

· 临床研究 ·

## 经颅磁刺激治疗阿尔茨海默病患者记忆障碍的疗效观察

易春艳<sup>1</sup>, 刘可智<sup>2\*</sup>, 陈思宇<sup>1</sup>, 张辉<sup>1</sup>, 王鸿健<sup>1</sup>, 徐江华<sup>1</sup>, 杨群<sup>1</sup>, 张坤<sup>1</sup>, 李琴<sup>1</sup>, 廖万辉<sup>1</sup>

(<sup>1</sup>南充市身心医院精神科, 南充 637000; <sup>2</sup>西南医科大学附属医院精神卫生中心, 泸州 646000)

**【摘要】目的** 探讨重复经颅磁刺激(rTMS)对阿尔茨海默病(AD)患者前瞻性记忆障碍的改善情况。**方法** 回顾性分析 2016 年 12 月至 2017 年 6 月南充市身心医院精神科接受治疗的前瞻性记忆障碍 AD 患者 60 例, 根据其治疗方式分为常规治疗组和 rTMS 组, 常规治疗组患者口服康复春口服液, rTMS 组患者口服药基础上给予 rTMS, 2 组患者均接受 4 周治疗。比较 2 组患者治疗前后认知功能、日常生活能力和血清肿瘤坏死因子- $\alpha$  (TNF- $\alpha$ ) 和白细胞介素-6 (IL-6) 水平差异。采用 SPSS 11.5 统计软件对数据进行分析, 组间比较采用 *t* 检验、单因素方差分析或  $\chi^2$  检验。**结果** 治疗前, 2 组患者认知功能差异无统计学意义 ( $P > 0.05$ )。治疗后, rTMS 组患者相比常规治疗组定向力 [(4.41 ± 1.02) *vs* (3.56 ± 0.95) 分]、瞬时记忆 [(4.78 ± 1.25) *vs* (3.11 ± 0.74) 分]、注意力和计算 [(3.97 ± 1.12) *vs* (2.55 ± 1.02) 分]、短时记忆 [(1.95 ± 0.21) *vs* (1.32 ± 0.13) 分]、语言 [(5.68 ± 1.98) *vs* (4.42 ± 1.52) 分] 以及视觉空间感觉 [(4.87 ± 1.35) *vs* (3.58 ± 1.12) 分] 认知功能得分增高, 日常生活能力得分也明显增高 [(97.25 ± 8.91) *vs* (70.52 ± 7.14) 分], 差异具有统计学意义 ( $P < 0.05$ )。rTMS 组患者治疗后相比常规治疗组 TNF- $\alpha$  [(18.48 ± 2.68) *vs* (23.87 ± 3.11) ng/L]、IL-6 [(7.03 ± 1.03) *vs* (9.35 ± 1.12) mg/L] 水平降低, 差异具有统计学意义 ( $P < 0.001$ )。2 组患者在治疗过程中未发生头痛、耳鸣等不良事件。**结论** rTMS 对 AD 患者有较好的治疗效果, 可改善患者认知功能和日常生活能力, 且无不良反应发生。

**【关键词】** 阿尔茨海默病; 记忆障碍; 经颅磁刺激; 认知

**【中图分类号】** R743.3

**【文献标志码】** A

**【DOI】** 10.11915/j.issn.1671-5403.2018.04.059

## Efficacy of transcranial magnetic stimulation in treatment of memory disorder in patients with Alzheimer disease

YI Chun-Yan<sup>1</sup>, LIU Ke-Zhi<sup>2\*</sup>, CHEN Si-Yu<sup>1</sup>, ZHANG Hui<sup>1</sup>, WANG Hong-Jian<sup>1</sup>, XU Jiang-Hua<sup>1</sup>, YANG Qun<sup>1</sup>, ZHANG Kun<sup>1</sup>, LI Qin<sup>1</sup>, LIAO Wan-Hui<sup>1</sup>

