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Assessment of the Presence and Quality of Osteoporosis Prevention Education Among At-Risk Internal Medicine Patients

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Abstract

Objective—Appropriate calcium and vitamin D intake for the prevention of osteoporosis represents an important component of osteoporosis prevention education (OPE). We sought to assess the presence and quality of OPE among osteoporotic and at-risk inpatients.

Design—Prospective chart review plus cross-sectional interview

Setting—Single academic tertiary referral medical center in Rochester, MN.

Participants—Adults admitted to an inpatient medicine service who were determined to be at risk for osteoporosis based on an investigator-developed screening tool or previously diagnosed with osteoporosis. Four-hundred sixty-four patients were screened, 192 patients were approached for participation, and 150 patients consented to be interviewed for the study.

Main Outcome Measures—Source of OPE, rates of appropriate calcium intake and supplementation.

Results—OPE from a healthcare provider was reported by 31.3% of patients, with only one patient reporting education from a pharmacist. Self OPE and no OPE were received by 29.3% and

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39.3% of patients, respectively. Appropriate overall calcium intake was found in 30.7% of patients, and only 21.3% of patients were taking an appropriate calcium salt.

Conclusion—Patients with osteoporosis and risk factors for osteoporosis lack adequate education from healthcare providers regarding appropriate intake of dietary and supplemental calcium and vitamin D. A particular deficit was noted in pharmacist-provided education. Specific education targeting elemental calcium amounts, salt selection, and vitamin D intake should be provided to increase the presence of appropriate overall calcium consumption.

Keywords

osteoporosis; dietary supplements; calcium carbonate; calcium citrate

Introduction

Although osteoporosis is a relatively silent disease, it may lead to substantial morbidity, mortality, and economic burden. It is estimated that greater than ten million Americans have osteoporosis, with an additional 33.6 million living with osteopenia.^{1–3}

The National Osteoporosis Foundation (NOF) recommends daily calcium and vitamin D intake in patients with and at risk for osteoporosis, based on data from controlled clinical trials suggesting that adequate intake may reduce fracture risk by preventing bone loss.^{1, 3} The 2010 NOF recommendations suggest at least 1,200 mg of elemental calcium per day for men and women age 50 and older, which may be supplied by both dietary and supplemental sources.^{1, 4} In addition to calcium, a daily dose of vitamin D in the amount of 800–1,000 international units is recommended by the NOF for adults age 50 and older¹ as vitamin D is known to assist with calcium absorption.

Despite the well-described burden of osteoporosis in the United States and the known benefit of calcium and vitamin D intake for prevention, many patients continue to consume inadequate amounts of calcium and vitamin D. Another consideration is the concurrent use of acid-suppression therapy which may inhibit the absorption of calcium carbonate; recommendations regarding the calcium salt selection warrant consideration since gastric dissolution and ionization of poorly soluble calcium salts (ie: calcium carbonate) represents an important step in calcium absorption.^{5–8} Mountjoy et al completed a study to assess compliance with NOF guidelines on calcium and vitamin D supplementation in postmenopausal, osteoporotic females³. They found only 70% of surveyed patients reported appropriate calcium and vitamin D supplement use and 28% of these patients were on concurrent acid suppression therapy that impacted the absorption of their calcium. Their findings suggest a deficiency in calcium and vitamin D supplementation, inappropriate calcium salt selection, and a need for further education of patients.

Assessment of where patients receive their OPE and a comparison of the effectiveness of different educational sources in following the guidelines to prevent osteoporosis and osteoporosis-related fractures is lacking in the literature. An analysis of the sources of OPE may reveal the deficits in current educational methods and may be an area for improvement.

Objective

The purpose of this study was to characterize the presence and source of OPE as well as the appropriateness of calcium and vitamin D intake. We hypothesized that osteoporotic and at-risk patients receive either no OPE or OPE from non-healthcare provider sources, which ultimately results in suboptimal calcium and vitamin D intake.

