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The lens of the eye, exposures in the UK medical sector and mechanistic studies of radiation effects.

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ICRP Symposium 2013



HPA/PHE reviews

Ainsbury et al 2009 *Radiat. Res* **172**: 1-9

- Threshold dose <2Gy, of the order of 0.5Gy
- MAY be more accurately described by a linear non-threshold model
- Uncertainty on mechanisms

Bouffler et al 2012 *J Radiol. Prot* **32**: 419-488

- Epidemiological studies still suggest 0.5Gy threshold
- Strengthening evidence that stochastic processes may contribute
- Endorses ICRP 20mSv/yr occupational limit recommendation



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Small UK medical sector survey

- Three UK hospital radiology depts supporting full range of interventional procedures
- 4 week period, January 2013
- Used PHE headband lens dosimeters
- Supported by questionnaire covering job title, procedures carried out, PPE use
- Funded by Health and Safety Executive



Headband dosimeter



Results - I

61 dosimeters returned:

- Median dose 0 mSv (< 0.15 mSv detection limit)
- Only 13 $>$ PDS minimum detectable dose of 0.15 mSv
- No correlation between type/No of procedures/PPE and dose...
- Maximum dose 1.60 mSv in 4 week period (just over 20 mSv^{-1})



Results - II

58 completed questionnaires:

- Mixture of consultants and registrars
- ~ 1000 procedures of ~ 20 different types
- Median ~ 15 procedures, range ~1 – 70
- Excellent PPE use in general *but* only 9 participants used lead glasses
- Dosemeters worn as per instructions
- DAP information available for all hospitals



Conclusions

- Limited survey, but highest dose procedures in 3 busy radiology depts; > 1000 procedures over 4 week period
- Doses depend on a large number of factors and vary widely, however recorded doses similar or < other studies
- Total of 13/61 doses > 0; 2/61 doses $\geq 20 \text{ mSv y}^{-1}$
 - Without lead glasses
 - Assuming workload same, no holidays
- Excellent PPE use; but only 9/58 participants used lead glasses
- DAP surrogate for operator dose?



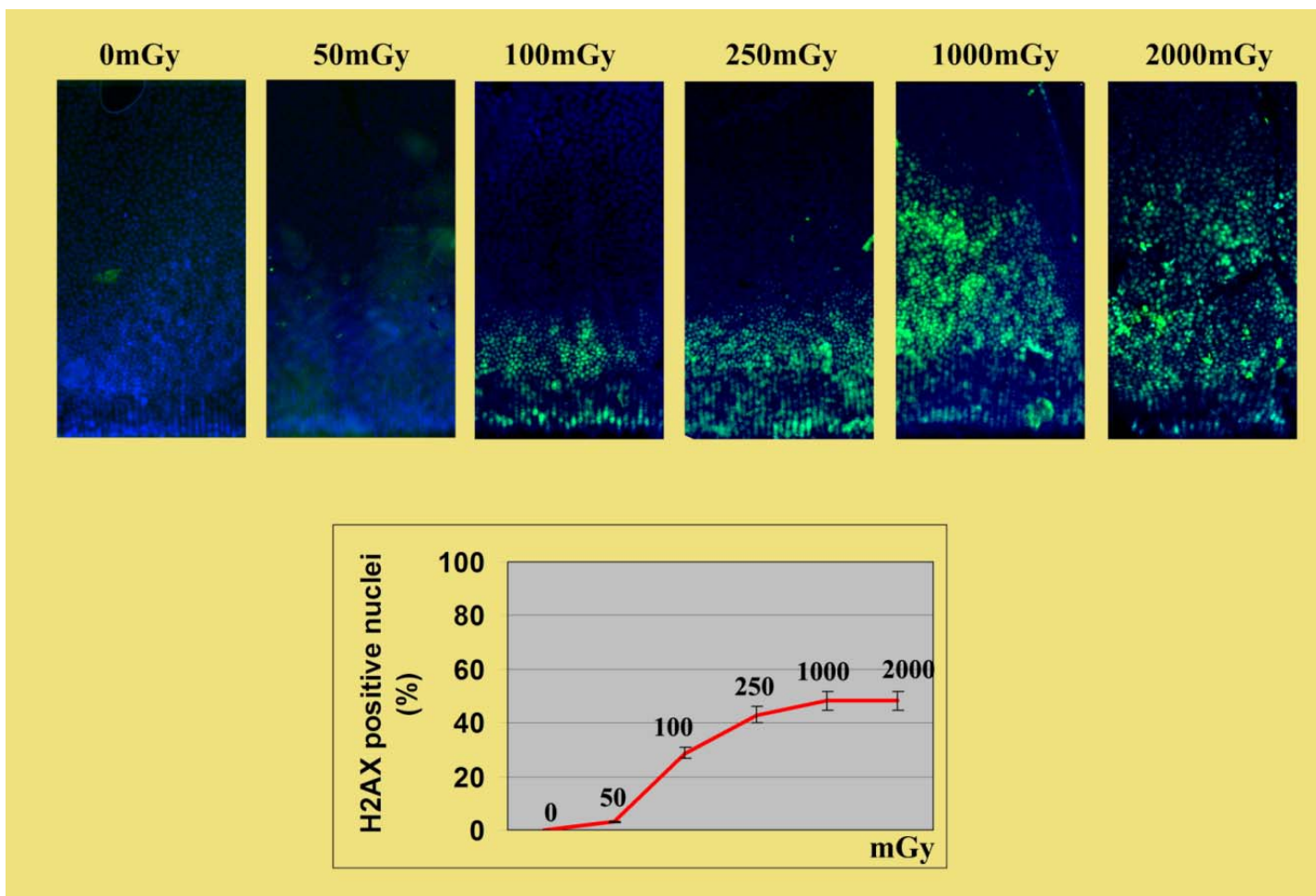
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Mechanistic study

