

· 临床研究 ·

单侧症状腰椎间盘突出患者双侧多裂肌的病理生理改变

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【摘要】目的 通过影像学及电生理方法探讨单侧症状腰椎间盘突出患者双侧多裂肌的病理生理变化。**方法** 选取出现单侧症状的腰椎间盘突出患者 36 例,按患侧(主诉疼痛侧)与对侧不同,将数据分为患侧组和对侧组。采用磁共振成像(MRI)测量患者双侧多裂肌的脂肪化面积及总平均信号强度值,利用肌电图(EMG)检查患者双侧多裂肌等长收缩时的波幅和运动单位时限值。测量完成后,对数据进行分析处理。**结果** 36 例患者的双侧多裂肌均有不同程度的脂肪化,且患侧组多裂肌脂肪化横断面面积(CSA)百分比 $[(44.20 \pm 15.14)\%]$ 较对侧组 $[(37.31 \pm 13.85)\%]$ 高($P < 0.05$),患侧组的平均信号强度 (59.03 ± 12.73) 高于对侧组 (54.67 ± 12.20) ($P < 0.05$);患者双侧多裂肌 EMG 的波幅及运动单位时限均增高、增宽,且患侧组波幅 $[(861.67 \pm 171.32) \mu V]$ 及运动单位时限 $[(14.49 \pm 2.37) ms]$ 的变化较对侧组显著($P < 0.05$)。**结论** 单侧症状腰椎间盘突出患者双侧多裂肌的影像学及电生理指标均会发生改变,且患侧较为明显。

【关键词】 多裂肌; 单侧症状; 腰椎间盘突出; 磁共振影像; 肌电图

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【Abstract】 Objective To investigate pathophysiological changes in the multifidus muscles of patients with lumbar disc herniation. **Methods** Thirty-six patients with unilateral symptoms caused by lumbar disc herniation were enrolled. They were divided into a symptomatic side group and a contralateral side group according to whether their symptomatic (algetic) or contralateral side would be studied. The percentage area of pimeiosis and the mean gross signal intensity of each multifidus were measured with magnetic resonance imaging (MRI). The amplitude and duration of motor unit potentials of each multifidus were recorded using electromyography (EMG) when the patients were performing isometric contraction. **Results** The bilateral multifidus muscles of 36 patients displayed various degrees of pimeiosis on magnetic resonance images. The percentage of pimeiosis cross-sectional area in the symptomatic side group was significantly higher than in the contralateral side group. $[(44.20 \pm 15.14)\% \text{ versus } (37.31 \pm 13.85)\%, P < 0.05]$ The mean value of the gross signal intensity was also significantly higher. Both the amplitudes and duration of the motor unit potentials recorded from the multifidus had increased and widened, but significantly more in the symptomatic side group than in the contralateral side group. **Conclusions** Both the imaging and electrophysiological data showed more significant changes on the symptomatic side in patients with unilateral symptoms caused by lumbar disc herniation.

【Key words】 Multifidus; Unilateral symptoms; Lumbar disc herniation; Magnetic resonance imaging; Electromyography

慢性下背痛是仅次于上呼吸道感染的常见疾病之一,其终生流行率高达 60% ~ 90%,年流行率约 15% ~ 45%^[1]。目前,慢性下背痛已成为导致功能障碍、致残误工、增加社会经济负担和影响人类生活

质量的重要原因之一^[2]。既往研究发现^[3],下背痛患者中普遍存在腰部肌肉变性,表现为肌肉萎缩,脂肪沉积增加,严重影响患者脊柱的稳定性,损害脊椎健康,并可能导致下背痛程度进一步加重^[3-4]。因此,开展对下背痛患者的腰部肌肉形态学研究显得十分重要。有研究指出^[5-7],下背痛患者腰部肌肉发生脂肪浸润退变,正常肌纤维被无收缩性组织取代,这种变化可能是导致患者下背痛反复发作的病理生理机制之一,并证实了椎旁肌(尤其是多裂肌)的萎缩变性与下背痛相关。Kamaz 等^[8]发现下背痛患者

