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·专家共识·

肌少症共识

中华医学会骨质疏松和骨矿盐疾病分会

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概 述

肌肉骨骼系统在保持体位、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、营养、力学刺激的系统性调节，以及两者间内分泌、旁分泌和机械力学的局部相互调节。此外，骨骼和肌肉间还存在某些相似的分子信号调节通路，有望成为干预的共同靶点。随着社会人口老龄化，肌肉骨骼疾病已经成为重要的公共健康问题。肌肉减少症（sarcopenia，简称肌少症）、骨质疏松症（osteoporosis）和骨折的发生均随增龄而增加，肌少症和骨质疏松症相伴出现被统称为“活动障碍综合征”（dysmobility syndrome），致使老年人易于跌倒和骨折，继而成为老年人群致残、致死的主要原因之一[1-2]。与骨质疏松症相比，肌少症近 10 年来才逐渐受到重视，并在基础和临床研究方面取得了重要进展，国外相关学会相继颁布了肌少症的临床指南。为了提高医务工作者对肌少症的认识、规范我国肌少症的临床诊疗工作，中华医学会骨质疏松和骨矿盐疾病分会组织并编撰此共识。本共识主要涵盖肌少症的定义、流行病学特点、发病机制、肌肉与骨骼的相互作用、肌少症与骨折的关系、肌少症的诊断及肌少症的防治等内容。

肌少症的定义

肌少症（sarcopenia）或称“肌肉减少症”，源于希腊语，“sarx”意为肌肉，“penia”意为减少或丢失，这是个新名词，于 1989 年由 Rosenberg 首次命名[3]。2010 年欧洲老年肌少症工作组（European Working Group on Sarcopenia in Older People，EWGSOP）发表了肌少症共识[4]。此后，国际肌少症工作组（International Working Group on Sarcopenia，IWGS）也公布了新共识[5]，将肌少症定义为“与增龄相关的进行性、全身肌量减少和/或肌强度下降或肌肉生理功能减退”。

肌少症与活动障碍、跌倒、低骨密度及代谢紊乱密切相关，是老年人生理功能逐渐减退的重要原因和表现之一。肌少症会增加老年人的住院率及医疗花费，严重影响老年人的生活质量，甚至缩短老年人的寿命[6-8]。

老年人肌少症的流行病学及发病机制

肌少症的流行病学

目前报道的肌少症患病率存在较大差异，可能受到研究人群和参考人群的影响。所使用评价肌肉质量、肌肉强度和肌力状态的方法和阈值不同，导致肌少症的患病率各异，但不同人群间肌少症患病率确实存在差异[9]。

采用生物电阻抗方法对 14 818 名年龄大于 18 岁的美国人群（30% 年龄 > 60 岁），测算骨骼肌质量指数（skeletal muscle mass index，SMI）显示肌少症患病率，结果 SMI 较峰值小于 1 个标准差的男女性分别为 45% 及 59%；SMI 较峰值小于 2 个标准差的男女性别分别为 7% 及 10%[10]。应用双能 X 线吸收仪（dual X ray absorptiometry，DXA）的检测方法，对 465 名加拿大老年男女性的研究显示，男性肌少症患病率为 38.9%，女性为 17.8%[11]。澳大利亚一项对平均年龄 86 岁的 63 名女性的研究示：Ⅰ°肌少症患病率为 25.4%，

Ⅱ°肌少症患病率为 3.2%[12]。对平均年龄为 72.5 岁英国社区老年人的调查显示，男女性肌少症患病率分别为 4.6% 和 7.9%[13]，而比利时社区老人调查结果显示肌少症患病率为 3.7%[14]。

在亚洲，老年人肌少症的估计患病率为 4.1% ~ 11.5%[15-18]。上海地区对 18 ~ 96 岁健康男女性别的调查结果提示：>70 岁男女性肌少症的患病率分别为 12.3% 及 4.8%；而高龄农村男女性肌少症患病率为 6.4% 及 11.5%，相关危险因素包括性别、年龄、乙醇消耗量、消化性溃疡[15]。香港社区老年男性的肌少症患病率为 9.4%，与高龄、认知功能低下、蛋白质或维生素摄入低有关[16]。中国台湾地区老年男女性肌少症患病率分别为 9.3% 和 4.1%，与语言表达能力障碍有关[18]；日本老年男、女性肌少症患病率分别为 9.6% 和 7.7%[17]；韩国 50 岁以上女性肌少症患病率为 12.1%[19]。

