Opportunistic Osteoporosis Screening: Addition of Quantitative CT Bone Mineral Density Evaluation to CT Colonography

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Abstract

Purpose: For patients undergoing CT colonography (CTC), the screening presents an opportunity for concurrent osteoporosis screening, without increasing radiation exposure or the time involved for the patient, using proximal femur quantitative CT-CT x-ray absorptiometry (QCT-CTXA).

Methods: This cohort included 129 women and 112 men (mean age: 60.1 ± 8.2 years; range: 50–95 years) who underwent CTC between March 2013 and September 2014. Areal bone mineral density (BMD; g/cm^2), and resultant left femoral neck T-score, was prospectively measured on the supine CT series. QCT results were reported with the CTC. Chart review evaluated whether the patients were eligible for BMD screening according to guidelines from the US Preventive Services Task Force and the National Osteoporosis Foundation guidelines; whether they had undergone prior BMD testing; and whether QCT results changed patient management.

Results: Overall, 68.0% (164 of 241) of patients from this cohort had not previously undergone BMD screening. According to the National Osteoporosis Foundation guidelines, 44.0% (106 of 241) of patients were eligible for screening. T-scores within the osteopenic and osteoporotic range were detected in 32.3% (78 of 241) and 5.0% (12 of 241) of patients, respectively. Of these patients with low BMD, 66.7% (60 of 90) either had not previously undergone screening or were eligible for BMD testing. Reporting of QCT-CTXA T-scores altered management in 9 patients (3.7%) who had low BMD.

Conclusions: Maximizing the pre-existing value from imaging studies is crucial in the current era of health care reform. We demonstrate that colorectal and osteoporosis screening can be combined at CT examination, adding clinical and likely economic value.

Key Words: Screening, CT colonography, osteoporosis, bone mineral density

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INTRODUCTION

Osteoporosis is a common condition, affecting >10 million people in the United States, and it is associated with a lifetime fracture risk of approximately 50% in women and approximately 20% in men [1,2]. Osteoporosis-related fractures affect quality and quantity of life, with hip fractures in particular associated with high morbidity and mortality [3,4] Despite these risks, and the availability of proven treatments to reduce fractures, osteoporosis is underdiagnosed and therefore undertreated in the United States [5-7]. The reasons for underdiagnosis are multifactorial and include non-adherence to screening guidelines, with approximately one-half of female Medicare beneficiaries having never been screened. In addition, guidelines are conflicting: US Preventive Services Task Force (USPSTF) guidelines state that screening of men is of undetermined benefit, owing predominantly to an insufficiency of data and to resource costs [7-9].

Abdominal CT scans obtained for other indications can be used in an opportunistic fashion to screen for osteoporosis, without substantial additional cost [10-12]. The most pertinent measurement for opportunistic screening is bone mineral density (BMD) at the femoral neck, because it can be used in conjunction with the World Health Organization (WHO) Fracture Risk

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Assessment Tool (FRAX™), to estimate fracture risk and guide treatment. Previous work has documented that quantitative CT-CT x-ray absorptiometry (QCT-CTXA) at the time of CT colonography (CTC) is equivalent to standard dual x-ray absorptiometry (DXA) in identifying low BMD [13].

Given the significant overlap of the patient population undergoing CTC, with those at risk for low BMD, adding CTXA evaluation to CTC could increase identification of patients who are at increased fracture risk, with minimal additional cost. To this end, we have added femoral neck CTXA BMD evaluation to CTC screening in our clinical practice. The purpose of this study was to evaluate the clinical impact of this practice, including the detection of patients with previously unrecognized low BMD. A secondary endpoint was determining whether this identification of low BMD had an effect on patient management.

METHODS

Patient Cohort

The University of Wisconsin Health Sciences Institutional Review Board approved this HIPAA-compliant retrospective study. The need for obtaining signed informed consent was waived for this retrospective analysis. Beginning in March 2013, all patients undergoing CTC, at 2 (of 7) clinical sites with a phantom available, underwent CTXA BMD assessment as part of their extracolonic evaluation. All patients aged >50 years who had clinical CTXA BMD assessment at the time of CTC, between March 2013 and September 2014, were identified. Patients who were referred from outside the institution were excluded from analysis, owing to the limited information available in the electronic medical record. The final study cohort consisted of 241 patients (129 women, 112 men), ranging in age from 50 to 95 years, with a mean (standard deviation [SD]) age of 60.1 (8.2) years at the time of CTC.

CT Acquisition

Multidetector CT (MDCT) scanning for standard CTC screening was performed using the low-dose technique. Immediately before MDCT imaging, the colon is distended with carbon dioxide, using a continuous, automated, low-pressure delivery system. Noncontrast supine and prone MDCT acquisitions of the abdomen and pelvis were obtained using 16- or 64-detector scanners (GE Healthcare, Waukesha, Wisconsin), with 1.25-mm collimation, a 120 kVp, and a low-dose, modulated, tube-current technique (noise index: 50 mA; range: 30-300 mA). Images are reconstructed using a standard soft-tissue algorithm, with 1.25-mm slice thickness at 1-mm intervals. For extracolonic evaluation (including BMD), the supine series is reconstructed as well, with a 5-mm slice thickness at 3-mm intervals. Each patient had a QCT calibration phantom on the CT table, centered at the hips (Fig. 1), to allow Hounsfield-unit calibration for BMD measurement.

CT X-Ray Absorptiometry Image Analysis

The procedure for QCT hip BMD acquisition has been described previously [13]. Briefly, CTC volume images were sampled using SlicePick software (Mindways Software, Inc, Austin, Texas), to produce a simulated projection anteroposterior image, to locate the femoral head and lesser trochanter, in the same way as with a localizer.

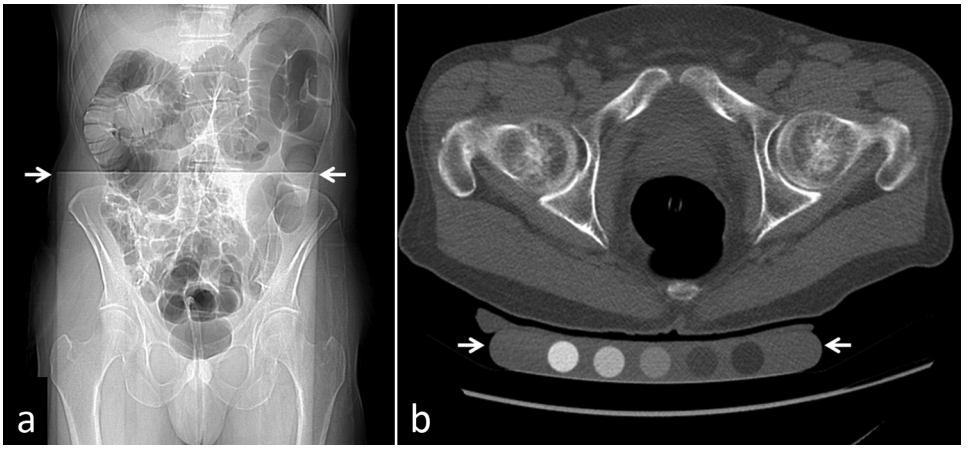

Fig 1. (a) CT scout image depicting phantom (top of phantom at *white arrows*) underneath patient. (b) Axial CT image depicting phantom (between *white arrows*) underneath patient.