Cerebral A-V fistula excision in a parturient

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Case Presentation

• 25 y, 33wks gestation
• 65kg, 172cm
• ‘worst headache of her life’
  – Left sided headache
  – Associated nausea & vomiting
• Visual disturbances, No diplopia
• Right nasal inferior quadrant anopia
• No significant past medical history
Patients CT scan – what does it show?

A. Meningioma
B. Giant Aneurysm
C. Hematoma
D. Brain Abscess
Sorry – I disagree

Try again
CORRECT !!
Left Occipital intraparenchymal **hematoma** – 2.9x2.1cm

Subdural hematoma – Left cerebral hemisphere & tentorium

Area of rounded enhancement adjacent to the hematoma – **vascular malformation**
Carotid Angiogram

- Showed dural AV fistula (DAVF) in the left occipito-parietal region (arrow)
- DAVFs are small connections between dural arteries and veins or a venous sinus
- DAVFs are associated with hormonal changes during pregnancy leading to increased angiogenesis
- Possible interventions are Neuroradiologic endovascular Radiation therapy Surgery
Which statement about intracranial vascular malformations is true for a pregnant patient?

A. Increased risk for hemorrhage from AV Malformation
B. Increased risk for rupture of Cerebral Aneurysm
C. Lower risk of re-bleeding from AVM
D. Pregnancy related mortality of ICH is < 1%
Sorry – I disagree

Try again
CORRECT !!
Pregnancy & ICH/SAH

• SAH – ruptured aneurysm (65%); AVMs (35%)
• Increased risk of aneurysm rupture
  – Increased blood volume & cardiac output
  – Hormonal changes to the arterial wall
• Pregnancy does NOT increase the risk of hemorrhage from AVM, but risk of re-bleed is 25%, compared to 3-6% in 1 year in a non-pregnant woman
• ICH accounts for 7% of all pregnancy-related mortality
• Maternal mortality is approx. 20%
Treatment plan for our patient

Patients was not considered a candidate for endovascular treatment.

Surgical plan was left parieto-occipital craniotomy and resection of dural AV fistula with intra-operative angiogram.
Anesthetic Management

A few common unique concern between OB Anesthesia and Neuro Anesthesia are mainly based on Organ Blood Flow: Brain vs. Uterus

- Monitoring
- Positioning
- Ventilation
- Anesthesia Maintenance
- Other pharmacologic concerns
Per ASA / ACOG joint statement, indications for intraoperative fetal monitoring in this case include:

A. The fetus is viable
B. Obstetrician is available
C. Pt. gave informed consent to emergency C-Section
D. Fetal monitoring is physically possible
E. All of the above
Sorry – I disagree

Try again
CORRECT!!
Intraoperative electronic fetal monitoring may be appropriate when all of the following apply:

• The fetus is viable
• It is physically possible to perform intraoperative electronic fetal monitoring
• A provider with obstetrical surgery privileges is available and willing to intervene during the surgical procedure for fetal indications
• When possible, the woman has given informed consent to emergency cesarean delivery
Monitoring

- Team approach: Neurosurgery, OB, Anesthesiology
- Standard ASA monitoring
- A-line for tight blood pressure control and ABGs
- Obstetrician: Cardio-Tocography (CTG)
  - Pre-induction, intraoperative, postoperative
  - Present in the OR throughout
  - To assess fetal status (heart rate, variability)
Fetal Monitoring

• Fetal heart rate and its variability
• Uterine tocography
• Loss of fetal heart variability is not always an indicator of fetal distress
  – Could be the effect of drugs on fetal ANS
• Fetal bradycardia is more concerning
  – But could be hypothermia, maternal respiratory acidosis, drugs which slow the heart rate
Avoid Fetal Asphyxia

- Avoid hypoxia & hypotension!
- Maternal hypoxia & hypocarbia
  - Uterine vasoconstriction
  - Utero-placental hypo-perfusion
  - Shift of Oxy-Hb dissociation curve to left
- Maternal hypercarbia causes fetal acidosis
- Maternal hypotension
  - Causes fetal ischemia
  - Treat with Phenylephrine not Ephedrine
  - Phenylephrine causes less fetal acidosis
Hemodynamic considerations

• A-line monitoring – controlled BP
• Maintain Cerebral and Uterine perfusion
  – Appropriate fluid administration
  – Avoid aorto-caval compression
  – Vasopressors – phenylephrine, ephedrine
• Central venous access
  – Administration of vasoactive drugs
  – CVP monitoring (aneurysms)
  – Aspiration of air embolism
What would be the best position in our case scenario to avoid aorto-caval compression?

A. Supine
B. Prone
C. Left lateral decubitus
D. Right lateral decubitus
CORRECT!!
Goal: Avoid Aorto-Caval compression
   Allow optimal surgical access
   • Gel boulder under left shoulder & flank
   • Rt lateral decubitus (Lt craniotomy)
   • Hips straightened to access the femoral artery for arteriogram
   • Lead apron over the abdomen to protect fetus
Right lateral decubitus position for uterine displacement and surgical access
Which of the following comparison between Propofol/Remifentanil TIVA and Volatile Agents is NOT correct?

