Ten Steps to Image Gently
Clinician Version

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Purpose

- Increase awareness of the Image Gently Campaign
- Provide goals to achieve the lowest imaging dose in the everyday clinical practice
- Propose simple practice changes which can be applied to the daily clinical and imaging setting
Content Organization

• Introduction

• Ten steps of the Image Gently Campaign
  – Clinical implication
  – Example practical application

• Post-presentation short assessment
Introduction

- The number of CT examinations performed annually continue to rise
  - More than 60 million performed per year
  - 4-7 million performed on pediatric patients

- 1991-1999
  - 11% of exams

- 2002
  - 15% of exams

Weist, Seminars in Ultrasound CT MR. 2002;23:402-10
Radiation Dose Definitions:

• Absorbed Dose (Gray – Gy)
  – Energy absorbed by a volume of matter
  – Difficult to measure - not practical

• Effective Dose Equivalent (Sievert – Sv)
  – Tissue weighting factor
  – Expression of risk *equivalent* to whole body exposure
Biological Effects of Radiation

• **Deterministic effects**
  – There is a threshold
  – Dose dependent: Severity depends on dose

• **Stochastic effects**
  – No threshold
  – Dose dependent: Likelihood of adverse effect if depend on the dose
How do we Study the Long Term Effects of Low Dose Radiation in Children?

• Atomic Bomb Survivor Data
• Medical Radiotherapy Patients
  – Tinea Capitis
  – Tonsilar hypertrophy
  – Thymic enlargement
• Diagnostic Imaging
  – Scoliosis X-rays
  – Inadvertent fetal exposures
Certainties About the Effects of Ionizing Radiation

- High dose radiation (> 100 mSv) is known to increase the risk of cancer

- Children are at higher risk than adults
Risk is Age Dependent

Cancer risk for a 4 year old is likely 3-5 times greater than for a 40 year old

ICRP 60
BEIR V
# Estimated Radiation Doses for 5 Year-Old Child

<table>
<thead>
<tr>
<th>Imaging Area</th>
<th>Effective Dose (mSV)</th>
<th>Equivalent Number of CXRS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-view ankle</td>
<td>0.0015</td>
<td>1/14th</td>
</tr>
<tr>
<td>2-view chest</td>
<td>0.02</td>
<td>1</td>
</tr>
<tr>
<td>2-view abdomen</td>
<td>0.05</td>
<td>2.5</td>
</tr>
<tr>
<td>Upper GI/SBFT</td>
<td>3</td>
<td>150</td>
</tr>
<tr>
<td>Head CT</td>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>Chest CT</td>
<td>3</td>
<td>150</td>
</tr>
<tr>
<td>Abdomen CT</td>
<td>10</td>
<td>500</td>
</tr>
<tr>
<td>Tc-99m radionuclide bone scan</td>
<td>6.2</td>
<td>310</td>
</tr>
<tr>
<td>Whole Body FDG PET/CT scan</td>
<td>15.3</td>
<td>765</td>
</tr>
<tr>
<td>Annual Background Radiation</td>
<td>3.5</td>
<td>175</td>
</tr>
<tr>
<td>Air travel: coast-to-coast round trip</td>
<td>0.03</td>
<td>1.3</td>
</tr>
</tbody>
</table>

[http://www.stuartxchange.org/RadiationExposure101.html#BackgroundExposue](http://www.stuartxchange.org/RadiationExposure101.html#BackgroundExposue)
Uncertainties About the Effects of Ionizing Radiation

- How low level radiation (< 100 mSv) affects the risk of cancer?

- The most widely used estimate of risk of cancer induction due to ionizing radiation is 0.05% per mSv.

- Risk for an abdominal CT = 1 in 4,000
If an institution performs 1200 CT scans per year, how many lives must be saved by CT to balance the risk benefit equation?

ONE

Haaga AJR 2001;177:289-291
• Ionizing radiation from diagnostic imaging slightly increases the risk of cancer

• For an indicated CT scan, the likely benefit is far greater than the estimated risk

• Clinicians and radiologists should work together to make the population exposure ALARA
Ten Steps

1. Increase awareness and understanding of CT radiation dose issues among radiologic technologists (RT)
2. Enlist the services of a qualified medical physicist
3. Obtain accreditation from the American College of Radiology for your CT program
4. When appropriate, use an alternative imaging strategy that does not use ionizing radiation
5. Determine if the ordered CT is justified by the clinical indication
6. Establish baseline radiation dose for adult-sized patients
7. Establish radiation doses for pediatric patients by “child-sizing” CT scanning parameters
8. Optimize pediatric examination parameters
9. Scan only the indicated areas: Scan once
10. Prepare a child-friendly and expeditious CT environment
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When Appropriate, Use an Alternative Imaging Strategy That Does Not Use Ionizing Radiation

- In the **acute** traumatic setting, CT remains the #1 imaging modality

- In the **subacute** and less emergent setting, US or MR should be considered before CT

- In patients with **chronic** illnesses such as IBD or VPS*, MR enterography or quick brain should be the first imaging modality

* IBD (inflammatory bowel disease), VPS (ventriculoperitoneal shunt)
TEN STEPS

Determine if the Ordered CT is Justified by the Clinical Indication

- An open dialogue should be encouraged between the clinical service and the radiologist:
  - To ensure the appropriate examination is ordered
  - To customize individualized protocols to reduce time, cost, and radiation
  - To eliminate unnecessary repeat CTs
Scan Only the Indicated Area and Scan Once

- Limit the volume of the body region scanned

- If the clinical concern is for acute appendicitis, “CT appendicitis” protocol should be used

- Limit multi-phase scanning when it will not alter clinical management
CT Appendicitis Protocol

- Outpatient only

- Only diagnostic consideration is acute appendicitis
  
  ✓ IV contrast ONLY
  
  ✓ Bottom of kidney => pubic symphysis
Conclusion

• Radiation reduction requires vigilance of the clinicians and radiologists.

• Before ordering or approving a CT examination, we should ask ourselves:

  ✓ Can I avoid CT imaging?
  ▪ Example: Use of US rather than CT for pelvic / ovarian pathology
  ▪ Example: Use of MRA rather than CTA for PE diagnosis

  ✓ Can I limit CT dose?
  ▪ Example: CT appendicitis protocol rather than the routine CT abdomen and pelvis, when the clinical concern is localized in the pelvis

  ✓ Is the protocol appropriate?
  ▪ Example: Routine CT with long drink for cases of suspected obstruction or distal bowel pathology to avoid early scanning and possible non-diagnosis, requiring repeat imaging.
References


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Feel Free to E-mail, too

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