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The Clinical and Radiological Characteristics of Male Patients who Underwent Vertebroplasty Due to Osteoporotic Compression Fracture

Je Beom Hong, Kyung Hyun Kim, Jeong Yoon Park, Dong Kyu Chin, Sung Uk Kuh, Yong Eun Cho

Department of Neurosurgery, Yonsei University College of Medicine, Gangnam Severance Spine Hospital, Spine and Spinal Cord Institute, Seoul, Korea

Objective: To investigate the clinical characteristics of male population who underwent vertebroplasty for osteoporotic compression fracture and evaluate the clinical, radiological outcomes compared to female group.
Methods: The medical records and radiological data were reviewed in total 155 patients who underwent vertebroplasty for osteoporotic vertebral compression fracture from February 2006 to November 2009. We compared 32 male patients with 123 female patients in terms of preoperative factors, intraoperative factors, and clinical and radiologic outcomes.
Results: The mean age of male group was 67.8±8.6 years and their mean T-score on bone mineral density (BMD) was -3.2±0.8. The mean age of female group was 71.8±8.9 years and their mean T-score was -3.7±0.7 (p=0.025 for age, p=0.002 for BMD). Male patients (21 out of 32, 65.6%) had more frequent traumatic event than female patients (51 out of 123, 41.5%) (p=0.012). The secondary osteoporosis was more frequently seen in male group than female group (53.1% vs 26.8%, p=0.005). The lump cement distribution pattern was found more frequently in male group than female group (46.9% vs 28.5 %, p=0.040). There was no statistically significant difference between the two groups in clinical outcomes.
Conclusion: Male patients had significantly more risk factors for secondary osteoporosis and obvious traumatic event than female group. Clinicians should always be aware of secondary causes of osteoporosis and history of traumatic events in male patients with osteoporotic compression fracture and also pay attention to correct the cause of secondary osteoporosis and recommend anti-osteoporosis management.

Key Words: Vertebroplasty · Secondary osteoporosis · Men · Osteonecrosis · Recollapse

INTRODUCTION

Osteoporosis, defined as a skeletal disorder of compromised bone strength predisposing to an increased risk of fracture, was long viewed as a disease of aging women[8,14]. And the osteoporosis in men is rarely recognized and treated, even after a fracture has occurred[9,10,14,18]. Until now, there have been few epidemiologic studies of osteoporosis in men although its prevalence is increasing and recent epidemiological and observational studies have shown that osteoporosis in men is an increasingly important clinical issue[14]. Men are also at risk for vertebral fractures like women. The incidence was 0.73 per 1,000 person-years in men, when it is 1.45 per 1,000 person-years in women, two-fold that of men, not 10-fold as usually reported[7,31]. In over 50% of men presenting with vertebral fractures, there were underlying causes of secondary osteoporosis such as corticosteroid and anti-convulsant treatment, family history of bone disease, current smoking and high alcohol consumption, of which oral steroid therapy and hypogonadism are the most common[2,13,28,29]. However, most men do not receive treatment for osteoporosis even after fracture. Papaioannou et al. reported that 90% of men with fragility fractures remained undiagnosed and not treated for osteoporosis[25].

Until now, to our knowledge, there have been few studies which reported the clinical characteristics and the radiologic findings or outcomes of the male patients with osteoporotic compression fractures. Thus, this study was designed to investigate the clinical characteristics of the male population who underwent vertebroplasty for osteoporotic compression frac-

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Corresponding Author: Kyung Hyun Kim, M.D.
Department of Neurosurgery, Yonsei University College of Medicine Gangnam Severance Spine Hospital, Spinal Neurosurgery, 146-92, Dogok-dong, Kangnam-gu, Seoul 135-720, Korea
Tel: +82-2-2019-3390, Fax: +82-2-3461-9229
e-mail: nskhk@yuhc.ac

ture, and to compare the clinical characteristics and radiological outcomes with female group.

MATERIALS AND METHODS

Our study included total of 155 patients who underwent percutaneous vertebroplasty for osteoporotic compression fracture between February 2006 and November 2009. There were 32 male patients and 123 female patients. Patients with burst fracture in which the posterior wall of the vertebral body was disrupted were excluded from this study based on preoperative computed tomography (CT) or magnetic resonance imaging (MRI).

