肌肉衰减症发病机制研究进展及其对临床诊断的指导意义

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摘要 社会快速老龄化过程中, 肌肉衰减症(sarcopenia)现患率呈现明显增高趋势, 已成为威胁全民健康、降低生活质量和消耗医疗资源的重大公共健康问题和社会经济问题。欧洲(EWGSOP)和亚洲(AWGS)肌肉衰减症工作组对其诊断路径和标准进行了多次修订, 在最新指南中将肌肉力量作为诊断可能肌肉衰减症的重要指标。肌肉衰减症发病机制尚不明确, 影响了精准化防治策略的制定和实施。目前认为, 老龄化过程中肠道微生态环境变化是导致肌肉衰减的重要基础; 而静态活动方式和高脂肪膳食可致慢性炎症环境和胰岛素抵抗, 成为肌肉衰减症发生发展的中心环节。本文检索了国内外关于肌肉衰减症的最新流行病学和机制研究, 分析导致肌肉衰减症发生的分子基础及目前对于肌肉衰减症筛查、评估和诊断的标准化流程, 以期为制定精准化防治策略提供参考。

关键词 肌肉衰减症, 老龄化, 脂肪浸润, 炎症, 胰岛素抵抗, 肠道菌群

在老龄化进程中, 人体成分发生重要变化: 一方面肌肉质量和力量逐渐丧失, 伴活动能力下降, 即肌肉衰减症(sarcopenia); 另一方面骨骼肌质量下降同时伴脂肪质量增加, 即肌肉衰减型肥胖(sarcopenic obesity, SO)^[1]。肌肉衰减症是年龄相关的进行性和广泛性肌肉质量及力量下降, 并导致衰弱、跌倒、残疾、生活质量下降和死亡风险增高等不良结局^[2]。2016年, 肌肉衰减症被正式确认为肌肉相关性疾病, 国际疾病分类标准编码[ICD-10]赋予诊断代码ICD-10-MC (M62.84)^[3]。肌肉衰减型肥胖是同时发生肌肉衰减和体脂肪增加, 其定义尚未明确, 部分原因是由于两种疾病状态各自存在多种诊断标准^[4]。增龄性肌肉丢失主要表现在I型及II型肌

纤维变小、萎缩, 肌纤维数量逐渐减少, 肌肉组织间有脂肪和纤维组织浸润, 使肌肉功能降低^[5]。每年因肌肉衰减症所致各种疾病造成经济损失超过180亿美元; 外科住院患者核心肌肉质量每下降1000 mm³, 需增加医疗成本10110美元^[6]。因此, 肌肉衰减症不仅是一个医学问题, 它实际已成为一个潜在的社会经济问题。

肌肉衰减症发病机制尚不明确, 炎症、免疫抑制、合成代谢抵抗和氧化应激程度增加与肌肉衰减症的发生相关, 其中静态行为方式及老龄化过程中出现的“食欲降低性厌食症”导致的蛋白质-能量营养不良加速了肌肉衰减^[7]。越来越多的研究认识到脂肪浸润或肌间脂肪组织对老龄化肌肉功能丧失的重要性, 并

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指出这一新的重要因素与缺乏体力活动密切相关^[8]。老龄化过程中,除骨骼肌出现丢失和功能下降,平滑肌和肠道的功能逐渐出现功能的退化,特别是肠道菌群通过组成的变化降低了肠屏障紧密连接,增加了肠屏障的通透性,导致各种有害代谢产物进入循环的概率增加^[9]。这些变化导致骨骼肌的代谢和收缩特性受损,从而降低老年人的身体机能,最终损害功能独立性和生活质量^[10]。因此,从分子层面明确肌肉衰减症发病机制,为制定干预措施提供理论基础,改善老年群体临床结局,提高生存质量,仍是目前临床营养学的热点课题之一。

