

· 临床研究 ·

中老年女性腰椎椎后肌群退变与腰椎骨密度的关系研究

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摘要 目的: 研究中老年女性腰椎椎后肌群退变与腰椎骨密度的关系。方法: 以一项前瞻性中国城乡流行病学研究项目招募的社区健康志愿者中的中老年女性作为研究对象, 共 115 例。45 岁 ≤ 年龄 < 60 岁者 62 例 (中年组), 年龄 ≥ 60 岁者 53 例 (老年组)。使用定量 CT 分别测量其腰椎骨密度, 并测量 L₃ 椎体中部层面椎后肌群的肌肉面积及脂肪面积, 计算腰椎椎后肌群内的肌肉脂肪浸润程度 (muscle fat infiltration, MFI) [MFI = 脂肪面积 / (肌肉面积 + 脂肪面积) × 100%]。采用直线相关分析和多元线性回归分析探讨腰椎骨密度与腰椎椎后肌群退变的关系。结果: 中年组的腰椎骨密度、椎后肌群肌肉面积均高于老年组 [(132.74 ± 35.74) mg · cm⁻³, (91.43 ± 28.40) mg · cm⁻³, $t = 6.779$, $P = 0.000$; (40.68 ± 6.62) cm², (38.01 ± 6.41) cm², $t = 2.182$, $P = 0.031$], 椎后肌群脂肪面积、MFI 均低于老年组 [(1.89 ± 0.99) cm², (2.34 ± 1.45) cm², $t = -1.997$, $P = 0.048$; (4.48 ± 2.11) %, (5.85 ± 3.44) %, $t = -2.604$, $P = 0.010$]; 2 组的体质指数比较, 组间差异无统计学意义 [(23.96 ± 3.22) kg · m⁻², (24.08 ± 3.06) kg · m⁻², $t = -0.190$, $P = 0.850$]。中年组、老年组及总体研究对象的腰椎骨密度均与年龄呈负相关 ($r = -0.552$, $P = 0.000$; $r = -0.599$, $P = 0.000$; $r = -0.690$, $P = 0.000$)。中年组腰椎骨密度与椎后肌群脂肪面积及 MFI 均呈负相关 ($r = -0.267$, $P = 0.037$; $r = -0.304$, $P = 0.017$), 与椎后肌群肌肉面积不存在直线相关关系 ($r = 0.081$, $P = 0.581$); 老年组腰椎骨密度与椎后肌群脂肪面积及 MFI 均呈负相关 ($r = -0.331$, $P = 0.017$; $r = -0.371$, $P = 0.007$), 与椎后肌群肌肉面积不存在直线相关关系 ($r = 0.235$, $P = 0.094$); 总体研究对象的腰椎骨密度与椎后肌群脂肪面积及 MFI 均呈负相关 ($r = -0.191$, $P = 0.042$; $r = -0.214$, $P = 0.023$), 与椎后肌群肌肉面积不存在直线相关关系 ($r = 0.132$, $P = 0.163$)。以腰椎骨密度为因变量, 以年龄、体质指数、腰椎椎后肌群肌肉面积和脂肪面积作为自变量, 进行多元线性回归分析, 得到的回归方程分别为, 腰椎骨密度 (中年组) = 379.695 - 3.929 × 年龄 - 7.609 × 腰椎椎后肌群脂肪面积、腰椎骨密度 (老年组) = 146.419 - 1.190 × 年龄 - 6.350 × 腰椎椎后肌群脂肪面积、腰椎骨密度 (总体研究对象) = 269.577 - 2.962 × 年龄 - 5.307 × 腰椎椎后肌群脂肪面积。结论: 中老年女性腰椎椎后肌群脂肪含量的增加可能会导致腰椎骨密度的下降, 是骨质疏松的重要危险因素。

关键词 腰椎; 骨密度; 定量 CT; 肌少症; 骨质疏松; 女性

A clinical study on the relationship between lumbar vertebrae posterior muscle group degeneration and lumbar bone mineral density in middle-aged and elderly females

