NEUROLOGIC COMPLICATIONS IN OBSTETRIC ANESTHESIA

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ACCME Disclosures
• No “Off Label” uses
• No Financial Conflicts commercial products

Additional disclosure:
• Author, Safe Baby System, due Dec 09
  – www.SafeBabySystem.com

“We all experience the same patients and problems. It is our knowledge and mindset that make the difference”

-Zakowski M

INTRODUCTION

• Maximize patient outcomes

• Minimize lawsuits

OUTLINE

• Obstetric deficits
• Anesthetic deficits
• Epidural Hematoma
• Infections
CASE PRESENTATION

You get called at 1 AM that your patient who delivered at 6 PM is complaining that she can’t get up to go to the bathroom.

She had epidural analgesia, pushed for 3 hours and had forceps delivery.

DDX PROLONGED NEURAL BLOCKADE

• Drug effect
  – prolonged duration
  – Neurotoxicity

• Trauma
  – peripheral nerve
  – central nervous system
  – external compression of root or cord

DDX PROLONGED NEURAL BLOCKADE

• Vascular
  – hemorrhage
  – decreased blood supply

• Neurologic disease: preexisting and new
  – Multiple sclerosis
  – HIV
  – Guillain-Barre

APPROACH

• History
• Physical
• Lab tests
• Consult, if needed
• Management

HISTORY

• Prior history back pain/numbness
• Was insertion of needle associated with pain/paresthesia?
• Was there ever a period of full recovery?
• Obstetric history
  – how long pushing?
  – what position 2nd stage?
  – Instrumentation
  – weight of baby

PHYSICAL EXAMINATION

• Full neurologic exam
  – paraspinous muscle
  – tenderness to deep palpation
  – sacroiliac joint
• Map symptoms
• Full chart documentation
LAB TESTS

- CBC
  - CSF
- CT scan better
  - intracranial blood, SAH
  - cortical bone structure
- MRI better
  - soft-tissue
  - blood or CSF flow
  - infection - Gadolinium enhanced

ADVANCED TESTING

- EMG
  - 2-3 weeks to change
  - <1 week, repeat >4 weeks
- SSEP
  - posterior cord
  - sensitive for cord compression, ischemia, distraction
- MEP
  - anterior cord

EMG

- Amplitude = axonal loss
- Latency = demyelination
- Fibrillation potentials = active axonal degeneration
  - start 2-3 week, max 1-3 month
- Recruitment = severity of axonal loss
- Limitations - nerve conduction studies
  - Large sensory and motor n.
  - Small unmyelinated n. not detected

OUTLINE

- Obstetric deficits
- Anesthetic deficits
- Epidural Hematoma
- Infections

OBSTETRIC INJURIES

- Incidence 2-5/10,000
- Risk factors:
  - prolonged labor
  - frequent use of forceps
  - large baby
  - positioning
COMMON PERONEAL NERVE
• Sensory - lateral calf, dorsum foot toes 1-2
• Motor - foot drop, inversion
• Compression - crosses fibular head
• Electrodiagnostic -
  – slowing of motor conduction
• False negative from motor response
  – 22% anomalous branch ext. digitorum brevis

LATERAL FEMORAL CUTANEOUS N.
• Sensory - anterolateral thigh
• Motor - none
• L2-3, lumbo sacral plexus
• Compression - lateral inguinal ligament
• Resolves spontaneously
• Risk factor - obesity

FEMORAL NERVE
• Sensory - anterior thigh and medial calf
• Motor - quadriceps
  – Knee extension
  – Mild - can walk flat, not stairs
  – Proximal e.g. lumbo sacral plexus affect iliopsoas (hip flexion)
• Hyperflexion hips
  – Compression by inguinal ligament
LUMBO-SACRAL PLEXUS
• Fetal head compression
• Risk factors
  – nulliparous, platypelloid
  – large baby, CPD, vertex
  – forceps
• Unilateral 75%
• Multiple roots
  – L4 - L5 most common

OBTURATOR NERVE
• Sensory - medial thigh
• Motor - hip adduction, internal rotation
• Compression
  – lateral pelvic wall
  – obturator canal
• Electrodiagnostic testing
  – lumbosacral plexus L3-4 vs obturator n.