1 肌肉衰减症发病机制的研究进展

1.1 老龄化过程肠道菌群改变导致了骨骼肌功能的衰退

老龄化过程中,肠道菌群生物多样性下降,变形菌门肠杆菌科水平增加,双歧杆菌、产丁酸盐菌和乳酸杆菌丰度下降^[11],内毒素(LPS)和硫酸吡啶酯水平上升^[12],导致肠屏障紧密连接降低^[13],肠屏障通透性增加,由此可导致肠内有害代谢产物进入体循环并诱导促炎信号通路活化并致肌肉衰减^[10]。

肠道菌群可通过不同形式影响骨骼肌代谢功能。肥胖猪肠道菌群转移至无菌小鼠体内发现,无菌小鼠复制了原宿主的肌细胞表型,此表型与老化骨骼肌的表型相似(即快速纤维萎缩伴随着快速至慢速纤维类型的变化),表明肠道菌群可转换肌纤维的类型^[14]。高脂膳食喂养小鼠致肠道通透性增加,宿主循环中LPS水平升高,诱导促炎因子释放(IL-1, IL-6和TNF- α),抑制肌肉蛋白合成,刺激蛋白质降解和凋亡,最终导致负氮平衡^[15]。LPS激活骨骼肌中NF- κ B和JNK磷酸化,下调胰岛素信号,诱导促炎因子释放,血糖耐受性受损^[16]。老龄化过程中,色氨酸衍生物硫酸吡啶酯水平增高,诱导促炎因子(IL-6和TNF- α)和肌肉降解标志物(myostatin和atrogin-1)表达^[17],并上调糖酵解和激活磷酸戊糖途径^[18]。双歧杆菌作为丁酸盐的主要来源,在肠道肌肉轴之间发挥重要的抗炎和促合成代谢作用^[19]。口服益生菌(罗伊氏乳杆菌和加氏乳酸杆菌)可降低恶液质小鼠体内炎症因子水平(IL-6和MCP-1)和肌肉萎缩因子(MuRF1和atrogin-1)表达,并增加胫骨前肌群质量^[20]。同时,双歧杆菌通过减少LPS的产生,减

少骨骼肌降解^[21]。罗伊氏乳杆菌通过上调转录因子FoxN1,降低系统炎症水平,改善恶液质小鼠肌肉质量和肌纤维尺寸^[22]。

肠道菌群通过代谢产物,影响骨骼肌的代谢,间接影响骨骼肌功能。菌群代谢物短链脂肪酸(SCFAs)通过调节骨骼肌中脂蛋白脂肪酶,特别是乙酰辅酶A羧化酶,可增加脂肪酸摄取、氧化,甚至可以阻止骨骼肌脂质的沉积^[23]。SCFAs通过影响GLUT4的表达增强骨骼肌对葡萄糖的摄取和糖原合成,同时间接改善了胰岛素抵抗状态^[24]。SCFAs借助促进单磷酸腺苷活化蛋白激酶(AMP-activated protein kinase, AMPK)和过氧化酶体增殖物激活受体 γ 辅激活因子1 α (peroxisome proliferator activated receptor gamma coactivator 1 α , PGC1 α)磷酸化影响骨骼肌糖脂代谢^[25]。高脂环境下(如高脂饮食/棕榈酸盐),SCFAs增加胰岛素受体底物1(IRS1)的表达和蛋白激酶b(PKB)的磷酸化,从而维持骨骼肌的胰岛素敏感性^[23]。SCFAs同时具有抗炎特性,其作用可能是通过GPR42/GPR43激活或HDAC抑制介导的^[26]。强化补充SCFAs可通过降低炎症反应程度,阻止脂质在肌肉中沉积,促进葡萄糖吸收,改善胰岛素敏感性,对骨骼肌产生正性效应。

1.2 脂肪异常分布产生毒性导致炎症反应和胰岛素抵抗,诱发肌肉衰减

随着老龄化进程,体成分发生显著的变化:脂肪组织再分布和肌肉组织发生衰减和功能衰退^[27],甚至BMI水平未发生变化。我们的研究发现,根据EWG-SOP2010肌肉衰减症严重程度分层标准,随着肌肉衰减症发展体脂百分比呈现出“倒U”型分布(pre-sarcopenia (%): 25.61 $\pm$ 7.96 vs. sarcopenia: 28.6 $\pm$ 7.33 vs. severe sarcopenia: 27.65 $\pm$ 10.03),说明脂肪和肌肉之间呈现出负相关,然而在肌肉衰减症的终末期呈现出“近似恶液质”表型。

