Perioperative Goal Directed Fluid Therapy.

Andrew Rhodes
London, UK
Conclusions:

- Morbidity and mortality were much more common than appreciated.
- Many patients who died did not go through critical care.
- There were marked variations in processes of care that may explain some of these differences.
Preoperative anaemia is associated with poor clinical outcome in non-cardiac surgery patients

D. M. Baron, H. Hochrieser, M. Posch, B. Metnitz, A. Rhodes, R. P. Moreno, R. M. Pearse and P. Metnitz, for the European Surgical Outcomes Study (EuSOS) group for the Trials Groups of the European Society of Intensive Care Medicine and the European Society of Anaesthesiology

Fig 1  Predicted mortality according to preoperative Hb concentrations.
Point prevalence of surgical checklist use in Europe: relationship with hospital mortality

I. Jammer1,2, T. Ahmad3, C. Aldecoa4, D. Koulenti5,6, T. Goranović7, I. Grigoras8, B. Mazul-Sunko7,9, R. Matos10, R. Moreno10, G. H. Sigurdsson11, P. Toft12, B. Walder13, A. Rhodes14 and R. M. Pearse3* for the European Surgical Outcomes Study (EuSOS) group†

<table>
<thead>
<tr>
<th>Checklist use</th>
<th>Unadjusted OR (95% CI)* for mortality</th>
<th>Adjusted OR (95% CI) for mortality excluding surgical checklist in model†</th>
<th>Adjusted OR (95% CI) for mortality including surgical checklist in model‡</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.84 (0.75–0.94)</td>
<td>N/A</td>
<td>0.71 (0.58–0.85)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

St George’s University Hospitals NHS Foundation Trust, Critical Care Directorate
What Drives Surgical outcomes?

• The patient
  – Presenting problem / physiological disturbance
  – Age
  – Co-morbid conditions

• The problem
  – The type, scale and urgency of the procedure

• Technical issues

• The healthcare system and processes

• The unknown
The enhanced recovery pathway

Active patient involvement

Referral from primary care
- Pre-operative
- Admission
- Intra-operative
- Post-operative
- Follow-up

Getting the patient in best possible condition for surgery
- Referral from primary care
- Pre-operative
- Admission
- Intra-operative
- Post-operative
- Follow-up

Whole team involvement
- Optimising haemoglobin levels
- Managing pre-existing co-morbidities e.g. diabetes/hypertension
- Referral from primary care
- Pre-operative
- Admission
- Intra-operative
- Post-operative
- Follow-up

The patient has the best possible management during surgery
- No routine use of wound drains
- No routine use of nasogastric tubes (bowel surgery)
- Active, planned mobilisation within 24 hours
- Early oral hydration
- Early oral nutrition
- IV therapy stopped early
- Catheters removed early
- Regular oral analgesia e.g. paracetamol and NSAIDS
- Avoidance of systemic opioid-based analgesia
- Discharge on planned day or when criteria met
- Therapy support (stoma, physiotherapy, dietitian)
- 24 hour telephone follow-up if appropriate
Surgery is associated with an increased need for oxygen in the post operative period.

Older P Anaesth Intens Care 1988 16, 389
OXYGEN TRANSPORT

Preop Operation 1 2 4 8 12 24 36 48 72 Postoperative Period (hours)

ml/min-M^2
600
500
450
400
ml/min-M^2
150
140
130
120
110
100
%
35
30
25
20

Oxygen Delivery

Oxygen Consumption

Oxygen Extraction

Survivors
Nonsurvivors

Shoemaker. CCM. 1979: 7; 237.
Peri-operative Oxygen Debt

Oxygen Debt (litres/M$^2$)

Intra-operative

Hours postoperative

1 2 4 8 12 24 36 48

survivors without complications or organ failure

survivors with complications or organ failure

non-survivors

Shoemaker et al
Hypothesis:
By pre-emptively augmenting the circulation to pre-defined goals, can we prevent the oxygen debt occurring and improve outcome?
Return from theatre

Haemodynamic Monitoring

250 ml fluid challenge (blood or colloid as appropriate)

Stroke volume increase >10%?

