Osteoporotic vertebral fractures in a tertiary care hospital

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Abstract

Objetive: to describe the clinical and paraclinical characteristics of patients with osteoporotic vertebral fractures at a tertiary care university hospital in Manizales, from January 2018 to January 2022.

Design: an observational, cross-sectional descriptive study was performed.

Patients: patients with vertebral fractures seen on diagnostic imaging.

Measurements: the clinical and sociodemographic characteristics and admission clinical and paraclinical test results were evaluated.

Results: a total of 174 patients were found, 68.2% of whom were females; 89.4% had high comorbidity (a Charlson index score higher than 3), 54.6% had malnutrition, 60.1% had polypharmacy and 85.4% had insufficient milk product consumption. In half of the cases, the vertebral fracture was severe (≥40% reduction in the vertebral body height, according to Genant), 19.8% had a prior fracture and 15.1% were receiving pharmacological treatment for osteoporosis. The bone profile findings showed decreased levels of albumin and vitamin D with elevated PTH.

Conclusions: two-thirds of the patients with osteoporotic vertebral fractures are females, with high comorbidity and malnutrition. Most were not receiving pharmacological treatment for osteoporosis. **(Acta Med Colomb 2022; 48. DOI: https://doi.org/10.36104/amc.2023.2759).**

Keywords: *osteoporotic fractures, spinal column fractures, parathyroid hormone, osteoporosis, vitamin D.*

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Introduction

Vertebral fracture (VF) is the most frequent manifestation of osteoporosis and may be symptomatic in 65-70% of cases (1, 2). A prevalence of 10-24% has been reported (1), with 11.2% in Latin America (3). It is often diagnosed incidentally through a chest x-ray (1) and it occurs most often in T7-T8 and T11-T12 (4). Identifying osteoporotic VFs allows secondary prevention of this disease, which prevents a new vertebral fracture 50-60% of the time (1,5). This study gathered clinical, sociodemographic and paraclinical information on patients with VFs at a tertiary care university hospital in Manizales, Colombia, over the last four years, in order to provide an appropriate characterization of this population.

Materials and methods

This was a descriptive, observational cross-sectional study at SES Hospital Universitario de Caldas, which has a fracture coordination unit affiliated with the International Osteoporosis Foundation (IOF). Patients were identified who met the imaging criteria (by x-ray, nuclear magnetic resonance or tomography) for VF (≥25% vertebral height loss) associated with bone fragility, that is, low-energy fractures which occur after minimal trauma such as a fall from standing height or less, without tumors (6), who were admitted between January 2018 and January 2022. All patients with VFs were included.

The population's clinical and sociodemographic characteristics were evaluated. The Charlson Comorbidity Index was classified as absent (0-1 point), low (2 points) and high (≥ 3 points) comorbidity (7); the Barthel Index was interpreted as total dependency (0-20 points), severe dependency (21-60), moderate dependency (61-90), slight dependency (91-99) and independence (100 points) (8); body mass index (BMI) was interpreted according to the WHO guidelines (9); the glomerular filtration rate was categorized according to the KDIGO guidelines (10); the hemoglobin level was classified as normal, or mild, moderate or severe anemia, according to the WHO criteria (11); inadequate consumption of dairy products was defined as less than two servings per day, according to the dietary guidelines based on foods for the Colombian population over the age of two published by

the Ministry of Health and Instituto Colombiano de Bienestar Familiar [Colombian Institute for Family Wellbeing] (12); low albumin was defined as <3.5 and normal as ≥3.5 (13); serum calcium levels were normal between 8.5 and 10.2, low at <8.5 and high at ≥10.3 (14); phosphorus was considered normal in a range from 3.4-4.5 mg/dL (15); TSH from 0.3-5.5 mIU/L (16); PTH 15-68.3 pg/mL (17) and alkaline phosphatase 20-140 U/L (18). Furthermore, vitamin D was classified as severe deficiency (<10 ng/mL), mild deficiency (10-20 ng/mL), insufficiency (20-30 ng/mL) and normal (> 30 ng/mL) (19); testosterone was considered normal between 2.1-9.7 ng/mL (20) and, finally, the fracture grade was categorized according to the Genant classification (21).

A descriptive statistical analysis was performed with Stata version 16.1 (StataCorp, TX, USA). Continuous variables with a normal distribution according to the Kolmogorov-Smirnov test are described using averages, standard deviation (SD) and 95% confidence intervals; continuous variables with a non-normal distribution are described using medians and interquartile range. Categorical variables are described in frequency distribution tables.

