World Health Organization

Session 3

Radiation effects and health risks from radiation exposure at the workplace

Contributed papers

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Summary of contributed papers

- Two contributed papers from **Iran** and **Egypt**

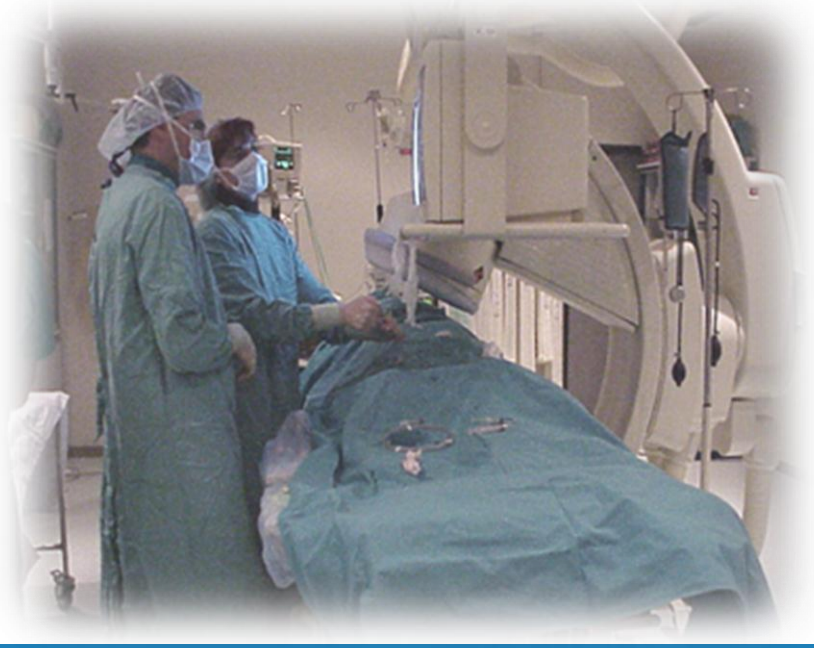
1. ***Occupational Radiation Exposure, DNA Damage and Genetic Polymorphisms in DNA Repair Genes*** *(F. Zakeri et al)*

2. ***Endothelial Progenitor Cells in Peripheral Blood of Cardiac Catheterization Personnel*** *(S. Korraa et al.)*

These papers have two common features

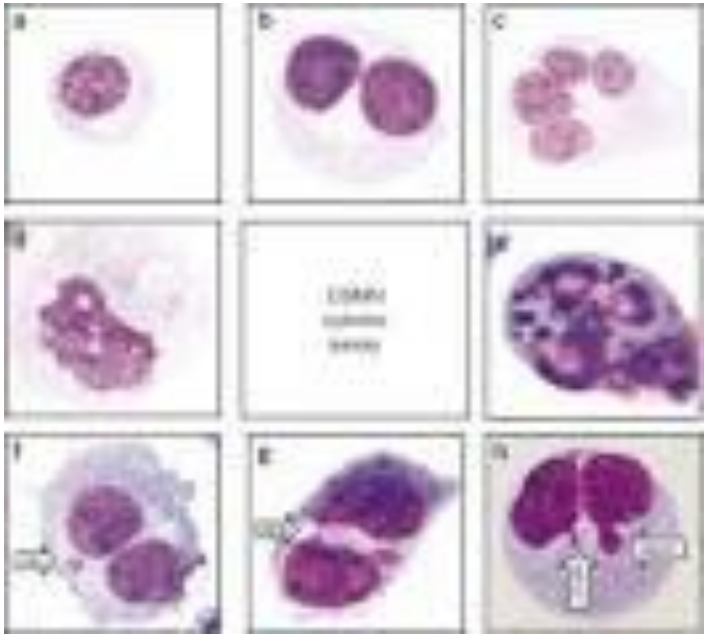
Study population:

- *health workers exposed during fluoroscopy procedures*



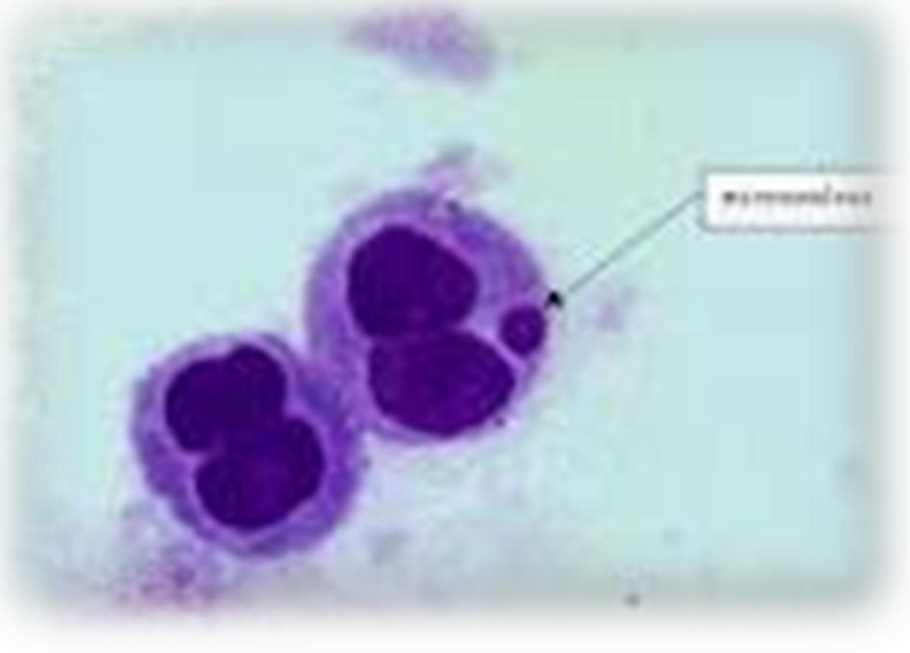
One of the end points:

- *frequency of micronucleus (MN) in peripheral lymphocytes*
  (cytokinesis-block micronucleus assay)



Frequency of MN in peripheral lymphocytes

- The cytokinesis-block MN assay in peripheral blood lymphocytes is a validated technique of biological dosimetry (e.g. accidental exposures). It has been also used to evaluate levels of DNA damage in workers occupationally exposed to radiation.



- *In addition to radiation, other genotoxic agents (e.g. tobacco) can increase the MN frequency.*
- *Baseline MN frequency depends strongly on age and gender.*

Paper N° 131

Occupational Radiation Exposure, DNA Damage and Genetic Polymorphisms in DNA Repair Genes

F. Zakeri[a,b], MR Farshidpour[b], MR Rajabpour[b], MJ Ahmadpour[b], F. Mianji[a,b]

a) *Nuclear Science and Technology Research Institute, Tehran, Iran*
b) *Iran Nuclear Regulatory Authority, Tehran, Iran*

Objective: to determine the relationship between genetic polymorphisms in genes coding DNA repair enzymes and the levels of DNA damage in interventional cardiology staff

Study population

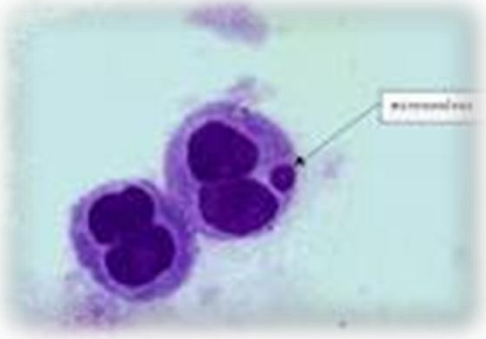
Characteristic	Exposed group[(a)]	Control group
Males	59	38
Females	31	22
Total	90	60
Mean age (years +/- SD)	41.5 +/- 7.6	41.4 +/- 9.1
Mean last year exposure	3.5 +/- 2.7 mSv	-
Mean last 5 years exposure	11.2 +/- 10.5 mSv	-
Mean years of employment	9.5 +/- 6.7	-