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ABSTRACT Objective: To study the relationship between lumbar vertebrae posterior muscle group degeneration and lumbar bone mineral density (BMD) in middle-aged and elderly females. **Methods:** One hundred and fifteen middle-aged and elderly females were selected as the subjects from community healthy volunteers that were recruited for a prospective urban and rural epidemiologic study in China. Sixty-two females ranged in age from 45 to 60 years (middle-aged group), and 53 females were ≥ 60 years old (elder group). Their lumbar BMD were measured by using quantitative computerized tomography (CT), and muscle area and fat area of posterior vertebral muscle group were measured at the level of middle-layer of L₃ vertebrae. The degree of muscle fat infiltration (MFI) (MFI = fat area / (muscle area + fat area) × 100%) of lumbar vertebrae posterior muscle group was calculated. The relationship between lumbar BMD and lumbar vertebrae posterior muscle group degeneration were analyzed by using linear correlation analysis and multiple linear regression (MLR) analysis. **Results:** The lumbar BMD and the muscle area of posterior vertebral muscle group were higher (132.74 ± 35.74 vs 91.43 ± 28.40 mg/cm³),

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$t = 6.779, P = 0.000; 40.68 \pm 6.62$ vs 38.01 ± 6.41 cm(2), $t = 2.182, P = 0.031$), and the fat area of posterior vertebral muscle group and the MFI were lower (1.89 ± 0.99 vs 2.34 ± 1.45 cm(2), $t = -1.997, P = 0.048; 4.48 \pm 2.11$ vs $5.85 \pm 3.44\%$, $t = -2.604, P = 0.010$) in middle-aged group compared to elder group. There was no statistical difference in body mass index (BMI) between the 2 groups (23.96 ± 3.22 vs 24.08 ± 3.06 kg/m(2), $t = -0.190, P = 0.850$). The lumbar BMD was negatively correlated with the age of research objects in middle-aged group and elder group and of general research objects ($r = -0.552, P = 0.000; r = -0.599, P = 0.000; r = -0.690, P = 0.000$). The lumbar BMD was negatively correlated with the fat area of posterior vertebral muscle group and the MFI ($r = -0.267, P = 0.037; r = -0.304, P = 0.017$) and there was no linear correlation between lumbar BMD and muscle area of posterior vertebral muscle group ($r = 0.081, P = 0.581$) in middle-aged group. The lumbar BMD was negatively correlated with the fat area of posterior vertebral muscle group and the MFI ($r = -0.331, P = 0.017; r = -0.371, P = 0.007$) and there was no linear correlation between lumbar BMD and muscle area of posterior vertebral muscle group ($r = 0.235, P = 0.094$) in elder group. The lumbar BMD of general research objects was negatively correlated with the fat area of posterior vertebral muscle group and the MFI ($r = -0.191, P = 0.042; r = -0.214, P = 0.023$), and there was no linear correlation between lumbar BMD and muscle area of posterior vertebral muscle group ($r = 0.132, P = 0.163$). The lumbar BMD (Y) was chosen as the dependent variable and age (X1), BMI (X2) and muscle area (X3) and fat area (X4) of lumbar vertebrae posterior muscle group were chosen as the independent variable to make a MLR analysis, and then the linear regression equations (middle-aged group: $Y = 379.695 - 3.929 \times X1 - 7.609 \times X4$; elder group: $Y = 146.419 - 1.190 \times X1 - 6.350 \times X4$; general research objects: $Y = 269.577 - 2.962 \times X1 - 5.307 \times X4$) were established. **Conclusion:** The increase in fat content of lumbar vertebrae posterior muscle group may lead to the decrease in lumbar BMD in middle-aged and elderly females, and it may be an important risk factor for osteoporosis.

