Post-Dural Puncture Headache (PDPH): an update

Dorel Sandesc
August Bier 1898: a personal experience of post dural puncture headache

“Toward the evening I was forced to take to bed and remained there for nine days, because all the manifestations recurred as soon as I got up. At midnight a violent headache set in that quickly became insupportable.”
Dural puncture

- Diagnostic lumbar puncture
  - To measure CSF pressure
  - Withdraw CSF for laboratory analysis
- Myelography (to instill radioopaque dye)
- Intrathecal chemotherapy
- Spinal anesthesia
- Accidental Dural Puncture (ADP) during epidural insertion
Postpartum headache within 6 weeks of delivery

985 women
38.7% reported postpartum headache

- Tension type: 38.4%
- Migraine: 37.4%
- Musculoskeletal: 12.3%
- Undetermined: 8.1%
- PDPH: 4.5%

## Incidence of PDPH -the role of the needle-

<table>
<thead>
<tr>
<th>Needle Type &amp; design</th>
<th>Gauge</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuohy (epidural)</td>
<td>16-18</td>
<td>45-80%</td>
</tr>
<tr>
<td>Quincke</td>
<td>20</td>
<td>16%</td>
</tr>
<tr>
<td>Quincke vs Pencil Point</td>
<td>22</td>
<td>10% vs 1.6%</td>
</tr>
<tr>
<td>Quincke vs Pencil Point</td>
<td>24</td>
<td>6% vs 1.5%</td>
</tr>
<tr>
<td>Quincke vs Pencil Point</td>
<td>25</td>
<td>6% vs 1.1%</td>
</tr>
<tr>
<td>Quincke vs Pencil Point</td>
<td>27</td>
<td>1.5% vs 0%</td>
</tr>
<tr>
<td>Pencil Point</td>
<td>29</td>
<td>&lt;2%</td>
</tr>
</tbody>
</table>
Incidence of PDPH

- other factors -

- Patient related (age, gender etc)
- Technical factors
  - Use of saline instead of air for loss of resistance (LOR)
  - Orientation of epidural needle bevel
  - Needle tip deformation and dural perforation

## Incidence of Accidental Dural Puncture (ADP)

<table>
<thead>
<tr>
<th>Study</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Darvish et al. Acta Anaesthesiol Scand 2011</td>
<td>1% (n≈900)</td>
</tr>
<tr>
<td>Baysinger et al. J Clin Anesth 2011</td>
<td>&lt;2%</td>
</tr>
<tr>
<td>Gungor &amp; Gunaydin Turk J Anesth 2008</td>
<td>1.2% (n=972)</td>
</tr>
</tbody>
</table>
Anatomy of the spinal dura mater -classical-

- the spinal dura mater: collagen fibres running in a longitudinal direction
Anatomy of the spinal dura mater - recent light & microscopic studies -

• collagen fibres arranged in several layers parallel to the surface that do not demonstrate specific orientation

• posterior dura varies in thickness, not predictable within an individual or between individuals

Cerebrospinal fluid

- **Total volume of CSF** $\approx 150$ mL
- **50% in the cranium** (75 ml supraspinal, 75 ml spinal)

- $\approx 450$-500 mL (0.35 mL/min) CSF is produced daily
- **CSF pressure in the lumbar region is**
  - 5 to $15$ cmH$_2$O in the supine position
  - it exceeds $40$ cmH$_2$O in the upright position
Dura mater and response to trauma

• In 1923: deliberate dural defects in the cranial dura of dogs took approximately one week to close.
• 1959: the dural repair was facilitated by fibroblastic proliferation from surrounding tissue and blood clot and NOT fibroblastic proliferation from the cut edge of the dura(1).
• Gormley’s original observation: bloody taps were less likely to lead to a post-dural puncture headache as a consequence of a persistence CSF leak(2).

PDPH: Pathophysiology
-intracranial hypotension-

- Persistent CSF loss through the hole
- Decrease in the CSF volume and/or pressure leading to shift of the intracranial contents and traction on the pain sensitive structures
- Loss of cushion effect

rate of CSF loss  rate of CSF production

0.084-4.5 ml/sec  >  0.0058 ml/sec
(0.35 ml/min)
Ciara McQueirns
"No Really, It's Just A Headache"
PDPH: Pathophysiology -cerebral vasodilatation-

• The Monro–Kellie doctrine: the sum of volumes of the brain, CSF, and intracranial blood is constant

• Decrease in CSF volume: compensatory increase in blood volume (venodilatation) responsible for the headache

Table 1.—The International Classification of Headache Disorders Diagnostic Criteria for Post-Dural Puncture Headache