[(a)] ***interventional cardiologists, technicians and nurses***

End points in peripheral blood lymphocytes

- **Frequency of micronucleus**

by cytokinesis-block micronucleus test in binucleated cells



- **Single nucleotide polymorphisms (SNPs)**

by polymerase chain reaction combined with restriction fragment length polymorphism (PCR-RFLP genotyping assay)

In genes coding DNA repair enzymes:

1. *XRCC1*
2. *OGG1*
3. *APE1*
4. *XRCC3*
5. *XPG*

Results

- MN frequency significantly higher in:
  - *exposed group vs. control group*
  - *within exposed group >3mSv/y vs. ≤3mSv/y*
  - *within exposed group >10 years vs. ≤ 10 years of exposure*
  - *exposed group carrying SNPS in the genes XRCC3 and XPG*
  - *control group carrying SNPs in the gene OGG1*

Authors' conclusion

- Occupational exposure to IR in interventional cardiologists, technicians and nurses is associated to increased DNA damage (expressed as higher MN frequency).
- DNA damage was higher in individuals carrying genetic polymorphisms in DNA repair enzymes (SNPs), suggesting that this might represent a particularly vulnerable population (mutagenic and cancer risk).
- The relationship between MN and SNPs in genes involved in DNA repair may contribute to evaluate susceptibility to ionizing radiation in individuals occupationally exposed.

Paper N° 168

Endothelial Progenitor Cells in Peripheral Blood of Cardiac Catheterization Personnel

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b) *National Health Institute, Cairo, Egypt*
c) *Faculty of Science, Suez Canal University, Cairo, Egypt*

Objective: to evaluate the level of circulating endothelial progenitor cells and its correlation with DNA damage in staff exposed during fluoroscopy cardiac procedures.

Study population

Characteristic	Exposed group[(a)]	Control group
n Total	70	40
Smokers	34	-
Non-smokers	46	40
Mean age (years +/- SD)	42.8 +/- 5.2	42 +/- 4.8
Annual dose (range)	2.16 – 8.44 mSv/year	-

[(a)] ***Staff involved in fluoroscopy*-guided *cardiac catheterization in 3 hospitals in Cairo, Egypt***

Biological end points

- **Frequency of micronucleus**

by cytokinesis-block micronucleus test in binucleated cells

- **Number of Endothelial Progenitor Cells (EPCs) in peripheral blood (PB)**

by flow cytometry with monoclonal antibodies for CD133, CD34 and kinase domain receptors (KDR)

- **Plasma levels of stromal growth factor (SDF-1)**

using ELISA assay

Results

- The staff involved in fluoroscopy-guided cardiac catheterization (CC) presented:
  - *Significantly higher micronucleus (MN) frequency*
  - *Significantly higher number of Endothelial Progenitor Cells (EPCs) in peripheral blood*
  - *Significantly higher plasma levels of stromal growth factor (SDF-1)*
- Smoker CC staff exhibited higher MN frequency and SDF-1 and lower levels of EPCs than non-smokers

Authors' conclusion

- Staff involved in fluoroscopy-guided cardiac catheterization present and increased MN frequency, which is higher in smokers vs. non-smokers.
- Circulating EPCs numbers and SDF-1plasma levels, which are markers of endothelial activation/damage, are significantly increased in the radiation exposed group.
- The dual effect of IR and smoking (i.e. additive effect on inducing SDF-1 expression as other DNA damaging agents, with an opposite effect on the number of EPCs in peripheral blood) is interpreted as a regenerative process decreased by smoking.
- Further studies are needed to elucidate the role of EPCs as a potential marker of radiation exposure.