Interventional cardiology has witnessed amazing technical and imaging advancements accompanied by extraordinary patient outcomes during the past few decades. However, during the same time period, there has been almost no substantial modification in cath lab design and little change in the incidence of injury to personnel,1,2 despite widespread recognition of the occupational hazards of the catheterization laboratory environment. Because catheter-based technologies continue to advance, and procedures have become more complex and require longer fluoroscopic time, health risks from both exposure of the physician and catheterization laboratory staff to increasing levels of ionizing radiation, and the wearing of burdensome personal protection, are inevitable. The development of cataracts and various bone marrow, brain, and thyroid malignancies have been definitively linked with radiation exposure.3,4 Long hours wearing protective shielding has clearly been associated with orthopedic injuries, resulting in lost time from work, and which sometimes are career ending.1,2,5 An increase in the prevalence of depression, anxiety, hypertension, and hypercholesterolemia has also been described.5,6 Additional possible side effects of radiation exposure include increased carotid intima-media thickness and shortening of the leukocyte telomere length, suggestive of early and aggressive vascular injury.7

The study by Andreassi et al8 in this issue of Circulation: Cardiovascular Interventions confirms the alarming incidence and variety of occupational-related illnesses of medical staff working in the interventional laboratory. The authors report a multicenter controlled study to determine the prevalence of occupational health risks in the cardiac catheterization laboratory. A total of 746 Italian workers, including physicians and paramedical staff, of whom 466 workers were exposed to radiation and 280 age and gender matched controls who were unexposed to radiation, completed self-administered questionnaires. The results demonstrate that skin lesions, orthopedic illnesses, cataracts, thyroid disease, hypertension, hypercholesterolemia, and anxiety/depression were more common among medical staff working in the catheterization laboratory, with a higher prevalence in physicians compared with nurses and technicians (69% versus 22% versus 9%, P=0.03). The incidence of cancers was higher in workers exposed to radiation, although this was not statistically significant; 45% of malignancies were skin related, with a higher trend to leftward distribution (closer to the x-ray source and scatter), and occur mostly in physicians with prolonged radiation exposure.

Some limitations of the study are well described by the authors, most significantly that the radiation-exposed workers had more risk factors compared with nonexposed personnel. Also, as this was a self-reported occupational exposure survey, the dosimeter data were not available in all subjects, and an occupational radiological risk score was used, which also poses problems.

Nevertheless, this study provides several new insights about the adverse effects of radiation exposure on medical staff. One important observation is that physicians have the highest prevalence of injuries and other adverse health effects, placing the likelihood of developing an illness in context. This is important in the interpretation of Orme et al, who evaluated workers in a single, multisite institution center, in that the number of physicians exposed in Andreassi et al was substantially higher (47% versus 15%). Another distinction from previous surveys1,2 also evaluating a multicenter population is that Andreassi et al includes a control group. This is critical because having a comparator group helps to better define the risks entailed in our career choice.

There is now more than enough information for us to conclude that the interventional catheterization laboratory is not a healthy workplace.5–11 There are distinct and definite risks inherent in our profession. During one’s career, the likelihood of suffering an orthopedic injury is 30% to 60%, cancer 3%, skin disease 8%, hypertension or hypercholesterolemia 12%, and cataracts 5%, which are 2 to 7 times higher than other medical occupations. Some risks are stochastic and others are deterministic, and there may well be individual variability in susceptibility. In addition, 7% of operators have had to limit their caseload because of radiation exposure and 9% have had a health-related period of absence.

So the question must be raised: why has there not been notable invention, cath laboratory design innovation, or creative approaches in personnel protection, whereas the progress made in the technology of our instruments, used within the same space, has been revolutionary?

