

pressed by both epithelial cells of salivary glands⁶ and keratinocytes.⁷ These are the main sources of VEGF during wound healing, acting in a paracrine and autocrine manner⁷ and promoting wound healing via stimulation of endothelial cell-mediated angiogenesis. Clinicians should consider sunitinib as a trigger for oral mucositis.

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Alendronate-Induced Asthma

TO THE EDITOR: Alendronate is a specific osteoclast inhibitor used in the treatment of postmenopausal osteoporosis. Adverse effects, from dyspepsia to esophageal stricture, muscle pain, flu-like syndrome, and vertigo, have been reported.¹ We present a case of an asthma attack induced by alendronate.

Case Report. A 45-year-old nonsmoking woman was admitted to the emergency clinic with dyspnea and wheezing. She had an 18-year history of mild persistent asthma that had been well controlled with inhaled salmeterol and fluticasone for 5 years. She denied having any asthma attacks during the past 2 years and was not using any other medications. One week prior to admission, she was diagnosed with osteoporosis, and alendronate 70 mg per week was started. Four hours after the first dose of alendronate, the woman was admitted to the emergency clinic with coughing, wheezing, and dyspnea of 30 minutes' duration. On admission, her vital signs were respiratory rate 30 breaths/min, oxygen saturation 94%, heart rate 110 beats/min, blood pressure 130/70 mm Hg, and temperature 37 °C. Breath sounds were decreased, with diffuse rhonchi, and the expiratory phase was prolonged. Cardiovascular examination was significant only for tachycardia. Otherwise, physical examination was normal. The patient's chest radiography and electrocardiogram were normal. Results of her renal and liver function tests and urinalysis were also normal. A complete blood cell count showed hemoglobin 13.4 g/dL, hematocrit 42%, white blood cell count $7.8 \times 10^9/L$, platelets $203 \times 10^9/L$, and eosinophils 0.67 (reference range 0.04–0.4) and an elevated level of immunoglobulin E, at 267 μ/mL (reference range 0–81 μ/mL). An infectious disease workup, including C-reactive protein level, erythrocyte sedimentation rate, and microbiologic exam of sputum, was negative. A diagnosis of acute asthma attack was made, and nebulized albuterol and intravenous hydrocortisone were started.

The patient improved within 12 hours of admission and was discharged. With the diagnosis of possible alendronate-induced acute asthma, alendronate was stopped and the patient's previous asthma medications were continued. After cessation of alendronate, she had no complaints during the following 2 weeks. Despite warnings that alendronate might precipitate asthma, the patient restarted alendronate, without a physician's advice, 2 weeks following discharge from the emergency clinic. After the second dose of alendronate, she again experienced dyspnea and wheezing within a few hours and was admitted to the emergency clinic with the same complaints. Since she gave a history of alendronate use again and her physical examination revealed asthmatic pulmonary symptoms with no clinical or laboratory signs of infection, albuterol and hydrocortisone were administered. Within the first hours of treatment, hypoxemia resolved.

Discussion. Although clinical studies have demonstrated that alendronate is safe and well tolerated, hypersensitivity reactions including urticaria and, rarely, angioedema^{2,3} have been reported. To our knowledge, this is the first report of an asthma attack secondary to alendronate. According to the Naranjo probability scale, alendronate was the probable cause of the asthma attack in this case.⁴

Although no direct causal relationship can be drawn from this report, the association between the alendronate use and the onset of the respiratory distress suggests that the 2 events were linked. Although we believe that the asthma attacks were due to alendronate, especially given the results of a rechallenge, we cannot ignore the possibility that the excipients in the commercial form of the drug (Fosamax, Merck Sharp & Dohme) were responsible for this reaction.

In the literature, there are several reports about alendronate that show a dose-dependent elevation of histidine decarboxylase activity in various

tissues (eg, liver, lung, spleen), leading to an increase in histamine.^{5,6,7} These results suggest a potential mechanism for exacerbation of an inflammatory reaction like asthma, due to histamine release.⁶ This may have played a role in our patient, but it is likely that no single factor was solely responsible for the development of respiratory distress. Esophageal irritation can cause stimulation of the vagal nerve at the inferior site of the esophagus, which can lead to bronchoconstriction. Bronchospasm following bisphosphonate therapy has also been reported in adults who received pamidronate.⁸

With increased use of alendronate, further reports may shed light on the incidence, clinical importance, and mechanism of this rare but serious adverse reaction. Clinicians should be aware that alendronate can cause an attack in patients with asthma.

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Maximizing Hospital Pharmacy Resources with Pharmacy Students

TO THE EDITOR: The American Society of Health System Pharmacists' (ASHP) visionary statements are aimed at making medication use more scientific, effective, and safe. One, in particular, states that pharmacists "will significantly enhance patients' health-related quality of life by exercising leadership in improving both the use of medications by individuals and the overall process of medication use."¹ Similarly, the American College of Clinical Pharmacy (ACCP) recognizes pharmacists as leaders in "initiating, fostering, and disseminating pharmacotherapy innovations that will optimize patient care outcomes."² To achieve these outcomes, the profession continues to expand to include prospective medication management; however, this requires additional resources. To overcome such obstacles, pharmacy students in advanced experiential rotations can be incorporated into pharmacy clinical services. We describe our experience with incorporating students into pharmacy clinical services.

Methods: Student clinical service responsibilities were identified as intravenous to oral conversion, compliance with Joint Commission and quality measures for acute myocardial infarction, congestive heart failure, community-acquired pneumonia, venous thromboembolism prophylaxis, stress ulcer prophylaxis, glycemic control, adverse drug reaction reporting targeting anticoagulants and other drug classes, and identifying and reporting medication errors. Students were also required to provide inservice education to the house staff and participate in research projects. A retrospective observational study was then conducted to evaluate the number and type of interventions made by students.

Students were required to participate on patient rounds and have their recommendations approved by their faculty preceptor prior to making and recording the interventions. Any interventions made without the approval of the faculty preceptor or outside of the approved services were excluded.

Interventions were organized into 2 categories: centralized services and patient-specific services. Centralized services included inservice education, clinical research, drug information provided to the medical team, and formulary management. Patient-specific services included adverse drug reaction and medication error reporting, pharmacokinetic and laboratory monitoring, drug therapy monitoring, collaborative drug management, renal dosing adjustment, and intravenous to oral conversion (Appendix I; available online at hwbooks.com/pdf/appendices/L583.pdf).

Results: Fifteen students were assigned to the internal medicine rotation from August 2007 through May 2008; one student did not satisfy the academic requirement and thus was excluded. The total number of interventions was 208; 11 interventions were excluded due to duplicate or incomplete documentation of events. A total of 197 interventions were made and categorized into centralized services (n = 35) and patient-specific services (n = 162) (Table 1).

Discussion: The impact of clinical pharmacy services has been shown to improve safety, quality, and efficiency of pharmaceutical care. Analysis of data from 885 hospitals involving 2,836,991 patients revealed an association between clinical pharmacy services and decreased hospital mortality rates compared with institutions without these services.³ Several clinical pharmacy services were linked to decreased hospital mortality; inservice education (10,660 fewer deaths; p = 0.037), adverse drug reaction management (14,518 fewer deaths; p = 0.012), and participation on medical rounds (11,093 fewer deaths; p = 0.021). Clinical research has also been shown to decrease hospital mortality rates; this could be attributed to academic health care centers or employment of highly educated and trained pharmacists.⁴

Pharmacy is transforming itself from a product-focused to a patient-focused profession.⁵ Student clinical services and documentation of interventions are one way to introduce this concept to students in an at-