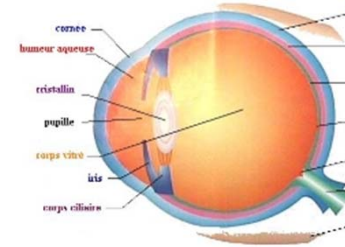


*Sophie Jacob – Alexandre Bertrand – Marie-Odile Bernier (IRSN)*

# Occupational cataracts and lens opacities in interventional cardiology: the O'CLOC Study

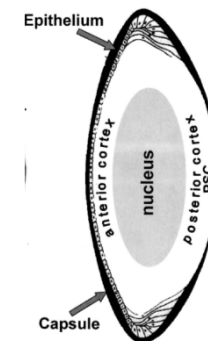
## Cataract or lens opacities?

- Opacification of the lens of the eye



- First cause of blindness in the world
  - Concerns old people in developed countries

- Three most frequent types are:
  - Nuclear
  - Cortical
  - Posterior subcapsular



## Known risk factors of cataract

- Age ++
- Hereditary: congenital cataract
- Diabetes
- Corticosteroids intake
- Exposure to UV
- Tobacco, Alcohol
- Ionising radiations (high doses)
- ...

# Radiation-induced lens opacities: a deterministic effect

- **Eye lens: a radio-sensitive organ**
  - Lens opacities appear after high doses of IR
  - A minimum dose is necessary to induce detectable lens opacities (*NCRP\* 93 report 116, ICRP 1990 pub 60, ICRP 2007 pub103*):
    - **0.5-2 Gy** for a single dose
    - **5 Gy** for fractionated doses
  - Occupational dose limits for ocular exposure recommended by ICRP and NCRP: **150 mSv/year**
- Main consequences of high doses exposure
  - Posterior subcapsular cataracts
  - *Cortical cataracts*

## Radiation-induced lens opacities: dose thresholds questioned

- On the basis of various exposed populations (*H&N survivors, Chernobyl liquidators, patients, airline pilots and astronauts, radiologists and radiological technologists, ...*):
  - Associations between exposure to IR and lens opacities at **doses below the current thresholds** were observed (Review: *Ainsbury EA et al., Rad.Research 2009*)
- ICRP 2007 Pub 103:
  - “The dose threshold for cataract induction and judgements on dose limits for the eye require further attention.”...




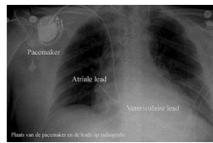
## Radiation-induced lens opacities: Preliminary conclusion

- Recent studies have raised question about deterministic radiation-induced lens effects
  - A lower dose-threshold for radiation-induced lens opacities ?
  - The absence of dose threshold ?
    - Stochastic effect?
- Actual research can not yet confirm the absence of dose-threshold or the need to revise the existing threshold
- New data from exposed human population are still necessary to confirm the absence or lower limit for dose threshold ...

# Interventional cardiology



- Doses received by interventional cardiologist**

Speciality	Procedures	Range of eye doses (μSv) by procedure*
Coronary interventional cardiologists (CIC)	Coronary angiography 	<b>(3.3 → 1117)</b>
	Coronary angioplasty 	<b>(8.7 → 1040)</b>
Arrhythmologists	Ablations 	<b>(47 → 320)</b>
	Pacemaker, intracardiac defibrillator implantation 	<b>(39;50)</b>

➔ **Eye dose may exceed 150mSv/year**

\*based on studies published from 1971 to 2006, Kim *et al.*, 2008

## Interventional cardiology

- Prevalence studies on posterior subcapsular lens opacities**

Country, Year	Exposed group	Observed	Unexposed group	Observed	Chi <sup>2</sup>
North America, 2004	59 radiologists and CIC	37,3% opacities 8% cataracts	None	-	-
IAEA – RELID Study	Bogota, Colombia +Montevideo, Uruguay, 2008/2009	58 CIC	93 unexposed people	12% opacities	P<0.005
	Malaysia, 2010	56 CIC	55 cardiologists	21% opacities	P<0.005



