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Patient preferences and acceptable risk for computed tomography in trauma

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ABSTRACT

Background: Rising use of computed tomography (CT) to evaluate patients with trauma has increased both patient costs and risk of cancer from ionizing radiation, without demonstrable improvements in outcome. Patient-centred care mandates disclosure of the potential risks, costs and benefits of diagnostic testing whenever possible.
Objective: We sought to determine (1) patient preferences regarding emergency department (ED) real-time discussions of risks and costs of CT during their trauma evaluations; and (2) whether varying levels of odds of detection of life-threatening injury (LTI) were associated with changes in patient preferences for CT.
Methods: Excluding patients already receiving CT and patients with altered mental status, we surveyed adult, English-speaking patients at four Level I verified trauma centres. After informing subjects of cancer risks associated with chest CT, we used hypothetical scenarios with varying LTIs to assess patients' preferences regarding CT.
Results: Of 941 patients enrolled, 50% were male and their mean age was 42 years. Most patients stated they would prefer to discuss CT radiation risks (73.5%, 95% CI [66.1–80.8]) and costs (53.2%, 95% CI [46.1–60.4]) with physicians. As the odds of detecting LTI decreased, preferences for receiving CT decreased accordingly: LTI 25% (desire 91.2%, 95% CI [89.4–93.1]), LTI 10% (desire 79.3%, 95% CI [76.7–81.9]), LTI 5% (desire 69.1%, 95% CI [66.1–72.1]) and LTI <2% (desire 53.8%, 95% CI [50.6–57.0]). If the LTI was <2% and subjects were required to pay $1000 out-of-pocket, only 34.5% (95% CI 31.4–37.5) would opt for CT.
Conclusion: Most non-critically injured patients prefer to discuss radiation risks and costs of CT prior to receiving imaging. As the odds of detecting LTI decrease, fewer patients prefer to have CT; at an LTI threshold of 2%, approximately half of patients would prefer to forego CT. Adding out-of-pocket costs reduced this proportion to one-third of patients.

Introduction

The use of computed tomography (CT) in United States health care has increased significantly over the past few decades, from approximately 2 million scans performed in 1980 to 85.3 million in 2011 [1–3]. Similarly, emergency department (ED) advanced diagnostic imaging for injury (primarily CT) has increased from 6% of visits in 1998 to 15% in 2007, without corresponding increases in hospital admissions or diagnoses of life-threatening conditions [4]. This increased CT use exposes more patients to potentially harmful ionizing radiation, contributes to ED crowding, and generates annual radiographic charges approaching $100 billion [5].

Diagnostic medical imaging is a major source of non-natural radiation exposure, accounting for 15–20% of annual doses [6]. In the evaluation of patients with trauma, CT is the largest source of radiation [6]. When compared to plain chest radiographs, for example, CT scans involve as much as 119 times more radiation [1].

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This ionizing radiation has been associated with an increased cancer risk in a linear, dose-dependent relationship [6,7]. It is estimated that 1 in 270 women who undergo CT coronary angiography at age 40 will develop cancer as a direct result of the scan, and approximately 29,000 future cancers may be related to the CTs performed in the U.S. during 2007 alone [1,7,8]. Although public awareness of radiation risk is increasing, most patients still remain unaware of radiation exposure risk from CT [2,9].

Respect for patient autonomy mandates providing informed consent for procedures that carry risk whenever possible. Yet, despite emerging knowledge about the potential cancer risks of CT, trauma imaging is typically obtained without informing patients of its risks or discussing their preferences. Patients may prefer to forego CT and accept a chance of missed injury in order to avoid the radiation exposure and costs of CT. Our objectives of this study were to determine (1) patient preferences for the discussion of risks and costs of CT during trauma evaluations in the ED, and (2) whether varying odds of detecting life-threatening injury (LTI) by CT changes these preferences. Knowledge of these patient preferences and risk tolerances may be useful to promote patient autonomy and shared decision making.