老龄化过程中,人体脂肪在静态生活方式和能量过剩状况下发生增殖和肥大,并由皮下转移到肌肉、内脏和骨骼间隙,导致肌脂肪变性(myosteatosis)^[28]。值得注意的是,脂肪异常分布,并不代表肥胖发生,但此时已伴有炎症因子升高和胰岛素抵抗^[29]。一方面,脂类及其衍生物(二酰甘油、长链酰基辅酶A和神经酰胺)在肌细胞间和细胞内蓄积并产生脂毒性,诱导线粒体功能障碍,扰乱脂肪酸 β -氧化,增强活性氧(ROS)

的产生,致胰岛素抵抗和蛋白质合成代谢异常,加速了炎症因子和肌肉因子合成释放^[30]。另一方面,这些肌肉因子(myostatin)反过来加速脂肪组织炎症,维持慢性低强度炎症反应,从而触发和促进肌肉衰减型肥胖(SO)的发展^[31]。

脂肪细胞功能异常,以游离脂肪酸的形式随循环达到肌肉组织,以三种形式浸润在肌肉细胞内,即肌间脂肪组织(inter-muscular adipose tissue, IMAT)、肌内脂肪组织(intra-muscular adipose tissue)和肌细胞内脂质(intra-myocellular lipids, IMCLs)^[32]。IMCLs可激活PKC并磷酸化胰岛素受体底物-1(IRS-1)的丝氨酸,干扰PI3K激活并阻断GLUT4易位,导致线粒体中葡萄糖利用率降低和脂肪酸氧化增加^[33]。因此,在骨骼肌中优先使用IMCLs而不是葡萄糖作为能量来源。在高胰岛素血症情况下,通过抑制p-4EBP1信号通路降低了肌肉蛋白合成(MPS)对氨基酸的反应^[34],在体内产生了合成代谢抵抗现象。TNF α 和IL-1 β 使IGF-1的局部表达减弱,导致进入肌肉的葡萄糖分解受损,并抵抗来自IRS1磷酸化及下游级联的mTORC1激活^[35]。异位的游离脂肪酸诱导NLRP3炎症小体形成,触发caspase-1,激活IL-1 β 和IL-18,促进炎症和胰岛素抵抗^[36]。同时,异位的游离脂肪酸会吸引免疫细胞,激活骨骼肌中的促炎性M1巨噬细胞,释放TNF α , IL-1 β 和TGF β ,刺激成纤维细胞向肌成纤维细胞分化。促炎信号通路的慢性刺激,特别是MAPK, JNK和NF- κ B,阻碍胰岛素信号传导、脂肪生成和脂肪细胞脂质储存能力,为持续的脂肪异常浸润产生了便利条件^[37]。促炎因子(如IL-1 β)抑制脂肪生成,抑制前脂肪细胞成熟为功能性甘油三酯(TAG)富集脂肪细胞的能力。因此,局部肌肉脂肪变性和胰岛素抵抗间的恶性循环导致了脂质摄取减少和局部游离脂肪酸浓度增加,恶化了局部高脂血症,形成了一个更大的恶性循环。

1.3 炎症环境和胰岛素抵抗是导致肌肉衰减的核心环节

衰老相关分泌表型(senescence-associated secretory phenotype, SASP)炎症细胞因子随年龄增长而增加,并成为-一个调节信号,逐渐扩散炎症诱导的胰岛素抵抗^[38]。营养因子作为主要的环境因素,在促进骨骼肌炎症、线粒体功能障碍和ROS生成方面起着关键作用^[39]。果糖,食物中常见的单糖,以增加血尿酸浓度、

