Preface: The Fracture Liaison Service

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Enter Jane Doe: a 76-year-old woman with no known medical problems and no currently prescribed medications. She looks well for her age, is active in her community, and walks 3-5 miles per day. One day while out walking, she falls from standing height and suffers a displaced fracture of the femoral neck. Ms. Doe has just experienced one of the most common forms of low-energy fractures, also known as fragility fractures, in the elderly. She is taken by ambulance to her local emergency room where X-ray confirms her diagnosis, and she receives surgical treatment by way of total hip replacement. The surgery is performed without complication, and through subsequent physical therapy, she regains some of her mobility and independence. Within a year, however, she suffers a second fracture, leaving her permanently disabled and in need of home care.

Meanwhile, Ms. Doe's grandson suffers a wrist fracture while playing basketball. At 12 years old, this is the third fracture of his life. He complains of intermittent blurry vision, but his clinical examinations are otherwise normal, and his parents and physicians conclude that he is an overactive child who is prone to injury. His fracture is treated without complications, but months later he suffers bilateral retinal detachments leaving his vision permanently impaired.

Now, let us envision the contribution of a Fracture Liaison Service (FLS) to the care of these two patients. After receiving surgical treatment for her hip fracture, Ms. Doe is referred to an FLS where a comprehensive history is obtained, a physical examination with emphasis on the skeleton is performed, bone density is determined via dual-energy absorptiometry (DEXA) scanning, and laboratory analysis including investigation of bone turnover marker (BTM) levels is conducted. She is determined to have hyperparathyroidism and undergoes treatment with eventual normalization of her bone density. She regains most of her prior function and avoids subsequent fracturing.

Her grandson is evaluated at the FLS and is found to have a spinal DEXA scan Z-score of -2.5, an age-comparative measure indicating severely low bone density. Clinical suspicion of genetic pathology is raised, and a consult is obtained. NextGen whole exome sequencing reveals heterozygous LRP5 mutations, and an ensuing ophthalmologic workup confirms a diagnosis of familial exudative vitreoretinopathy (FEVR), a genetic disorder that can lead to low bone density, multiple fractures, retinal detachments, and permanent vision loss if not properly treated. He receives appropriate treatment and eventually graduates from high school with no further fractures and preserved vision.

In both cases, the identification of their fractures as signal events led to the detailed evaluation and specific diagnosis and treatment of their underlying pathology. This illustrates the main thematic approach an FLS takes in treating the fracture patient. Put simply, the FLS is a centralized hub for the complete management of fracture patients, including the exploration, diagnosis, and treatment of underlying pathologies that predispose to subsequent fractures. The FLS alleviates the fragmentation of care often found among orthopedic, endocrine, and primary care services regarding which is primarily responsible for the longitudinal evaluation and management of fracture patients. This was once aptly termed the "Bermuda Triangle of osteoporosis care of fractures," referring to the observed phenomenon of osteoporotic fracture patients disappearing from interdisciplinary care teams without proper management due to discordance on who is ultimately responsible for their long-term care.[1]

In **"The Roles of a Fracture Liaison Service,"** the framework for the evaluation and management of fragility fracture patients in the FLS is discussed in detail, including the history, physical examination, determination of bone density, and laboratory analysis. The clinical and economic benefits of FLS are explored, and a real-world application of the FLS paradigm, the Rhode Island Fracture Liaison Service, is detailed.

In **"Osteoporosis and Fragility Fractures,"** osteoporosis and fragility fractures are discussed as well as their relationship to each other and to the FLS. The epidemiology, pathophysiology, evaluation, and management of osteoporosis are explored, and the clinical importance, epidemiology, predisposing factors, outcomes, and preventative strategies for fragility fractures are elucidated.

In **"Osteomalacia and Renal Osteodystrophy,"** the clinical classifications, presentations, pathophysiologies, and treatment modalities for various osteomalacias are discussed as alternative bone diseases to osteoporosis producing low bone density. Renal osteodystrophy, a specific form of metabolic bone disease affecting chronic kidney disease and kidney transplant patients characterized by osteomalacia and hyperparathyroidism, is presented.

