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EMERGENCY RADIOLOGY SPECIAL FEATURE: COMMENTARY

Radiation dose awareness and disclosure practice in paediatric emergency medicine: how far have we come?

[1]KATHY BOUTIS, MD, MSc and [2]KAREN E THOMAS, FRCR, FRCPC

[1]Division of Emergency Medicine, Department of Pediatrics, the Hospital for Sick Children, and University of Toronto, ON, Canada
[2]Department of Diagnostic Imaging, the Hospital for Sick Children, and University of Toronto, ON, Canada

Address correspondence to: Dr Kathy Boutis
E-mail: *kathy.boutis@sickkids.ca*

ABSTRACT

The past decade has brought increasing coverage in the medical literature and lay media of the potential association between low-level radiation from diagnostic imaging and an increased lifetime cancer risk. Both physician and public opinion increasingly favour a greater discussion of benefit and risk with patients and their families when such imaging is being considered. Particular attention has been directed towards CT, its use in children and the emergency department setting. We will review the evolution of radiation dose awareness and knowledge among emergency physicians (EPs) alongside the parallel increase in public awareness. We will then discuss expectations for risk disclosure and the challenges faced by EPs and radiologists as we strive to provide this in a clinically balanced and meaningful way.

CT is capable of providing definitive, life-saving diagnoses, and its faster scan time decreases the need for sedation relative to other imaging techniques such as MRI. Thus, despite some reported recent decline in the use of CT in paediatric institutions,[1,2] it remains a vital component of the urgent diagnostic evaluation of paediatric patients. However, CT represents the largest overall contributor to diagnostic medical radiation exposure in paediatric emergency medicine and deserves attention, given the current concern for a potential association between low-level radiation from diagnostic imaging and an increased lifetime cancer risk.[3]

Emergency physicians (EPs) are becoming increasingly aware of the active discussion around this potential risk associated with CT. It should be acknowledged that the medical literature addressing the extent and accuracy of EP radiation dose and risk knowledge is challenged by the inherent limitations of survey design, the choice of comparators as indicators of relative dose. There is also the issue of the range of estimated dose or risk accepted as "correct", and a more in-depth discussion of doses from specific imaging technologies can be found in previously published work.[4] Nevertheless, evidence available from studies over the past decade does suggest an expansion in the physician knowledge of radiation doses and potential risks. In 2004, Lee et al[5] demonstrated that only 9% of EPs at a US academic medical center believed there was an increased cancer risk from CT; but by 2014, 98% of paediatric EPs believed there was some risk.[6] In 2004, over 50% of EPs assessed the dose of an abdominopelvic CT as equivalent to less than 10 chest radiographs, a 10–25-fold underestimate.[5] By 2014, between 18 and 39% of EPs correctly assessed the effective dose of abdominopelvic CT and estimated increased lifetime malignancy risk from a 10- mSv exposure.[7] The same year, amongst paediatric EPs, less than 30% of EPs underestimated the current risk estimate associated with a head CT, while 35% EPs correctly identified the equivalent time period of background radiation and the current risk estimate associated with a head CT.[6] Nevertheless, despite some encouraging increases, there is still considerable opportunity for greater dissemination of knowledge amongst EPs.

There has been a parallel and substantial interval increase in public awareness of the potential risk associated with ionizing imaging modalities over the past 10 years. A 2004 study reported that only 3% of adult patients who received an abdominal CT in the emergency department (ED) believed there could be an increased malignancy risk.[5] In 2007, Larsen et al[8] surveyed parents of children scheduled to undergo non-urgent outpatient CT and found that 13% of respondents were aware of possible malignancy risks. In contrast, in 2013, a survey of parents whose children presented to a tertiary-care paediatric ED with a head injury

demonstrated that 50% of parents were aware that CT imaging may increase a child's future malignancy risk.[9] Similarly, in 2014, Zwank et al[10] surveyed 200 stable adult patients in the ED who had recently undergone CT. Of these, 41% of patients were aware that CT scans were associated with radiation exposure and 25% of patients were aware of the potential malignancy risk. Many EPs report experiencing an increase in patient questioning about possible risks.[6,11] The recent explosion of media coverage is probably the most influential factor contributing towards increasing patient and parental awareness, but communication from healthcare professionals is also becoming a more common information source.[9] There is a strong and consistent theme emerging from multiple studies that patients and their families want more information on possible risks associated with imaging procedures.[6,10,12] The majority (75%) of physicians also concur that potential risks should be discussed with patients.[12] These opinions are in line with current models of optimal care which promote patient autonomy, involvement in decision-making and patient-centred care.[12,13]