Keywords lumbar vertebrae; bone density; quantitative computerized tomography; sarcopenia; osteoporosis; femininity

随着人口老龄化的进展,肌肉骨骼疾病的患病率日益增加,已成为全球性的公共健康问题^[1]。肌少症与骨质疏松症、骨折的关系日渐成为研究热点^[2-3]。如何从肌肉、骨骼方面研究其与骨质疏松的相互关系,进而进行早期干预,对相关疾病的诊治有重要意义。椎旁肌群的退变程度是诊断肌少症的重要指标之一。目前骨骼肌质量测定常用的方法有双能 X 线吸光测定及 CT、MRI 测定等,笔者应用定量 CT (quantitative computerized tomography, QCT) 测量腰椎骨密度及腰椎椎后肌群的肌肉面积、脂肪面积,探讨中老年女性腰椎椎后肌群退变与腰椎骨密度的关系,现将结果报告如下。

1 研究对象

本研究样本人群来源于一项前瞻性中国城乡流行病学研究项目招募的社区健康志愿者,共 115 例,均为女性;45 岁 ≤ 年龄 < 60 岁者 62 例 (中年组),年龄 ≥ 60 岁者 53 例 (老年组)。排除了合并严重器质性疾病、全身代谢性骨病、脂肪萎缩症者及有近期腰椎骨折及手术史者、近期激素类药物应用史者。试验方案经北京积水潭医院医学伦理委员会审查通过。

2 方法

2.1 检查方法 采用 GE Optima 128 排 CT 及 Mind-

ways 公司的 5 样本 QCT 固体体模进行扫描,测量前常规校准。扫描参数:120 kV, 125 mAs, 床高 153 cm, 层厚 1.25 mm, 扫描视野 500 mm。将获得的容积数据传至 PRO5.0.3 Mindways QCT 骨密度分析软件进行测量。测量 L₂、L₃、L₄ 椎体松质骨体积骨密度,计算 3 个椎体骨密度的平均值 (图 1)。如上述 3 个椎体中某个椎体出现骨折或者严重骨质增生,则舍弃该椎体,另外选 L₁ 或 L₅ 进行测量。参考文献 [4-5], 选取 L₃ 椎体中部层面的薄层轴位图像为测量层面,沿椎后肌群 (多裂肌及竖脊肌) 边缘人工圈画感兴趣区,按预设阈值,以软件自动区分感兴趣区内的肌肉与脂肪组织,并计算出各自面积;脂肪面积与脂肪和肌肉面积之和的比值即为腰椎椎后肌群内的肌肉脂肪浸润程度 (muscle fat infiltration, MFI) (图 2)。所有测量均由 1 名有 5 年以上肌骨系统放射诊断经验、且经培训的医师完成。

2.2 数据统计方法 采用 SPSS19.0 软件进行数据统计分析。中年组和老年组体质量指数、腰椎骨密度、腰椎椎后肌群肌肉面积、腰椎椎后肌群脂肪面积、MFI 的组间比较均采用 t 检验,腰椎骨密度与体质量指数、腰椎椎后肌群肌肉面积、腰椎椎后肌群脂肪面积、MFI 的关系研究采用直线相关分析和多元线性回归分析。检验水准 $\alpha = 0.05$ 。