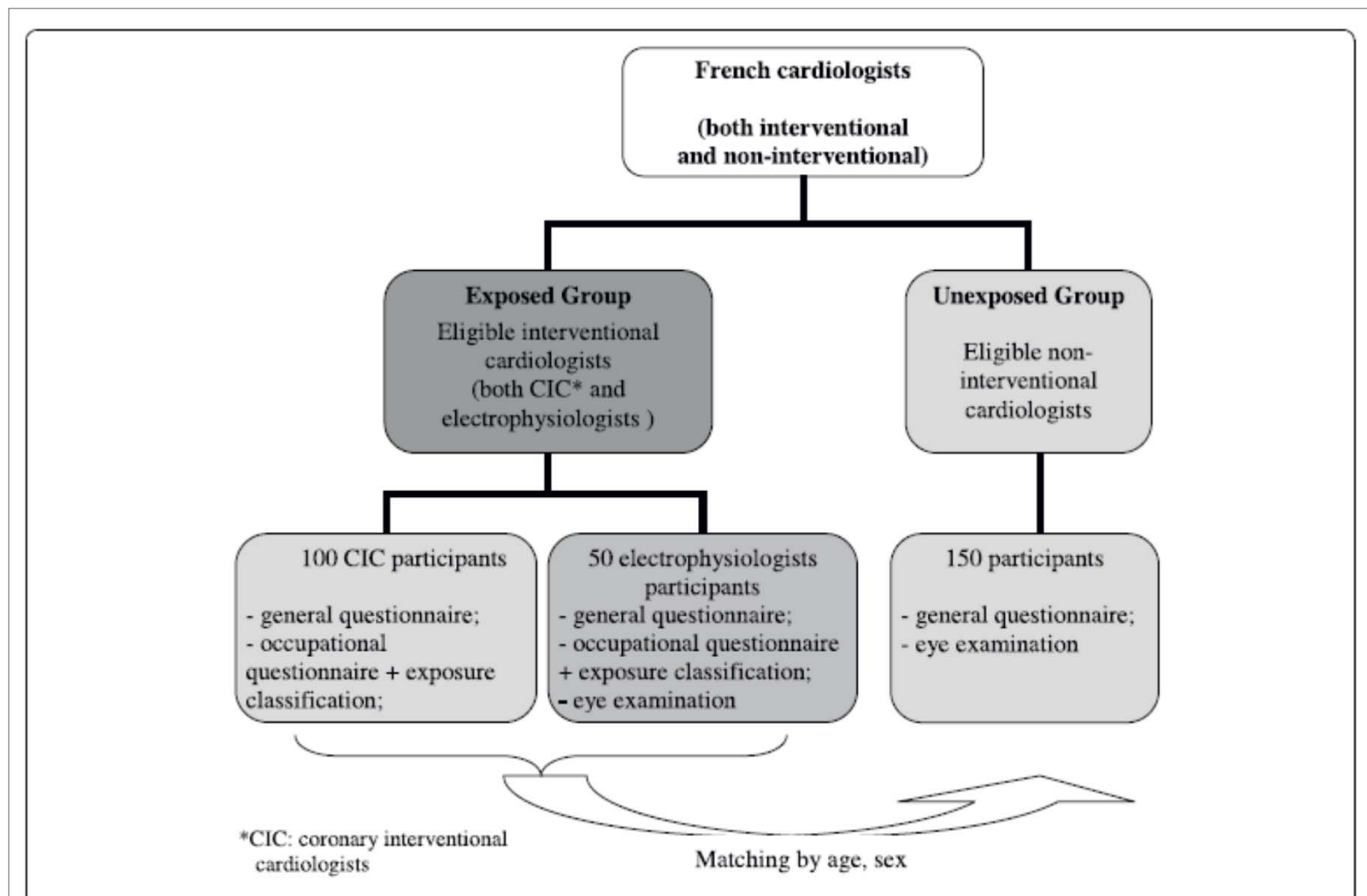
## Interventional cardiologists: a little-studied exposed population

- Exposed to scattered ionising radiation(X-rays)
  - Risks potentially in the same range as those for which early-stage cataracts have been observed
  - **But,**
    - few studies have examined cataracts among interventional cardiologists
    - The cause of the early cataracts identified has not been completely investigated
- ➔ An epidemiological study in this population should provide further knowledge about the potential risk of radiation-induced cataracts in populations with exposure levels thus far considered to be low

## O'CLOC Study

- Occupational Cataracts and Lens Opacities in interventional Cardiology
  - An ongoing study launched in France
  
- **Aims:**
  - Well-designed epidemiological study : hypothesis, events, design, risk factors, exposure,...
  - To test the existence of an increased risk of cataracts among interventional cardiologists compared with an unexposed control group including unexposed cardiologists

# O'CLOC Design : cross-sectional exposed/unexposed study



# O'CLOC Population

- **Recruitment of volunteer interventional and non interventional cardiologists**
  - In major French centers employing CICs and arrhythmologists (public and private hospitals)
- **Inclusion criteria:**
  - Age  $\geq$  40 years (for at least 10 years of interventional activity)
- **Exclusion criteria:**
  - History of significant personal medical radiation exposure (radiotherapy, brain scans)
- **Comparability between exposed and unexposed group**
  - Matching for age and sex

## O'CLOC Collected data – part 1

- **Medical history questionnaire (for all participants)**
  - General characteristics, potential risk factors for cataracts, history of significant exposure to IR

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### Medical information

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Weight

Size

Colour of the eyes

Left or Right handed

Smoking status

Diabetes

Myopia

Corticosteroids intake

History of cancer and radiotherapy

History of treated cataract

History of eye traumatism

Congenital cataract

History of CT scans and localisation

History of significant occupational exposure to ionising radiation for more than 12 consecutive months

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## O'CLOC Collected data – part 2

- **Occupational history questionnaire (for interventional cardiologists)**
  - Lifetime occupational activity and most common types of procedures