(<sup>1</sup>Department of Psychiatry, Nanchong Physical and Mental Hospital, Nanchong 637000, China; <sup>2</sup>Mental Health Center, Affiliated Hospital of Southwest Medical University, Luzhou 646000, China)

**【Abstract】Objective** To investigate the effect of repetitive transcranial magnetic stimulation (rTMS) on the prospective memory impairment in the patients suffering from Alzheimer disease (AD). **Methods** A retrospective analysis was carried out on 60 AD patients with prospective memory impairment in the Nanchong Physical and Mental Hospital from December 2016 to June 2017. According to the treatment they got, the patients were divided into conventional treatment group (control) and the rTMS group. The patients of the control group were given oral administration of Kangfuchun Oral Liquid, while those of the rTMS group were given the same medication plus rTMS. The 2 groups of patients were treated for 4 weeks. Their cognitive function, daily living ability and serum TNF- $\alpha$  and IL-6 levels were observed before and after treatment, and the results were compared. SPSS statistics 11.5 was used to perform the statistical analysis. Student's *t* test, analysis of variance, or Chi-square test was employed for comparison between the groups. **Results** Before treatment, there was no difference in cognitive function between the 2 groups ( $P > 0.05$ ). After treatment, the rTMS group had significantly better cognitive function in direction [(4.41 ± 1.02) *vs* (3.56 ± 0.95) scores], instantaneous memory [(4.78 ± 1.25) *vs* (3.11 ± 0.74) scores], attention and calculation [(3.97 ± 1.12) *vs* (2.55 ± 1.02) scores], short-term memory [(1.95 ± 0.21) *vs* (1.32 ± 0.13) scores], language [(5.68 ± 1.98) *vs* (4.42 ± 1.52) scores], and visual and spatial skills [(4.87 ± 1.35) *vs* (3.58 ± 1.12) scores], when compared with the treatment group ( $P < 0.05$ ), and such improvement was also seen in daily living ability [(97.25 ± 8.91) *vs* (70.52 ± 7.14) scores,  $P < 0.05$ ]. The serum levels of TNF- $\alpha$  [(18.48 ± 2.68) *vs*

收稿日期: 2017-11-03; 修回日期: 2017-12-14

基金项目: 南充市科技局项目(16YFZJ0104)

通信作者: 刘可智, E-mail: 3349067480@qq.com

( $23.87 \pm 3.11$ ) ng/L] and IL-6 [ $(7.03 \pm 1.03)$  vs  $(9.35 \pm 1.12)$  mg/L] were significantly lower in the rTMS group than in the control group ( $P < 0.001$ ). No headache, tinnitus or other adverse events were seen in the 2 groups of patients in the course of treatment. **Conclusion** rTMS shows good therapeutic effect on AD patients in improving the cognitive and memory function of the patients without adverse reactions.

**【Key words】** Alzheimer disease; memory disorders; repetitive transcranial magnetic stimulation; cognition

*This work was supported by the Project of Science and Technology Bureau of Nanchong (16YFZJ0104).*

*Corresponding author: LIU Ke-Zhi, E-mail: 3349067480@qq.com*

阿尔茨海默病(Alzheimer disease, AD)是一种神经变性疾病,常见于老年人,临床特征为记忆力、定向力和理解力减退。前瞻性记忆(prospective memory, PM)障碍是 AD 患者常见并发症,发病后患者日常活动减少,独立功能下降,可对生活和工作造成严重的影响<sup>[1]</sup>。常规治疗措施是对双侧前额叶采取伪刺激,用于稳定病情和缓解症状,但远期疗效欠佳。而重复经颅磁刺激(repetitive transcranial magnetic stimulation, rTMS)是一种电生理技术,利用时变磁场作用于患者大脑皮层从而产生感应电流,可改变皮层神经元,影响脑内代谢和神经元电活动,改善认知功能<sup>[2]</sup>。本研究回顾性分析了 PM 障碍 AD 患者采用常规治疗措施与 rTMS 的治疗效果,从而为 rTMS 的临床治疗提供可靠依据。

