UND Nurse Anesthesia Program Student Presentations

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North Dakota Association of Nurse Anesthetists
Fargo, ND

UND NURSE ANESTHESIA
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Transnasal Sphenopalatine Ganglion Block: A Novel Solution for Postdural Puncture Headaches

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Introduction

- 3,945,875 births in the US
  - **2,901,486** underwent epidural or spinal anesthesia during labor
  - So…. **73.5%** had regional anesthesia
    - **1.5%** had an accidental dural puncture
      - **50%** had PDPH
- **21,700 women***
  - "if mama ain't happy…"

(CDC, 2018; Susecon, Austin & Gabaldon, 2016, p. 15)

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Introduction-PDPH

- Pathophysiology
  - Accidental Dural Puncture
    - Pressure-volume mismatch
  - Intracranial hypotension
    - Postural headache
- Risk Factors
  - Provider related
  - Patient related
- Current Treatment
  - Conservative management
  - Invasive management

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Case Information

- Procedure: Epidural Blood Patch
- Age: 29 y.o.
- Gender: Female
- Ht: 5'2"
- Wt: 94 kg
- BMI: 37.8
- ASA: 2
- OBGYN: G4P4, 6 weeks postpartum
- Current symptoms
  - 9/10 intractable bifrontal headache, visual disturbances and nausea

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Pre-operative Evaluation

- Past Medical History
  - Asthma, migraines
- Surgical History
  - Cholecystectomy, knee surgery
- Current Medications
  - Albuterol, oxycodone, baclofen, metronidazole, ibuprofen, dulera, fluticasone
- Pre-op VS
  - BP 118/74, HR 86, RR 16, T97.8, SpO2 99% on RA
- Pertinent labs/ EKG/chest X-ray, etc.
  - Negative CT, MRI, LP
- Airway evaluation
  - Mallampati I, TM 3, Full ROM of neck, dentition normal

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Anesthetic Course

- Drugs
  - 2 mg midazolam after pumping
- Technique
  - Epidural
  - 18 ml of sterile autologous blood was injected into the L2-L3 interspace without incident
    - 1 space above previous puncture sites
  - Supine for 1 hour
- Rationale
  - Gold standard for PDPH treatment

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Intraoperative Issues

- Difficulty obtaining vascular access
  - Initially attempted in the left hand with a 18 ga needle
  - Only able to obtain 5 ml autologous blood
- Second vascular attempt-18 ga needle in the right hand
  - Obtained 20 ml autologous blood

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PACU

- Supine for 1 hr in PACU
- No issues
- Reported "significant" relief in headache
  - Tolerable at 2/10

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Discussion

- **Conservative Management**
  - Intravenous caffeine
    - Significant decrease in PDPH persistence
  - Gabapentin, hydrocortisone, theophylline
    - Significant decrease in PDPH pain scores
  - Cosyntropin, pregabalin, sumatriptan, adrenocorticotropin hormone
    - No significant change in PDPH persistence or pain scores
  - Bedrest
    - Alleviate symptoms, but doesn't hasten recovery
  - IV hydration
    - Will not improve CSF production
  - Intrathecal Catheter for 24 hrs

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Discussion

- **Epidural Blood Patch**
  - Sterile procedure
    - Access vein and epidural space
  - 2 mechanisms of action
    - Mechanical Pressure (Butterworth, Mackey, & Wasnick, 2013; Nagelhout & Plaus, 2014)
    - Speeds clot formation (Sachs & Smiley, 2014)
  - Efficacy
    - 90-95% initial attempt, second EBP 90%

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Discussion

- **Epidural Blood Patch cont.**
  - Contraindications
  - Side effects
  - Variations
    - Volume of blood
    - Blood vs. saline
    - Level

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Discussion

- **Transnasal Sphenopalatine Ganglion Block (TSGB)**
  - Dr. Sluder in 1908
  - Extracranial neural structure
  - Efficacy
    - 65-85% in headache intensity for chronic headaches
    - 11/13 obstetric patients (Cohen, Sakr, Katyal & Chopra, 2009)
    - 3/3 (Kent & Mehaffey, 2016)
    - 69% in obstetric patients (Cohen, Ramos, Grubb, Mellender, Mohiuddin & Chiricolo, 2014)

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Discussion

- Procedure
  - Varied methods
  - Varied medication
- Kent & Mehaffey, 2016:
  - Supine, neck extension, intranasal phenylephrine spray, Cue-tips saturated with 2% lidocaine, repeat
- Efficacy
  - 65-85% reduction in headache intensity (Mojica, Mo, & Ng, 2017)

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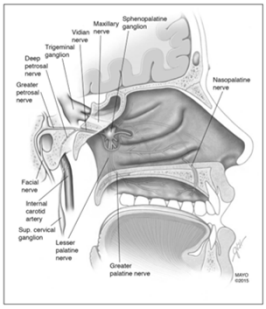
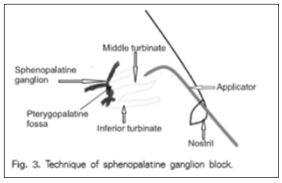
Discussion



(Robbins et al, 2016)



(Nair & Rayani, 2017)

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Recommendations

- Further research is needed in the obstetric population regarding the use of TSGB
- Encourage you to add it to your repertoire, along with conservative medical management, before utilizing an EBP

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Conclusion

- Comparison of Case with Evidence
  - 6 weeks post epidural puncture
  - 4 weeks post diagnostic lumbar puncture
  - Conservative management attempts:
    - Morphine, IVF, gabapentin, caffeine, fioricet, lidocaine patch, baclofen, steroids, Percocet, prednisone, ibuprofen, physical therapy, metoclopramide, diphenhydramine, battlefield acupuncture (auricular needle placement), acupuncture, massage, optometrist appoint, neurology consult
  - Patient experienced significant relief of headache with EBP

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Conclusion

- TSGB vs EBP
  - less invasive,
  - has less complications,
  - has less contraindications,
  - requires less time
  - is less risky,
  - requires less skill,
  - and is less expensive

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Thank You
Are There Any Questions?

Anesthetic Considerations for the Parturient with Immune Thrombocytopenic Purpura

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Introduction

- ITP is an autoimmune disorder that accelerates the rate of platelet destruction and leads to persistent thrombocytopenia.
- ITP accounts for 5% of pregnancy-associated thrombocytopenia.
- The condition in the parturient is associated with complications that include:
  - Maternal hemorrhage
  - Fetal intracranial hemorrhage
  - Spinal-epidural hematoma with neuraxial anesthesia

Case Information

- Planned repeat cesarean section for pregnancy at 36-weeks gestation
- 23-year old female
- 155 cm
- 90 kg
- No known drug allergies
- ASA physical status level 2

Pre-operative Evaluation

- Past Medical History:
  - Chronic ITP
  - Iron deficiency anemia
- Surgical History:
  - 3 previous cesarean sections
  - Laparoscopic cholecystectomy
- Obstetric History:
  - G4P3
  - Late prenatal care in 3rd trimester
  - No medical management of ITP during pregnancy
- Anesthetic History:
  - Uncomplicated

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Pre-operative Evaluation Continued

- Pre-operative vital signs:
  - Heart rate: 72/min
  - Blood pressure: 122/70 mmHg
  - Respirations: 12/min
  - Room air oxygen saturations (SpO2): 99%
  - Temperature: 36.1° Celsius
- Pertinent labs:
  - HGB: 12.4 g/dL
  - HCT: 37.2%
  - PLT: 87,000/mcL (stable)
  - Type and screened for 2 units PRBCs (available in OR)

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Anesthetic Course

- Pre-op:
  - 1L bolus LR via 20-gauge IV catheter
- Intrathecal administration:
  - Sitting position, one attempt at L3-4 space
  - 20-gauge introducer needle and 25-gauge, 3.5 inch pencil point spinal needle
  - Injection of 1.6 mL 0.75% bupivacaine, 20 mcg fentanyl, and 0.2 mg morphine
  - Level of blockade: T6 distribution
- Spontaneously breathing with nasal cannula at 3 L/min
- Additional 18-gauge IV catheter placed with NS and blood tubing attached
- Other medications administered:
  - 100 mcg phenylephrine IV, 2 g cefazolin IV, 4 mg ondansetron IV, 1L bag LR with 20 units oxytocin.