采用不同肌少症评估方法和诊断标准，以及调查不同人群，肌少症的患病率差异较大，具体如下[20-37]：老年男性肌少症患病率为 0 ~ 85.4%，老年女性为 0.1% ~ 33.6%；应用 DXA 测量肌肉量，男性肌少症患病率为 0 ~ 56.7%，女性患病率为 0.1% ~ 33.9%；应用生物电阻抗法测量肌肉量，男女性肌少症患病率分别为 6.2% ~ 85.4% 及 2.8% ~ 23.6%；社区老年居民肌少症患病率为 1% ~ 29%，长期居住于护理院人群的肌少症患病率为 14% ~ 33%，急诊老年人肌少症患病率为 10%；肌少症患病率随增龄而增加，与性别相关，男性似乎更容易罹患肌少症。

据推测，全球目前约有 5 千万人罹患肌少症，预计到 2050 年患此症的人数将高达 5 亿。亚洲老年人肌少症患病率低于欧美人群，可能因为亚洲人群的 RASM 临界值低于美国人群（男性分别为 5.72 kg/m^2:7.26 kg/m^2，女性分别为 4.82 kg/m^2:5.45 kg/m^2），即使采用身高校正之后，亚洲年轻人群平均峰值 RASM 仍然较高加索人群约低 15%[38]。总之，肌少症将是未来面临的主要健康问题之一。

肌少症的发病机制

肌少症是增龄相关疾病，是环境和遗传因素共同作用的复杂疾病，多种风险因素和机制参与其发生[39-40]，肌少症的发病机制涉及如下多个方面：

运动减少：增龄相关的运动能力下降是老年人肌肉量和强度丢失的主要因素[39,41]。长期卧床者肌肉强度的下降要早于肌肉量的丢失，活动强度不足导致肌力下降，而肌肉无力又使活动能力进一步降低，最终肌肉量和肌肉强度均下降[42]。较多研究提示老年人进行阻抗运动能显著增加肌肉量、肌肉强度和肌肉质量[43]。

神经-肌肉功能减弱：运动神经元的正常功能对肌纤维的存活是必需的，在肌少症发病机制中 α 运动神经元的丢失是关键因素，研究发现老年人 70 岁以后运动神经元数量显著减少，α 运动神经元丢失达 50%，显著影响下肢功能[44-45]。老年时期 α 运动神经元和运动单元数量的显著减少直接导致肌肉协调性下降和肌肉强度的减弱。在肌肉纤维数量上，对成人肌肉的研究发现，90 岁时肌肉中Ⅰ型和Ⅱ型纤维含量仅为年轻人的一半[46-47]。老年时期，由于星状细胞数量和募集能力下降，导致Ⅱ型纤维比Ⅰ型纤维下降更显著。星状细胞是肌源性干细胞，可在再生过程中被激活，分化为新肌纤维和新星状细胞，但是这种再生过程在应对损伤时将导致Ⅱ型纤维不平衡和数量减少，且老年人肌肉更易损和难修复。

增龄相关激素变化：胰岛素、雌激素、雄激素、生长激素和糖皮质激素等的变化参与肌少症的发病。肌少症时，身体和肌细胞内脂肪增加，这与胰岛素抵抗有关[48-50]。实验已证实老化肌细胞接受胰岛素作用后，蛋白生成能力明显降低[51]。雌激素对肌少症的发病作用存在不一致的证据，一些流行病学和干预研究提示雌激素可以预防肌肉量的丢失。对 5 项随机对照临床试验进行的系统分析，3 项研究表明雌激素替代治疗后肌肉强度增加，但不影响身体成分分布，一项研究表明替勃龙增加股四头肌和膝伸直肌强度，且增加瘦组织量、降低体脂量[52]。一项对健康、老化和身体成分的研究，发现雌激素替代治疗后，股四头肌横断面面积更高，但与膝伸直肌强度无关[53]。可见，雌激素主要影响肌肉强度，在肌少