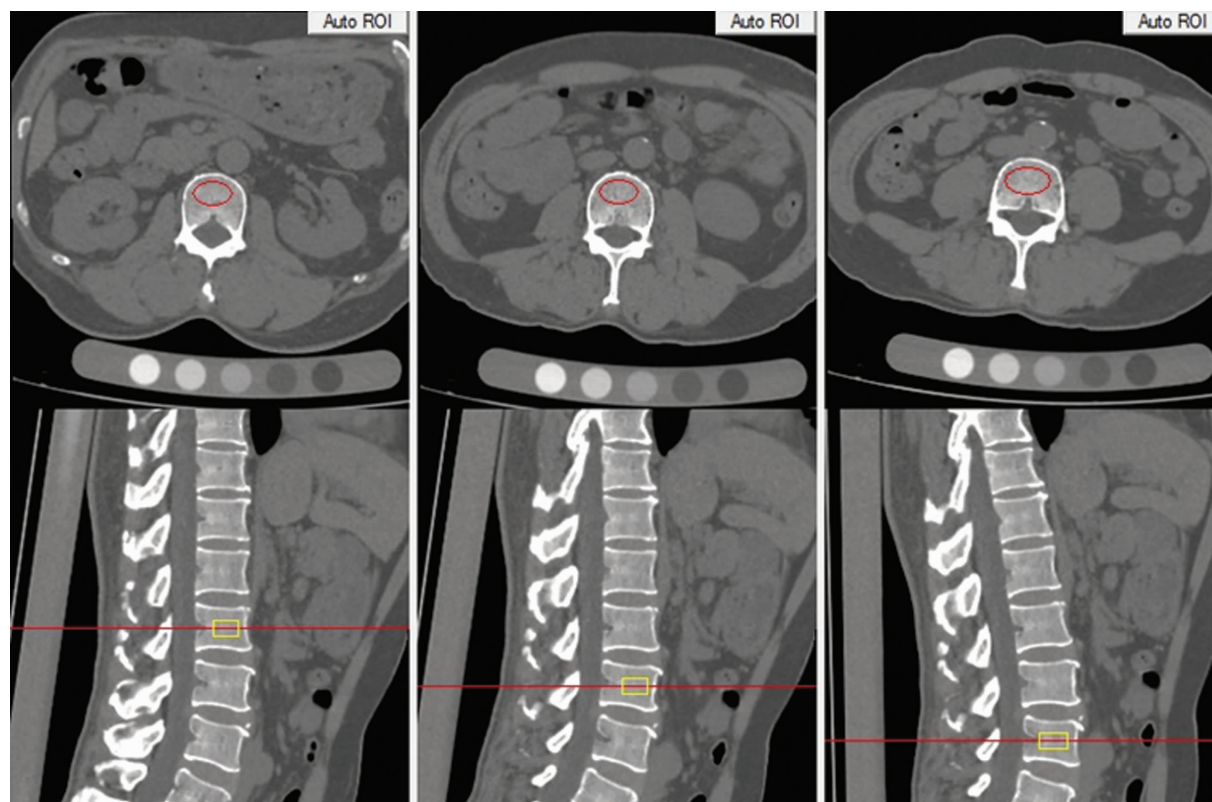


图1 定量CT骨密度分析软件测定L₂~L₄椎体松质骨体积骨密度

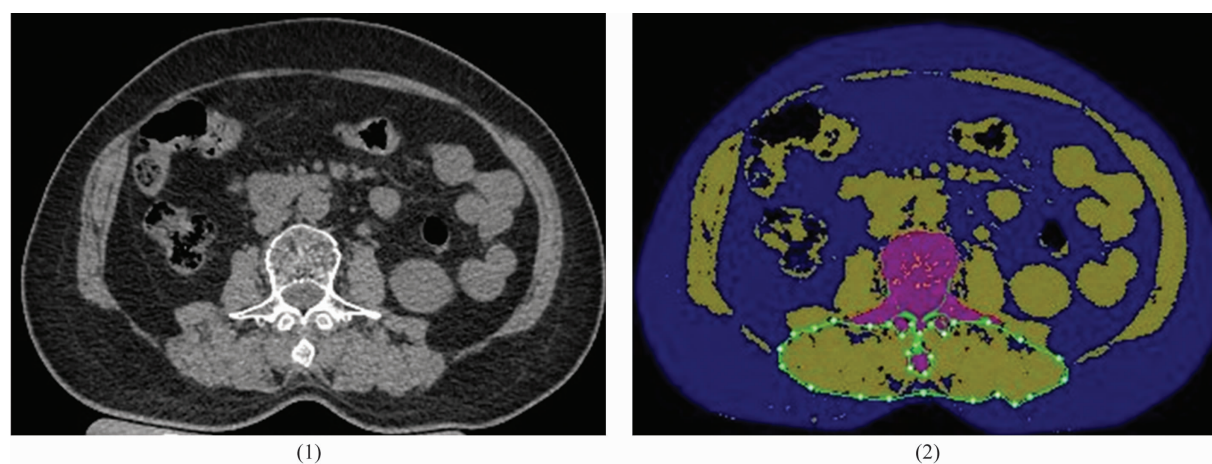


图2 定量CT骨密度分析软件测定腰椎椎后肌群肌肉脂肪浸润程度

(1)L₃椎体中部层面薄层轴位CT图像;(2)定量CT PRO软件手动圈定椎后肌群,蓝色区域代表脂肪组织,黄色区域代表肌肉组织

3 结果

中年组的腰椎骨密度、腰椎椎后肌群肌肉面积均高于老年组,腰椎椎后肌群脂肪面积、MFI均低于老年组;2组的体质指数比较,组间差异无统计学意义。见表1。

中年组、老年组及总体研究对象的腰椎骨密度均与年龄呈负相关($r = -0.552, P = 0.000$; $r = -0.599, P = 0.000$; $r = -0.690, P = 0.000$)。中年组腰椎骨密度与腰椎椎后肌群脂肪面积及MFI均呈负相关($r = -0.267, P = 0.037$; $r = -0.304, P = 0.017$),与

