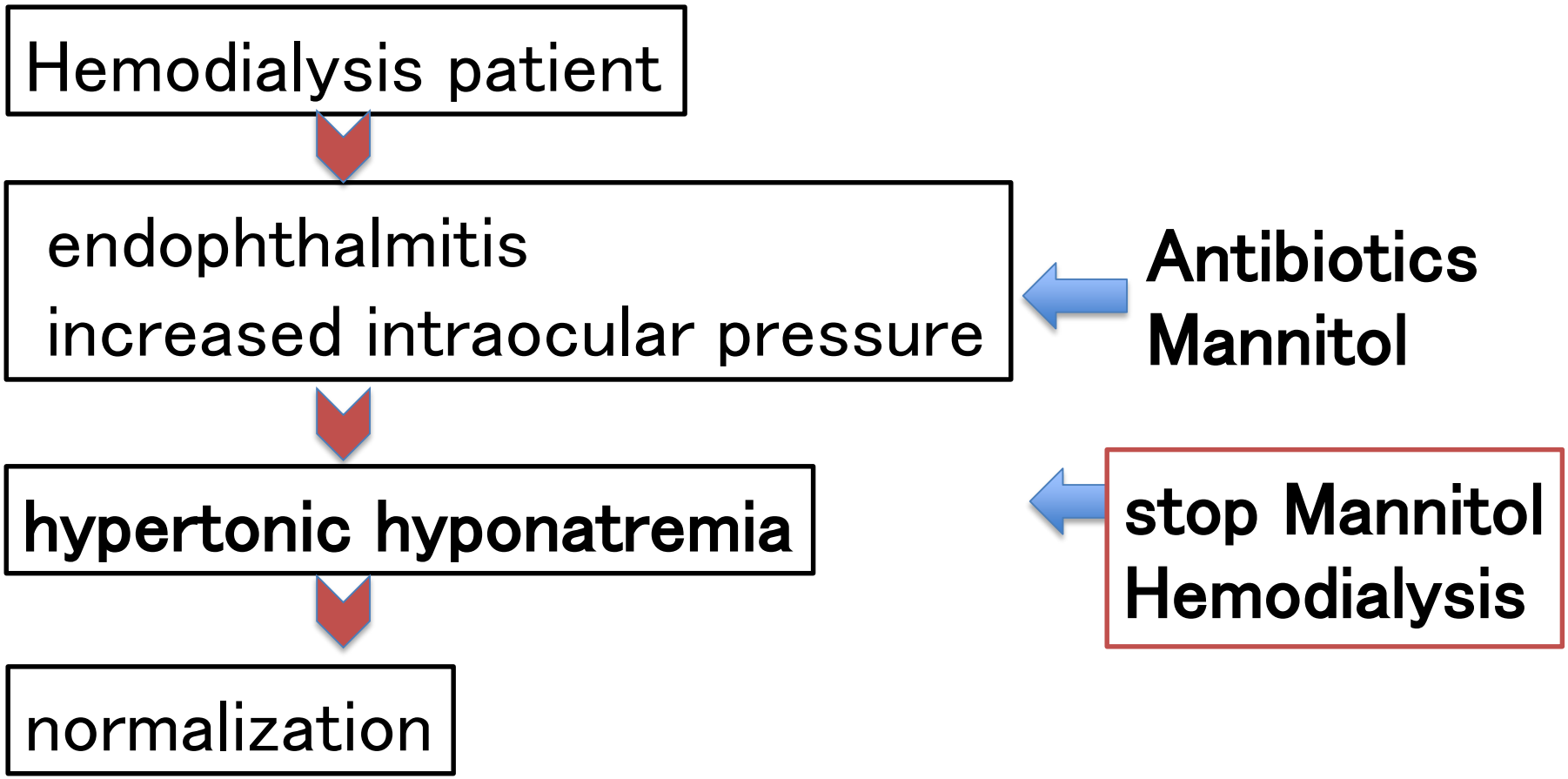
Patient's summary



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Take Home messages

- When treating a hyponatremic patient, please be careful not to miss hypertonic hyponatremia
- Check serum osmolality when diagnosing hyponatremia, or if you suspect Alcohol-related and other intoxications