上调TGF- β 1、激活NOX4和促进脂肪生成等方式形成炎性环境和促进ROS生成^[40]。过量果糖的消耗增加了肝脏脂肪生成,伴随着血液中脂质释放的增加,这些脂质随后被骨骼肌吸收,脂蛋白的过量产生引起炎症反应;因此,循环脂肪酸和炎症细胞因子的升高,可引起外周组织的胰岛素抵抗,导致全身胰岛素抵抗^[41]。

巨噬细胞在组织炎症中扮演重要角色。受到Th1和Th17 CD4+细胞以及CD8+细胞累积的影响,巨噬细胞经历从抗炎(M2)到促炎(M1)表型的极化^[42]。M1巨噬细胞在Th1介质(如干扰素 γ)激活下,分泌促炎症因子(TNF- α , IL-1 β , IL-6和MCP-1/CCL2等)^[43]。TNF- α 系疾病状态下与肌肉衰减相关的炎症因子^[44],经TNFR1(p55)调节肌肉蛋白降解,激活核转录因子(NF)- κ B和IKK,致肌肉组织环指蛋白1(RING-finger protein 1, MuRF1)表达上升,经泛素-蛋白酶体途径致骨骼肌降解^[45]。TWEAK是TNF- α 超家族成员,通过成纤维细胞生长因子诱导因子14受体(fibroblast growth factor-inducible 14, Fn14)发挥其功能,在高浓度状态下,由经典途径(IKK β)抑制肌肉细胞分化^[46];同时, TWEAK通过TRAF6调节,激活NF- κ B,使MuRF1表达上调,致骨骼肌衰减^[45]; TRAF6是E3泛素连接酶和自噬调节因子,在糖尿病状态下,小鼠TRAF6 mRNA表达升高;相反,敲除TRAF6小鼠MuRF1与atrogin-1表达下降^[47]。此外, TWEAK信号通路以NOX2依赖方式激活NADPH和释放ROS,致肌肉衰减^[46]。

老龄化过程中,脂联素分泌逐渐下降,衰老的脂肪细胞逐渐对胰岛素、瘦素和纤维生长因子-21(fibroblast growth factor-21, FGF21)等分泌因子形成抵抗状态,导致血糖和血脂水平升高^[48]。同时,衰老的脂肪细胞损伤了胰岛素信号通路导致脂肪组织分解异常,进一步促进了高脂血症的发生^[49]。慢性炎症在衰老的脂肪细胞中促进了脂肪组织功能障碍,导致了胰岛素抵抗和代谢性疾病的发生^[27]。老龄化过程中,线粒体功能障碍导致脂质氧化功能障碍,ROS堆积和局部的炎症反应激活了炎症信号通路c-Jun N-terminal kinase (JNK), I κ B kinase (IKK), protein kinase C (PKC)和p38-mitogen-activated protein kinase (p38-MAPK),然而信号通路抑制了胰岛素信号通路^[50]。值得注意的是,局部的高脂血症、脂肪细胞毒性和胰岛素抵抗形成了局部慢性炎症环境,进一步恶化了脂质代谢,加深炎症反应和胰岛素抵抗的程度,形成了恶性循环^[51],我们

称此为“the Metabaging Cycle”. 局部的肌肉胰岛素抵抗导致脂肪吸收减少, 局部游离脂肪酸的浓度增加, 因此恶化了局部的高胰岛素血症和肌肉中炎症反应强度^[52]. 局部脂肪沉积和肌肉胰岛素抵抗形成的“小”循环圈可以随着循环, 加深原有的慢性炎症反应强度, 形成一个炎症“风暴”诱导系统胰岛素抵抗的发生^[52] (图1).

2 人体成分的研究历程及肌肉衰减症临床诊断的进展

20世纪60年代开始, 北京协和医院基本外科曾宪九牵头在国内率先进行了体液平衡、人体成分及氮平衡研究, 为其后的肠外肠内营养支持的基础研究和临床实践打下了扎实的基础. 其中, 重要的研究成果包括曾宪九等人^[53]采用“重水法”测量人总体水, 费立民等人^[54]测量人体血容量, 杨乃发和蒋朱明^[55]分析老年健康人及胃癌患者的人体组成及补充水解蛋白对氮平衡影响等, 研究成果奠定肌肉衰减症的研究基础.

