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PROCAINE IN THE COMPOSITION OF MEDICATIONS PRESENT ON THE PHARMACEUTICAL MARKET OF UKRAINE

Objective. *To analyze the range of local anesthetic medications available on the current pharmaceutical market of Ukraine that contain procaine (procaine hydrochloride), and based on the obtained results, determine the feasibility of increasing production volumes and developing new medications containing procaine.*

Materials and Methods. *The analysis of the range of medications was based on data from the State Register of Medicines of Ukraine (as of April 2025). The study was carried out using statistical, logical, and graphical analysis methods.*

Problem Statement. *Due to the war between Russia and Ukraine, there is a consistently high demand for local anesthetics as the number of injured and wounded increases, leading to a greater need for surgical interventions and post-operative pain relief. On the other hand, the general impoverishment of the population, logistics challenges, and technological production stoppages caused by various wartime factors may negatively affect the domestic pharmaceutical market. Therefore, it is crucial to identify which affordable and available medications will take priority. This study focused on the domestic market of local anesthetic medications containing procaine hydrochloride and analyzed retail prices for the most popular ones in terms of availability in pharmacy networks across various regions of Ukraine. The obtained information will contribute to a better understanding of the accessibility of these medications for consumers, and the analysis conducted may serve as a foundation for strategic planning to increase the production of existing products and develop new local anesthetic medications based on procaine hydrochloride.*

Conclusions. *The marketing analysis of the Ukrainian pharmaceutical market for local anesthetic medications containing procaine (novocaine, procaine hydrochloride) showed that it is 100% filled with affordable domestic medications, with not only stable demand but also frequent shortages, particularly for combined analgesic medications in the form of ointments and gels. This opens up wide opportunities for expanding the range and creating new products.*

Key words: *procaine, procaine hydrochloride, local anesthetics, pharmaceutical market research, marketing research, price liquidity coefficient.*

Тарас Федюк, Андрій Миланич. ПРОКАЇН В СКЛАДІ ПРЕПАРАТІВ, ПРЕДСТАВЛЕНИХ НА ФАРМАЦЕВТИЧНОМУ РИНКУ УКРАЇНИ

Мета роботи. *Провести аналіз асортименту місцевоанестезуючих лікарських препаратів представлених на сучасному фармацевтичному ринку України, які містять у своєму складі новокаїн (прокаїн, прокаїну гідрохлорид), та на основі одержаних результатів визначити доцільність збільшення об'ємів виробництва та розробки нових препаратів з його вмістом.*

Матеріали і методи. *Аналіз асортименту препаратів проводили спираючись на дані Державного реєстру лікарських засобів України (станом на квітень 2025 р.). Роботу виконано з використанням статистичного, логічного та графічного методів аналізу.*

Постановка проблеми. *Через війну росії проти Україні постійно високою є потреба в місцевих анестетиках, оскільки спостерігається суттєве збільшення кількості травмованих і поранених, а отже, і необхідності операційних втручань та знеболення після них. З іншого боку загальне зубожіння населення, ускладнення логістики та технологічні зупинки виробництва, які зумовлені різними воєнними чинниками можуть мати негативний вплив на вітчизняний фармацевтичний ринок. Тому важливо визначити, які саме доступні і недорогі лікарські засоби будуть в пріоритеті. В даній роботі досліджувався вітчизняний ринок препаратів для місцевої анестезії, які містять в своєму складі прокаїну гідрохлорид та проводився аналіз роздрібних цін на найбільш популярні з них, щодо доступності в аптечних мережах у різних регіонах України. Отримана інформація сприятиме кращому розумінню рівня доступності цих препаратів для споживачів, а проведений аналіз може служити основою для стратегічного планування щодо збільшення випуску існуючих та розробки нових місцевоанестезуючих препаратів на основі прокаїну гідрохлориду.*