腰椎椎后肌群肌肉面积不存在直线相关关系($r = 0.081, P = 0.581$);老年组腰椎骨密度与腰椎椎后肌群脂肪面积及MFI均呈负相关($r = -0.331, P = 0.017$; $r = -0.371, P = 0.007$),与腰椎椎后肌群肌肉面积不存在直线相关关系($r = 0.235, P = 0.094$);总体研究对象的腰椎骨密度与腰椎椎后肌群脂肪面积及MFI均呈负相关($r = -0.191, P = 0.042$; $r = -0.214, P = 0.023$),与腰椎椎后肌群肌肉面积不存在直线相关关系($r = 0.132, P = 0.163$)。

由于中年组、老年组及总体研究对象的MFI均与

表 1 2 组研究对象的体质量指数、腰椎骨密度和腰椎椎后肌群肌肉脂肪面积 $\bar{x} \pm s$

组别	样本量 (例)	体质量指数 ($\text{kg} \cdot \text{m}^{-2}$)	腰椎骨密度 ($\text{mg} \cdot \text{cm}^{-3}$)	腰椎椎后肌群 肌肉面积(cm^2)	腰椎椎后肌群 脂肪面积(cm^2)	腰椎椎后肌群 肌肉脂肪浸润程度
中年组	62	23.96 ± 3.22	132.74 ± 35.74	40.68 ± 6.62	1.89 ± 0.99	$(4.48 \pm 2.11)\%$
老年组	53	24.08 ± 3.06	91.43 ± 28.40	38.01 ± 6.41	2.34 ± 1.45	$(5.85 \pm 3.44)\%$
<i>t</i> 值		-0.190	6.779	2.182	-1.997	-2.604
<i>P</i> 值		0.850	0.000	0.031	0.048	0.010

腰椎椎后肌群脂肪面积高度正相关($r = 0.962, P = 0.000; r = 0.939, P = 0.000; r = 0.947, P = 0.000$), 因而 MFI 不能进入回归模型分析。以腰椎骨密度为因变量, 以年龄、体质量指数、腰椎椎后肌群肌肉面积和脂肪面积作为自变量, 进行多元线性回归分析, 得到的回归方程分别为: 腰椎骨密度(中年组) = $379.695 - 3.929 \times \text{年龄} - 7.609 \times \text{腰椎椎后肌群脂肪面积}$, 腰椎骨密度(老年组) = $146.419 - 1.190 \times \text{年龄} - 6.350 \times \text{腰椎椎后肌群脂肪面积}$, 腰椎骨密度(总体研究对象) = $269.577 - 2.962 \times \text{年龄} - 5.307 \times \text{腰椎椎后肌群脂肪面积}$ 。

4 讨 论

骨骼、肌肉均从中胚层发育而来, 出生后二者协调发展, 在维持体位、完成运动、保护重要内脏器官及机体内环境稳态等方面发挥着重要作用。肌肉与骨骼不仅位置毗邻、功能相辅, 并受到神经、内分泌、免疫、力学刺激的系统性调节, 以及两者自分泌、旁分泌和机械力学的局部相互调节^[6]。中老年人骨骼肌肉系统的衰退会造成肌肉萎缩、骨质减少, 进而引起肌力减退、运动能力下降、骨质疏松性增大, 使骨折的风险增加^[6-8]。肌少症与骨质疏松症、骨折间密切相关, 甚至有学者提出肌少症与骨质疏松症可统称为“活动障碍综合征”^[9]。肌肉含量、强度及功能下降可显著增加骨质疏松风险, 也是引起跌倒及骨折的主要危险因素之一, 而骨强度下降也会明显增加肌少症患病率, 二者常伴随出现, 相互影响, 增加了老年人群的致残率及病死率^[10-11]。

