Shah and Gecys • Original Contribution

**Context:** Glucocorticoids are used for a variety of medical conditions. This class of drugs is arguably the most common cause of iatrogenic osteoporosis, but studies have shown that physicians are not investigating and treating glucocorticoid-induced osteoporosis.

**Objective:** To determine whether primary care physicians (osteopathic and allopathic) are evaluating and treating adult patients at risk for osteoporosis secondary to long-term prednisone use.

**Methods:** Electronic medical records from three primary care practices (family medicine, geriatric medicine, and internal medicine) were retrospectively reviewed to identify patients who were taking at least 2.5 mg of prednisone per day for 8 weeks or longer. Records were then grouped according to whether patients had undergone bone mineral density screening and had been given therapy to prevent or treat bone loss. Whether patients had comorbid risk factors for secondary osteoporosis (according to the National Institutes of Health Consensus Development Conference Statement on Osteoporosis) was noted to determine whether treatment was given because of prednisone use or because of the comorbid risk factors. Statistical analysis was performed using a Pearson product moment correlation 2-tailed \( \chi^2 \) test.

**Results:** The medical records of 49 patients met inclusion criteria (19 men, 30 women; mean age, 61 years; age range, 21–89 years). A statistically significant difference was found in physician evaluation practices for patients with vs patients without comorbid risk factors (82.1% vs 38.1%; \( P = .002 \)).

**Conclusion:** Primary care physicians do not routinely evaluate patients for osteoporosis secondary to glucocorticoid treatment, especially when patients do not have comorbid risk factors for osteoporosis.

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Osteoporosis is often associated with elderly individuals, especially postmenopausal women. However, this often silent disease can affect younger individuals as a result of other medical conditions and certain prescription drugs. Between 30% and 60% of osteoporosis cases are due to secondary causes; in men, this rate may be as high as 64%.\(^2,^3\) The morbidity, cost, and decreased quality of life associated with osteoporosis makes it crucial for physicians to identify and treat this subset of at-risk patients.\(^4\)

The most common secondary causes of osteoporosis in men are alcoholism, glucocorticoids, and hypogonadism.\(^3\) In women, secondary causes include anticonvulsant therapy, glucocorticoids, hyperthyroidism, and hypoestrogenemia.\(^3\) The most common cause of iatrogenic osteoporosis is glucocorticoid therapy, which is used for many medical conditions, including asthma, inflammatory bowel disease, rheumatoid arthritis, and systemic lupus erythematosus.\(^1,^5\) Glucocorticoids, such as prednisone, are known for their wide range of adverse effects, but studies have shown that many physicians fail to recognize that reduction in bone mineral density (BMD) is one of these effects.\(^5–^7\) As many as 1.5 million people in the United States (~0.5% of the US population) take oral glucocorticoids, and as many as 50% of patients taking glucocorticoids for longer than 6 months have secondary osteoporosis.\(^5,^6\)

Glucocorticoids cause rapid bone loss early in therapy— as much as a 10% to 20% decrease in BMD in as little as 3 months of therapy.\(^5\) Clinically significant bone loss can occur even with alternate-day dosing and low doses (<7.5 mg/d), strategies that are sometimes used to reduce the risk of adverse effects.\(^5,^9\)

The first symptomatic sign of osteoporosis is usually fracture.\(^10\) Fractures resulting from osteoporosis have a serious effect on quality of life. One study\(^11\) demonstrated that 1 year after hip fracture, only 41% of the men had regained their previous level of activity, and up to 20% of patients were unable to walk. The 3-month mortality rate for hip fractures...
is estimated to be as high as 23% depending on the setting in which the fracture occurs.\textsuperscript{4,12} In the United States, the estimated cost of treating osteoporosis exceeds $13 billion per year.\textsuperscript{4}

The aim of the current study was to identify whether primary care physicians are evaluating patients at risk for osteoporosis secondary to prednisone use. Although glucocorticoids such as prednisone may often be prescribed by specialists (eg, rheumatologists, pulmonologists), it is the responsibility of osteopathic family physicians to provide continuity of care, including managing any adverse effects or drug interactions that their patients have.