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通常伴有腰大肌横断面面积 (cross-sectional area, CSA) 下降。基于上述研究背景,本研究选取单侧症状的腰椎间盘突出患者为研究对象,运用影像学、电生理学等方法对其双侧多裂肌的变化进行研究分析,探讨其病理生理机制,旨在为临床上采用多裂肌训练法治疗慢性腰腿痛提供理论依据。

资料与方法

一、研究对象

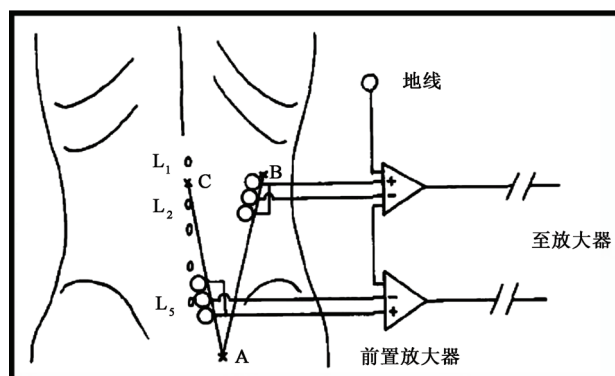
根据就诊时间先后顺序,随机选取 2010 年 7 月至 2011 年 6 月间经我院确诊的单侧症状腰椎间盘突出患者 36 例,所有患者均符合 2007 年第 3 版《实用骨科学》中关于腰椎间盘突出症的诊断标准^[9],经磁共振检查 (magnetic resonance imaging, MRI) 证实为 L_{4/5} 或 L₅-S₁ 椎间盘突出,并表现为单侧 (左侧或右侧) 腰腿痛。排除标准:①脊柱感染、原发性或转移性脊柱肿瘤、脊柱先天发育畸形、急性脊柱骨折创伤、神经源性或肌源性疾病患者;②有腰腹部手术史患者;③不配合研究者。本研究程序符合医院医学伦理委员会的伦理学标准,所有入选患者均签署知情同意书。入选患者中,男 18 例,女 18 例;年龄 (47.56 ± 10.54) 岁,最大 65 岁,最小 23 岁;病程 (15.69 ± 12.40) 月,最长 5 年,最短 6 个月;临床症状表现为单侧腰腿痛,其中左侧痛 19 例,右侧痛 17 例;采用罗兰多-莫里斯腰背痛/腿痛生活障碍问卷调查表 (Roland-Morris disability questionnaire, RMDQ)^[10] 评估疼痛程度,平均 (16.67 ± 4.87) 分,最高 23 分,最低 11 分。根据患者主诉,按患侧 (主诉疼痛侧) 与对侧不同,将数据分为患侧组和对侧组 2 组。

二、研究方法

1. MRI 测量:采用美国产 GE Signa CV/I 型 1.5T 核磁共振成像仪,行腰椎矢状面 T₁WI、T₂WI 及横断面 T₂WI 扫描。腰椎矢状面和横断面 T₂WI 扫描参数如下:TR 3000 ms, TE 100 ms,层厚 4 mm,层间隔 1 mm,矩阵 320 × 256,激励次数 3,可变带宽 31.2 kHz,矢状面视野 28 cm × 28 cm,横断面视野 20 cm × 20 cm。腰椎矢状面 T₁WI 扫描的参数如下:TR 560 ms, TE 12 ms,层厚 4 mm,层间隔 1 mm,矩阵 320 × 256,激励次数 3,可变带宽 15.6 KHz,矢状面视野 28 cm × 28 cm,横断面视野 28 cm × 28 cm。

