

# 骨质疏松性椎体压缩骨折经皮椎体成形术后 邻近椎体再骨折的危险因素探讨

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**摘要 目的:**探讨骨质疏松性椎体压缩骨折经皮椎体成形术(percutaneous vertebroplasty, PVP)后邻近椎体再骨折的危险因素。**方法:**收集采用 PVP 治疗的 225 例骨质疏松性椎体压缩骨折患者的病例资料。按照 PVP 术后是否发生邻近椎体骨折, 将患者分为再骨折组和未再骨折组。统计分析患者的性别、年龄、初次骨折椎体数量、术前椎体骨密度降低值、单个椎体骨水泥注射量、骨水泥椎间盘渗漏率和再骨折发生时间。**结果:**再骨折组 31 例, 未再骨折组 194 例。再骨折组邻近椎体再骨折时间为 PVP 术后 10 d 至 48 个月, 中位数 13 个月。再骨折组男 8 例、女 23 例, 未再骨折组男 39 例、女 155 例; 2 组患者的性别比较, 差异无统计学意义( $\chi^2 = 0.171, P = 0.679$ )。再骨折组初次骨折椎体数量  $< 3$  椎 27 例、 $\geq 3$  椎 4 例, 未再骨折组初次骨折椎体数量  $< 3$  椎 183 例、 $\geq 3$  椎 11 例; 2 组患者初次骨折椎体数量比较, 差异无统计学意义( $\chi^2 = 1.235, P = 0.266$ )。2 组患者单个椎体骨水泥注射量比较, 差异无统计学意义 [ $(3.59 \pm 1.45)$  mL,  $(4.97 \pm 1.06)$  mL,  $t = 0.624, P = 0.542$ ]。再骨折组的患者年龄大于未再骨折组 [ $(75.34 \pm 4.79)$  岁,  $(72.59 \pm 6.67)$  岁,  $t = 1.216, P = 0.000$ ], 术前椎体骨密度降低值大于未再骨折组 [ $(2.92 \pm 0.25)$  SD,  $(2.75 \pm 0.38)$  SD,  $t = 1.127, P = 0.031$ ]。再骨折组骨水泥椎间盘渗漏 12 例, 未再骨折组骨水泥椎间盘渗漏 15 例, 再骨折组的骨水泥椎间盘渗漏率高于未再骨折组( $\chi^2 = 21.444, P = 0.000$ )。**结论:**高龄、骨水泥椎间盘渗漏及椎体骨密度降低可能是导致骨质疏松性椎体压缩骨折 PVP 术后邻近椎体再骨折的危险因素。

**关键词** 脊柱骨折; 骨质疏松性骨折; 骨折, 压缩性; 椎体成形术; 手术后并发症; 再骨折; 危险因素; 临床试验

## Investigation on risk factors for adjacent vertebral refractures after percutaneous vertebroplasty in patients with osteoporotic vertebral compression fractures

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**ABSTRACT Objective:** To explore the risk factors for adjacent vertebral refractures after percutaneous vertebroplasty (PVP) in patients with osteoporotic vertebral compression fractures. **Methods:** The medical records of 225 patients with osteoporotic vertebral compression fractures who were treated with PVP were collected. The patients were divided into refracture group (31 cases) and non-refracture group (194 cases) according to whether the adjacent vertebral fractures happened after PVP. The gender, age, number of initial fractured vertebral bodies, decreased value of preoperative vertebral bone mineral density, consumption of bone cements that were injected into single vertebral body, incidence rate of leakage of bone cements into intervertebral disc and the occurrence time of refractures were analyzed. **Results:** The occurrence time of adjacent vertebral refractures ranged from 10 days to 48 months (Median = 13 months) after PVP in refracture group. The patients consisted of 8 males and 23 females in refracture group and the patients consisted of 39 males and 155 females in non-refracture group. There was no statistical difference in constituent ratio of gender between the 2 groups ( $\chi^2 = 0.171, P = 0.679$ ). The number of initial fractured vertebral bodies was  $< 3$  in 27 cases and  $\geq 3$  in 4 cases in refracture group, while it was  $< 3$  in 183 cases and  $\geq 3$  in 11 cases in non-refracture group. There was no statistical difference in the number of initial fractured vertebral bodies between the 2 groups ( $\chi^2 = 1.235, P = 0.266$ ). There was no statistical difference in consumption of bone cements that were injected into single vertebral body between the 2 groups ( $3.59 \pm 1.45$  vs  $4.97 \pm 1.06$  ml,  $t = 0.624, P = 0.542$ ). The patients were older and the decreased values of preoperative vertebral bone mineral density were greater in refracture group compared to non-refracture group ( $75.34 \pm 4.79$  vs  $72.59 \pm 6.67$  yrs,

