Motivation

Skin reddening after CT overdose

January 22, 2001

• Brenner DJ, et al. Estimated Risks of Radiation-Induced Fatal Cancer from Pediatric CT, AJR 2001
• “CT scans in children linked to cancer”
  – USA Today News
• "Each year, about 1.6 million children in the USA get CT scans to the head and abdomen--and about 1,500 of those will die later in life of radiation-induced cancer, according to research out today."
Consequences: Need optimization education

- Modern medical imaging devices are sophisticated pieces of equipments
- Multiple parameters with competing effects on image quality and dose
- Keep doses ALARA
- Keep benefits AHARA

Consequences: Scared and anxious patients

- Patients and family members seeking expert help after exposures
- Parents in particular calling, in tears, about “what they have allowed to be done to their child”
- One recent call, parent experienced 20 lb weight loss and grandparent was calling to get help

Consequences: Negative impact on care

- 84 y.o. male
- Abdominal aortic aneurysm
- Pre-surgical CT Angiogram ordered
- Leaves message for physician “requesting that his CT ‘with the cancer-causing stuff’ be changed to an ultrasound”
- Numerous cancelled appointments after each round of media coverage

Consequences: Can be lethal

- 30 y.o. professional female
- Pregnant with much anticipated first child
- Physical exams reveals neck/armpit nodules
- Chest CT and mammography performed to investigate (fetal dose essentially zero)
- Mother and father consider “therapeutic abortion” on counsel of (non-Mayo) primary physician

Malformation

<table>
<thead>
<tr>
<th>Likelihood of having a healthy baby (i.e. no malformations)</th>
<th>0 mGy</th>
<th>10 mGy</th>
<th>50 mGy</th>
<th>100 mGy</th>
</tr>
</thead>
<tbody>
<tr>
<td>96.00%</td>
<td>95.98%</td>
<td>95.90%</td>
<td>95.80%</td>
<td></td>
</tr>
</tbody>
</table>

From “Exposure to the pregnant patient to diagnostic radiations”, LK Wagner et al. (1997)
Difficulties in discussing radiation risk

- Perception of risk increases when:
  - I can't see it
  - I can't touch it
  - I can't measure it
  - I can't control it
  - Worse still if government or industry controls it
  - I'm not familiar with it
  - Experts tell me to "trust them"

What do our children learn about radiation?
What does society “know” about radiation?

Scientific response: We just need to educate people

Relative Risk

CT dose range

Ave background radiation

No risk

Excess Deaths Per 100 Expected

Dose (mSv)

Natural Background

Reference: Cohen, AJR 2002


The Linear No-Threshold Relationship Is Inconsistent with Radiation Biologic and Experimental Data

Radiology 251 (2009)

CHECKING THE FOUNDATION: RECENT RADIOPHYSIOLOGY AND THE LINEAR NO-THRESHOLD THEORY

Health Physics 99 (2010)
Below 100 mSv, risk estimates are meaningless

- Health Physics Society recommends against quantitative estimation of health risks below an individual dose of 50 mSv in one year or a lifetime dose of 100 mSv (above that received from natural sources)
- Below 50–100 mSv, risks of health effects are either too small to be observed or are nonexistent

This is so logical. Why isn’t it working?

People don’t really think rationally

Especially when it comes to risk

Perception of Risk

- Paul Slovic, Professor of Psychology
- Science, 1987
- Psychometric paradigm of risk perception
- To experts: risk means statistical odds of harm
- Logical, factual, scientific, quantifiable, data driven

Perception of Risk

Paul Slovic
Risk Estimation (Odds) ≠ Risk Perception

- To public/patients: risk means so much more than odds
  - How bad/scary is it (impact vs. odds)
  - How will it affect my loved ones
  - How much control do I have
  - Can I trust the experts
  - Do the experts have my best interest in mind
  - My family and I are too valuable to take chances with
  - Am I “safe”

What We Do and Don’t Know about Radiation Risk in Diagnostic Radiology

- Risk Estimation versus Risk Perception
  - Cynthia McCollough
- Biology Versus Epidemiology: The Need for an Integrated Model of Radiation Risk
  - Richard Vetter
- An Analysis of Recent Literature Regarding Radiation Risk
  - Louis Wagner and John Boice
- BEIR VII: What It Does and Doesn’t Say
  - Michael O’Connor