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Intraoperative Issues

- Hypotension:
  - Treated with 100 mcg phenylephrine IV
- Nausea:
  - Treated with 4 mg ondansetron IV

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Post-operative Course

- Total procedure time: 1 hour and 25 minutes
- Neonate transferred to NICU and parturient transferred to PACU
- Intake/Output:
  - Volume replacement:
    - Normal saline: 1000 mL
    - Lactated ringers: 1400 mL
    - Lactate ringers with 20 units oxytocin: 500 mL
  - Estimated blood loss: 500 mL
  - Urine Output: 400 mL
- Patient and neonate discharged home on post-operative day 4

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Pathophysiology

- ITP is an autoimmune disorder that involves the formation of IgG antiplatelet antibodies that recognize specific antigens on platelet membranes.
- The binding of the IgG antibodies to the platelet membrane marks the platelet for destruction by the reticuloendothelial system in the spleen.
- This accelerates the rate of platelet destruction and leads to persistent thrombocytopenia.

(Berkley & Kilpatrick, 2009; Stavroe & McCrae, 2009; Wysznyski et al., 2016)

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Complications

- Current literature indicates that women with ITP have a low risk of complications and can safely tolerate pregnancy.
- Major complication for the parturient is hemorrhage.
- Major complication in the fetus is the development of fetal thrombocytopenia and subsequent fetal intracranial hemorrhage.
  - Highest risk of hemorrhage occurs in neonates with platelet counts less than 50,000/mcL.
  - Intracranial hemorrhage can occur during delivery, but may not appear until 2-5 days postpartum.

(Berkley & Kilpatrick, 2009; Hindley, 2016; Provan et al., 2010; Stavroe & McCrae, 2009)

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Prenatal Medical Management

- CBC should be drawn:
  - Monthly in the 1st and 2nd trimester, bimonthly in the 3rd trimester, and weekly as the anticipated delivery date approaches.
  - More frequent monitoring may be required depending on the severity of the thrombocytopenia.
- Treatment is not required until 36-weeks gestation or 10 days prior to the anticipated delivery date if there is no evidence of bleeding and platelet counts remain above 30,000/mcL.
- Treatment is recommended if delivery is imminent, platelet counts are below 30,000/mcL, or bleeding is present.
  - First line therapy = oral corticosteroids (prednisone or prednisolone)
  - Alternative therapy = intravenous immunoglobulin (IVIg)

(Hindley, 2016; Gernsheimer & McCrae, 2007; Provan et al., 2010; Rajasekhar, Gernsheimer, Stasi, & James , 2013)

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Prenatal Medical Management Continued

- Platelet transfusion in conjunction with IVIg infusion is recommended if a rapid increase in platelets is required for life-threatening bleeding or emergent delivery.
  - Platelet transfusion alone is not an effective treatment for ITP.
  - A retrospective review by Spahr & Rodgers (2008) concluded that concurrent platelet transfusion and IVIg treatment was associated with minimal side effects, resolution of bleeding, and rapid increase in platelet counts.

(Provan et al., 2010; Rajasekhar et al., 2013; Spahr & Rodgers, 2008; Stavroe & McCrae, 2009)

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Mode of Delivery

- Maternal condition and obstetrical indicators should dictate the mode of delivery.
- Previous evidence indicated that elective cesarean section reduced the risk of fetal intracranial hemorrhage. However:
  - Belkin, Levy, & Sheiner (2009) conducted a retrospective study that found no association between intracranial hemorrhage and mode of delivery and concluded that routine use of cesarean section should be avoided.
  - Similarly, a retrospective study by Gasim (2011) reported a low incidence of poor neonatal outcomes that were unrelated to the mode of delivery.
- The primary concern during parturition is maintaining a platelet count greater than 50,000/mcL to minimize the risk of hemorrhage.

(Belkin et al., 2009; Gasim, 2011; Provan et al., 2010; Rajasekhar et al., 2013; Stavroe & McCrae, 2009).

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Neuraxial Anesthesia

- ITP increases the risk of spinal-epidural hematoma formation.
- No definitive recommendation exists regarding the minimally safe platelet count required for administration of neuraxial anesthesia in the parturient with thrombocytopenia.
  - The ASH Clinical Practice Guide on Thrombocytopenia in Pregnancy suggests that a minimum platelet count of 80,000/mcL may be appropriate.
  - Studies included within the International Consensus Report on the Investigation and Management of ITP indicate that a lower threshold of 75,000/mcL may be appropriate..

(Bernstein et al., 2016; Huang, McKenna, & Babins, 2014; Myers, 2012; Nagelhout & Plaus, 2014; Provan et al., 2010; Rajasekhar et al., 2013)

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Neuraxial Anesthesia Continued

- Thromboelastography (TEG) and rotational thromboelastometry (ROTEM)
  - The results from a prospective cohort study by Huang et al. (2014) suggest that neuraxial anesthesia can be safely performed in parturients with platelet counts greater than 56,000/mcL and a normal TEG result.
  - Similarly, a case study performed by Mauritz, Strouch, and Olufolabi (2016) reported utilizing ROTEM to safely perform a cesarean section under spinal anesthesia in a high-risk parturient with thrombocytopenia.

(Huang et al., 2014; Mauritz et al., 2016; Provan et al., 2010)

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Spinal-Epidural Hematoma

- A retrospective cohort study by Lee et al. (2017) found that the risk of epidural hematoma was 11% for a platelet count less than 50,000/mcL, 3% for 50,000 to 69,000/mcL, and 0.2% for 70,000 to 100,000/mcL.
- Similarly, a study by Goodier, Lu, Hebbar, Segal, & Goetzl (2015) containing parturients with platelet counts less than 100,000/mcL reported the risk of spinal-epidural hematoma to be 0 to 0.6%.
- Risk factors for the development of a symptomatic hematoma include spinal cord abnormalities, difficult needle placement, coagulopathy, increased needle size, and catheter placement.

(Bernstein et al., 2016; Goodier et al., 2015; Horlocker et al., 2010; Lee et al., 2017; Nagelhout & Plaus, 2014; Provan et al., 2010)

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Recommendations

- Prenatal management should include serial CBC monitoring and administration of oral corticosteroids or IVIg depending on clinical manifestations and maternal platelet counts.
- The routine use of cesarean section should be avoided. The mode of delivery is dependent on maternal condition and obstetrical indicators.
- The primary goal during delivery is to minimize the risk of maternal hemorrhage by maintaining a platelet count greater than 50,000/mcL.

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Recommendations Continued

- life-threatening bleeding or emergent delivery may necessitate platelet transfusion in conjunction with IVIg infusion.
  - Further research is needed regarding the optimal dose and timing for administration of IVIg and platelet therapy.
- Further research is needed regarding the minimally safe platelet count required for administration of neuraxial anesthesia.
- Further research is needed regarding the use of TEG/ROTEM to help guide safe neuraxial anesthetic practices.

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Conclusion

- The patient underwent repeat cesarean section at 36-weeks gestation with a history of chronic ITP.
  - Serial platelet counts were not drawn and the ITP was not medically managed.
- Cesarean section was the patient's only option for delivery due to her history of 3 previous cesarean sections.
- The platelet count was stable at 87,000/mcL and no bleeding manifestations were noted.
  - TEG and/or ROTEM were not utilized to further assess coagulation.
  - The spinal was placed in one attempt by an experienced anesthetist utilizing a 25-gauge pencil point spinal needle

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Conclusion Continued

- A parturient with ITP presents a challenge to the anesthesia care team that requires thorough anesthetic planning and vigilant monitoring.
- With the development of consistent guidelines and further research, anesthetic management of this population can be improved.