## 1 对象与方法

### 1.1 研究对象

回顾性分析 2016 年 12 月至 2017 年 6 月南充市身心医院精神科接受治疗的 PM 障碍 AD 患者 60 例,根据治疗方式分为常规治疗组和 rTMS 组。其中常规治疗组 30 例,男性 18 例,女性 12 例,年龄 65 ~ 74 ( $70.5 \pm 3.2$ ) 岁; rTMS 组 30 例,男性 15 例,女性 15 例,年龄 65 ~ 75 ( $70.5 \pm 3.0$ ) 岁。纳入标准: (1) 符合美国精神障碍诊断与统计手册第 5 版 AD 的诊断标准<sup>[3]</sup>; (2) 年龄  $\geq 65$  岁,性别不限; (3) 存在记忆障碍; (4) 小学以上文化程度; (5) 患者法定监护人签署知情同意书。排除标准: (1) 严重躯体疾病; (2) 酒精或药物滥用史; (3) 视力、听力障碍; (4) 不能配合检查,冲动伤人、毁物和自伤可能的患者。

### 1.2 方法

常规治疗组患者口服康复春口服液(湖南省回春堂药业有限公司,批准文号 Z20063216), 10 ml/次, 2 次/d。rTMS 组患者服药同时联合 rTMS 治疗,治疗中患者保持坐姿,尽量全身放松。日本光电 4000 型肌电图诱发电位仪 Maglite Compact 磁刺激器,线圈直径为 12 cm,脉冲时限为 100 s,刺激患侧额叶,最大刺激强度设置为 0.72 T,频率为 20 Hz,每天

1 序列,连续治疗 5 d。2 组患者共接受 4 周治疗,未发生头痛、耳鸣等不良事件。

### 1.3 评价指标

评估 2 组患者治疗前后瞬时记忆等认知功能、日常生活能力以及检测血清肿瘤坏死因子- $\alpha$  (tumor necrosis factor- $\alpha$ , TNF- $\alpha$ ) 和白细胞介素-6 (interleukin-6, IL-6) 水平。评估量表包括: (1) 蒙特利尔认知评估(Montreal Cognitive Assessment, MoCA) 量表: 有定向力、瞬时记忆和注意力等 6 个条目,总分 30 分,得分越高表明认知功能越好; (2) 日常生活能力(activity of daily living, ADL) 量表: 对患者的日常生活能力进行评价<sup>[5]</sup>, 该量表包括 10 个条目,总分 100 分,得分越高,表示独立生活能力越好,依赖性越小(< 20 分: 生活极严重障碍; 20 ~ 39 分: 生活严重障碍; 40 ~ 59 分: 生活中度障碍; 60 ~ 94 分: 生活轻度障碍; 95 ~ 100 分为生活能够自理)。

### 1.4 统计学处理

采用 SPSS 11.5 统计软件对数据进行分析。计量资料用均数  $\pm$  标准差( $\bar{x} \pm s$ ) 表示, 2 组比较采用  $t$  检验或单因素方差分析。计数资料用百分率表示, 组间比较用  $\chi^2$  检验。  $P < 0.05$  为差异有统计学意义。

## 2 结果

### 2.1 2 组患者基线资料比较

2 组患者性别、年龄、高血压比例、疾病严重程度间差异无统计学意义( $P > 0.05$ ; 表 1)。

### 2.2 2 组患者治疗前后认知功能比较

治疗前, 2 组患者认知功能差异无统计学意义( $P > 0.05$ )。治疗后, 2 组患者的认知功能均较治疗前改善, rTMS 组患者定向力、瞬时记忆、注意力和计算、短时记忆、语言以及视觉空间感觉等得分明显优于常规治疗组, 差异具有统计学意义( $P < 0.05$ ; 表 2)。

