undertransfusion

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Risk of under transfusion

• Identified « At risk » situations
  – During and immediately after anesthesia
  – Maternal haemorrhage in obstetric
  – Multiple trauma patients

• Various causes
  – Fear of transfusion
  – Lack of emergency transfusion protocols
  – Lack of communication between BTC and hospital
Deaths related to anesthesia - 1


Survey of anesthesia-related mortality in France. Anesthesiology, 2006. 105 (6) 10087-1097

Analysis of death certificates of 1999

Study performed in 2003
Deaths related to anesthesia - 2

- France 1999: 537,459 death certificates
- Analysis of ICD9 codes where anesthesia could be involved
  - Classification in two groups:
    - Interventional death:
      - In direct relation with anesthetic
      - In relation with interventional procedure
    - Violent death:
      - Trauma, traffic accident, falls, etc.
## Deaths related to anesthesia - 3

<table>
<thead>
<tr>
<th>Method for sampling</th>
<th>ratio</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Interventional death</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Direct role of anesthesia</td>
<td>1/1</td>
<td>281</td>
</tr>
<tr>
<td>– Age &lt; 40</td>
<td>1/1</td>
<td>734</td>
</tr>
<tr>
<td>&gt; 40 and &lt; 75</td>
<td>1/7</td>
<td>923</td>
</tr>
<tr>
<td>&gt; 75</td>
<td>1/11</td>
<td>921</td>
</tr>
<tr>
<td>• Violent death (All cases)</td>
<td>1/10</td>
<td>841</td>
</tr>
<tr>
<td>• Unrelated death in hospital</td>
<td>1/365</td>
<td>500</td>
</tr>
</tbody>
</table>

**Total death certificates analysed** 4200
Deaths related to anesthesia - 4

Analysis of the 4200 death certificates
• 2709 : excluded (no anesthesia/clear other explanation)
• 1491 : questionnaire sent to certifier
• 1452 Responses (97%) analyzed by an expert panel
  – 1217 responses OK
  – 235 responses requiring further informations
    • Second questionnaire + Peer review for 227 (96%)

Deaths not related to anesthesia : 1025
Deaths partially related to anesthesia : 366
Deaths totally related to anesthesia : 53
Deaths related to anesthesia - 5

Results (for the blood transfusion side only…) - _1

In 419 deaths partially or totally related to anesthesia

• Deviations from rules/standard/recommendations
  – Management of hypotension  n = 21  (5%)
  – Post-op management of blood loss  n = 9  (2%)

• Lack of adequate Hb monitoring  n = 150 (36%)
Mechanisms leading to death during anesthesia

Death totally or partially linked with anesthesia

Death associated with failure of correction of blood loss ≈ 100 / year

Lienhart et al 2003
Clinical observation: post operative management of blood loss

- Hip replacement in a 75y old male patient
- Known stenotic coronary pathology
- Hb = 9.8 g/dL at the end of surgery
- Prescription of blood count day 1 post-op:
  - Sample taken at 8 am
  - Blood count result available (1 pm)
  - Patient develops fatal myocardial infarction (2 pm)
  - Blood count (of 8 am) read after: 6.2 g/dL
Deaths related to anesthesia - 6

Results (for the blood transfusion side only…)

National projection (from 1999 data):
• about 100 deaths / year directly related to inadequate blood management
+ Much more deaths partially related to delayed or absent blood transfusion
  – Lack of Hb monitoring
  – Low threshold for transfusion
  – Reluctance to transfuse
Death related to hemorrhage in obstetric

• Maternal Mortality Rate in France:
  – 1989: 18 per 100,000 live births
  – 1999: 9 per 100,000 live births

Hemorrhage was the leading obstetric cause of maternal death (21%).

there are more than 10 deaths per year related to untransfused or incorrectly transfused maternal hemorrhage
Red Cell Concentrates use in France 1986-2005 and risk of undertransfusion

SFAR survey
Dissemination of SFAR survey results
Delayed transfusion of platelets

48y old female, AML5b
Induction chemotherapy since August 11, 2006:
Anti-HLA at entry: anti-B7 (non cytotoxic)

Transfusions:
- August 7: 2 RCC
- August 10: 2 RCC 1 APC
- August 13: 2 RCC 1 APC (low recovery)
- August 14: 1 APC (low recovery)
- August 17: 2 RCC 1 APC (prescr at 1.16pm, delivered 10.15pm)
- August 18: blood count = 1G/L 1 APC prescribed at 11.22 am
  major Haemorrhage at 5pm, APC issued at 5.48 pm
- August 19: death (intracranial haemorrhage)
Immediate incidents notified in France
2000 – 2005      (n = 12,029)

- Bacterial contamination: 45
- TRALI: 63
- ABO incompatibility: 79
- Other: 569
- "under transfusion"?: 600
- Unknown: 818
- Volume overload: 869
- Immunologic incompatibility: 1382
- FNHR: 2081
- Allergy - anaphylactoid: 6123
How to capture undertransfusion?

