Postoperative Hyponatremia

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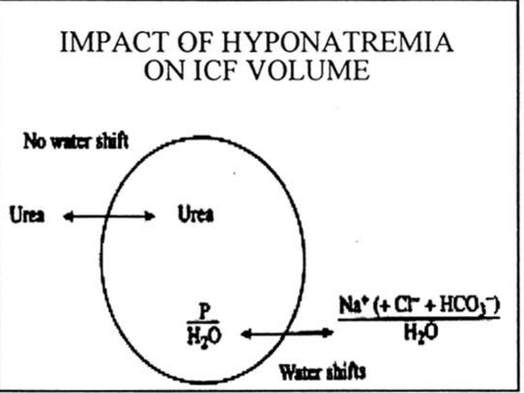
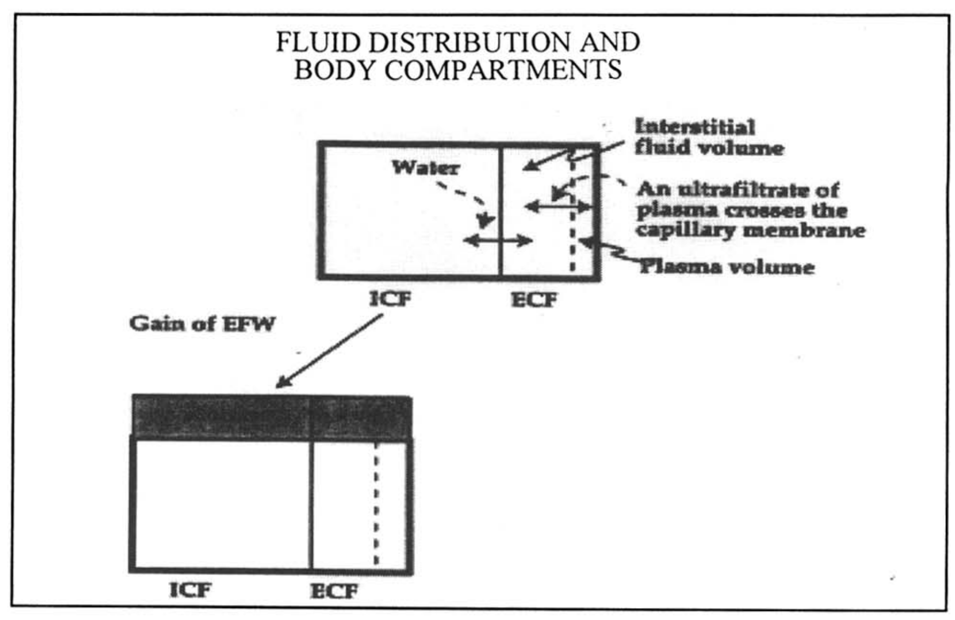
HYPONATREMIA

