Some of us have mutations that affect our ability to repair X-ray induced DNA damage. Should we be screened for this?

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Disclosures

- Dr Murphy invented an antioxidant formulation to predicate patients prior to CT and X-Ray.
Low dose Ionizing radiation (LDIR)

- Cancer risks
- Cardiovascular Risks
- Chronic inflammation from increase of reactive oxygen species (ROS).
- IAEA pays very little attention to this.
- They think we wear our badges.
- Some Cardiologists have been getting a life time dose of 1 Gray.


- Demonstrated significant DNA damage after procedures
- Demonstrated some individuals with greater sensitivity to radiation than others
- Leg protection and individual variation.

Cancer risk related to low-dose ionizing radiation from cardiac imaging in patients after acute myocardial infarction


ABSTRACT

Background: Patients exposed to low-dose radiation from cardiac imaging and therapy have increased risk of cancer. Method: Using an administrative database we selected a cohort of patients who had an acute myocardial infarction in 2011 and 2012 and had a history of radiation exposure from cardiac imaging and therapy. Results: Radiation exposure was associated with increased risk of cancer. Conclusion: Radiation exposure is a risk factor for cancer. The lifetime risk of cancer is increased by 1% in the first year after an acute myocardial infarction.


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- Demonstrated some individuals with greater sensitivity to radiation than others
- Leg protection and individual variation.

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Posterior Chamber Cataract

Figure 1: Nuclear sclerosis showing 1. lens capsule 2. posterior lens fiber 3. nucleus with higher concentration of lens fibrin 4. cortical 5. cataract 6. cataract 7. cortex

Figure 2: Nuclear sclerosis showing 1. lens fibers 2. lens fiber 3. lens fiber 4. lens fiber 5. lens fiber 6. lens fiber 7. lens fiber
Flight Crews are classified as radiation workers

**The Cosmic Radiation Environment at Air Carrier Flight Altitudes and Possible Associated Health Risks**


**Abstract** - The cosmic radiation environment at high flight altitudes is described and evaluated on a group of 118 volunteers with selected exposures. The results are compared with those from various other sources of cosmic radiation. The main difference is the decrease in the relative risk of cancer incidence associated with the space environment compared to that of the general population. The relative risk of cancer incidence in the space environment is 1.19 (95% CI: 0.89-1.58), with a confidence interval of 0.89-1.21 for men and 1.58 for women. The relative risk of cancer incidence associated with the space environment is 0.89 (95% CI: 0.74-1.06), with a confidence interval of 0.74 for men and 1.06 for women.
Preliminary in vitro data with a uric acid based antioxidant cocktail...

Substantial reduction in DNA injury is seen as a result of antioxidant premedication...

A Gel cap 1 hour prior to procedure

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<tr>
<td>Beta-Carotene</td>
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<td>Alpha lipoic acid</td>
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</table>

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References

DNA Repair Mechanisms
- Gamma H2AX, and P53

References

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Cardiovascular Disease Cohort Polymorphisms Protein Function/Pathway Findings

Patients with typical symptoms of ischemic heart disease

- **MRE11A rs2155209 C/T**
- **RAD52 rs7963551 G/T**
- **RAD51B rs17105278 C/T**
- **NBS1 rs2735383 C/G**

**DNA repair**

- RAD52 rs7963551 G/T heterozygotes showed significantly increased hazard of death vs. the combined GG and TT homozygotes.

HUNT Study (Nord-Trøndelag Health Study), Myocardial Infarction (MI) patient subset

- **NEIL3 rs12645561**
- **OGG1 rs1052133**
- **APEX1 rs1878703**
- **XRCC1 rs25489**

**DNA repair**

- Only NEIL3 rs12645561 TT genotype associated with increased MI risk.

We talk about Personalized medicine

- Should we make personalized career choices based on our DNA repair ability

Screening

- Begins with family and personal history.
- If genetic screening occurred one might look at Mutations and SNPs.
- SNPs are more common than mutations.
- Some thoughts

BRCA 1 and 2

- Female and male familial mutations.
- Ethnic and Geographical variations in prevalence.
- Iceland, Scandinavia, Germany Spain France.
- Ashkenazi Jewish population. (80% of the Jewish population).
- Women with BRCA 1 or 2 have a lifetime risk of 65-80% of developing breast cancer and 37-62% of developing breast cancer.
- Men with BRCA 1 or 2 have a 5-25% risk of prostate cancer and 6% risk of Breast Cancer.

TP53 Mutations

- P53 is the guardian of the genome.
- Ensures genetic stability and is key to the repair response.
- 50% of all human tumors carry a P53 Mutation.
- There is a P53 mutation data base.

ATM mutation

- Ataxia Telengiectasis mutation.
- Increases risk of breast cancer, lymphoid tumors.
- Increases radiation sensitivity by decreasing repair ability.
<table>
<thead>
<tr>
<th>Mitochondrial DNA</th>
<th>Screening of Trainees and staff</th>
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<tbody>
<tr>
<td>• Purely maternal transmission.</td>
<td>• Emotionally complex</td>
</tr>
<tr>
<td>• Can occupation radiation exposure result in mitochondrial DNA mutations that</td>
<td>• Ethically complex</td>
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<tr>
<td>cross generations?</td>
<td>• Worth a well informed conversation.</td>
</tr>
<tr>
<td></td>
<td>• We have the data to initiate this.</td>
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Thank You