Висновки. *Маркетинговий аналіз українського ринку лікарських препаратів для місцевої анестезії, які містять в своєму складі прокаїн (новокаїн, прокаїну гідрохлорид), показав, що він 100 % заповнений недорогими лікарськими засобами українського виробництва і на ньому спостерігається не тільки стабільний попит на ці препарати, а часто і дефіцит, особливо на комбіновані знеболювальні препарати у формі мазі та гелю, що відкриває широкі можливості щодо розширення асортименту та створення нових препаратів.*

Ключові слова: *прокаїн, прокаїну гідрохлорид, препарати для місцевої анестезії, дослідження фармацевтичного ринку, маркетингове дослідження, коефіцієнт ліквідності ціни.*

Problem Statement. Since ancient times, humanity has sought effective ways to alleviate pain. One of the main methods today is anesthesia – a condition in which sensation is lost, achieved either through general anesthesia or local anesthesia that blocks pain in specific areas.

Due to the full-scale war of Russia against Ukraine, local anesthetics have become critically important. There has been a significant increase in injuries among both military personnel and civilians. These include fragment and mine-explosive wounds, amputations, and surgeries that require local anesthesia to prevent pain shock and alleviate suffering [9]. Given the large expenditures from the state budget to support the army and the generally low income level of the population, it is essential to ensure the availability of affordable anesthetic drugs. Expanding the range of local anesthetics and improving production methods is a key task for Ukraine's pharmaceutical sector today.

One of the most widely used short-acting local anesthetics is novocaine (procaine hydrochloride), listed in the National List of Essential Medicines and Medical Devices [4]. It is an ester-type anesthetic used to relieve various types of pain and is widely applied in surface, infiltration, epidural, and spinal anesthesia [1,8,10]. This compound was first discovered in 1904 by Alfred Einhorn as a substitute for cocaine and patented under the name "Novocaine" [1]. Like cocaine, novocaine constricts blood vessels, helping reduce bleeding—an advantage over other anesthetics such as lidocaine. Other benefits of novocaine include its relatively low cost, accessibility, and low toxicity. Notably, in the 20th century, it was also used as a standard to evaluate the potency of other anesthetics in the human body [1].

Purpose of the Work. To analyze the range of local anesthetic drugs available on the Ukrainian pharmaceutical market containing procaine hydrochloride, to assess demand, and to determine the feasibility of developing new low-cost drugs based on this substance.

Results and Discussion. The study of the range of drugs on the pharmaceutical market of Ukraine containing procaine hydrochloride was conducted based on official data, in particular the State Register of Medicinal Products of Ukraine [2], the Compendium reference book [5], and the ATC (Anatomical Therapeutic Chemical Classification System), taking into account: trade names, compositions, manufacturers, and types of dosage forms. In our research, we used statistical, logical, marketing, and graphical methods of analysis. For statistical calculations, we considered as one unit the preparations of the same manufacturer with identical original names, concentrations of active substances, and dosage forms, although the packaging could differ.