2. 肌电图 (Electromyography, EMG) 测量:采用丹麦产 Keypoint 肌电诱发电位仪对患者 EMG 的波幅及运动单位时限进行测量。患者取俯卧位,充分暴露脊柱及探查区域,彻底放松腰背部肌肉,由专业操作者消毒穿刺部位皮肤,将 37.00 mm × 0.46 mm 的针电极分别插入双侧多裂肌,嘱其以单次最大力量做等长收缩,

维持 2 s,观察采集到的肌电信号图。进针点定位方法:测量右侧多裂肌肌电信号时,进针点为右髂后上棘和 L_{1/2} 棘突连线中点形成的直线与病变椎间盘右侧水平线的相交点,测量左侧时,进针点则为左髂后上棘与 L_{1/2} 棘突连线中点形成的直线与病变椎间盘左侧水平线的相交点,相应节段右侧多裂肌和髂肋肌的电极安放位置^[11] 详见图 1。接地电极安放位置与进针点相距 10 cm 以上,参数设置:波幅 200 μV,运动单位时限 10 ms。



注:A 为右髂后上棘,B 为平第 12 肋右侧髂肋肌外侧缘,C 为 L_{1/2} 棘突连线中点

图 1 相应节段右侧多裂肌和髂肋肌的电极位置示意图

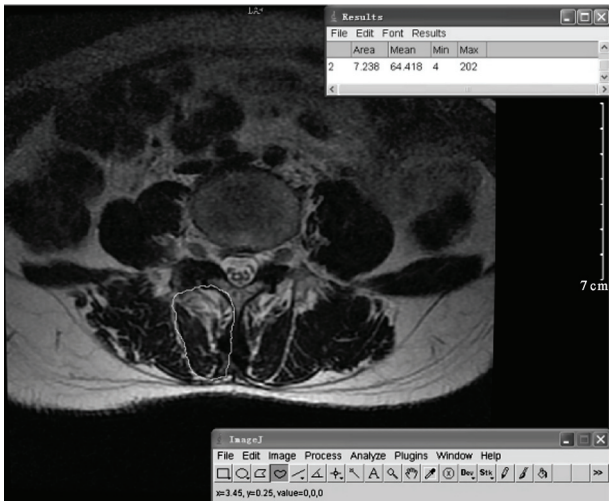
三、数据测量

1. 多裂肌脂肪化面积及平均信号强度:采用 Image J 软件,测量入选患者病变椎间盘横断面上双侧多裂肌的总面积及脂肪化面积,记录双侧多裂肌各自的总平均信号强度数值,详见图 2、图 3。单侧多裂肌脂肪化 CSA 占同侧多裂肌的百分比 = (单侧多裂肌脂肪化 CSA / 同侧多裂肌总面积) × 100%。



注:图中采用实线勾勒的面积即该患者右侧多裂肌的脂肪化区域

图 2 右侧多裂肌脂肪化区域 MRI 图像



注:图中采用实线勾勒的面积即该患者右侧多裂肌的总面积

图3 右侧多裂肌的 MRI 图像

2. EMG 波幅及运动单位时限:在患者肌肉完全放松的状态下,由专业操作人员按上述进针点位置将针电极插入一侧多裂肌后,嘱其以单次最大力量做等长收缩,维持 2 s,观察采集到的肌电信号图,分别记录其波幅及运动单位时限值,取平均值,对侧测量采用相同步骤,详见图 4。

四、统计学分析

采用 SPSS 16.0 版统计学软件对数据进行处理,所有数据均以 $(\bar{x} \pm s)$ 形式表示,患侧与对侧多裂肌的脂肪化面积、平均信号强度、等长收缩时 EMG 的信号变化等数据比较采用配对 t 检验,以 $P < 0.05$ 表示差异有统计学意义。

结 果

一、患者双侧多裂肌的 MRI 表现

通过 MRI 可看出,36 例患者的双侧多裂肌均有不

同程度的脂肪化,且患侧组多裂肌脂肪化程度较对侧组更严重,差异具有统计学意义($P < 0.05$);双侧多裂肌的平均信号强度均有不同程度增高,且患侧组较对侧组更为明显,差异有统计学意义($P < 0.05$)。详见表 1。

