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Risk factors of new symptomatic vertebral compression fractures in osteoporotic patients undergone percutaneous vertebroplasty

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ABSTRACT

PURPOSE

This study evaluated the risk factors of new vertebral compression fractures (VCFs) following percutaneous vertebroplasty (PVP).





METHODS

From June 2005 to January 2011, patients with osteoporotic VCFs (OVCFs) who were treated with PVP and met this study's inclusion criteria were retrospectively reviewed. Observed parameters were age, sex, bone mineral density, body mass index, amount of bone cement, cement leakage into the disk, preoperative kyphosis, preoperative degree of anterior vertebral compression, preoperative degree of middle vertebral compression, kyphosis correction, anterior vertebral height restoration, middle vertebral height restoration, and number of initial symptomatic fractures (levels treated). The data were analyzed by univariate and multivariate analysis for the emergence of new fractures after PVP to determine related risk factors.





RESULTS

A total of 182 patients met the inclusion criteria. There were 155 female and 27 male patients with a mean age of 69.7 years (range 49–91 years). The follow-up period was 24–50 months (average 26.4 months). A total of 294 VCFs among 182 patients were observed, 28 new VCFs occurred in 21 patients (21/182, 11.5 %) during the follow-up period. Statistical analysis indicated that higher BMI ($P = 0.004$) and a greater number of initial symptomatic Fractures ($P=0.017$) were significantly associated with new VCFs after PVP. It is the most obvious that the risk of new fractures increased 2.518-fold (95 % CI 1.176–5.395), when the number of initial VCFs increased by one level.





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CONCLUSIONS

The incidence of new symptomatic VCFs after PVP was higher in osteoporotic patients with initial multiple-level fractures.

Key words: Retrospective study ; Osteoporotic vertebral compression fracture ; Percutaneous vertebroplasty ; Risk factor



