An Update on Post-dural Puncture Headache After an Epidural Block

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Disclosure

I have no financial relationships with manufacturers of pharmaceuticals or devices.
The First Spinal Anesthetic

Augustus Bier, a German surgeon, was the first person to use intrathecal cocaine to produce surgical anesthesia.

In a classic paper published in 1899 he described the performance of spinal anesthesia on himself (which because of technical difficulties, failed) and on his assistant Hildebrandt (which was very successful).

These became also the first two described cases of post dural puncture headaches.
PDPH Diagnostic Criteria
International Headache Society

- Develops within 5 days after dural puncture
- Worsens within 15 minutes after sitting or standing and improves within 15 minutes after lying down
- Accompanied by at least 1 of the following:
  - neck stiffness
  - nausea
  - photophobia
  - tinnitus
  - hypoacusia
- Resolves either:
  - spontaneously within 1 week
  - within 48 hours after effective treatment of the spinal fluid leak (i.e. epidural blood patch)

PDPH: Etiology

- Dural puncture with continued CSF leak
- Decreased intracranial pressure
- Presumed vascular expansion as intracranial pressure drops
Risk factors for PDPH

- Large bore needles
- Multiple attempts (multiple holes in dura)
- Young adults > older adults
- Adults > children
- Females > males
- Cutting tip needles > pencil tip needles
- History of migraines, chronic HA, previous PDPH
- ? Diagnostic LP > spinal anesthesia

1954 Dripps & Vandam

10,098 spinals, 8460 patients
Every spinal Univ. Penn from 1948-1951

<table>
<thead>
<tr>
<th>% of Pts</th>
<th>PDPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>All patients</td>
<td>14%</td>
</tr>
<tr>
<td>Females</td>
<td>56.2</td>
</tr>
<tr>
<td>Males</td>
<td>43.8</td>
</tr>
<tr>
<td>16 G needle</td>
<td>9</td>
</tr>
<tr>
<td>19 G needle</td>
<td>2</td>
</tr>
<tr>
<td>20 G needle</td>
<td>29</td>
</tr>
<tr>
<td>22 G needle</td>
<td>53</td>
</tr>
<tr>
<td>24 G needle</td>
<td>7</td>
</tr>
</tbody>
</table>
Needle Type and PDPH After Spinal

The type of needle point affects headache rate:

1951: Hart & Whitacre reported lower headache rates with new pencil point needle
1987: Sprotte describes 34950 procedures with new 24G & 22G Sprotte needles with headache rate of 0.02%

There have been many studies comparing one or more types of pencil-point spinal needles with Quincke point needles that have consistently shown lower PDPH with pencil-point spinal needles

Quincke and Sprotte Dural Punctures

Strupp et al. 2001 Neurology 57: 2310
Proposed Methods to Reduce Accidental Dural Puncture and Post-Dural Puncture Headache

- Air vs saline for loss-of-resistance medium
- Combined Spinal-Epidural (CSE) vs epidural
- Orientation of needle bevel
- Epidural needle design
- Ultrasound-guided insertion
- Conversion to continuous spinal anesthesia
- Prophylactic epidural blood patches

Drug Therapies to Treat or Prevent PDPH

- Analgesics
- Caffeine
- Theophyline
- Sumatriptan
- Cosyntropin (ACTH)
- Epidural morphine
Prevention of PDPH in Parturients

- 2012 Meta-analysis:
- 40 RCTs (n=11,536 epidural insertions) studying different methods to reduce PDPH
  - combined spinal–epidurals (CSEs)
  - loss of resistance medium
  - prophylactic epidural blood patches
  - needle bevel orientation
  - different types of epidural needles
  - ultrasound-guided insertion
  - administration of cosyntropin (ACTH)
  - continuous spinal analgesia (wet-tap → CSA)

Bradbury et al. 2012 Acta Anaes Scand (eprint ahead of publ)

Effect of Interventions

Reduced incidence of ADP
  None found

Reduced incidence of PDPH
  Prophylactic blood patch
  Lateral orientation of the needle bevel during insertion
  Use non cutting point epidural needle
  Epidural morphine
  Administration of cosyntropin

No statistically significant reduction of either ADP or PDPH
  CSE
  Medium used for loss of resistance technique
  Ultrasound or acoustic device to assist epidural insertion
  Continuous spinal analgesia
Five methods reduced PDPH

1. Prophylactic epidural blood patch
   4 trials of varying quality

2. Lateral orientation of needle bevel on insertion*
3. Pencil-tip epidural needles*
4. Epidural morphine*
5. Cosyntropin (ACTH)*
   * each based on a single RCT

Converting to CSA After ADP

Bradbury et al. 2012 meta analysis found no benefit to converting to CSA, based on a single RCT (Russell 2012).