症发病中可能不是最重要的因素。而男性睾酮水平随增龄每年下降1%，这在男性肌少症发病中起重要作用[54]。很多研究显示老年男性低睾酮水平与肌肉量、强度和功能的下降均相关，体外实验也证实睾酮可剂量依赖地促进星状细胞数量增加，且是其功能的主要调控因子[55]。此外，老年人维生素D缺乏非常普遍，多项研究证实维生素D缺乏是肌少症的风险因素，并且1,25双羟维生素D水平降低与肌肉量、肌肉强度、平衡力下降和跌倒风险增加相关[56-57]。

促炎性反应细胞因子：促炎性反应细胞因子参与老年人肌少症的发病，研究发现血IL-6、TNF-α和C反应蛋白水平与肌肉量、肌肉强度有关[58]。荷兰老年人群的研究提示高水平IL-6和C反应蛋白使肌肉量和肌肉强度丢失风险增加[59]。这些炎性反应细胞因子增高引起肌肉组织合成代谢失衡，蛋白分解代谢增加。老年人炎性反应细胞因子长期增高是肌少症的重要危险因素。

肌细胞凋亡：肌肉活检显示老年人肌细胞凋亡显著高于年轻人，这是肌少症的基本发病机制[60]，肌细胞凋亡与线粒体功能失常和肌肉量丢失有关。研究证实肌少症主要累及的Ⅱ型肌纤维更容易通过凋亡途径而死亡[61]。增龄、氧化应激、低生长因子以及完全制动等可触发Caspase依赖或非依赖的凋亡信号通路。

遗传因素：遗传因素可以分别解释个体间肌肉强度、下肢功能和日常生活能力变异的36%～65%、57%和34%[62-64]。肌少症的全基因组关联分析（genome-wide association studies，GWAS）数据较少，2009年对1 000例无亲缘关系美国白人进行的GWAS与瘦组织（lean mass）分析，发现甲状腺释放激素受体（thyrotropin-releasing hormone receptor，TRHR）单核苷酸多态性（single nucleotide polymorphism，SNP）rs16892496和rs7832552与瘦组织变异有关[65]。最近一项1 550例英国孪生子全基因DNA甲基化研究，发现一些基因DNA甲基化与肌肉量变异相关[66]。目前遗传学研究主要集中在一些候选基因SNP与肌少症的表型，包括身体肌肉量、脂肪量和肌肉强度等关联研究，涉及的基因有GDF-8、CDKN1A、MYOD1、CDK2、RB1、IGF1、IGF2、CNTF、ACTN3、ACE、PRDM16、METTL21C和VDR等[66-70]。尽管发现了一些与肌少症相关的风险基因，但是未得到不同种族、更多人群一致的证实。

营养因素：已证实老年人合成代谢率降低30%，其降低究竟与老年人营养、疾病、活动少有关，还是仅与增龄有关，仍有争议[39,71]。老年人营养不良和蛋白质摄入不足可致肌肉合成降低，已有研究证实氨基酸和蛋白补充可直接促进肌肉蛋白合成，预防肌少症，推荐合适的饮食蛋白摄入量为每天每千克体质量1.0～1.2 g[71]。

肌肉与骨骼的相互作用

全身因素共同调节肌肉和骨骼

肌肉和骨骼作为运动系统的两大重要组成部分，共同受机体多种因素的调节[72-74]。在生长发育过程中肌量与骨量密切相关[75]，肌肉生长略快于骨骼，提示在成长期肌肉生长会促进骨量积累。老年期肌量和骨量也呈密切正相关。全身调节因素共同影响肌肉和骨骼的主要证据：由于成肌细胞和成骨细胞同源于多能间充质干细胞，因此肌肉和骨骼会受到某些相同的遗传因素的调控。GWAS研究提示myostatin、α-actinin 3、proliferator-activated receptor gamma coactivator 1-α（PGC-1α）、myocyte enhancer factor 2 C（MEF-2C）、GLYAT和METTL21C等的编码基因同时与肌少症和骨质疏松症密切相关[76]。