TABLE 7. Peripartum nerve injuries in obstetric patients

<table>
<thead>
<tr>
<th>Nerve</th>
<th>Radix</th>
<th>Mechanism of injury</th>
<th>Clinical picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumbar trunk</td>
<td>L4, L5</td>
<td>Postsacral and epidural trauma</td>
<td>Lumbosacral pain, neurogenic claudication</td>
</tr>
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<td>Femoral nerve</td>
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ANATOMY
• High takeoff artery of Adamkiewicz
  – 15%
• Spinal branch of internal iliac
  – crosses pelvic brim
  – susceptible to compression

ANTERIOR SPINAL ARTERY SYNDROME
• Artery of Adamkiewicz
  – supplies anterior 2/3rd spinal cord
• Loss of motor, pain, temperature
• Posterior column by vertebral arteries
  – vibration, joint sensation spared
• Risk factors
  – compression, severe hypotension, ?epi

ISCHEMIC INJURY
• Spinal cord blood supply
  – 85% artery of Adamkiewicz
  – 15% iliac artery, crosses lumbosacral trunk
• Anterior spinal artery syndrome
• Severe hypotension
• AVM
ANTERIOR SPINAL ARTERY SYNDROME

- Elderly
- PMH - vascular disease
- Onset - sudden
- No pain, fever
- Acute motor deficit
- CT/MRI - normal
- WBC - normal

ISCHEMIC INJURY

AVM: spinal cord
- Spinal venous pressure increased
- Moderate hypotension/compression
- Cutaneous AVM
  - 20% have spinal AVM at same dermatome level

OUTLINE

- Obstetric deficits
- Anesthetic deficits
- Epidural Hematoma
- Infections

ANESTHESIA RELATED DEFICITS

- Incidence 0.1-1/10,000
- Direct nerve trauma
- Severe hypotension/cardiac arrest
- Equipment problems
- Drug effect
  - adverse, wrong drug, wrong site of administration

DIRECT NERVE TRAUMA

- Listen to the patient
  - the customer is always right!
- Transient paresthesias
  - threading catheter
  - dural puncture
- 66% exhibited paresthesia or pain on injection (intraneuronal)
DIRECT NERVE TRAUMA

- Tuffier’s line - superior iliac crests
  - L4 spinous process in 79%
  - L3-4 interspace in 4%
  - L5-S1 interspace in 4%
- Spinal cord ends
  - T12-L1 30%
  - L1-L2 60%
  - L2-L3 10%

NEUROLOGIC DEFICITS

- Prospective - 103,000 RA
- All deficits present within 48 hours
- Transient - 3.3/10,000
  - 29/34 were transient (<3 month)
- Permanent - 0.1/10,000
  - paraplegia 1/103,000
  - elderly, severe hypotension

-NEUROLOGIC DEFICITS

- Deficit without paresthesia
  - 12/13 spinal
  - 9/12 received 5% lidocaine
- Spinal > epidural
  - 5.9 vs 2/10,000 neurologic injury
  - 4.7 vs 1.7/10,000 radiculopathy
  - resolved except one spinal bupivacaine

-NEUROLOGIC DEFICITS

- Obstetric population - retrospective
- 2,580,000 deliveries
- 505,000 epidurals
- Incidence - 0.75/10,000 mononeuropathy
- 37/38 resolved spontaneously (<3 months)
- Permanent 0.1/10,000
  - 2-3/5 non-anesthetic related

-Auroy Anesthesiology 1997:87:479
NEUROLOGIC DEFICITS

• Retrospective, 1990-1999 Sweden
  – 1,260,000 spinal, 450,000 epidurals (200K OB)
• Complications
  – OB 1/25,000 vs. non-OB 1/3600 (P<.0001)
• Spinal hematoma w/HELLP
  – Spinal 1, epidural catheter removal 1
• Permanent 0.1/10,000 epidurals
  – Direct trauma cord