### 2.3 2 组患者治疗前后日常生活能力比较

2 组患者治疗前进食、洗澡、修饰等得分无差别, 治疗后, rTMS 组患者进食、洗澡、修饰、穿衣、大小便控制、如厕、行走、上下楼等日常生活能力得分明显高于对照组, 差异具有统计学意义( $P < 0.05$ ; 表 3)。

2.4 2 组患者治疗前后 TNF-α 和 IL-6 水平的比较 后,rTMS 组患者 TNF-α、IL-6 水平低于对照组,差异  
2 组患者治疗前 TNF-α、IL-6 水平无差别,治疗 具有统计学意义( $P<0.001$ ;表 4)。

表 1 2 组患者基线资料的比较  
Table 1 Comparison of baseline data between two groups (n = 30)

| Item                          | Conventional treatment group | rTMS group     | $t/\chi^2$ | P value |
|-------------------------------|------------------------------|----------------|------------|---------|
| Gender( male/female, n )      | 18/12                        | 15/15          | 0.606      | 0.436   |
| Age( years, $\bar{x} \pm s$ ) | 70.5 $\pm$ 3.2               | 70.5 $\pm$ 3.0 | 1.024      | 0.513   |
| Hypertension[ n( % ) ]        | 16( 53.33 )                  | 18( 60.00 )    | 0.271      | 0.602   |
| Degree of disease[ n( % ) ]   |                              |                | 0.082      | 0.774   |
| Mild                          | 21( 70.00 )                  | 22( 73.33 )    |            |         |
| Severe                        | 9( 30.00 )                   | 8( 26.67 )     |            |         |

rTMS: repetitive transcranial magnetic stimulation

表 2 2 组患者治疗前后认知功能的比较( MoCA 量表)

Table 2 Comparison of cognitive function ( MoCA scale) before and after treatment between two groups (n = 30, score,  $\bar{x} \pm s$ )

| Item                            | Conventional treatment group |                   | rTMS group       |                     |
|---------------------------------|------------------------------|-------------------|------------------|---------------------|
|                                 | Before treatment             | After treatment   | Before treatment | After treatment     |
| Direction                       | 1.25 $\pm$ 0.32              | 3.56 $\pm$ 0.95 * | 1.28 $\pm$ 0.29  | 4.41 $\pm$ 1.02 * # |
| Instantaneous memory            | 1.15 $\pm$ 0.41              | 3.11 $\pm$ 0.74 * | 1.12 $\pm$ 0.38  | 4.78 $\pm$ 1.25 * # |
| Attention and calculation       | 1.27 $\pm$ 0.42              | 2.55 $\pm$ 1.02 * | 1.25 $\pm$ 0.38  | 3.97 $\pm$ 1.12 * # |
| Short-term memory               | 0.55 $\pm$ 0.08              | 1.32 $\pm$ 0.13 * | 0.54 $\pm$ 0.10  | 1.95 $\pm$ 0.21 * # |
| Linguistic capacity             | 3.82 $\pm$ 1.17              | 4.42 $\pm$ 1.52 * | 3.85 $\pm$ 1.14  | 5.68 $\pm$ 1.98 * # |
| Visual and spatial sense skills | 2.48 $\pm$ 0.11              | 3.58 $\pm$ 1.12 * | 2.49 $\pm$ 0.05  | 4.87 $\pm$ 1.35 * # |

MoCA; Montreal Cognitive Assessment; rTMS; repetitive transcranial magnetic stimulation. Compared with before treatment, \*  $P<0.05$ ; compared with the conventional treatment group, #  $P<0.05$

表 3 2 组患者治疗前后日常生活能力比较( ADL 量表)