The analysis was carried out based on the active pharmaceutical ingredient "procaine," not only using the ATC codes N01BA02 and N01BA52, but also C05AD05 and M02AX, in order to maximize the completeness of the information. The analysis of the results showed that as of April 2025, according to the State Register of Medicines, there are two Chinese suppliers of the substance with the international non-proprietary name "Procaine Hydrochloride" in the form of crystalline powder or crystals in polyethylene bags registered on the Ukrainian pharmaceutical market. These are the companies "Chongqing Southwest No. 2 Pharmaceutical Factory Co. Ltd." and "Guangxi Shengtai Chemical Co. Ltd.", whose products are imported by three Ukrainian companies: two from Kharkiv – PJSC "Lekhim-Kharkiv" and LLC "Pharmaceutical Company Zdorov'ya" – and LLC "Istok-Plus" from Zaporizhzhia. Additionally, one domestic company – LLC "Farmkhim" from Shostka, Sumy region – manufactures and supplies this substance to the Ukrainian market under the trade name NOVOKAIN BASE. As we can see, all domestic companies supplying this substance to the market are located in close proximity to the zone of hostilities or the border with the aggressor, which indicates certain risks for the uninterrupted production of drugs containing procaine hydrochloride. At the time of the study, there were only 24 such drugs registered in Ukraine, produced by fifteen exclusively domestic manufacturers from all regions of Ukraine. There were no foreign manufacturers of finished pharmaceutical forms registered in Ukraine at the time. The drugs containing procaine hydrochloride are available on the market under the trade names: NOVOKAIN (a total of 10 preparations), produced by LLC "Yuriya-Pharm", PJSC "Halychfarm", LLC "PHARMASEL", PJSC "Infuziya", JSC "Lubnyfarm", PJSC "Lekhim-Kharkiv", and PJSC "Monfarm"; NOVOKAIN-DARNITSA (2 preparations), producer – PJSC "Pharmaceutical Firm Darnitsa"; NOVOKAIN-ZDOROV'YA (2 preparations), producer – LLC "Pharmaceutical Company Zdorov'ya"; MENOVAZIN (9 preparations), producers – LLC "Ternofarm", LLC "DKP Pharmaceutical Factory", LLC "MEDLEV", LLC "Pharma Cherkasy", JSC "Lubnyfarm", PJSC "FITOFARM" (it should be noted that this enterprise has been relocated from Bakhmut to Boryspil), PJSC "Viola Pharmaceutical Factory", LLC "Micropharm"; MENOVAZIN-VISHFA, producer – LLC "DKP Pharmaceutical Factory".

Fig. 1 shows the results of the analysis of drugs by dosage form based on data from the State Register of Medicines of Ukraine.

As seen from the figure, the range of medicines, although considerable, could be expanded both in terms of variety and quantity. Most of the presented drugs are available in the form of injection solutions in ampoules and solutions for external use in bottles.

It should be noted that the drugs containing the word "NOVOKAIN" in their trade name are mono-drugs, including all injection and infusion solutions and rectal suppositories. The share of mono-drugs in the total number of drugs is 58.3%. In turn, the trade name MENOVAZIN refers to combination drugs and holds a market share of 41.7% (Fig. 2).

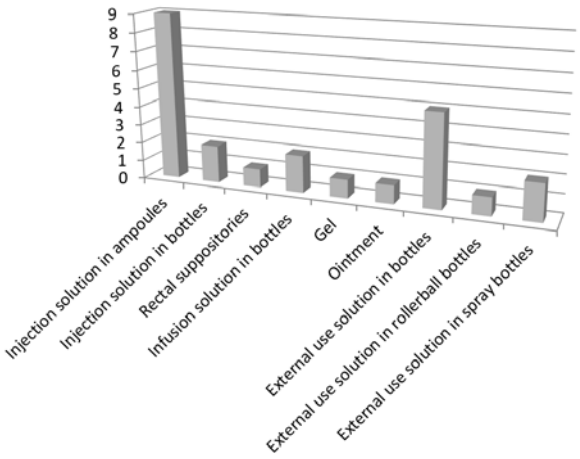

Fig. 1. Distribution of procaine hydrochloride drugs by pharmaceutical form

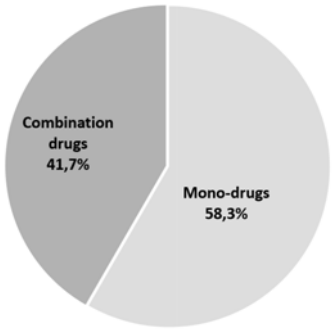

Fig. 2. Distribution of drugs by their composition

Among the manufacturing companies, the leaders in the range of mono-drugs are PJSC "Infuziya," while the leaders in combination drugs are LLC "DKP Pharmaceutical Factory," with each company producing 3 drugs, thus holding 13% of the market each. Only one of the listed manufacturers produces both mono- and combination drugs – JSC "Lubnyfarm," which produces 1 drug each in the form of injection solutions in ampoules and solutions for external use in bottles. The market structure by manufacturers is shown in Fig. 3.