-Moen Anesthesiology 2004:101:950

NEUROLOGIC DEFICITS

Metaanalysis, 1990+, OB, 1.17 million
• Epid Hematoma 0.59/100,000
• Deep Epid Infec 0.69/100,000
• Persistent Neuro 0.42/100,000
• Transient Neuro 1.8/10,000


NEUROLOGIC DEFICITS

Metaanalysis, 1995-2005

Per 10,000                   Spinal             Epidural
• Radiculopathy 3.78 2.19
• Cauda Equina 0.11 0.23
• Paraplegia 0.06 0.09


NEUROLOGIC DEFICITS

Retrospective, 2000
• 60% > 50 y.o.
• 3 OB - 2 direct trauma, 1 subarachnoid cyst

Per 100,000           OB   Non-OB
• Epidural 0.86   1.54
• SP+EPI (CNB) 0.71 1.5

-de Seze MP. Anesth Analg 2007:104:975-9

NEUROLOGIC DEFICITS

IT Catheters 28 ga Labor Analgesia
• Transient/minor neuro changes 17/329
• 1 catheter breakage
• 23/329 uncomfortable with max dose
• Headache: Any 12% vs 4%, PDPH 9% vs 4%
• ↑Pruritis, ↓motor block


NEUROLOGIC DEFICITS

• Prospective, 770,455 CNB (Epi/Sp/CSE)
• 84 Major - 52 met inclusion criteria
• Permanent - >6 month
• 2/3rds fully resolved
• Pessimistic 4.2/100,000
• Optimistic 2/100,000

-Cook TM. BJA 2009:102:179-90
NEUROLOGIC DEFICITS

- Periop 8 /100,000
- Chronic Pain 2.5/100,000
- OB 1.2/100,000

- 53% ASA I or II
- 45% of all patients = OB

- Cook TM. BJA 2009:102:179-90

OB Patients:

- Epidural 0.6 /100,000
- Spinal 1.5/100,000
- CSE 3.9/100,000 RR=6.5
- Overall 1.2/100,000

- Wrong Route - 6 in OB

- Cook TM. BJA 2009:102:179-90

NEUROLOGIC DEFICITS

PREEXISTING CNS DISEASE

Mayo Clinic 1988-2000, n=139

- CNS disease = MS, ALS, Post Polio Syndrome
- NONE had new or worsening post-op deficits
- RA
  - Spinal 54%, Epidural 42%, CSE 1%, Cont Spinal 3%
  - 11% technical complications (paresthesia)

- Horlocker TT Anesth Analg 2006:103:223-8

CARDIAC ARREST

per 10,000 Spinal Epidural

Kopp 2005 2.9 0.9
Auroy 2002 2.2 0
Pollard 2001 7 1
Auroy 1997 6.4 1

- Zakowski M

CARDIAC ARREST

SPINAL ANESTHESIA

- Incidence 7/10,000
  - vs 1/10,000 epidural
- Closed claims 40% mortality (n=14)
- Mechanism
  - pacemaker stretch RA
  - low pressure baroreceptor RA
  - paradoxical Bezold-Jarisch LV

- Pollard Anesth Analg 2001:92:252-6

CARDIAC ARREST

SPINAL ANESTHESIA

- Risk factors
  - Vagotonia
- Prevention
  - maintaining preload
- Aggressive Rx
  - atropine, ephedrine, epinephrine

- Pollard Anesth Analg 2001:92:252-6
MECONIUM HAPPENS

• Vigilance
• **Prompt recognition and proper treatment**
• Take care of patient first
• Document what you do – take credit!

