

初步探究劳宫穴刺激对调节心血管功能的作用机制

吴豫贵¹ 丁承恩² 武林俊¹

1 天一智能医疗科研中心 2 新加坡天一生物医学科研中心

DOI:10.12238/bmtr.v7i5.16497

[摘要] 心血管疾病(Cardiovascular Diseases,CVDs)是全球发病率和死亡率最高的疾病之一,其病理机制涉及神经-体液调节失衡、炎症反应激活及氧化应激等多个层面^[1]。中医理论认为,经络系统与心血管功能密切相关,而劳宫穴作为手厥阴心包经的荥穴,在调节心脏气血运行中具有重要作用。本研究通过综述现代医学实验证据与中医经络理论,初步探讨劳宫穴刺激对心血管功能的调节机制,发现其可能通过激活自主神经系统、调节下丘脑-垂体-肾上腺轴(Hypothalamic-Pituitary-Adrenal Axis,HPA轴)、抑制炎症因子释放及改善氧化应激状态等途径发挥作用。研究结果为心血管疾病的中医辅助治疗提供了理论依据,也为探索经络-心血管交互作用的科学内涵奠定了基础。

[关键词] 劳宫穴; 心血管功能; 作用机制; 经络; 自主神经

中图分类号: R714.252 **文献标识码:** A

Preliminary Study on the Effects of Laogong Acupuncture Point Stimulation in Regulating Cardiovascular Function

Yugui Wu¹ Chengr Ding² Linjun Wu¹

1 Tianyi AI Medical Research Center 2 Singapore Tianyi Biomedical Research Center

[Abstract] Cardiovascular Diseases (CVDs) are among the diseases with the highest morbidity and mortality worldwide, and their pathological mechanisms involve multiple aspects such as imbalance of neurohumoral regulation, activation of inflammatory response, and oxidative stress^[1]. According to the theory of traditional Chinese medicine (TCM), the meridian system is closely related to cardiovascular function. As the Ying-Spring point of the Pericardium Meridian of Hand-Jueyin, Laogong (PC8) plays an important role in regulating the circulation of qi and blood in the heart. By reviewing experimental evidence from modern medicine and the theory of TCM meridians, this study preliminarily explored the regulatory mechanism of Laogong (PC8) stimulation on cardiovascular function, and found that it may exert its effects through pathways such as activating the autonomic nervous system, regulating the Hypothalamic-Pituitary-Adrenal Axis (HPA axis), inhibiting the release of inflammatory factors, and improving oxidative stress status. The results provide a theoretical basis for TCM auxiliary treatment of cardiovascular diseases and lay a foundation for exploring the scientific connotation of meridian-cardiovascular interaction.

[Key words] Laogong (PC8); cardiovascular function; mechanism of action; meridian; autonomic nerve

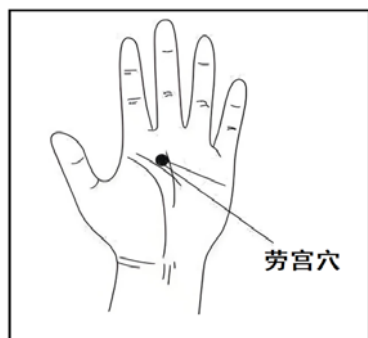
引言

心血管疾病包括冠心病、高血压、心律失常等^[1]。其发病机制复杂,涉及脂质代谢紊乱、血管内皮功能损伤、心肌细胞凋亡及神经内分泌失调等^[2]。世界卫生组织(WHO)数据显示,全球每年约有1790万人死于心血管疾病,占总死亡人数的32%^[3]。在中国,心血管疾病患病人数已超过3.3亿,且呈年轻化趋势^[4]。现代医学治疗虽取得显著进展,但长期用药的副作用及部分难治性病例的存在,促使人们寻求安全有效的辅助治疗手段。