1. Standard notification through hemovigilance:
   - Data from the French Hemovigilance network since 1994: 7 deaths related to no or delayed blood transfusion!

2. Selection of patients’ files according to criteria:
   - Hb laboratory results
   - And known risk of blood loss

3. Analysis of time from blood count prescription to blood transfusion:
   - In a context of low Hb level
   - In a context of emergency
Selection of patients files according to criteria
Example of selection based on:

- $\text{Hb} < 80 \text{ g/L} + \text{surgery} + \text{Age} > 60$
- 2 consecutive $\text{Hb} < 80 \text{ g/L}$
- Indication for blood transfusion?
- Patient transfused?

Conclusion undertransfusion: yes or no
## Hospital A

### Age of patient

<table>
<thead>
<tr>
<th>Hb</th>
<th>[15-50]</th>
<th>[50-60]</th>
<th>[60-70]</th>
<th>[70-80]</th>
<th>[80-90]</th>
<th>[90-+]</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-+</td>
<td>277</td>
<td>38</td>
<td>24</td>
<td>20</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>11-12</td>
<td>45</td>
<td>10</td>
<td>11</td>
<td>6</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>10-11</td>
<td>32</td>
<td>11</td>
<td>10</td>
<td>22</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>9-10</td>
<td>17</td>
<td>6</td>
<td>9</td>
<td>15</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>8-9</td>
<td>10</td>
<td>6</td>
<td>12</td>
<td>12</td>
<td>14</td>
<td>6</td>
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<tr>
<td>7-8</td>
<td>11</td>
<td>0</td>
<td>3</td>
<td>7</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>6-7</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>0-6</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**undertransfusion**  
G Andreu  EHS Frankfurt 2008 03 01
Orthopedy AND Hb < 9 g/dL AND age > 90

Graphs by NIP

undertransfusion

G Andreu  EHS Frankfurt 2008 03 01
Selection of patients files according to criteria

Example of selection based on time measurements:

- from Blood count prescription to beginning of transfusion

In two different conditions:

- BC prescribed with the mention “emergency”
- BC prescribed for low Hb level with no emergency
Pilot study (emergency): 2 centers, 90 observations
Pilot study (low Hb) : 4 centers, 111 observations

<table>
<thead>
<tr>
<th>Step</th>
<th>Emergency</th>
<th>Low Hb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood count prescription</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood sampling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood sample arrival in lab</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Result available</td>
<td>62'</td>
<td>45'</td>
</tr>
<tr>
<td>BC prescription</td>
<td></td>
<td></td>
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<tr>
<td>Prescription arrival in BTS</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>BC delivered (available)</td>
<td>41'</td>
<td>81'</td>
</tr>
<tr>
<td>BC taken away from BTS</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>BC reception in clinical ward</td>
<td>58'</td>
<td>43'</td>
</tr>
<tr>
<td>Begining of transfusion</td>
<td></td>
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</table>
## Transfusion process quality indicators

<table>
<thead>
<tr>
<th>Step</th>
<th>Actors</th>
<th>Reference</th>
<th>Official (EU) Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Donor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>BE</td>
<td>Guidelines</td>
<td>HV : adverse reactions in donors</td>
</tr>
<tr>
<td>Selection</td>
<td>BE</td>
<td>Guidelines</td>
<td>HV : prevalence of viral markers in donors</td>
</tr>
<tr>
<td>Blood component</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality</td>
<td>BE</td>
<td>GMPs</td>
<td>HV : events</td>
</tr>
<tr>
<td>Safety</td>
<td>BE</td>
<td>GMPs</td>
<td>HV : events</td>
</tr>
<tr>
<td>Availability</td>
<td>BE</td>
<td>Management</td>
<td></td>
</tr>
<tr>
<td>Outdating</td>
<td>BE</td>
<td>Management</td>
<td>?</td>
</tr>
<tr>
<td>Prescription</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Existence of prescription</td>
<td>HOS</td>
<td>Guidelines</td>
<td>?</td>
</tr>
<tr>
<td>Good indication</td>
<td>(BE)</td>
<td>HOS</td>
<td>Guidelines</td>
</tr>
<tr>
<td></td>
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<tr>
<td>Transfusion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compatible</td>
<td>BE</td>
<td>HOS</td>
<td>HV : adverse reactions in recipients</td>
</tr>
<tr>
<td>To the right patient</td>
<td>(BE)</td>
<td>HOS</td>
<td>HV : adverse reaction or event in recipient</td>
</tr>
<tr>
<td>On time</td>
<td>(BE)</td>
<td>HOS</td>
<td>?</td>
</tr>
<tr>
<td>Checked for tolerance</td>
<td>HOS</td>
<td>Guidelines</td>
<td>HV : adverse reactions in recipients</td>
</tr>
<tr>
<td>Checked for efficiency</td>
<td>(BE)</td>
<td>HOS</td>
<td>HV : adverse reactions in recipients</td>
</tr>
</tbody>
</table>
Aknowledgements

Medical and Scientific Direction, EFS
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« Platelet transfusion »
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