Neurosurgery & Pregnancy

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Dr. Wayne Rubenstein

Not his wife
Physiological Changes

Pregnancy

- Immunological
- Hormonal
- Intravascular Volume
- Intra-abdominal Pressure
- Hypercoagulability
- Delivery-Related Increases in ICP
Physiological Changes

Cardiovascular

- 3 Major Changes
  - Increased Blood Volume
  - Increased Cardiac Output
  - Decreased Blood Pressure
    - 70% Dec Total Peripheral Resistance
- Adaptive / Protective mechanism ensuring perfusion to fetus and protecting mother from effects of blood loss associated with delivery
Literature

- Scant Neurosurgical Series
- Few Pts studied in these series
- Pathology is Mixed
  - Tumor
  - Vascular
  - Hydrocephalus
  - Trauma
Neurosurgical management of intracranial lesions in the pregnant patient: a 36-year institutional experience and the review of the literature
Aaron Cohen-Gadol, Jonathan Friedeman, Jennifer Friedman, Shane Tubbs, James Munis, Frederic Meyer
JNS, Vol 111, Dec 2009

- Mayo Clinic
- 34 Pregnant Pts with brain lesions
  - 14 pts Vascular
  - 14 pts Tumor
  - 4 pts Trauma
  - 2 pts Hydrocephalus
Incidence of Neurosurgical Conditions in Pregnancy

**Brain Tumors**

- 3.6 / 1,000,000 to 3 / 100,000

**Accelerated Growth**

- Immunotolerance
- Increase E₂, Prg
- Increase Cardiac Output

**Vascular Abnormalities**

- 0.01 - 0.05 %
Indications for Acute Neurosurgical Intervention

- Significant Mass Effect
- Significant Shift
- Hydrocephalus
- Impending Hemiation
Indications for Acute Neurosurgical Intervention

- Two lives at risk
- Timing of intervention depends on neurological status of mother
- Obstetric concerns important but secondary
Intracranial Hemorrhage & Pregnancy

- Rare
- 0.01-0.05% of All Pregnancies
- Responsible for 5-12% Maternal Deaths
Neurosurgery & Pregnancy

- Cerebral Aneurysms
- Arteriovenous Malformations
- Venous Sinus Thrombosis
Neurosurgery & Pregnancy

- Cerebral Aneurysms
- Arteriovenous Malformations
- Venous Sinus Thrombosis
Cerebral Aneurysms

- **Incidence:** 0.2-7.9%
- **Etiology:** Congenital, Hypertensive, Embolic, Infectious, Traumatic
- **Usually located at Branch Points of Major Cerebral Arteries**
Cerebral Aneurysms

- Rupture produces Subarachnoid Hemorrhage
- “Worst HA Of Life”
- Life Threatening
- Significant Morbidity and Mortality
Cerebral Aneurysms

- 10% Die on Rupture
- 66% Severely Injured or Dead 1 month after SAH
Cerebral Aneurysms in Pregnancy and Delivery: Pregnancy and Delivery Do Not Increase the Risk of Aneurysm Rupture
Young Woo Kim, Dan Neal, Brian Hoh
NS, Vol 72, Number 2, Feb 2013

- Univ of Florida, Catholic Univ, Korea
- 1988-2009
- Nationwide Inpatient Sample Data
- Calculated Risk of Aneurysm Rupture
  - Pregnancy & Delivery
    - Observed # Ruptured Anrsms (Preg or Deliv) / Expected # Based on Incidence in Population
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Diagram:
- NIS DATA, 1988-2009 (N ≈ 160 million)
- All pregnancies (N ≈ 20 million)
  - Pregnancies with delivery (N ≈ 17.3 million)
    - Ruptured aneurysm (N=172)
    - Unruptured aneurysm (N=218)
  - Pregnancies without delivery (N ≈ 2.7 million)
    - Ruptured aneurysm (N=714)
    - Unruptured aneurysm (N=193)
Cerebral Aneurysms in Pregnancy and Delivery: Pregnancy and Delivery Do Not Increase the Risk of Aneurysm Rupture