Results

A total of 174 patients were included, accounting for 100% of the sample with VFs. The average age was 77.7 years, with an SD of 9.2, 68.2% of whom were women. Altogether, 89.4% of the patients had a high Charlson Comorbidity Index and 61.7% showed complete independence on the Barthel index. Tobacco and alcohol exposure risk factors were analyzed, finding that most did not use them. Regarding their nutritional status, 54.6% of the analyzed sample had malnutrition (whether overweight, underweight or obesity). Prior dairy product consumption was inadequate in most patients and 60.1% had polypharmacy. Kidney function was adequate, with 52.5% having a GFR greater than 90 ml/min/1.73 m^2 according to the Cockroft-Gault equation (Table 1).

Among the clinical characteristics of the fractures, 51.4% had severe fractures (≥40% vertebral body height loss according to Genant) (21). Regarding the number of fractures, 56.6% had a single fracture, while 6.2% had ≥4 fractures, with an unknown mechanism, equivalent to 80.7% of the patients having prevalent fractures. Notably, 19.8% had already had a prior fracture and 15.1% were already on medications for osteoporosis, 4.6% of whom were mainly managed with oral bisphosphonates. Of the analyzed sample, 2.9% had a fatal outcome due to complications of comorbidities other than osteoporosis (Table 2).

An evaluation of the paraclinical profile showed that most of the patients had an adequate hemoglobin level, with an average of 12.9 g/dL and an SD of 2.1. Albumin and vitamin D were low, with the latter mostly in the mild deficiency range. The only elevated laboratory test was PTH. Most of the analyzed sample had normal phosphorous, calcium and alkaline phosphatase levels (Table 3).

Table 1. *Clinical and sociodemographic characteristics of the study patients (total number n= 174).*

	n	%
Age (years)		
Average	77.7	
SD	9.2	
95%CI	76.3 – 79.1	
Sex		
Female	118	68.2
Male	55	31.8
Charlson Comorbidity Index		
High	117	89.4
Low	15	10.6
Barthel Index		
Severe dependency	4	2.5
Moderate dependency	11	6.9
Slight dependency	46	28.9
Complete independence	98	61.7
Smoking		
Active smoker	9	6.6
Mild ex-smoker	5	3.6
Moderate ex-smoker	3	2.2
Heavy ex-smoker	23	16.8
No	97	70.8
Alcohol		
Yes	6	4.2
No	136	95.8
Body mass index (BMI)		
Low weight	8	5.6
Normal	64	45.4
Overweight	45	31.9
Obesity I	19	13.5
Obesity II	5	3.6
Glomerular filtration rate (Cockroft-Gault)		
Normal (G1)	91	53.5
Mild reduction (G2)	54	31.7
Mild to moderate reduction (G3a)	12	7.1
Moderate to severe reduction (G3b)	7	4.1
Severe reduction (G4)	3	1.8
Kidney failure (G5)	3	1.8
Polypharmacy		
Yes	89	60.1
No	59	39.9
Dairy product intake		
Adequate	21	14.6
Inadequate	123	85.4

SD: standard deviation.
95%CI: 95% confidence interval.

Discussion

Our findings suggest that, when osteoporotic VFs occur, most are in malnourished female patients with low vitamin D and high PTH. Eighty percent of the cases were prevalent VFs (asymptomatic).

The World Health Organization (WHO) has defined osteoporosis as a metabolic disease characterized by low bone mass and deteriorated bone microarchitecture leading to greater fragility and, consequently, an increased risk of

Table 2. *Clinical outcomes (total number n= 174).*

	n	%
Fracture grade		
Mild	13	17.5
Moderate	23	31.1
Severe	38	51.4
Number of fractures		
1	73	56.6
2-3	48	37.2
≥4	8	6.2
Fracture mechanism		
Unknown	138	80.7
Slipping	15	8.8
Instability	11	6.4
Tripping	5	2.9
Syncope	1	0.6
Physical effort	1	0.6
Prior fractures		
Spinal column	9	5.8
Hip	6	3.9
Humerus	5	3.3
Ulna/radius	8	5.2
Tibia	1	0.8
Spinal column, humerus and radius	1	0.8
None	122	80.2
Type of treatment		
Conservative treatment	128	84.7
Vertebroplasty	20	13.2
Osteosynthesis	2	1.3
Laminectomy	1	0.8
Previous treatment		
Oral bisphosphonate	7	4.6
Zoledronic acid	5	3.2
Denosumab	5	3.2
Teriparatide	5	3.2
Combined	1	0.6
None	129	84.9
Calcium and vitamin D supplementation therapy		
Yes	32	21.1
No	120	78.9
Vital status at discharge		
Alive	166	97.1
Deceased	5	2.9

fracture. Bone mineral density (BMD) assessment through a bone density scan is the gold standard for diagnosing osteoporosis, as it detects a reduction equal to or greater than -2.5 standard deviations (SD) compared to the mean value obtained for young people of the same sex (22,23). However, diagnosing osteoporosis based exclusively on the BMD scores identifies less than 50% of the people who end up having an osteoporotic fracture (23), and a diagnosis based on a history of a vertebral or hip fragility fracture is also accepted (24). According to the International Osteoporosis Foundation (IOF), osteoporotic fractures affect one out of three women and one out of five men 50 years old or older. This is why it is important to identify other characteristics that could suggest an osteoporotic substrate, as shown in this study.