We reviewed the preoperative factors, intraoperative factors, and clinical, radiological outcomes. Preoperative factors included age, bone mineral density (BMD, T-score), trauma/smoking/alcohol history, underlying medical diseases, and preoperative osteonecrosis. BMD (g/cm^2) was measured at the lumbar spine and the femoral neck by DXA (Dual-energy X-ray Absorptiometry, Hologic inc, Waltham, MA, USA). We defined the osteonecrosis on preoperative MR images which showed the intravertebral vacuum cleft sign or the fluid sign. The vacuum cleft sign indicates a collection of intravertebral air and the vacuum has low signal intensity with all MR sequences. The fluid sign indicates a collection of intravertebral fluid and the fluid collection appears as a well-circumscribed area of low signal intensity on T1-weighted MR images, with high signal intensity on T2-weighted images[3,32,36].

Intraoperative factors included cement distribution pattern, cement leakage, and injected cement volume. The cement distribution patterns were classified as an interdigitation pattern or a lump pattern according to their radiographic findings. In the interdigitation pattern, which we believe to be the ideal result after vertebroplasty, the injected cement has a sponge-like appearance and a trabecular filling pattern. In contrast, in the lump pattern, the injected cement has a compact, solid filling pattern[6,17].

Clinical and radiological outcome included VAS (visual analogue scale) and recollapse of the treated vertebrae. Recollapse was defined when the height of the index vertebra was decreased on lateral plain radiographs after vertebroplasty.

Student's t-test was used for the statistical analysis of age, BMD, injected cement volume, and VAS. Statistical comparison of the epidemiological factors (trauma history, smoke/alcohol/medical history), preoperative osteonecrosis, and the radiological outcomes (cement distribution pattern, cement leakage, recollapse) were performed using Fisher's exact test. $p < 0.05$ was considered statistically significant. SPSS 15.0 for Windows (SPSS, Chicago, IL, USA) was used for all statistical analyses.

RESULTS

1. Preoperative factors

The mean age of male group (32 patients) was 67.8±8.6 years and their mean T-score on bone mineral density was -3.2 ±0.8. The mean age of female group (123 patients) was 71.8±

Table 1. Characteristics between two groups

Characteristic		Value		
		Male (n=32)	Female (n=123)	p-value
Preoperative factors	Age, years (Mean±SD)	67.8±8.6	71.8±8.9	0.025†
	Bone mineral density (T-score)	-3.2±0.8	-3.7±0.7	0.002†
	Number of Trauma (%)	21 (65.6)	51 (41.5)	0.012*
	Number of Smoke (%)	5 (15.6)	2 (0.02)	0.004*
	Number of Alcohol (%)	7 (21.8)	1 (0.01)	0.000*
	Underlying medical disease (%)	17 (53.1)	33 (26.8)	0.005*
	Preoperative osteonecrosis (%)	16 (50.0)	42 (34.1)	0.075*
Intraoperative factors	Interdigitation pattern	17 (53.1%)	88 (71.5%)	0.040*
	Cement Leakage	8 (25%)	42 (34.1%)	0.222*
	Cement Volume (Mean±SD) (ml)	5.71±0.93	5.37±1.16	0.110†
Clinical and radiological outcomes	Preoperative VAS (Mean±SD)	8.5±0.9	8.6 ±0.3	0.120†
	Postoperative VAS (Mean±SD)	3.4±0.4	3.5 ±0.9	0.131†
	Recollapse	11 (34.3%)	39 (31.7%)	0.464*

$p<0.05$ (student`s t-test or Fisher's exact test), †student's t-test, *Fisher's exact test, VAS: visual analogue scale

8.9 years old and their mean T-score was -3.7±0.7 (Table 1).

Involved vertebrae were located from the T6 to L5 levels in both groups. In male group, affected levels were T6 (n=1), T8 (n=1), T9 (n=1), T10 (n=2), T11 (n=3), T12 (n=5), L1 (n=8), L2 (n=3), L3 (n=3), L4 (n=4), and L5 (n=1). In female group, affected levels were T6 (n=1), T7 (n=4), T8 (n=5), T9 (n=3), T10 (n=2), T11 (n=12), T12 (n=26), L1 (n=39), L2 (n=10), L3 (n=14), L4 (n=6), and L5 (n=1).

