

doi: 10.13241/j.cnki.pmb.2019.02.031

肌内效贴镇痛联合康复训练对脑卒中偏瘫患者下肢运动功能、步行参数和生活质量的影响 *

邵慧兴 马 力 刘湘敏 刘 蕊 钟晓俊

(南方医科大学附属医院/广州市花都区人民医院康复医学科 广东 广州 510800)

摘要 目的:探讨肌内效贴镇痛联合康复训练对脑卒中偏瘫患者下肢运动功能、步行参数和生活质量的影响。**方法:**选取 2017 年 1 月-2018 年 1 月期间我院收治的脑卒中偏瘫患者 200 例为研究对象。根据随机数表法将患者分为对照组 (n=100) 与观察组 (n=100)。两组患者均接受常规康复训练,观察组在此基础上联合肌内效贴镇痛治疗。两组均治疗 4 周,观察并比较两组患者治疗前后下肢运动功能、步行参数和生活质量。**结果:**两组患者治疗后简化 Fugl-Meyer 运动功能量表(FMA-L)、徒手肌力测试(MMT)、Berg 平衡量表(BBS)均较治疗前升高,且观察组高于对照组($P<0.05$);两组患者治疗后改良 Ash-worth 量表(MAS)、计时起立行走测试(TGUT)均较治疗前降低,且观察组低于对照组($P<0.05$)。两组患者治疗后步速、步幅、患侧步长、健侧步长、步态周期、双腿支撑期均较治疗前升高,且观察组高于对照组($P<0.05$);两组患者治疗后步态不对称指数较治疗前降低,且观察组低于对照组($P<0.05$)。两组患者治疗后 Barthel 指数(BI)较治疗前升高,且观察组高于对照组($P<0.05$)。**结论:**肌内效贴镇痛与康复训练联合治疗脑卒中偏瘫患者,疗效满意,可显著改善患者下肢运动功能、步行参数以及生活质量。

关键词:肌内效贴;康复训练;脑卒中偏瘫;下肢运动功能;步行参数;生活质量

中图分类号:R743 文献标识码:A 文章编号:1673-6273(2019)02-342-04

Effect of Intramuscular Acombined with Rehabilitation Training on Lower Limb Motor Function, Walking Parameters and Quality of Life in Stroke Patients with Hemiplegia*

SHAO Hui-xing, MA Li, LIU Xiang-min, LIU Rui, ZHONG Xiao-jun

(Department of Rehabilitation Medicine, Huadu Hospital Affiliated to Southern Medical University·Huadu District People's Hospital of Guangzhou, Guangzhou, Guangdong, 510800, China)

ABSTRACT Objective: To investigate the effects of intramuscular analgesic combined with rehabilitation training on lower limb motor function, walking parameters and quality of life in stroke patients with hemiplegia. **Methods:** 200 patients with hemiplegia who were treated in our hospital from August 2017 to January 2018 were selected as the subjects. According to the number table method, the patients were randomly divided into control group (n=100) and observation group (n=100). The two groups were all received routine rehabilitation training, and the observation group combined with intramuscular therapy on the basis of control group. The two groups were treated for 4 weeks, the lower limb motor function, walking parameters and quality of life of the two groups before and after treatment were observed and compared. **Results:** The simplified Fugl-Meyer exercise function scale (FMA-L), unarmed strength test (MMT) and Berg balance scale (BBS) in the two groups after treatment were higher than those before treatment, and the observation group was higher than that of the control group ($P<0.05$). The improved Ash-worth scale (MAS) and timed walking test (TGUT) in the two groups after treatment were lower than those before treatment, and the observation group was lower than that of the control group ($P<0.05$). The pace, stride, affected side stride length, normal side stride length, gait cycle and leg support in the two groups after treatment were all higher than those before treatment, and the observation group was higher than that of the control group ($P<0.05$). The gait asymmetry index of the two groups decreased after treatment, and the observation group was lower than that of the control group ($P<0.05$). The Barthel index (BI) of the two groups increased after treatment, and the observation group was higher than that of the control group ($P<0.05$). **Conclusion:** Intramuscular analgesic combined with rehabilitation training for stroke patients with hemiplegia can significantly improve the lower limb motor function, walking parameters and quality of life.

