Surveys of Interventional Occupational Health Hazards: Is the interventional radiation occupation strictly a young person’s profession?
INTRODUCTION

The use of fluoroscopically guided interventional procedures has seen a significant increase during this century, and has been accompanied by an equally significant increase in health issues for the physicians and staff members involved.

For our purposes we will refer to interventional procedures as those that use fluoroscopic devices to view the advancement of catheters through blood vessels for diagnostic or therapeutic purposes. While these procedures are most commonly performed in a cardiac catheterization laboratory by Interventional Cardiologists, other specialties may be involved as well, such as Interventional Radiologists, Neuro-Interventional Radiologists, Vascular and Interventional Radiologists, as well as Interventional Pain Physicians.

The fluoroscopic imaging devices employed in these procedures utilize radiation beams that are focused on the specific part of the patient being treated, but which also create scatter emissions affecting the health care personnel involved. To protect against the hazardous effects of these emissions the physician operator and ancillary staff in attendance commonly wear heavy “lead aprons” which can cause stress on the shoulders, spine, hips, knees and ankles of the wearer. However, these lead garments do not protect the head which can be subject to eye and brain injuries caused by this radiation exposure.

In order to protect against the hazardous health effects of radiation exposure, personnel who are involved with radiation emitting devices are supposed to wear dosimeters to monitor the safe level of exposure.

A number of surveys have been conducted and articles written addressing the occupational health effects of working in an interventional environment. We will summarize these surveys and address some of the issues raised by the surveyors.

THE SURVEYS

Surveys of occupational health hazards associated with interventional radiologic procedures have been conducted by different entities of differing subject groupings and addressing different issues. Consequently, there is no good way to really compare them to determine changes in the effects of the hazards over time. Nor is there a way to use the results of the surveys to judge the extent to which advances in radiation protective devices have succeeded in addressing the occupational hazards which beset interventionists.

This is not intended to be an exhaustive list of surveys addressing this issue. However, it is hoped that the results of these surveys may lend some insight to the problem and foster more comprehensive and standardized surveys among a wider range of affected professionals.

The relationship between back pain and lead apron use in radiologists, by B Moore, E vanSonnenberg, G Casola and R A Novelline was a survey done over 20 years ago (1992). It was sent to 688 radiologists, of which 236 responded. Of those who responded, over two-thirds (75.8%) indicated that they experienced back pain.

Prevalence of spinal disc disease among interventional cardiologists, by Ross A.M., Segal J., Borenstein D., Jenkins E., Cho S, was a study performed in 1997 in which 385 of 852 Interventional Cardiologists responded. Of those responding, over two-thirds (75.8%) indicated that they experienced back pain.

Occupational hazards of interventional cardiologists: prevalence of orthopedic health problems in contemporary practice, by Goldstein JA, Balter S, Cowley M, Hodgson J, Klein LW; for the Interventional Committee of the Society of Cardiovascular Interventions. This survey seems to be one of the most referenced surveys on this topic. It included responses from 424 SCAI (Society for Cardiac Angiography and Interventions) member respondents and demonstrated that 60% of those with 20 years
or more in an interventional environment suffered from spine problems. Overall 42% reported spine problems and 28% indicated problems with hips, knees or ankles. In addition, more than one-third of the respondents indicated that they had had to take time off of work because of their injury.

RADIATION CATARACT RISK IN INTERVENTIONAL CARDIOLOGY PERSONNEL, by Eliseo Vano, Norman J. Kleiman, Ariel Duran, Madan M. Rehani, Dario Echeverri, and Mariana Cabrera in 2010 was an international study strictly of the incidence of eye injury, in the form of cataracts, among interventional cardiologists. The findings of this study showed that the 116 interventional cardiologists suffered more than three times the amount of eye injury as that of a similarly aged non-exposed control group of 93 individuals (38% vs. 12%). Similarly, it was found that 21% of nurses and technicians in the interventional environment suffered similar eye problems.