随着人体成分研究的不断深入, 人们对肌肉衰减症的界定不断清晰. 1998年, Baumgartner等人^[56]将肌肉衰减症定义为骨骼肌指数的临界值比年轻健康的成年人骨骼肌指数平均值低两个标准差(SD)以上. 2010年, 欧洲肌肉衰减症工作组(European Working Group on Sarcopenia in Older People, EWGSOP)提出“肌肉质量下降并伴有肌肉力量或功能下降”即可诊断为肌肉衰减症^[57]. 2014年, 亚洲肌肉衰减症工作组(Asian

Working Group on Sarcopenia, AWGS)公布了亚洲地区肌肉衰减症的诊断切点值, 即相对肌肉指数 $<7.0 \text{ kg/m}^2$ (男性)和 $<5.7 \text{ kg/m}^2$ (女性); 握力 $<26 \text{ kg}$ (男性)和 $<18 \text{ kg}$ (女性); 步速 $\leq 0.8 \text{ m/s}$ ^[58]. 2018年, EWGSOP根据近十年临床实践和基础研究新进展, 发布了新版EWGSOP2, 将肌肉衰减症定义更新为“仅有肌肉力量下降为可能肌肉衰减症, 若同时伴有肌肉质量和力量下降即可诊断为肌肉衰减症^[59]. 上述两项加上躯体功能降低就可诊断为严重肌肉衰减症”. AWGS 2019年重新修订了肌肉衰减症的诊断标准和路径: 将男性低肌肉力量的标准界定为 $<28 \text{ kg}$; 活动能力下降定义为6 m步速 $<1.0 \text{ m/s}$, 综合短时体力活动量表(short physical performance battery, SPPB) ≤ 9 分, 或者椅子站立实验(5-time chair stand test) $\geq 12 \text{ s}$. 另外, 基于研究人群的来源背景筛选了新的指标: 对于社区和医院来源的老人, 初始筛查高危人群采用小腿围($<34 \text{ cm}$ 男性, $<33 \text{ cm}$ 女性), 简单五项计分问卷(simple five-item scoring questionnaire, SARC) ≥ 4 分, 或者SARC-CalF ≥ 11 分. AWGS 2019年也引入了可能肌肉衰减症“possible sarcopenia”, 定义为仅有肌肉力量下降或活动能力下降^[60].

在各种评估肌肉状况的方法中, 计算机断层扫描(CT)和磁共振成像(MRI)被认为是区分脂肪、肌肉与其他软组织的金标准. 然而, 由于成本高且存在辐射, 上述方法不作为诊断肌肉衰减症的常规方法^[61]. 另一种被称为双能X射线吸收法(DXA)的低辐射方法被推荐用于估计全身或某些部位的瘦体质量和脂肪质

图1 骨骼肌衰减的机制图

Figure 1 The mechanism of muscle atrophy.

量^[62]。然而, 这种技术的高成本和稀缺性限制了它在诊断肌肉衰减症中的应用。生物电阻抗分析(BIA)作为一种经济实惠且易于使用的工具, 已广泛用于评估整体肌肉质量及分布、筛查肌肉衰减症的主要方法^[63]。