In another (simultaneous) meta analysis (Heesen et al. 2013), found a benefit. It included 9 studies:
   2 RCT (including Russell 2012)
   7 where allocation was not random
**RCT Protocol (Russell 2012)**

- 19 Maternity units in UK
- Randomized by maternity unit; reversed in yr 2
- 97 women with accidental dural puncture (ADP)
- Randomized to:
  - repeat epidural
  - threading catheter through dural puncture for CSA

<table>
<thead>
<tr>
<th></th>
<th>Repeat Epid</th>
<th>CSA</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients with ADP</td>
<td>47</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Developed PDPH</td>
<td>62%</td>
<td>72%</td>
<td>ns</td>
</tr>
<tr>
<td>Received EBP</td>
<td>55%</td>
<td>50%</td>
<td>ns</td>
</tr>
</tbody>
</table>

**Conversion to CSA: Effect on PDPH**


Intrathecal catheterization and the incidence of postdural puncture headache.
Conversion to CSA: Effect on EBP

Meta analysis by Heesen, et al. 2013

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>ITC Event</th>
<th>Control Event</th>
<th>Total Event</th>
<th>Weight</th>
<th>Risk Ratio M-H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arad*</td>
<td>12</td>
<td>66</td>
<td>30</td>
<td>37</td>
<td>0.22 [0.13, 0.36]</td>
</tr>
<tr>
<td>Cohen**</td>
<td>5</td>
<td>30</td>
<td>3</td>
<td>15</td>
<td>3.6% [0.23, 3.03]</td>
</tr>
<tr>
<td>Kau†</td>
<td>16</td>
<td>60</td>
<td>52</td>
<td>162</td>
<td>12.9% [0.52, 1.34]</td>
</tr>
<tr>
<td>Norris**</td>
<td>4</td>
<td>35</td>
<td>4</td>
<td>21</td>
<td>3.6% [0.17, 2.19]</td>
</tr>
<tr>
<td>Paech†</td>
<td>10</td>
<td>24</td>
<td>41</td>
<td>51</td>
<td>11.7% [0.32, 0.85]</td>
</tr>
<tr>
<td>Russell†</td>
<td>37</td>
<td>57</td>
<td>32</td>
<td>58</td>
<td>14.4% [0.80, 1.23]</td>
</tr>
<tr>
<td>Rutter†</td>
<td>17</td>
<td>34</td>
<td>27</td>
<td>37</td>
<td>13.7% [0.46, 1.01]</td>
</tr>
<tr>
<td>Spiegel†</td>
<td>54</td>
<td>102</td>
<td>32</td>
<td>52</td>
<td>15.0% [0.65, 1.14]</td>
</tr>
<tr>
<td>Walters†</td>
<td>25</td>
<td>63</td>
<td>34</td>
<td>59</td>
<td>14.0% [0.47, 1.00]</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>471</td>
<td>492</td>
<td>100.0%</td>
<td>0.64 [0.49, 0.84]</td>
<td></td>
</tr>
<tr>
<td>Total events</td>
<td>170</td>
<td>255</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 0.10; Chi² = 23.04, df = 8 (P = 0.003); I² = 65%
Test for overall effect: Z = 3.10 (P = 0.001)

Intrathecal catheterization and the need for epidural blood patch.

RCTs of PEBP

- Previous studies lacked randomization, blinding, proper protocols to prevent bias and power of suggestion.
- 3 Randomized controlled trials of PEBP in OB patients.

Prophylactic Epidural Blood Patch
Ackerman et al. 1990

- Randomized, controlled, partially blinded (observer but not subject) trial
- 21 OB patients with ADP
- PEBP via catheter as it was removed after labor
- After 24 hrs offered therapeutic EBP

<table>
<thead>
<tr>
<th></th>
<th>PEBP</th>
<th>Control</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed PDPH</td>
<td>1 / 10</td>
<td>7 / 11</td>
<td>0.02</td>
</tr>
<tr>
<td>Received EBP</td>
<td>1 / 10</td>
<td>5 / 11</td>
<td>ns</td>
</tr>
</tbody>
</table>

Prophylactic Epidural Blood Patch
Colonna-Romano & Shapiro, 1989

- Randomized controlled unblinded trial
- 39 OB patients with ADP
- 15 ml PEBP via catheter as it was removed vs oral hydration & bedrest.