Key words: Intramuscular analgesic; Rehabilitation training; Stroke hemiplegia; Lower limb motor function; Walking parameters; Quality of life

Chinese Library Classification(CLC): R743 **Document code:** A

Article ID: 1673-6273(2019)02-342-04

* 基金项目:广州市花都区科技计划项目(17-HDWS-011)

作者简介:邵慧兴(1978-),女,硕士,主治医师,从事中西医结合治疗相关疾病方面的研究,E-mail:tyeybg@163.com

(收稿日期:2018-04-27 接受日期:2018-05-23)

前言

脑卒中是因脑部血管突然破裂或者血管阻塞导致血液不能流向大脑引发脑组织损伤的一类疾病,其发病率、致死率、致残率均较高^[1-3]。尽管现代神经医疗以及康复技术迅猛发展,但脑卒中后遗留的功能障碍并发症发生率仍居高不下,尤其是脑卒中偏瘫患者下肢运动功能的丧失,给患者的日常生活带来了极大的影响^[45],因此,探索如何快速有效的改善脑卒中偏瘫患者的下肢运动能力具有重要的临床意义。有学者研究报道,脑卒中偏瘫患者仅进行常规的康复训练,效果一般,加之脑卒中偏瘫患者康复训练过程中反复进行膝关节过度伸展易形成累积性损伤,阻碍患者康复进程^[67]。肌内效贴是一种贴于体表的贴布,具有消肿、止痛、放松以及促进软组织功能活动的效用^[89]。鉴于此,本研究通过探讨肌内效贴镇痛联合康复训练对脑卒中偏瘫患者下肢运动功能、步行参数和生活质量的影响,旨在为临床治疗脑卒中偏瘫患者提供数据支持,现作如下报道。

1 资料与方法

1.1 一般资料

选取 2017 年 1 月 -2018 年 1 月期间我院收治的 200 例脑卒中偏瘫患者。纳入标准:(1)所有患者均符合中华医学会制定的 2007 版《全国脑血管病学术会议》中有关脑卒中相关诊断标准^[10];(2)均经头颅 CT 或 MRI 确诊;(3)患者意识清晰,可单独配合完成本次相关训练及评估;(4)病程不超过 1 年;(5)患者及其家属知情本研究并签署知情同意书。排除标准:(1)伴有肝、肾等脏器功能障碍者;(2)伴有肩周炎、类风湿性关节炎等疾病者;(3)双侧大脑发生障碍,双侧肢体均有病变者;(4)患有精神疾病者;(5)伴有其他影响步行的疾病者。根据随机数表法将患者分为对照组(n=100)与观察组(n=100),其中对照组男 52 例,女 48 例,年龄 44-65 岁,平均(53.28±4.59)岁;病程 2-10 d,平均(5.17±1.05)d;病变性质:脑梗死 61 例,脑出血 39 例;左侧 47 例,右侧 53 例。观察组男 55 例,女 45 例,年龄 46-68 岁,平均(54.38±5.06)岁;病程 3-12 d,平均(5.46±1.25)d;病变性质:脑梗死 58 例,脑出血 42 例;左侧 44 例,右侧 56 例。两组患者一般资料比较无差异(P>0.05),本研究经我院伦理委员会批准同意。

1.2 治疗方法

两组患者入院后均行常规治疗,随后两组患者均接受常规康复训练,具体训练包括:关节活动度训练、躯干、骨盆控制训练、重心转移训练、立位平衡训练、患侧下肢负重训练等,每次训练均持续 30 min,2 次/d,5 d/周,持续常规康复训练 4 周。在此基础上,观察组联合肌内效贴镇痛治疗,贴扎前在患侧贴一长为 5 cm 肌效贴,进行 24 h 过敏试验,试验未过敏者进行以下贴扎。具体操作如下:(1)采用 Y 形贴布自然拉力,患者体位仰卧位,患者下肢屈曲,锚端固定于大腿近端,尾端沿股四头肌走行绕髌骨于胫骨粗隆汇合;(2)使用 Y 形贴布自然拉力,患者体位俯卧位,患者下肢充分背屈,锚端固定于跟腱处,尾端沿腓肠肌两侧走行分别止于胫骨内外踝起点;(3)采用 I 形贴布自然拉力,患者体位呈仰卧位,患者下肢踝部中立,锚端固定于胫骨外侧踝下,尾端沿小腿前外侧止于足背。上述肌内效贴镇