在现代老龄化过程中, 由于久坐的生活方式、慢性压力和过量的营养摄入, 脂肪组织会发生膨胀、炎症、纤维化和萎缩^[27], 当超过脂肪组织承载能力后, 由皮下逐渐转移到肌肉间、内脏中和骨骼间隙, 导致肌脂肪变性(myosteosis)^[64], 影响了骨骼肌的功能。值得注意的是, 脂肪的异常分布, 并不代表肥胖的发生, 是否此时伴有肌肉质量的丢失需进一步采用CT截取腿部横截面积来确定^[29]。早期捕捉这种状态需要新的诊断方法, 通过可以测量局部肌肉质量, 如前臂、大腿或小腿, 便携式BIA设备测量肢体肌肉质量, 或者在肌肉与脂肪分布的CT扫描中测量大腿的横截面积。最新研究表明, D3肌酸稀释法具有高重复性和最小侵袭性^[65], 在估计骨骼肌重量方面具有良好应用前景。在肿瘤研究中, 由于CT图像分析能够区分和量化肌肉、脂肪组织和其他器官, 因此它已成为癌症患者身体成分评估的金标准^[66]。

在近期一项基于469830名英国生物库参与者的研究中, 当肌肉衰减症采用肌肉质量丢失和步速降低定义时, 肌肉衰减症与老年人不良临床结局(全因死亡率、心血管疾病、呼吸系统疾病和慢性阻塞性肺病的发病率和死亡率)的相关性最强^[67]。然而, 北京协和医院临床营养科肌肉衰减症课题组的最新研究表明, 步速降低在鉴别身体功能下降方面缺乏强有力关联^[68], 而握力和小腿周长能有力地鉴别高危肌肉衰减症患者^[69], 最新的诊断标准中也提示了小腿围在筛查肌肉衰减症中的重要作用。北京协和医院临床营养科肌肉衰减症课题组的横断面研究基于人体成分、腹围、小腿围、中臂围等指标以及生化指标, 建立了肌肉衰减症筛查预测模型“PUMCH指数(PUMCH index)”^[69]。这是继SARC以来, 第一个用于亚洲人群肌肉衰减症风险评估模型, 为无法提供人体成分测量技术的医疗机构提供了辅助诊断方法。高水平的同型半胱氨酸和高敏C反应蛋白与肌肉衰减症之间具有独立相关性, 其女性中的相关性更强^[70]。我们的研究显示, 促炎因子(TNF- α 和TWEAK)是肌肉衰减症的危险因素^[68], 低25OH维生素D与男性骨骼肌丢失存在显著相关性^[69], 因此需要建立一系列可靠的预测性血清或尿液生物标

记物来早期筛查肌肉衰减症, 如基于肌肉衰减症危险因素特征采取分性别对进行筛查, 同时基于慢性病患者的疾病特征进行联合诊断。总之, 需要更多的努力来建立一个全球性的, 标准化的定义和评估老龄化以及疾病相关的肌肉衰减症。

3 肌肉衰减症与老年人临床结局的关系

肌肉衰减症的临床表现为衰弱, 可致步态平衡性不稳, 并增加跌倒、外伤和骨折风险, 显著增加感染率、入院率及死亡率, 形成老年人群高死亡率因果链^[5]。肌肉衰减症患者跌倒(横断面研究: OR=1.60, 95%CI=1.37~1.86, $P<0.001$, $I^2=34\%$; 前瞻性研究: OR=1.89, 95%CI=1.33~2.68, $P<0.001$, $I^2=37\%$)和骨折(横断面研究: OR=1.84, 95%CI=1.30~2.62, $P=0.001$, $I^2=91\%$; 前瞻性研究: OR=1.71, 95%CI=1.44~2.03, $P=0.011$, $I^2=0$)风险显著升高^[71]。

肌肉衰减症与各类慢性疾病关系密切。一方面, 慢性患者常伴有肌肉衰减情况。研究表明, 15.7%糖尿病患者伴有肌肉衰减症, 糖尿病患者骨骼肌质量指数(SMI)值显著降低^[72]。韩国KNHANES研究显示, 12.2%非酒精性脂肪肝患者伴有肌肉衰减症, 且肌肉衰减症与肝纤维化显著相关^[73]。此外, 肝硬化患者的骨骼肌丢失似乎反映了一般身体状况的慢性损害, 而不是肝脏疾病的急性严重程度^[74]。年龄相关的肌肉衰减症在慢性心力衰竭(CHF)患者早期即可出现, 并随CHF的进展而恶化, 而这两种情况彼此形成恶性循环^[75]。射血分数降低(HFrEF)的CHF患者肌肉衰减症患病率比同龄健康成人高出近20%^[76]。