Methods

The institutional review board of the University of Medicine and Dentistry of New Jersey–School of Osteopathic Medicine (UMDNJ-SOM) in Stratford approved the study protocol. Electronic medical records from three primary care medical offices (osteopathic and allopathic) were searched to identify patients aged between 18 and 90 years who had taken at least 2.5 mg of oral prednisone per day for 8 weeks or longer. Patients who met these criteria were grouped according to whether they received BMD screening, prophylaxis, or treatment for prednisone-induced osteoporosis. It was also noted whether patients had common comorbid conditions or took medications that placed them at risk for osteoporosis to determine whether prophylaxis or treatment was provided because of prednisone use or because of comorbid risk factors. In addition, if the patients had diagnosed osteoporosis, they were considered to have a comorbid condition unless their record specifically mentioned prednisone-induced osteoporosis. Patient records were excluded from analysis if the information recorded was incomplete, making the duration or indication of therapy uncertain. Both paper and electronic records were searched to ensure completeness of information. No personal identifiable information was collected. Statistical analysis was performed using SPSS software (version 12.0; Chicago, Ill).

Results

Forty-nine of 6508 patient medical records met the study criteria, including data from 19 men and 30 women aged between 21 and 89 years (mean age, 61 years). The characteristics of the patient population are listed in Table 1. Thirty-one (63%) of the 49 patients received screening, prophylaxis, or treatment for prednisone-induced osteoporosis. Of those patients, 19 (59.4%) of 32 were from family medicine, 6 (75%) of 8 were from geriatric medicine, and 6 (66.7%) of 9 were from internal medicine practices. The documented osteoporosis screening method for all three physicians’ offices was a dual-energy x-ray absorptiometry (DXA) bone density scan, and the methods of prophylaxis and treatment included bisphosphonates, calcitonin, hormone replacement therapy, and supplementation with calcium and vitamin D.

A total of 28 (57%) patients had comorbid conditions that placed them at risk for osteoporosis, and 23 (82%) of these patients received screening, prophylaxis, or treatment for osteoporosis (Table 2). Of the 21 (43%) patients who did not have comorbid risk factors for osteoporosis, 8 (38%) received screening, prophylaxis, or treatment (Table 3). A $\chi^2$ test showed a statistically significant difference ($\chi^2=10.12, P=.002$) between these two groups. Patients with a common comorbid risk factor for osteoporosis were more likely to receive screening, prophylaxis, or treatment for osteoporosis than were those who did not have one or more of these comorbid conditions (Figure).

Comment

Osteoporosis will develop in approximately half of patients who take glucocorticoids long term (6 months).\textsuperscript{5} It is widely recognized that patients who take more than 7.5 mg/d of glucocorticoids for a prolonged period are at risk for osteoporosis.\textsuperscript{2,8,14} How-

