

IRSN

INSTITUT
DE RADIOPROTECTION
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Risk of radiation-induced cataract for interventional cardiologists: Results of the O'CLOC study



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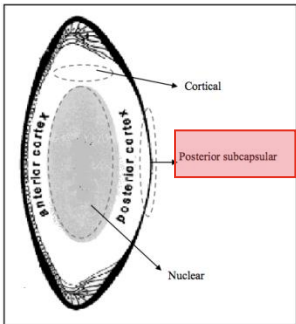
IRPA 13

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Radiation-induced cataract

➤ Cataracts

■ Presence of opacities in the eye lens



- Different types : nuclear, cortical, **posterior subcapsular**
- Different classifications: Merriam Focht, LOCS, WHO, ... (+ stages)
- Different causes: age, congenital cataracts, tobacco, diabetes, corticosteroids intake, UV, ionizing radiations (high doses), ...

➤ Radiation induced cataract

■ Eye lens opacities appear when a dose-threshold is exceeded

- ICRP 2011 (statement April 2011)
 - “ For the lens of the eye, the **threshold** in absorbed dose is now considered to be **0.5 Gy**. “ (2 Gy in ICRP 2007)
 - “ For **occupational exposure** ... an equivalent **dose limit** for the lens of the eye of **20 mSv** in a year, averaged over defined periods of 5 years, with no single year exceeding 50 mSv. “(150 mSv in ICRP 2007)

➤ Why interventional cardiologists ?

■ Exposure to X-rays:

- Depending on the type of procedure and use of radiation protection equipments:
 - **eye lens doses/procedures may range from 10 μ Sv to 1000 μ Sv** (Kim et al. 2008) : some cardiologists may receive annual doses > 150 mSv or >20 mSv

■ Prevalence studies on posterior subcapsular changes in eye lens among ICs

- Latin America (Vano et al. 2010): 38% vs. 12% among unexposed (**RR= 3.2**, $p < 0.05$)
- Malaysia (Ciraj Bjelac et al. 2011): 52% vs. 9% among unexposed (**RR= 5.7**, $p < 0.05$)
- Finland (Mrena et al. 2011): dose response relationship with chest dose

In France ?

O'CLOC Study

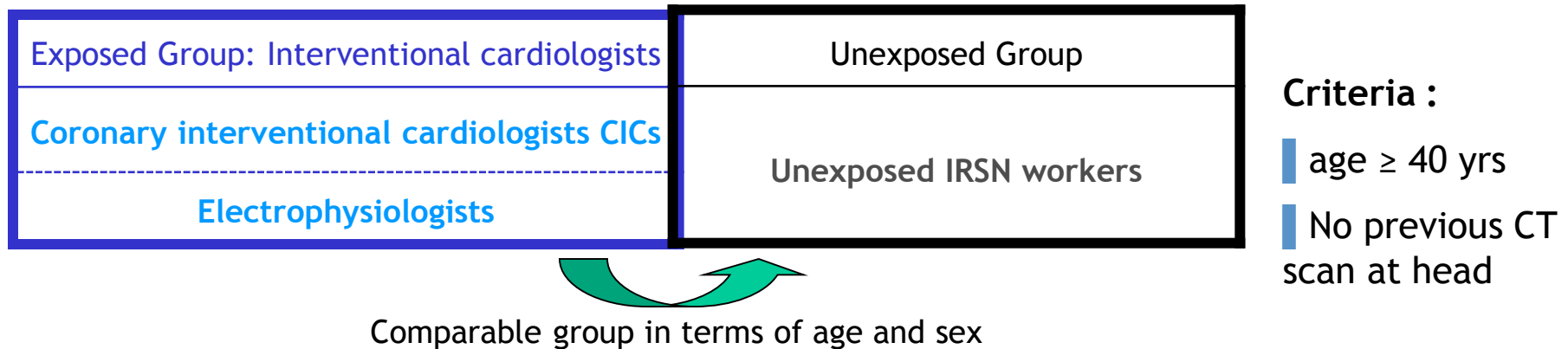
Occupational Cataracts and Lens Opacities in interventional Cardiology

➔ To analyze the risk of lens opacities among French interventional cardiologists compared with control unexposed group:

- What is the range of eye doses for this population ?
- Do interventional cardiologists have a higher risk of lens opacities compared with unexposed populations?