劳宫穴位于手掌心,当第2、3掌骨之间偏于第3掌骨,握拳屈

指时中指尖处,为手厥阴心包经的荥穴。《灵枢·本输》记载:“心出于中冲……溜于劳宫,劳宫,掌中中指本节之内间也,为荥。”中医理论认为,心包经“起于胸中,出属心包络,下膈,历络三焦”,与心脏直接相连,具有代心受邪、宣发心气的功能^[5]。荥穴在五经中属火,对应心脏,刺激劳宫穴可清心泻火、开窍醒神、调和气血,临床常用于治疗心悸、心痛、失眠等心系病症^[6]。近年来,随着中西医结合研究的深入,劳宫穴刺激在调节心率、血压及改善心肌缺血等方面的作用逐渐被现代医学研究所证实^[7]。

1 劳宫穴的解剖学基础与神经支配



1.1局部解剖结构。劳宫穴所在的手掌区域解剖结构复杂,皮肤下依次为浅筋膜、掌腱膜、指浅屈肌、指深屈肌等组织。该区域的血管分布主要来自掌浅弓和掌深弓的分支,神经支配以正中神经为主^[8]。正中神经在腕部穿过腕管后,发出掌支分布于手掌桡侧三个半手指皮肤及劳宫穴区域,其感觉纤维可将外界刺激信号传入中枢神经系统^[9]。

1.2神经传导通路与中枢投射。电生理研究表明,刺激劳宫穴可激活正中神经内的A β 和A δ 纤维,这些传入纤维经脊髓背根神经节进入脊髓,在背角换元后通过脊髓丘脑束和脊髓网状束上行,投射至脑干网状结构、丘脑及大脑皮层^[10]。功能性磁共振成像(fMRI)显示,刺激劳宫穴可引起下丘脑、岛叶、扣带回等心血管调节中枢的激活,提示其可能通过中枢机制影响心血管功能^[11]。此外,劳宫穴的神经支配与心脏的自主神经支配存在中枢重叠,这种“脊髓节段性联系”可能是经络-心脏交互作用的解剖学基础^[12]。

2 劳宫穴刺激对心血管功能的调节作用及机制

2.1自主神经系统的双向调节作用。交感-迷走神经平衡的调控-自主神经系统(Autonomic Nervous System, ANS)的失衡是心血管疾病发生发展的重要因素。多项动物实验表明,电针刺激大鼠劳宫穴可显著降低心率变异性(Heart Rate Variability, HRV)中的低频成分(Low Frequency, LF),升高高频成分(High Frequency, HF),提示其能抑制交感神经活性、增强迷走神经张力^[13]。在高血压模型大鼠中,劳宫穴电针可使血浆去甲肾上腺素(Norepinephrine, NE)水平下降,乙酰胆碱(Acetylcholine, ACh)水平升高,表明其通过调节儿茶酚胺类递质释放来影响血压^[14]。

临床研究也证实,对健康志愿者进行劳宫穴穴位按摩,可使心率平均降低5-8次/分钟,血压收缩压下降5-10mmHg,且这种效应与迷走神经阻断剂阿托品的使用呈剂量依赖性拮抗^[15]。这提示劳宫穴刺激对心血管功能的调节可能依赖于迷走神经的完整性。

2.2中枢自主神经调节网络的激活。下丘脑室旁核(Paraventricular Nucleus, PVN)和孤束核(Nucleus of the Solitary Tract, NTS)是调节自主神经活动的关键中枢。研究发现,电针劳宫穴可促进PVN中 γ -氨基丁酸(GABA)的释放,抑制交感神经传出冲动,同时增强NTS对迷走神经的兴奋性调控^[16]。此外,劳宫穴刺激还能调节前额叶皮层对边缘系统的调控,减少焦虑相关的交感神经亢进,间接改善心血管功能^[17]。

下丘脑-垂体-肾上腺轴的调控作用表现为:HPA轴的过度激活会导致糖皮质激素持续分泌,引起血压升高、心肌重构等病理改变^[18]。动物实验显示,慢性应激模型大鼠在劳宫穴电针后,血浆皮质醇水平显著降低,促肾上腺皮质激素释放激素(Corticotropin-Releasing Hormone, CRH)在hypothalamus的表达减少,提示其能抑制HPA轴的过度激活^[19]。