$t = 1.216, P = 0.000; 2.92 \pm 0.25$  vs  $2.75 \pm 0.38$  SD,  $t = 1.127, P = 0.031$ ). The leakage of bone cements into intervertebral disc was found in refracture group (12 cases) and non-refracture group (15 cases), and the incidence rate of leakage of bone cements into intervertebral disc was higher in refracture group compared to non-refracture group ( $\chi^2 = 21.444, P = 0.000$ ). **Conclusion:** Great age, leakage of bone cements into intervertebral disc and decrease in vertebral bone mineral density may be the risk factors which lead to the adjacent vertebral refractures after PVP in patients with osteoporotic vertebral compression fractures.

**Key words** spinal fractures; osteoporotic fractures; fractures, compression; vertebroplasty; postoperative complications; refractures; risk factors; clinical trial

经皮椎体成形术 (percutaneous vertebroplasty, PVP) 是目前临床上治疗骨质疏松性椎体压缩骨折的常用方法之一, 尤其对骨折引起的顽固性胸腰背部疼痛有良好的效果<sup>[1]</sup>。但随着该技术的广泛应用, PVP 术后邻近椎体骨折的问题也逐渐受到了人们的关注<sup>[2]</sup>。有文献统计, PVP 术后椎体骨折的发生率为 38%, 而新发骨折部位多以手术椎体邻近节段为主<sup>[3]</sup>。目前对于 PVP 术后邻近椎体骨折的原因及危险因素存在较多争议。本研究拟通过回顾性分析采用 PVP 治疗的 225 例骨质疏松性椎体压缩骨折患者的病例资料, 探讨骨质疏松性椎体压缩骨折 PVP 术后邻近椎体再骨折的危险因素。

## 1 临床资料

**1.1 一般资料** 纳入研究的患者共 225 例, 均为 2011 年 2 月至 2014 年 3 月在河南省中医院住院治疗的骨质疏松性胸腰椎压缩骨折患者。男 47 例, 女 178 例; 年龄 61 ~ 87 岁, 中位数 71 岁; 初次骨折椎体数量 < 3 椎 210 例, 骨折椎体数量  $\geq 3$  椎 15 例。所有患者均采用 PVP 手术治疗, 单个椎体骨水泥注射量 3 ~ 7.5 mL。试验方案经医院医学伦理委员会审核通过。

**1.2 诊断标准** 采用《中医病证诊断疗效标准》中胸腰椎骨折的诊断标准<sup>[4]</sup>。

**1.3 纳入标准** ①符合上述诊断标准; ②椎体骨密度降低  $\geq 2.5$ SD; ③采用 PVP 手术治疗; ④治疗及随访资料完整。

**1.4 排除标准** ①合并其他代谢性疾病者; ②合并脊柱肿瘤、结核者; ③既往有脊柱手术史者。

## 2 方法

**2.1 临床治疗** 患者取俯卧位, 常规消毒铺巾后, 经 C 形臂 X 线机透视定位穿刺点, 经穿刺点进行局部麻醉。透视引导下经椎弓根穿刺, 建立工作通道, 前端接近椎体前缘, 搅拌骨水泥至拉丝状, 经工作通道由推杆注入骨水泥。术后常规给予抗感染治疗, 术后第 1 天患者即可佩戴腰围下床活动。

