从太极拳练习到微循环改善：潜在机制与研究展望

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摘要：背景：微循环是心血管系统的终极器官，是一个复杂且异质的网络，由连接动脉和静脉系统的末端小动脉、毛细血管和小静脉组成，作为循环系统的最末端，也是血液中营养物质、氧气等交换的主要场所。太极拳动作具有螺旋式的伸缩旋转特点，并且练习过程中主张“以意导气，以气运身”，身体松静，达于手足尖端，可以畅通气血。中医历代名家认为气血关系密切，因此，太极拳运动与人体微循环有很密切的联系。**目的：**本研究主要综述太极拳习练对微循环的积极影响，探讨太极拳练习微循环的可能机制，并对未来研究方向作出展望。**方法：**采用文献资料法，通过关键词“太极拳”、“微循环”、“微血管”、“血流动力学”、“血液流变学”、“经皮氧分压”、“调节机制”等关键词在中国知网数据库、万方数据库、Pubmed 数据库、Web of Science 数据库搜索相关文献，为太极拳练习改善微循环的作用，及其潜在调节机制，提供理论支撑。**结果：**1.太极拳影响微循环集中在四个方面（1）在血管形态方面，太极拳运动改善微血管形态异常（2）基于血流动力学视角，太极拳运动改善微血管反应性，增强血流灌注能力（3）基于血液流变学视角，太极拳运动降低血液粘度，促进血液循环（4）太极拳运动改善经皮氧分压，提高氧合能力。2.微循环调节机制：运动调节微循环的机制多样化：（1）促使血管生成因子 VEGF 增加导致毛细血管生长，改善微血管网络，降低血管阻力（2）引起血管收缩与扩张的影响因子的平衡，如前列环素以及血栓素等（3）减少氧化应激反应，增强抗氧化能力，改善氧化还原环境（4）促进自主神经系统中交感系统与副交感系统的平衡，降低交感神经活性，增强副交感神经活性（5）促炎性细胞因子降低，增强抗炎因子，改善促炎与抗炎平衡。（6）增强 NO 释放，增强内皮依赖性舒张能力（7）增强血流动力变化，增加剪切应力。运动调节微循环的机制较为复杂多样，在调节微循环的过程中可能涉及到多种机制协同作用。3.太极拳可能影响微循环的机制：（1）太极拳运动通过提高 NO 含量，增强血管舒张能力，来改善微循环（2）太极拳运动通过降低炎性因子血清白介素、肿瘤坏死因子来改善微循环（3）太极拳运动改善自主神经平衡性，来改善微循环。（4）太极拳运动增强抗氧化能力，来改善微循环。**结论：**1.太极拳运动改善微循环的循证研究初步见效，但需要增强自身系统理

论或者视角研究，缺乏诸如中医治病辩证、五行生克的太极拳机理。2 目前对于太极拳调节微循环的机制研究多样化，如神经调节、抗炎、抗氧化调节、血管收缩舒张调节等，但是对太极拳促进微循环调节机制研究仍需要扩展，针对关键分子的研究需要扩充；针对调节机制需要点线结合，形成调节路径范式。

关键词：太极拳；微循环；机制

From tai chi practice to microcirculation improvement : potential mechanisms and research prospects

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Abstract: Background: Microcirculation is the ultimate organ of the cardiovascular system. It is a complex and heterogeneous network composed of terminal arterioles, capillaries and venules connecting arteries and venous systems. As the end of the circulatory system, it is also the main place for the exchange of nutrients and oxygen in the blood. Tai Chi movement has the characteristics of spiral expansion and rotation, and in the process of practice, it advocates ' guiding qi with meaning and transporting body with qi '. The body is relaxed and quiet, reaching the tip of the hand and foot, which can smooth qi and blood. Famous doctors of traditional Chinese medicine believe that qi and blood are closely related. Therefore, Tai Chi exercise is closely related to human microcirculation. **Objective:** This study mainly reviews the positive effects of Taijiquan practice on microcirculation, discusses the possible mechanism of Taijiquan practice microcirculation, and looks forward to the future research direction. Methods: Using the method of literature, through the keywords “Tai Chi”, “microcirculation”, “microvessel”, “hemodynamics”, “hemorheology”, “transcutaneous oxygen partial pressure”, “regulation mechanism” and other keywords in the CNKI database, Wanfang database, Pubmed database, Web of Science database search related literature, for Tai Chi practice to improve the role of microcirculation, and its potential regulatory mechanism, to provide theoretical support. **Results:** 1.Tai Chi affects microcirculation in four aspects (1) In terms of vascular morphology, taijiquan exercise improves microvascular morphological abnormalities (2) Based on the perspective of hemodynamics, Tai Chi exercise improves microvascular reactivity and enhances blood perfusion (3) Based on the perspective of hemorheology, taijiquan exercise reduces blood

viscosity and promotes blood circulation (4) Tai Chi exercise improves transcutaneous oxygen partial pressure and improves oxygenation capacity. 2.Microcirculation regulation mechanism : The mechanism of exercise regulating microcirculation is diversified : (1) Promote the increase of angiogenesis factor VEGF to lead to capillary growth, improve the microvascular network, and reduce vascular resistance (2) Cause the balance of factors affecting vasoconstriction and dilation, such as prostacyclin and thromboxane (3) Reduce oxidative stress, enhance antioxidant capacity, and improve redox environment (4) Promote the balance of sympathetic and parasympathetic systems in the autonomic nervous system, reduce sympathetic activity, and enhance parasympathetic activity (5) Reduce pro-inflammatory cytokines, enhance anti-inflammatory factors, and improve the balance of pro-inflammatory and anti-inflammatory. (6) Enhanced NO release, enhanced endothelium-dependent relaxation ability. (7) Enhance hemodynamic changes and increase shear stress. The mechanism of microcirculation regulation by exercise is more complex and diverse, and multiple mechanisms may be involved in the process of regulating microcirculation. The mechanism of Tai Chi may affect microcirculation: (1) Tai Chi exercise improves microcirculation by increasing NO content and enhancing vasodilation. (2) Tai Chi exercise improves microcirculation by reducing inflammatory factors serum interleukin and tumor necrosis factor. (3) Tai Chi exercise improves autonomic nerve balance and improves microcirculation. (4) Tai Chi exercise enhances antioxidant capacity to improve microcirculation. **Conclusion:** 1. Evidence-based research on Tai Chi exercise to improve microcirculation has achieved initial results, but it is necessary to strengthen its own system theory or perspective research, and lack of Tai Chi mechanism such as TCM syndrome differentiation and five elements. At present, the research on the mechanism of Tai Chi regulating microcirculation is diversified, such as nerve regulation, anti-inflammatory, anti-oxidation regulation, vasoconstriction and relaxation regulation, but the research on the mechanism of Tai Chi promoting microcirculation regulation still needs to be expanded, and the research on key molecules needs to be expanded. The regulation mechanism requires a combination of points and lines to form a regulation path paradigm.

Keywords: Tai Chi; microcirculation; mechanism

分论坛 3：太极拳数字化传播与创新发展研究