How and why I give IV fluid

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2015 Disclosures

- **Consultant for Grifols – manufacturer of colloid (albumin) products**
- **Consultant for Baxter – manufacturer of crystalloid and colloid products**
- **SCA Scientific Program Chair**

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SCA 2015

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Fluids and public health

- **30% of ICU patients experience an episode of fluid resuscitation every day**
- **IV fluids are the commonest inpatient prescription in the world**
- **Fluid based GDT in the OR has been a cornerstone of ERAS**

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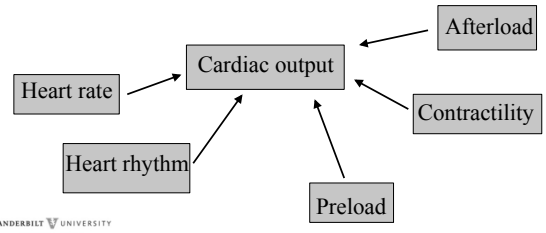
Basic physiology

- Cardiac output



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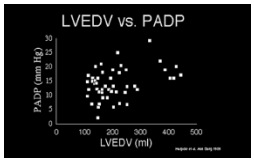
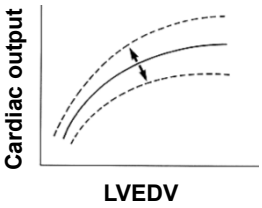
Preload

- Is a volume not a pressure!





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Correct Hemodynamics

- Administer fluids, inotropes and vasoactive drugs to restore:-
  - An effective circulation
  - An effective mean arterial pressure
  - An effective oxygen carrying capacity
- Give fluids and drugs according to need and not just as a routine: make the patient earn their fluid (and blood and O_2)
- Deviate from guidelines with a clinical reason to do so

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Clinical Indices of Adequate Perfusion

- Good urine output (1ml/kg/hr)
- No angina
- No reduction in conscious level
- Good capillary return
- Warm extremities

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Specific Endpoints

- Blood Pressure: MAP is the main determinant of perfusion in a pulsatile circuit: at least 60 and sometimes 90
- Lactate: High levels correlate with poor outcome. Low levels do not rule out underperfusion
- SvO_2: Useful if low. Normal value does not rule out underperfusion

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Aims of Fluid Therapy

- Convert hypodynamic situation to normal or hyperdynamic state
- Increase cardiac output until either effective circulation restored or plateau reached on Starling curve
- Blood: Always if Hb < 7 g/dl
  Never if Hb > 10 g/dl
  For symptoms if 7-10 g/dl

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Aims of Vasoactive Therapy

- Restore MAP when optimum fluid therapy and appropriate inotropic therapy have not
- Vasopressor treatment may be needed emergently while fluid therapy is underway
- All who receive vasoactive therapy in the ICU should have an A-line in place
- A-lines: Radial – Brachial - Femoral – Axillary

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Fluids in Shock

- 50% of patients with hypotension will respond to fluid therapy alone
- Type not as important as how and how much
- Give by bolus and against an index of preload
- Encourage bedside generation of dynamic Starling curve

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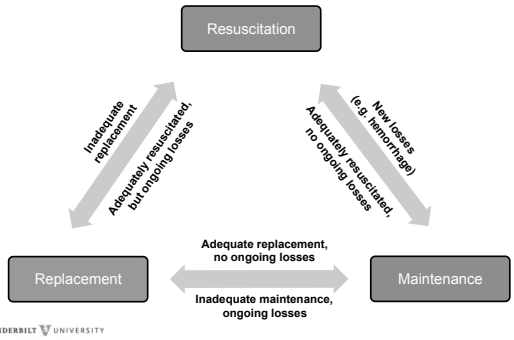
Reasons IV Fluids are Given



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3Rs: Right amount of the Right fluid at the Right time

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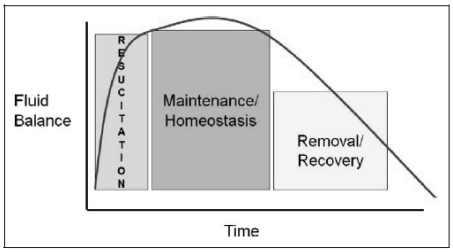
Fluid Balance During Hospital Stay



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Goldstein J *Intensive Care Med* published online 14 November 2012

Challenges with IV Fluids

- Low awareness of the specific constituents of different fluids
- Little formal education and training exists on fluid management
- Wide variety in type of fluid charts used
- Fluid requirements are not re-assessed as patient status changes
- Insufficient attention to identify, treat and monitor fluid and electrolyte status