**2.2 分组及试验指标观察** 按照 PVP 术后是否发生邻近椎体骨折, 将患者分为再骨折组和未再骨折组。统计患者的性别、年龄、初次骨折椎体数量、术前椎体骨密度降低值、单个椎体骨水泥注射量、骨水泥椎间盘渗漏率和再骨折发生时间。

**2.3 数据统计分析** 采用 SPSS 21.0 软件进行数据统计分析, 2 组患者性别、骨水泥椎间盘渗漏率、初次骨折椎体数量的组间比较采用  $\chi^2$  检验, 年龄、术前椎体骨密度降低值、单个椎体骨水泥注射量的组间比较采用  $t$  检验, 检验水准  $\alpha = 0.05$ 。

## 3 结果

所有患者均顺利完成手术, 术后均获得随访, 随访时间 24 ~ 48 个月, 中位数 32 个月。再骨折组 31 例, 未再骨折组 194 例。邻近椎体再骨折时间为 PVP 术后 10 d 至 48 个月, 中位数 13 个月。2 组患者性别、初次骨折椎体数量、单个椎体骨水泥注射量比较, 组间差异均无统计学意义。再骨折组的患者年龄大于未再骨折组, 骨水泥椎间盘渗漏率高于未再骨折组, 术前椎体骨密度降低值大于未再骨折组。见表 1。

表 1 2 组骨质疏松性椎体压缩骨折患者临床资料比较

组别	例数	性别(例)		年龄 ( $\bar{x} \pm s$ , 岁)	骨水泥椎间盘渗漏(例)		术前椎体骨密度降低值 ( $\bar{x} \pm s$ , SD)	初次骨折椎体数量(例)		单个椎体骨水泥注射量 ( $\bar{x} \pm s$ , mL)
		男	女		有	无		< 3 椎	$\geq 3$ 椎	
再骨折组	31	8	23	$75.34 \pm 4.79$	12	19	$2.92 \pm 0.25$	27	4	$3.59 \pm 1.45$
未再骨折组	194	39	155	$72.59 \pm 6.67$	15	179	$2.75 \pm 0.38$	183	11	$4.97 \pm 1.06$
检验统计量		$\chi^2 = 0.171$		$t = 1.216$	$\chi^2 = 21.444$		$t = 1.127$	$\chi^2 = 1.235$		$t = 0.624$
P 值		0.679		0.000	0.000		0.031	0.266		0.542

## 4 讨 论

高龄患者雌激素分泌减少,导致骨代谢紊乱和维生素 D 减少<sup>[5-7]</sup>,使骨折的风险增大。局部骨密度检测可用于预测该部位骨折的风险,骨密度降低 1 SD,该部位骨折的相对风险增高 1.63 倍<sup>[8]</sup>。PVP 术治疗后的患者,尤其是绝经后妇女,应重视骨密度的变化,及时并有针对性地进行抗骨质疏松治疗,预防邻近椎体再发骨折。

骨水泥的注入会明显改变手术椎体和邻近椎体生物力学特性。评价骨水泥注入后骨折椎体生物力学特性的指标为最大抗压强度和椎体刚度,前者反映椎体对轴向载荷的抗压能力,后者反映在轴向载荷下抵抗椎体楔形变的能力<sup>[9]</sup>。对 PVP 术后对邻近椎体生物力学影响的有限元分析发现,虽然向骨折椎体注入骨水泥能为骨折椎体提供更高的抗压强度和刚度,但椎体刚度过强可导致载荷不均匀扩散,压力直接传递至邻近椎间盘和椎体,使相邻终板应力增加<sup>[10]</sup>。Nouda 等<sup>[11]</sup>在尸体标本上所做的生物力学实验的结果也证实了这一观点。而这则可能使 PVP 术后邻近椎体骨折的风险增加。

由于 PVP 术中是在高压条件下向椎体内注射骨水泥,而控制骨水泥渗漏的发生多依赖于临床医生的经验,因此渗漏率较高<sup>[12-13]</sup>。有研究表明,注入的骨水泥可通过骨折椎体的上、下终板渗漏至邻近椎间盘,使椎间盘的强度和硬度较之前提高约 19%,应力增加,最终导致邻近椎体发生骨折<sup>[14-15]</sup>。

本研究的结果提示,高龄、骨水泥椎间盘渗漏及椎体骨密度降低可能是导致骨质疏松性椎体压缩骨折 PVP 术后邻近椎体再骨折的危险因素。

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