“TRANSKRANIAL MAGNIT STIMULYATSIYANING (TMS) GEN O‘ZGARISHLARIGA TA’SIRI BILAN INSULT TIKLANISHINING MOLEKULYAR MEXANIZMINI O‘RGANISH”

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Anotatsiya: *So‘nggi yillarda transkranial magnit stimulyatsiya (TMS) usuli insultdan keyingi neyroreabilitatsiyada samarali, invaziv bo‘lmagan neyromodulyatsion yondashuv sifatida keng tadqiq qilinmoqda. Ushbu tadqiqotda TMSning insultdan keyingi gen ekspressiyasi va sinaptik plastiklikka ta’siri o‘rganildi. Klinik kuzatuvlarda 60 nafar insult o‘tkazgan bemor ishtirok etdi: ulardan 30 nafari TMS terapiya guruhiga, 30 nafari standart fizioterapiya guruhiga kiritildi. 6 haftalik davolashdan so‘ng TMS guruhida BDNF (Brain-Derived Neurotrophic Factor), VEGF (Vascular Endothelial Growth Factor) va c-Fos genlarining ekspressiyasi sezilarli oshgani kuzatildi ($p<0.05$). Klinik jihatdan esa motor funksiyalar NIHSS shkalasi bo‘yicha o‘rtacha 35% ga yaxshilandi. Tadqiqot natijalari TMS insultdan keyingi neyroplastiklikni genetik va molekulyar darajada faollashtirishi mumkinligini ko‘rsatadi.*

Kalit so‘zlar: *Transkranial magnit stimulyatsiya, gen ekspressiyasi, insult, neyroplastiklik, BDNF, VEGF, c-Fos, neyroreabilitatsiya, molekulyar mexanizm.*

Abstract (English): *In recent years, transcranial magnetic stimulation (TMS) has been widely studied as an effective, non-invasive neuromodulatory approach in post-stroke neurorehabilitation. This study investigated the effect of TMS on gene expression and synaptic plasticity after stroke. The clinical study included 60 post-stroke patients: 30 received TMS therapy, while 30 underwent standard physiotherapy. After six weeks of treatment, the TMS group showed a significant increase in the expression of BDNF (Brain-Derived Neurotrophic Factor), VEGF (Vascular Endothelial Growth Factor), and c-Fos genes ($p<0.05$). Clinically, motor functions improved by an average of 35% according to the NIHSS scale. The results indicate that TMS may activate neuroplasticity at genetic and molecular levels during post-stroke recovery.*

Keywords :*Transcranial magnetic stimulation, gene expression, stroke, neuroplasticity, BDNF, VEGF, c-Fos, neurorehabilitation, molecular mechanism.*

Аннотация (Русская): *В последние годы транскраниальная магнитная стимуляция (ТМС) активно изучается как эффективный, неинвазивный нейромодулирующий метод в постинсультной нейрореабилитации. В данном исследовании была изучена роль ТМС в изменении экспрессии генов и синаптической пластичности после инсульта. В клиническом наблюдении участвовали 60 пациентов, перенёсших инсульт: 30 из них получали терапию ТМС, а 30 — стандартную физиотерапию. Через 6 недель лечения в группе ТМС отмечалось значительное повышение экспрессии генов BDNF*

(нейротрофический фактор мозга), VEGF (фактор роста эндотелия сосудов) и c-Fos (p<0.05). Клинически моторные функции улучшились в среднем на 35% по шкале NIHSS. Результаты показывают, что ТМС может активировать нейропластичность на генетическом и молекулярном уровнях в период восстановления после инсульта.

Ключевые слова: *Транскраниальная магнитная стимуляция, экспрессия генов, инсульт, нейропластичность, BDNF, VEGF, c-Fos, нейрореабилитация, молекулярный механизм.*

Tadqiqot maqsadi: Insultdan keyingi tiklanish davrida transkranial magnit stimulyatsiyaning (TMS) gen ekspressiyasiga ta’sirini aniqlash va ushbu o‘zgarishlar orqali neyroplastiklikning molekulyar mexanizmlarini o‘rganish.

Tadqiqot materiali va usullari: Tadqiqot turi-Prospektiv eksperimental klinik tadqiqot**.** Ishtirokchilar 60 nafar insult (ischemik tip) o‘tkazgan bemorlar, yoshi 45–70 oralig‘ida**,** 1-guruh (n=30): TMS terapiyasi + standart reabilitatsiya**,** 2-guruh (n=30): faqat standart reabilitatsiya. Tadqiqot 10 Hz chastotada, har kuni 20 daqiqa davomida 6 hafta davom etadi.Klinik- NIHSS, Barthel indeksi, MMSE testi**.** Molekulyar- RT-PCR orqali *BDNF*, *VEGF*, *c-Fos* genlarining ekspressiya darajasi orqali baholanadi**.** Statistik tahlilga ko’ra SPSS 26.0 dasturida t-test, ANOVA, Pearson korrelyatsiyasi ($\alpha = 0.05$).

Tadqiqot natijasi: Genetik o’zgarishlar - *BDNF* ekspressiyasi TMS guruhida 2.8 baravar oshgan (p=0.003)**,** *VEGF* ekspressiyasi 1.9 baravar oshgan (p=0.012)**,** *c-Fos* faolligi esa 1.6 baravar yuqori bo‘lgan (p=0.028) natijalarni ko’rsatdi. Klinik natijalarga ko’ra NIHSS ko‘rsatkichi o‘rtacha 7.8 dan 5.1 gacha kamaygan (35% yaxshilanish), Barthel indeksi 42 dan 67 gacha oshgan hamda MMSE ballari 22 dan 26 gacha oshgan (kognitiv tiklanish). Korrelyatsiyaga ko’ra *BDNF* darajasi bilan NIHSS natijalari o‘rtasida kuchli teskari korrelyatsiya ($r = –0.74$, $p<0.01$) aniqlandi.

Xulosa: Transkranial magnit stimulyatsiya insultdan keyingi neyroplastiklik jarayonlarini kuchaytiradi va *BDNF*, *VEGF*, *c-Fos* genlarining ekspressiyasini oshiradi. Ushbu genetik o‘zgarishlar neyron o‘sishi, sinaptik qayta tiklanish va angiogenez mexanizmlarini faollashtirib, klinik tiklanish darajasini yaxshilaydi. TMS neyroreabilitatsiyada farmakoterapiya bilan bir qatorda qo‘llanishi mumkin bo‘lgan istiqbolli molekulyar asosli yondashuv sifatida tavsiya etiladi.

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