Fluid losses > input?

Observe

Yes

No

Dopexamine to maximum 1 mcg/kg/min

DO₂I >600 ml/min/m²

Dopexamine reduced if tachycardia or myocardial ischaemia develop

Yes

No

DO₂I >600 ml/min/m²
By Measuring and Targeting Oxygen Delivery it can be increased in the Post operative Period.
And This Can Reduce Complications and Hospital length of Stay.
Perioperative increase in global blood flow to explicit defined goals and outcomes after surgery: a Cochrane Systematic Review

M. F. W. Grocott, A. Dushianthan, M. A. Hamilton, M. G. Mythen, D. Harrison, K. Rowan and Optimisation Systematic Review Steering Group

### Table 2: Data synthesis for all outcomes. RR, relative risk; IV, inverse variance; MD, mean difference

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Number of studies</th>
<th>Number of patients</th>
<th>Statistical method</th>
<th>Effect size and $I^2$</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality (longest follow-up)</td>
<td>31</td>
<td>5292</td>
<td>RR (IV, fixed, 95% CI)</td>
<td>0.89 (0.76–1.05), $I^2=15%$</td>
<td>0.18</td>
</tr>
<tr>
<td>Mortality (hospital or 28 day)</td>
<td>31</td>
<td>5292</td>
<td>RR (IV, fixed, 95% CI)</td>
<td>0.81 (0.65–1.00), $I^2=01%$</td>
<td>0.055</td>
</tr>
<tr>
<td>Renal impairment</td>
<td>21</td>
<td>4307</td>
<td>RR (IV, fixed, 95% CI)</td>
<td>0.71 (0.57–0.90), $I^2=20%$</td>
<td>0.004</td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>12</td>
<td>2921</td>
<td>RR (IV, fixed, 95% CI)</td>
<td>0.84 (0.67–1.06), $I^2=00%$</td>
<td>0.14</td>
</tr>
<tr>
<td>Total number of infections</td>
<td>9</td>
<td>733</td>
<td>RR (IV, fixed, 95% CI)</td>
<td>0.88 (0.69–1.12), $I^2=00%$</td>
<td>0.29</td>
</tr>
<tr>
<td>Infection types</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest/pneumonia</td>
<td>13</td>
<td>2945</td>
<td>RR (IV, fixed, 95% CI)</td>
<td>0.78 (0.61–1.00), $I^2=00%$</td>
<td>0.054</td>
</tr>
<tr>
<td>Sepsis</td>
<td>5</td>
<td>474</td>
<td>RR (IV, fixed, 95% CI)</td>
<td>0.68 (0.26–1.77), $I^2=06%$</td>
<td>0.43</td>
</tr>
<tr>
<td>Abdominal</td>
<td>6</td>
<td>55</td>
<td>RR (IV, fixed, 95% CI)</td>
<td>0.53 (0.23–1.22), $I^2=00%$</td>
<td>0.14</td>
</tr>
<tr>
<td>Wound</td>
<td>10</td>
<td>2802</td>
<td>RR (IV, fixed, 95% CI)</td>
<td>0.65 (0.50–0.84), $I^2=22%$</td>
<td>0.0013</td>
</tr>
<tr>
<td>Urinary tract</td>
<td>8</td>
<td>612</td>
<td>RR (IV, fixed, 95% CI)</td>
<td>0.54 (0.26–1.15), $I^2=00%$</td>
<td>0.11</td>
</tr>
<tr>
<td>Respiratory failure/ARDS</td>
<td>9</td>
<td>844</td>
<td>RR (IV, fixed, 95% CI)</td>
<td>0.51 (0.28–0.93), $I^2=00%$</td>
<td>0.027</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>15</td>
<td>3328</td>
<td>RR (IV, fixed, 95% CI)</td>
<td>1.01 (0.71–1.45), $I^2=00%$</td>
<td>0.95</td>
</tr>
<tr>
<td>Congestive cardiac failure/pulmonary oedema</td>
<td>14</td>
<td>3223</td>
<td>RR (IV, fixed, 95% CI)</td>
<td>1.00 (0.81–1.24), $I^2=00%$</td>
<td>0.98</td>
</tr>
<tr>
<td>Venous thrombosis</td>
<td>10</td>
<td>2740</td>
<td>RR (IV, fixed, 95% CI)</td>
<td>1.04 (0.39–2.77), $I^2=12%$</td>
<td>0.93</td>
</tr>
<tr>
<td>Number of patients with complications</td>
<td>17</td>
<td>1841</td>
<td>RR (IV, random, 95% CI)</td>
<td>0.68 (0.58–0.80), $I^2=34%$</td>
<td>&lt;0.00001</td>
</tr>
<tr>
<td>Length of hospital stay</td>
<td>27</td>
<td>4729</td>
<td>MD (IV, random, 95% CI)</td>
<td>−1.16 (−1.89 to −0.43), $I^2=87%$</td>
<td>0.0019</td>
</tr>
<tr>
<td>Length of critical care stay</td>
<td>14</td>
<td>1873</td>
<td>MD (IV, random, 95% CI)</td>
<td>−0.45 (−0.94 to −0.03), $I^2=87%$</td>
<td>0.065</td>
</tr>
</tbody>
</table>
The data indicate that for every 100 patients exposed to treatment, **13/100 will avoid a complication**, 2/100 will avoid renal impairment, 5/100 will avoid respiratory failure, and 4/100 will avoid a postoperative wound infection.
Meta-analysis of the effect of goal-directed therapy on bowel function after abdominal surgery