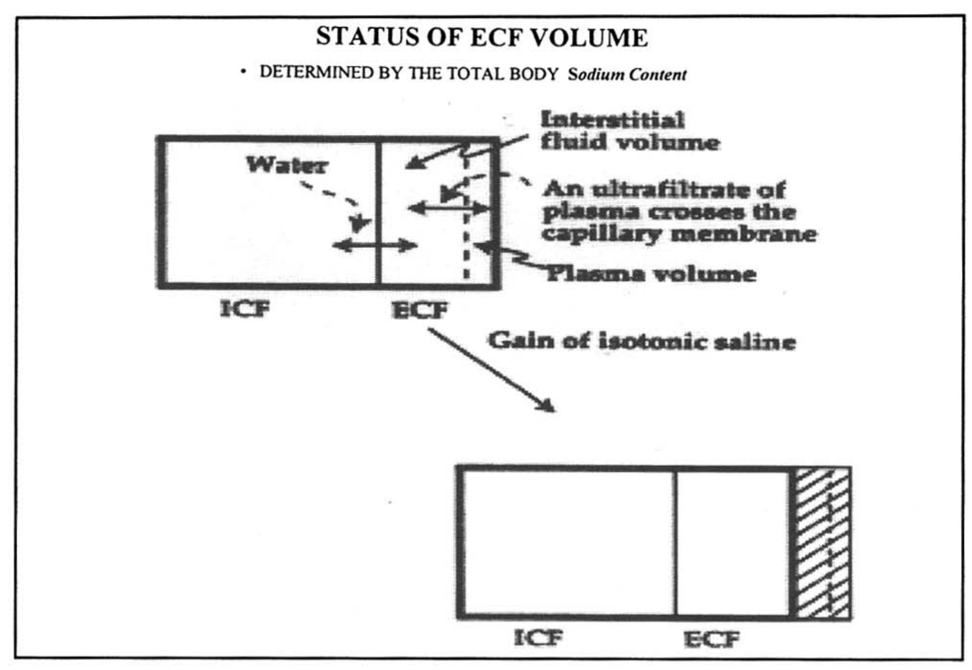
$$[Na^+] = \frac{Na^+}{H_2O}$$

RELATIVE TO Na^+ THERE IS EXCESS H_2O

BODY FLUIDS ARE *Hypotonic*







ACUTE vs CHRONIC HYPONATREMIA

BRAIN CELLS ARE THREATENED BY
Acute Hyponatremia

BRAIN CELLS
Regulate their ICF Volume

EXTRUSION OF OSMOLS:
K^+, Cl^-, AMINOACIDS

Begins within hours, complete in 72 hours

THERAPEUTIC CONTROVERSY

ACUTE HYPONATREMIA:
Treat Agressively

CHRONIC HYPONATREMIA:
Treat Slowly

No water shift
Urea ↔ Urea
$\frac{P}{H_2O}$ ↔ $\frac{Na^+(+Cl^- + HCO_3^-)}{H_2O}$
Water shifts

HYPONATREMIA:FAILURE OF WATER EXCRETION

WATER EXCRETION REQUIRES:

Suppression of ADH
Adequate urine flow rate

STIMULI OF ADH SECRETION

- ECF VOLUME CONTRACTION
- HYPERNATREMIA
- DRUGS
- PAIN
- ANXIETY
- NAUSEA
- EMESIS

POST OPERATIVE STATE

MANY STIMULI FOR ADH SECRETION

AVOID FREE WATER ADMINISTRATION

Is this sufficient to avoid postoperative hyponatremia?

POSTOPERATIVE HYPONATREMIA

Clinical Picture

n=65

- NAUSEA and VOMITING **100%**
- HEADACHE
- WEAKNESS
- LETHARGY
- SEIZURES **58%**
- RESPIRATORY ARREST

AYUS and ARIEFF
Ann Med 1992 .7:891-897

POST OPERATIVE HYPONATREMIA

What are the facts?

- **INCIDENCE 1-5 %**
- **8% DEVELOP ENCEPHALOPATHY**
- **52% SEVERE MORBIDITY OR DEATH**
- **CAN OCCUR WITH $[Na^+]$ =128 mM**

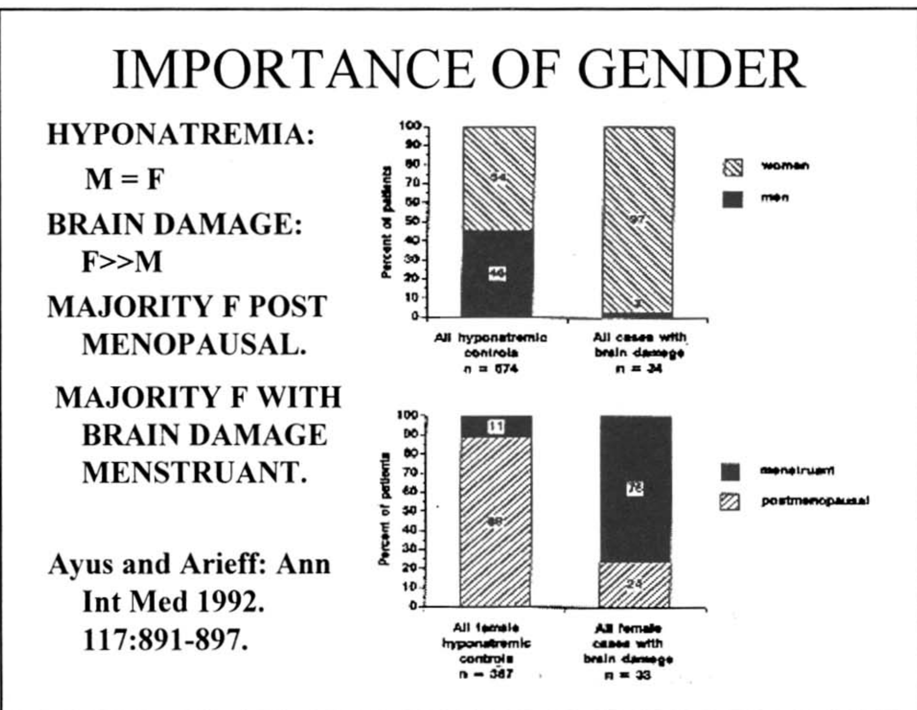
AYUS and ARIEFF
Neurology 1996
46:323-328.