Figures and Tables

Measurement of kyphosis angle and the degree of vertebral compression

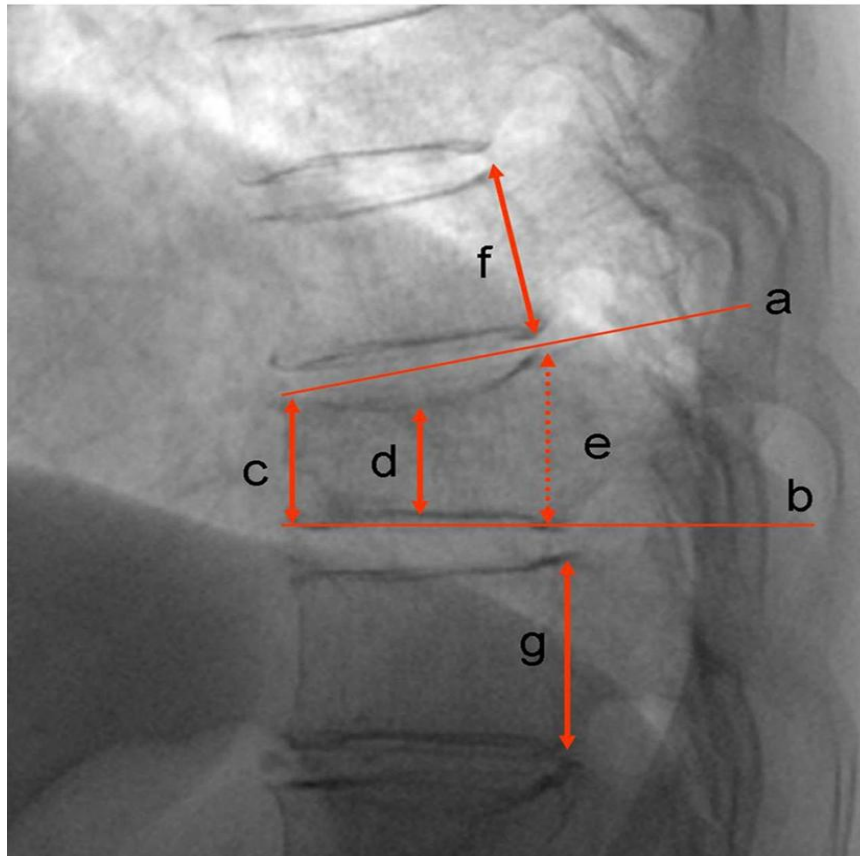


Figure 1. a Upper edge of the vertebral fracture (dashed line), b lower edge of the vertebral fracture (dashed line). The angle between lines a and b is the vertebral kyphosis angle. c Anterior height of the VCF, d middle height of the VCF, f upper posterior vertebral height adjacent to the VCF, g lower posterior vertebral height adjacent to the VCF, e estimate of the posterior vertebral height of the VCF (average of f and g). $c/e = \text{DAVC} (\%)$, $d/e = \text{DMVC} (\%)$



Table 1 Patient characteristics for the entire cohort (mean \pm SD)

Patients (n = 182)												
Sex (male/female)			Age (years)				BMD (T-score)			BMI (kg/m ²)		
27/155			69.7 \pm 9.3				-4.5 \pm 1.1			21.8 \pm 3.6		
Number of initial fractures												
1 level			2 levels				\geq 3 levels					
102			54				26					
Initial VCFs (n = 294)												
Cement leakage into disk			Amount of bone cement (mL)				Preoperative kyphosis (°)			Kyphosis correction (°)		
37			3.6 \pm 1.1				12.5 \pm 6.5			-2.0 \pm 2.6		
Preoperative DAVC (%)			Preoperative DMVC (%)				Anterior vertebral height restoration (%)			Middle vertebral height restoration (%)		
68.5 \pm 16.7			50.7 \pm 14.1				4.6 \pm 8.9			9.0 \pm 9.4		
Level												
T5	T6	T7	T8	T9	T10	T11	T12	L1	L2	L3	L4	L5
Initial VCFs (n = 294)												
3	5	13	20	17	14	31	56	54	46	22	10	3
New VCFs (n = 28)												
1	0	0	0	3	3	1	3	6	2	4	3	2

DAVC degree of anterior vertebral compression, DMVC degree of middle vertebral compression



Table 2 Summary of clinical features of 21 patients with new symptomatic VCF

No.	Sex	Age (years)	BMD (T-score)	BMI (kg/m ²)	Amount of bone cement (mL)	Cement leakage into disk	Initial VCFs	New VCFs	New VCFs occurrence time (months)
1	F	72	-4.6	19.2	4	(+)	T12	T10	20
2	F	82	-5.0	23.4	3	(-)	L2	T5	7
3	F	84	-4.5	28.1	3	(-)	T10	L1	7
4	F	66	-4.2	26.2	6	(-)	L1	L4	1
5	F	67	-3.4	25.2	5	(-)	L1	T12	12
6	F	67	-3.6	27.8	2.5	(-)	L3	L1	23
7	F	53	-4.0	22.6	2.5	(-)	T12	T9	48
8	F	77	-5.0	21.2	2	(-)	T7	T12/L4	13
9	F	73	-4.4	27.1	3/4.5	(-)	T8/T11	T12	4
10	F	61	-5.3	26.7	3.6/3	(-)	T9/T12	L2/L3	7
11	F	66	-3.9	19.5	5/1.5	(-)	L1/L2	T9	3
12	F	69	-4.8	24.4	5/3	(+)	T9/T12	L1	2
13	F	76	-5.5	18.7	2/2	(-)	T10/T11	L3	1
14	F	71	-6.1	27.3	2.5/3	(-)	T5/T8	L2	11
15	M	76	-5.4	19.2	4/2/3.5	(-)	T12/L1/L2	L4/L5	1
16	F	66	-4.6	27.1	3/3/3	(+)	T7/T12/L2	L1	4
17	M	58	-5.2	20.1	2.5/3/3	(-)	T11/T12/L2	L3	1
18	F	82	-4.4	15.6	3/5/5	(-)	T12/L1/L3	T11	2
19	M	61	-3.1	24.8	2.5/5/3	(-)	T12/L1/L2	T9/T10/L5	1
20	F	80	-7.1	31.2	2/2/4	(-)	T7/T8/T12	L3/L4	3
21	F	69	-4.8	22.9	2/2/3.5/5	(-)	T6/T7/T8/L2	T10/T12	10