The answer is entirely comprehensible in the context of the economics of personnel management and cost considerations. With each part of a hospital being run as a separate business entity, profitability is paramount. Keeping costs and salaries low and revenue high is the hallmark of good
administration, much to the detriment of the skilled people who must work long hours, perform heavy physical labor, be exposed to radiation, and wear bulky personal protection. The broad labor management concept has been: hire the youngest and brightest, pay them the lowest competitive wage, work them hard with the promise of substantial nonfinancial rewards, and when they begin to expect more, replace them with the next generation. After obtaining proficiency by intensive and prolific experience, such personnel can achieve supervisory status themselves, or move confidently in a different direction, if they choose. Certainly, investing money in an innovative cath laboratory design to protect its workers is hardly cost effective when nurturing a long career is not the goal of management.11,12

Why is this labor tenet accepted? Some reasons are that physicians and allied health personnel are highly educated and highly motivated, have chosen our career willingly, are compensated generously, and stay in the field because the work is so satisfying and exciting. Moreover, young cardiologists choosing interventional cardiology as a career have a limited understanding of these potential long-term repercussions, and even when informed, choose to cope through denial and disregard the warnings. Another reason is that being physically close to the patient means being close to the x-ray source; this is problematic, since when the distance from the source is doubled, the intensity at the new distance is only 25% of the original intensity. Given our sense of responsibility, designs that move the physician or hinder access have met resistance. Finally, until fairly recently, only a portion of the nonphysician workforce envisaged the interventional laboratory as their long-term career choice.

In the past decade, the Multi-Specialty Occupational Health Group challenged the traditional conventions,11,12 but those who could make the decision to design a better laboratory, and pay for it, never responded to the message. Because these labor tactics constitute a proven, effective strategy, having flourished for several generations, supervisors and administrators are loath to change direction when the conduct has worked well, from their viewpoint. Rather than directly confront the issue, physicians become part of the problem. One study3 demonstrated that many physicians do not routinely wear their radiation badge, so that their exposure is unmeasured or falsely low, lest they be banished from the laboratory, although there is a clear evidence showing that wearing the dosimeter leads to lower operator and patient exposure.13

Adoption of radiation safety protocols14 and improved radiation equipment and imaging15 to decrease dose have been effective, but the major motivation is to allow longer procedures without the patient being exposed to dangerous levels. Newer ideas, such as ceiling suspended aprons, and shielded gloves and caps, continue the concept of individual protection, rather than propose a new paradigm. Vascular robotic technology is promising in this regard but has not been widely adopted.

To the extent to which nurses, technicians, and physicians gain invaluable experience over years of practice, the constant whirling to train and adapt the never-ending torrent of young replacements would seem to be poor business practice. But it has succeeded because interventional practice and techniques change so rapidly that the experts of today must continually upgrade their practice, or obsolescence will ensue. How long this can continue in a world of ever increasing computerization and technological progress is unclear, but certainly, industry and hospital leaders perceive no reason to invest capital funds to protect workers who are going to be replaced eventually.

The existence and consequence of these economic imperatives, which are a foundation of the occupational hazards we are exposed to, must be overtly acknowledged by all of the stakeholders. Accepting the profit motive as an authentic origin, and finding the courage to change business practice, is the only path to innovative cath laboratory design and shielding techniques that can prevent these occupational hazards. The true economic cost of thinking of interventional staff as expendable is vastly underappreciated, but more importantly, as a principle of personnel management, disingenuous. Accepting the risks as part of a self-deceptive bargain should not be necessary.11 The time may come when this hazardous environment may need to be actively regulated by federal and state agencies; and one can readily conceive of personal injury cases being brought, as has happened in many other occupations. We call on industry and hospital administration to provide responsible stewardship, and for physician societies and interventional leaders to advocate visibly and set new priorities, so that those of us who choose to help patients live a longer and healthier life can ourselves enjoy a long and healthy career, one that allows us to use all the magnificent and cherished skills we have dedicated years to master.

Disclosures

None.

References


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The Economic Imperatives Underlying the Occupational Health Hazards of the Cardiac Catheterization Laboratory
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