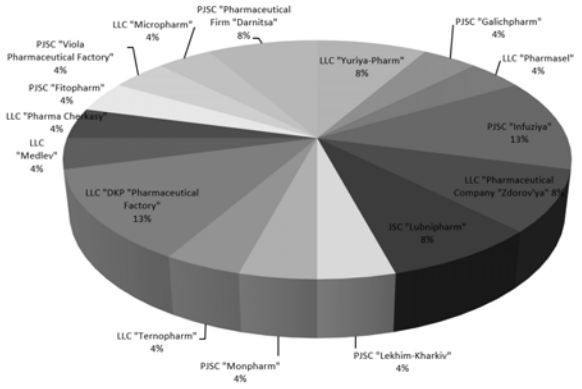

Fig. 3. Market structure by drug manufacturers

Analyzing the prices of drugs in pharmacy chains across different regions of Ukraine in the cities of Kyiv, Lviv, Odesa, Kharkiv, and Dnipro, as presented on the websites "Tabletki.ua" [6] and Kompendium [5] as of April 10, 2025, it can be noted that all of them are

Table 1

Price range and availability of procaine-containing drugs in major cities of Ukraine

Drug name	Price range (UAH) and number of pharmacies where available				
	Kyiv	Lviv	Odesa	Kharkiv	Dnipro
Novocaine-Darnytsia inj. sol. 0.5%, 5 ml × 10 amp.	57,01-100,00 1290 pharmacies	64,66-95,60 408 pharmacies	70,90-94,81 451 pharmacies	73,94-95,00 500 pharmacies	66,10-96,80 391 pharmacies
Novocaine inj. sol. 5 mg/ml, 5 ml × 10 amp.	38,00-71,20 991 pharm.	51,30-71,20 338 pharm.	52,40-71,00 353 pharm.	52,40-71,20 425 pharm.	49,91-70,90 325 pharm.
Novocaine inj. sol. 0.5%, 200 ml bottle	62,95-103,20 640 pharm.	62,95-95,20 103 pharm.	45,58-103,10 261 pharm.	51,10-95,20 326 pharm.	53,40-95,20 175 pharm.
Novocaine rectal suppositories 0.1 g × 10	61,96-103,10 974 pharm.	92,44-93,10 326 pharm.	61,60-101,49 343 pharm.	68,30-102,68 26 pharm.	69,55-105,30 338 pharm.
Novocaine infusion sol. 0.5%, 200 ml bottle	63,60-110,50 367 pharm.	37,30-84,45 58 pharm.	59,20-94,30 105 pharm.	53,40-96,52 72 pharm.	61,80-87,40 141 pharm.
Menovazin gel, 40 g tube	122,37-143,44 16 pharm.	120,70-143,44 7 pharm.	121,60-143,44 12 pharm.	Not available	Not available
Menovazin sol. for external use, alcohol, 40 ml bottle.	15,00-55,00 239 pharm.	14,62-18,84 41 pharm.	16,00-30,00 94 pharm.	15,52-27,18 79 pharm.	16,27-26,40 67 pharm.
Menovazin roll-on sol., alcohol, 50 ml bottle	62,11-85,00 99 pharm.	52,50-81,30 72 pharm.	70,84-75,59 13 pharm.	65,13-81,30 14 pharm.	60,10-78,30 36 pharm.
Menovazin spray sol., alcohol, 50 ml bottle	53,10-91,20 1125 pharm.	48,19-77,40 371 pharm.	52,00-81,83 419 pharm.	50,30-78,10 434 pharm.	51,95-73,30 345 pharm.