- C57BL/6 mice exposed *in vivo*
- Human and mouse lens epithelia and a LEC cell line
- 20-2000mGy
- Early (24h) and late (1, 3, 6, 10 month) changes
- Multiple end points looking for discontinuities/thresholds in dose-response



DNA Damage



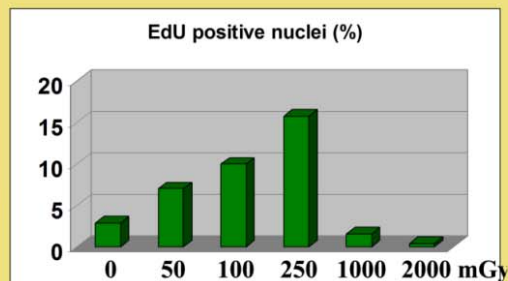
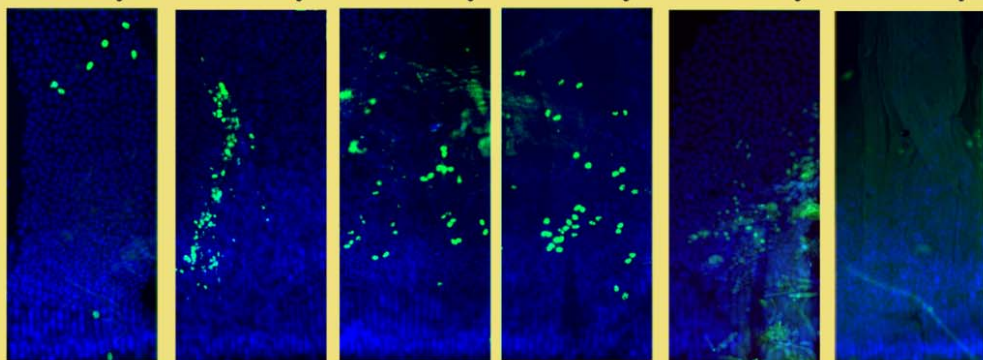
γ H2AX – 24 hours post-exposure



Effects on proliferation

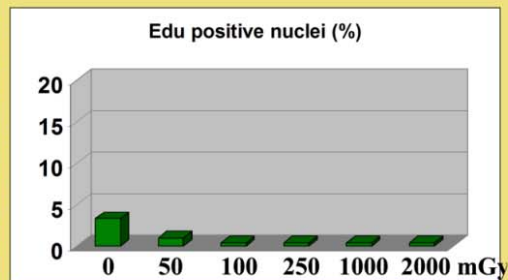
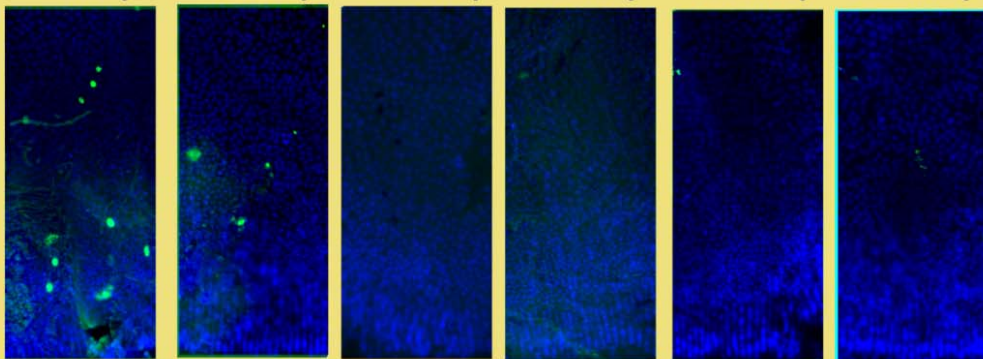
24hrs

0mGy 50mGy 100mGy 250mGy 1000mGy 2000mGy



1month

0mGy 50mGy 100mGy 250mGy 1000mGy 2000mGy





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Additional endpoints/studies

- Morphological assessment of lens fibregenesis
- Cell cycle arrest
- Cellular senescence
- Also looking in blood, skin, whiskers of exposed mice to investigate tissue differences in radiosensitivity



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