痛治疗两天更换一次,共治疗 4 周。

1.3 观察指标

(1)下肢运动功能 于治疗前、治疗 4 周后(治疗后)采用简化 Fugl-Meyer 运动功能量表^[11](Fugl-Meyer assessment of lower extremity motor, FMA-L)评定患者下肢运动功能(总分 34 分,得分越高下肢功能越好);于治疗前后采用徒手肌力测试^[12](manual muscle test, MMT)评价股四头肌肌力(0-5 分,得分越高股四头肌肌力恢复越好);于治疗前后采用 Berg 平衡量表^[13](Berg balance scale, BBS)评价下肢平衡能力(动作总共 14 套,每套评分 0-4 分,总分 56 分,得分越高下肢平衡能力越好);于治疗前后采用改良 Ash-worth 量表^[14](modified Ash-worth scale, MAS)评价小腿三头肌张力(0-4 分,得分越低小腿三头肌张力越好);于治疗前后记录计时起立行走测试(timed get up and go test, TGUT):患者收到指令后,从坐到站,随后走 3 m 后回到原点并坐下这一系列动作的时间。(2)步行参数 于治疗前后记录患者步行参数,要求患者独立完成 10 m 长步道,记录步速、步幅、患侧步长、健侧步长、步态周期、双腿支撑期、步态不对称指数。其中步态不对称指数计算方法:(患侧摆动相-健侧摆动相)/(患侧摆动相+健侧摆动相)*100%。(3)生活质量 采用 Barthel 指数^[15](Barthel index, BI)评分量表评价两组患者生活质量,BI 评分量表包含 10 项内容,总分 100 分,分数越高生活质量越高。

1.4 统计学方法

研究数据录入 SPSS25.0 软件处理,计量资料用($\bar{x} \pm s$)表示,采用 t 检验,计数资料以率(%)表示,采用卡方检验,检验标准设置为 $\alpha=0.05$ 。

2 结果

2.1 两组患者治疗前后下肢运动功能比较

两组患者治疗前 FMA-L、MMT、BBS、MAS 以及 TGUT 比较差异无统计学意义(P>0.05);两组患者治疗后 FMA-L、MMT、BBS 均较治疗前升高,且观察组高于对照组(P<0.05);两组患者治疗后 MAS、TGUT 均低于治疗前,且观察组低于对照组(P<0.05);详见表 1。

2.2 两组患者步行参数比较

两组患者治疗前步速、步幅、患侧步长、健侧步长、步态周期、双腿支撑期、步态不对称指数比较差异无统计学意义(P>0.05);两组患者治疗后步速、步幅、患侧步长、健侧步长、步态周期、双腿支撑期均较治疗前升高,且观察组高于对照组(P<0.05);两组患者治疗后步态不对称指数较治疗前降低,且观察组低于对照组(P<0.05);详见表 2。

2.3 两组患者治疗前后生活质量比较

两组患者治疗前 BI 比较无差异(P>0.05);两组患者治疗后 BI 较治疗前升高,且观察组高于对照组(P<0.05);详见表 3。

3 讨论

患者一旦发生脑卒中,脱离了生命危险后,依然伴随着不同严重程度的并发症发生^[16]。患者的高级神经中枢对于控制自身平衡的能力受限,低级神经中枢支配的异常运动模式则取代正常的运动模式,因此,脑卒中偏瘫患者在步行以及运动的

表 1 两组患者治疗前后下肢运动功能比较($\bar{x} \pm s$)

Table 1 Comparison of lower limb motor function in two groups before and after treatment($\bar{x} \pm s$)

Groups	FMA-L(score)		MMT(score)		BBS(score)		MAS(score)		TGUT(s)	
	Before	After	Before	After	Before	After	Before	After	Before	After
	treatment	treatment	treatment	treatment	treatment	treatment	treatment	treatment	treatment	treatment
Control group (n=100)	21.57± 2.52	23.27± 3.26*	3.28± 0.59	3.82± 0.48*	21.64± 3.19	32.12± 3.82*	2.12± 0.53	1.58± 0.65*	31.20± 8.22	24.75± 7.35*
Observation group (n=100)	21.49± 2.49	29.10± 2.92*	3.33± 0.62	4.28± 0.57*	21.97± 3.28	39.85± 4.26*	2.24± 0.47	1.23± 0.52*	32.18± 7.17	18.06± 6.27*
t	0.226	13.321	0.584	6.173	0.721	13.510	1.694	4.205	0.898	6.925
P	0.822	0.000	0.560	0.000	0.472	0.000	0.092	0.000	0.370	0.000

Note: compared with before treatment, *P<0.05.

