

腰椎 Modic 改变的发生机制和治疗进展

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摘要 腰椎 Modic 改变是引起腰背部疼痛的原因之一, 但是目前腰椎 Modic 改变的具体发生机制尚未完全明确, 且尚无最佳治疗方法。本文从腰椎 Modic 改变的分型、发生机制、临床意义、治疗方法 4 个方面, 对腰椎 Modic 改变的发生机制和治疗进展进行了综述。

关键词 腰椎; Modic 改变; 磁共振成像; 综述

椎体终板由骨性终板和软骨终板构成, 其中骨性终板由椎体上下面的骨骺板骨化而成, 且呈轻度凹陷状, 而软骨终板则是由椎体终板的中央薄层透明软骨构成。Modic 改变又称椎体终板信号改变, 即 MRI 上椎体终板及终板下骨质的异常影像学变化。有研究^[1-4]发现, 腰椎 Modic 改变是引起腰背部疼痛的原因之一, 因此深入研究腰椎 Modic 改变的发生机制可为腰背部疼痛的治疗提供参考。现就腰椎 Modic 改变的发生机制和治疗进展综述如下。

1 腰椎 Modic 改变的分型

目前腰椎 Modic 改变的分型仍沿用 1988 年 Modic 提出的分型原则, 即根据腰椎 MRI 的影像特征分为 3 种类型。I 型: MRI 上 T1WI 呈低信号, T2WI 呈高信号, 提示椎体终板炎性改变或水肿; II 型: MRI 上 T1WI 和 T2WI 均呈高信号, 提示椎体红骨髓向黄骨髓转化; III 型: MRI 上 T1WI 和 T2WI 均呈低信号, 提示椎体终板硬化。

2 腰椎 Modic 改变的发生机制

2.1 机械应力异常 一般情况下, 腰椎 Modic 改变的发生与椎体损伤有关。行椎间盘切除术后, 椎体的生物力学结构也相应改变, 这可能促进腰椎 Modic 改变的发生^[5]。Han 等^[6]研究发现, 腰椎 Modic 改变与肥胖和高强度的体力劳动有关。肥胖会使椎体终板长期处于高负荷状态, 而高强度的体力劳动也会增加作用于椎体终板的剪切力, 一旦椎体终板的负荷超过阈值, 可能会导致椎体终板和骨小梁损伤^[7]。腰椎 Modic 改变多见于 L₄ ~ L₅ 或 L₅S₁ 节段^[8], 而 L₄ ~ L₅

和 L₅S₁ 节段是全身承受应力最大的部位^[9], 这提示持续、过载及不平衡作用于椎体终板的机械应力会引起椎体终板的损伤, 从而导致腰椎 Modic 改变。

2.2 炎症反应 从椎体终板损伤到腰椎 Modic 改变形成这一过程, 也是复杂的炎症反应过程。Moon 等^[10]研究发现, 在 Modic 改变的椎体中有肿瘤坏死因子 (tumor necrosis factor, TNF) - α 的存在。TNF - α 属于促炎细胞因子^[11], 在有 Modic 改变的椎体中发现 TNF - α , 提示该椎体内曾发生过炎症反应。Rajasekaran 等^[12]对有 Modic 改变者和无 Modic 改变者的椎间盘进行了蛋白质组学研究, 在 Modic 改变组中发现 TNF - α 会通过上调关节软骨细胞和滑膜成纤维细胞中软骨酸性蛋白 1 的表达引起炎症反应或软骨破坏。Walter 等^[13]研究发现, TNF - α 可以刺激髓核产生白细胞介素 (interleukin, IL) - 1 β 、IL - 6 和 IL - 8 等促炎细胞因子, 而这些促炎细胞因子又会使 TNF - α 含量增加, 最终形成恶性循环。椎体终板损伤后, 大量促炎物质的释放可使 TNF - α 含量增加, 加剧软骨终板的破坏, 最终导致腰椎 Modic 改变的发生。