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Anesthetic Considerations for the Parturient with Idiopathic Intracranial Hypertension

Levi La Porte, SRNA

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Anesthesia in Labor and Delivery

- Over 4 million births per year in the U.S.
- 32% of all births come through cesarean section
- Approximately 61% of all parturients receive spinal or epidural anesthetics to aid with the delivery process
- Although women of child-bearing years are typically healthy, comorbidities may exist that require consideration for proper anesthetic planning

(Martin, Hamilton, Osterman, Driscoll, & Matthews, 2017; Osterman & Martin, 2011)

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Idiopathic Intracranial Hypertension

- Described in 1897 by Quincke
- Unknown cause
- Increased ICP in the presence of negative neuroimaging and negative CSF studies. Increased CSF volume present
- Has been known as: serous meningitis, pseudotumor cerebri, benign intracranial hypertension, and idiopathic intracranial hypertension (IIH)
- Occurrence: 1:100,000 in general population, but 1:5,000 in obese women of child-bearing age
- Despite its rare occurrence, it carries important considerations for neuraxial anesthesia that may result in permanent neurologic damage if not planned for appropriately

(Kesler & Kupferminc, 2013; Karmaniolou, Petropoulos, & Theodoraki, 2011; Month & Vaida, 2012)

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Idiopathic Intracranial Hypertension

<u>SYMPTOMS</u>

- Headache
  - Worse in the morning
  - Photophobia
- Back, neck, shoulder pain
- Nausea and vomiting
- Pulsatile tinnitus
- Visual disturbances
  - Related to 6th cranial nerve compression
  - 10-20% of cases progress to visual loss

(Karmaniolou et al., 2011; Kesler & Kupferminc, 2013)

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Diagnosis of IIH

Diagnosis made based on Modified Dandy Criteria with the presence of:

- Patient is awake and alert
- Symptoms of raised intracranial pressure
- No localizing signs with the exception of sixth cranial nerve palsy
- CSF pressure of 25 mmHg or greater in the lateral decubitus position
- Normal CSF composition
- Normal imaging studies without evidence of thrombosis, except for empty sella turcica
- No other explanation for the raised ICP

(Karmaniolou et al., 2011, pg. 652)

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Idiopathic Intracranial Hypertension

Treatment:

- Medical Management
  - Weight control
  - Diuretics
    - Acetazolamide
  - Anti-inflammatory drugs
    - Corticosteroids
  - Therapeutic lumbar punctures
- Surgical Management
  - Lumboperitoneal Shunt
  - Optic Nerve Sheath Fenestration

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Case Information

- Primary cesarean section for fetal presentation in breech position
- 21-year-old female
- 160 cm
- 155 kg
- ASA physical classification status: 3
- No known allergies

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Pre-operative Evaluation

Past Surgical History

- Negative

Past Medical History

- Primigravida 37-weeks gestation
- Morbid Obesity
- Idiopathic Intracranial Hypertension (IIH) [diagnosed this pregnancy]

Outpatient Medications

- Acetazolamide QID
- Tylenol PRN
- Multi-vitamin

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Pre-operative Evaluation History of Present Illness

- Pregnancy course complicated with neck/shoulder pain, ringing in the ears, dizziness, nausea, vomiting, headache, and blurred vision
- Consulted by Neurology and Ophthalmology
  - Neuroimaging and lumbar puncture were negative for pathology
  - Diagnosed with IIH with papilledema
- Managed with one therapeutic lumbar puncture after diagnosis
- Maintained with acetazolamide QID

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Pre-op Vitals:
TPR: 36.0, 90 bpm, 18/min
BP: 130/70 mmHg
SpO2: 98% on room air

Airway Assessment:

- Mallampati III
- Inter-incisor distance >3
- Full dentition and neck ROM
- Thyromental distance >3

Pertinent Lab Values:
Unremarkable
Hemoglobin: 12.1 g/dL
Hematocrit: 37%
Platelets: 191,000/mcL

Patient complained of a mild headache, but denied visual disturbances in pre-op

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Operative Course

- Anesthetic
  - Single shot subarachnoid block (SAB)
    - 1.2 mL of 0.75% bupivacaine with 8.25% dextrose
    - 20 mcg fentanyl
    - 0.3 mg morphine
  - *Patient denied worsening of headache or visual changes with SAB*
  - T6 dermatome level sensory block achieved
- Additional Medications
  - Ondansetron 4 mg
  - Cefazolin 2 grams
  - Phenylephrine 100 mcg x 3 for hypotension
  - Ephedrine 5-10 mg x 3 for hypotension
  - Oxytocin 20 units in 1 L Lactated Ringer's IV solution

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Operative Course

- Twenty-one minutes after placement of SAB a viable baby girl was born
- Fluid Totals:
  - 2700 mL crystalloid
  - 800 mL blood and amniotic fluid loss
  - 75 mL clear yellow urine
- *The patient denied headache or visual disturbance in PACU*
- Patient and baby were discharged home on post-op day 3 denying visual disturbance and complaining of only a minor headache

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Discussion

Components of Intracranial Pressure

- With the rigid skull, the volume must remain fixed, but regulated to prevent an increase or decrease in ICP
- Three components: Brain Tissue, Blood, and CSF
- Monro-Kellie Doctrine states that any increase in volume (tissue, blood, or CSF) will result in reduction of blood or CSF volume to maintain a relatively constant ICP
- Compensatory mechanisms for an increasing ICP:
  - Displacement of CSF into spinal compartment
  - Increased CSF absorption
  - Decreased CSF production
  - Decreased cerebral blood volume

(Butterworth et al., 2013; Leffert & Schwamm, 2013; Oropello, Pastores, & Kvetan, 2017)

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Cerebral Spinal Fluid

CSF flows in the subarachnoid space to cushion and provide buoyancy to the brain and promote optimal conditions for function

FLOW OF CSF:

- Produced in the ependymal cells of the choroid plexus
- Left & right ventricles
- Foramen of Monro
- Third ventricle
- Aqueduct of Sylvius
- Fourth ventricle
- Foramen of Luschka & Magendie
- Subarachnoid space
- Superior sagittal sinus (site of absorption at the arachnoid villi)

CSF stats:

- 150 mL total volume
- Produced at a rate of 20-30 mL/hr
- 400-500 mL of new CSF is produced and absorbed daily
- Normal ICP 5-15 mmHg

(Nagelhout & Plaus, 2014)

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Idiopathic Intracranial Hypertension Anesthetic Considerations

- Pre-operative planning and understanding of how their conditions were managed is crucial
- ICP fluctuates naturally with the labor and delivery process
  - Uterine contractions and "pushing" increase central venous pressure, cardiac output, blood pressure, and ICP
- Any sustained elevation in ICP could potentially cause visual loss in the patient from pressure on the optic nerve
- IIH is not a specific indication for cesarean delivery and patients may attempt to undergo vaginal deliveries
- Close monitoring of the patient throughout the labor process for neurologic and ocular changes

(Anson, Vaida, Giampetro, & McQuillan, 2015; Evans & Lee, 2010; Karmaniolou et al., 2011; Kesler & Kupferminc, 2013; Leffert & Schwamm, 2013)

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Idiopathic Intracranial Hypertension Epidural

- Pressure from an epidural bolus injection can be translated into the intrathecal space & upward into the cranium
- Pressure increase varies with volume of injection & baseline ICP levels
- Post-dural puncture headache (PDPH) occurrence is very low in IIH
- IIH patients are not at risk for tonsillar herniation with CSF loss like with other conditions of increased ICP
- Incremental epidural dosing of 5 mL every 5-7 minutes; typical infusion rates used during labor are safe in IIH
- Remember the inability to bolus medication through the epidural in case of emergent cesarean sections

(Anson et al., 2015; Karmaniolou et al., 2011; Leffert & Schwamm, 2013; Month & Vaida, 2012; Moore, Meela, Keally, Crowley, McMorrow, & O'Kelly, 2014)

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Idiopathic Intracranial Hypertension Single-shot Spinal Injection

- Subarachnoid block (SAB) is not contraindicated in IIH as it is with space occupying lesions
- Volume injected will translate pressure upward into the cranium potentially increasing ICP
- Month & Vaida (2012) describe withdrawal of 5 mL of CSF over 5 minutes prior to smallest effective volume injection
- If the patient has been managed aggressively with diuretics or lumbar punctures, recall that reduced CSF volume will result in greater local anesthetic spread from SAB
- For these reasons, studies suggest using the smallest effective volume when utilizing single shot injections