<table>
<thead>
<tr>
<th></th>
<th>PEBP</th>
<th>Control</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed PDPH</td>
<td>4 / 19</td>
<td>16 / 20</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Received EBP</td>
<td>3 / 19</td>
<td>7 / 20</td>
<td>ns</td>
</tr>
</tbody>
</table>
Prophylactic Epidural Blood Patch
Scavone et al. 2004

- Randomized controlled double-blinded trial
- 64 OB patients with ADP
- 15 ml PEBP via catheter vs sham injection.
- Standardized criteria to determination need for EBP

<table>
<thead>
<tr>
<th></th>
<th>PEBP</th>
<th>Control</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed PDPH</td>
<td>18 / 32</td>
<td>18 / 32</td>
<td>ns</td>
</tr>
<tr>
<td>Received EBP</td>
<td>11 / 32</td>
<td>15 / 32</td>
<td>ns</td>
</tr>
</tbody>
</table>

Prevention of PDPH in Parturients
Bradbury 2012 Meta-analysis, in the section:
Does prophylactic EBP reduce PDPH?

Included four studies:
3 RCT’s (Ackerman, Colonna-Romano, Scavone)
1 abstract of a study still unpublished
  Found an effect that appeared both
  “statistically and clinically significant”.

If abstract removed from analysis:
  No statistical difference.
Cochrane 2010 Meta-analysis

Another earlier meta-analysis that concluded there was a benefit of prophylactic blood patch

- 6 trials involving 265 subjects (incl. 4 in Bradbury analysis)
- Not restricted to OB or accidental dural puncture
- Prophylactic epidural blood patch decreased PDPH.
- Severe PDPH was comparable with or without prophylactic epidural blood patch.

- Boonmak & Boonmak 2010 Cochrane Database of Systematic Reviews 2010: CD001791

Effect of epidural needle type on PDPH

- Prospective RCT to epidural catheter insertion with a 17G Tuohy or 18G Special Sprotte® needle.
- 1077 parturients requesting epidural analgesia at 3 tertiary obstetrical units, randomized between 2 needles
- No difference in patient variables, technique variables, or PDPH characteristics.

Epidural Sprotte® needle (aka Special Sprotte®)

Accidental dural punctures (ADP)

<table>
<thead>
<tr>
<th>Group</th>
<th>Tuohy (n = 537)</th>
<th>Sprotte (n = 532)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADP</td>
<td>10 (1.9%)</td>
<td>18 (3.4%)</td>
<td>NS</td>
</tr>
<tr>
<td>Recognized ADP</td>
<td>8 (80%)</td>
<td>11 (61%)</td>
<td>NS</td>
</tr>
<tr>
<td>“Unrecognized ADP”</td>
<td>2 (20%)</td>
<td>7 (39%)</td>
<td>NS</td>
</tr>
</tbody>
</table>

Incidence of PDPH and EBP after ADP

<table>
<thead>
<tr>
<th>Group</th>
<th>Tuohy (n = 10)</th>
<th>Sprotte (n = 18)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed PDPH</td>
<td>10 (100%)</td>
<td>10 (55.5%)</td>
<td>0.025*</td>
</tr>
<tr>
<td>PDPH after CSF seen</td>
<td>8 (100%)</td>
<td>3 (27.2%)</td>
<td>0.003*</td>
</tr>
<tr>
<td>Received EBP</td>
<td>7 (70%)</td>
<td>3 (16.6%)</td>
<td>NS</td>
</tr>
</tbody>
</table>