<p>| Table 1 | Characteristics of Patients for Whom Primary Care Physicians Prescribed Glucocorticoids (N=49) |
|---------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| Characteristics | Patients by Practice Type |</p>
<table>
<thead>
<tr>
<th></th>
<th>All Patients</th>
<th>Family Medicine</th>
<th>Internal Medicine</th>
<th>Geriatric Medicine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients, No. (%)</td>
<td>49</td>
<td>32 (65.3)</td>
<td>9 (18.4)</td>
<td>8 (16.3)</td>
</tr>
<tr>
<td>Men</td>
<td>19 (38.8)</td>
<td>13 (40.6)</td>
<td>3 (33.3)</td>
<td>3 (37.5)</td>
</tr>
<tr>
<td>Women</td>
<td>30 (61.2)</td>
<td>19 (59.3)</td>
<td>6 (66.7)</td>
<td>5 (62.5)</td>
</tr>
<tr>
<td>Mean age, y</td>
<td>61*</td>
<td>59.5†</td>
<td>58.4‡</td>
<td>70.6§</td>
</tr>
<tr>
<td>Men</td>
<td>65</td>
<td>64.5</td>
<td>68.3</td>
<td>57.7</td>
</tr>
<tr>
<td>Women</td>
<td>59.3</td>
<td>56</td>
<td>53.5</td>
<td>78.4</td>
</tr>
<tr>
<td>Mean age of patients receiving screening, prophylaxis and treatment, y</td>
<td>62.87</td>
<td>62.6</td>
<td>53.5</td>
<td>73</td>
</tr>
<tr>
<td>Men</td>
<td>65.78</td>
<td>67.7</td>
<td>NA</td>
<td>59</td>
</tr>
<tr>
<td>Women</td>
<td>61.68</td>
<td>59.6</td>
<td>53.5</td>
<td>80</td>
</tr>
</tbody>
</table>

* Age range, 21–89 y.  
† Age range, 35–89 y.  
‡ Age range, 21–86 y.  
§ Age range, 47–81 y.  

**Abbreviations:** NA, not applicable.
ever, because studies have shown that as little as 2.5 mg of glucocorticoids per day can result in bone loss,\textsuperscript{2,8,13,14} we chose to include patients who were taking at least 2.5 mg/d.

A study in Iceland reported that just 32\% of physicians prescribed prophylactic therapy for glucocorticoid-induced osteoporosis.\textsuperscript{6} Multiple surveys of physicians, both practicing in primary care and in specialty fields, including rheumatology, pulmonology, and gastroenterology, have demonstrated that rheumatologists were most likely to prescribe prophylaxis and treatment for patients at risk for decreased BMD as a result of glucocorticoid therapy.\textsuperscript{5,15} However, a retrospective review of medical records concluded that academic rheumatologists inadequately managed this condition.\textsuperscript{16}

The results of the current study indicate that the rate of physician evaluation for glucocorticoid-induced osteoporosis is significantly greater in patients with common comorbid risk factors for osteoporosis. In patients treated with prednisone who had no additional osteoporosis risk factors, we found an overall screening, prophylaxis, or treatment rate of 38.1\%. These patients tended to be men (16 [76.2\%] of 21). The fact that the prevalence of osteoporosis in men tends to be less than in women and the prevailing stereotype that osteoporosis is a disease limited mainly to postmenopausal women may account for part of the reason why men with this condition are often undertreated.\textsuperscript{17} Another study replicated the finding of low rates of screening and treatment of men at risk for glucocorticoid-induced osteoporosis.\textsuperscript{18}

Patients taking glucocorticoids should be screened for osteoporosis whether they have additional risk factors for osteoporosis or not. Now that DXA is widely available and covered under Medicare,\textsuperscript{19} at-risk patients should be evaluated and treated immediately. In addition, prophylactic or therapeutic regimens should be prescribed.

In the current study, 8 (61.5\%) of 13 patients who underwent DXA scans were being treated for osteoporosis. The benefit of

\begin{table}[h]
\centering
\begin{tabular}{|l|c|c|c|c|}
\hline
Screening, Prophylaxis, and Treatment & All patients (n=28) & Family Medicine (n=17) & Internal Medicine (n=6) & Geriatric Medicine (n=5) \\
\hline
BP & 8 & 4 & 2 & 2 \\
BP + calcitonin + DXA & 1 & 1 & ... & ... \\
BP + DXA & 2 & 1 & ... & 1 \\
Calcium + vitamin D & 1 & 1 & ... & ... \\
Calcitonin & 1 & ... & ... & ... \\
DXA & 4 & 3 & 1 & ... \\
DXA + HRT & 3 & 3 & ... & ... \\
HRT & 3 & ... & 3 & ... \\
\hline
No. of patients who received screening, prophylaxis, and treatment & 23 & 13 & 6 & 4 \\
\hline
\end{tabular}
\caption{Patients With Comorbid Risk Factors Who Received Screening, Prophylaxis, and Treatment for Glucocorticoid-Induced Osteoporosis (n=28)}
\end{table}

