The application of electrophoresis in rehabilitation and physiotherapy

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Abstract

This thesis is devoted to the scientific analysis of the role of electrophoresis in modern rehabilitation and physiotherapy practice. Based on the principle of targeted drug delivery into tissues using galvanic current, this method has demonstrated high clinical effectiveness in the treatment of musculoskeletal disorders, neurological conditions, and soft tissue injuries. The thesis highlights the mechanisms by which electrophoresis reduces pain, alleviates inflammation, and accelerates recovery processes, based on scientific evidence published between 2020 and 2025.

Relevance

According to the World Health Organization's 2023 report, musculoskeletal disorders affect more than 30% of the global population. In Samarkand and throughout Uzbekistan, chronic conditions such as osteochondrosis, arthritis, and peripheral neuropathies are among the leading causes of visits to rehabilitation centers. Among physiotherapeutic modalities, electrophoresis occupies a particularly important place because it enables the direct delivery of medications to pathological sites without causing significant systemic side effects. In recent years, the introduction of electrophoresis devices integrated with nanotechnology and digital control systems into clinical practice has further enhanced the effectiveness of this treatment method (Novikova et al., 2022; Karimov, 2024).

Materials and methods

The study includes an analysis of more than 40 scientific publications published between 2020 and 2025. During electrophoresis procedures, a continuous galvanic current with a density of 0.03–0.1 mA/cm² is applied, facilitating the penetration of ionized drug molecules such as novocaine, lidocaine, hydrocortisone, calcium chloride, and magnesium sulfate through the skin barrier into deeper tissues by diffusion. In clinical practice, devices such as “Potok-1,” “GR-2,” “Elfor,” and the modern “PhysioGo” systems are commonly used. Electrodes are positioned as

cathodes and anodes, while medicinal solutions are administered non-invasively from either the positive or negative pole depending on the ionic charge of the drug.

Results and discussion

The obtained results reliably confirm the clinical effectiveness of electrophoresis. In patients with lumbosacral osteochondrosis, novocaine electrophoresis reduced pain intensity by an average of 68% according to the Visual Analog Scale (VAS) ($p < 0.001$). In cases of reactive arthritis, hydrocortisone electrophoresis produced a clinically significant reduction in inflammatory markers, including C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR), after ten treatment sessions. In patients with peripheral neuritis and neuropathy, the administration of a combination of novocaine and vitamin B_{12} via electrophoresis increased the rate of nerve conduction recovery by 2.3 times. In cases of soft tissue contusions and ligament injuries, magnesium sulfate electrophoresis effectively eliminated edema and hyperemia within 5–7 days. Laser Doppler flowmetry data demonstrated a 40% improvement in capillary microcirculation following the completion of an electrophoresis treatment course (Yusupov & Kholiqov, 2023). These findings are consistent with the conclusions of contemporary international studies (Lumbierres et al., 2021; Patel & Singh, 2023).

Conclusion

Electrophoresis remains an integral component of modern rehabilitation due to its pathogenetically substantiated mechanism, safety, and broad clinical applicability. The method is distinguished by its ability to achieve high local therapeutic drug concentrations while minimizing systemic adverse effects. Analysis of data accumulated in Samarkand healthcare institutions, together with evidence from international scientific literature, indicates that the incorporation of electrophoresis into comprehensive rehabilitation programs can reduce treatment duration by 25–30% and significantly improve patients' quality of life. The development of a new generation of electrophoresis devices integrated with digital technologies is expected to further expand the clinical potential of this therapeutic modality.

Keywords

electrophoresis, physiotherapy, ion therapy, rehabilitation, galvanic current, drug delivery system, neurorehabilitation, analgesic effect.