INTERESTING CASES

RX
• Ventilate but don’t forget to….
• **TREAT THE HYPOTENSION !!!**

CARDIAC ARREST

OBSTETRICAL ANESTHESIA

• Epidural - 0.06/10,000
  – 2/3 recovered - Scott Br J Anaesth 1990:64:537
• Later study 0.08/10,000
  – 1/1 recovered from total spinal - Scott Int J Obstet Anesth 1995:4:133
• Maternal mortality 0.017/10,000
  – general = 16.7; regional - Hawkins Anesthesiology 1997;
  • Latest data - 1.7x, rate 1/million births
  • Hawkins SOAP 2009

COMPARATIVE RISKS

Mortality - autos
• 2.34/10,000 licensed drivers
  – 1.58/10,000 population USA
  – 1.2/10,000 population EU
Injury - autos
• 196/10,000 licensed drivers
  – 132/10,000 population
Work-related fatality
• 0.48/10,000 workers

-1996 NHTSA, 1997 BLS
-2002 WHO

OUTLINE

• Obstetric deficits
• Anesthetic deficits
• **Epidural Hematoma**
• Infections

EPIDURAL HEMATOMA

• Incidence 1/150,000
• Hemostatic abnormality
• Insertion and removal
• Low molecular weight heparin
  – FDA contraindicated
EPIDURAL HEMATOMA
LMWH

INCIDENCE
• 1:3,100 epidurals
• 1:41,000 spinals
• 40+ Cases
• early post-op or intra-op LMWH
• concomitant anti-platelet


ASRA 2nd Consensus
Neuraxial & Anticoagulation

• Avoid Thrombolytics for 10 days
  – Non-compressible vein puncture
• Fibrinolytic/Thrombotic drugs
  – Different times for d/c- RA interval
• Neuro check ≤ Q 2 hours
  – Minimize motor block w/infusions
• D/C catheters
  – Fibrinogen last to return to normal

Classical Coagulation Cascade

Anticoagulation Drugs-Targets

Platelet-Coagulation Factor Interactions
“Surface Assembly of Complexes”

Antiplatelet Drugs

Vessel Wall Injury

Platelet Adhesion and Activation

Aspirin

Ticlopidine, Clopidogrel

GP IIb/IIIa Antagonists

Platelet Aggregation
HEPARIN UNfractionated

- Mini-dose, prophylaxis SQ
  - NO contraindication for RA
  - Check platelet count ≥4 days; HIT
- Intra-op Heparin ≥1 h post RA
- D/C catheter 2-4 h post last heparin dose and >1 h post removal
- Neuro checks
- Bloody tap - no data to cancel case

LMWH

- Anti-Xa level not predictive
- Monotherapy - avoid anti-platelet, warfarin
- Bloody tap - delay LMWH ≥24 h
- Pre-op LMWH [switch to regular Heparin]
  - Prophylaxis - RA ≥ 10-12 h post dose
  - Therapeutic - RA ≥ 24 h post dose
- Post-op LMWH
  - QD dosing wait 6-8 h
  - BID dosing wait 24 h, remove cath 2 h prior to 1st dose

WARFARIN

- D/C 4-5 days prior
  - PT/INR initially Factor VII
  - Factor II, X increase later
- Avoid other anticoagulant drugs
- Check PT/INR if 1st dose >24 h pre-surg
- Remove catheter INR <1.5

ANTI-PLATELET

- NSAID
- Thienopyridine
  - Ticlopidine - hold 14 d
  - Clopidogrel - hold 7-10 d
- Platelet GP IIb/IIIa antagonist
  - Abciximab hold 1-2 d
  - Eptifibatide hold 4-8 h, Post-op hold 4 weeks
  - Tirofiban hold 4-8 h, Post-op hold 4 weeks

NEW ANTI-COAGULANTS

Direct Thrombin inhibitors (Rx FFP)
- Hirudin - inhibits thrombin free and bound
  - Desirudin
  - Lepirudin
  - Bivalirudin
- Argatroban - (L-arginine derivative)
- Fondaparinux - Xa inhibitor, irreversible