2.3 细菌感染 Stirling 等^[14]最先报道, 在腰痛患者的椎间盘内发现细菌的存在。Yuan 等^[15-17]研究发现, 腰椎 Modic 改变者的椎间盘内存在痤疮丙酸杆菌。Aghazadeh 等^[17]对行椎间盘切除术的腰椎间盘突出症患者进行了相关研究, 发现多数有腰椎 Modic 改变的样本组织内存在痤疮丙酸杆菌, 认为腰椎 Modic 改变与痤疮丙酸杆菌有关。痤疮丙酸杆菌是一种厌氧菌, 而椎间盘内的环境相对无氧, 因此适合痤疮丙酸杆菌的生长。然而部分学者^[18-19]对细菌感染

与腰椎 Modic 改变有关持相反意见。Ahmed - Yahia 等^[18]对不同手术入路的腰痛患者进行了相关研究,发现前侧入路组的椎体细菌阳性检出率低于后侧入路组,然而椎体细菌阳性检出率在有或无腰椎 Modic 改变的患者之间没有差异,由此认为后侧入路手术更易引起污染,从而出现阳性结果。Rajasekaran 等^[12]在有腰椎 Modic 改变者的椎间盘内发现,宿主防御蛋白、半乳糖凝集素 - 8、人源重组蛋白 P01 均呈特异性表达,同时还发现了泛素介导的蛋白质降解过程。由于半乳糖凝集素 - 8 和人源重组蛋白 P01 是与革兰氏阳性菌及阴性菌有关的抗菌蛋白^[20],泛素系统可能参与细菌感染过程^[21],宿主防御蛋白与细菌感染引起的炎症反应有关^[22],在有 Modic 改变的腰椎组织内发现这些物质,提示该处曾发生细菌感染。Djuric 等^[23]研究发现,免疫失调可能为腰椎 Modic 改变组织被细菌感染创造了条件。

2.4 遗传变异 Karppinen 等^[24]研究发现,IL - 1 基因簇和基质金属蛋白酶 - 3 基因的遗传变异与腰椎 Modic 改变 II 型有关,且这种相关性是多基因共同作用的结果,而单个基因的遗传变异与腰椎 Modic 改变无关。Kanna 等^[25]研究发现,IL - 1 基因簇的遗传变异与腰椎 Modic 改变无关,而维生素 D 受体基因和基质金属蛋白酶 - 20 基因的遗传变异与腰椎 Modic 改变有关。虽然腰椎 Modic 改变具有遗传性已被证实^[26],但遗传变异在腰椎 Modic 改变中的具体作用机制尚不明确。

3 腰椎 Modic 改变的临床意义

3.1 腰椎 Modic 改变对椎间盘和椎体的影响 腰椎 Modic 改变可影响椎间盘的退变程度。Xiao 等^[27-28]研究发现,腰椎 Modic 改变者的椎间盘退变程度较无腰椎 Modic 改变者的严重,并且 Modic 改变面积与椎间盘退变程度呈正相关,因此认为 Modic 改变可作为椎间盘退变程度的评价指标。此外,Hayashi 等^[28-30]研究发现,有 Modic 改变的椎体更容易移位,可造成腰椎侧凸或椎间盘突出症复发,原因可能是有 Modic 改变的椎体终板与椎体连接处相对薄弱。发生 Modic 改变的椎体软骨终板较为薄弱,其受损后软骨终板碎片可进入突出的椎间盘组织,影响椎间盘边缘新生血管形成及巨噬细胞浸润,不利于突出的椎间盘组织重吸收^[31]。

3.2 腰椎 Modic 改变对腰椎手术效果的影响 腰椎 Modic 改变可能影响腰椎手术效果。Hao 等^[32]研究

发现,行内镜下腰椎间盘突出术的患者中,有腰椎 Modic 改变者的术后腰椎间盘突出症复发率较高。Kumarasamy 等^[33]研究发现,行显微镜下腰椎间盘突出术的患者中,有 Modic 改变者的术后椎间盘炎发病率高于无 Modic 改变者,且术后 1 年时有 Modic 改变者的腰部疼痛及运动功能恢复情况均较差。Pradip 等^[34]研究发现,腰椎 Modic 改变是腰椎术后感染的独立危险因素。王牧一等^[35]研究发现,腰椎 Modic 改变可增加腰椎融合术后融合器下沉的风险。Takahashi 等^[36-37]研究发现,腰椎 Modic 改变不仅会影响术后腰椎功能恢复,甚至会加重术后相关症状。我们认为,临床可将腰椎 Modic 改变纳入与手术相关的评估标准中,全面评估手术风险,制定合理的手术方案,从而促进患者早期康复。