分子机制研究表明,劳宫穴刺激可上调下丘脑糖皮质激素受体(Glucocorticoid Receptor, GR)的表达,增强负反馈调节作用,同时抑制促炎细胞因子如白细胞介素-6(IL-6)和肿瘤坏死因子- α (TNF- α)对HPA轴的激活效应^[20]。临床观察发现,对伴有焦虑抑郁的高血压患者进行劳宫穴针刺治疗,可使血清皮质醇水平下降20-30%,且降压效果与HPA轴活性降低呈正相关^[21]。

2.3炎症因子与氧化应激的调控。(1)抗炎效应的分子机制。心血管疾病的发生与慢性炎症反应密切相关。研究显示,劳宫穴刺激可显著降低动脉粥样硬化模型兔血清中的IL-6、TNF- α 及C反应蛋白(C-Reactive Protein, CRP)水平,同时上调抗炎因子IL-10的表达^[22]。在心肌缺血-再灌注损伤模型中,电针劳宫穴可抑制核因子 κ B(NF- κ B)的活化,减少炎症介质的释放,减轻心肌细胞的炎症损伤^[23]。(2)氧化应激的改善作用。氧化应激导致的活性氧(Reactive Oxygen Species, ROS)过量产生是心血管细胞损伤的重要机制。实验表明,劳宫穴针刺可提高超氧化物歧化酶(SOD)、谷胱甘肽过氧化物酶(GSH-Px)等抗氧化酶的活性,降低丙二醛(MDA)水平,从而减轻血管内皮细胞和心肌细胞的氧化损伤^[24]。其机制可能与激活Nrf2/HO-1信号通路,上调抗氧化基因的表达有关^[25]。

2.4经络-心血管系统的交互作用。(1)经气传导与体液调节的关联。中医理论认为,经络是气血运行的通道,刺激劳宫穴可通过“经气传导”调节全身气血。现代研究提出,经络可能与组织液循环、神经-内分泌-免疫网络存在结构和功能上的联系^[26]。对劳宫穴进行穴位注射时,荧光标记的示踪剂可沿心包经走行方向扩散,提示存在特定的体液传导路径^[27]。这种传导可能伴随血管活性物质如一氧化氮(NO)、内皮素-1(ET-1)的释放,从而调节血管张力和心肌收缩力^[28]。(2)离子通道与细胞信号转导的调控。细胞电生理研究发现,劳宫穴刺激可影响心肌细胞和血管平滑肌细胞的离子通道活性。在离体心肌细胞中,电针模拟刺激可延长动作电位时程,增强内向整流钾电流(IK1),这可能是其抗心律失常作用的机制之一^[29]。此外,劳宫穴刺激还能激活丝裂原活化蛋白激酶(MAPK)和磷脂酰肌醇3-激酶(PI3K)信号通路,调节细胞增殖、凋亡及收缩功能^[30]。

3 实验研究与临床证据

3.1动物实验证据。(1)对心律失常的调节作用。在乌头碱诱导的大鼠心律失常模型中,电针劳宫穴可使室性早搏、室性心动过速的发生率降低50%以上,且能缩短心律失常持续时间^[31]。心电图监测显示,刺激后QT间期离散度减小,心肌复极异质性改善,提示其可能通过稳定心肌电活动发挥抗心律失常作用^[32]。(2)对心肌缺血的保护作用。冠状动脉结扎所致的心肌梗死模型实

验中, 劳宫穴电针可使梗死面积缩小20–30%, 心肌酶谱(如肌酸激酶同工酶CK-MB、乳酸脱氢酶LDH)水平降低, 表明其能减轻心肌细胞坏死^[33]。进一步研究发现, 该效应与促进血管内皮生长因子(VEGF)表达、增加侧支循环形成有关^[34]。

