Pregnancy in Military Aviation
Hazards, Risks, and Controls

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Disclosure

• The views expressed are those of the author and do not necessarily reflect the views of the United States Air Force or the United States Government.

• I have no relevant financial relationships to industry.
Pregnancy in Aviation

• Pregnancy is not a disease by itself
• Pregnant women can fly safely, properly assessed
• Pregnancy is associated with often unrecognized aeromedical risk

• Uncertainty in hazards-
  – Variable physiology across pregnancies
  – Variable physiology within pregnancies
  – Limited research

• Understanding the risks within a collective collaboration among providers can control risk and improve safety
Aeromedical Hazards of Pregnancy

- Physiological changes
- Pregnancy-specific conditions
- Preexisting medical conditions
- Effects on medication use
- Environmental effects on mother
- Environmental effects on fetus
- Increase risk individually and in combination
Physiological Changes
Often Unrecognized or Imperceived

- Hypercoagulability
- Hemodynamics
- Cardiovascular
- Gastrointestinal
- Pulmonary
- Endocrine

- Vision
- Renal
- Immune
- Ergonomic
- Sleep Pattern
- Heat Exposure
Physiological Changes

• Vision
  – Corneal thickening affects visual acuity
    • Related to corneal edema
    • Begins as early as first trimester
    • Variable within and across pregnancies
  – Visual acuity checked at least every 2 weeks
    • when asymptomatic
  – Vision checked promptly for visual symptoms
  – Contact lens use is not recommended for correction

Distribution A: Approved for public release; distribution is unlimited. Case Number: 88ABW-2013-2293, 13 May 2013
Physiological Changes

• Hypercoagulability
  – **Pregnancy is a hypercoagulable state**
    • VTE 5-fold increase: #1 cause of maternal mortality (9% of deaths)
    • VTE: 1-2 /1000 pregnancies; 1.1 deaths/1000 pregnancies
    • 70-80% DVT; 15-25% PE; 50% during and 50% postpartum
    • Changes: Fibrinogen, vWF, Factors (V, VIII, X), plasminogen
  – **Preexisting thrombophilia further increases risk**
    • Factor V Leiden- 20-25% of all VTE in pregnancy
    • Screening not generally recommended
    • Factors for screening may be identified by history
  – **Venous stasis**
    • Pelvic vascular compression; Periods of inactivity
Physiological Changes

• Hemodynamics
  – Increased blood volume
    • Increased plasma to red cell mass ratio: relative anemia
    • Decreased oncotic pressure:
      – favors generalized edema
      – Increased susceptibility for pulmonary edema
  – Iron deficiency - maternal
    • Increased iron use for fetal requirements
  – Oxygen disassociation curve – pH change
    • Respiratory alkalosis favors oxygen transfer to fetus
  – May affect blood pressure, G-tolerance, vision, fatigue
Physiological Changes

- **Cardiovascular**
  - 10-fold increase in uterine blood flow
  - Uterine compression of pelvic veins and vena cava
    - Decrease venous return and cardiac preload
  - **Blood pressure decrease – typical, lowest in 2nd trim**
    - Low resistance in placenta
    - Decreased systemic vascular tone
    - Progesterone relaxes smooth muscle and compliance
    - Decreased pressor response
  - **Effects on G-tolerance, hypoxia tolerance, vision, fatigue**
Physiological Changes

• **Pulmonary**
  - **40% increase in tidal volume**
    • Hyperventilation, hypocapnia
    • Respiratory alkalosis, increased pH,
  - **20% decreases in these lung volumes:**
    • Reserve volume
    • Residual volume
    • Functional residual capacity
  - **More susceptible**
    • Infection and pulmonary edema
  - **Effect on hypoxia tolerance, rapid decompression**
Physiological Changes

• Renal
  – 50% increase in renal blood flow and GFR
  – 60-80% increase in renal plasma flow
  – Medication clearance increased
  – Increased urine production
    • Dehydration, urinary frequency, urgency
  – Progesterone relaxes ureters – decrease motility
    • Ascending infections
    • Nephrolithiasis

  – Effects on G-tolerance, fatigue, distraction, pain
Physiological Changes

• Gastrointestinal
  – Progesterone relaxation of smooth muscles
  – Decreased motility, relaxed LES
  – Increased nausea, retching, and vomiting
    • Hyperemesis gravidarum
  – Anti-emetic: meds, OTC, non-pharm
    • Aviation: noncompatible (meds) vs. compatible (effective?)
  – Effects: distraction, dehydration, pain
Physiological Changes

• Endocrine
  – Diabetogenic state
    • Placental hormones:
      – increase with gestational age and placenta size
    • H. chorionic somatomammotrophin (H. placental lactogen):
      – Prepares breasts for lactation
      – Major contributor to insulin resistance
    • Estrogen and progesterone: some insulin resistance
    • Favors fetal glucose availability
  – Gestational diabetes or glucose intolerance
  – Screened at 26-28 weeks, sooner for risk
  – Management:
    • Diet, Glyburide, Insulin, Metformin
    • Monitoring
Physiological Changes