Methods

Study design, participants, and setting

We conducted this cross-sectional survey of ED patients who presented to four urban American College of Surgeons verified Level I trauma centres between July 2012 and April 2013. After providing a scripted consent that emphasised voluntary and anonymous participation, we surveyed a convenience sample of patients with the following exclusions: (1) receiving CT scan, (2) altered mental status, (3) intoxication, (4) critical illness, (5) incarceration, (6) psychiatric hold, and (7) inability to understand an English-language survey. We gave subjects the option to read and complete the survey independently or to have the questions read to them by trained research staff. We obtained institutional review board approval at all sites.

Survey instrument

After review of the limited prior work in this field, we developed an instrument consisting of yes/no/not sure, multiple choice, and free-text response questions [2,10–15]. A faculty health care literacy expert, who was not otherwise involved in the study, reviewed the preliminary instrument and made recommendations regarding structure and content. We conducted a pilot test of the instrument on five ED patients to assess understanding and test-retest consistency.

The first set of questions assessed preferences for being informed about radiation risks and costs of CT. We then provided subjects with the following risk statement: "According to recent estimates, the lifetime risk of developing cancer from the radiation of a chest CT may be as high as 0.26% (1/380) for a 20 year old woman (risks of developing cancer are likely lower for older persons and may be lower depending on the type of CT scanner used)" and gave them a series of hypothetical situations with varying risks of life threatening injury (LTI) detected on CT (range from 25% to <2%). For each scenario, we asked subjects whether they would want their physicians to order a CT. See Appendix A for the full survey instrument.

Data analysis

We managed data using Research Electronic Data Capture (RedCAP), hosted by the University of California, San Francisco [16]. We summarised and reported demographic data in aggregate form and performed statistical tests using STATA version 9.0 (StataCorp, College Station, TX).

Our a priori sample size determination was governed by the width of the confidence intervals around the point estimates for proportions in the yes/no survey questions. Seeking to establish a point estimate of the risk patients are willing to accept with 95% confidence within 4% of this point estimate, our minimum sample size was 666 subjects.

We calculated 95% confidence intervals for each of our point estimates at varying risk of LTI detection and determined whether gender, age >42 years (the median age of our study population), and higher education level (any education beyond a high school degree) were associated with differences in desire to discuss radiation risks and in preferences for CT. We additionally determined whether lower income (less than $30,000) and lack of insurance were associated with differences in desire for discussions of CT costs and lower preferences for CT with a $1000 out of pocket cost. We used multiple logistic regression to assess whether any of these subject characteristics were independently associated with CT preference in each of the five hypothetical situations.

Results

Of the 941 subjects enrolled, the mean age was 42 years and 50% were male. See Table 1 for complete subject characteristics.

Most subjects stated that they would prefer to discuss trauma CT radiation risks (73.5%, 95% CI [66.1, 80.8]) and costs (53.2%, 95% CI [46.1, 60.4]) with their physicians prior to receiving CT. As

Table 1
Subject characteristics ($n = 941$).

	n (%)
Characteristic	
Gender	
Male	473 (50.3)
Female	467 (49.6)
Transgender	1 (0.1)
Age (yr), mean (SD)	42 (15.5)
Race/ethnicity	
White (non-Hispanic)	393 (41.9)
Black	228 (24.3)
Hispanic	222 (23.6)
Chinese	11 (1.2)
Other Asian	36 (3.8)
Other	51 (5.4)
Education	
No formal education	3 (0.3)
Some elementary/middle school	20 (2.1)
Completed middle school	20 (2.1)
Some high school	105 (11.2)
Completed high school	250 (26.6)
Some college	290 (30.8)
Completed college	170 (18.1)
Some graduate school	23 (2.4)
Completed graduate school	60 (6.4)
Annual income ($n = 895$)	
<$10,000	337 (37.7)
$10,000–$30,000	265 (29.6)
$30,001–$60,000	153 (17.1)
$60,001–$100,000	72 (8.0)
>$100,000	68 (7.6)
Health Insurance (more than 1 response allowed)	
Private insurance	218 (23.2)
Kaiser/other HMO	119 (12.6)
Medicare	112 (11.9)
Medicaid	214 (22.7)
Other city/state-funded	123 (13.1)
No insurance	139 (14.8)
Don't know	51 (5.4)