3.3 腰椎 Modic 改变对腰背部疼痛程度的影响 对腰痛患者而言,腰椎 Modic 改变是一个不良信号,可能意味着更严重的临床症状。Mera 等^[38-39]研究发现, I 型和 II 型腰椎 Modic 改变与腰背部疼痛程度有关。Chen 等^[40]研究发现,腰痛患者中腰椎 Modic 改变 II 型者最为多见、III 型者最为少见。Hanimoglu 等^[41]研究发现,腰椎 Modic 改变 I 型者的椎体 Modic 改变面积与腰椎功能障碍指数呈正相关关系。这一结果有助于判断腰椎 Modic 改变 I 型者的腰椎功能障碍严重程度。Jensen 等^[42]研究发现,有腰椎 Modic 改变的腰痛患者,其腰痛持续时间长于无腰椎 Modic 改变者。Tian 等^[43]研究发现,经皮腰椎间盘切除术联合经皮骨水泥成形术是治疗伴腰椎 Modic 改变 I 型的腰椎间盘突出症的有效方法。我们认为,对于有腰椎 Modic 改变的腰痛患者应早期进行针对性治疗,从而达到改善预后的目的。

4 腰椎 Modic 改变的治疗方法

4.1 非手术治疗

4.1.1 药物治疗 Gjeften 等^[44]研究发现,英利昔单抗可用于治疗腰椎 Modic 改变。英利昔单抗是一种单克隆抗体,其可以通过抑制 TNF - α 的表达减轻炎症反应,临床常用于治疗慢性腰背部疼痛^[45-47]。Albert 等^[48-49]研究发现,采用抗生素治疗伴 I 型腰椎 Modic 改变的腰背部疼痛,可以获得良好效果。引起腰椎 Modic 改变的原因较多,并非所有存在 Modic 改变者的椎间盘内均有感染发生,因此应注意合理应用抗生素。Cao 等^[50-51]研究发现,椎间盘内注射类固

醇类药物治疗伴腰椎 Modic 改变的椎间盘源性腰痛, 可以显著改善患者的腰背部疼痛症状, 且能减小 Modic 改变面积。Cai 等^[52]研究发现, 唑来膦酸治疗伴腰椎 Modic 改变的腰痛效果良好, 但失眠、抑郁等不良反应的发生率较高, 临床应谨慎应用。

4.1.2 针灸和推拿治疗 袁仕国等^[53]研究发现, 推拿治疗伴 I 型腰椎 Modic 改变的慢性非特异性腰痛效果显著。推拿疗法是治疗腰背部疼痛的常用方法, 其作用机制可能是通过抑制 TNF- α 和 IL-6 的表达减轻炎症反应^[54-56]。针灸疗法也是治疗腰背部疼痛的常用方法, 其作用机制可能与减轻炎症反应、调控神经-免疫-内分泌系统有关^[57-60]。我们认为, 临床可采用针灸和推拿治疗腰椎 Modic 改变, 通过减轻局部炎症反应减少椎体终板破坏, 从而延缓或控制 Modic 改变的进一步发展。

4.2 手术治疗 腰椎 Modic 改变非手术治疗无效时可采用手术方法治疗。Sairyo 等^[61]报道, 椎间孔镜下椎间盘切除术治疗 I 型腰椎 Modic 改变引起的慢性腰痛效果良好。对于腰椎 Modic 改变引起的慢性腰背部疼痛患者, 可采用窦椎神经射频消融术治疗, 能够有效减轻腰背部疼痛症状^[62-63]。

5 小 结

目前, 腰椎 Modic 改变的具体发生机制尚未完全明确, 也无针对腰椎 Modic 改变的统一治疗方法。我们认为, 未来进行与腰椎 Modic 改变有关的研究时, 可从感染条件和感染标志物两个方面进行深入探讨, 这对提高腰椎 Modic 改变的疗效具有积极意义。此外, 有关英利昔单抗、针灸和推拿治疗腰椎 Modic 改变的疗效, 未来还需开展更多的高质量研究予以证实。

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(收稿日期:2022-05-07 本文编辑:时红磊)

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(收稿日期:2022-04-07 本文编辑:郭毅曼)