Published data on how often EPs discuss radiation exposure from CT with their patients is relatively sparse and based primarily on self-reporting surveys, focus groups and anecdotes. However, recent reports of discussion rates of 24–37% among general EPs,[11,12] and over 60% among paediatric EPs,[6] suggest that such conversations are more frequent now than a decade ago when Lee et al[5] reported a 9% ED physician disclosure rate. While there are clear limitations to self-reporting surveys and patient perception may not always parallel that of physicians, it is probable that there has been some change in practice, especially in the paediatric ED setting. This is supported by a recent focus group study finding that the normative view that radiation from CT should be discussed in the ED was shared by both patients and physicians.[12]

Factors identified as prominent in the decision of paediatric EPs not to discuss radiation exposure include concern of precipitating excess parental worry about future cancer risk, concern that a needed scan might be denied and when decisions involve the emergent management of a critically ill child.[6] Litigation, time constraints, frustration with changing dose and risk numbers in the literature and lack of easily accessible guidance on how to communicate these risks to patients were barriers raised by general EPs.[12] Conversely, factors which appear to increase the likelihood of discussion occurring include if the patient is a child, a disparity between patient and physician perception of the need for a scan, if the patient has undergone multiple previous CT scans of the same body part for a similar clinical presentation and/or when a direct enquiry is made by a patient or family.[6,7,12] EPs have expressed a strong desire for electronic decision support to promote these conversations and optimize ordering of ED imaging that exposes patients to ionizing radiation.[7,11]

While there is a growing body of opinion that some form of potential risk disclosure is appropriate, there is as yet little consensus as to when such a disclosure is appropriate, what information should be provided, who should be responsible for this communication and the framework in which this is carried out.[14] Should the decision depend on the imaging modality, specified level of expected dose, age or life expectancy of the patient, emergent *vs* non-emergent nature of the study or a combination of these factors? Should the process resemble a "written informed consent" or "informed discussion" which may or may not be documented in the health record?[15–17] Currently, the latter approach may be perceived to offer more flexibility in approach, since it implies and encourages more discussion between parties. Furthermore, it may be a more appropriate setting to acknowledge our uncertainties in risk projection, a situation which is unlikely to change in the near future.[6,12,18,19] This "informed discussion" approach also dovetails more generally with the expressed desire of patients and families to receive greater counselling and discussion around their diagnostic and treatment options as part of shared decision-making.[12,13]

Detailed description of the various communication approaches that a physician may use in their discussions with patients and their families is beyond the scope of this short review. However, the principles are those of open communication, discussion of the anticipated benefit of the scan, followed by acknowledgment that there may be a small potential future risk. Some EPs attempt to put this risk in context with other sources of radiation exposure, exposure to radiation from everyday life or other risks we take in everyday life.[6] The measures taken in the radiology department to ensure that the scan will be as safe as possible could also be part of these discussions. The most effective approach may not be the same for all families and the extent to which families will be able to engage in this discussion is likely to vary widely. For example, it would not be reasonable to expect an EP to engage in these discussions during an emergent resuscitation. Some advice is available from the paediatric radiology literature[14,18,20] and the Image Gently Campaign website (http://imagegently.org). However, many physicians still feel there is a relative lack of concise information tools available to assist them in providing the "common sense" explanations wanted by patients.[12]

There is ongoing debate within the medical community as to whether the referring physician or the radiologist is best placed to conduct benefit to risk discussions, but most patients generally expect this to be performed by the referring physician.[14] Regardless, a collaborative approach is necessary with radiologists supporting their emergency medicine colleagues by providing dose information, context to risk estimates, education on dose-saving technologies and local radiation safety measures and assistance with patient communication as needed. Ongoing feedback between physician, radiologist and patient groups will be essential as we go forward in this process and communication strategies evolve over the coming years.

In summary, radiation dose and risk awareness has increased considerably among EPs over the past decade. Although there is still room for improvement, our attention must now be directed towards the debate around risk disclosure—the "who, what, when, where and how". Such information is increasingly expected by our patients and is in concordance with the principles of autonomy and shared decision-making. We must do

this in a way that is clinically balanced such that it provides a clear explanation of the expected benefit of the scan under consideration and increases the patient's understanding of the role of imaging within the wider management plan. Collaboratively, we must strive to find the communication approaches that will provide the most effective, consistent and helpful information to patients and their families. This is our challenge for the next decade.