To understand the pathophysiology and focus the treatment of osteoporosis, the functions of PTH and vitamin D must be understood correctly, along with their relationship in maintaining calcium homeostasis.

Calcium-sensing receptors (CaSR) in the parathyroid glands regulate the secretion of PTH, increasing its production when calcium levels decrease (25). Parathyroid hormone stimulates bone resorption, calcium absorption in the duodenum, and tubular reabsorption of calcium (26) as well as 1,25-dihydroxy-vitamin D synthesis in the kidney which, in turn, increases calcium reabsorption in the gut and kidney (27, 28). In the osteoblasts, it stimulates the RANKL-RANK system, which fosters osteoclast differentiation and survival (26). Therefore, both hyperparathyroidism and vitamin D deficit are predisposing factors for osteoporosis. They were both abnormal in this study, in line with what is described in the literature.

It has been scientifically shown that serum PTH levels rise in a compensatory fashion when vitamin D levels and/or calcium intake decrease. A physiological increase has also been associated with older age (29), findings which were also seen in this study.

Specifically regarding VFs, they are reported to be the most common complication of osteoporosis (30) and, according to IOF, are one of the main causes of pain, disability, loss of physical independence and premature death in millions of people around the world. An isolated VF tends to be the first osteoporotic fracture to occur, and precedes the onset of proximal femoral, radial, sacral or pelvic osteoporotic fractures (31-33), which has been termed the "cascade effect" (33-35), with a five times greater risk of a new VF after the first one, and a 2-3 times greater risk of a hip fracture (36, 37). In this regard, recognizing osteoporotic VFs and providing appropriate treatment may prevent or delay the occurrence of a subsequent fracture.

A study on the global incidence and prevalence of osteoporotic VFs found that at least one of every five men and women over the age of 50 have one or more vertebral fractures (37). The European Vertebral Osteoporosis Study (EVOS) (38), the European Prospective Osteoporosis Study (EPOS) (39) and the LAVOS study (3) showed a 12.2% prevalence of osteoporotic VFs in both men and women, with an incidence of 10.7% in women and 5.7% in men, in European patients over the age of 50. Another recent global study also reported 20-24% prevalence rates in white North American women ≥50 years old, with a white/black ratio of 1.6, determining that the prevalence of these is lower in Latin America than in Europe and North America (11-19%), possibly due to poor reporting (37).

Table 3. *Laboratory tests on admission (total number n= 174).*

	n	%
Hemoglobin		
Average	12.9	
SD	2.1	
95%CI	12.6 – 13.2	
Hemoglobin level		
Normal	141	83.4
Mild anemia	17	10.1
Moderate anemia	9	5.3
Severe anemia	2	1.2
Creatinine		
Median	0.8	
IQR	0.7 – 1.0	
Albumin		
Average	3.3	
SD	0.5	
95%CI	3.2 – 3.4	
Albumin level		
≤3.5	94	59.5
>3.5	64	40.5
Calcium		
Average	9.3	
SD	5.7	
95%CI	8.4 – 10.2	
Calcium level		
Normal	122	74.8
Low	37	22.7
High	4	2.5
Phosphorus		
Average	3.75	
SD	1.5	
95%CI	3.5 – 4.0	
Phosphorus level		
Normal	96	67.6
Low	25	17.6
High	21	14.8
TSH		
Average	3.67	
SD	4.97	
95%CI	2.89 – 4.44	
TSH level		
Normal	117	73.1
Low	10	6.3
High	33	20.6
Parathyroid hormone		
Average	70.06	
SD	56.13	
95%CI	61.18 – 78.94	
Parathyroid hormone level		
Normal	74	47.4
Low	0	0.0
High	82	52.6
Alkaline phosphatase		
Average	91.2	
SD	45.6	
95%CI	81.9 – 100.5	
Alkaline phosphatase level		
Normal	82	85.4
High	14	14.6
Vitamin D		
Average	21.6	
SD	10.8	
95%CI	19.8 – 23.3	
Vitamin D level		
Normal	28	18.7
Insufficiency	37	24.7
Mild deficiency	69	46.0
Severe deficiency	16	10.6
Testosterone		
Average	2.98	
SD	1.96	
95%CI	2.26 – 3.70	
Testosterone level		
<2.62	14	45.1
≥2.62	17	54.9

SD: standard deviation
95%CI: 95% confidence interval
IQR: interquartile range

A study in Colombia which collected information from 10 fragility fracture healthcare facilities in four cities and obtained 1,699 patient charts found an average age in both men and women of 79 years, with more women than men (40), findings which are congruent with this study. In addition, they reported diabetes mellitus, vitamin D insufficiency and corticosteroid therapy (40) as some of the most frequent secondary causes of osteoporosis, with vitamin D insufficiency also seen as a cause in our study, in line with these findings.