重要的内分泌因子会同时影响肌肉和骨骼。老年人群中维生素D缺乏与肌少症和骨质疏松症的发生有关；GH/IGF-1轴对骨骼和肌肉产生共同调节，运动后IGF-1水平升高可能是运动对肌肉和骨骼正性作用的纽带。男性雄激素剥夺治疗和女性绝经后均引起肌量丢失和骨量减少，表明性激素对肌肉骨骼具有重要调节作用。

某些疾病状态同时累及肌肉和骨骼。皮质醇增多症患者同时发生肌少症和骨质疏松症；糖尿病患者的代谢异常，特别是糖基化终末产物的堆积，导致肌少症和骨折风险增加；慢性炎性反应，如类风湿关节炎和炎性肠病，会同时引起肌少症和骨质疏松症。

老年人营养缺乏普遍存在，营养不良时肌少症和骨质疏松症可同时出现。力学刺激同时影响肌肉和骨骼，既直接刺激成肌细胞和成骨细胞的分化，又分别诱发肌肉和骨骼释放多种生物活性因子而相互调节。

肌肉与骨骼的相互调节

肌肉和骨骼位置毗邻、相互调节、密不可分。二者任何一方的结构、功能改变均会对另一方造成显著影响，其机制包括力学作用和可能的化学作用两个方面。力学作用一方面指肌肉收缩产生的应力对骨骼的影响，另一方面指骨骼供肌肉附着作为肌肉运动的杠杆，支持肌肉；而化学作用是指肌肉与骨骼产生的活性物质通过内分泌或旁分泌的方式作用于对方。因此，维持肌肉健康不仅仅能增加肌强度，还能减少骨丢失，进一步改善骨强度；反之，维持骨骼健康也能进一步提高肌量和强度，降低跌倒风险。

肌肉对骨骼的调节：肌肉可通过力学作用和可能的化学作用对骨骼产生影响。力学作用主要是通过肌肉收缩，对骨骼产生应力刺激，使骨密度和骨强度增加。有研究显示，刺激肌肉收缩能预防肢体悬吊失重动物的骨丢失，说明肌肉收缩在一定程度上能减少骨丢失。化学作用主要是指肌肉产生的化学物质可能通过旁分泌或内分泌机制作用于成骨（前体）细胞、破骨细胞或骨细胞，促进成骨和/或抑制破骨。MyoD 和 Myf5 基因敲除小鼠由于缺乏骨骼肌，小鼠胚胎在母体子宫内无自主活动能力，出生后不能存活，骨骼表现为矿化不良，且新生骨中的破骨细胞数量增多，提示肌肉可促进骨骼发育[77]。由肌肉产生的骨诱导因子（osteoglycin，OGC）和 FAM5C（family with sequence similarity 5，member C）是重要的分泌型骨形成因子[78-79]。肌肉产生的其他内分泌因子包括 IGF-1、白介素-15、白介素-7、白介素-15、骨连素、MMP-2 和成纤维细胞生长因子等均可能影响骨代谢[79]。肌肉运动后产生的鸢尾素则可能通过 Wnt-β-catenin 通路促进成骨细胞分化和 RANKL/RANK 途径抑制破骨细胞形成[80]。肌肉收缩的机械刺激能直接作用于骨细胞，影响其分泌硬骨素（sclerostin）等调节骨形成。肌肉生长抑制素（myostatin）主要在骨骼肌表达，肌肉生长抑制素功能缺失会引起肌肉肥厚、肌肉功能和骨量增加。肌肉生长抑制素敲除能抑制破骨细胞分化，说明骨骼肌的肌肉生长抑制素可能对破骨细胞的分化有促进作用[81]。可见，肌肉不仅通过力学作用，还可能通过生物活性因子的内分泌、旁分泌机制，影响骨骼发育及骨转换。但肌肉产生的化学因子对骨骼的作用究竟是直接作用还是通过影响肌力产生的间接作用，还有待进一步研究。