(A) Headache that worsens within 15 minutes after sitting or standing and improves within 15 minutes after lying, with at least one of the following and fulfilling criteria C and D
- Neck stiffness
- Tinnitus
- Hypacusia
- Photophobia
- Nausea
(B) Dural puncture has been performed
(C) Headache develops within 5 days of dural puncture
(D) Headache resolves either
   1. Spontaneously within 1 week
   2. Within 48 hours after effective treatment of the spinal fluid leak (usually by epidural blood patch)
Differential Diagnosis

- Non-specific headache
- Migraine
- Caffeine withdrawal
- Meningitis
  - chemical or infective
- Headache due to sinusitis
- Drugs like amphetamine, cocaine
- Pneumocephalus
- Preeclampsia
- Pituitary apoplexy
- Cerebral vein thrombosis
- Subdural hematoma
- Intracranial tumour
Emilio Pettoruti’s Futurist Headache
PREVENTION of PDPH

1. Needle tip & designs for preventing PDPH (2013)
2. *Epidural or intrathecal catheter placement techniques for preventing PDPH* (2010)
3. Posture & fluids for preventing PDPH (2013)
1. Needle tip & designs for preventing PDPH

Use of

- atraumatic needles without age limits
- proper needle material
- finer gauge needles in predisposed patients
2. Preventive Catheters Strategies

Epidural catheter replacement and intrathecal catheter techniques for preventing post-dural puncture headache following an inadvertent dural puncture in labour (Protocol)

Newman MJ, Cyna AM, Middleton P

Intra Thecal Catheter

Resiting epidural catheter

THE COCHRANE COLLABORATION®
Does intrathecal catheter placement after wet tap reduce risk of headache?

115 consecutive unintentional dural punctures

<table>
<thead>
<tr>
<th></th>
<th>% PDPH</th>
<th>Blood Patch</th>
</tr>
</thead>
<tbody>
<tr>
<td>A- epidural catheter @ a different space</td>
<td>91.9</td>
<td>81.1</td>
</tr>
<tr>
<td>B- intrathecal catheter removed @ delivery</td>
<td>51.4</td>
<td>31.4</td>
</tr>
<tr>
<td><strong>C- intrathecal catheter left in situ for 24 h</strong></td>
<td><strong>6.2</strong></td>
<td><strong>3.1</strong></td>
</tr>
</tbody>
</table>

Overall incidence: PDPH 46.9% - blood patch 36.5%

Ayad S et al. RAPM 2003;28:512-15
Hieronymus Bosch
47 studies initially included
  10 - Editorials/reviews/surveys
  10 - Case Reports
  6 - Non obstetric patients
21 studies
  7 - IT catheters not for accidental dural punctures
  6 - no control group
8 studies analyzed
**Fig. 2** Intrathecal catheterization and the incidence of postdural puncture headache.

**Fig. 3** Intrathecal catheterization and the need for epidural blood patch.

<table>
<thead>
<tr>
<th>n=29749 regional blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=128 witnessed ADP (0.43%)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Resited epidural catheter (n=39)</td>
</tr>
<tr>
<td>ITC (n=89)</td>
</tr>
<tr>
<td>Odds Ratio = 2.3 (95% Confidence Interval 1.04-4.86, p=0.04)</td>
</tr>
</tbody>
</table>
Intrathecal Catheters: risk of infection?

• However, it appears that limited periods of use (96 h or less) is not associated with either frequent local or spinal infections(1)

• Serious complications are rare in both hospitalized and homebound patients with intrathecal catheters(2)

3. Preventive bed rest and fluids

<table>
<thead>
<tr>
<th>23 trials, n=2477</th>
<th>Bed rest (%)</th>
<th>Early mobilization (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence of PDPH</td>
<td>26.4</td>
<td>20.5</td>
</tr>
<tr>
<td>Severe PDPH</td>
<td>10.6</td>
<td>10.7</td>
</tr>
<tr>
<td>Any headache after lumbar puncture</td>
<td>33.6</td>
<td>28.6</td>
</tr>
</tbody>
</table>

Authors’ conclusions

- **No evidence** for routine bed rest after ADP is **beneficial** for the prevention of PDPH onset
- Role of fluid supplementation in the prevention of PDPH still remains **unclear**
Jean Spietzer.