REFERENCES

1. Parker MW, Shah SS, Hall M, Fieldston ES, Coley BD, Morse RB. Computed tomography and shifts to alternate imaging modalities in hospitalized children. *Pediatrics* Aug 2015. Epub ahead of print. doi: http://dx.doi.org/10.1542/peds.2015-0995
2. Menoch MJ, Hirsh DA, Khan NS, Simon HK, Sturm JJ. Trends in computed tomography utilization in the pediatric emergency department. *Pediatrics* 2012; **129**: e690–7. doi: http://dx.doi.org/10.1542/peds.2011-2548
3. Pearce MS, Salotti JA, Little MP, McHugh K, Lee C, Kim KP, et al. Radiation exposure from CT scans in childhood and subsequent risk of leukaemia and brain tumours:a retrospective cohort study. *Lancet* 2012; **380**: 499–505. doi: http://dx.doi.org/10.1016/S0140-6736(12)60815-0
4. Thomas KE. Comparative dose in pediatric radiology: uncertainty, estimates and ballparks. *Pediatr Radiol* 2011; **41**: S212–S4.
5. Lee CI, Haims AH, Monico EP, Brink JA, Forman HP. Diagnostic CT scans: assessment of patient, physician, and radiologist awareness of radiation dose and possible risks. *Radiology* 2004; **231**: 393–8. doi: http://dx.doi.org/10.1148/radiol.2312030767
6. Boutis K, Fischer J, Freedman SB, Thomas KE. Radiation exposure from imaging tests in pediatric emergency medicine: a survey of physician knowledge and risk disclosure practices. *J Emerg Med* 2014; **47**: 36–44. doi: http://dx.doi.org/10.1016/j.jemermed.2014.01.030
7. Griffey RT, Jeffe DB, Bailey T. Emergency physicians' attitudes and preferences regarding computed tomography, radiation exposure, and imaging decision support. *Acad Emerg Med* 2014; **21**: 768–77. doi: http://dx.doi.org/10.1111/acem.12410
8. Larson DB, Rader SB, Forman HP, Fenton LZ. Informing parents about CT radiation exposure in children: it's OK to tell them. *AJR Am J Roentgenol* 2007; **189**: 271–5. doi: http://dx.doi.org/10.2214/AJR.07.2248
9. Boutis K, Cogollo W, Fischer J, Freedman S, BenDavid G, Thomas KE. Parental perception of potential cancer risk associated with ionising radiation exposure from computed tomography. *Pediatrics* 2013; **132**: 305–11. doi: http://dx.doi.org/10.1542/peds.2013-0378
10. Zwank MD, Leow M, Anderson CP. Emergency department patient knowledge and physician communication regarding CT scans. *Emerg Med J* 2014; **31**: 824–6. doi: http://dx.doi.org/10.1136/emermed-2012-202294
11. Barbic D, Barbic S, Dankoff J. An exploration of Canadian emergency physicians' and residents' knowledge of computed tomography radiation dosing and risk. *CJEM* 2015; **17**: 131–9. doi: http://dx.doi.org/10.2310/8000.2014.141355
12. Robey TE, Edwards K, Murphy MK. Barriers to computed tomography radiation risk communication in the emergency department: a qualitative analysis of patient and physician perspectives. *Acad Emerg Med* 2014; **21**: 122–9. doi: http://dx.doi.org/10.1111/acem.12311
13. Hull A, Friedman T, Christianson H, Moore G, Walsh R, Wills B. Risk acceptance and desire for shared decision making in pediatric computed tomography scans. *Pediatr Emerg Care* 2015; **31**: 759–61. doi: http://dx.doi.org/10.1097/PEC.0000000000000467
14. Lam DL, Larson DB, Eisenberg JD, Forman HP, Lee CI. Communicating potential radiation-induced cancer risks from medical imaging directly to patients. *AJR Am J Roentgenol* 2015; **205**: 1–9. doi: http://dx.doi.org/10.2214/AJR.15.15057
15. Goske MJ. Doctor, is a CT scan safe for my child? *Br J Radiol* 2014; **7**: 1–3. doi: http://dx.doi.org/10.1259/bjr.20130517
16. Harvey HB, Brink JA, Frush DP. Informed consent for radiation risk from CT is unjustified based on current scientific evidence. *Radiology* 2015; **275**: 321–5. doi: http://dx.doi.org/10.1148/radiol.2015142859
17. Nievelstein RA, Frush DP. Should we obtain informed consent for examinations that expose patients to radiation? *Am J Roentgenol* 2012; **199**: 664–9. doi: http://dx.doi.org/10.2214/AJR.11.8319
18. Broder JS, Frush DP. Content and style of radiation risk communication for pediatric patients. *J Am Coll Radiol* 2014; **11**: 238–42. doi: http://dx.doi.org/10.1016/j.jacr.2013.10.003
19. Marin JR, Grudzen CR. Emergency physician radiation risk communication: a role for shared decision-making. *Acad Emerg Med* 2014; **21**: 211–3. doi: http://dx.doi.org/10.1111/acem.12313
20. Fahey FH, Treves ST, Adelstein SJ. Minimizing and communicating radiation risk in pediatric nuclear medicine. *J Nucl Med* 2011; **52**: 1240–51. doi: 10.2967/jnumed.109.069609