PROJECTED MORBIDITY FROM POSTOPERATIVE HYPONATREMIA IN THE USA

number of patients

25 million
250,000
50,000
25,000
10,000

Total surgeries in the USA
Postoperative hyponatremia
Hyponatremic encephalopathy
Hyponatremic brain damage or death



WHAT IS THE BASIS?

Hypotheses

- Na^+-K^+ ATPase:
  Inhibited by ESTROGENS and enhanced by ANDROGENS
- INTRACEREBRAL VASOPRESSIN:
  Effects on cerebral perfusion and O_2 utilisation via V_1 receptor more pronounced in Females

PREMENOPAUSAL WOMEN

Can post operative hyponatremia be avoided if one avoids the administration of hypotonic intravenous solutions?

22 PREMENSTRUAL ✸
42±1 yrs, 70±4kg

- Gynecologic surgery
- 2.2±0.7 hrs
- IV:50% as N/S and 50% as Ringers Lactate ($130mM\ Na^+$ and $4mM\ K^+$)
- Foley catheter for 24 Hrs
- No oral intake

Steele et al.
Ann Int Med.1997.126:20-25.

HYPONATREMIA DESPITE ISOTONIC FLUIDS

	PRE	24 HR POST
$[Na^+]$	140±0.5	136 ±0.5
$[K^+]$	4.1±0.1	3.8±0.1
CREAT (μM)	62±2	59±3
UREA (mM)	3.5±0.2	2.5±0.3
GLUCOSE (mM)	4.8±0.1	5.3±0.4

Steele et al.
Ann Int Med.1997.126:20-25.

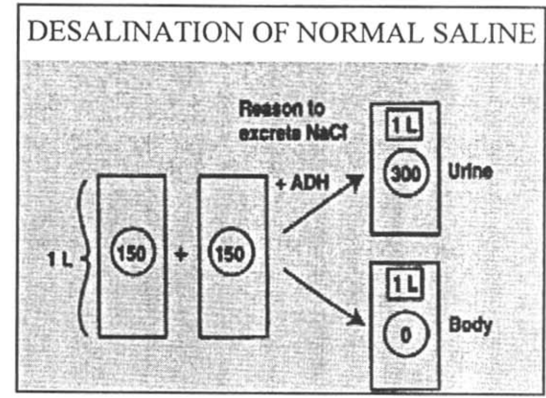
BALANCE DATA
24 HOURS

	H_2O Liters	Na^+ mmol	K^+ mmol
INFUSED	5.3±0.2	765±36	11±1
EXCRETED	2.5±0.2	398±37	10±1
BALANCE	**+ 2.9±0.3**	**+367±50**	**-90±7**

$Na^+ + K^+$ BALANCE: +277±50

Steele et al.
Ann Int Med.1997.126:20-25.

DESALINATION OF NORMAL SALINE



FACTORS DETERMINING IMPACT OF DESALINATION

- ADH ACTIVITY
- STIMULUS FOR Na^+ EXCRETION
- VOLUME OF SOLUTION DELIVERED
- BODY SIZE

PREVENTIVE MEASURES

- **REDUCE STIMULUS TO EXCRETE Na^+**
  Minimize Na^+ intake preop
- **ISOTONIC FLUIDS ONLY**
- **MINIMIZE INTRAOPERATIVE FLUIDS**
  Replace losses and maintain BP

TREATMENT

- **EARLY DIAGNOSIS**
  Awareness of high risk group
  Headache, Nausea, Vomiting
- **POST OPERATIVE HYPONATREMIA IS A MEDICAL EMERGENCY**

ACUTE HYPONATREMIA

In postoperative hyponatremia, the threat is ACUTELY SWOLLEN BRAIN CELLS

THEREFORE
TREAT AGGRESSIVELY !

Raise the [Na^+] by:

5mM or to 130mM in 1 hour