*Reclining Man With Headache*
4. Drugs, preventive

Drug therapy for preventing post-dural puncture headache
(Review)

Basurto Ona X, Uriona Tuma SM, Martinez-Garcia L, Solà I, Bonfill Cosp X
Coffeine

- Crosses blood brain barrier
- Central nerve system (CNS) stimulant
- Cerebral vasoconstritor
- 300-500 mg oral/iv once/twice daily
  (one coffee: 50-100 mg; 330 ml Coca-Cola: 50 mg)
  - after 4hs, decrease the severity of symptoms
  - after 24 hs, no difference in severity of symptoms
  - no reduction in the EBP need
**Theophylline**
- Methylxantine derivative
- Oral preps are long-acting
- Cerebral vasoconstrictor
- Cardiac problems restrict its use (CNS stimulation)
- Increase CSF production by stimulating the Na-K pumps

**Sumatriptan**
- 5HT$_{1D}$ receptor agonist
- Cerebral vasoconstrictor
- Advocated for migraine
- Expensive
- SC injection (6 mg)
- $t_{1/2} = 2$ h
- ineffective
Honore Daumier
5. Prophylactic Epidural Blood Patch

64 parturients with accidental dural puncture

Prophylactic EBP or Therapeutic EBP

<table>
<thead>
<tr>
<th></th>
<th>PEBP (n=32)</th>
<th>TEBP (n=32)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset of PDPH (d)</td>
<td>2.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Maximum VAPS (0-10)</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Recommended therapeutic EBP (n)</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>Therapeutic EBP performed (n)</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>&gt; 1 Therapeutic EPB (n)</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

No. days with PDPH was less in Prophylactic EPD group

Scavone BM et al. Anesthesiology 2004; 101: 1422-7
Prophylactic vs therapeutic blood patch for obstetric patients with accidental dural puncture – a randomised controlled trial

M. H. Stein,1 S. Cohen,2 M. A. Mohiuddin,3 V. Dombrovskiy4 and I. Lowenwirt5

109 women RCT
Prophylactic blood patch vs conservative management
Intervention: 15-20 ml of blood via catheter 5 hours after LA
Group P, n=60; Group C, n=49

Results: PDPH: 18.3% (P) vs 79.6% (C) p<0.0001
Blood patch in C group: 73.4%
2nd blood patch: 10% (P) vs 11.1% (C)
Migraine Painting by Tim Nyberg
THERAPY

1. Medical Therapy
2. Invasive Therapy

Goals

- Control the vasodilation with cerebral vasoconstrictor drugs
- Replace the lost CSF fluid
- Seal the puncture site
Drugs

- **Gabapentin** 300-400 mg (GABA analog)
  - **Pregabalin** 50 mg (every 8 h for 3 days)
- **Frovatriptan** 2.5 mg oral once for 5 days
- **Caffeine and theophylline**
- **ACTH**
  - increase CSF production via Na active transport mechanism or raise beta endorphine levels
  - 60 units IM or 1.5 unit/kg iv over 1 hour
- **Hydrocortisone** iv 200 mg
Epidural Bloof Patch (EBP)

- **History** (Gormley 1960, DiGiovanni & Dunbar 1970)

- **Plug theory**

- **Pressure patch hypothesis**
EBP

Contraindications of EBP
- Infection on the back
- Sepsis
- Coagulopathy
- Raised white cell count
- Prexia
- Patient refusal

Indication
- Severe and/or failed conservative treatment

Timing
- Beyond 24 h after ADP

Recumbent positioning
- For 2 h after patching may improve the efficacy
Effectiveness of EBP

Prospective observational study, 1988-2000, 504 pts:
- success: 93% (75% complete, 18% incomplete)
- failure: 7%
- success post 2nd blood patch: 97%

Safa-Tisseront et al. Anesthesiology 2001; 95:334-9
The Scream
Edvard Munch
Săndesc D. Monica Lupei. C. Plavat. Conventional treatment or epidural blood patch for the treatment of different etiologies of postdural puncture headache.

*Acta Anaesthesiol Belg 2005, 56(3) : 265-269*

- EBP is a gold standard therapy of PDPH, significantly superior to conventional medical treatment no matter the etiology

- There is no reason to delay the EBP for more than 24 hours

- In our opinion the technique has to be performed at the level of the causative dural puncture or with one space lower

Epidural Fibrin glue (fibrin+thrombin)

- Placed blindly or CT guided
- Risks:
  - infections
  - immune reactions
  - anaphylaxis
  - spinal cord or nerve root compression via mass effect

Crul et al. Anesthesiology 1999
Sachs & Smiley. Sem Perinatol 2014
Neurosurgical Treatment

Successful treatment of post-dural-puncture headache with surgical dura repair two years after spinal anesthesia

Christos D Pouskoulas¹,⁎, Ethan Taub²,⁎ and Wilhelm Ruppen¹

Figure 2. View of the operative field under the microscope
Sărbători Fericite!