➤ O'CLOC Study design

Multicenter cross sectional exposed/unexposed



Inclusion period: October 2009-April 2011

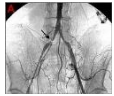
➤ Collected information

■ Medical questionnaire (for all participants)

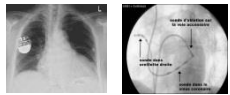
- Individual information and risk factors of cataracts (age, BMI, diabetes, tobacco, corticosteroids, myopia)

■ Occupational questionnaire (for ICs)

- Description of work history (centers, periods)
- For each working period, description of workload (proc. / week)



- **2 coronary interventional cardiology proc.:** coronarography, angioplasty



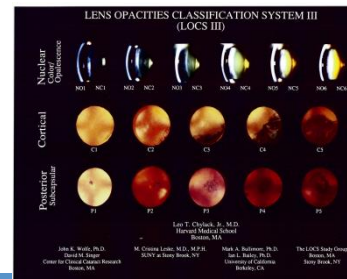
- **4 electrophysiology proc.:** pacemaker/defibrillator implantation, cardiac resynchronisation therapy, radiofrequency ablation, RFA of atrial fibrillation

- ++ Use of radiation protection equipments



■ Ophthalmologic examination (for all participants)

- Dilated pupils, slit lamp examination, LOCS III classification



➤ Population characteristics

	Exposed group of interventional cardiologists N=106	Unexposed group N=99	p-value*
Age at interview (years)	51.1 ± 7.3	49.6 ± 6.7	0.20
Men	99 (93%)	86 (87%)	0.11
BMI	23.7 ± 2.6	24.5 ± 3.1	0.13
Smokers (past or present)	40 (38%)	44 (44%)	0.39
Diabetes	1 (1%)	0 (0%)	1.00
Myopia	55 (52%)	58 (59%)	0.40
Corrected visual acuity	0.97 ± 0.09	0.98 ± 0.06	0.24
Corticosteroids use	1 (1%)	3 (3%)	0.35

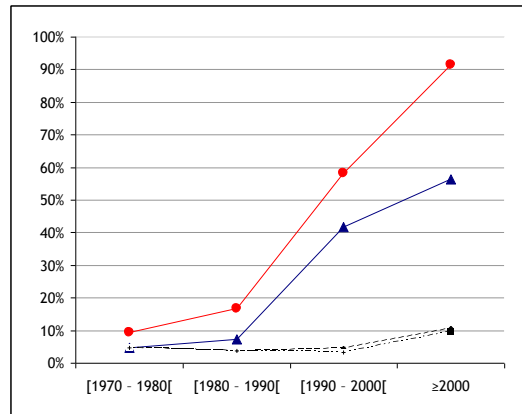
➤ Eye lens level of exposure

Mean doses per procedure observed in Europe in 2009 (ORAMED project)

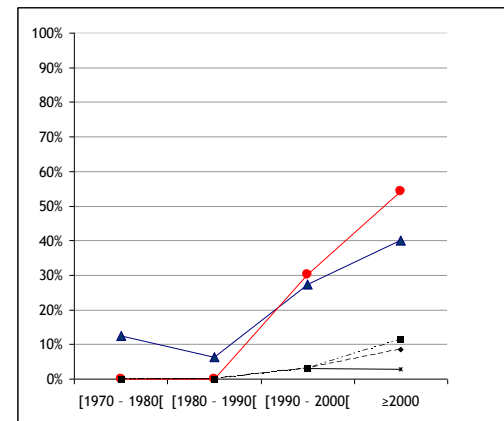
Mean doses ($\mu\text{Sv}/\text{procedure}$)	
Coronarography	46
Angioplasty	102
PM or DEF: implantation	59
PM or DEF: resynchronization	236
RF Ablation except AF	65
RF Ablation of AF	130

Mean dose reduction	
Lead eye glasses	80%
Lead face shield	50%
Suspended ceiling shield	50%
Cabin	99,99%

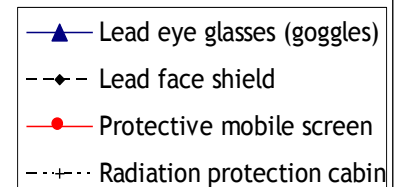
Use of radiation protection equipments (questionnaire)



