Key papers in the field of nutrition
Pharmacist

S. Mühlebach
Key papers in the field of nutrition

Pharmacist

S. Mühlebach
Consultant in Clinical Nutrition
University Hospital „Inselspital“
Berne (Switzerland)
Evaluation of 6 years use of sodium hydroxide solution to clear partially occluded central venous catheters

Suzanne G. Bader\textsuperscript{a}, Petra Balke\textsuperscript{a}, Cora F. Jonkers-Schuitema\textsuperscript{b,\textdagger}, Tirzah A.J. Tas\textsuperscript{b}, Hans P. Sauerwein\textsuperscript{c}

\textsuperscript{a}University of Amsterdam Nutrition & Dietetics, Amsterdam, The Netherlands
\textsuperscript{b}Nutrition Support Team, Academic Medical Center, P.O. Box 22700, 1100 DD Amsterdam, The Netherlands
\textsuperscript{c}Department of Endocrinology and Metabolism, Academic Medical Center, Amsterdam, The Netherlands
Layout

- HPN: challenges and outcome factors
Parenteral Nutrition (PN): risk-benefit

- Effective when indicated
- Complications risks
  - i.v. access
  - Patients partly more fragile (neonates, critically ill)
  - Aseptic preparation (individualisation)
  - Complex pharmaceutical formulation (disperse system with physico-chemical instabilities / incompatibilities)
  - High costs compared to EN
- Multi-professional skills needed (pharmaceutical support)

## HPN complications

<table>
<thead>
<tr>
<th>Episode per catheter year (95% confidence interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catheter sepsis</td>
</tr>
<tr>
<td>Catheter occlusion</td>
</tr>
<tr>
<td>Central vein thrombosis</td>
</tr>
<tr>
<td>Fluid/electrolyte problems</td>
</tr>
</tbody>
</table>

Catheter occlusion 2nd most complication in HPN*

Factors on HPN outcome

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>1yr survival ≈ 90% M. Crohn, ischemic bowel, motility disorders</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1yr survival ≈ 20%: cancer</td>
</tr>
<tr>
<td>Remaining bowel</td>
<td>Permanent intestinal failure, if small bowel &lt; 100cm (adult), &lt; 50cm (child)</td>
</tr>
<tr>
<td>Age (at onset)</td>
<td>Survival: children &gt; middle aged &gt; geriatric</td>
</tr>
<tr>
<td>Experience supervisors</td>
<td>Mortality: early years program &lt;&lt; later program</td>
</tr>
<tr>
<td>Opiate / sedative dependence</td>
<td>Dependent patients more hospital care, more sepsis</td>
</tr>
</tbody>
</table>

From: Howard L. Gastroenterology 2003;124:1651-61
HPN: prevalence

**US (1992)**
HPN ~ 120 per 10^6 inhabitants
- Neoplasm 40%
- M. Crohn 10%
- Mean duration 60 days (!)
- Incidence: 10-20/10^6/yr

**Europe (1997)**
HPN ~ 1-13 per 10^6 inhabitants
- Neoplasm 40%
- Crohn's disease 20%
- Incidence: 1-3/10^6/yr

**The Netherlands**
HPN ~ 5.1 per 10^6 inhabitants
(≈ 100 totally; two centers)
- Short bowel 50%
- Motility disorders 30%
- Others 15%
- Duration 0.5-336 months (mean 38)
(1970-2004 n=290 patients)

N.N., JPEN 2002;26(1 Suppl):1;
J.W. Puntis, Nutrition 1998;14:809
C.F. Jonkers-Schuitema, H.P. Sauerwein
Layout

- HPN: challenges and outcome factors
- Study details
Catheter occlusion: patient's profile

Exclusion from evaluation:
Age <18 y at start HPN
HPN ≤ 3 months

Retrospective information on catheter occlusions
Evaluation over 6 years (1997-2003)

n = 45 patients

17 patients died
12 patients stopped HPN

Table 1 Patient characteristics.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>14</td>
<td>27</td>
</tr>
<tr>
<td>Female</td>
<td>31</td>
<td>69</td>
</tr>
<tr>
<td><strong>Age at initiation HPN</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;40 years</td>
<td>12</td>
<td>27</td>
</tr>
<tr>
<td>40–60 years</td>
<td>29</td>
<td>64</td>
</tr>
<tr>
<td>&gt; 60 years</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td><strong>Diagnosis</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mesenteric thrombosis</td>
<td>19</td>
<td>42</td>
</tr>
<tr>
<td>Septicaemia peritonitis</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Crohn's disease</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Radiation enteritis</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Motility disorder</td>
<td>14</td>
<td>31</td>
</tr>
<tr>
<td><strong>Reason home parenteral nutrition</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short bowel</td>
<td>27</td>
<td>60</td>
</tr>
<tr>
<td>Malabsorption</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>Motility disorder</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>Mechanical obstruction</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td><strong>Type of catheter</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port-a-cath®</td>
<td>33</td>
<td>74</td>
</tr>
<tr>
<td>Pass-port®</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Central venous catheter</td>
<td>11</td>
<td>24</td>
</tr>
</tbody>
</table>
PN: pharmacy-compounded (standard) AiO admixture