(Anson et al., 2015; Butterworth, Mackey, & Wasnick, 2013; Karmaniolou et al., 2011, Leffert & Schwamm, 2013)

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Idiopathic Intracranial Hypertension Indwelling Intrathecal Catheter

- Aly & Lawther (2007) and Moore et al. (2014) both describe using an indwelling catheter with success on laboring patients with both vaginal and cesarean deliveries
- Benefits to indwelling intrathecal catheter:
  - Provide continuous labor analgesia
  - Continuous monitoring of CSF pressure throughout laboring process
  - Use the catheter as a drain if neurologic status declines
- Moore et al. (2014) reported ICP ranging from 25 to 27 mmHg at rest peaking at 60 mmHg during pushing
- None of the literature suggested when to intervene or what CSF volume to remove if intervention was needed

(Aly & Lawther, 2007; Karmaniolou et al., 2011, Moore et al., 2014)

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Idiopathic Intracranial Hypertension Combined-Spinal Epidural (CSE)

- Month & Vaida (2012) described a CSE technique that withdrew 5 mL of CSF over 5 minutes and instilled 10 mcg fentanyl intrathecally. Patients reported improvement of headache pain with removal of CSF
- They placed a epidural catheter with no bolus. An infusion of 0.125% bupivacaine with fentanyl 2 mcg/mL was infused at 6 mL/hr
- Advantage to this approach:
  - Withdrawal of CSF to control symptoms
  - Intrathecal fentanyl to eliminate need for bolus
  - Slow epidural infusion for continued analgesia
- Disadvantage: bolus required if conversion to emergent cesarean section

(Month & Vaida, 2012)

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Idiopathic Intracranial Hypertension

Patients with LP shunts or Optic Nerve Fenestration

- Neuraxial anesthesia controversial
  - Risk of infection of the shunt
  - Ineffective spinal administration – local anesthetic leaks into the peritoneum
  - Damage and malfunction of the shunt
- Kesler & Kupferminc (2013) advocate general anesthesia for c-section
- Karmaniolou et al. (2010) suggest performing epidurals on an alternative interspace than the LP shunt
- Consider prophylactic anti-biotics with neuraxial anesthesia in the presence of a shunt
- Perform imaging prior to the removal of the catheter to assure no shunt entanglement is present

(Anson et al., 2015; Karmaniolou et al., 2011; Kesler & Kupferminc, 2013)

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Recommendations

- Parturients with IIH may be allowed to labor and deliver vaginally or via cesarean section
- Epidural: Slow infusion is safe, but bolus should be avoided making this a poor choice with possibility of cesarean section
- Subarachnoid block may result in greater dermatomal spread if management has depleted CSF levels. SAB is a safe anesthetic route
- Intrathecal catheters have been used successfully to drain CSF, monitor ICP, and provide medication delivery
- Neuraxial anesthesia requires special attention in the presence of a lumboperitoneal shunt

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Conclusion

- Neuraxial anesthesia continues to be the anesthetic of choice for labor and delivery
- Idiopathic intracranial hypertension is a rare condition with potentially serious complications with poor anesthetic management
- Neuraxial anesthesia can be used effectively with certain considerations for the parturient in the labor and delivery time period

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Thank You!
Are There Any Questions?

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Anesthesia Considerations for Intraoperative Neurophysiological Monitoring

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Introduction

- When a patient is having high risk neurosurgery, intraoperative neurophysiological monitoring is used to detect, and hopefully prevent, postoperative neurological deficits
- Neurophysiological monitoring involves monitoring evoked potential waveforms that result from electrical stimulation and depicts the integrity of the neurological pathway being monitored

(Nagelhout & Plaus, 2014;Pino, 2016)

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Introduction Continued

- Evoked potential waveforms are obtained, recorded, and compared to the baseline waveforms
- When a change in waveform occurs, there is likely an insult that is occurring to the area being monitored
- Examples of insults include:
  - systemic hypotension, anesthetic agents, hypoxia, hypothermia, and hypercarbia/hypocarbia

(Miller, 2015)

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Case Information

- Right sided Anterior Cervical Discectomy and Fusion (ACDF) of C4-C7
- 65-year-old female
- 185.4 cm
- 113.9 kg with a BMI of 32.84
- Allergies to bupropion and environmental
- ASA physical status: level 3

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Pre-operative Evaluation

- Past Medical History
  - bradycardia, peripheral vascular disease, hypothyroidism, lumbar degenerative disc disease, chronic thrombocytopenia, spondylosis of lumbosacral region, postoperative nausea/vomiting, GERD, iron deficiency anemia, hyperparathyroidism, depression, anxiety, bipolar disorder, chronic opioid use, and osteoarthritis
- Surgical History
  - Roux-En-Y gastric bypass surgery, pannus removal, right hemicolectomy with closure of ileostomy, takedown of ileostomy, ventral herniorrhaphy, total knee arthroplasty X2, right L4-S1 facet injections under fluoroscopy, and incisional hernia repair with I&D of abscess

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Pre-operative Evaluation Continued

- Pre-op VS
  - Blood pressure: 122/80
  - Respirations: 16
  - Temperature: 36.8
  - Heart rate: 59
  - Room air oxygen saturation: 96%
- Mallampati: 2
- Thyromental distance: 3 finger breadths
- CBC was within normal limits
- HGB: 10.8 g/dL
- HCT: 31.8 g/dL
- TSH: 5.18

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Anesthetic Course

- Pre-induction
  - 20 gauge peripheral IV, Midazolam 1 mg IV, 20 gauge arterial line
- Intravenous induction
  - Lidocaine 100 mg, Propofol 200mg, Succinylcholine 180 mg, Ketamine 50mg, IV Methadone 14 mg
- Airway
  - Pre-oxygenated by mask with 10 L/min for 10 minutes, Video laryngoscopy facilitated placement of 7.0 cuffed ETT, ventilator was used to maintain oxygenation saturation greater than 96% and normal carbon dioxide levels.

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Anesthetic Course Continued

- Intraoperative neurophysiological monitoring
  - SSEP and MEP were applied and baseline waveforms were obtained
- Maintenance
  - Expired sevoflurane at 0.75 MAC, ketamine infusion at 10 mcg/kg/min, lidocaine infusion at 3 mg/min
- Additional medications
  - Cefazolin 2 grams, dexamethasone 10 mg, ondansetron 4 mg

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Intraoperative Issues

- Hypotension
  - Ephedrine 5 mg
  - Ephedrine 10 mg
- Bradycardia
  - Glycopyrrolate 0.2 mg given twice
- Hypertension
  - Labetalol 10 mg

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Anesthetic Course Continued

- Discontinuation of anesthetics
  - Ketamine infusion was turned down to 8 mcg/kg/min 90 minutes prior to extubation
  - Ketamine was stopped 45 minutes prior to extubation
  - Lidocaine infusion was continued until patient was in PACU
- Neurological assessment
  - Improved amplitude in both somatosensory evoked potentials (SSEP) and motor evoked potentials (MEP)
  - Post-op neurological assessment
    - Patient was able to follow commands and move all extremities

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Discussion

Anesthetic Considerations for Intraoperative Neurophysiologic Monitoring

- Prior to the extensive use of intraoperative neurophysiological monitoring, the wake up test was the only way to assess for new onset neurological deficit during spinal procedures
- The two most commonly used types of intraoperative neurophysiological monitoring for the spinal cord
  - SSEP:
    - Provides information regarding the ascending pathway
  - MEP:
    - Provides information regarding the corticospinal motor tract pathway

(Gunter & Ruskin, 2016; Ajiboye et al., 2017; Ajiboye et al., 2016)

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Anesthetic Considerations for Intraoperative Neurophysiological Monitoring

- Baseline SSEPs and MEPs are obtained prior to the start of the procedure
  - A change in latency of 10% and/or a change in amplitude of 50% indicates that a neurological insult is occurring, and an impending neurological deficit could result if the insult is not remedied and the waveforms do not return to baseline
- The waveforms are obtained and the amplitude and latency are monitored throughout the remainder of the procedure

(Gunter & Ruskin, 2016)