J. C. Gómez-Izquierdo¹, L. S. Feldman², F. Carli¹ and G. Baldini¹

<table>
<thead>
<tr>
<th>Reference</th>
<th>GDT</th>
<th>Non-GDT</th>
<th>Weight (%)</th>
<th>WMD</th>
<th>WMD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chalandon et al.³⁶</td>
<td>1-7 (3-11)</td>
<td>2 (0-11)</td>
<td>8.0</td>
<td>-0.10 (-0.55, 0.35)</td>
<td></td>
</tr>
<tr>
<td>Gan et al.²³</td>
<td>3 (0-5)</td>
<td>2 (0-5)</td>
<td>21.0</td>
<td>-1.70 (-1.60, -1.60)</td>
<td></td>
</tr>
<tr>
<td>Nijs et al.²⁴</td>
<td>0 (0-3)</td>
<td>4 (1-13)</td>
<td>5.7</td>
<td>-0.03 (-0.09, 0.00)</td>
<td></td>
</tr>
<tr>
<td>Harms et al.⁴⁴</td>
<td>3 (1-6)</td>
<td>6 (2-16)</td>
<td>20.9</td>
<td>-2.00 (-2.80, -1.20)</td>
<td></td>
</tr>
<tr>
<td>Walter et al.⁴⁵</td>
<td>8 (1-14)</td>
<td>7 (1-14)</td>
<td>20.0</td>
<td>-1.00 (-1.50, -0.50)</td>
<td></td>
</tr>
<tr>
<td>Zhao et al.⁴⁷</td>
<td>4 (0-7)</td>
<td>4 (0-7)</td>
<td>20.0</td>
<td>0.03 (-0.57, 0.59)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>20.0</td>
<td>-0.95 (-1.80, -0.10)</td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: s² = 0.99; χ² = 8.43, 8 df, P = 0.07, I² = 94%
Test for overall effect: Z = 2.19, P = 0.03