Table 3 Comparison of daily living ability ( ADL scale) before and after treatment between two groups (n = 30, score,  $\bar{x} \pm s$ )

| Item                      | Conventional treatment group |                    | rTMS group       |                      |
|---------------------------|------------------------------|--------------------|------------------|----------------------|
|                           | Before treatment             | After treatment    | Before treatment | After treatment      |
| Eating                    | 5.22 $\pm$ 1.02              | 6.30 $\pm$ 1.26 *  | 5.24 $\pm$ 0.98  | 9.78 $\pm$ 2.02 * #  |
| Bathing                   | 5.55 $\pm$ 1.11              | 6.04 $\pm$ 0.18 *  | 5.53 $\pm$ 1.02  | 8.45 $\pm$ 2.11 * #  |
| Modification              | 5.02 $\pm$ 1.01              | 6.12 $\pm$ 0.65 *  | 4.98 $\pm$ 0.89  | 9.48 $\pm$ 1.98 * #  |
| Put on clothes            | 4.11 $\pm$ 0.87              | 6.35 $\pm$ 2.52 *  | 4.13 $\pm$ 1.03  | 9.55 $\pm$ 2.15 * #  |
| Stool control             | 6.10 $\pm$ 1.32              | 7.22 $\pm$ 1.68 *  | 6.12 $\pm$ 1.15  | 9.76 $\pm$ 2.18 * #  |
| Urination control         | 5.12 $\pm$ 1.12              | 6.31 $\pm$ 2.15 *  | 5.15 $\pm$ 1.23  | 9.82 $\pm$ 2.34 * #  |
| Go to the toilet          | 5.31 $\pm$ 1.25              | 6.34 $\pm$ 1.89 *  | 5.15 $\pm$ 1.21  | 9.73 $\pm$ 2.08 * #  |
| Transfer bed and chair    | 7.02 $\pm$ 1.12              | 8.11 $\pm$ 3.47 *  | 7.05 $\pm$ 1.35  | 9.74 $\pm$ 2.61 * #  |
| Walk on the ground        | 6.84 $\pm$ 1.03              | 7.28 $\pm$ 2.68 *  | 6.82 $\pm$ 1.11  | 9.85 $\pm$ 2.53 * #  |
| Go up and down the stairs | 5.02 $\pm$ 1.02              | 6.33 $\pm$ 0.06 *  | 4.98 $\pm$ 0.85  | 9.41 $\pm$ 2.36 * #  |
| Total score               | 53.26 $\pm$ 6.28             | 70.52 $\pm$ 7.14 * | 53.25 $\pm$ 6.45 | 93.25 $\pm$ 3.91 * # |

ADL: activity of daily living; rTMS; repetitive transcranial magnetic stimulation. Compared with before treatment, \*  $P<0.05$ ; compared with conventional treatment group, #  $P<0.05$

表 4 2 组患者治疗前后 TNF-α 和 IL-6 水平的比较

Table 4 Comparison of TNF-α and IL-6 level before and after treatment between two groups (n = 30,  $\bar{x} \pm s$ )

| Group                  | TNF-α( ng/L )    |                  | IL-6( mg/L )     |                 |
|------------------------|------------------|------------------|------------------|-----------------|
|                        | Before treatment | After treatment  | Before treatment | After treatment |
| Conventional treatment | 35.37 $\pm$ 4.30 | 23.87 $\pm$ 3.11 | 12.85 $\pm$ 2.11 | 9.35 $\pm$ 1.12 |
| rTMS                   | 35.35 $\pm$ 4.02 | 18.48 $\pm$ 2.68 | 12.82 $\pm$ 2.05 | 7.03 $\pm$ 1.03 |
| t                      | 0.021            | 8.303            | 0.064            | 9.463           |
| P value                | 0.491            | <0.001           | 0.474            | <0.001          |

rTMS; repetitive transcranial magnetic stimulation; TNF-α; tumor necrosis factor-α; IL-6; interleukin-6

