



## Editorial

# Zero Radiation in the Cardiac Catheterization Laboratory: An Aspirational Goal or Moral Imperative?

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I have always been an avid college football fan. Is there anything better than The Big House on a brisk, autumn Saturday afternoon (especially after 2 consecutive wins over archrival “The” Ohio State University)? And, as you follow the careers of these young student-athletes after college graduation, if fortunate enough to make the National Football League (NFL) Draft, their singular focus at the next level becomes impressing coaches and team ownership.

The NFL rookie is not thinking primarily about concussion syndrome or chronic traumatic encephalopathy. Rather, the young athlete’s chief focus (and how he is solely judged) is running faster, jumping higher, blocking, tackling, scoring touchdowns, and sacking the quarterback. Notwithstanding our love for the sport, let’s not kid ourselves: there are long-term, obvious, historically verifiable neurologic and orthopedic consequences facing the football player inherent in his “workplace” environment.

Having successfully completed my cardiology fellowship under the direction of Dr William O’Neill and securing a position as an interventional cardiologist in Scottsdale, Arizona, my focus shifted to achieving professional milestones, akin to scoring touchdowns, as an interventionalist. My passions revolved around ST-segment elevation myocardial infarction-percutaneous coronary intervention during the embryonic stages of this discipline and complex coronary intervention in the early drug-eluting stent era.

Fast-forward to 2023—the landscape of my profession has evolved, and my interests have adapted. Now, my professional pursuits center on advancements such as nonsurgical, catheter-based heart valve replacement and repair, historically the domain of the open-heart surgeon; these technological advancements have captured my attention and have become my new areas of focus and professional fascination.

Similar to a young NFL athlete who may overlook the implications of concussion syndrome, as a young interventionalist, I, like many others, disregarded the potentially harmful effects of daily exposure to ionizing radiation in the cardiac catheterization laboratory (cath lab) where these procedures are performed. At the age of 33 years, I naively accepted, as an article of faith, that the standard-issue protective lead apron we wore

when performing procedures and the drop-down lead shield provided sufficient safety. I hadn’t previously considered the long-term consequences of ionizing radiation exposure or the potential downstream orthopedic maladies associated with wearing a cumbersome lead apron for extended periods, sometimes up to 16 hours a day.

## A brief history lesson

On September 16, 1977, at the Medical Policlinic of the University of Zurich, Dr Andreas Grüntzig performed the world’s first nonsurgical, coronary artery balloon angioplasty in an awake patient, forever altering the landscape of cardiology.<sup>1</sup> This was one of the most important technological and therapeutic advances in medicine in the 20th century. Further fueling this technological revolution would be the development of the coronary stent. The subsequent explosion in catheter-based percutaneous therapies for the treatment of coronary artery disease would give rise to a new medical subspecialty, interventional cardiology, dependent on the use of real-time moving x-ray imaging (fluoroscopy) in the cath lab where these procedures are now routinely performed. But, from the beginning, the emphasis in interventional cardiology was almost exclusively directed at procedural refinements and technological innovations, while the potential consequences of exposing physicians and other cath lab staff to ionizing radiation during these procedures remained largely ignored.

As time has passed, I have become more circumspect about safety in the cath lab. It has become evident that chronic occupational radiation exposure in the fluoroscopic laboratory presents significant health hazards for physicians and staff, with the potential for direct radiation-induced injuries such as cataracts and cancers. I now appreciate that the mandated lead apron, much like a football helmet, is not unassailably intact. While it addresses one issue, it falls short of being a complete solution and inadvertently gives rise to a new problem. The cumulative burden of constantly bearing the weight of these necessary lead aprons has never been taken into consideration, leading to previously unforeseen orthopedic afflictions. This realization has shed light on the

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overlooked consequences of occupational radiation exposure and the physical toll it can take on health care professionals working in a field where radiation protection is crucial. Addressing these challenges and finding innovative solutions to minimize the orthopedic impact of protective gear are vital to ensuring the well-being and longevity of those in this profession.

Fortunately, in the past few decades, there has been a heightened awareness in the NFL that has led to equipment enhancements and sideline protocols aimed at promoting athlete safety and reducing injuries. Thus, it is perplexing that in the most advanced medical specialty of modern times, there has been little discussion and virtually no progress in creating a safer work environment and mitigating occupational health hazards in the cath lab. Despite an increased emphasis on the importance of workplace safety innovations for interventional cardiologists,<sup>2,3</sup> there has been minimal positive action taken in this regard.

