Pediatric Radiology (2021) 51:152–154
https://doi.org/10.1007/s00247-020-04887-8

EXPOSURE

Published online: 19 November 2020

Guidance on using shielding on patients for diagnostic radiology applications. A joint report of the British Institute of Radiology, Institute of Physics and Engineering in Medicine, Public Health England, Society & College of Radiographers, and the Society for Radiological Protection. March, 2020.
https://www.bir.org.uk/media/414334/final_patient_shielding_guidance.pdf

This consensus document is supported by evidence-based research on patient-contact shielding. The authors concluded that contact shielding provides minimal or no benefit in diagnostic and interventional radiology, can adversely interfere with imaging, and can result in increased radiation exposure from repeat examinations or interference with automatic dose controls. They recommended cessation of all patient-contact shielding including gonadal, eye, thyroid and breast shielding. In the past, gonadal shielding was used to protect against concerns for heritable disease. In the United Kingdom, the mean entrance surface dose for pelvic radiographs has been reduced 60-fold since 1904, 6-fold between 1958 and 2010. Further, there is no evidence that radiation exposure results in excess of heritable disease in humans. Thus, the main reason to use contact shielding is to reduce the risk of carcinogenesis or radiation-induced posterior subcapsular cataracts. Rather than focus on contact shielding, the authors argued for "as low as reasonably practicable" (ALARP), balancing the risks and benefits by optimizing the examination. Contact shielding best protects against the primary beam and not secondary sources of radiation including scatter; however, shielding can interfere with the automatic dose control, increasing dose, or obscuring pathology and necessitating repeat exposure. Reject analysis should include causes of reject from shielding. Ovarian shielding is also problematic because the ovaries' exact location is variable within the pelvis. Collimation is one way to optimize the examination because the primary radiation drops to 1% at 25 mm from the edge of the collimator. Secondary sources include tube leakage, scatter from collimator housing, extra-focal radiation, internal scatter from irradiated tissue, and backscatter. Internal scatter is the major source of secondary radiation to organs and is not reduced by contact shielding. Specific recommendations for radiography, fluoroscopy, interventional radiography, CT, mammography and dental radiography are addressed. Pregnant patients and pediatric patients are discussed by modality. The document is an excellent review of the research, with literature citations supporting the recommendations along with simple steps to optimize radiation protection for different types of examination and modalities. Finally, because patients might expect shielding, there is a chapter discussing communications and a separate, downloadable frequently-asked-questions brochure for patients (https://www.bir.org.uk/media/427407/bir_patient_shielding_folded_a4_flyer_final.pdf).

Letter to the editor: low dose radiation to COVID-19 patients to ease the disease course and reduce the need of intensive care. Høilund-Carlsen PF, Braad PE, Gerke O, Iversen KK, Vach W. *J Nucl Med*.
https://doi.org/10.2967/jnumed.120.251892

and

Virtual workshop low dose radiation therapy for COVID-19: benefits or risks? Organized by the National Council of Radiation Protection and Measurements; Radiation Research Program, Division of Cancer Treatment and Diagnosis, National Cancer Institute; and Radiation and Nuclear Countermeasures Program, Division of Allergy, Immunology, and Transplantation, National Institute of Allergy and Infectious Diseases. July 23, 2020.

This letter to the editor suggests using low-dose radiation in the treatment of patients infected with SARS-CoV-2 coronavirus disease 2019 (COVID-19). The authors argued that in the range of low-dose radiation up to 200 mSv there are no short-term side effects and that the linear no-threshold model has not been validated in this range, and that it might have beneficial effects on the body's deoxyribonucleic acid (DNA) repair and immune systems. Before the advent of penicillin, therapeutic X-ray treatment was proposed and, in a limited fashion, tested for treating pneumonia. The authors argued for the use of low-dose radiation in the range of 100–300 mSv as a simple therapeutic or as an adjunct to other drug interventions. In this range they argued it will have anti-

inflammatory actions without significant toxicity, preventing or limiting severe pneumonia. Without experimental experience, the authors guessed that it will reduce the number of intensive care unit (ICU) patients by one-third and shorten ICU stay by 20%. They argued for a randomized controlled trial. At the same time of this published letter, the National Council on Radiation Protection and Measurements and programs within the National Cancer Institute and National Institute of Allergy and Infectious Diseases had a workshop to discuss low-dose radiation treatment of COVID-19 patients. The workshop's stated goals included reviewing existing clinical and preclinical trials, the potential benefits and risks; exploring the mechanisms of treatment; and discussing consideration for future studies. The expected result of the workshop was to consider factors when designing a clinical trial. To date there has not been a published proceeding from that workshop.