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Anesthetic Considerations for Intraoperative Neurophysiological Monitoring

- In order for the spinal cord and the corresponding nerve roots to function appropriately, they must be provided with adequate blood flow, oxygen and at an appropriate body temperature
- Nearly all anesthetics result in a dose-dependent suppression in both MEP and SSEP waveforms
  - MEPs are generally more sensitive to the effects of anesthetic agents than SSEPs
  - Increased latency and decreased amplitudes will occur with a higher MAC value of the inhalational agent
  - The intravenous anesthetics and anesthetic adjuncts that are used produce a varied effect on the evoked potentials

(Rabai, Sessions, & Seubert, 2016; Shils & Sloan, 2015; Gunter & Ruskin, 2016)

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Anesthetic Considerations for Intraoperative Neurophysiological Monitoring

- Inhalational agents
  - A 2016 review of the current literature conducted by Gunter & Ruskin regarding intraoperative neurophysiological monitoring
    - It is likely that SSEPs and MEPs can be conducted with up to a 0.5 MAC of either desflurane or sevoflurane
  - Chong and associates conducted a randomized crossover trial in 2014 of 14 patients undergoing elective spinal surgery to evaluate the effects of sevoflurane and desflurane
    - Sevoflurane is more likely to produce MEP suppression as compared to baseline evoked potentials than desflurane

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Anesthetic Considerations for Intraoperative Neurophysiological Monitoring

- Inhalational agents continued
  - In 2014, Tamkus and associates conducted a retrospective review of 1,814 patient charts. This study focused on the rate of false positives in patients undergoing either a TIVA technique, a balanced anesthesia technique, or solely having inhalational agents for general anesthesia
    - Sevoflurane is associated with more false positives as compared to desflurane
    - Inhalational agents produced more false positives as compared to a TIVA technique

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Anesthetic Considerations for Intraoperative Neurophysiological Monitoring

- Intravenous agents
  - In 2013, Sloan and associates conducted a retrospective case review of 129 patients who underwent spinal surgeries while receiving a TIVA approach either with or without intravenous lidocaine.
    - Lidocaine has no appreciated effect on either SSEPs or MEPs
    - A continuous infusion of lidocaine results in a decrease in the total amount of propofol, opioids, and MAC value of an inhalational agent that are required for the case

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Anesthetic Considerations for Intraoperative Neurophysiological Monitoring

- Intravenous agents continued
  - In 2015, Rozet and associates performed a double blind, randomized control trial with 40 patients undergoing spinal surgery to determine to effects of dexmedetomidine
    - Dexmedetomidine generally has little to no effect on SSEPs or MEPs
    - If a loading dose is given too fast and the depth of anesthesia is deepened too quickly, both SSEPs and MEPs will be adversely affected

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Anesthetic Considerations for Intraoperative Neurophysiological Monitoring

- Intravenous agents continued
  - Propofol can cause a dose dependent suppression of SSEP and MEP
  - When ketamine is given as a continuous infusion, it has no effect on latency, but increases the amplitude of both SSEPs and MEPs
  - Opioids produce a very slight decrease in amplitude and increase in latency with SSEPs and MEPs

(Penney, 2010)

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Recommendations

- Future research studies that could help develop an evidence based gold standard protocol when it comes to intraoperative neurophysiological monitoring include a large scale randomized controlled trial comparing a balanced anesthesia technique to a TIVA technique
- Future research could also explore the potential benefits of administering boluses of lidocaine and ketamine during induction
- Future research could be used to explore the efficacy of administering intravenous methadone during induction, as was done with the patient in this case report

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Recommendations Continued

- There are several different anesthetics and adjuncts that can be used to provide anesthesia for intraoperative neurophysiological monitoring
  - Inhalational agents can pose to be problematic with their effect on amplitude and latency
    - Desflurane is better for monitoring than sevoflurane
    - The TIVA approach is often the preferred method of anesthesia because the majority of the intravenous anesthetics allow for consistent MEP and SSEP monitoring

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Conclusion

- Intraoperative neurophysiological monitoring of SSEPs and MEPs are important tools to help detect potential new onset neurological deficits with spine surgery
- There are a variety of anesthesia interventions that can be carried out to ensure optimum conditions for intraoperative neurophysiological monitoring
  - Maintaining adequate blood pressure, oxygenation/ventilation, and temperature
  - Following the specific parameters that are required to maintain consistent SSEP and MEP waveforms

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Anesthesia Considerations for Spinal Anesthesia in Infants

Cody Grassel, SRNA

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Case Information

- Orchiopexy, inguinal hernia repair, and circumcision
- 14 days old
- 2.54 kg
- Male
- ASA 2

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Pre-operative Evaluation

- Past Medical History
  - Premature birth at 34 weeks
  - Unilateral high scrotal testicle
  - Nutritional intake less than requirements
- No previous surgical history
- Pre-op VS
  - Heart rate 143/min
  - Blood pressure 78/47 mm Hg
  - Respiratory rate 54/min
  - Oxygen saturation 100% on room air
  - Temperature 36.8 C
- Unable to evaluate airway

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Anesthetic Course

- Spinal Anesthesia
  - Lateral position
  - 25 gauge 5 cm spinal needle
  - L4-L5 interspace
- Drugs
  - 80 mg acetaminophen
  - D10 IV at 11 mL/hr
  - 0.6 mL of 0.5% bupivacaine
  - 2 mL of 24% oral sucrose solution x2

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Intraoperative Issues

- About 70 minutes into the procedures the patient started to show signs of discomfort.
- 2 mL of 24% oral sucrose solution was placed on the patients pacifier.
  - Intervention was repeated 5 minutes later.

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PACU

- The patient was transferred to the back to the NICU.
- Vital signs were within normal limits.
- No episodes of postoperative apnea.
- The patient was discharged home 2 days later.

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Neonate Spinal Anatomy

- The spinal cord begins at the medulla oblongata and terminates at L3.
- In neonate's the dural sac terminates at S3.
- The neonate's pia mater is highly vascular.
- The iliac crests represent the levels L4-L5 or L5-S1.
- The vertebral column has one anterior concave curvature.
- Spinal ligaments in neonates are less dense than adults.
- The neonate's lamina are cartilaginous.

(Morton, Foreman, & Albertine, 2011; Gupta & Saha, 2014; Frawley & Ingelmo, 2010)

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Cerebral Spinal Fluid

- In infants the total amount of CSF is 4 mL/kg and neonates as high as 10 mL/kg.
  - In adults the total amount of CSF is about 2mL/kg.
- Neonate's have nearly 50% of the total CSF around their spinal cord.
  - In adults an estimated 33% is around the spinal cord.

(Nagelhout & Plaus, 2014; Gupta & Saha, 2014)

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Hemodynamic Response

- The preganglionic autonomic response during spinal anesthesia in neonates is minimal compared to adults.
- It is related to an immature sympathetic nervous system, decreased peripheral blood volume, and a reduction in vagal efferent activity.

(Libby, 2009; Gupta & Saha, 2014)

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Neonate Spinal Anesthesia

Positioning

- Performed in the sitting or lateral position.
  - Excessive neck flexion can lead to airway obstruction.
- The University of Vermont suggests position to be determined based off of the providers preference.
- The Vermont Infant Spinal Registry performed spinal anesthesia on 1554 infants during a retrospective cohort study.
  - The spinal failure rate was 3.6%.

(Williams, Adams, Aladjem, Kretuz, Sarorelli, & Vane, 2006)

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Neonate Spinal Anesthesia

Spinal Needle Gauges

- Among the reviewed literature, spinal needle gauges ranged form 22-29.
- The distance from skin to subarachnoid space in mm can be estimated by two equations:
  - 0.03 x height in cm
  - 2 x kg +7

(Willams et al., 2006; Gupta & Saha. 2014)

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Neonate Spinal Anesthesia

Complications

- Cardio-respiratory insufficiency
- High or total spinal anesthesia
- Systemic toxicity
- Postdural puncture headache
- Neuraxial hematoma
- Infection

(Gupta & Saha, 2014)

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Neonate Spinal Anesthesia and Local Anesthetics

Dosing

- Neonates require a larger mg per kg dose of local anesthetics compared do adults undergoing spinal anesthesia.
- The increased amount of CSF creates a larger volume of distribution, diluting the local anesthetic.