THE OCCUPATIONAL EFFECTS OF INTERVENTIONAL CARDIOLOGY: RESULTS FROM THE WIN FOR SAFETY SURVEY, by Buchanan GL, Chieffo A, Mehilli J, Mikhail GW, Mauri F, Presbitero P, Grinfeld L, Petronio AS, Skelding KA, Hoye A, Mehran R, Morice MC in 2012. This survey conducted on behalf of WIN, the Women In Innovation, obtained 615 responses of which 448 were Interventional Cardiologists. Orthopedic problems, including back, neck and hip pain, were reported by 19.5% of the respondents with 5.5% reporting varicose veins, 2.4% blood count problems and 2.0% cataracts. Meanwhile, 62.1% reported work restrictions based on being a pregnant female.

OCCUPATIONAL HEALTH HAZARDS OF WORKING IN THE INTERVENTIONAL LABORATORY by Nicholas M. Orme, Charanjit S. Rihal, Rajiv Gulati, David R. Holmes, Ryan J. Lennon, Bradley R. Lewis, Ian R. McPhail, Kent R. Thielen, Sorin V. Pislaru, Gurpreet S. Sandhu, Mandeep Singh. This study, done by members of the Mayo Clinic, Rochester, MN, included 1543 employees of which 1042 worked in an interventional environment. The results of this survey demonstrated that ancillary staff in the interventional setting were just as susceptible to orthopedic injury as were the primary operators, if not more so. In fact, 62% of technicians and 60% of nurses reported back issues, compared to 44% of attending staff and 19% of trainees.

MAJOR TAKEAWAYS

There were two major contributing factors common to the results of these surveys,

1. the age of the operator, or number of years of exposure, and
2. the caseload volume, or how often the operator was performing interventional procedures.

Taken together, these two factors may reflect the cumulative effect of the need for the interventionist, as well as the supportive staff, to wear heavy radiation shielding garments during the interventional procedures.
WHERE DO WE GO FROM HERE?

We were fortunate to be able to speak by phone to Lloyd Klein, MD, the lead author of the most recent SCAI survey and a contributor to the 2004 survey with Dr. Goldstein. With regard to the implications of the two studies, he indicated a sense of disappointment that the results did not show significant improvement in the face of advances in interventional techniques as well as improved technology to control radiation emissions. In fact, while the two studies cannot be directly correlated, Klein saw an apparent increase in orthopedic issues which he attributed to the increased caseload being taken on by interventionists.

To paraphrase Dr. Klein, in order to make any substantial change in the incidence of orthopedic issues among interventionists, we need to get the lead out.

He applauded the changes that have been made by manufacturers of the protective apparel to utilize lead alternatives for radiation absorption and for designing kilt-type garments to get the lead weight off of the shoulders. Klein contends, however, that what needs to be done is to remove the weighty burden entirely.

Klein noted that while there have been improvements in shielding devices, such as ceiling mounted barriers and roll-about shields, they are often difficult to work around and impede access to the patient. A recently developed device resembles a cage that the operator can put his/her hands through to perform the needed functions. A more recent innovation is that of a true robotic system in which the operator performs procedures basically by manipulating a joystick device. All of these approaches provide enhanced protection, but take the operator away from the patient contrary to what has been taught and, experientially, been found to be beneficial to the process and outcome. In order to fully appreciate the benefits of these advances will take at least a whole new generation of young interventionists.

As for the Mayo Clinic study that indicated the increased rate of orthopedic incidences among the supportive staff, Klein observed that while the primary operator is in and out of the procedure room, the ancillary staff is there for the full time of the procedure.

ASSOCIATED PROBLEMS

It has been reported, privately and elsewhere, that some interventional physicians may purposely not wear the required dosimeters in order to be able to continue pursuing their professional passion in spite of the danger of heightened radiation exposure.

