Neurological Complications of the Parturient

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Neurological injury

- Pre-existing pathophysiological condition
- Complication of labor
- Complication of neuraxial anesthesia
- Pathophysiological condition induced by pregnancy
Most Common Neurological Issues

- **Antepartum**
  - Headache
  - Seizures
  - Pre-existing neuropathies

- **Postpartum**
  - Headache
  - Seizures
  - Lower back pain
  - Lower extremity numbness

Obstetric neuropathy 1-9 out of every 1,000 births
Physiological Changes of Pregnancy

- **Blood Volume**: 40-50% (HTN)
- **Estrogen**: stimulates clotting factors
- **Progesterone**: enhances venous distensibility/vessel leakage
Neurological changes

Cerebral vascular resistance

Cerebral blood flow (22% 3\textsuperscript{rd} trimester)

Headaches

- Primary disorder (20%)
- PDPH (81%) after accidental dural puncture
  - accidental dural puncture (0.6%-1.3%)
- Intracranial hypotension
- Subdural placement of catheter
- Pseudotumor cerebri (primary idiopathic intracranial hypertension)
- CNS disorders
  - Pneumocephalus
  - Cerebral venous thrombosis
  - Subdural hematoma
  - Posterior reversible encephalopathy syndrome

Case One

Healthy 28-year-old primagravida
Epidural attempted, dural puncture
Intrathecal catheter placed
Good analgesia

DC’d 24 hours after delivery
6 hours later postural headache
Placed blood patch
Discharged home next day, 3 days later headache returns
Another blood patch relieves headache
2 days later headache returns—stronger & more progressive (worse when standing + N/V + diplopia)
International Headache Society
Definition of PDPH

Bilateral
Develops within 7 days of lumbar puncture
Worsens within 15 minutes of upright position
Improves within 30 minutes of horizontal position

PDPH develops in more than 50%

Post-dural puncture headache

At risk population: larger needles, cutting needle, youth, pregnant

Symptoms: frontal occipital headache that worsens with standing/sitting and gets better when lying

Associated symptoms:
- Pain radiating to neck, photophobia, neck stiffness, nausea, diplopia, tinnitus
Blood patch issues

Volume of blood?
Pt activity at home?
Multiple attempts?

Success of epidural blood patch
First blood patch 60-70%
Second blood patch >90%

If two were unsuccessful then need further investigation/neurological consult

Prevention of PDPH after ADP

Conservative measures are often not effective

Common interventions studied to minimize risk of PDPH:

- Epidural morphine (3mg after delivery, 3mg before catheter removal)
- Prophylactic blood patch (5-20 mL)
- Intrathecal catheter placement (24 hours)
- Dexamethasone (8-10 mg)
- Cosyntropin (1mg IV)

Interventions may be helpful, but underpowered and/or poorly studied with results that have not been reproducible.


Cosyntropin 1 mg IV

RCT, N=95
Cosyntropin or 0.9% saline given 30 minutes after delivery/epidural DC’d.
All PDPH were managed conservatively for 48 hours, then EBP, a second EBP was performed after another 24 if needed
Cosyntropin (33%) suffered PDPH vs control (69%) [P= 0.001]

Hakim. Cosyntropin for prophylaxis against PDPH after ADP. Anesthesiology, 2010;113(2): 413-420
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Diplopia: Abducens Nerve Palsy

CT → bilateral subacute SDH
MRI → right parietal cortical venous thrombosis

Cerebral venous sinus thrombosis

Rare
Third trimester/postpartum
Underlying thrombophilia?
Headache progressively worse or sudden thunderclap headache

Incidence is higher in underdeveloped countries due to higher frequency of poor nutrition and increased risk of CSF hypotension

Edlow, et al. (2013). Lancet 12, 175-185
Cerebral Venous Thrombosis
CVT

Incidence: 1:10,000 – 1:25,000 or
(0.0001% – 0.00025%)

65% cases pregnancy-related

Most common in postpartum

Venous sinus damage from ICP flux

Pregnancy-induced hypercoagulable state

Often preceded by an intense H/A (thunderclap)


CVT Symptoms

*Positional H/A
Dizziness
Nausea/vomiting
Blurred vision
*One-sided weakness
Lethargy
*Seizures
Coma

*Significant and commonly observed CVT symptoms
Case Two

Pneumocephalus
Air vs saline?