Table 3 Incidence of new fractures and cement leakage

	Patients with new VCF (n = 21)	Patients without new VCF (n = 161)	Incidence
1 level	8	94	7.8 % (8/102)
2 levels	6	48	11.1 % (6/54)
≥3 levels	7	19	26.9 % (7/26)
Total levels	21	161	11.5 % (21/182)

	Patients with new VCF (number of initial VCFs, n = 42)	Incidence	Patients without new VCF (number of initial VCFs, n = 252)	Incidence	Incidence (total)
Cement leakage into disk (A)	3	7.1 % (3/42)	34	13.5 % (34/252)	12.6 % (37/294)
All of cement leakage (B)	17	40.5 % (17/42)	82	32.5 % (82/252)	33.7 % (99/294)
A/B		17.6 % (3/17)		41.5 % (34/82)	37.4 % (37/99)

	Adjacent fractures Fractures	Non-adjacent fractures fracture	Incidence
New VCF	6	22	21.4 % (6/28)





Table 4 Characteristics of patients with and patients without new VCF (mean \pm SD)

Variable	Patients with new VCF (n = 21)	Patients without new VCF (n = 161)	P
Sex (male/female)	3/18	24/137	0.94
Age (years)	70.3 \pm 8.3	69.7 \pm 9.5	0.779
BMD (T-score)	-4.7 \pm 0.9	-4.5 \pm 1.1	0.421
BMI (kg/m ²)	23.7 \pm 4.0	21.6 \pm 3.5	0.010*
Number of initial fractures			
1 level	8	94	0.001*
2 levels	6	48	
\geq 3 levels	7	19	
Cement leakage into disk	3	32	0.541
Amount of bone cement (mL)	3.5 \pm 1.2	3.8 \pm 1.1	0.186
Preoperative kyphosis (°)	13.9 \pm 3.6	13.0 \pm 6.3	0.492
Preoperative DAVC (%)	66.6 \pm 11.1	67.4 \pm 15.7	0.788
Preoperative DMVC (%)	52.7 \pm 11.0	49.6 \pm 13.0	0.311
Kyphosis correction (°)	-2.3 \pm 2.8	-2.4 \pm 2.5	0.770
Anterior vertebral height restoration (%)	4.6 \pm 7.0	5.9 \pm 8.0	0.493
Middle vertebral height restoration (%)	8.3 \pm 8.5	10.1 \pm 8.4	0.362

DAVC degree of anterior vertebral compression, DMVC degree of middle vertebral compression

* Statistically significant

Table 5 Results of multivariate logistic regression analysis

Variable	Regression coefficient	OR (odd ratio)	P	95 % CI for OR
Sex	-0.369	0.692	0.629	0.155-3.084
Age (years)	0.027	1.027	0.367	0.969-1.090
BMD (T-score)	-0.244	0.784	0.332	0.479-1.282
BMI (kg/m ²)	0.237	1.268	0.004*	1.077-1.492
Amount of bone cement (mL)	-0.129	0.879	0.637	0.516-1.499
Preoperative kyphosis (°)	0.089	1.093	0.330	0.914-1.305
Preoperative DAVC (%)	-0.019	0.981	0.638	0.907-1.062
Preoperative DMVC (%)	0.072	1.075	0.086	0.990-1.167
Kyphosis correction (°)	-0.062	0.940	0.668	0.707-1.249
Anterior vertebral height restoration (%)	-0.011	0.989	0.833	0.896-1.093
Middle vertebral height restoration (%)	0.038	1.039	0.423	0.946-1.141
Cement leakage into disk	-0.437	0.646	0.543	0.159-2.635
Number of initial fractures	0.924	2.518	0.017*	1.176-5.395

DAVC degree of anterior vertebral compression, DMVC degree of middle vertebral compression

* Statistically significant