**Occupational history**

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List of all centres and periods of activity  
For each period, precise:

- Coronary angiography?
  - Mean number of procedures per week or year
  - Radial or femoral access route
- Coronary angioplasty?
  - Mean number of procedures per week or year
  - Radial or femoral access route
- Pacemaker or intracardiac defibrillator: implantation ?
  - Mean number of procedures per week or year
  - Mean fluoroscopy time per procedure
- Pacemaker or intracardiac defibrillator: resynchronisation?
  - Mean number of procedures per week or year
  - Mean fluoroscopy time per procedure
- Radiofrequency catheter ablation except atrial fibrillation ?
  - Mean number of procedures per week or year
  - Mean fluoroscopy time per procedure
- Radiofrequency catheter ablation of atrial fibrillation?
  - Mean number of procedures per week or year
  - Mean fluoroscopy time per procedure

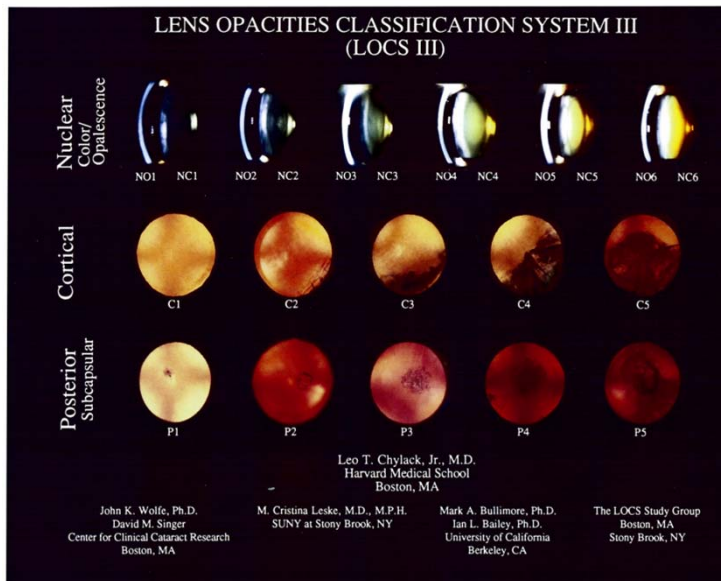
Frequency of use of radiation protection tools:

- Lead apron
- Lead thyroid shield
- Lead eye glasses (goggles)
- Other eye protection
- Lead gloves
- Protective mobile screen
- Radiation protection cabin

Frequency of use of dosimetric badge

## O'CLOC Collected data – part 3

- **Ophthalmologic examinations (for all participants)**
  - Including slit lamp examination and LOCS III classification for lens opacities



For each eye:

History of treated cataract  
 Eyeglasses or contact lenses power (in diopters)  
 Measured refraction (in diopters)  
 Best corrected visual acuity  
 Intraocular pressure  
 LOCS III classification for lens opacities

Nuclear (Color/Opalescence)

No opacities  
 Stages 1 to 6  
 Completely opacified  
 Not evaluable

Cortical

No opacities  
 Stages 1 to 5  
 Completely opacified  
 Not evaluable

Posterior subcapsular

No opacities  
 Stages 1 to 5  
 Completely opacified  
 Not evaluable

Other significant pathologies (glaucoma, etc...)

## O'CLOC Planned analysis

- **Retrospective evaluation of IR exposure**
  - Exposure category level combining:
    - Information collected in the occupational questionnaire
    - Dosimetric follow-up collected in SISERI database
    - Litterature review for specific procedures
  
- **Estimation of cataract risk associated with exposure**
  - For any type of cataract or type-specific
  - For any exposure or by exposure category level
    - Adjustment for potential risk factors, sub-speciality



# O'CLOC Time plan

- **Recruitment**

- October 2009 → April 2011
- September 2010:
  - 121 interventional cardiologists
  - 37 non interventional cardiologists

- **Results should be available by 2011**

- **First publication already available**

- Jacob S, Michel M, Spaulding C, Boveda S, Bar O, Brézin AP, Strehlo M, Maccia C, Scanff P, Laurier D, Bernier MO.  
**Occupational cataracts and lens opacities in interventional cardiology (O'CLOC study): are X-Rays involved?** *BMC Public Health*. 2010 Sep 8;10:537.

# O'CLOC Strengths and Limits

- **Limits**

- Unexposed group: difficulties in the recruitment of non interventional cardiologists
- Retrospective evaluation of exposure
  - Crude assessment for eye doses: category level

- **Strengths**

- Two specialities in interventional cardiology: CIC and electrophysiology
- Not only posterior subcapsular lens opacities

# Conclusion

- **O'CLOC should provide**

- A detailed description of interventional activity and potential IR exposure based on a French sample of interventional cardiologists
  - Including radiation protection tools use
- Arguments to improve cardiologists' awareness of the importance of radiation protection
- Further knowledge on the potential risk of radiation-induced cataracts

**Thank you for your attention!**