\begin{table}[h]
\centering
\begin{tabular}{|l|c|c|c|c|}
\hline
Screening, Prophylaxis, and Treatment & All Patients (n=21) & Family Medicine (n=15) & Internal Medicine (n=3) & Geriatric Medicine (n=3) \\
\hline
BP & 2 & 2 & ... & ... \\
BP + calcitonin & 1 & ... & ... & 1 \\
BP + calcitonin + DXA & 1 & 1 & ... & ... \\
BP + DXA & 1 & 1 & ... & ... \\
Calcium + vitamin D & 1 & ... & ... & 1 \\
Calcitonin & 1 & 1 & ... & ... \\
DXA & 1 & 1 & ... & ... \\
DXA + HRT & ... & ... & ... & ... \\
HRT & ... & ... & ... & ... \\
\hline
No. of patients who received screening, prophylaxis, and treatment & 8 & 6 & 0 & 2 \\
\hline
\end{tabular}
\caption{Patients Without Comorbid Risk Factors Who Received Screening, Prophylaxis, and Treatment for Glucocorticoid-Induced Osteoporosis (n=21)}
\end{table}

Abbreviations: BP, bisphosphonates; DXA, dual-energy x-ray absorptiometry; HRT, hormone replacement therapy.
Sambrook et al.20 found that calcium supplementation reduced glucocorticoids. Buckley et al.21 found that patients taking low-dose glucocorticoids did not prevent the rate of bone loss in patients taking glucocorticoids. However, animal studies have shown that bisphosphonates are used for osteoporosis prevention and treatment, and some investigators conclude that bisphosphonates are not recommended for osteoporosis treatment.

Calcitonin has been reported to maintain current BMD.22 The current study shows that 6 (28.6%) of 21 patients with no comorbidities and 11 (42.9%) of 28 patients with comorbidities were taking either bisphosphonates or calcitonin. Currently, there is no strong evidence to support the contention that combination therapy is superior to monotherapy for improving BMD.29

It is imperative when caring for patients taking glucocorticoids to evaluate BMD and initiate prophylactic or therapeutic treatment as soon as possible. It has been shown that doses as low as 2.5 mg of prednisone can adversely affect bone.2,8,14 Patients should also be advised to make lifestyle changes consistent with reducing the risk of osteoporosis, such as abstaining from tobacco use, refraining from excessive alcohol intake, and engaging in weight-bearing activities.21

We hope that the data presented in this article will draw attention to the often overlooked adverse effect that glucocorticoid therapy has on BMD, especially in untreated male patients.

Acknowledgments

The authors thank Thomas A. Cavalieri, DO, and Anita Chopra, MD, for their assistance in patient population identification and medical record access, Sherry C. Pomerantz, PhD, in providing assistance with statistical analysis, and Paul M. Krueger, DO, for his insightful suggestions.

Figure. Percentage of patients who received intervention for glucocorticoid-induced osteoporosis according to physician specialty and whether patients had risk factors for osteoporosis. Intervention included dual-energy x-ray absorptiometry bone density scanning, and prescription medications for osteoporosis prevention or treatment.

However, bisphosphonates also have a US Food and Drug Administration Use-in-Pregnancy category rating of C, meaning that risk to the fetus cannot be ruled out.26,27 Premenopausal women who are pregnant or plan to become pregnant must exercise caution regarding bisphosphonates, as the effect of bisphosphonates on the developing fetus has not been evaluated. However, animal studies have shown that fetal skeletal deformities and fetal wasting can result from high doses of bisphosphonates.28 Because low doses of bisphosphonates are used for osteoporosis prevention and treatment, some investigators conclude that fetal risk is not high.28

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References