Most frequently cited complications

- Difficult catheter insertion
- Paresthesia
- Intravascular catheter insertion
- Accidental dural puncture
- PDPH
- Patchy block
- Dilute local anesthetics
- Slow onset of local anesthetics

No significantly different complication rate between the 2 techniques

*Focus on measures to reduced severity of PDPH once dural puncture occurs*


Pneumocephalus

Air LOR
Acts as a space-occupying lesion
Headache, sore/stiff neck, nausea/vomiting, blurred vision, tinnitus, dizziness, seizures, depressed LOC
Pneumocephalus

Volume of air (3-40 mL)
Immediate or delayed

Classic symptoms
Sudden severe H/A
Often shooting from neck to forehead
Not necessarily postural in nature
Diplopia
Dilated pupils
Neuro changes
Motor deficits

(Resolves after air absorption and conservative treatment)

Kowe & Waters, Neurology Clinics, 2012
Reversible Cerebral Vascular Syndrome

First reported in 1988
Also, known as postpartum angiopathy
(within 1 week after delivery)
Call-Fleming syndrome
8-39% also have PRES
Abrupt onset thunderclap headache
(associated with photophobia)

Edlow, et al. (2013). Lancet 12, 175-185
Posterior reversible encephalopathy syndrome

Accompanies eclampsia, HTN, renal disease, sepsis

Postpartum

Headache, seizures, visual disturbances (diplopia)

Vasogenic edema

MRI → focal edema

Edlow, et al. (2013). Lancet 12, 175-185
Case Three
Epidural catheter within subdural space

Subdural injection characteristics


Lessons Learned?

Other types of postpartum headaches:

- Primary (migraines, tension)
- Secondary (CVT, reversible cerebral vasoconstriction syndrome, stroke, intracranial hematomas, meningitis, tumors, posterior reversible encephalopathy syndrome (PRES))

Additional Lessons:

- Detailed neurological evaluation for a failed epidural blood patch
- Progressively worse headache (thunderclap?)
  - Look for diplopia or blurred vision
- Air or saline used for epidural placement?

Edlow, et al. (2013). Lancet 12, 175-185
Neuraxial Hematoma

32 year-old membranes spontaneously ruptured, repeat C-section SAB placed without incident 3rd day postoperatively → lower back pain and worsening lower extremity weakness Emergency laminectomy/evacuation hematoma

Incidence Epidural Hematoma < 1 in 150,000
Incidence even lower in the obstetric population
Neuraxial hematomas in obstetric patients occur with existing coagulopathies
Epidural hematomas occur in setting of INR > 1.5 when catheter inserted/DC’d

Madjugiri, et al. BMJ Case Reports, October 29, 2012
Epidural hematoma

1: 150,000 to 1: 200,000

Suspect if:

• Longer lasting epidural
• Unusual back pain/tenderness
• Persistent numbness
• Motor weakness
• Sphincter dysfunction

Epidural abscess
1:500,000

Meningitis
1: 39,000

Case Four

30-year-old female G3P2 scheduled for a repeat C-section under SAB
27g pencil tip inserted L₂-L₃
Pt complained of pain down right leg
Good CSF flow (no pain on injection)
8 hours later complained of throbbing pain radiating down right leg with weakness, toe paresthesia, and numbness on whole of right leg.
MRI→ no abnormality, but small syrinx
Conus medullaris lesion
Resolved 3 months later
Conus Medullaris

80% population cord ends at L₁
20% population cord ends at L₂

- Cord may extend as low as L₃
- No constant relationship to iliac crest lining up with L₄
- At level of the conus nerve roots form a lattice in close proximity to the cord with arachnoid membrane

Neuraxial complications

Damage to conus medularis

Pain with needle placement and/or injection

<table>
<thead>
<tr>
<th>Size of needle (G)</th>
<th>Presumed level and details of insertion</th>
<th>Dose of hyperbaric bupivacaine 0.5%</th>
<th>Outcome of block</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>L₂–₃; free flow of CSF</td>
<td>2.5 ml with fentanyl 12.5 μg</td>
<td>Good</td>
</tr>
<tr>
<td>25</td>
<td>L₂–₃; free flow of CSF</td>
<td>2.6 ml</td>
<td>Good</td>
</tr>
<tr>
<td>25</td>
<td>L₂–₃; CSF after needle withdrawn</td>
<td>2.0 ml with fentanyl 25 μg</td>
<td>T₄</td>
</tr>
<tr>
<td>25</td>
<td>L₂–₃; CSF after needle withdrawn; pain on injection</td>
<td>3.0 ml</td>
<td>Incomplete on left side</td>
</tr>
<tr>
<td>26</td>
<td>L₂–₃; free flow of CSF</td>
<td>2.5 ml</td>
<td>T₄-₆</td>
</tr>
<tr>
<td>25</td>
<td>L₂–₃/L₃–₄ (uncertain); no recorded difficulty with insertion</td>
<td>2.3 ml with fentanyl 25 μg</td>
<td>T₄</td>
</tr>
<tr>
<td>27</td>
<td>L₁–₂/L₂–₃; difficult insertion</td>
<td>3.0 ml</td>
<td>Good</td>
</tr>
</tbody>
</table>

^
^ed of pain on insertion of the spinal needle. CSF, cerebrospinal fluid. Sanders T₁₁–₁₂ later confirmed. linik L₁–₂ later confirmed.
Lessons Learned:

Always respect a paresthesia
Double check level
See if there is a lower interspace
Watch angular orientation of needle
Replace stylette before removal to ensure nerve tissue pushed away from bevel

Case Five
Postpartum nerve injuries

0.008%-0.5%

0.92%

Sanford (2013) had 2,524 deliveries

That’s potentially 23 nerve injuries in one year!