21 out of 32 (65.6%) male patients had an obvious traumatic event (e.g. fall down, car accident, lifting a heavy material, etc.) preceding the onset of severe back pain which is higher rate than female patients (51 out of 123 (41.5%), p=0.012, Table 1).

Both smoking and alcohol abuse history were more frequently seen in male group than female group 5/32 (15.6%) vs 2/123(0.02%), p=0.004, 7/32 (21.8%) vs 1/123 (0.01%), p=0.000, respectively, table 1).

There were 17 out of 32 (53.1%) male patients with medical history related with secondary osteoporosis. In 123 female patients, 33 patients (26.8%, p=0.005, Table 1) had a medical history related to secondary osteoporosis. The medical histories related to secondary osteoporosis are listed in Table 2. Among male patients with medical history, there were 2 patients with diabetes mellitus, 4 patients with chronic steroid use due to ulcerative colitis, intramedullary spinal cord tumor, and Behçet disease, 5 patients with anticoagulative medication due to cardiac or cerebrovascular events, 1 patient with antidepressants medication, 1 patient with antiviral therapy due to C-viral hepatitis, 1 patient with liver cirrhosis, and 3 patients with whole body radiation therapy due to advanced stage cancer (Table 2).

Preoperative osteonecrosis is more frequently showed in male group although there was no statistically significant difference (50.0% vs 34.1%, p=0.075, Table 1).

Table 2. The medical history related with secondary osteoporosis

	Male (17)	Female (33)
Diabetes	2	11
Chronic steroid use	4	0
Anticoagulants use	5	14
Antidepressants use	1	3
Antiviral therapy	1	1
Liver cirrhosis	1	0
Asthma	0	1
Hyperthyroidism	0	1
Whole body radiation therapy due to advanced stage cancer	3	2

2. Intraoperative factors

In the injected cement distribution pattern, interdigitation pattern was found more frequently in male group (17 out of 32, 53.1%) than female group (88 out of 123, 71.5%, p=0.040, Table 1). There was no statistically significant difference in the incidence of cement leakage and the injected cement volume between two groups. The incidence of cement leakage was 42 out of 123 female patients (34.1%) and 8 out of 32 male patients (25%, p=0.222). The injected cement volume was 5.71 mL±0.93 for male patients and 5.37 mL±1.16 for female patients (p=0.110, Table 1).

3. Clinical and radiological outcomes

There were no significant differences in clinical outcomes (VAS) between the two groups. Preoperative VAS was 8.5±0.9 in male group and 8.6±0.3 in female group (p=0.120). In both groups, VAS was decreased immediately after the operation. Postoperative VAS was 3.4±0.4 in male group and 3.5±0.9 in female group (p=0.131).

11 out of 32 male patients (34.3%) were complicated with recollapse of previously treated vertebrae which is higher rate than that of female group (39/123, 31.7%). However, this result was not statistically significant (p=0.464, Table 1).

DISCUSSION

The osteoporosis in men is rarely recognized and treated, even in the presence of clear risk factors[9,10,14,18] because the osteoporosis was long viewed as a disease of aging women[8,14]. The prevalence of osteoporosis in men in the United States has been estimated at between 3% and 7%, and male osteoporosis accounts for up to 20% of all cases of osteoporosis[21]. This prevalence, however, is increasing. Longer life spans and the aging of the population are bringing both greater numbers and greater percentages of the male population into the osteoporotic range[16]. According to a European-based population study, the prevalence of vertebral body deformity, a surrogate measure for vertebral body fracture, is greater in men than that of women below the age of 60 years. With further aging this is reversed, presumably because the incidence of osteoporosis increases more rapidly in women than in men[16,22].

In our study, the mean age of male patients was 67.8±8.6 years which is younger than female patients (71.8±8.9, p=0.025). And our data also showed male vertebral fracture patients have higher rates of trauma history (65.6%) than female group (41.5%, p=0.012). In previous studies, it has been sug-

gested that a number of vertebral fractures in middle-aged men are traumatic reflecting greater exposure to trauma during their working life[20,24], and this findings are consistent with the results of our study.