骨质疏松症与肌少症均是与增龄相关的疾病^[6-7, 9, 11-12]。随着年龄增加, 骨量和骨骼肌均减少, 30 岁以后肌肉质量每十年减少 3% ~ 8%, 60 岁后肌肉减少的速度更快^[13]。本研究显示, 中年组、老年组及总体研究对象的腰椎骨密度均与年龄呈负相关, 且老年组腰椎骨密度低于中年组, 这与国内外以往的研究结果一致^[14-15], 即骨密度随年龄增大呈下降趋势。老年组椎旁肌群脂肪面积及 MFI 均大于中年组, 而中年组的椎旁肌群肌肉面积大于老年组, 提示随年龄增

大, 腰椎椎后肌群出现萎缩、脂肪浸润增加的趋势, 这也与以往研究结果类似^[16-17]。同时, 根据我们既往研究结果, 对于正常中老年女性腰椎椎后肌群的退变, 年龄与椎后肌群的脂肪含量呈正相关, 而与肌肉面积不存在直线相关关系^[18]。

在本研究中, 我们也观察到: 无论是中年组, 老年组, 还是对总体研究对象, 腰椎骨密度与椎后肌群脂肪面积及 MFI 均呈负相关, 而与肌肉面积不存在直线相关关系, 即腰椎椎后肌群脂肪含量对腰椎骨密度起负性作用, 脂肪浸润的增加可能是骨质疏松的一个重要危险因素, 这一结果与以往研究相符^[19-21]。这些研究肯定了腰椎椎旁肌量对于腰椎骨密度的正性促进作用。随着年龄增长, 肌肉间及肌束间脂肪细胞增多, 由于脂肪细胞释放细胞因子导致肌肉损伤, 脂肪细胞越多, 肌肉萎缩程度越显著, 肌肉力量下降也越明显, 而骨密度也随之降低。也有一些学者的观点与本研究结果不完全相同。如 Lee 等^[22]应用 MRI 测量绝经后女性腰椎椎旁肌肉面积及脂肪含量, 分析其与腰椎骨密度的关系, 结果显示椎旁肌群脂肪含量与腰椎、髋关节骨密度均呈负相关, 椎旁肌肉面积与腰椎骨密度呈正相关, 但与髋关节骨密度不存在直线相关关系; Kim 等^[23]应用类似方法研究绝经后女性腰椎骨折患者, 认为骨密度与椎旁肌肉脂肪浸润呈负相关, 而与椎旁肌肉面积呈正相关。究其原因, 上述研究采用双能 X 线吸收测定法测定骨密度, 其测量范围包含椎体皮质骨及附件结构, 测量结果易受椎体骨赘形成等因素的影响, 对年龄相关性骨量丢失的敏感度可能偏低; 另外, 其研究对象与本研究选取的社区人群不同, 均为绝经后女性, 并包含很多椎体骨折患者, 也可能对结果造成一定影响。但这些学者关于脂肪浸润对骨密度的负性作用的观点均与本研究结果一致。

影响骨密度、骨骼肌变化及其相互间关系的因素众多、机制复杂, 相关研究也一直未间断过。本研究采用定量 CT 进行评测, 在观察腰椎骨质及椎间盘退变的同时, 通过软件进行腰椎骨密度及椎旁肌群面积、脂肪含量等定量评估, 探讨它们之间的关系, 测量

方法简便,可重复性强,具有一定的实用性。但本研究也有一定局限性,首先是样本量偏低,可能对结果产生一定影响;其次,本研究仅对腰椎椎后肌群的单一层面进行了测量,对肌肉的萎缩减少及脂肪浸润情况只能进行初步观察和分析。因而本研究仅是初步研究,未来需要大样本量、多年龄段的研究,以及改进研究方法进一步加以验证。

综上所述,中老年女性腰椎椎后肌群脂肪含量的增加可能会导致腰椎骨密度的下降,是骨质疏松的重要危险因素。

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