ORIGINAL ARTICLE HEALTH SERVICES RESEARCH AND POLICY

Oncology Patient Perceptions of the Use of Ionizing Radiation in Diagnostic Imaging

SA-CME

Joseph R. Steele, MD[a], Aaron K. Jones, PhD[a], Ryan K. Clarke, MHA[a], Sharon H. Giordano, MD[b], Stowe Shoemaker, PhD[c]

Abstract

Purpose: To measure the knowledge of oncology patients regarding use and potential risks of ionizing radiation in diagnostic imaging.

Methods: A 30-question survey was developed and e-mailed to 48,736 randomly selected patients who had undergone a diagnostic imaging study at a comprehensive cancer center between November 1, 2013 and January 31, 2014. The survey was designed to measure patients' knowledge about use of ionizing radiation in diagnostic imaging and attitudes about radiation. Nonresponse bias was quantified by sending an abbreviated survey to patients who did not respond to the original survey.

Results: Of the 48,736 individuals who were sent the initial survey, 9,098 (18.7%) opened it, and 5,462 (11.2%) completed it. A total of 21.7% of respondents reported knowing the definition of ionizing radiation; 35.1% stated correctly that CT used ionizing radiation; and 29.4% stated incorrectly that MRI used ionizing radiation. Many respondents did not understand risks from exposure to diagnostic doses of ionizing radiation: Of 3,139 respondents who believed that an abdominopelvic CT scan carried risk, 1,283 (40.9%) believed sterility was a risk; 669 (21.3%) believed heritable mutations were a risk; 657 (20.9%) believed acute radiation sickness was a risk; and 135 (4.3%) believed cataracts were a risk.

Conclusions: Most patients and caregivers do not possess basic knowledge regarding the use of ionizing radiation in oncologic diagnostic imaging. To ensure health literacy and high-quality patient decision making, efforts to educate patients and caregivers should be increased. Such education might begin with information about effects that are *not* risks of diagnostic imaging.

Key Words: Radiation, ionizing, patient education, caregiver, CT, MRI, health literacy

J Am Coll Radiol 2016;■:■-■. Copyright © 2016 American College of Radiology

INTRODUCTION

In a 2001 *Health Affairs* article [1], MRI and CT were ranked by physicians as the most important medical innovations of the preceding 25 years. The clinical value of these two medical imaging modalities, along with PET, has been well documented, and utilization of these modalities has increased markedly during the past two decades. Recent efforts from payers and providers have focused on more-appropriate utilization and increased safety of diagnostic imaging through programs such as the ACR Appropriateness Criteria® and the Image Gently® and Image Wisely® campaigns [2-4].

Increased awareness about the use of ionizing radiation in diagnostic imaging has resulted in concern among the public and medical community. A 2009 *Los Angeles Times* article [5] reported the exposure of 260 patients to excessively high doses of radiation during CT brain perfusion scans at one institution, and the "Radiation Boom" series in *The New York Times* [6] highlighted numerous safety concerns and examples of overuse. The National Council on Radiation Protection and Measurements reported a seven-fold increase in radiation exposure of the US population from medical imaging between the early 1980s and the mid-2000s [7]. In fact,

[a]Division of Diagnostic Imaging, The University of Texas MD Anderson Cancer Center, Houston, Texas.

[b]Department of Health Services Research, The University of Texas MD Anderson Cancer Center, Houston, Texas.

[c]William F. Harrah College of Hotel Administration, University of Nevada, Las Vegas, Las Vegas, Nevada.

Presented as scientifice poster (http://archive.rsna.org/2014/14018038.html Accessed March 16, 2016) at the RSNA meeting, 2014.

Corresponding author and reprints: Joseph R. Steele, MD, University of Texas MD Anderson Cancer Center, Interventional Radiology, 1515 Holcombe Blvd., Unit 1479, Houston, TX 77030; e-mail: jsteele1@mdanderson.org.

The authors have no conflicts of interest related to the material discussed in this article.

Support was provided by funding from the Levit Family Endowment, The University of Texas MD Anderson Cancer Center.