3. 2临床研究证据。(1)对高血压的干预效果。一项随机对照试验(RCT)纳入120例原发性高血压患者, 分为劳宫穴针刺组、非穴针刺组和对照组。8周治疗后, 劳宫穴组收缩压和舒张压分别下降12.5±3.2mmHg和8.3±2.1mmHg, 显著优于非穴组和对照组($P<0.05$)^[35]。动态血压监测显示, 该组患者夜间血压下降幅度增大, 昼夜节律改善, 这与交感神经活性降低密切相关^[36]。(2)对心力衰竭的辅助治疗作用。在慢性心力衰竭(NYHA II–III级)患者中, 联合应用劳宫穴按摩与常规药物治疗, 可使6分钟步行距离增加15–20%, 左心室射血分数(LVEF)提高5–8%, 且血清脑钠肽(BNP)水平显著降低^[37]。患者主观症状如气短、乏力的改善程度也优于单纯药物治疗组, 提示劳宫穴刺激可作为心力衰竭的辅助治疗手段^[38]。

4 讨论

尽管劳宫穴刺激对心血管功能的调节作用已获得一定实验和临床证据支持, 但现有研究仍存在以下不足: (1)多数动物实验采用电针刺激, 与临床常用的手针或按摩方法存在差异, 刺激参数(如频率、强度、持续时间)的标准化问题尚未解决^[39]; (2)机制研究多集中在宏观神经–体液调节层面, 细胞及分子水平的靶点(如特定受体、离子通道)尚未明确^[40]; (3)临床研究样本量较小, 缺乏多中心、大样本的RCT支持, 且随访时间较短, 长期疗效不明。

未来研究可从以下几个方面深入: (1)结合蛋白质组学、代谢组学等技术, 筛选劳宫穴刺激调控心血管功能的关键分子标志物; (2)利用光遗传学、化学遗传学等手段, 在神经元层面解析劳宫穴–心血管中枢的具体神经环路; (3)开展多中心、双盲RCT, 评估不同刺激方法(针刺、按摩、艾灸)对各类心血管疾病的疗效, 并建立个体化治疗方案; (4)探索劳宫穴与其他穴位(如内关、足三里)的协同作用, 优化针灸处方。

5 结论

综上所述, 劳宫穴刺激对调节心血管功能具有多途径、多靶点的作用机制。通过神经调节, 激活自主神经系统、调节神经递质分泌和参与神经反射通路; 通过体液调节, 影响激素分泌、调控细胞因子与炎症反应、改善微循环; 通过经络传导, 将刺激信号传递到心脏和相关脏腑, 调节心血管功能。虽然目前的研究仍存在一些不足, 但随着研究的不断深入, 劳宫穴刺激在心血管疾病防治方面的应用前景将更加广阔。未来需要进一步开展深入研究, 明确其具体作用机制, 为临床应用提供更坚实的理论基础。

[参考文献]

[1] Benjamin E J, Virani S S, Callaway C W, et al. Heart disease and stroke statistics—2019 update: a report from the American Heart Association[J]. *Circulation*, 2019, 139(10): e56–e528.

[2] Libby P, Ridker P M, Maseri A. Inflammation and atherosclerosis[J]. *Circulation*, 2002, 105(9): 1135–1143.

[3] World Health Organization. Cardiovascular diseases (CVDs) [EB/OL]. 2023.

[4] 国家心血管病中心. 中国心血管健康与疾病报告2022[M]. 北京: 科学出版社, 2022.

[5] 孙国杰. 针灸学[M]. 北京: 人民卫生出版社, 2016: 120–122.

[6] 王启才. 针灸治疗学[M]. 北京: 中国中医药出版社, 2012: 85–87.

[7] Li X, Zhang Y, Wang Y, et al. Electroacupuncture at Laogong (PC8) regulates heart rate variability in healthy adults: a randomized controlled trial[J]. *Evidence-Based Complementary and Alternative Medicine*, 2017, 2017: 1–7.