### 3 讨 论

AD 是临床常见的神经系统退行性疾病,以认知功能障碍为主要并发症,文献报道 PM 障碍较多<sup>[6,7]</sup>。PM 障碍 AD 患者独立能力下降,在日常生活与工作中需要他人的提醒、帮助,严重影响生活质量。临床常采用双侧前额叶伪刺激治疗,虽然线圈外观、放置位置、产生的声音、震动与真刺激相一致,但仍为没有磁场产生的伪刺激<sup>[8]</sup>。该方式可降低海马神经元胞质中钙离子水平,由于细胞内钙离子超载可引发神经元功能与结构受损并造成细胞死亡,因此降低钙离子水平可缓解其对神经元的损伤,促进学习和记忆<sup>[9]</sup>,但单独使用该方式的临床疗效有限。rTMS 是一种新型的非侵入性神经生物刺激技术,由刺激器与线圈组成,具有无痛、无创、快捷和方便等特征,利用脉冲电磁场作用于颅脑产生回馈,通过线圈产生范围内的磁场,刺激大脑皮层,带给大脑神经元更强烈变化,从而增加皮层兴奋性,有效调节神经元功能<sup>[10]</sup>。本研究表明,rTMS 组患者定向力、瞬时记忆、注意力和计算、短时记忆、语言以及视觉空间感觉等得分明显优于常规治疗组,认知功能改善效果显著,和上述分析一致。

临床研究表明,PM 主要依赖于前额叶皮层与丘脑,rTMS 作用于患者双侧或单侧前额背外侧皮层,对额叶皮层可产生兴奋作用,增加额叶血液循环,改变神经递质,从而改善记忆,达到提高认知功能的目的<sup>[11,12]</sup>。炎症反应参与 AD 整个病程,患者体内炎症因子在脑组织反应区域表达上调,因此通过检测临床常用的敏感炎症因子指标可反映患者疾病状况,TNF- $\alpha$ 、IL-6 为临床最常用的炎症因子,反映机体炎症反应程度,其水平变化与机体炎症反应具有密切联系。本研究 rTMS 组患者经治疗后 TNF- $\alpha$ 、IL-6 水平低于对照组,其原因可能为 rTMS 作为一种皮层刺激方法,利用感生电流对神经元的动作电位进行调节,可扩张阻力血管,增加大脑中动脉血流量,促进脑血液循环,抑制炎症因子分泌,从而降低其水平,促进受损皮层自我修复与再生。

AD 患者皮层下白质损伤与认知功能障碍存在密切联系,rTMS 可提高局部微管相关蛋白-2、N-乙酰天门冬氨酸和血浆脑源性神经生长因子水平,促进白质生长与修复<sup>[13,14]</sup>。文献报道<sup>[15]</sup>,rTMS 能提高额叶中部扣带回前方刺激区的脑葡萄糖代谢率,增加脑代谢,促进神经元修复。本研究 rTMS 组患者日常生活能力得分明显高于对照组,分析其原因为 rTMS 通过磁刺激运动皮层,兴奋大脑与脊髓,经过对强度、频

率、刺激时间的调节,不断影响中枢神经系统兴奋性,增强海马 CA1 区长时程,持久调节大脑的功能脑区活动,经感应电流增强突触可塑性,弥补受损脑功能,从而促进学习与记忆,提高生活协调能力。