表 1 患者双侧多裂肌 MRI 脂肪化 CSA 百分比及平均信号强度比较 $(\bar{x} \pm s)$

组别	例数	脂肪化 CSA 百分比 (%)	平均信号强度
患侧组	36	44.20 $\pm$ 15.14 ^a	59.03 $\pm$ 12.73 ^a
对侧组	36	37.31 $\pm$ 13.85	54.67 $\pm$ 12.20

注:与对侧组比较,^a $P < 0.05$

二、患者双侧多裂肌的 EMG 表现

36 例患者双侧多裂肌的波幅及运动单位时限均有不同程度的增高、增宽,且患侧组波幅及运动单位时限的变化较对侧组显著,差异有统计学意义($P < 0.05$)。详见表 2。

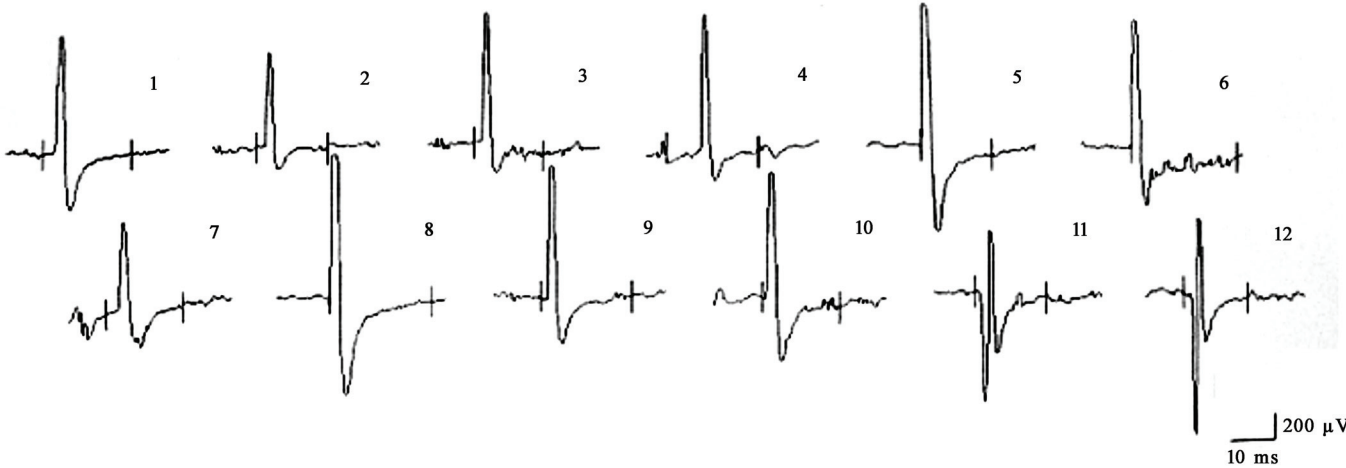
表 2 患者双侧多裂肌 EMG 波幅及运动单位时限比较 $(\bar{x} \pm s)$

组别	例数	波幅(μV)	运动单位时限(ms)
患侧组	36	861.67 $\pm$ 171.32 ^a	14.49 $\pm$ 2.37 ^a
对侧组	36	786.31 $\pm$ 128.38	13.58 $\pm$ 2.25

注:与对侧组比较,^a $P < 0.05$

讨 论

腰背肌劳损是导致下背痛的一个不可忽视的重要因素。在前屈或拾起重物等活动时,腰背肌需要产生一定的力量来对抗躯体上身所受重力的影响^[12],所以当脊柱受到损伤时,肌肉往往先于其它椎旁结构而出现病理生理变化。多裂肌是椎旁的重要肌群,Kamaz 等^[8]应用 CT 扫描证实慢性下背痛可导致包括多裂肌、腰方肌、腰大肌等在内的椎旁肌出现不同程度的萎缩,