表 2 两组患者治疗前后步行参数比较($\bar{x} \pm s$)

Table 2 Comparison of walking parameters between two groups before and after treatment ($\bar{x} \pm s$)

Groups	Time	Pace(m/s)	Stride(m)	Affected side	Normal side	Gait cycle(s)	Leg support (s)	Gait asymmetry index
				stride length	stride length			
				(m)	(m)			
Control group (n=100)	Before treatment	0.41± 0.16	0.49± 0.21	0.31± 0.16	0.35± 0.18	1.06± 0.37	0.49± 0.09	0.26± 0.08
	After treatment	0.47± 0.14*	0.57± 0.27*	0.38± 0.15*	0.40± 0.12*	1.17± 0.36*	0.57± 0.16*	0.19± 0.12*
Observation group(n=100)	Before treatment	0.44± 0.13	0.47± 0.27	0.30± 0.13	0.36± 0.17	1.04± 0.42	0.52± 0.13	0.25± 0.07
	After treatment	0.57± 0.12* [#]	0.72± 0.22* [#]	0.46± 0.11* [#]	0.45± 0.15* [#]	1.39± 0.42* [#]	0.68± 0.15* [#]	0.14± 0.09* [#]

Note: compared with that before treatment, *P<0.05; compared with the control group, [#]P<0.05.

表 3 两组患者治疗前后生活质量比较($\bar{x} \pm s$)

Table 3 Comparison of quality of life before and after treatment in the two groups($\bar{x} \pm s$)

Groups	BI(score)	
	Before treatment	After treatment
Control group(n=100)	33.28± 7.19	44.57± 9.26*
Observation group(n=100)	32.26± 8.58	58.19± 10.52*
t	0.911	9.718
P	0.363	0.000

过程当中,患者下肢运动功能遭到异常神经的严重干扰,给患者的日常生活带来严重影响^[17,18]。临床上对于脑卒中偏瘫患者的早期康复治疗,改善患者下肢运动功能是康复训练的最主要目标^[19,20]。近年来肌内效贴在医学和运动领域中获得了一定的应用与关注,肌内效贴的主要作用原理为利用胶布的粘弹性质以及独特的力学方向,同时配合肌动力学以及生物力学,最终达到强化或者放松肌肉的目的^[21,22]。肌内效贴本身不带任何药物成分,一般是由防水弹力棉布、离型材料以及医用压克力胶组成,通常每平方弹力胶布上贴 50-70 g 左右的胶水^[23,24]。国内外多项研究表明,肌内效贴可显著缓解脑卒中后肩手综合征患者肩部疼痛以及肿胀,同时还可改善患者肩关节半脱位状态^[25,26]。

有学者研究报道,降低小腿三头肌张力,加强股四头肌肌力、颈前肌肌力,可维持偏瘫患者随意协调下肢运动模式^[27]。本研究结果显示,观察组 FMA-L、MMT、BBS 评分高于对照组, MAS、TGUT 低于对照组,表明肌内效贴与康复训练联合治疗脑卒中偏瘫患者,对患者下肢运动功能具有显著地改善作用。分析其原因,一方面是由于肌内效贴利用贴布的粘弹性以及自

然拉力,在止痛和消肿的基础上,还可对肌肉关节起到支撑和稳定作用,加强感觉输入以及神经促通,最终改善姿势控制障碍;另一方面在肌内效贴的辅助训练下,偏瘫患者可接收到正确的运动模式引导,持续性的感觉输入类似于治疗师们不断的纠正,提高了治疗效果,缩短了起立行走所需时间,同时贴布与皮肤自然贴合时可产生褶皱,褶皱均具有一定的方向性,可改变筋膜及组织液流向趋势,改善血流微循环^[28]。此外,两组患者治疗后步速、步幅、患侧步长、健侧步长、步态周期、双腿支撑期均较治疗前升高,且观察组高于对照组,治疗后步态不对称指数较治疗前降低,且观察组低于对照组(P<0.05)。表明观察组所采用肌内效贴镇痛联合康复训练对于偏瘫患者各项步行参数控制的更好,分析其作用机制,主要体现在以下几点:肌内效贴具有增加肌肉收缩以及放松肌肉的作用;肌内效贴对皮肤的张力可改善关节的本体感觉;肌内效贴具有一定的矫形作用,可维持正常的着地力线^[29,30]。本研究结果还显示,两组患者治疗后 BI 较治疗前升高,且观察组高于对照组(P<0.05)。提示肌内效贴镇痛联合康复训练可显著改善脑卒中偏瘫患者的生活质

