SAWA UNIVERSITY

جامعة ساوة الاهلية
كلية التقنيات الصحية والطبية
قسم التخدير - اللجنة العلمية

# مادة أسس التخدير 1 الكورس الاول

# IV FLUIDS TYPE AND USAGE (part2)



Sawa University — جامعـــــة ســـــاوة الاهلية

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Second .. Stage. — المرحلـــــــــة .الثانية .


نظـــــــري ...محاضرة رقم 4.

Theoretical Lecture No.4 .....


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## 2. Hypertonic saline

Hypertonic 3% saline is employed in therapy of severe symptomatic hyponatremia.

Hypertonic 3%, 7.5% or 23.4% saline can be used in case of severe brain edema.

## 3. 0.45% Sodium Chloride

A hypotonic concentration of sodium chloride.

Hypotonic concentrations of sodium chloride (0.45%) are best for parenteral maintenance fluids rather than aggressive intravascular volume repletion.

# 4. Lactated Ringer's

- Ringer's solution: introduced in 1880 by Sydney Ringer (UK) who studied mechanisms of cardiac contraction.
- The solution was designed to promote the contraction of isolated frog hearts, and contained Ca+ and K+ in a sodium chloride diluent.
- In the 1930s Alexis Hartmann (American pediatrician) proposed the addition of sodium lactate buffer to Ringer's solution for the treatment of metabolic acidosis.
- **The lactated Ringer's solution is also known as Hartmann's solution**

# Lactated Ringer's uses

- Have sodium, potassium and chloride contents similar to extracellular fluid have fewer adverse effects on acid-base balance (in case of hyperchloremic metabolic acidosis(
- It is used as a replacement fluid in burn patients when BSA > 20% ( parkland formula )

# Lactated Ringer's disadvantages

- The calcium in lactated Ringer's can bind to certain drugs and reduce their bioavailability and efficacy e.g. Amphoterecin, Ampicillin, Thiopentone etc.
- Calcium binding to the citrated anticoagulant in blood products can inactivate the anticoagulant and promote the formation of clots in donor blood.
- For this reason, lactated Ringer's solution is contraindicated as a diluent for blood transfusions.

# 5.Dextrose solutions

- D5% is used to prevent protein breakdown in an NPO patients after consumption of endogenous glycogen (24-48h(
- D5% (D5W) is used for replacement of pure water deficits and as a maintenance fluid for patients with hypernatremia.
- D10%, D20% or D50% are used in hypoglycemia.
- D20%, D25% or D50% are used in TPN (The use of 5% dextrose solutions to provide calories is obsolete(

- When glucose gets utilized, only water remains

- Distribution:

  - <10% remains in Intra vascular space
  - <30% in Interstitium
  - >50% in Intra cellular space

» This cause Cellular swelling

  - 5% dextrose-in-water solution is not an effective volume expander

# Dextrose solutions disadvantages

- Lactate Production: The proportion of a glucose load that contributes to lactate formation

✔ 5% in healthy subjects
✔ 85% in critically ill patients

Thus, in patients with circulatory compromise, abnormal glucose metabolism can transform glucose from a source of useful energy to a source of toxin production.

# Disadvantages of Glucose infusions

- Enhanced CO2 production (which can be a burden in ventilator-dependent or COPD patients(
- Hyperglycemia.
- Increased risk of infection, Neuropathy.
- Aggravation of ischemic brain injury.
- Increased mortality in septic shock.

# Colloids

**Do not pass across diffusional barriers as readily as crystalloids**.

## 1.Natural (plasma-derived) colloids :

- Human albumin.

## 2.Synthetic colloids :

- Dextran (e.g. dextran 40 and dextra 70 )
- Gelatin (e.g. gelofusine and hemaccel (
- Starch (e.g.hydroxyethyl starch (HES(

# 1. Albumin solution

Responsible for 75% of the oncotic pressure of plasma. Acts as buffer, antioxidant and transport protein.

Commercially is available as 5% solution or 20% solution in an isotonic saline diluent.

5% solution has colloid oncotic pressure (COP) 20 mm Hg (similar in oncotic activity to plasma).

Approximately half of the infused volume of 5% albumin stays in the vascular space.

The oncotic effects of albumin last 12-16 hours

# 2. Albumin solution 20%

COP of 70 mm Hg

Expands the plasma volume by 4 to 5 times the volume infused.

Infusion of 100 mL of 20% albumin can increase the plasma volume 400 to 500 mL.