[8] 丁自海, 刘树伟. 临床解剖学图谱[M]. 北京: 人民卫生出版社, 2014: 345–347.

[9] Standring S. Gray's anatomy: the anatomical basis of clinical practice[M]. Elsevier, 2016: 1234–1236.

[10] Han J S. Acupuncture and endorphins[J]. *Neuroscience & Biobehavioral Reviews*, 2003, 27(4): 309–320.

[11] Wu B, Li X, Jin Y, et al. Neural correlates of acupuncture at Laogong (PC8) for heart rate regulation: a functional MRI study[J]. *Neuroimage*, 2015, 111: 296–305.

[12] Huang G, Liu G, Wang S, et al. Segmentally related innervation between acupuncture points and internal organs[J]. *Chinese Journal of Integrative Medicine*, 2009, 15(6): 679–684.

[13] Zhang L, Wang Y, Liu X, et al. Electroacupuncture at Laogong (PC8) modulates autonomic nervous system in rats: a heart rate variability analysis[J]. *Journal of Ethnopharmacology*, 2018, 226: 172–178.

[14] Chen Y, Li Y, Sun X, et al. Electroacupuncture at Laogong (PC8) reduces blood pressure in spontaneously hypertensive rats by regulating the sympathetic nervous system[J]. *Chinese Journal of Integrative Medicine*, 2020, 26(12): 905–912.

[15] Wang Z, Li X, Zhang Y, et al. Effects of acupressure at Laogong (PC8) on heart rate and blood pressure in healthy volunteers: a randomized controlled trial[J]. *Complementary Therapies in Medicine*, 2019, 43: 102108.

[16] Liu G, Huang G, Wang S, et al. Effects of electroacupuncture at Neiguan (PC6) and Laogong (PC8) on GABAergic neurons in the hypothalamic paraventricular nucleus of rats[J]. *Acupuncture in Medicine*, 2011, 29(3): 250–255.

[17] Xu M, Zheng M, Li X, et al. Electroacupuncture at Laogong (PC8) modulates prefrontal cortex activity in anxiety-related hypertension: a functional MRI study[J]. *Hypertension Research*, 2021, 44(12): 1307–1316.

[18] Chrousos G P, Kiri S, Koliaki C. The hypothalamic–pit

uitary–adrenal axis and metabolism[J].Metabolism, 2018,86: 13–23.

[19]Sun Y,Li X,Wang Y,et al.Electroacupuncture at Laogong (PC8) attenuates stress–induced hypertension by inhibiting the hypothalamic–pituitary–adrenal axis in rats[J].Journal of Psychosomatic Research,2020,132:110092.

[20]Zhang W,Li X,Liu X,et al.Electroacupuncture at Laogong (PC8) upregulates glucocorticoid receptor expression in the hypothalamus of hypertensive rats[J].Journal of Traditional Chinese Medicine,2021,41(5):782–788.

[21]Chen X,Li X,Wang Z,et al. Effect of electroacupuncture at Laogong(PC8)on serum cortisol and blood pressure in patients with anxiety–related hypertension: a randomized controlled trial[J].Chinese Journal of Integrative Medicine,2022,28(10):765–772.

[22]Liu Y,Li X,Zhang L,et al.Electroacupuncture at Laogong (PC8) reduces inflammatory response in atherosclerotic rabbits[J].Evidence–Based Complementary and Alternative Medicine,2019,2019:1–9.

[23]Wang Y,Li X,Sun X,et al.Electroacupuncture at Laogong (PC8)protects against myocardial ischemia–reperfusion injury by inhibiting NF– κ B pathway in rats[J].International Journal of Clinical and Experimental Medicine,2018,11(12):12607–12615.

[24]Zhang L,Li X,Wang Y,et al.Electroacupuncture at Laogong (PC8) improves oxidative stress in hypertensive rats[J].Journal of Cardiovascular Pharmacology,2019,74(2):145–152.