Table 2

Price liquidity coefficient of drugs by regions

Drug name	Price liquidity coefficient (C_{liq}) of procaine-containing drugs by region				
	Kyiv	Lviv	Odesa	Kharkiv	Dnipro
Novocaine-Darnytsia inj. sol. 0.5%, 5 ml × 10 amp.	0,754	0,479	0,337	0,285	0,464
Novocaine inj. sol. 5 mg/ml, 5 ml × 10 amp. (JSC Lubnypharm)	0,874	0,388	0,355	0,359	0,421
Novocaine inj. sol. 0.5%, 200 ml bottle	0,639	0,512	1,262	0,863	0,783
Novocaine rectal suppositories 0.1 g × 10	0,664	0,007	0,648	0,503	0,514
Novocaine infusion sol. 0.5%, 200 ml bottle	0,737	1,264	0,593	0,807	0,414
Menovazin gel, 40 g	0,172	0,188	0,180	N/A	N/A
Menovazin sol. for external use, alcohol, 40 ml bottle	2,667	0,289	0,875	0,751	0,623
Menovazin roll-on sol., alcohol, 50 ml bottle	0,369	0,549	0,067	0,248	0,303
Menovazin spray sol., alcohol, 50 ml bottle	0,718	0,606	0,574	0,553	0,411

inexpensive. Their prices range from 14.62 UAH (the lowest price for MENOVAZIN in bottles) to 143.44 UAH (the highest price for MENOVAZIN in gel form). As seen in Table 1, the price of the drugs may vary slightly, as well as their availability in pharmacies depending on the region. It was found that at the time of the market study, MENOVAZIN in ointment form was not available in any pharmacy. For this reason, this drug is not represented in Table 1.

To analyze the availability of pharmaceutical drugs containing procaine hydrochloride, we determined the price liquidity coefficient (C_{liq}) [7] for each region. It is known that when $C_{liq} \leq 0,5$, we can speak of a high level of competition for the drug and its availability in the market. The following formula was used for the calculation:

$$C_{liq} = (P_{MAX}-P_{MIN})/P_{MIN}$$

where P_{MAX} i P_{MIN} are, respectively, the highest and lowest price of the drug in packaging in UAH [3,7].

The calculation results are presented in Table 2.

As seen from Table 2, among the drugs containing procaine hydrochloride, only one drug, namely Menovazin Gel, has a low and practically identical liquidity coefficient in all regions where it is present in the market. This fact, along with the availability of the drug in only 35 pharmacies in three of the five major cities across different regions of the country, indicates a high level of competition for it in its segment and a consistently high demand. In turn, drugs such as Menovazin, ethanol solution for external use in 50 ml roll-on bottles, and Novokain-Darnitsa, 0.5% injection solution in 5 ml ampoules (10 pcs.), also show a good liquidity coefficient and low fluctuations across regions, indicating stable demand in the market. It is worth noting separately that for Menovazin, ethanol solution for external use in 40 ml bottles by LLC "Micropharm," the liquidity coefficient values (Sliq) are generally high and show a large variance (from 0.289 to 2.667), indicating its unstable demand. When comparing the overall liquidity coefficient values (Sliq) for drugs containing procaine hydrochloride across regions, the highest values are found in Kyiv, while the lowest are in Dnipro, which is the closest to the front line.

Conclusions. Thus, the marketing analysis of the Ukrainian market for local anesthetic pharmaceutical drugs containing procaine hydrochloride (novocaine) has shown that the substances registered on the market are mainly of Chinese origin or produced in Sumy region, which is constantly subjected to enemy attacks, presenting certain risks for the market. As for the finished pharmaceutical forms, the market is 100% filled with domestically produced drugs. The leaders in terms of product range among monodrugs are PJSC "Infuziya," while for multicomponent drugs, LLC "DCP "Pharmaceutical Factory" leads. All the drugs containing procaine, presented in pharmacy networks, are inexpensive and not only have stable demand but often face shortages, especially the combined forms in the form of ointments and gels. When considering by regions, the highest demand for drugs containing procaine is observed in Dnipro, while the lowest is in the capital. Therefore, it can be confidently stated that there are wide opportunities in Ukraine for increasing the production volumes of pharmaceutical drugs, expanding their range, and creating new procaine hydrochloride-based drugs.

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