Wong et al. Best Practice & Research Obstetrics Gynecology, 2010;24:367-381
Postpartum nerve injuries

Anesthesia-related
- Direct trauma
- Low conus medullaris
- High needle placement
- Cord trauma
- Dural puncture (CN VI, VIII)
- Traumatic catheterization
- Indirect trauma
- Abscess, hematoma

Nulliparity
- Morbid obesity
- T2DM
- Neuromuscular disease

Prolonged 2\textsuperscript{nd} Stage Labor
- Instrumentation
- Pushing time
- Thigh flexion, abduction,

Postpartum Neurological deficits
Contributing factors

Instrumental delivery
Short stature
Prolonged labor
Primiparity
Persistent transverse/posterior fetal position
Prolonged lithotomy during labor

Postpartum Neurological Deficits

Neuraxial causes

- Direct trauma to cord
  - low conus medullaris
  - traumatic catheterization
  - high needle placement

- Indirect trauma
  - hematoma
  - abscess

- Meningitis
- Spinal cord ischemia
- Cauda equina syndrome
- Others
  - Dural puncture/CSF leak
  - Total spinal block
  - Back pain
  - Seizures (systemic toxicity)
  - Pneumocephalus
At risk for peripheral nerve injury

No superior technique/Avoid high injection pressures

Be aware of comorbid conditions increasing nerve injury risk:

• Diabetes
• Severe peripheral vascular disease
• Chemotherapy
• Multiple sclerosis
• Paresthesia elicited
• Nulliparity
• Labor progress
• Obesity

10-27 per 10,000 deliveries
Back Pain

SAB 15%
Epidural 30%
Pain is self-limiting
Early symptom of epidural hematoma/abscess
Causes: multiple attempts/ligamentous injury, periosteal trauma, local inflammation
## Birth Trauma (Obstetric Palsies)

<table>
<thead>
<tr>
<th>Palsy</th>
<th>Manifestations</th>
<th>Possible Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral femoral cutaneous (L2-L3)</td>
<td><strong>Sensory:</strong> Anterolateral thigh numbness</td>
<td>Prolonged pushing in lithotomy</td>
</tr>
</tbody>
</table>
| Femoral (L2-L4)              | **Sensory:** Anterior thigh/medial leg/calf & foot numbness  
**Motor:** weak hip flexion & knee extension, patellar reflex | Prolonged pushing with hips excessively flexed       |
| Lumbosacral plexus (L1-S4)   | **Sensory:** Lateral leg and dorsum foot  
**Motor:** foot drop                                  | Fetus head against posterior rim of pelvic bone, forceps delivery |
| Common peroneal              | **Sensory:** Anterolateral leg and dorsum foot  
**Motor:** foot drop                                  | Prolonged pushing in lithotomy; mother’s hands on lateral knees |
| Obturator (L2-L4)            | **Sensory:** Inner thigh and knee numbness          | Fetal head compression on lateral pelvic wall, forceps delivery |
Lateral Femoral Cutaneous
Meralgia Paresthetica
Lateral aspect of thigh
Burning, uncomfortable pain, tingling, numbness
No motor involvement
Femoral

Femoral and Obturator Nerves

- Sensory distribution


Peroneal Neuropathy

Foot Drop

The deep peroneal nerve gives innervation to the tibialis anterior muscle of the lower leg which is responsible for dorsiflexion of the ankle.
Obturator

Numbness/pain over groin
Adductor weakness
Months to resolve
Metabolic Neuropathies

B₁₂ deficiency post-bariatric surgery
Thyroid disorders
Diabetes

Lower extremity limb weakness (calves)
Case Six

- 25 year-old G2P1, 39 weeks
- Active labor
- Epidural placed without problem
  - Test dose 3mL (1.5% lidocaine with epi)
  - 10 mL bolus then gtt started at 8 mL/hr
- An hour later the OB nurse calls
  - Left side face “feels funny”
  - Miosis/ptosis
Horner’s syndrome after epidural

• Incidence greater in parturients
• Constellation of symptoms
  • Miosis
  • Ptosis
  • Anhydrosis
  • Ipsilateral facial flushing
  • Sympathectomy
• Mean time of onset: 25 minutes post-insertion
• Mean duration: 3.5 hours