(Libby, 2009)

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Neonate Spinal Anesthesia and Local Anesthetics

Dosing

- 0.5 mg/kg of hyperbaric bupivacaine (Verma et al., 2014).
- 0.6-0.8 mg/kg of isobaric bupivacaine (Somri et al., 1998).
- 1 mg/kg of bupivacaine (Shenkman et al., 2012).
- 0.4-0.6 mg/kg of tetracaine (Wellborn et al., 1990).
- 0.54 mg/kg tetracaine (Williams et al., 2006).
- 1 mg/kg of tetracaine (Shenkman et al., 2012).

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Neonate Spinal Anesthesia and Local Anesthetics

Duration

- The duration of local anesthetics in neonates undergoing spinal anesthesia is significantly shorter than in adults.
- The increased cardiac output in neonates results in increased blood flow to the spinal cord.
- The increase in blood flow to the spinal cord results in a faster distribution, uptake, and elimination of local anesthetics from the subarachnoid space.

(Libby, 2009)

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Neonate Spinal Anesthesia and Local Anesthetics

Duration

- The addition of epinephrine increases the duration of the block in infants.
- Epinephrine increased the average duration of block from 84 minutes to 109 minutes in hyperbaric tetracaine .
- Epinephrine increased the average duration of block from 70 minutes to 81 minutes isobaric bupivacaine .

(Frawley & Ingelmo, 2010)

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Sucrose

- The uses of 0.05 to 2 mL of 12 to 50% sucrose solution placed on the neonate's pacifier has been shown to provide analgesia for the infant.
- Thought to provide analgesia by directly activating the opioid receptors, enhancing or releasing endogenous opioids.

(Frawley & Ingelmo, 2010)

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Postoperative Apnea

- Postoperative apnea (POA) can be an emergent situation in neonates.
- In the past POA has been reported to occur in 49% of general anesthetic cases involving preterm infants. The more recent literature shows a POA rate of 5%.
- POA has been defined by the length of respiratory pause or respiratory pause associated with bradycardia or decreased oxygen saturation.

(Libby, 2009)

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Postoperative Apnea

- Infants have immaturely developed respiratory central control mechanism being further effected by inhalational agents.
- Inhaled agents produce a decrease in muscle tone resulting in an increased likelihood of upper airway obstruction and lower airway collapse.
- The diaphragm and chest wall are also affected by the decrease in muscle tone increasing the likelihood of hypoxia.

(Jones, Craven, Lakkudi, Foster & Badawi, 2015; Mathew, 2011)

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Postoperative Apnea

- Risk factors for POA include
  - Gestational age less then 60 weeks
  - Previous episode of apnea
  - Anemia
  - Low birth weight
  - Anesthetic agents
  - Bronchopulmonary dysplasia

(Robles-Rubio, Brown, Bertolizio, & Kearney, 2104; Ozdemir & Arikan, 2013)

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Spinal Anesthesia Compared to General Anesthesia

- Kim, Thorton, and Eipe (2009), 133 infants who underwent inguinal hernia surgery.
- Spinal anesthesia
  - 4 of 63 infants experienced POA (6.3%)
- General anesthesia
  - 6 of 60 infants experienced POA (10%)
- Spinal Supplementation
  - 4 of 9 infants experienced POA (44.4%)

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Spinal Anesthesia Compared to General Anesthesia

- Davidson et al. (2009) a cohort study of 129 infants undergoing inguinal hernia repair.
- Spinal Anesthesia
  - Early apnea occurred in 0 of 29 infants.
  - Late apnea occurred in 1 of 29 infants.
- General Anesthesia
  - Early Apnea occurred in 6 of 91 infants
  - Late apnea occurred in 5 of 91 infants.
- Spinal Supplementation
  - Early apnea occurred in 3 of 7 infants.
  - Late apnea occurred in 0 of 7 infants.

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Spinal Anesthesia Compared to General Anesthesia

- Davidson et al., (2015) 722 infants undergoing inguinal hernia repair involved in the randomized control trial.
- Awake Regional Group
  - Postoperative apnea occurred in 6 of 286 infants (2.1%).
    - Early apnea occurred in 1 of 286 infants.
    - Late apnea occurred in 6 of 286 infants.
- General Anesthesia Group
  - Postoperative apnea occurred in 15 of 358 infants (4.2%).
    - Early apnea occurred in 12 of 358 infants.
    - Late apnea occurred in 7 of 358 infants.

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Spinal Anesthesia Compared to General Anesthesia

- Gurri et al. (2016) cohort study of premature infants undergoing inguinal hernia repair.
- Regional Anesthesia
  - POA occurred in 10.8% of infants.
- General Anesthesia
  - POA occurred in 15.5% of infants.
  - 20% remained intubated 4 hours postoperative.

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Spinal Anesthesia Compared to General Anesthesia

- Sormi et al. (1998) conducted a randomized control trial involving 40 high-risk infants undergoing inguinal hernia repair.
- Spinal Anesthesia
  - 1 of 17 infants developed apnea at 10 and 14 hours postoperatively.
- General Anesthesia
  - 7 of 20 infants developed apnea.
  - 4 remained on mechanical ventilation postoperatively.

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Recommendations

- In neonates, spinal anesthesia can be preformed on inguinal hernia repairs.
- The procedure should be expected to be less than 90 minutes.
- Preoperative and intraoperative sedatives should be avoided.
- Positioning of the patient should be based on the anesthesia providers preference.
- The midline approach should be preformed.
- 0.5-1.0 mg/kg of bupivacaine.
- 0.5-1.0 mg/kg of tetracaine.

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Conclusion

- Neonatal spinal anesthesia has many differences compared to adults.
- Spinal anesthesia has been shown to decrease the incidence of postoperative apnea in infants under going inguinal hernia repair.
- Spinal anesthesia does not eliminate postoperative apnea, however it does eliminate the risk factors associated with general anesthesia.

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Effect of Intravenous Ondansetron on Blood Pressure when Administered Prior to the Establishment of Subarachnoid Anesthesia

Brandon Boyd, SRNA

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Introduction

- Spinal anesthesia was first used in 1898 using cocaine for an ankle procedure. The patient did develop nausea and a headache (Wulf 1998).
- It is commonly used today for procedures involving the perineum, lower extremities, and abdomen.
- Hypotension is a known and common effect of spinal anesthesia.
- **Prevalence of spinal-induced hypotension (SIH) is cited between 15-33%** (Tubog, Kane, and Pugh, 2017) **to as high as 80%** (Wang et al., 2014).
- Patient factors, comorbidities, and technique may attribute to the varying prevalence.

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Detriments of SIH

- **Non-obstetric populations**
  - Patients with comorbidities such as HTN or vascular disease are at risk for cerebral or myocardial ischemia when exposed to dramatic decreases in BP
  - Interventions to correct BP drops d/t spinal anesthesia might not be tolerated by certain patient populations (heart failure, severe CAD)

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Detriments of SIH

- **Obstetric Populations**
  - Gomez et al. (2014) list complications from SIH including "maternal nausea and vomiting, in severe cases unconsciousness, pulmonary aspiration, and placental hypoperfusion with fetal hypoxia, acidosis, and neurologic injury" (p. 138).

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Pathophysiology of SIH

- Local anesthetics are injected into the subarachnoid space
- As LA spreads from the injection site, the concentration gradient decreases resulting in a differential blockade
- Type B autonomic nerve fibers (sympathetic pre-ganglionic fibers) are of the most susceptible to LA
- Sympathetic neurons tend to be blocked up to six spinal segments above somatic sensory fibers

(Nagelhout & Plaus, 2014)

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Pathophysiology of SIH

- Vasomotor tone is influenced by autonomic efferent fibers arising from T5-L1. Blocking these results in vasodilation.
- Cardiac accelerator fibers arise from T1-T4. Blocking these results in bradycardia.
- Overall result of blockade of sympathetic fibers causes arterial vasodilation, decreased SVR, venous pooling, and decreased venous return.