There are many modalities for diagnosing VFs. X-rays have been the most frequent diagnostic method, with the Genant method being the standard for evaluating images (2,21,34), describing four grades: grade 0 indicates no fracture, grade 1 indicates a 20-25% height loss, grade 2 a 25-40% loss and grade 3 indicates a more than 40% loss (1). On the other hand, magnetic resonance imaging has greater sensitivity for diagnosing VFs than other imaging techniques and can help determine the age of the fracture, as well as distinguish osteoporotic changes from neoplastic fractures (31,36). Given its cost in our setting, it is not recommended for routine use.

Up to 65% of osteoporotic VFs are asymptomatic (1,2,5) and they should be suspected with height losses of at least 4 cm, with pain being the most common clinical manifestation in those who develop any symptom (32,41). They can cause decreased activity and physical function, with social isolation and work limitations (31,42). They tend to go unnoticed or have their symptoms attributed to other common etiologies like degenerative joint disease or muscle pain (24,33).

A study evaluating 70 patients with fragility fractures found that 81.43% of them reported having been examined

by a physician in the year prior to the fracture; at least 65% of the patients in the study population met the criteria for osteoporosis screening, but only 11.4% had been screened. In addition, they showed a post-fragility fracture survival probability of close to 70% for hospital stays lasting 30 or more days, increasing to 94% if discharged at 15 days, concluding that both primary and secondary prevention in our setting has been insufficient (43). The most frequent diagnosis in our setting is made incidentally through a chest x-ray, and therefore only approximately 40 to 60% of osteoporotic VFs are diagnosed (11, 35), with only 40% of these women and less than 20% of the men referred for osteoporosis assessment (11, 35).

In hospitalized patients, it has been suggested that caring for VFs detected despite not being the reason for hospitalization was a more effective secondary fracture prevention strategy than ambulatory treatment deferred until after discharge (36). Therefore, it has also been recommended that radiologists report the VFs identified on other x-rays, such as chest x-rays, regardless of the reason for ordering the test, and that, with this report, timely assessment and treatment be started (2,44). In our study, this strategy was applied during recruitment and follow up of patients in the Coordinated Fracture Program at SES Hospital Universitario de Caldas. Notably, early diagnosis and prompt treatment can lead to an up to 41% reduction in the risk and recurrence of osteoporotic fractures, thus helping decrease morbidity and mortality and their resulting costs (43).

A spine x-ray should be ordered for patients complaining of thoracolumbar pain; however, given its multiple causes, this should be individualized to the patient, evaluating clinical markers, the physical exam and risk factors for osteoporosis (2). Some characteristics that may suggest the presence of a VF are advanced age, female sex, lateral waist pain, back pain which improves with lying down or is described as "crushing" and not radiating to the lower extremities, the presence of smoking, a history of COPD, previous fractures, late menarche, the chronic use of steroids and a 4 cm loss of height (45).

There are diverse consequences of osteoporotic VFs: short or long-term physical, psychological, social and public health problems (11, 31). In addition, they indicate a significantly greater risk of developing new fractures in the future and are also associated with greater morbidity and mortality (6, 11, 45), contributing to other systemic complications like reduced pulmonary function and gastrointestinal problems including hiatal hernia, gastroesophageal reflux, constipation and intestinal obstruction (37); thus, identifying and treating them early could decrease future morbidity.

Study weaknesses

Most of the diagnostic imaging reports by radiology did not describe the severity according to the grade of the fracture. In addition, a small percentage of patients did not have some of the data, as shown in the results.

Conclusions

Vertebral fracture is the most common fracture in people with osteoporosis and tends to be the first to occur. Therefore, its timely identification and treatment helps prevent new osteoporotic fractures, both in the vertebrae as well as the long bones. This study provided, for the first time, the clinical, paraclinical and sociodemographic characterization of patients in a Colombian population, in order to facilitate early intervention, improving their prognosis and morbidity. These characteristics included age over 78 years, female sex, vitamin D deficit, elevated PTH, malnutrition according to BMI or albumin levels, inadequate dairy product consumption and a multiple disease profile.

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