量,主要由于上述联合康复治疗效果较佳,下肢运动功能得到了极大的改善,主观感受得到满足,进而提高生活质量。

综上所述,针对脑卒中偏瘫患者采用肌内效贴与康复训练联合治疗,可促进患者下肢功能的恢复,改善患者生活质量,同时有利于偏瘫患者各项步行参数恢复正常。

参考文献(References)

- [1] Fabri TL, Stewart ML, Stevens SA. Informing pediatric rehabilitation: Language-based neuropsychological profile following traumatic brain injury and stroke secondary to arteriovenous malformation[J]. *J Pediatr Rehabil Med*, 2018, 11(1): 15-21
- [2] Song TJ, Chang Y, Chun MY, et al. High Dietary Glycemic Load is Associated with Poor Functional Outcome in Patients with Acute Cerebral Infarction[J]. *J Clin Neurol*, 2018, 14(2): 165-173
- [3] Bashir Q, Ishfaq A, Baig AA. Safety of Diagnostic Cerebral and Spinal Digital Subtraction Angiography in a Developing Country: A Single-Center Experience[J]. *Interv Neurol*, 2018, 7(1-2): 99-109
- [4] Bowen MT, Rebello LC, Bouslama M, et al. Clinical and Imaging Outcomes of Endovascular Therapy in Patients with Acute Large Vessel Occlusion Stroke and Mild Clinical Symptoms [J]. *Interv Neurol*, 2018, 7(1-2): 91-98
- [5] Malisch TW, Zaidat OO, Castonguay AC, et al. Clinical and Angiographic Outcomes with the Combined Local Aspiration and Retriever in the North American Solitaire Stent-Retriever Acute Stroke (NASA) Registry[J]. *Interv Neurol*, 2018, 7(1-2): 26-35
- [6] Akpinar CK, Gurkas E, Aytac E. Moderate to Severe Anemia Is Associated with Poor Functional Outcome in Acute Stroke Patients Treated with Mechanical Thrombectomy[J]. *Interv Neurol*, 2018, 7(1-2): 12-18
- [7] Danwang C, Mazou TN, Tochie JN, et al. Global epidemiology and patterns of cerebral venous thrombosis: a systematic review and meta-analysis protocol[J]. *BMJ Open*, 2018, 8(4): e019939
- [8] Kasawara KT, Mapa JMR, Ferreira V, et al. Effects of Kinesio Taping on breast cancer-related lymphedema: A meta-analysis in clinical trials[J]. *Physiother Theory Pract*, 2018, 34(5): 337-345
- [9] Kuciel N, Sutkowska E, Cieniska A, et al. Impact of Kinesio Taping application on pregnant women suffering from pregnancy-related pelvic girdle pain - preliminary study [J]. *Ginek Pol*, 2017, 88(11): 620-625
- [10] 郑延松. 第二届全国肾脏病临床研究进展研讨会暨中华医学会老年分会第七届全国肾脏病学术会议召开[J]. *中华老年心脑血管病杂志*, 2007, 9(10): 717
- [11] 赵津京,王凯,杨志丽,等.磁共振扩散张量成像联合 Fugl-Meyer 量表对老年急性脑梗死患者疗效评估的作用[J]. *中国脑血管病杂志*, 2014, 11(12): 639-642
- [12] 孙丽红,杨鹏,董瑶,等.基于熵权法的老年人肌力模糊综合评价[J]. *中国康复理论与实践*, 2017, 23(12): 1464-1469
- [13] 赵春艳,周娟,赵慧华,等.静态平衡仪与 Berg 平衡量表对老年住院患者跌倒风险预测价值差异的研究[J]. *中华现代护理杂志*, 2017, 23(29): 3717-3721
- [14] 杨雅敬,朱毅.肌内效贴对脑卒中后上肢痉挛的疗效[J]. *中国康复理论与实践*, 2016, 22(9): 1045-1048
Yang Ya-jing, Zhu Yi. Effects of Kinesio Taping on Spasticity of Upper Limbs after Stroke[J]. *The theory and practice of China's rehabilitation*, 2016, 22(9): 1045-1048
- [15] 高小芬,于卫华.采用 Barthel 指数评定表对医养结合老年患者护理级别再分度研究[J]. *护理学杂志*, 2014, 29(4): 1-4