骨骼对肌肉的调节：骨骼也通过力学和化学作用对肌肉产生影响。成骨细胞或骨细胞分泌的因子，如骨钙素、硬骨素和成纤维细胞生长因子-23 等，均可能对肌肉有调节作用。骨钙素对肌肉会产生同化作用，骨骼中产生的骨钙素可能通过 GPRC6A/AMPK/mTOR/S6 激酶途径调节肌量和功能[82-83]。骨钙素还可能影响糖脂和能量代谢进而影响肌肉功能。骨特异性因子羧基化骨钙素（Glu-OC）可部分修复功能受损的肌肉[83]。经典的 Wnt 信号通路的激活是肌肉分化所必需，骨细胞分泌的硬骨素和 Indian Hedgehog（Ihh）等对 Wnt 信号通路有调控作用，表明骨细胞可能远程调节肌细胞的分化[84]。骨细胞和成骨细胞分泌的成纤维细胞因子-23 具有抑制肾小管重吸收磷和降低 1α 羟化酶活性的作用，可导致低磷血症和活性维生素 D 水平过低，由此会影响肌肉的代谢和功能，当然 FGF-23 对肌肉是否有直接调控作用还有待阐明[85]。此外，骨骼细胞中的特异性间隙连接蛋白 Connexin43 可直接参与肌肉生长和功能的调控[86]。但究竟骨骼对肌肉的影响是如何通过机械应力和生物因子共同协调发挥作用的，仍有待深入研究。

肌少症与骨质疏松及骨折

如前所述，肌少症和骨质疏松症可统称为“活动障碍综合征”，因此，老年人群的骨折可视为两者的共同后果[1]。大量研究表明，老年人群骨折与肌量减少、肌力下降、跌倒增加、骨量减低密切关联。

多数大样本横断面研究显示，肌肉含量与骨

密度呈正相关，肌肉含量下降是骨质疏松症的重要危险因素。一项对非洲裔美国人、高加索人及中国人的研究结果表明瘦肉含量及握力与骨密度呈正相关，四肢肌肉含量每增加一个标准差，骨量减少/骨质疏松的风险下降 37%。肌少症者较正常人罹患骨量减少/骨质疏松的风险增加 1.8 倍[87]。韩国健康及营养调查结果显示，肌少症合并维生素 D 缺乏组男女性全髋及股骨颈骨密度均显著降低[88]。我国上海研究结果显示，肌少症在 70 岁以上女性的患病率为 4.8%，男性为 13.2%，与日本及韩国患病率接近，但低于高加索人，受试者下肢及躯干肌肉含量分别是股骨与脊柱骨密度的强预测因子[89]。

肌少症不仅与低骨密度密切关联，也是髋部骨折的重要危险因素。有研究显示肌少症女性罹患骨质疏松症、骨折及 1 年内至少跌倒 1 次的风险显著升高，比值比分别为 12.9、2.7 及 2.1[90]。日本横断面研究结果表明老龄、低骨密度及肌少症是髋部骨折的主要危险因素[91]。由此可见，肌少症是跌到及骨折的重要危险因素。

一项前瞻性随访 10.7 年的研究结果表明肌少症男性具有较低脊柱与全身骨密度，以及较高的非椎体骨折率；肌少症女性具有较低的全髋骨密度[92]。一项前瞻性研究表明降低的骨密度、肌肉量、肌肉强度、肌功能，以及增加的肌间脂肪含量，均与髋部骨折风险增高相关[93]。香港一项前瞻性研究随访 11.3 年结果表明，肌少症是低骨密度及其他骨折危险因素以外的骨折独立危险因素[94]。前瞻性研究更加有力地证实了肌少症、骨质疏松症是导致骨折的重要危险因素。

肌少症与骨质疏松症相互影响、紧密关联的机制较为复杂，包括肌肉收缩力学负荷对骨骼的影响，以及肌肉与骨骼间复杂精密内分泌调控的生物学机制[95-97]。肌肉力学刺激影响骨骼的生长、骨骼几何形状和骨密度[98]。骨骼与肌肉均起源于间充质祖细胞，它们受重叠基因及体液因子的调控。骨骼与肌肉之间相互交织的内分泌信号网络，决定了骨骼与肌肉的相互影响。许多共同信号通路参与调节肌细胞与骨骼细胞的代谢过程，包括 Wnt/β-catenin 信号通路、PI3K/Akt 通路等[99-100]。在治疗方面，肌少症与骨质疏松症也有相通之处。