注:图中所示为本研究中 1 例患者左侧多裂肌的 EMG 图像,波幅为 $(1271.00 \pm 162.50) \mu V$,运动单位时限为 $(17.30 \pm 1.95) ms$

图4 本研究中 1 例患者左侧多裂肌的 EMG 图像

其中以多裂肌最为严重。已有研究也证明^[13-14], 骨骼肌在失神经支配状态下, 相应肌肉可出现快速萎缩和脂肪化, 且多裂肌在椎间盘源性损伤中出现 CSA 缩小现象。

本研究采用 MRI 对患者的多裂肌进行脂肪化及萎缩程度测定, 发现所有患者双侧多裂肌均存在不同程度的脂肪化与萎缩, 这一病变会导致多裂肌的肌肉预激活延迟和协调控制功能障碍, 继而影响腰椎的稳定性, 与复发性腰痛的发生演变过程密切相关^[15]。从 MRI 图像上可看出肌萎缩以双侧为主, 而临床工作中, 患者疼痛的范围却多以单侧为主, Larivière 等^[16]认为这一现象可能与神经肌肉的激活模式发生变化所致。与疼痛对侧比较, 结果提示患者多裂肌萎缩和脂肪化程度较对侧更为明显 ($P < 0.05$), 有研究认为这种现象不应归结为肌肉废用性萎缩, 因其发生迅速且部位集中, 推测可能是出现症状一侧肌肉的痉挛程度较对侧严重, 导致疼痛侧的肌肉血运受到影响, 使局部肌肉新陈代谢的速度减慢, 继而出现萎缩^[17]。

对所有入选患者进行 EMG 检查后, 发现所有患者的双侧多裂肌在等长收缩时, 波幅和运动单位时限均出现不同程度的增高与增宽, 提示下背痛患者的多裂肌功能减退, 稳定肌的预先激活被延迟或协同收缩能力下降丧失^[18]。前馈活动缺乏, 导致肌肉稳定脊柱的作用力不能充分发挥, 使脊柱的稳定性受到影响^[19]。有症状一侧多裂肌的肌电波幅较对侧肌更高、运动单位电位时限较对侧肌更宽 ($P < 0.05$), 原因可能为多裂肌肌力下降, 产生收缩时, 该侧肌纤维募集率下降, 短肌纤维比长纤维的启动时间晚^[20], 导致机体需要调动更多的肌纤维、花费更长的时间来促使动作发生, 这一变化为复发性腰痛的发生机制提供了有力证据。

解剖学和生物力学的相关研究已证实了脊柱的节段性运动有多裂肌参与, 其中深部多裂肌在神经系统中可控制椎间剪力和扭转动作, 使其不产生力矩, 且这一过程不需要依靠拮抗肌的共收缩作用, 不具有运动方向的特异性^[21]。深层多裂肌和浅层多裂肌分别通过椎间精细控制和对抗屈曲扭矩来维持脊柱的定向力, 两者不同的控制方式为临床上制订具有针对性的多裂肌康复训练策略提供了理论基础。本研究认为, 依据多裂肌的病理生理变化, 可制订相应的训练计划, 尤其是针对患侧多裂肌的肌力训练, 以改善慢性腰痛患者的腰椎稳定性, 提高复发性腰痛患者的治愈率, 预防复发。尽管目前较多研究均认为多裂肌变化与椎间盘突出间可能存在互为因果的关系, 但在实际临床工作中, 患有慢性腰痛的患者多裂肌功能存

在不同程度的减退, 表明多裂肌在维持腰椎稳定性中的作用十分重要, 在今后的研究工作中, 应适当关注这一点, 为采用多裂肌训练方法治疗慢性腰腿痛提供理论依据。

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Pulsed electromagnetic field for early osteoarthritis

BACKGROUND AND OBJECTIVE Osteoarthritis (OA) is a common and growing diagnosis encountered by physicians. Pulsed electromagnetic fields (PEMFs) are known to modulate the calmodulin (CaM) dependent nitric oxide (NO)/cyclic guanosine monophosphate (cGMP) signaling pathway, impacting pain in patients with OA. This study was designed to determine whether PEMF, configured to modulate the CaM/NO/cGMP signaling pathway, can reduce pain among patients with early knee OA.