• Immune System
  – Generalized suppression
    • Tolerance to fetal antigens
    • Susceptibility to infection
  – Vaccinations
    • No live virus vaccinations
      – Except if disease risk exceeds risk to pregnancy (rare)
    • Other vaccines per CDC guidelines
      – Influenza
      – Diphtheria, pertussis, tetanus
      – Others
Physiological Changes

• **Ergonomic**
  – Body size, BMI
  – Breast enlargement
  – Weight distribution
  – Generalized edema
  – Cockpit and safety equipment fittings
  – Egress

• **Sleep**
  – Disturbances more common in pregnancy
  – More common as pregnancy progresses
  – Fatigue issue
Environmental Effects
Heat Exposure

• **Mother**
  – Pregnancy generates more heat
  – Increased maternal BMI
  – Flight gear- heat retention
  – Dehydration
  – Heat intolerance

• **Fetus**
  Heat exposure:
  – Increased birth defects possible
    • Neural tube defects
  – Increased preterm labor possible
Environmental Effects
Fetus

• Noise and Vibration
  – Fetal hearing developed before 20 weeks
  – Newborn hearing deficits possible
  – Excess noise associated with growth restriction

• Radiation
  – 1st trimester greatest risk for possible effects
  – <50 mSv: no effect
  – 10 hour civilian flight average: 0.5 mSv
  – Little effect
  – May be greater for military flights
Pregnancy-Specific Conditions Creates “High Risk” Pregnancies

- Miscarriage
- Ectopic
- Molar pregnancy
- Uterine anomalies
- Incompetent cervix
- Vaginal bleeding
- Unexpected pain
- Congenital defects
- Multiple gestation

- Preterm labor
- Rupture of membranes
- Preeclampsia
  - Headaches/seizure
- Thyroid dysfunction
- Gestational diabetes
- Oligohydramnios
- Chorioamnionitis
- Growth restriction
Preexisting Conditions and/or Treatments

Conditions & potential pregnancy changes:
- Hypertension, thyroid, diabetes
- IBD, IBS, dermatologic
- Migraines, SLE, arthritis
- Psychiatric/psychological
- Others

Medications
- Change to pregnancy-compatible medication
- Adjust dose to fit distribution and clearance
- May be different than what has been tolerated in flight, or those waived for flight.
Military Training Requirements
Aviation

• Aviation Physiology and Safety Training
  – Pool
  – Egress
  – Hypobaric Chamber
  – Hypoxia training

• Not allowed during pregnancy
  – Waived until after pregnancy: USAF
  – Not Allowed and Not Waived: USN
  – Must be considered in waiver disposition
Military Waiver to Continue Flying

• **Waivers**
  – Trained aircrew only
    • Not for untrained or while in-training
    • Instructor pilots – must have qualified co-pilot
  – Special consideration for ATC, GBC, MOD
  – Initiated by the pregnant female
  – Concurrence: Flight Surgeon, OB, and Command

• **General requirements: for physiological considerations**
  – 13-24 weeks USAF; 12-28 weeks: USN, USA, USCG
  – Multi-crew, pressurized, non-high performance
  – Non-ejection seat
Monitoring in Pregnancy

- Ultrasound
  - Normal & Intrauterine
- Accurate dating
  - Waiver period assignment
- Anemia
- Hypotension
- Hypertension
- Training Qualification

- Visual acuity
- Blood sugar
- Infections: pulm/urine
- Pregnancy-specific conditions
- Preexisting conditions
- Medication changes
- Flight associated symptoms
Postpartum

• Physiological change resolution
  – 6 weeks postpartum to resolve
  – 6 weeks for thrombosis risk, greatest in the first week

• Pregnancy-related disease resolution
  – Preeclampsia, diabetes, others: 6 weeks

• Preexisting condition stabilization
  – Reestablish medications and control

• Complications of pregnancy/delivery resolution
  – Depends on delivery method and complication

• Postpartum depression consideration
• Breast feeding consideration
• Physiology qualification status
Hazard Control – Risk Management

- Uncertainty of hazards increases calculated risk
  - Unknown/unrecognized risk – unmanageable
  - Known risks – manageable if recognized

- Pregnancy Uncertainties:
  Anxiety, inconsistency, miscommunication, misperception, misunderstanding, complacency
  - Variability across pregnancies
  - Variability within pregnancy
  - Limited human research
  - Unperceived changes with strong desire to fly
Hazard Control – Risk Management

- A normal pregnancy can fly safely, with ORM
  - Not for high-risk pregnancy
  - Discontinue when risk status increases

- Requires: Coherent Collaboration of Care
  - Flyer, Flight Surgeon, OB Care, Command
    - Different levels and areas of understanding the associated risks
    - Different perception of associated risks
    - Need a Shared Mental Model (TeamSTEPPS)
  - Understanding of hazards and risks
    - Communicate aeromedical, medical, and operational risk
  - Appropriate monitoring and assessment
    - Recognize variable conditions of increased risk:
      - Physiological, Medical, Fetal, Environmental
Pregnancy in Aviation

- Operational medical risk management
- Understanding policy and areas of risk
- Appropriate monitoring and reporting
- Teamwork: coherent collaboration
- Consistent application for female flyers
- Safety for pregnant pilots, aircrew, and fetus
- Appropriate return to flying postpartum
Bibliography


Questions?