肌少症的诊断

肌少症缺乏特异的临床表现，患者可表现为虚弱、容易跌倒、行走困难、步态缓慢、四肢纤细和无力等，其诊断有赖于肌力、肌强度和肌量的评估等方面。

肌少症判定标准应综合肌量和肌肉功能的评估，主要评估指标有肌量（mass）减少、肌强度（strength）下降、日常活动功能（physical performance）失调等。1998 年 Baumgartner 等[101]基于 DXA 肌肉量测量，提出了肌量减少的诊断标准。该标准以身高校正后的四肢肌量为参照指标［四肢肌量（kg）/身高^2（m^2）］，如低于青年健康人峰值的 -2SD 可诊断肌量减少，具体诊断阈值为：男性 < 7.26 kg/m^2、女性 < 5.45 kg/m^2。亚洲肌少症工作组的建议：以日常步速和握力作为筛查指标，该标准简便易行[102]。欧洲老年人群肌少症工作组建议用 DXA 或生物电阻抗法测定肌量，用手握力测定肌力，用步速或简易体能状况量表（short physical performance battery，SPPB）测定功能，每项评分与健康年轻人比较，分为前肌少症、肌少症及严重肌少症。鉴于肌少症的研究刚刚起步，国内相关数据及工作经验有限，因此参考国外的有关标准及我国现有的研究[101-104]，建议筛查与评估步骤如下：（1）先行步速测试，若步速 ≤ 0.8 m/s，则进一步测评肌量；步速 > 0.8 m/s 时，则进一步测评手部握力。（2）若静息情况下，优势手握力正常（男性握力 > 25 kg，女性握力 > 18 kg），则排除肌少症；若肌力低于正常，则要进一步测评肌量。（3）若肌量正常，则排除肌少症；若肌量减低，则诊为肌少症（图 1）。

肌量测定应首选 DXA，也可根据实际情况选择 MRI、CT 或 BIA 测量。肌量诊断阈值：低于参照青年健康人峰值的 -2SD，优势手握力结果可能受上肢骨关节疾病（如类风湿关节炎）和测量体位或姿势等因素的影响。年轻继发肌少症患者也可参照该流程进行评估。

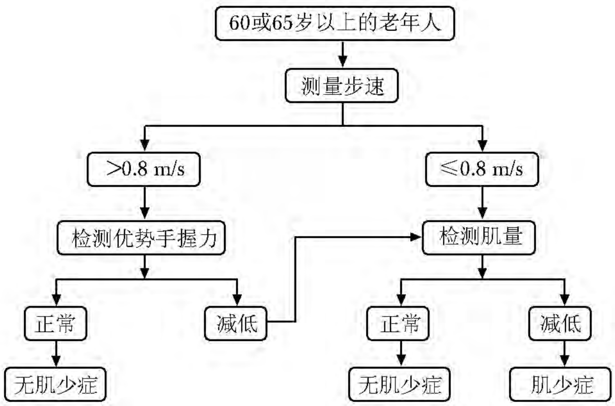

图 1 肌少症筛查与评估流程图

Fig 1 Flow chart of of sarcopenia screening and assessment

肌少症的防治

肌少症的防治对象包括所有的肌少症人群，包括各种疾病、药物和废用等所致的肌少症和老年性肌少症。防治措施包括运动疗法、营养疗法和药物治疗。

运动疗法

运动是获得和保持肌量和肌力最为有效的手段之一。应鼓励自青少年期加强运动，以获得足够的肌量、肌力和骨量。在中老年期坚持运动以保持肌量、肌力和骨量。老年人运动方式的选择需要因人而异。采用主动运动和被动活动，肌肉训练与康复相结合的手段，达到增加肌量和肌力，改善运动能力和平衡能力，进而减少骨折的目的[105-107]。

营养疗法和维生素 D 补充

大多数老年人存在热量和蛋白质摄入不足，因此，建议老年人在日常生活中要保持平衡膳食和充足营养，必要时考虑蛋白质或氨基酸营养补充治疗[108-109]。

维生素 D 不足和缺乏在人群中普遍存在，在不能经常户外活动的老年人中更是如此，此类患者往往表现为肌肉无力，活动困难等。在老年人群中，筛查维生素 D 缺乏的个体，补充普通维生素 D 对增加肌肉强度、预防跌倒和骨折更有意义[110-111]。