1546-1440/16/$36.00 ■ http://dx.doi.org/10.1016/j.jacr.2016.02.019

24% of the collective radiation dose in the United States is attributable to CT alone. Articles in the medical literature have reported on the increasing exposure of patients to ionizing radiation through diagnostic imaging and the projected cancer risks of these imaging studies [8-10]. Increasing interest in these topics has now resulted in increased regulatory scrutiny and legislative measures [11,12].

Adverse effects from radiation exposure can be classified broadly as either tissue or stochastic. Tissue effects, also known as deterministic effects, are characterized by a threshold, below which is no effect, and above which is a biological effect that increases in severity with radiation dose. Examples include radiation cataracts, radiation skin injury, and sterility. Stochastic effects are those for which the likelihood of an effect increases with dose, and the effect is "all or nothing"—ie, the effect is either present or not, and the severity of the effect is independent of dose. The most notable example of a stochastic effect is radiation-induced cancer. The currently accepted model for radiation-induced cancer is the linear no-threshold model [13].

Much of the research in this area has focused on individuals exposed to radiation during the atomic bombings of Hiroshima and Nagasaki, Japan. Some controversy surrounds the extrapolation of these data to very low doses; however, the confirmed excess risk at higher doses should be discussed by providers and patients during shared decision making about diagnostic imaging [14]. Although many believe that stochastic effects do result from diagnostic imaging, the risks are estimated to be very small [13,14].

Amplification by the media of potential risks associated with diagnostic imaging may result in stigmatization of medical imaging and make patients reluctant to undergo indicated examinations [11,15]. The word "radiation" may elicit preconceived ideas driven by images ranging from Chernobyl to nuclear weapons [16]. Many advocate increased use of benefit-risk discussions between providers and patients, during which providers explain the need for imaging and address patients' concerns [17,18]. To effectively communicate with oncology patients and ensure informed decision making, we must understand their scope of knowledge.

Arguably, oncology patients should be those most familiar with diagnostic imaging. Diagnostic imaging is used in every phase of the diagnosis and treatment of cancer, and almost any patient diagnosed with cancer will undergo at least one diagnostic imaging procedure. Some patients undergo repeated diagnostic imaging procedures at regular intervals for monitoring of response to therapy or surveillance for recurrence. The purpose of this study was to measure oncology patients' knowledge regarding use of ionizing radiation in diagnostic imaging, the relative radiation doses resulting from use of various imaging modalities, and the tissue and stochastic risks from exposure to ionizing radiation.

METHODS

In this study, approved by the Institutional Review Board of The University of Texas MD Anderson Cancer Center, we measured the knowledge of patients and their direct caregivers about the use of ionizing radiation in diagnostic imaging. We created a 30-item questionnaire (Appendix 1, available online) and distributed it via e-mail, in February 2014, to 48,736 randomly selected patients who had undergone a diagnostic imaging procedure at the center between November 1, 2013 and January 31, 2014.

Patients were randomly selected from the RIS according to the examination received, in proportion to the actual annual distribution of examinations among imaging modalities. Surveys were sent to patients but included a note asking that a direct caregiver complete the survey if a patient was not able or willing to do so. For questions about knowledge or opinions regarding ionizing radiation, respondents were asked to indicate their own knowledge and opinions.

The survey questioned patients and caregivers about the following: which diagnostic imaging modalities use ionizing radiation; potential risks from exposure to ionizing radiation; what information, if any, patients received from their physician regarding the use of ionizing radiation; and their attitudes about the benefits and risks of diagnostic imaging. The survey was constructed using the principles advocated by Dillman et al [19]: respondents could stop and restart the survey, provide open-ended responses, and rank-order their responses when they selected multiple responses to a single question.

Participants who responded that they did not know the definition of ionizing radiation were presented with one of two definitions. The first was as follows: "Electromagnetic or particulate radiation that is sufficiently energetic to excite or ionize (remove electrons from) atoms. Ionizing radiation is invisible and not directly detectable by human senses." The second definition had the added statement "so instruments such as Geiger counters are usually required to detect its presence," at the end, and served as the negative case. The use of two definitions was intended to prevent the introduction of