Preoperative osteonecrosis was more frequently found in male group than female group although there was no statistically significant difference. Interdigitation distribution pattern was more in female group than male group with a statistical significance. However, recollapse rate of previously treated vertebrae was not significantly higher in male group than female group. Vertebral osteonecrosis is thought to have two possible mechanisms being either traumatic or non traumatic[36]. Delayed post-traumatic osteonecrosis, also known as Kummell's disease is the first mechanism of vertebral osteonecrosis[15,19,21]. The second mechanism (non traumatic mechanism) involves repeated microtrabecular fractures in a vertebral body[36]. We found the more frequent traumatic event in male group. And we carefully reasoned that more frequent traumatic event and related delayed bone healing would result in more preoperative osteonecrosis in male group. Some authors suggested that preoperative osteonecrosis could be a predisposing factor for recollapse of treated vertebrae because thermal necrosis caused by injected cement might result a solid lump distribution pattern rather than a contiguous bone interdigitation pattern which might aggravate the process of osteonecrosis[17]. Although we expected that more frequent preoperative osteonecrosis in male group would result higher rate of a solid lump distribution pattern and higher rate of recollapse, we could not prove this hypothesis with statistical significance.

The osteoporosis in men is thought to have a more underlying secondary cause than women. Approximately, more than 50% of men with osteoporosis are diagnosed with an underlying "secondary" cause[12,14,26,27]. According to NIH consensus conference in 2000, 30-60% of osteoporosis in men is due to secondary causes, including most commonly alcohol, chronic glucocorticoid excess and hypogonadism, among others[1]. Many other studies showed that the three major causes of secondary osteoporosis in men are alcohol abuse, glucocorticoid excess (either endogenous Cushing's syndrome or, more commonly, chronic glucocorticoid therapy), and hypogonadism[4,14,23,30]. We also found that the underlying disease associated with osteoporosis in men is more common than women (53.1% vs 26.8%, p=0.005). And smoking, alcohol history of male patients were more common than female patients (15.6 % vs 0.02%, p=0.004, 21.8% vs 0.01%, p=0.000 respectively). Bone strength is a term used to describe the ability of bone to resist fracture[5]. Determining bone strength reflects the integration of three factors: quantity, quality, and turnover[11]. BMD reflects bone quantity. Bone quality is a function of the structural and material properties of bone[33]. The structural properties include bone geometry (size and shape of the skeleton) and microarchitecture, whereas the material properties include the organization and composition of the mineral and collagen components of the extracellular matrix, as well as the extent of microdamage within the tissue[11]. Many diseases and conditions affect bone quality besides osteoporosis[33]. These include disorders of bone mineral homeostasis, imbalance of bone remodeling, collagen disorders and drugs affecting bone quality. For example, glucocorticoids not only increase bone turnover, resulting in increased bone resorption, but also affect mineral homeostasis by reducing calcium absorption and causing secondary hyperparathyroidism[15,34,35].

As a result, diseases or conditions that cause secondary osteoporosis can lead to a decrease in bone strength more than primary osteoporosis via their adverse effects on bone quality. In our study, we have found that male vertebral fracture patients have higher BMD than female patients (T-score, -3.2± 0.8 vs -3.7±0.7, p=0.002). However, Bone quantity, quality, and turnover are all important in determining bone strength. So, clinicians should always be aware of secondary causes of osteoporosis that affect bone quality, especially, diseases amenable to treatment[33].

Our study has limitations which include that our study is a retrospective study, a small number of patients were included. Another limitation of our study is that we only included patients who underwent vertebroplasty. This study would be more valid and reliable if patients treated conservatively were enrolled in this investigation. Future large number, prospective study should be needed for clarifying our hypothesis.

CONCLUSION

Male group have more frequent traumatic event and more frequent secondary osteoporosis than female group. Preoperative osteonecrosis was more frequently found in male group than female group although there was no statistically significant difference. Male group showed more frequent lump cement distribution pattern than female group after vertebroplasty (p =0.040). Preoperative osteonecrosis might be a predisposing factor of lump cement distribution pattern. As a consequence, in male osteoporotic compression fracture patients, clinicians should take history for secondary causes of osteoporosis and traumatic event more carefully and pay attention to possibility of lump cement distribution pattern after vertebroplasty.

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