综上所述,在常规治疗基础上联合 rTMS 对 AD 患者有较好的治疗效果,可明显改善记忆障碍和日常生活能力,具有较好的临床应用价值。

### 【参考文献】

- [1] Tarasoff-Conway JM, Carare RO, Osorio RS, *et al.* Clearance systems in the brain-implications for Alzheimer's disease[J]. *Nat Rev Neurol*, 2015, 11(8): 457-470. DOI: 10.1038/nrneurol.2015.119.
- [2] 阎澍好, 宋为群. 经颅磁刺激在阿尔茨海默病和轻度认知障碍中的临床研究 and 应用进展[J]. *中国康复医学杂志*, 2015, 30(1): 69-72. DOI: 10.3969/j.issn.1001-1242.2015.01.020. Yan SY, Song WQ. Clinical research and application advances of transcranial magnetic stimulation in Alzheimer's disease and mild cognitive impairment[J]. *Chin J Rehabil Med*, 2015, 30(1): 69-72. DOI: 10.3969/j.issn.1001-1242.2015.01.020.
- [3] McKhann C, Drachman D, Folstein M, *et al.* Clinical diagnosis of Alzheimer's disease: report of NINCDS-ADRDA work group under the auspices of Department of Health and Human Services Task Force on Alzheimer's disease[J]. *Neurology*, 1984, 34(7): 939-944.
- [3] 王晓妮, 唐毅, 韩璠. 阿尔茨海默病诊断标准的演变[J]. *医学研究生学报*, 2015, 28(2): 195-198. DOI: 10.3969/j.issn.1008-8199.2015.02.021. Wang XN, Tang Y, Han Y. The evolution of criteria for the diagnosis of Alzheimer's disease[J]. *J Med Postgra*, 2015, 28(2): 195-198. DOI: 10.3969/j.issn.1008-8199.2015.02.021.
- [4] 王士博, 王越, 于晓雯, 等. 炎症因子在阿尔茨海默病发病机制中的作用[J]. *中华老年多器官疾病杂志*, 2016, 15(9): 713-716. DOI: 10.11915/j.issn.1671-5403.2016.09.170. Wang SB, Wang Y, Yu XW, *et al.* Role of inflammatory cytokines in pathogenesis of Alzheimer's disease[J]. *Chin J Mult Organ Dis Elderly*, 2016, 15(9): 713-716. DOI: 10.11915/j.issn.1671-5403.2016.09.170.
- [5] Tromp D, Dufour A, Lithfous S, *et al.* Episodic memory in normal aging and Alzheimer's disease: insights from imaging and behavioral studies[J]. *Ageing Res Rev*, 2015, 24(Pt B): 232-262. DOI: 10.1016/j.arr.2015.08.006.
- [6] Chou YH, Hickey PT, Sundman M, *et al.* Effects of repetitive transcranial magnetic stimulation on motor symptoms in Parkinson disease: a systematic review and meta-analysis[J]. *JAMA Neurol*, 2015, 72(4): 432-440. DOI: 10.1001/jamaneurol.2014.4380.
- [7] Umezaki Y, Badran BW, Gonzales TS, *et al.* Daily left prefrontal repetitive transcranial magnetic stimulation for medication-resistant burning mouth syndrome[J]. *Int J Oral Maxillofac Surg*, 2015,

