Recommendations developed to reduce radiation exposure in pediatric orthopedic patients

March 14 2017

Pediatric patients are particularly vulnerable to radiation exposure from medical imaging, according to numerous studies, potentially raising their risk to develop cancer later in life. And orthopaedic surgeons are often at the forefront in deciding if a pediatric patient needs medical imaging.

Now, a new analysis looks at the available evidence on radiation exposure in medical imaging in pediatric orthopaedic care—and provides recommendations aimed at optimizing decision-making to reduce unnecessary exposure. The findings are being presented at a Scientific Exhibit at the American Academy of Orthopaedic Surgeons 2017 Annual Meeting March 14-18 in San Diego.

"Traditionally, there has not been enough discussion on how we can disseminate information to best treat children with the least possible exposure to radiation," says senior research author David H. Godfried, MD, clinical associate professor of orthopaedic surgery and pediatrics, and director of the Center for Children at NYU Langone's Hospital for Joint Diseases. "A CT scan may be absolutely necessary for a child. But whenever there is an option, physicians should choose to obtain this information another way."

For their research, Godfried and Ayesha Rahman, MD, a fifth-year resident in the department of Orthopaedic Surgery at NYU Langone, reviewed peer-reviewed literature on different options in imaging

technology that may be used in pediatric orthopaedic injuries, including X-rays and CT scans of the spine, pelvis, hip, knees, shoulder, elbow, hand and wrist, and foot and ankle. They then quantified the amount of radiation in each of these scans.

They subsequently identified that pediatric patients who require surgery for hip dysplasia, scoliosis and leg-length discrepancy are among those most likely to undergo imaging such as X-rays or CT scans, and therefore may be among those children who are most vulnerable to exposure risk.

For example, their analysis found that pediatric patients with hip dysplasia that required surgery received two times more X-rays and underwent multiple CT scans compared to non-surgical pediatric patients, which cumulatively increased their overall risk of fatal cancer or genetic defects by less than one percent, a small but significant risk. In another finding, female scoliosis patients received two times more X-rays than non-surgical patients, amounting to twice the radiation exposure to the breasts, ovaries and bone marrow, and correlating to an over two percent increased lifetime risk of fatal breast cancer, almost one percent risk of fatal leukemia, and three percent risk of genetic defects. Non-surgical patients had approximately half that risk.

Best Practices to Reduce Radiation Exposure in Children

Based on the available evidence, the authors developed the following list of best practices that orthopaedic surgeons should follow:

- Follow the ALARA, or "as low as reasonably achievable" principle, to limit exposure to parts of the body that are absolutely essential for diagnosis

- Eliminate repeated exposures resulting from technical errors
- Limit precise collimation to the region of interest
- Limit fluoroscopy to short bursts as needed (don't "go live")
- Utilize low-dose CT protocols adjusted for the size of the patient
- Limit CTs of the spine and pelvis in pediatric patients
- Female patients are more susceptible to adverse effects than male patients
- Scoliosis patients should have limited follow-up X-rays
- Leg length, scoliosis, and hip dysplasia (anteversion) studies should utilize EOS imaging technology rather than traditional X-rays
- X-rays are an acceptable diagnostic tool for extremities, such as the wrist, ankle, etc.
- CT scans are an acceptable diagnostic tool for triplane fractures

"We have examined our use of X-rays in different clinical situations and the effect on patient outcomes, and have been able to reduce or eliminate the need for X-rays in many instances including certain post-operative and routine follow-up visits," says Dr. Rahman. "While X-rays are still a necessary and important diagnostic tool in the pediatric population, our goal is to reduce radiation exposure to these patients wherever possible without compromising patient care."

Several of these practices have been implemented at NYU Langone in collaboration with institution-wide efforts put forth by the Department of Radiology to reduce radiation exposure. One example, according to the researchers, is children with scoliosis or suspected spine problems now are often imaged with EOS imaging machines that provided useful information with about one-tenth the radiation exposure than a conventional CT or X-ray of the spine.

In hip dysplasia cases, orthopaedic surgeons work with musculoskeletal radiologists to reduce the number of slices from a CT scan of the hip,

from a typical 5 to 10 slices to only one or two, which may provide enough helpful information to ensure a successful surgery with less radiation exposure.

Orthopaedic surgery and radiology collaborators have also implemented intraoperative use of low-dose protocols on fluoroscopy machines, which reduces radiation exposure to both patients as well as physicians and staff in the operating room.

NYU Langone Orthopaedic surgeons reported at the AAOS 2016 meeting results from a joint effort with radiologists to reduce radiation in CT scans for joint fractures with one-fourteenth the amount of normal CT radiation—without compromising image quality or a surgeon's ability to effectively diagnose an injury. This ultra-low dose protocol is also being used in other musculoskeletal imaging studies.

Provided by New York University School of Medicine