Special Sprotte needle: trend to more ADP but with lower PDPH rate

Morley-Forster et al. 2006 Can J Anaesth; 53: 572

Users Preferred Tuohy

<table>
<thead>
<tr>
<th>Group</th>
<th>Tuohy (n = 537)</th>
<th>Sprotte (n = 532)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>User satisfaction (% satisfied)</td>
<td>84.7 ± 17.3</td>
<td>68.2 ± 25.3**</td>
<td></td>
</tr>
<tr>
<td>Insertion attempts (n)</td>
<td>1.4 ± 0.8</td>
<td>1.4 ± 0.7</td>
<td></td>
</tr>
<tr>
<td>Excellent loss of resistance to air (%)</td>
<td>66.6</td>
<td>36.8**</td>
<td></td>
</tr>
<tr>
<td>Paresthesia (catheter insertion %)</td>
<td>2.2</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>Blood in needle (%)</td>
<td>8.7</td>
<td>6.3</td>
<td></td>
</tr>
<tr>
<td>Failed blocks (%)</td>
<td>2.8</td>
<td>7.0**</td>
<td></td>
</tr>
<tr>
<td>Switched needles (%)</td>
<td>0</td>
<td>3.2**</td>
<td></td>
</tr>
</tbody>
</table>

**P < 0.001
Epidural Morphine Decreases Rate of PDPH

- 50 OB patients with recognized ADP
- Epidural morphine 300 mg q 24 hr x 2 before catheter removed.

<table>
<thead>
<tr>
<th></th>
<th>Epid MS</th>
<th>Control</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed PDPH</td>
<td>3 / 25</td>
<td>12 / 25</td>
<td>0.014</td>
</tr>
<tr>
<td>Received EBP</td>
<td>0 / 25</td>
<td>4 / 25</td>
<td>?</td>
</tr>
</tbody>
</table>

Intravenous ACTH Decreases Rate of PDPH

- 90 OB patients with recognized ADP
- 30 minutes after delivery and catheter removal, patients randomized to 1 mg cosyntropin (synthetic ACTH) [iv] vs placebo.

<table>
<thead>
<tr>
<th></th>
<th>ACTH</th>
<th>Control</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed PDPH</td>
<td>15 / 45</td>
<td>31 / 45</td>
<td>0.001</td>
</tr>
<tr>
<td>Received EBP</td>
<td>5 / 45</td>
<td>13 / 45</td>
<td>0.035</td>
</tr>
</tbody>
</table>
Drug Therapy to Treat PDPH

2011 Cochrane meta-analysis of RCTs assessing any pharmaceutical treatment of PDPH.

- 7 RCTs, 200 subjects, mostly spinal anesthesia.
- Caffeine (iv or po), gabapentin, theophylline showed evidence of pain relief vs placebo.
- Hydrocortisone + conventional treatment was better than conventional treatment alone.

- Basurto Ona et al. 2011, Cochrane Database of Systematic Reviews 2011: CD007887

Oral Caffeine

Camann et al. 1990 Anes Analg 70:181

- 40 Post-partum patients with PDPH
- 29/40=26G Quincke, 11/40=17G epidural
- Oral capsule of 300 mg caffeine or placebo

<table>
<thead>
<tr>
<th>Number of patients better or worse at 4 hours</th>
<th># WORSE</th>
<th># BETTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caffeine</td>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td>Placebo</td>
<td>8</td>
<td>12</td>
</tr>
</tbody>
</table>

\[ \Delta VAS 4hr \quad VAS 24 hr \quad EBP \]

\[ -36.1 \pm 5.5 \quad 41 \pm 8 \quad 35\% \]

\[ -10.9 \pm 6.7 \quad 31 \pm 10 \quad 55\% \]

P=0.014 \quad P=ns \quad P=ns
Best Volume of Blood for EBP

• What is the best volume of blood to use?
• Gormley (1960) had 100% success with 2-3 ml
• Numerous observational studies found volumes from 7.5-20 ml to be effective, some claiming better success with larger volumes.
• Larger volumes may be more associated with back pain on injection.
• Randomized controlled trials are few.

Volume of Epidural Blood Patch

• RCT; 121 OB patients in 10 centers with ADP who developed PDPH randomized to EBP with 15, 20, or 30 ml autologous blood.
• Similar efficacy between groups. Pain scores were better in the 20 and 30 ml groups, but the 95% confidence intervals overlapped.

• Paech et al. 2011, Anesth Analg 113:126
Headache Relief by EBP

\[ P = 0.01 \text{ for group 15 mL versus groups 20 and 30 mL.} \]

Summary: What Works

To Avoid ADP:
- No technique changes the rate

To Lessen the rate of PDPH:
- *Maybe* prophylactic EBP
- *Maybe* threading catheter for CSA
- *Maybe* using Sprotte epidural needle
- *Maybe* epidural morphine or iv ACTH
- Caffeine gives some temporary relief
- Therapeutic EBP works well.
- EBP with 20 ml gives maximum benefit.