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Editors
Šarūnas Mickus
Simona Pūkienė
Lukas Naimovičius

Cover and Interior design
Milda Stancikaitė

Vilnius University Press
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Dear participants,

The 65th international conference for students of Physics and Natural sciences Open Readings 2022 brings together young researchers from all over the world. Open Readings 2022 is a virtual event where the conference attendees can share their work and ideas on an extensive range of topics and connect with one another. We hope that the conference participants will enjoy memorable lectures from world-class speakers and presentations from eager young scientists.

We wish you good luck in your scientific journey. Stay curious and creative.

Yours sincerely,

Open Readings 2022 Organizing Team

DESIGN OF AN ANESTHETIC MEDICINE PROLONGED ACTION BASED ON NOVOCAINE

Karyna Savchenko, Vadym Lisovyi, Dmytro Oliinyk, Daryna Taran,
Galyna Kuzmina, Volodymyr Bessarabov

Department of Industrial Pharmacy, Kyiv National University of Technology and Design, Ukraine
k.savchenko@kyivpharma.eu

Pain is a peculiar psychophysiological state of a human, which arises due to the influence of excessive stimuli, which cause organic or functional disorders in the body. Effective treatment of pain eliminates physical suffering, stress, facilitates the work of the heart and lungs, reduces the risk of venous thrombosis and helps to normalize digestion [1].

Despite the achievements of modern local anesthesia, novocaine remains the standard analgesic in clinical practice. Being a weak base, it blocks Na^+ channels, prevents the generation of impulses in the endings of sensitive nerves and the conduction of impulses through nerve fibers. It changes the potential of action in the membranes of nerve cells without a pronounced effect on the resting potential, suppresses the conduction of pain and mechanical impulses. When absorbed and entering the bloodstream, it reduces the excitability of peripheral cholinergic systems, reduces the formation and release of acetylcholine from the preganglionic extremities (has some ganglioblocking action), eliminates spasm of smooth muscles [2] and reduces excitability.

When administered parenterally, novocaine is well absorbed and rapidly hydrolyzed in the bloodstream under the action of two types of cholinesterases: acetylcholinesterase and butyrylcholinesterase to paraaminobenzoic acid and diethylaminoethanol. Cholinesterase inhibitors were added to the analgesic drug to prolong the action of novocaine. Polyphenolic compounds from the group of flavonoids, which are known to have antioprotective, antioxidant, anti-inflammatory and immunomodulatory properties, were considered inhibitors. As potential analgesics, flavonoids suppress inflammatory processes, oncological diseases, progress of neuropathic conditions. As a result, silibinin was chosen due to its high bioavailability and low toxicity.

The following methods were used during the study: bibliometric, empirical, mathematical. Kinetic studies were performed using the spectrophotometric method using a UV spectrophotometer SPECORD 200 (Analytic Jena, Germany).

When silibinin is introduced into the reaction mixture, the rate of hydrolysis of novocaine by butyrylcholinesterase is reduced. The rate constant of the first order when adding 100 μm of silibinin to the system decreased from $1.26\pm0.07\times10^{-3}$ c^{-1} to $0.76\pm0.07\times10^{-3}$ c^{-1}, which confirms the inhibitory properties of flavonoids. At concentrations of silibinin in the system of 25, 50 μm, the rate constant decreases by 1.2 and 1.4 times, respectively.

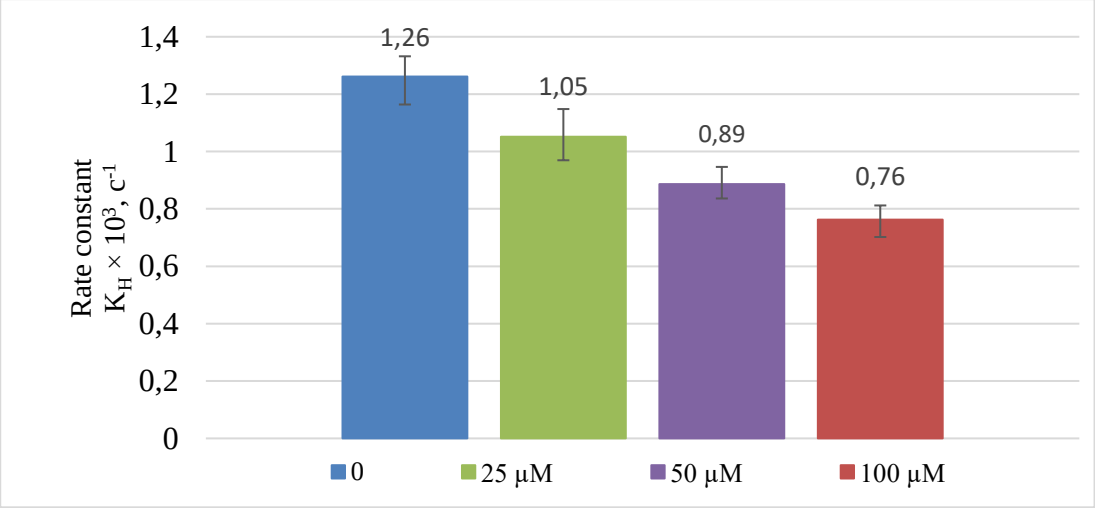

Fig. 1. Dependence of the rate constant of the first order of hydrolysis of novocaine without inhibitor and in the presence of silibin

The study found that silibinin effectively inhibits human serum butyrylcholinesterase. Thus, the development of a prolonged-release analgesic drug based on novocaine with the addition of silibinin to prolong the analgesic effect is promising.

[1] Joseph M Neal 1, Anne Gravel Sullivan, Richard W Rosenquist, Dan J Kopacz (2017). Regional Anesthesia and Pain Medicine: US Anesthesiology Resident Training-The Year 2015, 42(4):437-441. doi: 10.1097/AAP.0000000000000623.
[2] Ombregt L. (2013). Procaine: Principles of treatment. A System of Orthopaedic Medicine. Science Direct, 83–115 e.5 https://doi.org/10.1016/B978-0-7020-3145-8.00005-3.