Nutrients

- **Na** 100 mmol
- **K** 50 mmol
- **Ca** 5 mmol
- **Mg** 4 mmol

**Stability range:**
- 0-37.5 mmol
- 0-20 mmol (CaCO₃)
- 0-12 mmol

**Components:**
- **750 ml Glucose (40%)**
- **1000 ml Vamin 18 (11.2%)**
- **500 ml LCT Intralipid 20%**
- **P 7.5 mmol**

**Electrolytes:**
- 300 g Glu
- 112 g AA
- 100 g LCT
- Vitamins
- Trace elements

**Heparin lock:**
- 5 ml 100 U

**Shelf life:** 8 days
Central venous catheters:

Landmarks for central vein catheterization:
- The jugular veins
- The subclavian vein
- PICC

Subcutaneous port

From van Gossum et al, LLL Approach to PN 2007
Partial occlusion: NaOH treatment

Partial occlusion:
spontaneous flow 25 - 59 drops/min
(100 ml 0.9% NaCl)

**Catheter evaluated** for mechanical occlusion and malposition.

**Perfused**
10 ml 0.1M NaOH (sterile, pyrogen-free)
rate of 1 ml/h for 10 h
followed by a 2-h lock

**Rinsing** 0.9% NaCl at the same speed for 3 h
quick flush of 20 ml of 0.9% NaCl

All external connections renewed
500 ml 0.9% NaCl given.

**Flow rate measured**
if still below 60 drops/min, procedure repeated (max two extra procedures).
Layout

- HPN: challenges and outcome factors
- Study details
- Results
Results

- 130 occlusions (1 occlusion: 221 FD) in 28 catheters (1-19 per patient)
- 95 (73%) treated with NaOH
- 78% (73/95) effectively cleared (P<0.05; $\chi^2$ test)
- 22% (22/95) failed
- Procedure repeated 1-6 time (mean 2.6)
- **Use extension:** 32 catheters (7-1592 d; mean 328)
  - 66% (21/32) used for > 3 months
- 11 catheters had to be replaced

Slow i.v. administration of 0.1 m NaOH not hazardous (catheter degeneration, lab abnormalities, blood pressure, pulse)
### Risk factors for occlusion

**Table 2** Influence of fat component of the TPN formulation in occluding catheters.

<table>
<thead>
<tr>
<th>Fat in TPN</th>
<th>Feeding days</th>
<th>Occlusions</th>
<th>Incidence/feeding days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>21,575</td>
<td>129</td>
<td>1 at 167</td>
</tr>
<tr>
<td>No</td>
<td>7126</td>
<td>1</td>
<td>1 at 7126</td>
</tr>
</tbody>
</table>

**Table 3** Influence of calcium of the TPN formulation in occluding catheters.

<table>
<thead>
<tr>
<th>Calcium (mmol)</th>
<th>Feeding days</th>
<th>Occlusions</th>
<th>Incidence/feeding days</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5</td>
<td>2553</td>
<td>3</td>
<td>1 at 851</td>
</tr>
<tr>
<td>5–10</td>
<td>13290</td>
<td>55</td>
<td>1 at 242</td>
</tr>
<tr>
<td>&gt;10</td>
<td>12858</td>
<td>72</td>
<td>1 at 179</td>
</tr>
</tbody>
</table>

P < 0.05

RR = 43

RR = 4
Layout

• HPN: challenges and outcome factors
• Study details
• Results
• Discussion and conclusions
Catheter occlusion

• Removal often needed

• Causes:
  – thrombus formation (fibrinolytics: Urokinase®)
  – lipid deposition
  – drug precipitation

Ethanol / HCl disappointing results
NaOH (acts on fibrin and lipids)
highly effective
Occlusion incidence?

Incidence rate:
4.5 /1000 feeding days

Literature
Incidence rate:
0.65-3.17 /1000 FD
(background information?)

CVC complications in 447 patients on home PN: an analysis of over 100'000 catheter days.
Conclusion

We conclude that perfusion of a partial occluded central venous catheter (defined as 25–60 drops/min) used for parenteral nutrition with 0.1M NaOH is safe and gives a significant long-term improvement in catheter care, by preventing total occlusion and operative removal.
Layout

• HPN: challenges and outcome factors
• Study details
• Results
• Discussion and conclusions
• Remarks on occlusion incidence
CVC rinsing and catheter complications

<table>
<thead>
<tr>
<th>Complications</th>
<th>NaCl 0,9%</th>
<th>Heparin</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>14</td>
<td>32</td>
</tr>
<tr>
<td>Removal</td>
<td>7</td>
<td>19</td>
</tr>
<tr>
<td>Infection</td>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>Occlusion</td>
<td>1</td>
<td>8</td>
</tr>
</tbody>
</table>

* All complications
  * AIO PN admixture
  + Na Heparin (0.5 IU/ml)
  (significant droplet aggregation)

Clin Nutr 2002;21:475 (slide offered by PD Dr. Thul, Charité)
Type of catheters

n=447

- Port system
- tunnelled catheter

Complication and type of catheter

- Frequency of complications [%]
  - All complications: 52%
  - Removal: 43%
  - Infection: 27%
  - Occlusion: 25%

- Patients: 447

- Types of catheters:
  - Port
  - Broviac

- Summary:
  - 21% Port, 10% Broviac
  - 15% Port, 2% Broviac