The ultimate goal is to achieve a work environment in the cath lab with as close to zero radiation exposure as possible. This would eliminate the need for burdensome personal protective apparel and alleviate its associated orthopedic consequences. It is disheartening that such advancements have been slow to materialize, considering the urgent need to prioritize the well-being and safety of health care professionals. The disparity between the progress made in athlete safety and the lack thereof in the medical field highlights the importance of addressing this issue and implementing necessary changes to create a safer working environment for interventional cardiologists.<sup>4,5</sup>

Undeniably, there is a surfeit of scientific data and personal experiences within our profession that clearly demonstrate the potential health hazards we face in the cath lab.<sup>6-16</sup> Further evidence would only serve to underscore this reality. Among my personal experiences is the heartbreaking case of my mentor, Dr Edward B. Diethrich of Phoenix, a renowned innovator in heart and vascular medicine. His tragic passing from a brain tumor, likely stemming from a lifetime of cath lab radiation exposure, serves as a stark reminder of the inherent risks we face.

The deaths of Dr Diethrich and numerous others have carried the burden of proof to act now to mitigate these risks with available technology. With available technology, we can act collectively as a profession and with hospital leadership. It is imperative to broaden our focus beyond improving clinical outcomes to include the well-being and safety of those who work in this field. Ignoring the long-term hazards associated with radiation exposure may lead to unanticipated consequences that overshadow the professional achievements we strive for.

Convincing hospital administrators that this type of investment is worth pursuing may be somewhat like the aging quarterback trying to convince the front office to convert to a double tight end set with a fullback rather than the current spread offense. It may not have the same flashy appeal, but it possesses substance and effectiveness. It's also important to acknowledge that "retooling" an NFL offense comes with significant costs.

As Dr Dean J. Kereiakes of Cincinnati pointed out recently, from the hospital perspective, the cost of converting the cath lab to a zero-radiation environment has never been more challenging than at present in the wake of the COVID-19 pandemic (oral communication, July 2023). In the context of workforce attrition, incremental costs related to "traveling" staff, staff recruitment and retention bonuses, supply-chain-related vendor costs, and falling contribution margins, the prospect of piling on cost to provide more comfortable "radiation exposure protection" for a staff who has recently received both a salary increase and bonus without accompanying incremental reimbursement can be a daunting proposition. The current financial status of the American hospital system blurs the line of distinction between what is the "right thing" to do and what is financially feasible.

## Gender disparity in our profession

Another supporting fact has gained recognition only recently. It is indeed possible that while women are excelling in cardiology as a whole, they are disproportionately underrepresented in interventional cardiology. Gender differences in the pursuit of training programs in electrophysiology and interventional cardiology have been observed and studied.<sup>17,18</sup> The realities of cath lab radiation exposure and its potential health risks may influence some individuals, especially women, to choose against pursuing careers in the fluoroscopic specialties.

If the known relative lack of safety discourages women from entering our field, then our specialty's talent pool is not as diverse or rich as it could be. By investing in greater cath lab safety, hospital administrators can address and perhaps reduce this gender disparity, which is crucial for the advancement and inclusivity of interventional cardiology.

Recognizing and actively working to mitigate the disparate impact that using archaic cath lab safety gear causes can lead to a more diverse and talented workforce. By removing these barriers and creating an inclusive culture, we can tap into the full potential of individuals from all backgrounds, resulting in improved patient care, innovative research, and the overall advancement of the field.

This was not always readily apparent to me. In fact, I had never considered this as a possibility. After all, I was a Midwest kid, raised in working class Flint, Michigan (the epicenter of the auto industry of the 1970s), who drives a pickup truck to work and was raised fairly conservatively. While the Sisters of St Felix did a tremendous job teaching reading, writing, and arithmetic, understanding the existence of gender bias and the unwitting discriminatory effect of ingrained behaviors was not among the lesson plan priorities at St Francis School. But in 2017, I read an eye-opening piece authored by Dr Celina Yong in which she describes "Breaking the Catheterization Laboratory Ceiling."<sup>19</sup> This and 2 subsequent publications clearly describe the phenomenon that while many factors uniquely dissuade women from careers in interventional cardiology, a primary concern is radiation exposure in the cath lab during childbearing years.<sup>17,18</sup> This underscores that radiation exposure in the cath lab is not only inherently harmful but is also its own "glass ceiling" and among the proximate reasons that interventional cardiology lags behind other subspecialties in providing opportunities free of gender bias.

Given the wealth of evidence and the tangible impact on individuals, the burden of proof has shifted to our profession and those in charge of hospital development, planning, operations, and facilities to explain why we should not act immediately. Until now, zero radiation in the cath lab has been an aspirational goal. In my opinion, it is our legal, financial, and moral imperative to act without delay.

Hospital chief executive officers can take a lesson from NFL owners who were rightly advised not to ignore the issue of concussion syndrome among NFL athletes. They eventually acted appropriately, and so should we. Not taking this seriously could become a class action nightmare, further destabilizing the already tenuous financial status of the American hospital system.

By prioritizing the goal of zero radiation in the cath lab and embracing it as a moral obligation, we can create a safer and more sustainable work environment. This is not just a matter of professional practice; it is a call to uphold our ethical responsibilities toward the health and well-being of those dedicated to the field of interventional cardiology.

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