The incidence of head and neck cancer in interventional cardiologists

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ABSTRACT

The occupational risk to interventional cardiologists related to using X-rays in the catheterisation laboratory (cath lab) includes a range of radiation-induced effects. The primary concern is the possibility of developing head and neck malignancies. A literature review of reports on developing head and neck malignancies among interventional cardiologists was conducted. Several individual cases of head and neck malignancies have been reported, predominantly on the left side. However, these studies do not have a sufficient sample size to generalise the results. Based on the available reports, it is concluded that head and neck malignancies are unlikely to constitute an occupational risk for interventional cardiologists. More research is required to establish whether head and neck malignancies are more prevalent among interventional cardiologists.

SA Heart® 2024;21:66-69

INTRODUCTION

It is well known that ionising radiation, such as X-rays, is used as a noninvasive modality to diagnose various diseases, including cancer. However, ionising radiation for interventional procedures has become increasingly popular in recent decades due to its minimal invasiveness. As therapeutic techniques advance, interventional cardiologists utilise catheter-based diagnostics and treatments more frequently using fluoroscopy, a real-time X-ray imaging modality, resulting in an exponential increase in their exposure to radiation,[1] predominantly to the head and neck regions not protected by lead aprons or leaded glasses.[1-4]

The growing concern over radiation-induced diseases among physicians performing interventional procedures, especially in interventional cardiology, highlights the need for stringent protective measures.[5,6] Experienced interventional cardiologists working in high-volume catheterisation laboratories close to the X-ray source have some of the highest occupational exposure rates to ionising radiation, with an annual exposure equivalent to 200 - 250 chest X-rays.[7] As the field advances with longer and more complex procedures, addressing both deterministic and stochastic effects becomes pivotal, acknowledging the need for advancements in safety protocols and technologies to minimise the potential risks associated with the increased duration of exposure.[8]

Radiation has both stochastic and deterministic effects. The stochastic effects of radiation suggest that cancer is indeed a random side-effect of radiation exposure, which can occur at any level of exposure. The deterministic effect of radiation exposure implies that a side-effect can be anticipated after exceeding a threshold dose. Reports have indicated an asymmetrical risk of brain tumours on the left side, possibly due to higher radiation exposure, underscoring the importance of awareness and taking appropriate precautions.[8,9] This review analyses studies concerning the occupational exposure of interventional cardiologists to X-rays and evaluates the effects of radiation on head and neck tumours associated with these exposures.

METHODS

The diverse sampling techniques described in the literature highlight the comprehensive approach to data collection for tumour induction research.[10] Methods included slit camera examinations, retrospective estimation of cumulative eye lens doses, interviews, medical record analysis, family input, and tele-

phone surveys. Additionally, some studies incorporated clinical eye examinations, dose rate testing, and blood sample analysis to assess the long-term effects of low-dose radiation exposure.[11-13]

A literature search was conducted. Articles were collected using the EBSCOhost network, which included Academic Search, Africa-wide, Scopus, and Medline databases, as shown in Figure 1. Keywords used were "cancer risk", "radiation effects", "brain tumours", "radiation exposure", "cath lab", "occupational dose", and "interventional cardiology", and their synonyms. Articles published from 2010 - 2023 and selected based on their title and abstracts were included for review. Selected articles had to contain information about interventional cardiologists performing interventional procedures and their occupational dose, radiation effects, or cancer development. The information analysed included the sample size and the location of effects. Articles that did not mention head and neck cancers, interventional cardiologists, or a catheterisation laboratory and did not perform original research were excluded. The resulting helpful articles are shown in Table I.

RESULTS

Several cases of radiation-induced head and neck malignancies among interventional cardiologists have been reported in the literature, as shown in Table I. In the Italian study by Andreassi, et al., data collection took place during the Annual Scientific meetings of the Italian Society of Interventional Cardiologists in 2011 and 2012, where a structured questionnaire was completed by participants.[14] The study revealed a median lifetime dose of 21 mSv (quartile: 12-71 mSv); however, it is unknown whether it was a whole-body- or head dose; therefore, the assumption was made that it was a whole-body dose. The median working time was 10 years.

The research study by Roguin, et al.[15] provided a list of several of these cases. The types of tumours identified were mainly glioblastoma multiforme, which accounted for 78% of all tumours and occurred on the left-hand side 74% of the time. The other interesting fact of the study was the average working years of 20 and distribution over North America, the Middle East and Europe.

The multi-centre study in Pakistan reported a 2% prevalence of head and neck malignancy in a sample of 50 interventional cardiologists who had worked for more than 10 years.[16] The side involved in the identified head and neck tumour was not specified. The doses recorded by personal radiation monitoring devices (PRMD) were not mentioned as part of the data collection.