A. Volatile Agents may interfere more with MEP / SSEP
B. TIVA may improve neonatal neuro-behavioral performance
C. Volatile Agents may add a tocolytic effect in premature labor
D. Volatile Agents may increase CBF, CBV
E. TIVA always causes increase in ICP
Sorry – I disagree

Try again
CORRECT !!
Anesthetic Management

• TIVA or “half-TIVA” may be preferred if neurophysiologic monitoring is planned
• Inhalational agents may result in increased latency and amplitude of electrical signals at MAC > 1.0
• MAC > 0.7 - 1 should be avoided due to increase of cerebral blood flow and increase in ICP
• TIVA is associated with reduced neonatal neuro-behavioral performance compared to volatile anesthetics after C-Section
• Volatile anesthetics add tocolytic effect if premature labor occurs
Anesthetic Management

The following approach was chosen for our patient:

• Induction
  – Propofol, fentanyl, rocuronium

• Maintenance
  – Propofol 50-100 μg/kg/min
  – Remifentanil 0.1-0.2 μg/kg/min
  – Desflurane 0.3 MAC + FIO2 -0.7

• Lidocaine 2% at the Mayfield pin sites
• Dexamethasone + Ondansetron
• IV acetaminophen 1 gm
Maternal Hyperventilation can lead to ...

A. Uterine hyperperfusion
B. Right shift of maternal Oxy-Hb dissociation curve
C. Fetal distress
D. Uterine atony
E. Increased ICP
Sorry – I disagree

Try again
CORRECT !!
Hyperventilation

• Hyperventilation: brain “relaxation” for improved surgical exposure and access to the surgical field
• Some maternal hyperventilation is physiologic in pregnancy (normal PaCO₂ in pregnancy – 28-32 mmHg)
• Further maternal hyperventilation (PaCO₂ <25 mmHg)
  – Uterine artery vasoconstriction
  – Leftward shift of maternal Oxy-Hb diss. Curve
    • Fetal hypoxia
• Hyperventilation to treat ICP
• Recommendations for raised ICP (PaCO₂ 25-30 mmHg)
Anesthetic Management

Mechanical ventilation

• TV – 500; f – 15; aim to keep ETCO$_2$ - 30-32 mmHg
• CTG showed fetal bradycardia and it was noted that the ET CO$_2$ decreased to 26-27 mmHg
• The ventilator rate was reduced to 10/min
• ETCO$_2$ -32 mmHg and the fetal decelerations resolved
Which statement about fluid management of this patient is IN-correct?

A. **Avoid Glucose containing solutions**
B. **Anemia in pregnancy is physiologic**
C. **Mannitol causes fetal dehydration**
D. **If un-crossed-matched blood is transfused – avoid Rh negative units**
E. **Hypotonic i.v. fluid can contribute to cerebral edema**
CORRECT !!
Raised ICP – Fluids and Diuretics

- Mannitol
  - accumulates in the fetus
  - fetal hyper-osmolality
  - fetal dehydration
  - reduced fetal lung fluid
  - 0.5 mg/kg appears safe

- Furosemide
  - Additive effect, to be used cautiously

- IV fluids
  - Isotonic, glucose-free
  - Minimize the expansion of cerebral edema
Transfusion

• Keep in mind:
  - physiologic (dilutional) anemia of pregnancy
  - fibrinogen is normally increased in pregnancy

• If massive bleeding – high pre-defined FFP:RBC ratio to avoid coagulopathy

• If no time to obtain typed/cross-matched blood, type-O, Rh-negative blood is recommended.
  (Rh-negative to avoid Rh sensitization in childbearing aged women)
What drug or drug combination should be avoided in this patient?

A. Rocuronium
B. Vecuronium
C. Neostigmine / Glycopyrrolate
D. Neostigmine / Atropine
E. Succinylcholine
Sorry – I disagree

Try again
CORRECT !!
Neuro-Muscular Blockade

• Transfer across the placenta as measured in the umbilical fetal vein and maternal artery (F:M ratio)
  – Non-Depolarizing Agents – minimal (0.06)
  – Succinylcholine – negligible
  – Neostigmine – limited
  – Atropine – significant (0.9)
  – Glycopyrrolate – (0.23)

• Use Atropine for reversing NM blockade to avoid fetal bradycardia
Recovery and follow-up

• Extubated in the OR
• Transferred to Neuro ICU on nasal oxygen with monitoring
• In the NICU, fetal monitoring was continued
• Discharged home on 3\textsuperscript{rd} post-op day
• Uneventful C-Section at 38 wks under Spinal Anesthesia
Post-operative Analgesia

• Appropriate postoperative analgesia - to avoid hemodynamic changes
• Multimodal approach to decrease opioid requirements
• Opioids - increased incidence of PONV
• Sedative effects of opioids may complicate post-operative assessment
• Consider scalp blocks after craniotomy
• Transverse abdominis plane (TAP) block after c-section to reduce opioids requirements.
Summary

• Optimize & Maintain
  – Normal maternal physiology
  – Utero-placental blood flow & oxygen delivery

• Avoid
  – Unwanted drug effects on the fetus
  – Stimulating the myometrium
  – Awareness during GA
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