CICs



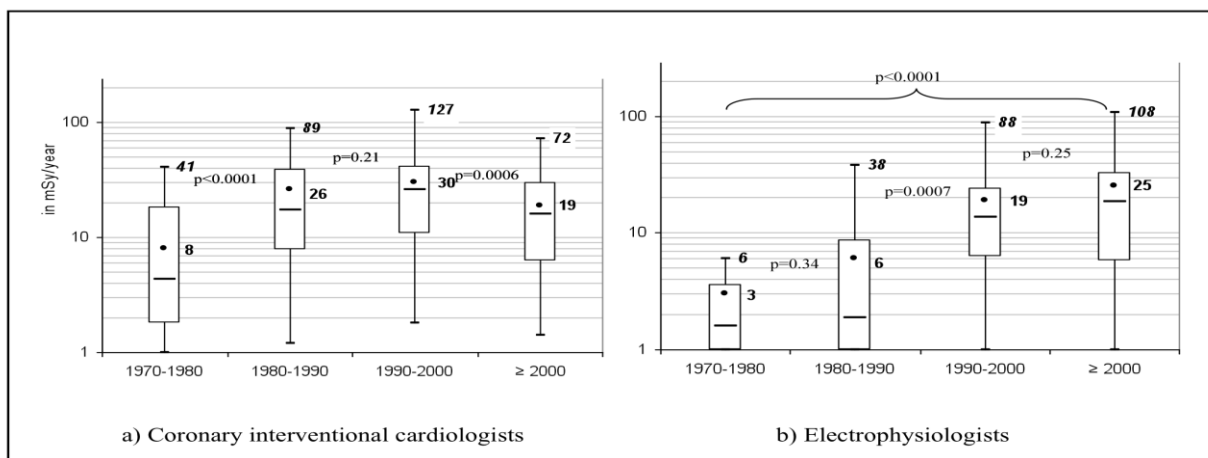
Electrophysiologists



Results on the cumulative dose (mean duration of work=22 years)

<i>en mSv</i>	Mean \pm SD	p-val.
All cardiologists	423 \pm 359 (min 25; max 1658)	
CICs	455 \pm 373 (min 29; max 1658)	p=0.09
Electrophysiologists	343 \pm 308 (min 25; max 1650)	

Results on the mean annual dose



Conclusions on eye lens exposure

Based on retrospective assessment of eye lens doses:

➤ Range of doses from 25 mSv to 1600 mSv

➤ CICs AND electrophysiologists

- After a mean duration of activity of 20 years, more than **28%** of CICs and **19%** of electrophysiologists have already exceeded the new ICRP threshold of **500 mSv** for radiation induced lens opacities
- **60%** of cardiologists have been exposed to more than **20 mSv/year** (the ICRP recommended annual limit) at least once since 2000
 - with the old limit of 150 mSv/year, only 1 cardiologist was above

Results consistent with a risk of radiation induced lens opacities

➤ Lens Opacities

Stage LOCS III \geq 1 either at left or right eye

■ Comparaison between cardiologists and unexposed individuals

	Interventional cardiologists N=106	Unexposed group N=99
	% (95% CI)	% (95% CI)
Nuclear	60% (51 - 69)	69% (60 - 78)
Cortical	23% (15 - 31)	29% (20 - 38)
Posterior Subcapsular	17 % (10 - 24)	5% (1 - 9)
	OR adjusted= 3.8 (1.3 - 11.4)	

➤ Posterior Subcapsular Lens Opacities

■ Work activity parameter and association with PSC

	OR ajusté
Duration of work	
≤17 yrs	1.9 (0.4 - 9.7)
17 - 25 yrs	3.9 (1.1 - 14.2)
> 25 yrs	5.9 (1.1 - 36.6)
Use of lead eye glasses	
< 75% of time	3.9 (1.3 - 11.7)
≥ 75% of time	2.2 (0.4 - 12.8)
Cumulative dose	
≤187mSv	4.1 (1.1 - 14.8)
187 - 430 mSv	5.4 (1.5 - 18.8)
430 mSv	1.4 (0.3 - 6.7)

Conclusions on the risk of lens opacities

- There is a significant risk of **posterior subcapsular** lens opacities in the population of French interventional cardiologists compared with unexposed workers
 - The risk increases with the duration of work
 - Regular use of **lead glasses** can limit this risk (epidemiological approach)
 - Relationship with the dose: still to explore in more details

Thank you for your attention !

■ O'CLOC study group:

- S Jacob (Epidemiologist, IRSN)
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- MO Bernier (Epidemiologist, IRSN)
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- O Bar (Cardiologist, Clinique St Gatien)
- A Brézin (Ophtalmologist, Hôpital Cochin)
- C Maccia (dosimetry, CAATS)
- P Scanff (passive dosimetry, SISERI, IRSN)
- L Donadille (dosimetry, IRSN)