Fluids & Transfusion
(This is not a physiology lecture)

Dr Richard Gordon-Williams
ST 7 in Anaesthesia
UCL Hospitals
The Great Debate

- Crystalloid
- Colloids
- Synthetic
- Human (Blood / Albumin)
- Isotonic / Iso-osmolar
- Balanced

Analogy courtesy of Prof Mythen
Its what you do with them
• **Does not apply to patient during perioperative period**

• Advised Protocol driven fluid management

**BUT 5Rs is a good approach**

1. **Resuscitation**
2. **Routine Maintenance**
3. **Replacement**
4. **Redistribution**
5. **Reassessment**
We are the “experts”

Graph of Distribution of fluid given across centres for colorectal surgery

Find Reference

Large variation in “expert” opinion in perioperative fluid management
Case study 1

- 28 year old 60kg Male, F&W
- Elective removal of metalwork (approx. 1 hour)

**What should we hang?**

A. Nothing  
B. 500ml Bag  
C. 1L Bag  
D. 1L at induction & further 1L intra-op

**Which Fluid?**

A. Nothing  
B. Hartmanns  
C. Normal Saline  
D. 5% Dextrose  
E. 0.45% Saline + 4% Dextrose
Elective Surgery & Enhanced Recovery

- Peri-operative losses can now be minimal
  - Lack of excessive bowel prep
  - Decreased starvation
  - CHO loading
  - Early E&D

- Resuscitation minimal ~ 120ml (2hour fluid fasting)
- Routine maintenance ~60ml
- Replace losses - Superficial Surgery ~0ml
- Little redistribution of fluid in elective surgery ~0ml

**TOTAL 180ml**

- Midazolam 2ml
- Fentanyl 4ml
- Propofol 20ml
- Cefuroxime 20ml
- Atracurium 5ml
- Ondansetron 4ml
- Dexamethasone 2ml
- Paracetamol 100ml
- Diclofenac 3ml
- Reversal 2ml
- Flush >20ml

**TOTAL >180ml**
Case study 2

• 28 year old 60kg Male in A&E with ?perforated Duodenal Ulcer. HR 126, BP 78/43, Dry, pH 7.28, BE -6.4, Lact 4.0, Na 144, K 3.4, Hb 142

What should we hang?
A. Nothing
B. 500ml Bag
C. 1L Bag
D. 1L at induction & further 1L intra-op

Which Fluid?
A. Nothing
B. Hartmanns
C. Normal Saline
D. 5% Dextrose
E. 0.45% Saline + 4% Dextrose
Pop Quiz

• How many Bags of Ready Salted Crisps are equivalent to a 1 L bag of Normal Saline?
  A. 5  
  B. 10  
  C. 15  
  D. 20  
  E. 25
Dose that makes the Poison

- **0.9% NaCl 1L contains:**
  - 158mmol Na$^+ + \text{Cl}^-$
  - Equal to 9g Salt
  - Ready Salted = 0.45g
  - Double our RDA (4g)!
  - 70p per Litre
  - **20 Packets of Crisps**

- **Dangers of Normal Saline**
  - Water follows salt
  - Fluid overload
  - Infusion 0.9% NaCl causes reduction in renal blood flow and tissue perfusion$^1$
  - Chloride restrictive fluid regimen leads to a reduction in AKI and need for RRT$^2$
Goal Directed Fluid Therapy

- We do this already – HR, BP, UO, Lactate, BXS

- We have gadgets to help optimise:
  - LiDCO
  - PiCCO
  - ODM
  - Echo
  - Swing on Arterial line (Pulse Pressure Variation)

- But needs to be a correlate of CO (Not CVP)
Goal Directed Fluid Therapy

Estimation of fluid requirements in surgery
- Goal directed fluid therapy
- Cardiac output monitoring or surrogates
- Don’t forget UO, Blood gases etc

Frank-Starling Curve

Stroke Volume vs. Left Ventricular End-Diastolic Volume
The Perioperative Period

- The intra-operative period is a drop in the ocean

- Routine Maintenance
- Replace losses (NG, Drains)
- Oral maintenance and replacement of losses is the goal
- Try and stop fluids as early as possible
After resuscitation he has come for a laparotomy, over-sew & washout.