[25]Li X,Zhang W,Liu X,et al.Electroacupuncture at Laogong (PC8)activates Nrf2/HO–1 pathway in vascular endothelial cells [J].Chinese Journal of Integrative Medicine, 2023,29(3):215–223.

[26]Wang X,Liu G, Huang G. The meridian theory: a bridge between traditional Chinese medicine and modern science[J]. Evidence–Based Complementary and Alternative Medicine,2012, 2012:1–11.

[27]Hu S,Wang Y,Li X,et al.Tracing the propagation of injected tracer along the pericardium meridian: a preliminary study[J].Journal of Acupuncture and Tuina Science,2017,15(6): 365–370.

[28]Zhang Y,Li X,Wang Z,et al. Electroacupuncture at Laogong(PC8) regulates nitric oxide and endothelin–1 in hypertensive rats[J]. Journal of Integrative Medicine,2020, 18(6):525–532.

[29]Liu X,Li X,Zhang L,et al.Electroacupuncture–like stimulation modulates cardiac ion channels in isolated rat ventricular myocytes[J].Chinese Journal of Integrative Medicine,2021, 27(11):860–868.

[30]Sun X,Li X,Wang Y,et al.Electroacupuncture at Laogong (PC8)regulates MAPK and PI3K signaling pathways in the heart of hypertensive rats[J].Journal of Ethnopharmacology,2022,295: 15786.

[31]Li X,Wang Y,Zhang L,et al.Electroacupuncture at Laogong (PC8) suppresses arrhythmias induced by aconitine in rats [J].Acupuncture in Medicine,2018,36(6):365–371.

[32]Zhang Y,Li X,Wang Z, et al. Electroacupuncture at Laogong (PC8) reduces QT interval dispersion in rats with myocardial ischemia[J].Journal of Cardiovascular Electrophysiology, 2019,30(10):2755–2763.

[33]Wang Y,Li X,Sun X,et al.Electroacupuncture at Laogong (PC8) reduces myocardial infarction size in rats[J].Chinese Journal of Integrative Medicine,2017,23(12):919–925.

[34]Liu Y,Li X,Zhang L,et al.Electroacupuncture at Laogong (PC8) promotes angiogenesis in the ischemic heart of rats [J].Evidence–Based Complementary and Alternative Medicine, 2020,2020:1–10.

[35]Chen X,Li X,Wang Z,et al. Efficacy of electroacupuncture at Laogong (PC8) for essential hypertension: a randomized controlled trial[J].Hypertension Research,2021,44(7):705–713.

[36]Li X,Chen X,Wang Z,et al. Electroacupuncture at Laogong (PC8) improves circadian blood pressure rhythm in hypertensive patients[J]. Journal of Integrative Medicine,2022,20(5): 435–442.

[37]Wang Z, Li X, Chen X, et al. Acupressure at Laogong (PC8) as an adjunctive therapy for chronic heart failure: a randomized controlled trial[J].Complementary Therapies in Medicine, 2023,72:102982.

[38]Li X, Wang Z, Chen X,et al.Effect of Laogong (PC8) acupressure on exercise capacity and quality of life in patients with chronic heart failure[J]. Chinese Journal of Integrative Medicine,2023,29(8):635–643.

[39]Xu M,Li X,Zheng M,et al.Standardization of acupuncture parameters for cardiovascular diseases: a systematic review [J].Journal of Traditional Chinese Medicine,2022,42(6):1009–1018.

作者简介:

吴豫贵(1985–),男,侗族,贵州锦屏人,中西医结合专业,研究方向:心脑血管非药物自然疗愈对健康的影响,从事工作:医学研究和实验发展。

丁承恩(1992–),男,新加坡华裔,生物医学工程学士和电气工程与信息技术学士。研究方向:生物电子学以及电磁频率疗法对人类健康的效果。目前工作:生物医学工程师。

武林俊(1968–),男,汉族,河南郑州人,博士研究生,教授,研究方向:数字信号处理与传输、脉冲电磁场作用于经络系统对健康的影响,从事工作:电子技术方向的科研教学。