In **"Monoclonal Gammopathies in a Fracture Liaison Service,"** the spectrum of disorders characterized by the overproduction of plasma B-cells and immunoglobulin known as monoclonal gammopathies are discussed, with special emphasis on monoclonal gammopathy of uncertain significance (MGUS), a pre-malignant form of multiple myeloma. The clinical presentation of MGUS and its association with osteoporosis and fracture are explored and highlighted with data from the Rhode Island FLS, leading to the conclusion that the term "MGUS" be replaced with "MGSS," or "monoclonal gammopathy of skeletal significance."

In **"Hyperparathyroidism in a Fracture Population,"** the clinical presentation, diagnosis, and treatment of primary hyperparathyroidism (PHPT) are discussed, with special emphasis on its effects on the skeleton. Normocalcemic hyperparathyroidism (NPHPT), a variant of PHPT defined by normal serum calcium and persistently elevated parathyroid hormone levels, is also presented. Current evidence linking NPHPT to osteoporotic fractures, including observations from the Rhode Island FLS, is presented, raising the question if serum calcium measurements alone are sufficient to evaluate parathyroid function in the setting of osteoporotic fractures.

Finally, in **"Vertebral Compression Fractures,"** the epidemiology, clinical presentation, diagnosis, and treatment (including surgical and non-surgical management) of vertebral compression fractures (VCFs) are discussed. The susceptibility of VCF patients to subsequent fractures and their consequences is also described, as well as pharmacotherapy and the role an FLS can play in mitigating the sequelae of primary VCFs.

FLS MODELS

It is important to note that several types of bone health programs exist and an FLS is but one example. While the Rhode Island FLS specifically addresses patients who have already suffered a fracture, some alternative programs are designed to screen asymptomatic populations to find and treat low bone density in the hopes of decreasing fracture incidence. As might be expected, these programs are especially popular with closed panel models of health care delivery such as Accountable Care Organizations and Health Maintenance Organizations. Regardless of approach, the primary goal of all bone health programs should be the reduction of injury via multidisciplinary, comprehensive, high-quality, and cost-effective patient care. The recognition of the potential contributions of FLS programs is of importance to any medical groups serving elderly, osteoporotic, and fracture patients.

An FLS regards a fragility fracture as a signal symptom of metabolic bone loss, physical compromise, or environmental hazards, alerting clinicians to the presence of comorbidities and providing a framework for the identification of patients with a recent fracture, the diagnostic workup of the fragility fracture patient, the treatment of underlying contributors to the fracture, and follow-up to reduce sequelae. Because most patients in an FLS are defined as "symptomatic" by virtue of their fracture, the prevalence of intercurrent diseases and life circumstances in FLS patients is relatively greater than in the general population and offers the opportunity for study. Approaches and findings in our FLS are described in this volume. It is our hope that the findings of the FLS will find their way into screening programs and individual patient care.

Reference

1. Harrington J. Dilemmas in providing osteoporosis care for fragility fracture patients. US Musculoskelet Rev Touch Brief II. 2006;64-65.

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The editors also owe a great debt of gratitude to the late Henry Mankin, MD, former chair of orthopedics at Harvard and the Massachusetts General Hospital, who taught metabolic bone diseases in an orthopedic context. Dr. Mankin sought to infuse orthopedic diagnoses and treatment with clinical medicine and its basic sciences for a fuller understanding of surgical pathology and treatment potential. He was a charismatic personality and brilliant teacher, and an anecdote serves as an illustration.

Using the biblical story of Lot's wife being turned into a pillar of salt, Dr. Mankin described the fate of an individual who consumed a high phosphate hamburger and a high calcium milkshake and then received a blast of vitamin D by going out into the sun as being turned into stone for exceeding the calcium-phosphorous solubility product. While Lot's wife's crystallization was due to her disobedience, the crystallization of Dr. Mankin's information was due to rapt attention.

Dr. Mankin could not know the long-term impact of his teaching in this community, and this could be a reminder to us all that we will most likely not realize the widespread effects of our teaching on our students and on the care of our patients.

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