There is 1.5L of blood stained fluid in the suction. MAP is 59mmHg. Hb on ABG 74. SVV 18%.

What should we do?
A. Reassess
B. Further 250ml boluses guided by Cardiac Output monitoring
C. Transfusion of 1 unit of Blood
D. Put out a major Haemorrhage Call
E. Start Noradrenaline
Transfusion Overview

• **Oxygen delivery to tissues** (O₂ Flux)  
  \[ \text{Cardiac Output} \times \text{Oxygen content of blood} \]

  \[ \text{Hb} \times \text{SaO}_2 + \text{pO}_2 \]

• Heart and Brain are most sensitive to hypoxia

• But they come with risks
  
  – Acute immune haemolytic reaction, TRALI, GvHD, Cancer progression, FE Overload
• “evidence-based, multidisciplinary approach to optimise the care of patients who might need transfusion...”

• **Preoperative**
  – Detection of anaemia, optimisation Hb, Fe infusions

• **Intraoperative**
  – Blood conservation
    • Tranexamic acid/ Cell salvage/ Surgical technique/ Warming
  – Transfusion triggers
    • Patients ability to compensate for anaemia (cardiorespiratory disease)
    • Rate of ongoing blood loss
    • Likelihood of further blood loss
    • Balance of risks vs benefits of transfusion

• **Postoperative**
  – Single unit transfusion policy
Transfusion Triggers

- **Hb >10**  NO
- **Hb < 7**  YES
- **Hb 7-10**  MAYBE
  - ?Cardiopulmonary reserve
  - ?Symptomatic patients
Massive Transfusion

- Replacement of one blood volume in a 24 hour period
- Transfusion of >10 units in 24 hours
- Transfusion of 4 or more units within 1 hour when ongoing need is foreseeable
- Replacement of >50% of the total blood volume within 3 hours

- **Obstetrics**
  - >2000ml
  - >150mls/min
  - Uncontrolled/ ongoing

Shock with evidence of bleeding
Get some Help....

- **Major Haemorrhage Call**
- **Two 14G IV cannulae**
  - Resuscitate with warmed crystalloid/colloid
  - Warm patient
  - Consider invasive monitoring: arterial line + central venous access
- **FBC, ABG/VBG > Hb, K+, Ca+**
- Coagulation screen / TEG
- X- match
- Repeat after products/4hourly
- **Ask for products early – FFP takes 30 mins to thaw!!**
- May need to give blood products before results are available
Haemorrhage spiral

Haemorrhage → Coagulopathy → Resuscitation → Haemodilution, Hypothermia & Acidosis

Temperature

Factor Activity
Goals in Massive Transfusion

**Oxygen Delivery**

- Packed Red Cells
- Haematologist
- Blood Bank
- Porter
- Product Checking
- Infusing
- Recording
- Tests of Hb

**Make a Clot**

- Surgeon / Radiologist
- Clotting Products
- Platelets
- Clotting factors
- Fibrinogen
- Stop fibrinolysis
- Calcium
- Heat

"I think you should be more explicit here in step two."
Products

- **Code Red Pack A:**
  - 6 units RBC
  - 4 units FFP

- **Code Red Pack B:**
  - 6 units RBC
  - 4 units FFP
  - 1 pool platelets
  - 2 pools cryoprecipitate

- **Platelets**
  - Target plt count > 100 \( \times 10^9 / l \) for multiple/CNS trauma, > 50 in other situations

- **FFP**
  - Aim for PT / APTT < 1.5 x control

- **Cryoprecipitate**
  - Aim for fibrinogen > 1g/L
  - Higher in obstetrics

- **Calcium + Tranexamic Acid 1g**
1. Do I need fluid?
2. Avoid high Chloride load
3. Use Goal Directed Fluid Therapy
4. Avoid post-operative fluids if possible
5. Massive transfusion in a logistical problem – get hands
6. Avoid cold fluids that don’t carry clot or blood
Thank you