a Time to tolerate oral intake

<table>
<thead>
<tr>
<th>Reference</th>
<th>GDT</th>
<th>Non-GDT</th>
<th>Weight (%)</th>
<th>WMD</th>
<th>WMD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chalandon et al.³⁶</td>
<td>2 (0-2)</td>
<td>2 (0-12)</td>
<td>24.7</td>
<td>0.10 (-0.52, 0.72)</td>
<td></td>
</tr>
<tr>
<td>Nijs et al.²⁴</td>
<td>3 (0-5)</td>
<td>4 (1-14)</td>
<td>5.7</td>
<td>-1.70 (-5.41, 3.41)</td>
<td></td>
</tr>
<tr>
<td>Harms et al.⁴⁴</td>
<td>3 (1)</td>
<td>4 (1-9)</td>
<td>15.0</td>
<td>-1.00 (-2.80, -1.20)</td>
<td></td>
</tr>
<tr>
<td>Walter et al.⁴⁵</td>
<td>6 (2-22)</td>
<td>5 (1-14)</td>
<td>29.4</td>
<td>-1.00 (-1.50, -0.50)</td>
<td></td>
</tr>
<tr>
<td>Zhao et al.⁴⁷</td>
<td>4 (0-4)</td>
<td>4 (0-4)</td>
<td>20.0</td>
<td>0.03 (-0.57, 0.59)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>20.0</td>
<td>-0.65 (-1.20, -0.11)</td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: s² = 0.23; χ² = 12.44, 4 df, P = 0.02; I² = 67%
Test for overall effect: Z = 2.06, P = 0.02

b Time to first bowel motion

<table>
<thead>
<tr>
<th>Reference</th>
<th>Postop. nausea/vomiting</th>
<th>GDT</th>
<th>Non-GDT</th>
<th>Weight (%)</th>
<th>Risk difference</th>
<th>Risk difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forget et al.⁴²</td>
<td>0 of 41</td>
<td>0 of 41</td>
<td>28.8</td>
<td>-0.10 (-0.20, 0.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gan et al.²³</td>
<td>7 of 50</td>
<td>18 of 50</td>
<td>25.0</td>
<td>0.02 (-0.18, 0.20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zhang et al.⁴⁶</td>
<td>8 of 40</td>
<td>8 of 40</td>
<td>19.8</td>
<td>0.00 (-0.21, 0.21)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zhang et al.⁴⁷</td>
<td>6 of 39</td>
<td>15 of 39</td>
<td>17.2</td>
<td>0.30 (-0.53, 0.20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>21 of 161</td>
<td>41 of 141</td>
<td>100.0</td>
<td>-0.15 (-0.26, 0.00)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: s² = 0.01; χ² = 5.71, 3 df, P = 0.18; I² = 47%
Test for overall effect: Z = 2.48, P = 0.01

BJS 2015; 102: 577–589
A Cost-Effectiveness Analysis of Postoperative Goal-Directed Therapy for High-Risk Surgical Patients

Claudia Ebm, MD, MSc; Maurizio Cecconi, MD, FRCA, FICM, MD (UK)¹ ²; Les Sutton, MBA, MSc¹; Andrew Rhodes, MD, FRCP, FRCA, FICM¹ ²

*Includes fluids, drugs, supplementary material*
Residual questions

• Is the difference due to the act of protocolizing care?

• Are all elements of the protocol necessary?
  – Different protocols
  – Different monitors
  – Different targets

• Are the results generalizable?
  – During or after surgery
  – Which patients
Endpoints for Goal Directed Therapy

MAP

Time

DO2I

Time

MAP

DO2I

St George’s University Hospitals NHS Foundation Trust, Critical Care Directorate
Conclusions

✓ Post operative morbidity and mortality is common.

✓ There is marked variability in practice in how post operative care is delivered - this is exemplified with the handling of haemodynamics.

✓ There is evidence that protocolized haemodynamic therapy can reduce variability and complications.

✓ This should be part of a comprehensive package of care to improve the outcomes for this patient group.
Thank You!