METHODS This double-blind, placebo-controlled, randomized trial included 34 patients with knee OA and an initial visual analogue scale (VAS) pain score of at least four on a 10 cm scale. Those randomized to the treatment group received a PEMF signal, consisting of a 7 ms burst of 6.8 MHz sinusoidal waves, repeating at 1 burst/s, and delivering a peak induced electric field of 34 ± 8 V/m in the knee for 15 minutes twice daily. Those in the control group were treated with sham devices. The patients were asked to self-report maximum daily VAS pain scores at baseline, and then daily for the first 14 days and then from days 29 to 42.

RESULTS No adverse effects were reported. The treatment group realized a 50% decrease in the mean maximum VAS, starting on day one and persisting to day 42 ($P < 0.001$). The overall decreases in VAS scores from baseline were 2.7 ($P < 0.001$) for the active group and 1.5 ($P = 0.168$) for the sham group. The difference between groups was significant at days three, 14, 29 and 42 ($P = 0.036-0.008$).

CONCLUSION This randomized, placebo-controlled trial of patients with early osteoarthritis of the knee found that a pulsed electromagnetic field, applied 15 minutes twice per day, significantly reduced pain.

【摘自: Nelson F, Zvirbulis R, Pilla AA. Noninvasive electromagnetic field therapy produces rapid and substantial pain reduction in early knee osteoarthritis: A randomized, double-blind, pilot study. Rheumatol Intern, 2013, 33: 2169-2173.】

Ayurvedic medicine for knee osteoarthritis

BACKGROUND AND OBJECTIVE The ancient Ayurvedic medicine system is a 5,000-year-old system of natural healing whose origins lie in the Vedic culture of India. Among the target conditions this system is thought to improve is osteoarthritis (OA). This study compared the effect of two anti-arthritis Ayurvedic formulas, SGC (Zingiber officinale, Tinospora cordifolia, Phyllanthus emblica) and SGCG (Zingiber officinale, Tinospora cordifolia, Phyllanthus emblica and B. serrata) with two standard Western medications.

METHODS Subjects were patients aged 40 to 70 years of age, diagnosed with knee OA. All had pain valued at least four on a 10 cm visual analogue scale (VAS). The subjects were randomized to receive one of four treatments, glucosamine sulfate, 2 g daily, celecoxib, 200 mg daily, SGCG, 400 mg daily or SGC, 400 mg daily. The patients were evaluated at baseline and at two and four weeks, and then monthly until study completion at six months. Outcome measures included VAS pain scores, WOMAC pain scores and function difficulty scores. Laboratory tests included CBC, lipid profile, kidney and liver function tests and urinalysis.

RESULTS From baseline to study completion at six months, significant improvement was noted in all treatment groups in pain VAS and WOMAC scores, with no significant difference between groups. Seven patients in the Ayurvedic group were withdrawn due to a threefold rise in the upper limit of normal in one liver enzyme (SGPT).

CONCLUSION This study of patients with symptomatic knee osteoarthritis found that the Ayurvedic formulations, SGCG and SGC, are equivalent to glucosamine and celecoxib in reducing pain and improving function.

【摘自: Chopra A, Saluja M, Tillu G, et al. Ayurvedic medicine offers a good alternative to glucosamine and celecoxib in the treatment of symptomatic knee osteoarthritis: A randomized, double-blind, controlled equivalence drug trial. Rheumatology, 2013, 52: 1408-1417.】