Methods

This prospective, observational study and subsequent cross-sectional interview was conducted at a single academic tertiary referral medical center from October 2010 through January 2011. The Mayo Clinic Institutional Review Board approved the study protocol and amendments, and all participants provided informed consent. Patients admitted to inpatient medicine services were screened for study inclusion to determine a diagnosis of osteoporosis or presence of risk factors. Patients meeting inclusion criteria were approached for a bedside interview to collect data needed to fulfill the study objectives.

Patients 18 years of age or older admitted to a medicine service during the study period were included if they were determined to be at risk for osteoporosis or diagnosed with osteoporosis during screening, and if informed consent was provided when approached for conduction of the interview.

Patients were excluded if they had any of the following conditions: stage V kidney disease, current hemodialysis, severe cognitive impairment, history of recurrent calcium-based renal stones or other contraindication to calcium therapy, or current pregnancy. Additionally, patients were excluded if they were at the end of life, or unable or unwilling to participate in the interview.

The primary study objectives were to determine the primary source of OPE as well as the percentage of patients receiving appropriate composite calcium intake (dietary and supplemental), considering the following four components: elemental calcium amount, calcium salt (calcium carbonate vs calcium citrate), presence of vitamin D co-therapy and overall appropriate intake. The secondary objectives were to determine the difference of the primary objectives among OPE subgroups (healthcare provider, self, or no education) and to determine the percentage of patients taking a calcium supplement and receiving overall appropriate calcium intake.

An investigator-developed screening tool was utilized to aid in identification of patients from a chart review for study inclusion. Collectively, the 2010 NOF Guidelines, 2010 position statement from the North American Menopause Society, 2009 position statement from the American College of Preventive Medicine, and the World Health Organization's FRAX® algorithm for quantification of fracture risk provided the foundation for screening tool development.^{1, 9–11} Specific screening tool risk factors are listed in Table 1.

Data collection was completed using an interview tool developed in conjunction with our institution's Survey Research Center. The interview tool included six sections and was designed to assess the presence and source of OPE, presence of calcium supplementation,

amount of dietary calcium intake, calcium supplement detail (e.g. dose, salt, frequency, and administration with or without food), presence of vitamin D co-therapy or adequate sun exposure, presence of concomitant proton pump inhibitor therapy, demographic information, and baseline education. In a pilot of eleven patients preceding the study period, the interview tool was validated for patient comprehension. Feedback from the eleven patients resulted in amendments to the interview tool.

Screening and interviews were conducted in a standardized fashion by the same two investigators throughout the study. All data was collected via bedside interview and review of the electronic medical record post interview.

An investigator review panel analyzed all interview data for determination of the percentage of patients receiving appropriate calcium intake. Determinations were made for each of the four components of calcium intake defined in the primary objective. The interview panel reached consensus whether each of the four components of calcium intake was appropriate for all 150 patients. Power calculation was done, determining that our sample size of 150 patients gave us 85% power to estimate with 95% confidence the proportion of patients receiving appropriate calcium supplementation to within 10% of the previously published proportion of 40% by Hall et al¹³. Descriptive statistics were performed for the primary and secondary objectives, and the chi square test was used to analyze categorical data for the secondary objective (JMP version 8.0 for Windows; SAS Institute Inc; Cary, NC 2008). P values < 0.05 were considered statistically significant.

Results

A total of 464 patients were screened with 150 patients meeting inclusion criteria, providing consent and participating in bedside interview (Figure 1). Our study population was primarily Caucasian and the majority had completed high school (table 2).

The majority of patient reported either receiving no OPE (39.3%) or receiving OPE from physicians and clinics (30.7%) (figure 2). Just one patient reported receiving OPE from a pharmacist; making the total OPE provided by all healthcare providers 31.3% of the study sample. Only 30.7% of patients were found to be receiving overall appropriate calcium intake which was defined as correct amount of elemental calcium, vitamin D co-therapy and ingestion of correct calcium salt. Only 21.3% of patients were assessed to be taking an appropriate calcium salt given the presence of concomitant acid suppression therapy whereas 51.3% of patients were found to be taking the correct amount of elemental calcium and 48.7% were appropriately receiving vitamin D co-therapy.