EPIDURAL HEMATOMA SIGNS/SYMPOMTS

- Bilateral leg weakness
- Urinary incontinence
- No rectal sphincter tone
- Decreased reflexes
- Prolonged sensory/motor block
EPIDURAL HEMATOMA
MANAGEMENT/ThERAPY
• Immediate CT/MRI
  – extradural compression
• Surgical decompression
  – <6-12 hours
• Steroids

OUTLINE
• Obstetric deficits
• Anesthetic deficits
• Epidural Hematoma
• Infections

EPIDURAL ABSCESS
• Incidence 0.2-1.2/10,000 tertiary admissions
• Concurrent infection elsewhere
• Risk factor - Diabetes
• Review - associated w/epidural
  – 1/39, 0/35
• Obstetric epidurals
  – 1/505,000
  – 1/200,000
  – 1/160,000
- Baker NEJM 1975:293:463
- Danner Rev Infect Dis 1987:9:265
- Scott Br J Anaesth 1990:64:537
- Moen Anesthesiology 2004:101:950

EPIDURAL ABSCESS
SIGNS/SYMPOTOMS
• Delayed onset days-weeks
• Fever, headache, backache
• Tenderness to deep palpation at site
• Pain with movement - flexion>extension
• WBC increased
• CSF- WBC increased

- Cameron CM. Anesthesiology 2007:106:997-1002

EPIDURAL ABSCESS
• Pain service catheters, n=8210
• Incidence 1/1368 (n=6)
• Combination Fever and Epidural Site Infection in 5/6 abscesses
• MRI indicated

- Cameron CM. Anesthesiology 2007:106:997-1002
EPIDURAL ABSCESS

SIGNS/SYMPTOMS

• Nerve root pain 1-3 days after onset
• Progressive neurologic deficits
• Leg pain, weakness
• Bowel/bladder dysfunction
• Paraplegia- flaccid, later spastic
• Decreased reflexes

MANAGEMENT/THERAPY

• MRI-gadolinium enhanced/CT
  – extradural compression
• Antibiotics
• Surgical decompression
  – <6-12 hours
• Steroids

| TABLE 5. Differential diagnosis of epidural abscess, epidural hematoma, and anterior spinal artery syndrome |
|---|---|---|
| Age | Any age | Elderly | Elderly |
| History | Diabetes, infection (?) | Anticoagulants, heparin, coumadin | Vascular disease, hypertension (?) | Sudden |
| Onset Symptoms | FEVER, back pain, tenderness | Acute | Acute |
| Sensory/Motor Deficits | None or paraplegia, delayed | Progressive motor deficit (hours)
  | Progressive motor deficits (hours) | Acute motor deficit |
| Reflexes | Decreased | Decreased |
| MRI/CT scan | Extradural compression | Extradural compression |
| Cerebrospinal fluid | T6/B | T6/B |
| Labs | TPS/PTT, fibrinogen | Normal |

ASRA PRACTICE ADVISORY July 2006

INFECTIOUS COMPLICATIONS

• Hand wash with antiseptic
  – Unknown surgical scrub
• Consider removing jewelry
  – Watches > rings
• Sterile glove + hand washing
  – Not require gowns
• Masks reduce oral pathogens
  – Not proven
• Bacterial filters not required short term <2d
• Alcohol + Chlorhexidine 1st choice

INFECTIONS PDPM

• Review 1952-2005, n=179 PDPM
• 3 OB deaths
• 49% Viridans strep (ORAL)
• 36% no organism
• 5% Staph aureus

• Epidural abscess - Staph A.
• PDPM - post spinal

INFECTIONS PDPM

Clinical course

• 2-3 h bacterial onset
• ↑ TNF, cytokines - alter BBB
  – Leukocytes, toxic metabolites
  – Loss cerebrovascular autoregulation

- Baen ET Anesthesiology 2006:381-93
Infectious Disease Society Guideline 2004
• Dexamethasone decreased mortality pneumococcus
  – Gram + diplococci