(Nagelhout & Plaus, 2014)

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Pathophysiology

- **Bezold-Jarisch Reflex (BJR)**
  - Cardioinhibitory reflex (bradycardia, hypotension)
  - Induced by activation of serotonin (5-HT) receptors (Trebelsi et al., 2017)
  - Serotonin is released in response to hypotension
  - Activation of 5-HT2 receptors located in veins and arteries causes vasoconstriction (Terkawi et al., 2015)
  - Activation of 5-HT3 receptors in cardiac ventricles and on the vagus nerve induces vasodilation and bradycardia (Terkawi et al., 2015)

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Ondansetron

- Serotonin receptor subtype 3 (5-HT3) antagonist.
- Commonly used as an antiemetic as it blocks 5-HT3 receptors in the chemoreceptor trigger zone of the medulla (Vargo Anesthesia, 2012).
- Will also block 5-HT3 receptors peripherally, including those within the cardiac ventricles and on the vagus nerve (Trebelsi et al., 2017).

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Ondansetron Adverse Effects

- Most common include diarrhea, fever, and headache (Butterworth, Mackey, & Wasnick, 2013).
- QT prolongation can occur with 5-HT3 antagonists; more often with dolasetron but, has not been linked clinically to adverse arrhythmias (Butterworth, Mackey, & Wasnick, 2013).
- **Concerns of prenatal adverse effects (spontaneous abortion and development issues)…** Wang et al. (2014) **explored this and determined that ondansetron in appropriate doses is not associated with an increased risk.**

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Case Information

- Total knee arthroplasty
- 64 year-old
- 5'2"
- 72.5 kg
- Female
- ASA 2

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Pre-operative Evaluation

- Past Medical History: Asthma, GERD, HTN
- Surgical History: Tubal ligation, rotator cuff repair, and knee arthroscopy
- No known drug allergies
- Home medications: albuterol, Celebrex 200 mg, gabapentin 100 mg, and hydrochlorothiazide 25 mg
- Pre-op VS: BP 138/84, HR 74, RR 16, SpO2 95%, Temp 98.9 degrees F
- No abnormal pre-op labs or studies
- Airway evaluation was unremarkable

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Anesthetic Course

- Patient received 2 mg midazolam in pre-op
- In OR at 0631; 4 mg ondansetron IV given and 500 mL bolus of LR started
- Patient attached to standard monitoring
- Supine BP 135/85 (101), HR 79, SpO2 100%, RR 14
- Per MDA an additional 6 mg midazolam given
- Patient seated on OR table and spinal administered at 0645 in one atraumatic attempt at L3-4 space
- 1.6 mL bupivacaine 0.75%, and 25 mcg Fentanyl

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Anesthetic Course

- After spinal, patient immediately placed supine and propofol infusion started at 12.5 mcg/kg/min
- Oxygen applied at 3 liters per minute via nasal cannula
- One gram of cefazolin and one gram of tranexamic acid administered
- **First post block BP 109/68 (88), HR 68**
- **Ten minutes post block BP 101/60 (73), HR 68** for which 100 mcg phenylephrine given

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Anesthetic Course

- **This was the only vasopressor dose given**
- Tourniquet up at 0708, incision at 0710
- Throughout SBP ranged from 98-120 mmHg, DBP ranged from 53-68 mmHg.
- Lowest MAP encountered was 68, this was 85 minutes post-SAB and occurred after tourniquet was let down
- HR throughout ranged from 58-80 BPM
- Tourniquet down at 0801 (total time 53 minutes)

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Anesthetic Course

- After tourniquet let down, a second gram of tranexamic acid was given
- Propofol infusion d/c'd at 0813
- Total LR given was 1.2 liters
- EBL 225 ml

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Intraoperative Issues

- Hypotension (relative) for which phenylephrine (100 mcg) given
- Difficulty determining height of block due to amount of midazolam given prior to block administration

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PACU

- Patient to PACU at 0831; BP 108/64, HR 61, SpO2 100%, RR 14
- Surgeon realized he forgot to place subcutaneous sutures and decided to do so in PACU
- 2 additional mg midazolam given to facilitate this
- Patient tolerated well, no complications

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IV Ondansetron to Attenuate SIH

- Reviewed 13 RCTs
- Methods of each study were similar but there is variability between them
- Differences in studies include:
  - Dose of LA
  - Adjunct medications used in the spinals
  - Use of colloid or crystalloid pre- or co-loading
  - Definitions of hypotension & the threshold for treating hypotension
  - Patient populations and demographics
  - Dose of ondansetron

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IV Ondansetron to Attenuate SIH

- **8 of the studies determined pre-treating with IV ondansetron did reduce the incidence of SIH**; 5 determined the incidence was unchanged
- Not all addressed vasopressor doses for correcting SIH; seven of the studies cited that patients who were pretreated with ondansetron required less

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IV Ondansetron to Attenuate SIH

- **Non-Obstetric Populations**
  - Marashi et al. (2014) looked at 3 study groups (70 patients per group), placebo group, 6 mg ondansetron group, and 12 mg ondansetron group.
  - 17% of placebo group developed hypotension (defined as MAP < 80)
  - **No hypotension noted in the intervention groups**
  - Two studies by Owczuk et al. (2008 & 2015) had similar findings with 8 mg doses of ondansetron

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IV Ondansetron to Attenuate SIH

- **Obstetric Populations**
  - Varying results
  - Trabelsi et al. (2015) showed a difference in SIH incidence between a control group (n = 40; **77.5%** incidence) and 4 mg ondansetron intervention group (n = 40; **37.5% incidence**).
  - Ortiz-Gomez et al. (2014) showed no difference in incidence between control group, and three study groups which received 2 mg, 4 mg, and 8 mg ondansetron, respectively. **However, those that received 4 mg and 8 mg ondansetron required half as much ephedrine to treat hypotension.**

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IV Ondansetron to Attenuate SIH

- Another Barrier
  - Almost no studies addressed other factors that can cause hypotension such as:
  - Pitocin administration
  - Propofol infusions
  - Tourniquet use and metabolic byproducts

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Recommendations

- Additional, more uniform, studies should be completed to determine the actual effectiveness of using IV ondansetron to attenuate SIH
- It can be recommended to administer 4 mg ondansetron IV prior to SAB
  - Lack of risk/adverse effects
  - There is potential for diminishing hypotension which carries negative consequences
  - Likelihood of decreasing vasopressor medication use (cost saving)
  - Most of these patients will receive ondansetron during the case anyway (no additional cost)

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Conclusion

- With this recommendation, it needs to be realized that this practice cannot fully replace the current strategies of mitigating SIH (fluid bolus, vasopressors, etc).
- It should be looked at as an additional strategy to be used in conjunction with the tools that already exist.
- Anesthesia providers should use case-to-case judgement

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Thank You
Are There Any Questions?

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Tranexamic Acid Utilization in Cesarean Section Patients

Justin Heinz, SRNA

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Cesarean Section

- Cesarean section rate is 32%
- **Postpartum Hemorrhage (PPH) is leading cause of maternal morbidity and mortality**
  - Responsible for ¼ of all maternal death
  - **166,000 PPH cases per year in U.S.**
  - 1/3 of mothers affected in developing nations
- Anemia complication
  - Some developing countries have anemia rates as high as 70%

(Goswami et al., 2013; Wang et al., 2015)

Pathophysiology

- **Cardiovascular changes**:
  - Heart rate increases 20-30%
  - Cardiac output increases up to 40%
  - Blood volume increases 25-40%
    - Plasma volume increases 40-50%
    - RBC volume increases 20%
  - SVR decreases 20%

(Nagelhout & Plaus, 2014)

Pathophysiology

- **Respiratory changes**:
  - Capillary engorgement
    - Airway edema, narrow glottic opening, friable tissue
  - Minute ventilation increased 50%
  - **Oxygen consumption increased 33%**
  - Functional residual capacity decreased
  - Expiratory reserve decreased
  - Residual volume decreased

(Nagelhout & Plaus, 2014)