DISCUSSION

Most reported cases were left-sided, the side closest to the X-ray source. The development of cataracts is also considered a potential risk in catheterisation laboratories as the eyes are susceptible to ionising radiation.[10,17,18] Cases of multiple left-sided cutaneous malignancies have also been reported.[10,19]

Due to the small sample sizes in the reported studies, there is no conclusive evidence that occupational exposure in catheterisation laboratories causes the appearance of head and neck malignancies.[20] References to cases without conducting a new study further limit establishing direct correlation.[21] Acknowledging these constraints, there is a need to evaluate larger cohorts of subjects.

Case-control design and case studies in small populations[19] limit the precision and generalisability of findings. Broad confidence intervals contribute to the uncertainty.[6] Inadequate sample sizes and outdated data may affect the relevance of the findings in a contemporary setting.[22] It is crucial to address

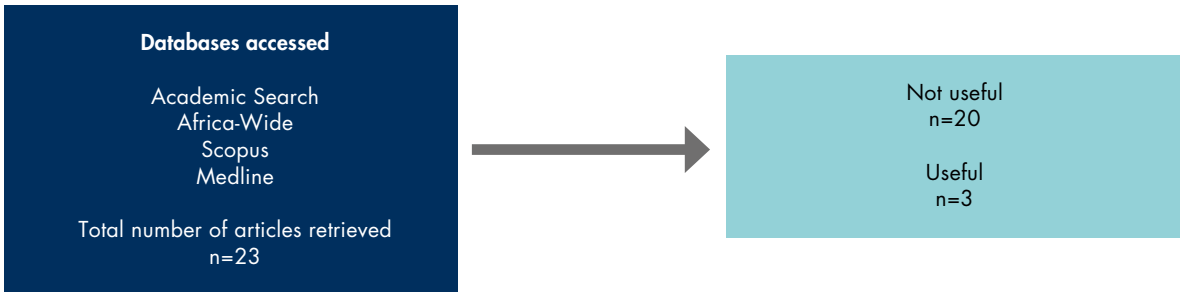

FIGURE 1: Databases accessed and the number of articles retrieved and included for review.

TABLE I: Summary of articles with the study type, sample size and findings on head and neck effects due to radiation to interventional cardiologists.

Authors	Country / Region	Study type	Population used	Sample size	Findings
Andreassi, et al.[14]	Italy	Structured self-administered questionnaire	Interventionalists	45	Tumours occurred in 5. Tumours identified: 2 basal cell carcinomas, 1 melanoma, 1 seminoma, 1 prostate adenocarcinoma. Side involved: 2 left-sided and 3 unspecified.
Roguin[15]	Europe & North America	Reports	Interventionalists	23	Tumours occurred in 23. Tumours identified: 13 GBM, 3 meningiomas, 2 parotids, 2 astrocytoma, 1 neck lymphoma 1 tonsillar tumour. Side involved: 18 were left-side, 1 midline, 2 right-sided and 2 unspecified.
Tariq, et al.[16]	Pakistan	Interviews	Interventionalists	50	Tumours occurred in 1. Tumours identified: 1 head and neck neoplasms. Side involved: Not specified.

GBM: glioblastoma multiforme.

these limitations in future studies to accurately determine the validity and applicability their findings in the context of evolving radiation protection practices. The studies quoted (Table I) either did not require or did not report dosimeter-measured occupational radiation doses to the heads of interventional cardiologists. Knowing the distribution of the radiation dose an individual had received when a head or neck tumour is discovered may indicate the dose threshold for the induction of neoplastic changes.

Understanding the dual nature of cellular changes due to low-dose radiation is essential.[21] While some modifications may be advantageous, the associated risks, such as increased DNA damage and oxidative stress, highlight potentially harmful consequences. Given these uncertainties, acknowledging limitations in research becomes crucial for a comprehensive assessment of the long-term implications and to guide further studies in this complex field.[21]

Various aspects of radiation exposure in interventional cardiology have been highlighted, addressing factors such as occupational conditions, protective measures like lead-free caps, variations in operator doses, and the impact of ClarityIQ (low-dose high-quality imaging) technology on reducing radiation exposure. Additionally, the studies emphasised the importance of minimising radiation risks through techniques such as reducing fluoroscopy time, using radiation reduction technology, and optimising imaging-chain geometry.[4,11]

CONCLUSION

Head and neck malignancies are uncommon among interventional cardiologists. The small sample sizes and the limited number of reports available do not allow an accurate risk assessment. Further studies are needed to clarify the incidence. This review article highlights the importance of sufficient radiation protection knowledge and implementation by interventional cardiologists. In addition, improved radiation protection training and awareness may have significant long-term benefits.

ACKNOWLEDGEMENTS

We thank Ms A.M. Mophoso (Library and Information Services) and Dr Daleen Struwig (Medical editor) of the University of the Free State for their assistance with journal articles and manuscript editing, respectively.

Conflict of interest: none declared.

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