DYNAMICS OF PATENTING INVENTIONS ON THE PROBLEM OF USING ULTRASOUND TECHNOLOGIES IN MINIMALLY INVASIVE SURGERY

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Relevance. In the process of studying and analyzing literature on the research topic in authoritative databases (Google Scholar, PubMed, Scopus), more than 22 thousand scientific publications were identified, but no reviews of patent information were found. It should be emphasized that patent information is an important part of scientific and technical information, as it reflects the results of research and development work aimed at developing new or improving known methods, devices or substances that are world novel and protected by patents.

Aim: to analyze the contribution of inventors from countries of the world community to the problem of using ultrasound technologies in minimally invasive surgery.

Research methods. To achieve this goal, a patent search was carried out in the PATENTSCOPE search engine created by the World Intellectual Property Organization (https://patentscope.wipo.int/search/en/search.jsf). This system provides access to international patent documents in accordance with the Patent Cooperation Treaty (PCT), as well as to patent documents from regional and national funds. Patent search results are presented as of March 23, 2025.

Results and its discussion. As a result of the analysis in the PATENTSCOPE database for the specified period of time, 82 patents were identified relating to various aspects of the research topic. In the last ten-year period, 55 patents were registered which is 67% of their total number (Table).

Table – Publication dates and patenting dynamics for the period 2016-2025

Years	Number of patents	Years	Number of patents
2016	4	2021	10
2017	6	2022	10
2018	5	2023	4
2019	5	2024	3
2020	6	2025*	2

* Until March 2025 inclusive.

The results of Table convincingly indicate a dynamic increase in the number of patents over the years of the last decade which indicates an increase in the interest of inventors in the research problem.

An assessment of inventive activity on the research topic in the countries of the world community showed that the USA occupies the leading position in the number of issued patents (25). The next two positions belong to the Russian Federation and

the Chaina (21 and 15 patents respectively). 16 patents were registered in International patent offices (PCT and EPO). Single patents were issued in Australia (3), Canada (1) and Germany (1).

A telling example of the successful use of ultrasound in minimally invasive surgery is a patent issued by Chinese inventors in 2024. The invention discloses a method and system for directing minimally invasive interventional ultrasound to penetrate deep into human tissue, which allows obtaining ultrasound images with a good field of view and high resolution and increasing the accuracy of surgery in minimally invasive interventional surgery [1].

Inventors from USA patented a method for minimally invasive surgery using therapeutic ultrasound in spine and orthopedic procedures. The method includes a minimally invasive access port, a therapeutic ultrasound probe to treat a targeted area through the port, and a protective sheath that enables application of the therapeutic ultrasound without causing unintended tissue damage [2].

The invention of Russian scientists relates to medicine, in particular to the field of obstetrics and fetal surgery. Against the background of premedication and sedation of the patient, an intravenous catheter is inserted for continuous tocolysis of the pregnant woman during the operation. Diagnostic cordocentesis is performed under ultrasound control. In this case, the state of blood flow in the sacrococcygeal teratoma is monitored using color Doppler. After the surgical manipulation, ultrasound monitoring of the fetal heartbeat, blood flow in the umbilical artery, and blood flow in the sacrococcygeal teratoma is performed in the operating room. The method allows for minimally invasive correction of intrauterine sacrococcygeal teratoma with exophytic growth, stopping cardiovascular insufficiency and non-immune hydrops in the fetus, prolonging pregnancy, and preventing perinatal loss [3].

Of interest is a patented device for teaching minimally invasive breast surgery, which includes a breast model, a color Doppler ultrasound equipment used to determine the position of a tumor-like body in the breast model, a rotating cutter used to puncture and cut off the tumor-like body under the guidance of the color Doppler ultrasound equipment, and a negative pressure aspirator communicating with the puncture needle of the rotating cutter. The minimally invasive breast surgery trainer can be used for teaching minimally invasive breast surgery to improve the practical level of the operation [4].

A device for minimally invasive surgery has been registered with the European Patent Office (EPO). A device is provided herein having a proximal portion and a distal portion, and an ultrasound transducer may be disposed within the distal portion and configured to scan tissue and identify certain portions of a patent's anatomy during the scanning process. The results of the detection may be presented to an operator of the device aurally and/or visually, such as in a 3-D volumetric image. By scanning the tissue, identifying the anatomy, and presenting the results to an operator, unnecessary damage to elements of the patients anatomy may be avoided or lessened. In some aspects, multiple transducers may be positioned on the device to increase the scanning range and/or scanning accuracy of the device. The device may provide an inner channel for the passage of surgical tools while scanning tissue [5].

Summary. The results of the study allow to conclude that scientists from a

number of countries around the world have made a significant contribution to the development and patenting of new methods devices and substances related to the specified problem. The highest inventive activity was noted over the years of the last decade (2015-2024).

The information presented in this article may be useful to specialists in the field of study and clinical use of ultrasound in minimally invasive surgery. Patent information is reliable, relevant, has global novelty and is widely used to analyze the inventive activities of scientific organizations and identify trends in the global development of science and technology.

References

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PRACTICAL USE OF MINIMALLY INVASIVE SURGICAL CARE IN BILIARY HYPERTENSION SYNDROME

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Background. Biliary hypertension syndrome (BHS) arises from obstructive pathologies – such as malignant strictures, pancreatic head cancer, intraductal