- Baen ET Anesthesiology 2006:381-93
INFECTIONS PDPM

- Bacteremia and LP
- URI - increases dispersal oral organisms
- Dental caries
- Masks - decrease dispersal
  - 15 minutes excellent
  - 8 hours good

ANTI-INFECTIONS EDITORIAL

- Bacteriocidal skin disinfectant peak 2 min
- Hand washing - must
  - Not replaced by sterile gloves
- Alcohol based chlorhexidine
  - Faster, stronger, -cidal
- PDPM 1.3/10,000 spinals
  - Range 0.2-1/10,000 spinals
  - OR < General (Moen 2004)
- Masks - higher bacterial load

- Baen ET Anesthesiology 2006:381-93

CASE PRESENTATION

You get called at 1 AM that your patient who delivered at 6 PM is complaining that she can’t get up to go to the bathroom. She had epidural analgesia, pushed for 3 hours and had forceps delivery.

CASE PRESENTATION

- History
  - by 8 AM the left leg improves somewhat.
- Physical exam
  - weakness R>L LE
  - sensory decreased R>L
- CT scan - negative
- Steroids given by neurologist

CASE PRESENTATION

- Hospital Day 3 -
  - still weakness left leg
  - right leg improved, only mildly weak
- Physical therapy ordered
- Further testing needed?
NEUROLOGIC DEFICITS
ASA Closed Claims >1990

<table>
<thead>
<tr>
<th>Claims</th>
<th>Female</th>
<th>Median $</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-S n. root</td>
<td>15%</td>
<td>71%</td>
</tr>
<tr>
<td>Spinal cord</td>
<td>16%</td>
<td>48%</td>
</tr>
<tr>
<td>Sciatic/peroneal</td>
<td>5%</td>
<td>58%</td>
</tr>
<tr>
<td>Others</td>
<td>10%</td>
<td>58%</td>
</tr>
</tbody>
</table>

-Cheney Anesthesiology 1999:90:1062-9

NEUROLOGIC DEFICITS
ASA Closed Claims

- Heparin IV intra-op, spinal hematoma
  - n=13 (epi 11 sp 2)
- Substandard care - missed dx
- Persistent numbness or weakness lower extremities
  - dilute local infusion post-op
  - prolonged local effect
  - diabetic neuropathy

-Cheney Anesthesiology 1999:90:1062-9

NEUROLOGIC DEFICITS
ASA Closed Claims

- Lumbo-Sacral n. root
  - 93% (n=67) regional
    - spinal 37, epidural 25
- Paresthesia insertion
  - spinal 18, epidural 6
- Pain injection
  - CSE, 1 epid
- Multiple attempts
  - 10 spinal, 4 epidural

-Cheney Anesthesiology 1999:90:1062-9

ASA CLOSED CLAIMS OB

- 635 OB claims
- Minor claims
  - Headache, pain during anesthesia, back pain
- Maternal death GA > RA
- Cesarean > labor analgesia


ASA CLOSED CLAIMS OB

- Seizures
  - 85% epidural
  - 75% serious injury
- Nerve injury
  - 52% paresthesia
  - 19% neurotoxicity

CLOSED CLAIMS OB 2009 Relative Frequency
- Maternal Death decreased
  - $1.1 million
- Newborn brain damage decreased
  - $900,000
- Nerve injury increased
- Back pain increased
- Headache similar

-Closed Claims OB 2009 Regional Anesthesia
- High CNB death/brain damage
  - Labor Epidural 53%
  - Cesarean 47%
  - 12 epid/3 spinals
  - False negative test dose/aspiration
  - Delayed Dx/Rx 80%
- Cardiac arrest - 2 without high block

-Zakowski M

QUOTE
"We all experience the same patients and problems. It is our knowledge and mindset that make the difference"

-Zakowski M

CONCLUSION
- Pessimist
- Optimist
- Realist

-Zakowski M

END of Kaiser Permanente 2009 lecture****