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Basic Considerations

- Fluid therapy should be individualized
  - Understand the purpose and goals of giving IV fluid to your specific patient
- Prescribe IV Fluids like drugs
  - Specific dose
  - Specific indication
- Reassess routinely
  - Changes in patient status may require a change in fluid prescription

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Indications and Goals

Indication	Goal
Resuscitation	• Restore / preserve intravascular fluid volume • Restore effective tissue perfusion • Re-establish and maintain a balance between tissue oxygen demand and supply
Fluid and Electrolyte Replacement	• Provide normal daily maintenance requirements plus compensate for abnormal losses • Aim to replace like with like: replace fluid lost with fluid of similar composition • Consider composition of balanced fluids vs plasma
Maintenance	Provide daily requirements of water and electrolytes • Water 25-35 ml/kg/day • Sodium 1 mmol/kg/day • Potassium 1 mmol/kg/day

Overall Goal for All Patients

- Right Amount
- Right Fluid
- Right Time

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Delivering the

RIGHT AMOUNT

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Fluid Gain in the ICU

- Patients with sepsis in the ICU may gain as much as 12.5 L of body water during the first 2 days of resuscitation
- Excretion of this excess load may take up to 3 weeks
- This is bad!

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How does this happen ?

- Patients receive lots of fluid, lots of sodium chloride
  - Kidneys can't excrete sodium load
  - Chloride causes renal vasoconstriction and exacerbates fluid retention and edema
  - Leaky capillaries in sick patients exacerbates edema
- Patients don't receive much potassium
  - Potassium depletion reduces ability to excrete sodium

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Consequences of excess fluid

- Decreased renal blood flow and GFR
- Intra-mucosal acidosis
- Prolongation of gastric emptying time
- Ileus
- Hyperchloraemic acidosis
- Weight gain
- Low serum sodium due to ADH release
  - Can lead to administration of more sodium
- Cellular dysfunction

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Sodium Chloride and Volume Depletion

- Reduced stroke volume – poor organ perfusion, hypotension
- Impaired renal perfusion - ARF
- Increased viscosity of mucus
- Reduced saliva
- Increased blood viscosity can lead to clots

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Moderation

- The objective of care is restoration of normal physiology and normal function of organs, with a normal blood volume, functional body water, and electrolytes.
- This can never be accomplished by inundation.

FD Moore & GT Shires, Ann Surg (1967)

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Right Amount of Fluid Depends on Reason IV Fluid is Needed

- Resuscitation
  - Restore circulation and oxygen supply to vital organs with 250 – 500 mL of fluid immediately and monitor response (but what type?)
- Fluid and electrolyte Replacement
  - Amount should incorporate daily maintenance plus any abnormal losses
- Maintenance
  - Amount should be sufficient to maintain normal status in body fluid compartments, and allow kidney to excrete waste products

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The Right Amount of Fluid Depends on the Type

Volume effect of colloids:crystalloids was thought to be 1:3

Not True!

Recent data shows the ratio is more likely to be only 1:1.3

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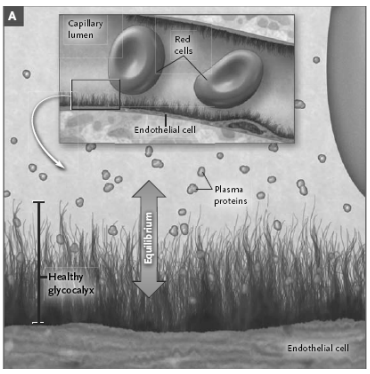
The Endothelial Glycocalyx

Healthy



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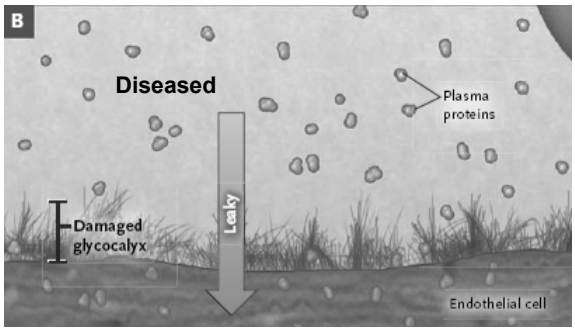
The Endothelial Glycocalyx



Restrictive or Liberal Strategy ?