Pathophysiology

- **Coagulations changes**
  - Fibrinogen, D-dimer, plasminogen & Factors VII, VIII, IX, & X are all increased
  - Plasminogen activator inhibitors increased
  - Fibrinopeptide A, Beta-thromboglobulin, & platelet factor IV are increased
- 0.7-1.7:1000 venous thromboembolism risk

(Cunningham et al., 2018; Gong et al., 2016)

Case Information

- Surgical Procedure
  - *Repeat*, elective cesarean section
- Pertinent Patient Information
  - 24 years old
  - 5'4"
  - 113kg
  - ASA 3
  - No known allergies

Pre-operative Evaluation

- Past Medical History
  - GERD & Asthma
  - Gravida 3, Para 2
  - Uneventful pregnancy
- Surgical History
  - Emergent cesarean section
- Pre-operative vital signs
  - BP 118/66, HR 89, RR 18, O2 saturation 100%
- Labs
  - **Hgb 12.0g/dL, Hct 35.8%,** Platelets 327,000
- Airway Evaluation
  - Mallampati II, thyromental distance 3 fingerbreadths, neck FROM

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Anesthetic Course

- Lactated Ringers 800 mL preload
- Subarachnoid Block
  - 1.4 mL 0.75% Bupivacaine; Fentanyl 20 mcg
  - 25 gauge Pencan needle; midline approach
- Nasal Cannula 3L
- Lactated Ringers infusion 3200 mL
- Pitocin 30units
- Ofirmev 1g
- Ondansetron 4mg
- Total Anesthesia time: 129 minutes

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Intraoperative Issues

- Nausea and Hypotension 6 minutes after SAB
  - Symptoms continued for 12 minutes
  - Treated with Ephedrine for a total of 30 mg
  - Urine output 50 ml/hr
- **Increased Blood Loss**
  - **EBL @ 1200+ mL**

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PACU/Postop

- Asymptomatic
  - Denied pain, dizziness, lightheadedness, & nausea/vomiting
- Vital signs stable
- Postop Day 1
  - **Hgb 9.1g/dL; Hct 30.5%**
- No transfusion
- Discharged day 3 on iron supplements

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Cesarean Section

- Anesthetic plan depends on maternal status, fetus status, urgency, and patient desires
- General Anesthesia
- Spinal Anesthesia
  - Advantages: decreased mortality (less failed intubations), better neonatal outcomes (less depressant drugs), less blood loss, & mom is awake
  - Became technique of choice over epidural in early 1990's when pencil-point needles were created

(Benhamou & Wang, 2009; Ni et al., 2017)

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Cesarean Section Complications

- **Hypotension**
  - Occurs in 60-70% of C-sections with SAB
  - Accompanied with Nausea/Vomiting
  - Can lead to decreased level of consciousness, uteroplacental hypotension, and cardiovascular collapse
  - Treated with fluids and vasopressors
- **Blood loss**
  - Vaginal (500 mL) vs C-Section (800-1000 mL)
  - Hemorrhage not clearly defined
    - (EBL 1500-2500 mL; Hgb drops 4 g/dL; 4 units RBCs transfused)

(De Lange et al., 2012; Nagelhout & Plaus, 2014; Ni et al., 2017)

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Blood Loss Treatment Options

- **Fluids**
  - Crystalloid (e.g. LR, 0.9% normal saline) 3x EBL
  - Useful for small to moderate blood loss
- **Transfusions**
  - Restore intravenous volume and maximize oxygen carrying capacity
  - Transfusion products: RBCs, FFP, Platelets, and Factor VII
  - Maintain adequate intravascular volume and blood pressure with crystalloid fluids until there is substantial blood loss or indication of organ ischemia (ASA)
  - Recommended to use a hemoglobin transfusion threshold of 7 g/dL in a hemodynamically stable obstetric patient
  - No significant differences in morbidity and mortality when using a hemoglobin transfusion threshold of 7 g/dL versus 8 g/dL
- **Pharmacologic Options**
  - Pitocin, Methergine, Hemabate
  - **Tranexamic Acid ??**

(ASA, 2012; Frigo et al., 2017; Yazer & Triulzi, 2016)

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Tranexamic Acid

- Synthetic derivative of the amino acid lysine that exerts its anti-fibrinolytic effect through the reversible blockade of the lysine binding sites on plasminogen and plasmin molecules
- Administered intravenously in various dosing regimens
  - Bolus: per kilogram or standard dose
  - Infusion: 1mg/kg/hr most common
- Has not been shown to alter BP, HR, RR, prothrombin time, Hgb, and platelets

(Ahmed et al., 2015; Xu et al., 2013)

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Tranexamic Acid

- Half-life 2-3 hours
- Cleared by kidneys
  - Impaired renal function is not a contraindication, but using a lower dose over longer interval should be considered
- Does pass placenta
- Side effects:
  - Mild: Gastrointestinal & Neurological
  - Severe: DVT
- Contraindications: Acquired defective color vision, hypersensitivity, active intravascular bleeding, & subarachnoid hemorrhage
  - Relative: vascular occlusive events, taking another procoagulant or hormonal contraception

(Ahmed et al., 2015; Mayeux et al., 2016)

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Tranexamic Acid in Non-Obstetric Cases

- **Cardiac Surgery**: Cochrane review found no difference in morbidity & mortality
  - Blood loss reduced by 273 ml
- **Orthopedic Surgery:** Cochrane review of TKA/THA
  - Intraoperative blood loss reduced by 116 ml & postoperative by 229 ml
- **Trauma:** TXA is being incorporated in resuscitation and massive transfusion protocols
  - Study of 10,000 trauma patients found TXA reduced bleeding and death

(Henry et al., 2011; Mayeux et al., 2016)

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Tranexamic Acid in Obstetrics

- During cesarean section, fibrinogen and fibrin are quickly degraded due to activation of the fibrinolytic system when the placenta is removed
  - Process can last 6-10 hours postpartum
- Tranexamic acid has a role in offsetting this process of increased degradation products, as it is an antifibrinolytic agent

(Senturk et al., 2013; Xu et al., 2013)

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Tranexamic Acid in Obstetrics

- **Studies of TXA given prior to cesarean section to determine efficacy of reducing intraoperative blood loss**
- 1 gram
  - Study of 660 patients
    - Total blood loss: 499 ml vs 600 ml
    - Drop in Hgb: -1.4 g/dL vs -2.2 g/dL
  - Study of 740 patients
    - Total blood loss: 241 ml vs 510 ml
    - Drop in Hgb: -0.48 g/dL vs -1.42 g/dL
- 10mg/kg
  - Study of 124 patients
    - Drop in Hgb: -1.1 g/dL vs -2.4 g/dL
  - Study of 100 patients
    - Total blood loss: 329 ml vs 545 ml

(Abdel-Aleem et al., 2013; Ahmed et al., 2014; Ali et al., 2011; Gungorduk et al., 2011)

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Tranexamic Acid in Obstetrics

- Study of anemic patients with Hgb values between 7 and 10 g/dL (90 patients) that compared doses of TXA
  - 10 mg/kg: blood loss 146 mL less than control
  - 15 mg/kg: blood loss 262 mL less than control
- Meta-Analysis that included studies that used TXA dosages of 10 mg/kg, 15 mg/kg, and 1 gm
  - Total blood loss: Average of 141 mL less than control
  - Drop in Hgb: -0.45 g/dL vs -1.3 g/dL

(Goswami et al., 2013; Wang et al., 2015)

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Tranexamic Acid in Obstetrics

- All studies reviewed did not find an increase in adverse events in patients who received TXA
  - This included events of DVT
- Some studies also found that the control groups needed to use additional uterotonics

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Recommendations

- Based on evidence found, there appears to be a role for TXA in cesarean section patients
- Thorough preoperative evaluation is important to determine if patient is at risk for increased blood loss
- Determine if patient is anemic or has a history of anemia
- Further studies would be beneficial to determine most effective dose and timing of administration
  - Study patients beyond 24 hours
  - Larger studies of effects on neonates

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Conclusion

- Case Review
- TXA has shown to decrease total blood loss and lessen the drop in hemoglobin when compared to placebo groups
- TXA has proven to have a safe pharmaceutical profile
- TXA is currently being used successfully in multiple other areas of surgery

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Thank You
Are There Any Questions?

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