

IN SUMMARY
ENERGY IMPACT ON PREGNANCY

ENERGY IMPACT ON PREGNANCY

Hyperthermia

- Hyperthermia promotes in-vivo and in-vitro synthesis of PG
- During hyperthermia inhibition of PG promotes severe acidosis
- Selected PG's induce expression of heat shock proteins (HSP) and induce thermotolerance
- Molecular changes unclear
- Possible role of prostaglandins as protective
- Sheep demonstrate increased prostaglandin plasma levels in mother and fetus
- Inhibition of PG synthesis resulted in fetal death
- Prevent aggregation in the lens (cataract)
- Effect protein folding
- Stabilization of extended chains
- Membrane translocation
- Regulation of heat shock response
- Binding and stabilization/regulation of steroid receptors
- Thermotolerance, proteolysis, resolubilization of aggregates
- Glycoprotein maturation in the ER
- Folding catalysts
- "Quality Control"

Heat Teratogenesis

Non-teratogenic doses of ASA potentiate hyperthermic teratogenesis

Arsenicals, vitamin A, ethanol, Lead

Day 8.5 in rate selected - initial phase of organogenesis

Impairments if somitogenesis (axial skeleton)

Dysraphia of rostral neuropore (exencephaly)

Dose response relationship

Axial skeleton has lower threshold (43°)

79.6% vs. 9.6%

Sensitivity of neural tubes is strain dependent

Ultrasound

- Sound absorbed differently by different media
- Process not well understood
- Temperature rise may be major effect
- Thermal conductivity
- Frequency
- Heat capacity
- Physiotherapy
- Several degrees in 10 minutes
- Total rise over 10 degrees in small volume
- Experimental Pulse Echo >250watts/cm²
- No *gross* effects on fetal development
- ? Intracellular effect
- Levels tested are 100 times greater than in clinical use
- Possible effect of U/S on DNA
- In use >40 years for fetal imaging without any obvious issues
- Most women have >2 U/S per pregnancy
- 40% of All U/S is for OBS use
- Grayscale, B-Mode, 3D, Harmonic imaging, simultaneous multigate imaging
- General belief that it is safe

- Amplitude reduction as u/s wave enters tissue
- Energy is transferred
- Absorption – conversion into heat
- Scatter – part that changes direction
- Thermal indices
- Soft tissue (TIS)
- Bone (TIB)
- Cranial bone (TIC)

Role of Bubbles

- Occurrence of gaseous bubbles in air-water interface
- Transient – violent activity with hot spots
- High temperature
- High pressure
- Both
- Short bursts (microseconds)
- Stable
- Gaseous body oscillates due to presence of US field
- Fluid near bubble starts to flow
- Produces enough stress to disrupt cell membranes

Hyperthermia is proven teratogen

- Biologic tissue exposed to us can produce heat and temp rise
- General threshold is 1.5-2°C above maternal core before teratogenicity
- An increase of 2.5-5° can occur within an hour
- With modern US machine we never see a rise more than 1°C
- No evidence of effect below 39°C
- “diagnostic exposure that produces an in situ rise of no more than 1.5° above normal levels may be used without reservation on thermal grounds”
- “a diagnostic exposure that elevates embryonic and fetal in situ temperature above 41°C for 5 minutes should be considered potentially hazardous.”

- Soft tissue first to be produced embryologically
- Temp rise can be predicted
- Skeleton produced later – no boney effects in first weeks of gestation
- Routine B-mode never causes rise of more than 1.5°C
- In first trimester however there may be greater exposure because of lack of bone protection

Prospective studies - animal only or tissue culture

- No difference in malformations, abortions, stillbirth
- Possible reduction in growth
- Growth gap gone after 3 months

- Few studies dealing with chromosome anomalies and U/S
- Little or no change with one exceptional study
- No epidemiologic data
- Unethical not to perform U/S on a pregnancy
- No difference in childhood malignancies

Microwaves

Effects studied with no effects

- Fish tail tissue
- Mouse testes
- Mouse hepatocytes
- Human erythrocytes
- Firefly light organ
- Drosophila larvae
- Amphibian embryos
- Chick embryos
- Mouse ovaries
- Rat thymus
- Mouse CNS
- Human lymphocytes

Electromagnetic Fields

- increasing generation of electric power during this century is not associated with a concomitant rise in the incidence of birth defects
- Over 70 EMF research projects dealing with animal and in vitro studies that are concerned with some aspect of reproduction and growth
- Large proportion of the embryology studies utilized the chick embryo and evaluated the presence or absence of teratogenesis after 48 to 52 hours of development
- Results of chick embryo data are inconsistent
- Embryo culture or cell culture studies are of little assistance in determining the human risk of EMF
- In vitro or in vivo studies in nonhuman species can be used to study only mechanisms and the effects that have been suggested by human investigations

Video Display Terminals

No evidence of harm in humans due to VLF radiation

FUNDAMENTAL QUESTIONS

1. What teratogenic effects are known to result from hyperthermia?
2. What does the temperature/effect curve look like?
3. Is there a clinical temperature above which a pregnant woman should not be permitted to reach?
4. Describe the tissue effects of ultrasound energy?
5. At what energy levels can one begin to see effects?
6. Are there any demonstrated clinical effects of diagnostic ultrasound?
7. Are there any risks in living near microwave towers?
8. Describe the possible mechanism of action of microwave teratogenesis