- 44(8): 1048 – 1051. DOI: 10.1016/j.ijom.2015.04.008.
- [8] Umezaki Y, Badran BW, DeVries WH, *et al.* The efficacy of daily prefrontal repetitive transcranial magnetic stimulation (rTMS) for burning mouth syndrome (BMS): a randomized controlled single-blind study[J]. Brain Stimul, 2016, 9(2): 234 – 242. DOI: 10.1016/j.brs.2015.10.005.
- [9] 李江涛, 郑敏军, 曹辉. 经颅磁刺激技术的研究进展[J]. 高电压技术, 2016, 42(4): 1168 – 1178. DOI: 10.13336/j.1003-6520.hve.201604005037.
- Li JT, Zheng MJ, Cao H. Research progress in transcranial magnetic stimulation technology[J]. High Voltage Eng, 2016, 42(4): 1168 – 1178. DOI: 10.13336/j.1003-6520.hve.2016-04005037.
- [10] 李丽君, 胡卫疆, 高雅坤, 等. 重复经颅磁刺激治疗广泛性焦虑障碍的疗效及不良反应的 meta 分析[J]. 中华行为医学与脑科学杂志, 2016, 25(7): 662 – 666. DOI: 10.3760/cma.j.issn.1674-6554.2016.07.019.
- Li LJ, Hu WJ, Gao YK, *et al.* Efficacy and adverse reactions of repetitive transcranial magnetic stimulation on general anxiety disorder: a meta-analysis[J]. Chin J Behav Med Brain Sci, 2016, 25(7): 662 – 666. DOI: 10.3760/cma.j.issn.1674-6554.2016.07.019.
- [11] 王单, 黄居科, 谭婷婷, 等. 脑外伤患者大脑健侧重复经颅磁刺激对患者认知功能和功能独立性的影响[J]. 中华物理医学与康复杂志, 2016, 38(5): 353 – 355. DOI: 10.3760/cma.j.issn.0254-1424.2016.05.008.
- Wang D, Huang JK, Tan TT, *et al.* Effects of repeated transcranial magnetic stimulation on cognitive function and functional independence in patients with brain injury[J]. Chin J Phys Med Rehabil, 2016, 38(5): 353 – 355. DOI: 10.3760/cma.j.issn.0254-1424.2016.05.008.
- [12] 牛素英, 杨林霖, 邸亚丽, 等. 低频重复经颅磁刺激对酒依赖戒断后抑郁焦虑及睡眠状况的改善作用[J]. 中华行为医学与脑科学杂志, 2015, 24(5): 443 – 446. DOI: 10.3760/cma.j.issn.1674-6554.2015.05.015.
- Niu SY, Yang LL, Di YL, *et al.* The effect of low frequency repetitive transcranial magnetic stimulation treatment on the anxiety, depression and sleep problems due to withdrawal reactions in alcohol dependence patients[J]. Chin J Behav Med Brain Sci, 2015, 24(5): 443 – 446. DOI: 10.3760/cma.j.issn.1674-6554.2015.05.015.
- [13] 傅彩峰, 高朝, 苏天慧, 等. 低频重复经颅磁刺激对脑梗死患者恢复期运动功能的影响[J]. 中国康复医学杂志, 2016, 31(2): 150 – 153. DOI: 10.3969/j.issn.1001-1242.2016.02.005.
- Fu CF, Gao C, Su TH, *et al.* Effects of low frequency repetitive transcranial magnetic stimulation for motor function in cerebral infarction recovery period[J]. Chin J Rehabil Med, 2016, 31(2): 150 – 153. DOI: 10.3969/j.issn.1001-1242.2016.02.005.
- [14] 赵利娜, 张志强, 张立新, 等. 1 Hz 重复经颅磁刺激对缺血性脑卒中后上肢运动功能的疗效[J]. 中国康复理论与实践, 2015, 21(2): 216 – 219. DOI: 10.3969/j.issn.1006-9771.2015.02.022.
- Zhao LN, Zhang ZQ, Zhang LX, *et al.* Effect of 1 Hz repetitive transcranial magnetic stimulation on upper limb motor function after stroke[J]. Chin Rehabil Theory Prac, 2015, 21(2): 216 – 219. DOI: 10.3969/j.issn.1006-9771.2015.02.022.
- [15] 甘景梨, 段惠峰, 程正祥, 等. 重复经颅磁刺激对精神分裂症患者认知功能的影响[J]. 中华物理医学与康复杂志, 2015, 37(3): 219 – 223. DOI: 10.3760/cma.j.issn.0254-1424.2015.03.018.
- Gan JL, Duan HF, Cheng ZX, *et al.* Repetitive transcranial magnetic stimulation and cognitive function in schizophrenia: a randomized controlled study[J]. Chin J Phys Med Rehabil, 2015, 37(3): 219 – 223. DOI: 10.3760/cma.j.issn.0254-1424.2015.03.018.
- [16] 吴越, 徐文炜, 刘晓伟, 等. 不同频率重复经颅磁刺激对阿尔茨海默病患者认知功能的影响[J]. 实用医学杂志, 2015, 31(10): 1624 – 1627. DOI: 10.3969/j.issn.1006-5725.2015.10.020.
- Wu Y, Xu WW, Liu XW, *et al.* Effect of repetitive transcranial magnetic stimulation with different frequency on cognitive function in patients with Alzheimer's disease[J]. J Prac Med, 2015, 31(10): 1624 – 1627. DOI: 10.3969/j.issn.1006-5725.2015.10.020.

(编辑: 王彩霞)