另一方面, 肌肉衰减症增加各类慢病风险。横断面研究表明, 肌肉衰减型肥胖患者心血管危险因素和代谢综合征的患病率较高^[77]。此外, 肌肉脂肪浸润对血管改变的影响可能是增加慢性阻塞性肺疾病(COPD)消瘦患者心血管风险的重要机制^[78]。肌肉衰减型肥胖患者与非肌肉衰减症和无肥胖状态患者相比, 发生心肺功能降低、高空腹血糖水平、高血压、血脂异常和胰岛素抵抗等代谢综合征的风险高达8倍^[79]。美国国家健康和营养调查III对14000多名成年人进行的大型横断面分析也报道了类似的结果, 其中肌肉衰减型肥胖组发生胰岛素抵抗和血糖异常的风险最高^[80]。对超重和肥胖成年女性的研究显示, 肌肉衰减型肥胖使糖

尿病和高血压的发生概率增加了近550%(OR=5.42, 95%CI=1.37~21.40, $P<0.05$)^[81]. 此外, 与正常人和单纯肥胖的受试者相比, 肌肉衰减型肥胖的代谢状况更差. 43.5%的受试者患有慢性肾病(CKD), 12.1%患有缺血性心脏病(IHD), 5.9%患有中风^[82].

4 结论

综上所述, 老年人会受到各种慢性病或者机能衰退的影响, 单纯采用诊断指南推荐的评估指标, 可能会错误地评价老年人群的肌肉功能状态. 对于存在认知功能障碍或者外周神经系统疾病的老年人, 采用握力评估其肌肉力量可能会存在误差; 对于合并有恶性肿瘤或者COPD的患者单独采用RSMMI来评估患者的

整体肌肉情况可能会产生偏倚, 应基于患者的既往史采用有针对性的体成分检测方式和评估指标判断其肌肉衰减的整体情况; 对于BMI偏高的老年人单独考虑肌肉的情况可能会忽略脂肪对肌肉衰减的掩盖效应, 应综合考虑老年人群的肌肉衰减型肥胖出现的代谢影响, 采用生化指标对患者进行综合评估. 因此, 对于肌肉衰减症的筛查、评估和诊断路径应该进行分类评价, 基于受试者的年龄、性别、认知功能和慢性病合并症进行有针对性的综合评估.

老龄化过程中肠道微生态环境的变化与宿主形成炎症应答圈. 静态活动方式和高脂肪膳食模式可导致慢性炎症环境和胰岛素抵抗, 成为发生肌肉衰减症的重要基础. 从分子层面明确肌肉衰减症发病机制, 仍是目前亟需解决的重要课题.

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Progress in pathogenesis research of sarcopenia and its guidance for clinical diagnosis

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The rapidly aging population of China and the increasing prevalence of sarcopenia have become a major public health problem that threatens public health, reduces the quality of life, and consumes large amounts of medical resources. The European (EWGSOP) and Asian (AWGS) working groups on sarcopenia have revised the diagnostic pathway several times. In the latest version of the diagnostic guidelines (EWGSOP2), muscle strength (grip strength) was indicated as an important tool for the diagnosis of possible sarcopenia. Because the pathogenic mechanism remains unclear, the development of prevention and treatment strategies has been slow and difficult. At present, it is believed that the change of gut microbe environment is an important basis for sarcopenia during aging, and a sedentary lifestyle and high-fat diet can cause chronic inflammatory environment and insulin resistance, which become the central link of the occurrence and development of sarcopenia. Our review outlines current knowledge concerning the possible mechanism of sarcopenia and epidemiology to analyze the molecular basis of sarcopenia and evaluate the current standardized process for screening, evaluation, and diagnosis of sarcopenia, to provide reference for formulating precise prevention and control strategies.

sarcopenia, aging, myosteatosis, inflammation, insulin resistance, gut microbe

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