The training to become an interventionist is quite extensive and takes upwards to five years representing a significant investment in time and money for the physician. It is only natural that an individual with this amount of investment would want to see a significant return. To have their earning potential cut short by radiation related illnesses on one hand, or radiation protection related orthopedic issues on the other is unconscionable. The physician and supportive staff need to be protected from both issues.

The associated problem, to which hospital management and administration must come to grips, is the effect on cash flow which these orthopedic issues represent. The interventionists who are most subject to orthopedic issues and work time loss are those that are the more experienced and expert in the field. When they have to take time off, or curtail their work load, this represents a diminished cash to the hospitals and an inability to meet the needs of the members of the community they serve.

In addition, the occupational-related orthopedic issues affecting the supportive staff in the interventional lab can represent an additional financial exposure as well.
SO WHAT IS THE ANSWER?

Dr. Klein’s response to this question was to devise better shielding of the x-ray tube and image intensifier to decrease emissions; and patient table barriers, and/or suspended shielding systems that can protect both the operator and support staff.

The optimal answer may be a suspended system that protects the lower body, torso and head of the operator while being flexible to allow maneuverability and immediate access to the patient. It would be a system that provides weightless total body protection and not interfere with the operator’s line of sight.

The Zero-Gravity™ weightless system by TIDI® Products is just such a system.

Zero-Gravity™ vs. Conventional Lead Shields
Comparison of operator eye exposures when working from femoral region, side or head of patient.

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<th>Fluoroscopy Minutes</th>
<th>Operator Exposures (microSV/min)</th>
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<tbody>
<tr>
<td>HEAD</td>
<td>215</td>
<td>0.022</td>
</tr>
<tr>
<td>SIDE</td>
<td>67</td>
<td>0.035</td>
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<tr>
<td>FEMORAL</td>
<td>47</td>
<td>0.013</td>
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1. ZERO-GRAVITY™ FLOOR UNIT

The easiest and simplest (and cheapest) means is by way of the Zero-Gravity™ Floor Unit. This mobile unit extends from 7¾ feet to nearly 9 feet in height, with a suspension arm that provides 150° swing rotational movement and almost 4 feet of forward and back movement. It is securely mounted on a sturdy base suspends a 70 lb., flexible, 1.0 mm Pb equivalent, protective shoulder/body shield that is weight-free to the wearer. In addition, the shield also includes a 0.5 mm Pb equivalent lead acrylic head/face shield that provides an unobstructed view while protecting the throat, face, eyes and brain from excessive radiation exposure.
2. ZERO-GRAVITY™ MONORAIL

The next step up on the ladder of convenience and ease of use is the Zero-Gravity™ Monorail system. This system provides all of the benefits of the Floor Unit for suspending the Total Body Shield and does so by being mounted on a monorail track affixed to the ceiling. It provides a full 4 feet of access to one side of the table and can accommodate an additional Total Body Shield, to provide protection for additional staff. When not in use it can be stored out of the way.

The shoulder/body shield, with the attached lead acrylic head/face shield, is connected to the wearer by means of a magnet attached to a mesh vest that the operator wears under the surgical gown. This magnetic connection allows the operator to move freely without worrying about getting disconnected from the body shield.

3. ZERO-GRAVITY™ MONORAIL HINGED SWING ARM

For the ultimate in convenience, patient access and radiation protection you may wish to choose the Zero-Gravity™ Monorail Hinged Swing Arm configuration. It provides all the benefits of the Monorail and Floor units, including 360° rotation of the Total Body Shield and provides a full 7 1/2 foot reach to both sides of the table. This means that with two suspended Total Body Shields both the physician operator and a nurse, tech or other assistant can be equally protected. The clinician also has access to the patient from opposite sides of the table if so desired.

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TIDI® Products is a diversified manufacturer and cutting-edge engineering resource for OEMs and medical device distributors around the globe.

We work collaboratively with clinicians to produce patient positioning, infection prevention and radiation protection systems designed to safeguard patients and clinicians alike.

To learn more about radiation protection alternatives, visit TIDIProducts.com.