- Currently: trend towards restrictive fluid strategy
- Commonly accepted definitions of "restrictive" or "liberal" fluid strategies do not exist
- Definition, methodology and results not well-defined in the literature, precluding evidence-based guidelines for procedure-specific perioperative fixed-volume regimens

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Goal-directed Fluid Therapy

- Meta-analyses have shown that cardiac output guided fluid management appears to reduce hospital stay and morbidity
- Goal-directed fluid therapy appears to reduce inflammation, morbidity, and mortality in patients who undergo major surgery

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Summary: Right Amount of IV Fluid

- Maximum effect with minimum sodium, chloride and water loading
- Before patients can recover, they must excrete the water, sodium and chloride given during resuscitation
- Reason IV fluid is needed must be considered when determining what to administer
- Fluids differ in electrolyte content; choice of fluid matters too

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Delivering the Right Amount of the

RIGHT FLUID

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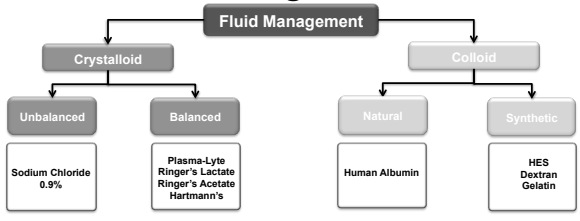
Treatment Choices for Fluid Management



Different fluids with different modes of action, and different side effects

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Crystalloids and Colloids

Colloid solutions	Crystalloid solutions
• Contain large proteins or synthetic glucose polymers which are too large to pass through the walls of capillaries under normal conditions • Colloids are thought to have greater volume effect compared with crystalloids, but current research shows ratio to only be 1:1.3	• Contain electrolytes (e.g. sodium, potassium, calcium, chloride) • An isotonic crystalloid solution is distributed in the entire extracellular space (plasma plus interstitial space)

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Delivering the Right Amount of the Right Fluid at the

RIGHT TIME

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Criteria for IV Fluid Administration

- **Fluids should be given to address a specific patient need, not because of routine practice**
- **Objective criteria should be used when:**
  - **Starting IV fluids**
  - **Increasing or decreasing IV fluids**
  - **Stopping IV fluids**

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How do we assess fluid balance?

- **Physical exam**
  - **"Stethoscope findings" (rales, rhonchi), pulse, weight, skin perfusion/ temperature, urine output and electrolyte concentration, fluid balance charts**
- **Metabolic monitors**
  - **Lactate, SVO_2, ABG**
- **Static monitors**
  - **BP (MAP), CVP, PAOP**
- **Dynamic monitors**
  - **Pulse pressure variation**
  - **Cardiac output**
  - **Stroke volume variation**
  - **Passive leg raise**
  - **Continuous TEE**

Key Clinical Questions:
- **Is the patient fluid deficient?**
  If so…
- **Is the patient responsive to fluids?**

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Trends in Fluid Assessment

Liberal fluid strategy	Restrictive fluid strategy
Invasive monitoring with PACs	Minimally invasive monitoring
Static indices	Dynamic indices

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Signs That a Patient May be Hypovolemic

- **Systolic BP < 100 mmHg**
- **HR > 90 bpm**
- **Capillary refill > 2 seconds or extremities are cold to touch**
- **RR > 20 bpm**
- **Passive leg raising test is positive**
- **Blood pressure drop when sitting up**
- **Invisible/collapsing neck veins**
- **Thirst**
- **Low urine output**

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Functional Questions to Consider Prior to Starting Fluids

- Is tissue oxygenation adequate?
  - Surrogates:
    - Mixed venous oxygen saturation
    - Central venous oxygenation
    - Serum lactate
- Is the patient volume responsive?
- Is vasomotor tone increased or decreased?
- Is the heart able to sustain an adequate CO when arterial pressure is restored without going into failure?

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Patient Assessment and Monitoring for Fluid Therapy

- Patient monitoring and reevaluation on a routine basis is crucial for safe fluid therapy
- Reason for IV fluids may change as patient status changes, so IV fluid orders should be re-evaluated frequently
- Goal is to stop IV fluid as soon as patient can meet needs enterally

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Summary: The Right Amount of the Right Fluid at the Right Time

- Fluid therapy should be individualized
  - Understand the purpose and goals of giving IV fluid to your specific patient
- Prescribe IV Fluids like drugs
  - Specific dose and indication
- Choose a fluid based on composition and patient needs
  - Default fluid for critically ill should likely be a balanced crystalloid
- Reassess patient using objective measures and adjust fluid prescription accordingly

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