Occupational Cataracts and Lens Opacities in interventional Cardiology: the O'CLOC study

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Abstract:
Interventional cardiologists are repeatedly and acutely exposed to scattered ionizing radiation (X-rays) during their diagnostic or therapeutic procedures. These exposures may cause damages to the eye lenses and induce early cataracts known as radiation-induced cataracts.

The O'CLOC study is an ongoing epidemiological study designed to test the hypothesis of an increased risk of cataract among interventional cardiologists as compared with unexposed cardiologists.

This paper summarizes a detailed article on the O'CLOC study protocol that has been published elsewhere (1).

1 BACKGROUND

1.1 Radiation-induced cataracts: threshold paradigm is challenged

The radiosensitive nature of the eye to high doses of ionizing radiation is well known. Current recommendations in radiation protection are based on the assumption that the cataracts (posterior subcapsular cataracts in particular) are radiation-induced deterministic effects of ionizing radiation and will appear only if a threshold dose is exceeded (currently 2 Gy for a single exposure to 5 Gy for fractional exposure). Moreover, in the workplace, the legal standards of radiation gives a dose limit to lens of 150 mSv / year (2).

But in recent years, increased incidence of cataracts was observed in populations exposed to lower doses, such as astronauts, airline pilots, the "liquidators" of the accident of Chernobyl clean-up workers, the survivors of the atomic bomb, residents of contaminated buildings, etc. (3, 4).

1.2 Interventional cardiology

The wider use of medical imaging involving X-rays during interventional procedures has led to steadily increase the exposure of the medical staff to ionizing radiations (IR). The expansion of interventional cardiology procedures in recent years, makes it a specialty with a high potential for exposure and interventional cardiologists may present a risk of radiation-induced effects at eye level, an area often neglected in the radiation protection of operators (5).
1.2.1 Exposure

Dosimetry studies in the operators of interventional medicine, including cardiology, have shown that a potential risk to the eyes could exist. The table below presents the range of doses observed for most common procedures in interventional cardiology.

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

*based on studies published from 1971 to 2006 (6)

Indeed, the recommended annual limit in the workplace could be exceeded taking into account the cumulative exposure of the practitioners according to the type and number of procedures performed.

1.2.2 Prevalence studies

Few studies have examined cataracts among interventional cardiologists whereas they are exposed to the same range of dose as those for which lens opacities have been observed.

The table below presents the prevalence studies among coronary interventional cardiologists (CIC) that were performed. Only posterior subcapsular cataracts or lens opacities were considered.

<table>
<thead>
<tr>
<th>Country, Year</th>
<th>Exposed group</th>
<th>Observed</th>
<th>Unexposed group</th>
<th>Observed</th>
<th>Chi²</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America, 2004 (7)</td>
<td>59 radiologists and CIC</td>
<td>37.3% opacities 8% cataracts</td>
<td>None</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bogota, Colombia +Montevideo, Uruguay, 2008/2009 (8)</td>
<td>58 CIC</td>
<td>38% opacities 93 unexposed people</td>
<td>12% opacities</td>
<td>P&lt;0.005</td>
<td></td>
</tr>
<tr>
<td>Malaysia, 2010 (9)</td>
<td>56 CIC</td>
<td>52% opacities 55 cardiologists</td>
<td>21% opacities</td>
<td>P&lt;0.005</td>
<td></td>
</tr>
</tbody>
</table>

These studies showed that an increased risk was possible. Further investigation are nevertheless still needed.
2 THE O’CLOC STUDY

In France, the IRSN, in collaboration with the interventional cardiology groups of the French Society of Cardiology, has launched in October 2009, the O’CLOC study (Occupational Cataracts and Lens opacities in Interventional Cardiology).

2.1 Aims

With an epidemiological study protocol - multicenter cross-sectional study with exposed and unexposed group - O’CLOC study was designed to test the existence of an increased risk of cataracts among interventional cardiologists compared with a control unexposed group including cardiologists.

2.2 Population and collected data

Recruitment in the O’CLOC study is based on volunteer interventional and non interventional cardiologists from major French centers employing CICs and arrhythmologists (public and private hospitals). A total of 150 interventional cardiologists in the exposed group and 150 unexposed practitioners in the reference group will be included.

To participate, volunteers have to be at least 40 years old (ensuring a minimum of 10 years of interventional activity in the exposed group). A history of significant personal medical radiation exposure (radiotherapy, brain scans) is an exclusion criteria. Finally, matching for age and sex between both groups will be performed.

The participation of cardiologists consists in a telephone questionnaire and an eye examination to detect cataracts and early stages of lens opacities:

- For all participants we collect information on medical history, including general characteristics, potential risk factors for cataracts (diabetes, corticosteroids, …) and history of significant exposure to IR.

- For interventional cardiologists, information on lifetime interventional cardiology activity and most common types of procedures is collected with a specific occupational questionnaire.

- All participants have an ophthalmologic examination including slit lamp examination and LOCS III classification for lens opacities (10).

2.3 Analysis and time plan

2.3.1 Retrospective evaluation of IR exposure

We will assign an exposure category level to each interventional cardiologist combining information from the occupational questionnaire, the SISERI database, an information
system recording occupational dosimetry of potentially exposed French workers, centralized at IRSN, and a literature review for specific procedures and corresponding mean doses.

2.3.2 Estimation of cataract risk associated with exposure

Analysis will be performed to estimate the risk in the exposed group of interventional cardiologists compared with the unexposed reference group, considering any type of cataract or specific cataract, for any exposure or by exposure category level. Adjustement for potential risk factors and the impact of sub-speciality (coronary interventional cardiology or electrophysiology) will also be considered.

2.3.3 Time plan

Inclusion period started in October 2009 and should end during the 1st trimester of 2011. In September 2010, 158 cardiologists have been already recruited (120 interventional and 37 non-interventional).

The results should be available by 2011.

3 CONCLUSION

The epidemiological approach of this study will provide further knowledge on the potential risk of developing radiation-induced cataracts, in particular among interventional cardiologists.

The O’CLOC study should also improve cardiologists’ awareness of the importance of radiation protection (1).

4 REFERENCES