Trends in use of advanced imaging in pediatric emergency departments, 2009–2018. Marin JR, Rodean J, Hall M et al. *JAMA Pediatr.* https://doi.org/10.1001/jamapediatrics.2020.2209

and

Editorial: less radiation but more overall advanced imaging in children — good news or bad news? Schroeder AR, Imler DL. *JAMA Pediatr.* https://doi.org/10.1001/jamapediatrics.2020.2222

Historically, CT has been the most commonly used advanced imaging modality in the pediatric emergency department (ED). The Image Gently and Image Wisely radiation protection advocacy campaigns have raised awareness about the potential to cause cancer from ionizing radiation. The authors tested whether there has since been a decrease in CT utilization and concomitant increase in US and MRI in pediatric EDs. Advanced imaging data, encounter diagnosis, length of stay/discharge, and 3-day ED revisit rates from patients younger than 18 years in the Children's Hospital Association database of 32 children's EDs with visits between Jan. 1, 2009, and Dec. 31, 2018, were analyzed. Analysis showed that 1,919,283 out of a total of 26,082,062 ED visits (7.4%) resulted in one or more advanced imaging studies. The rate of advanced imaging statistically significantly increased from 6.4% in 2009 to 8.7% in 2018 (P<0.001). CT usage statistically significantly decreased from 3.9% in 2009 to 2.9% in 2018 (P=0.001); this change occurred between 2009 and 2014 and remained steady thereafter. US usage statistically significantly increased from 2.5% in 2009 to 5.8% in 2018 (P<0.001). MRI usage also statistically significantly increased from 0.3% in 2009 to 0.6% in 2018 (P<0.001). The analysis showed that 133,862 visits (7.0%) included more than one advanced imaging modality, 92,232 visits (68.9%) included both CT and US. Despite the decrease in CT usage, advanced imaging modality usage greatly increased, especially for US in the evaluation of appendicitis and abdominal pain, and for MRI in the evaluation of ventricular shunt. ED length of stay did not change despite increased advanced imaging modality usage, but there was a decrease in rates of admission and 3-day revisits. The authors attributed raised awareness of radiation risk and decrease in CT utilization to the Image Gently and the Image Wisely media campaigns, and they credited the American Academy of Pediatrics and the American College of Radiology efforts for the increased use of other modalities such as US in the evaluation of appendicitis. The authors noted that the increase in US utilization was greater than the decrease in CT, representing overutilization. Likewise, with the advent of fast MRI, MRI is supplanting CT in the evaluation of ventricular shunt malfunction. Concussion evaluation is one situation in which decreasing CT utilization was not met with a rise in MRI usage, likely because of clinical decision rules for head trauma. The leveling off of CT utilization since 2014 suggests that we have reached the limit of CT utilization reduction.

In the accompanying editorial, the authors argued that while the reduction of CT might lead to fewer cancers, we have replaced one imaging modality (CT) with other modalities. In fact, US utilization more than doubled and MRI utilization doubled, not just supplanting CT. Currently, 1 in 12 ED visits results in an advanced imaging modality study. Advanced imaging can result in over-diagnosing a finding that does not benefit the patient but might lead to other interventions that do not improve outcomes. The authors argued that a multi-prong approach is needed to combat excessive imaging.

Comparison of the effectiveness of single-component and multicomponent interventions for reducing radiation doses in patients undergoing computed tomography: a randomized clinical trial. Smith-Bindman R, Chu P, Wang Y, et al. *JAMA Intern Med.* 2020;180(5):666–675. https://doi.org/10.1001/jamainternmed.2020.0064

This international clinical trial tested whether audits alone versus a multicomponent intervention could reduce the mean effective dose and proportion of high-dose CT scans in adults as the primary outcomes. The authors also looked at organ dose and volumetric CT dose index ($CTDI_{vol}$) as secondary outcomes. The multicomponent intervention included targeted suggestions, a quality improvement collaborative, and best-practice sharing. CT studies included chest, abdomen, combined chest/abdomen and head CTs in patients older than 18 years in participating centers that use Radimetrics dose-management program. After accruing baseline data (age, gender, $CTDI_{vol}$, dose–length product, effective dose, and mid-scan diameter [surrogate for patient size]), the centers

went through an audit intervention. Then there was a second data accrual. The centers then went through the multicomponent intervention and the last data accrual. One hundred centers completed the study consisting of 1,156,657 CT scans. Audit alone only significantly reduced the number of high-dose CT scans for the combined chest/abdomen group when evaluating effective dose. Multicomponent intervention reduced the number of high-dose CT scans for head, chest, abdomen and combined chest/abdomen when evaluating effective dose. Multicomponent intervention reduction was much greater when evaluating organ dose than effective dose or $CTDI_{vol}$. The percentage decrease in effective dose was greater for multicomponent intervention than audit intervention. Image quality did not suffer based on surveys. The authors concluded that multicomponent intervention can reduce CT doses. The authors also found that organ dose showed a greater magnitude of change than effective dose because it directly measures change in radiation exposure in the exposed organs. They concluded that organ dose reduction is clinically important. They did not study what types of intervention were most effective but gave examples that chest/abdomen study dose reduction was achieved mainly by reducing the number of acquisitions while head CT dose reduction was achieved by lowering the acquisition settings. They concluded that "The goal of dose optimization is appropriate radiation doses — not the lowest possible dose but the lowest dose needed to answer clinical questions."

Abstracted by: Steven Don
E-mail: dons@mir.wustl.edu