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- 48,873 Hospitalized for Pregnancy had Unruptured Aneurysm
  - 714 Hospitalized for RUPTURED Aneurysm During Pregnancy
- 318,128 Hospitalized for Delivery Had Unruptured Aneurysm
  - 172 Hospitalized for RUPTURED Aneurysm During Delivery
- Assumed a Prevalence of 1.8% of Unruptured Aneurysm among all women of pregnancy age
- Reported Incidence of Aneurysmal Rupture in Pregnancy 3-11 per 100,000
- Risk of Rupture During Pregnancy 1.4%
- Risk of Rupture During Delivery 0.05%
- Similar to General Population
Cerebral Aneurysms in Pregnancy and Delivery: Pregnancy and Delivery Do Not Increase the Risk of Aneurysm Rupture

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- Is Treatment a Predictor of Mortality for Ruptured Aneurysms with Pregnancy and with Delivery?
  - Mortality Rate with Pregnancy 9.5%
  - Mortality Rate with Delivery 18%
  - Mortality Rate (P) NO Treatment 10.2%
  - Mortality Rate (P) ANY Treatment 5.2%
  - Mortality Rate (D) NO Treatment 20.4%
  - Mortality Rate (D) ANY Treatment 6.7%

- No Statistical Significance difference was found between Coiling vs Clipping
Is Treatment a Predictor of Neurological Status at Discharge for Ruptured Aneurysms with Pregnancy and with Delivery?

- Poor Outcome Rate with Pregnancy: 14.6%
- Poor Outcome Rate with Delivery: 23.7%
- Poor Outcome Rate (P) NO Treatment: 15%
- Poor Outcome Rate (P) ANY Treatment: 11.8%
- Poor Outcome Rate (D) NO Treatment: 25.7%
- Poor Outcome Rate (D) ANY Treatment: 13.6%

No Statistical Significance difference was found between Coiling vs Clipping
Cerebral Aneurysms in Pregnancy and Delivery: Pregnancy and Delivery Do Not Increase the Risk of Aneurysm Rupture

Young Woo Kim, Dan Neal, Brian Hoh
NS, Vol 72, Number 2, Feb 2013

- Incidence of Vaginal Delivery or Cesarean Delivery for Pts with Unruptured Aneurysm
  - C-Section 25.52% in pts with NO Documented Anrsm
  - C-Section 70.18% in pts with Anrsm
Management of Ruptured Cerebral Aneurysms in Pregnancy
Management of Ruptured Cerebral Aneurysms in Pregnancy

- Same as for non-pregnant pts
- Based on Neurological rather than Obstetrical criteria
- Most studies show Treatment (Clipping or Coiling) provides improved outcome and lower mortality than Non-Treatment
Management of Ruptured Cerebral Aneurysms in Pregnancy
Coiling Vs Clipping
Management of Ruptured Cerebral Aneurysms in Pregnancy

Coiling Vs Clipping

- Clipping has been more commonly performed than Coiling
  - Trends are changing
- Concern regarding prolonged radiation exposure to developing fetus with coiling
Management of Ruptured Cerebral Aneurysms in Pregnancy

Coiling Vs Clipping


- Effects of radiation on fetus depend on dose and stage of fetal development
- Used phantom study, exposed it to XRT during a “typical” Coiling
- The Dose of XRT is still several magnitudes below that which naturally occurs
Conclusion

- Coiling can be safely performed if abdomen is shielded, fluoroscopy is limited in proximity to uterus, use of newer X-ray imaging devices and fetal monitoring if possible
Neurosurgery & Pregnancy

- Cerebral Aneurysms
- Arteriovenous Malformations
- Venous Sinus Thrombosis
Arteriovenous Malformations

- Rare
- 0.01% Population
- Congenital Abnormalities
- Arise from primitive but abnormal AV connections
Arteriovenous Malformations