The secondary objective was to compare adherence rates to NOF guidelines for calcium supplement between different OPE sources with our primary interest being comparison between different health care providers. However, since pharmacists were the source of OPE for only one patient, a healthcare provider group was formed which was comprised of physicians and pharmacists which made up 31.3% of study subjects. Adherence rates for this group was compared to those who reported receiving no OPE (39% of study subjects) and those who received OPE from self-resources including media and internet (29% of study

subjects). A statistically significant difference in appropriate amount of elemental calcium, including dietary intake, was found between the no OPE and healthcare provider OPE groups (37.9% vs 77.8%, $p<0.0001$). A similar significant difference was found between the healthcare provider OPE and self OPE subgroups (77.8% vs 48.8%, $p=0.0048$). With respect to calcium salt selection, a significant difference was found between the no OPE and healthcare provider OPE subgroups (66.7% vs 31.6%, $p=0.013$). No significant difference between subgroups in terms of appropriate presence of vitamin D co-therapy and overall calcium supplementation was revealed, however it was observed that between 89–95% of patients in each subgroup were receiving vitamin D co-therapy and between 29–32% of patients in each subgroup were attaining overall appropriate calcium intake (figure 3). Of the 79 patients taking a calcium supplement in the study, 26 (32.9%) were receiving overall appropriate dietary and supplemental calcium intake.

Analysis of the difference in baseline education among OPE subgroups revealed a higher percentage of patients with a less than high school baseline education (13.6%) in the no OPE group than in the healthcare provider and self OPE groups (6.4% and 6.8%, respectively) but this difference was not statistically significant ($p=0.1078$).

Discussion

Healthcare providers represent unique sources of quality, detailed OPE for patients with and at risk for osteoporosis. However, we found that only 31.3% of our study sample received OPE from a healthcare provider, with only one patient reporting OPE from a pharmacist. The lack of healthcare provider OPE may have contributed to the finding that only 30.7% of our study sample was receiving overall appropriate calcium intake. Only 21.3% of patients taking a calcium supplement were taking an appropriate calcium salt, which suggests that appropriate calcium salt selection and strategies to maximize absorption should be emphasized when providing OPE. We found that vitamin D was consistently present in patients taking a calcium supplement, regardless of OPE source. This may be attributed to the wide variety of calcium and vitamin D combination products on the market and also may be due to the media coverage of the importance of vitamin D in recent years.

When providing education on appropriate calcium and vitamin D intake for the prevention of osteoporosis and osteoporosis-associated fractures, education should focus on recommended daily doses, dose per administration, frequency of administration, the need for administration with food when appropriate, and calcium salt considerations. A unique opportunity exists for education regarding calcium salt selection since calcium carbonate, a poorly soluble calcium salt, should be given with food and without concomitant proton pump inhibitor therapy in order to optimize absorption. These administration recommendations warrant consideration since gastric dissolution and ionization of poorly soluble calcium salts represents an important step in calcium absorption.^{5–8} Even though calcium carbonate is generally significantly less expensive than calcium citrate, calcium citrate is probably a better choice for many patients in order to maximize absorption.

Pharmacists represent a highly underutilized resource for OPE. For example, Hall et al noted significantly improved compliance with osteoporosis treatment guidelines via the

implementation of a pharmacist-managed osteoporosis service within family medicine clinics¹³. Based on our study finding, we demonstrated an opportunity for pharmacists to provide OPE to patients with a focus on appropriate calcium salt selection recommendations. Such OPE may be provided at every episode of care in both the inpatient or outpatient setting, with inpatient OPE possibly manifesting as discharge counseling and outpatient OPE being accomplished through medication therapy management (MTM) visits in collaboration with physicians.

As demonstrated in our study, patients are likely to receive osteoporosis education from sources other than health care providers, with an emphasis on media sources and the internet. Nearly 30% of our population reported receiving education from sources such as TV, magazines, newspapers, books, pamphlets, friends, family, and the internet. Rozenfeld et al¹⁴ demonstrated the impact of the media on health information in a 2006 survey of 3,000 female patients ages 50 to 85 (with a response rate of 26%) and found that 70% of survey respondents admitted to being somewhat or very likely to use the internet to gain knowledge about health-related issues. Furthermore, two-thirds of respondents said they would be likely to read about osteoporosis on a physician-prescribed osteoporosis management web site if one were to be developed. These results suggest that the population is increasingly reliant on media sources for health-related information, and our findings support this notion. Healthcare providers may therefore be challenged to provide more OPE to at-risk patients and reinforce OPE from other sources to ensure appropriate and individualized calcium intake.