Bell’s palsy

0.017% pregnancy and puerperium
50% recovers within weeks - months

Damage to CN VII
- Begins/worsens over 3-5 days
- Associated with
  - T2DM
  - Increased BP
  - Trauma
  - Toxins
  - Lyme disease
  - Guillian-Barre
  - Sarcoidosis
  - Myasthenia gravis
  - Infection

Symptoms:
- Loss feeling
- Headache
- Tearing
- Drooling
- Taste change
- Hypersensitive to sound
- Cannot close eye on affected side

Klein, Clinical Obstetrics & Gynecology, 56(2), June 2013, 382-388
Post-Partum Assessment

Timing/onset of symptoms?
Location/severity of symptoms?
Are the symptoms progressing/regressing?
Do they radiate?
Did the patient receive neuraxial anesthesia?
Was there any paresthesia with neuraxial placement?
Was there full recovery from neuraxial anesthesia?
What was the duration of labor?
How long was the patient pushing in lithotomy?
Was any instrumentation used?

Visual changes
Back pain
Injection site
Signs of infection
Laboratory values
Medications
Pre-existing co-morbidities
Carpal Tunnel Syndrome

Numbness/tingling over hand/thumb
Pain increased at night
Not always relieved after pregnancy

Klein, Clinical Obstetrics & Gynecology, 56(2), June 2013, 382-388
Liability and OB Anesthesia

37% claims were for minor injuries (e.g., headache, pain during anesthesia, back pain and emotional distress)
21% claims were for nerve injuries

Keeping everyone happy can be difficult...
Thank you!
Headaches and Preeclampsia connection

80% complain of headache
“shining forth”
flashing lights
A. Pregnant and post-partum women with acute neurological symptoms

1. Are they identical to pre-pregnancy neurological symptoms?
   - Yes: Treat as before, and carefully monitor response
   - No: Isolated headache?
     - No: Headache plus seizures, visual symptoms, motor deficits, or altered consciousness or neurological signs
     - Yes: Symptoms and signs consistent with typical prepurum eclampsia?
       - No or postpartum: Go to part C
       - Yes: Treat for eclampsia and carefully monitor response

B. Pregnant and post-partum women with isolated headache

1. Symptoms identical to pre-existing primary headache syndrome or compatible with pure pre-eclampsia or postdural puncture headache?
   - Yes: Treat likely cause and monitor response
   - No: Red flags
     - Is this a thunderclap headache, or one that is new, unusual, or unique to the patient?
     - Is there a change in headache pattern for this patient?
     - Does the patient have previous cerebrovascular disease?
     - Is the blood pressure raised?

C. Patients with other neurological symptoms or signs (with or without headache and not thought to be pure eclampsia), or eclamptic patients not responding to treatment

Additional considerations for post-partum patients
Primary headache is still the most common cause
If a spinal anaesthetic was used, consider postdural puncture headache (or subdural haematoma complicating postdural puncture headache)
Eclampsia can occur up to 6 weeks post partum

C Patients with other neurological symptoms or signs (with or without headache and not thought to be pure eclampsia), or eclamptic patients not responding to treatment

Appropriate consultations
Neurology and obstetrics
In some cases: critical care, neurosurgery, haematology, or endocrinology
Consider transfer to specialised centre

Advanced neuroimaging
Most of these patients will need both brain and cerebrovascular imaging by MRI!

Differential diagnosis
Eclampsia
CVT
Stroke (infarct or haemorrhage)
SAH
RCVS
PRES
Subdural haematoma

Rare conditions
Choriocarcinoma
Amniotic fluid and air embolism
Pituitary apoplexy
Thrombotic thrombocytopenic purpura
Wernicke’s encephalopathy

Non-contrast brain CT or MRI

Negative or non-diagnostic

Positive

Thunderclap headache?

Yes
Treat diagnosis (might need further imaging)

No

Do lumbar puncture

Negative

Advanced imaging for CVT, PRES, RCVS, eclampsia, dissection, and other diagnoses

Positive

Further imaging and treatment based on lumbar puncture results

Other steps
Laboratory tests including complete blood count, platelet count, uric acid, and liver function tests
MRA/CTA might be falsely negative early in RCVS
Discuss with radiologist to perform the correct sequences

Pre-eclampsia (2-8% all pregnancies)

Defined: new onset HTN and proteinuria after 20 weeks in a previously normotensive woman

Mild: BP > 140/90 and proteinuria > 3g/24h

Severe: BP >160/110 (2 times > 6h apart) and proteinuria > 5g/24h

Edlow, et al. (2013). Lancet 12, 175-185
Pre-eclampsia & Seizures

Mild  0.6%
Severe  2-3%

Mortality for eclampsia is brain ischemia or hemorrhage

Edlow, et al. (2013). Lancet 12, 175-185
Pre-eclampsia (Questions???)

How is BP?
Laboratory values
Proteinuria
End-organ issues (renal, CV, pulmonary)
Labor progress (discussion with OB)