药物治疗

目前还没有以肌少症为适应证的药物，临床上治疗其他疾病的部分药物可能使肌肉获益，进而扩展用于肌少症。包括同化激素、活性维生素 D、β 肾上腺能受体兴奋剂、血管紧张素转换酶抑制剂、生长激素等。

同化激素/选择性雄激素受体调节剂（selective androgen receptor modulators，SARMs）：前者包括睾酮及合成类固醇激素。睾酮不仅可增加骨密度和骨强度，还可增加老年人的肌强度，低剂量睾酮能增加肌量和减少脂肪量，而大剂量睾酮则可同时增加肌量和肌力，对男性和女性均有效[112-113]。安全性方面，Meta 分析表明老年人使用睾酮并未增加病死率，但也有研究提示补充睾酮 3 个月内会增加心脏事件。诺龙（nandrolone）是注射用合成类固醇激素，可增加肌纤维面积和肌量，但对肌强度、机体功能状态并未发现有益的影响[114]。SARM 类药物（MK-0773、LGD-4033、BMS-564929、Enobosarm 等）尚在进行临床研究，对瘦肉量、肌量可能有益，但整体而言并不优于睾酮[115-117]。

活性维生素 D：常用于 65 岁以上的老年人，在中华医学会原发性骨质疏松诊疗指南中也有类似推荐[118]。1α,25-双羟维生素 D_3 和艾迪骨化醇（活性维生素 D 类似物）可诱导成肌细胞的分化[119]。活性维生素 D 使用可增加肌肉强度和减少跌倒风险。但是还缺少使用活性维生素 D 增加肌量的直接证据。Meta 分析表明使用阿法骨化醇治疗 1 年的患者其外周 SMI 无显著变化，而下肢肌量明显增加；而对照组在 1 年后 SMI 显著降低，下肢肌量无显著变化[120]。

生长激素类药物：研究提示生长激素可增加老年人的瘦肉量和肌量，与睾酮联合应用可在 8 周内增加肌量，在 17 周达到最大肌肉强度。不良反应包括关节肌肉疼痛、水肿、腕管综合征和高血糖、心血管疾病风险、男性乳房发育等[121]。生长激素释放肽 Ghrelin 会增加摄食和生长激素分泌，研究显示其可使癌症患者、老年肌少症患者摄食增加和获得肌量，安全性方面还需要进一步观察[122-123]。

交感神经 β2 受体兴奋剂： 克伦特罗（clenbuterol）在心力衰竭患者中能使肌量增加；然而，丹麦大规模的病例对照研究表明使用短效 β-兴奋剂会增加骨质疏松性骨折的危险，其他类型的 β-兴奋剂对骨质疏松性骨折患者没有影响[124-125]。Espindolol 是一种吲哚洛尔的 S-对映体，能使高龄动物的肌量增加、脂肪量减少，Ⅱ期临床研究提示其可以增加肌量、握力和降低脂肪量[126]。

血管紧张素转换酶抑制剂（angiotensin-converting enzyme inhibitors，ACEI）： 有研究显示培哚普利可增加左室收缩功能障碍老年人的行走距离[127]。HYVET 研究表明培哚普利会降低髋部骨折的风险[128]。但尚缺少 ACEI 对骨骼肌作用的直接证据。

其他药物： 如肌肉生长抑制素（Myostatin）抗体、活化素 II 受体配体捕获剂（ACE-031）等，可能改善肌量及瘦肉量，后者的动物研究显示其可增加猴子的骨量和骨强度，这些以肌肉为靶点的新型药物尚在研发当中[129-130]。

康复治疗

康复治疗主要包括运动疗法和物理因子治疗，有氧运动和抗阻训练均能减少随着年龄增加的肌肉质量和肌肉力量的下降。对缺乏运动或受身体条件制约不能运动的老年人，可使用水疗、全身振动和功能性电刺激（functional electrical stimulation，FES）等物理治疗[131]。此外，其他物理因子，如电磁场、超声等在肌肉减少的防治中也有一定作用，但具体作用机制和应用条件还有待进一步明确。

总之，肌肉与骨骼具有密切关联。临床工作中应扩宽思路，提高对老年人群常常共存的两种疾病即肌少症与骨质疏松症的认识，应该同步考虑这两种密切相关疾病的诊断，并对肌少症给予积极有效的防治。

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