Consideration of baseline education is crucial when analyzing data assessing education on a specific topic. Our study population was well educated at baseline, with the majority of patients having completed a high school or college education. This allowed a more accurate assessment of the true impact of OPE, considering that we were interacting with a population that was more likely to understand and retain healthcare information.

Limitations

Our study has several limitations. First, the investigation was conducted at a single medical center with a patient sample tending to be of higher educational status and primarily Caucasian race, potentially limiting the ability to extrapolate the findings to the general population as well as creating a selection bias. Second, poor documentation of menopausal status in the electronic medical record likely resulted in many at-risk females ages 50–64 failing to meet inclusion, as the age for inclusion for females per the screening tool was 65 years. Third, vitamin D intake was not assessed in patients who were not taking a calcium supplement, which limits the ability to assess for adequate absorption in patients achieving an appropriate daily elemental amount due to a high dietary calcium intake. Fourth, we did not investigate the dual-energy x-ray absorptiometry (DXA) scan history of study participants, which would have allowed further identification of patients having received physician-provided OPE, since physicians ordering DXA scans have likely discussed osteoporosis with the patient. Fifth, there was potential for selection bias since the selection of patients for interview was not randomized. Lastly, recall bias must be considered since

the data collected via the interview tool relied on the memory of patients providing the interview.

Conclusion

Improved patient education regarding the recommended amounts of dietary and supplemental calcium and vitamin D for patients with and at risk for osteoporosis is needed in order to optimize long-term outcomes. Improved education may help to ensure patients receive overall benefit from supplements added to their medication regimen. Osteoporosis is a chronic disease that can lead to serious consequences if preventive measures are not taken. Enhanced educational initiatives must be emphasized by pharmacists and other healthcare providers alike.

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Abbreviations

OPE	Osteoporosis prevention education
NOF	National Osteoporosis Foundation

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CKD V = Stage V Chronic Kidney Disease

HD = Hemodialysis

Figure 1.
Patient Enrollment

Figure 2.
Primary Source of Osteoporosis Education (OPE) (n=150)

HCP = healthcare provider

OPE=Osteoporosis Education

Figure 3.

Difference of Appropriate Calcium Intake Among OPE Subgroups

Table 1

Osteoporosis Risk Factors Included on Screening Tool in Addition to Age

Males	Females	Both
Hypogonadism	Early menopause (<65 years)	Diagnosis of osteoporosis
COPD		Rheumatoid arthritis
		Use of glucocorticoids (equivalent of prednisone 5 mg per day or more) for 3 or more months
		Hyperparathyroidism
		History of hyperthyroidism
		Chronic anticonvulsant therapy
		Race – Caucasian or Asian
		Prior fracture
		Type 1 diabetes mellitus
		Osteogenesis imperfecta
		Chronic malnutrition
		Malabsorption
		Chronic liver disease
		BMI <20 kg/m ² or weight <57 kg
		Alcohol intake (3 or more drinks per day)
		Current tobacco use
		Parenteral history of fracture

Table 2

Baseline Characteristics of Patient Population

Characteristic	Result (n=150)
Age, mean (SD), years	66.3 (16.7)
Female (%)	93 (62)
Weight, mean (SD), kg	78.8 (20.5)
Race	146 (97.3)
Caucasian (%)	2 (1.3)
African American (%)	1 (0.67)
Asian (%)	1 (0.67)
Other (%)	
Residence Prior to Admission	140 (93.3)
Home/Self Care (%)	5 (3.3)
Nursing Home/Extended Care Facility (%)	5 (3.3)
Unknown (%)	
Baseline Education Completed	14 (9.3)
Less than High School (%)	76 (50.6)
High School (%)	60 (40)
College (%)	