- [16] Champagne PO, Lemoine E, Bojanowski MW. Surgical management of giant sphenoid wing meningiomas encasing major cerebral arteries [J]. *Neurosurg Focus*, 2018, 44(4): E12
- [17] Motorna NV, Rybalko SL, Starosyla DB, et al. The study of leukocyte phagocytic activity in the presence of herpetic infection and stroke[J]. *Wiad Lek*, 2018, 71(1 pt 2): 155-159
- [18] Wang X, You S, Sato S, et al. Current status of intravenous tissue plasminogen activator dosage for acute ischaemic stroke: an updated systematic review[J]. *Stroke Vasc Neurol*, 2018, 3(1): 28-33
- [19] Leung LY, Han PKJ, Lundquist C, et al. Clinicians' perspectives on incidentally discovered silent brain infarcts - A qualitative study[J]. *PLoS One*, 2018, 13(3): e0194971
- [20] Zhang JJ, Liu X. Aspirin plus dipyridamole has the highest surface under the cumulative ranking curves (SUCRA) values in terms of mortality, intracranial hemorrhage, and adverse event rate among 7 drug therapies in the treatment of cerebral infarction [J]. *Medicine (Baltimore)*, 2018, 97(13): e0123
- [21] Zellner A, Bockstahler B, Peham C. The effects of Kinesio Taping on the trajectory of the forelimb and the muscle activity of the Musculus brachiocephalicus and the Musculus extensor carpi radialis in horses [J]. *PLoS One*, 2017, 12(11): e0186371
- [22] Ortiz Ramírez J, Pérez de la Cruz S. Therapeutic effects of kinesio taping in children with cerebral palsy: a systematic review [J]. *Arch Argent Pediatr*, 2017, 115(6): e356-e361
- [23] Aghapour E, Kamali F, Sinaei E. Effects of Kinesio Taping on knee function and pain in athletes with patellofemoral pain syndrome [J]. *J Bodyw Mov Ther*, 2017, 21(4): 835-839
- [24] Koroğlu F, Çolak TK, Polat MG. The effect of Kinesio taping on pain, functionality, mobility and endurance in the treatment of chronic low back pain: A randomized controlled study [J]. *J Back Musculoskelet Rehabil*, 2017, 30(5): 1087-1093
- [25] Choi JH. Effects of kinesio taping and hot packs on premenstrual syndrome in females[J]. *J Phys Ther Sci*, 2017, 29(9): 1514-1517
- [26] 陈丽,戴燕琼,周慧玉,等.肌内效贴布联合肌电生物反馈对偏瘫型脑瘫患儿手功能的影响 [J]. *现代生物医学进展*, 2017, 17(33): 6465-6468
- [27] 王盛,王翔,王彤,等.渐进性全身垂直振动治疗方案对缺血性脑卒中偏瘫早期患者下肢功能与平衡功能的影响[J]. *中国康复医学杂志*, 2017, 32(3): 297-300
- [28] Araujo AC, do Carmo Silva Parreira P, Junior LCH, et al. Medium term effects of kinesio taping in patients with chronic non-specific low back pain: a randomized controlled trial[J]. *Physiotherapy*, 2018, 104(1): 149-151
- [29] Au IPH, Fan PCP, Lee WY, et al. Effects of Kinesio tape in individuals with lateral epicondylitis: A deceptive crossover trial [J]. *Physiother Theory Pract*, 2017, 33(12): 914-919
- [30] Elbasan B, Akaya KU, Akyuz M, et al. Effects of neuromuscular electrical stimulation and Kinesio Taping applications in children with cerebral palsy on postural control and sitting balance[J]. *J Back Musculoskelet Rehabil*, 2018, 31(1): 49-55