It is intended for shifting fluid from the interstitial space to the vascular space in hypoproteinemic conditions,

**Should not be used for volume resuscitation in hypovolemia**.

# 3.Gelatins

- COP 27-34 mmHg
- The cheapest colloid available.
- Unlimited volume for resuscitation.
- Unimpaired renal function and hemostasis.
- Rapidly excreted by the kidneys (shorter duration 3-4 hr(
- Anaphylactoid reactions: direct histamine release.
- Gelofusine is compatible with blood but hemaccel contains ca+2.
- Hemaccel and gelofusine have the same concentration of sodium (154 meq/L) but gelofusine contain less chloride (120 meq/L(

# 4. Hydroxyethyl starches

COP 28 mm Hg

Long elimination half-life (17 days) but The oncotic effects of hetastarch disappear within 24 hours

The earlier HES fluids were associated with coagulation dysfunction and pruritis, but the tetrastarches used these days have no effect on bleeding times. Renal impairment in critically ill patients is associated with osmotic nephrosis like

lesions in the proximal and distal tubules.

# 5. Dextrans

COP 40 mm Hg (greater increase in plasma volume(

Not used for volume expansion because of a high incidence of anaphylactic reactions and negative effects on coagulation.

Decrease in blood viscosity and inhibition of erythrocyte aggregation.

Interfere with cross-matching.

# Comparison between Colloid

| Colloid | Concentration | Oncotic pressure mmHg/ osmolarity/mOsm/l | Initial volume expansion % | Persistence in body | Maximum dose |
|---|---|---|---|---|---|
| Albumin | 4% | 20–29 | 80 | t ½ 20 days intravascular expansion 16–24 hours | |
| Albumin | 25% | 100–120 | 200–400 | | |
| HES *(Voluven)* | 6% in normal saline | 20–29/308 | 80 | Intravascular expansion 8–12 hours | 50 ml/kg |
| HES *(Voluven Lyte)* | 6% in a balanced salt solution | 20–29 286.5 mOsm/l | 80 | 8–12 hours | 50 ml/kg |
| Gelatin *(gelofusine, haemacel)* | 3% in saline Na 154, Cl 120 | 26–29 274 mOm/l | 70 | Intravascular expansion: 2–7 hours | |
| Dextran 70 | 6% | 168–191 | 200 | 6 days | 1.5 g |

# Indications for colloids

1. Fluid resuscitation in patients with severe intravascular fluid deficits (e.g. hemorrhagic shock) prior to the arrival of blood for transfusion (in conjunction with crystalloid)
2. Fluid resuscitation in the presence of severe hypoalbuminemia or conditions associated with large protein losses such as burns.

It should be noted that colloid solutions are prepared in normal saline (Cl-145-154 mEq/L) and thus can also cause hyperchloremic metabolic acidosis

**What option for fluid resuscitation would you choose ?**

# Crystalloids and Colloids

| | Advantages | Disadvantages |
|---|---|---|
| **Crystalloid** | Cheap | Only 25% remains in circulation |
| | Available | Most interstitial goes |
| | Less side effects | Larger resuscitation volume (X3) |
| | Resuscitate the ECF space | More resuscitation time |
| | | Shorter half-life Pulmonary & peripheral oedema |
| **Colloid** | Spares pulmonary + peripheral interstitial space | Expensive Doesn't restore interstitial volume<br>Enters interstitial space if leaky (sepsis) |
| | Shorter resuscitation time Longer half-life | **More side effects** |

| | |
|---|---|
| 50-100% remains inintravascular space (depending on type) | Immune reactions<br>Interference with hemostasis<br>X-matching problems<br>Use of starches<br>May be associated with worse outcome |

# Calculation of maintenance fluid

Rule of 4:2:1 (infusion per hour) 4 mL/kg/hr for kg 1-10

+ 2 mL/kg/hr for kg 10-20

+1 mL/kg/hr above 20 kg

* A patient who weighs 40 kilograms would require :

40 mL/hr + 20 mL/hr + 20 mL = 80 mL/hr

* Shortcut formula :

body weight + 40 (= 80 mL/hr in this example) (Working if body weight >20kg)

# Further consideration

Once the maintenance requirements have been calculated, additional potential losses need to be considered to avoid under or over hydration, the following sources of fluid loss and the electrolyte composition of these fluids need to be appreciated:

- Nasogastric aspirates
- Vomit
- Diarrhea
- Stoma, drains, fistula etc.
- Polyuria

# Any questions?