- Risk of Rupture 1-4%
- Symptoms
  - HA
  - Seizures
  - Weakness
- Hemorrhage
  - 10-20% Death
  - 20-30% Morbidity
Arteriovenous Malformations

- Treatment Options
  - Observation
  - Surgical Resection
  - Gamma Knife Stereotactic Radiosurgery
  - Endovascular Obliteration
Arteriovenous Malformations

- **A.R.U.B.A. Study**
  - A Randomized trial of Unruptured Brain AVMs
- **No Treatment was Superior to Any Treatment**
- **Controversial**
  - Follow Up
    - 3 Years
Arteriovenous Malformations

Pregnancy

- Unclear if pregnancy actually increases the incidence of AVM rupture
- Multiple Retrospective Studies with conflicting results
  - Robinson et al JNS 41: 63-70, 1974
    - 10-87%
    - 3-4%
- Other studies impugn 2nd and 3rd Trimester with increased hemorrhagic risk (Due to increased CO)
- Overall risk of AVM rupture in pregnancy 1 in 10,000
Arteriovenous Malformations

Pregnancy

- Labor & Delivery is NOT associated with increased AVM rupture
  - Forest et al. Stereotact Funct NS 61(Suppl 1). 1993
  - Horton et al. NS 27. 1990

- Therefore, several groups (but not all, believe Vaginal Delivery is acceptable alternative to C-Section
CASE

- 34 year old female
- 30 weeks gestation
- 2nd child
- Acute onset of Severe HA, N/V
- Neurologically Intact
Gamma Knife Radiosurgery
Gamma Knife surgery is a bloodless surgery for neurological diseases. The surgery does not require the skull to be opened for performance of the operation. The patient is treated in one session and can normally return home shortly after treatment.

The method facilitates treatment of very small targets deep within the brain.

The radioactive beams are focused on the target in the brain with extremely high precision and without damaging healthy tissue.
Neurosurgery & Pregnancy

- Cerebral Aneurysms
- Arteriovenous Malformations
- Venous Sinus Thrombosis
Venous Sinus Thrombosis

- Uncommon form of stroke
- Affects mostly young
- 0.5-1% of Strokes

Risk Factors:
- Thrombofilia, IBD, Cancer
- Pregnancy, Dehydration, Infection
- OCP, Substance Abuse
- Head Trauma
Venous Sinus Thrombosis
Venous Sinus Thrombosis
Venous Sinus Thrombosis

- **Pregnancy / Post-Partum**
  - Highest Risk in first 2 weeks Post-Partum
  - 1/10,000 Child Births
- **Symptoms**
  - HA
  - N/V
  - Seizures
  - Hemiparesis
  - Papilledema
  - Blurred Vision
  - Altered Mental Status
Venous Sinus Thrombosis

- Diagnosis
  - CT
Venous Sinus Thrombosis

- **Diagnosis**
  - MRI/MRA
Venous Sinus Thrombosis

- **Diagnosis**
  - Cerebral Angiography
Venous Sinus Thrombosis

Treatment

- Management is complicated
  - Measures that counteract thrombosis (AC)
  - Increase Risk of Hemorrhage
Venous Sinus Thrombosis

Treatment

- Treat Infection if this is the cause
- HEPARIN IV gtt
- Avoid Steroids
- Control Hypertension
- Anti-Convulsants
- Monitor ICP Neurologic exam compromised
- Surgery – Decompressive Craniectomy
- Long-term AC with Coumadin
Venous Sinus Thrombosis

Prognosis

- 30% Mortality
- Poor Prognosticators
  - Coma
  - Rapid Neuro Decline
  - Fixed Neuro Deficit
  - Large and/or Deep Hemorrhages
  - Deep Venous Involvement
Conclusions

- The Incidence of Cerebral Aneurysms, AVMs, and Venous Sinus Thrombosis in the Pregnant patient is relatively low.
- Neurological Status of the patient is the main driver of treatment.
THANK YOU