

### Morphological and Biochemical Changes in the Kidneys after Chemotherapy

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#### Article Information

**Received:** March 11, 2023

**Accepted:** April 12, 2023

**Published:** May 13, 2023

**Keywords:** *Chemotherapy, metastasis, tubulopathy, cytostatic, acid-base balance, morphology, nephron, glomerulus, proximal convoluted tubule, distal convoluted tubule.*

#### ABSTRACT

The use of chemotherapy for breast cancer is immunotherapy. The greatest nephrotoxicity among the above-listed have alkylating drugs and antimetabolites. In addition to cytostatic agents, various types of accompanying therapy in cancer patients. The use of immunomodulation during chemotherapy has a positive effect on kidney damage.

**Relevance.** The use of chemotherapy for breast cancer is immunotherapy. The main objectives of immunotherapy for breast cancer are to stop or slow down the growth of the primary tumor and metastases, prevent metastasis and recurrence after surgery, and increase the effectiveness of other treatments (chemotherapy, radiation therapy) [4,5].

In the early stages of cancer, with large resectable tumors, the doctor may prescribe immunomodulators before surgery, in combination with chemotherapy. This helps to reduce the size of the tumor and make the operation easier [1].

For example, to carry out a resection of the mammary gland instead of its complete removal. After surgery, immunotherapy continues with chemotherapy, which now serves to prevent relapse [10].

If doctors do not plan to perform an operation to remove a breast tumor, then immunomodulators are used to control the disease. It inhibits the further growth and spread of the tumor throughout the body. This option is used in the advanced stages of cancer, with active metastasis, or if a woman refuses surgical treatment for any reason. In the advanced stages of cancer, immunotherapy is combined with chemotherapy, hormone treatment, and radiation. This is possible due to its excellent tolerability and the absence of serious side effects. Immunotherapy is not equally effective in all women. Doctors conduct a preliminary examination to determine exactly whether this type of treatment is necessary [11].

The examination includes biochemical, morphological and molecular analyses. The results of examinations show how much the tumor is able to evade attacks by the immune system, and which type of immunomodulation will lead to the highest treatment success rates [2].

Immunotherapy combines drugs that destroy cancer cells by acting on different parts of the immune system. Sometimes these are factory-made drugs, sometimes they are drugs that are made individually. The greatest nephrotoxicity among the above are alkylating drugs and antimetabolites. In addition to cytostatic agents, various types of accompanying therapy in cancer patients (antibacterial, antifungal, antiviral drugs, immunoglobulins, contrast agents, bisphosphonates, analgesics, anticoagulants) can also lead to kidney damage [8].

It is necessary to evaluate the risk factors for nephrotoxicity of polychemotherapy before starting treatment, which are divided into patient-related, renal and drug-related. Patient-related factors primarily include female gender and age over 65 years. For the elderly, a reduction in muscle mass is characteristic, which leads to a decrease in the level of creatinine in the blood serum. This masks changes in estimated glomerular filtration rate (GFR); a decrease in the intravascular volume of fluid, contributing to an increase in the concentration of drugs. Often in this cohort, patients have hypoalbuminemia, which, regardless of its origin (renal, extrarenal), is accompanied by a decrease in drug binding to proteins [6].

The use of certain cytotoxic drugs may also be accompanied by the development of tubulopathies. Damage to individual segments of the tubules can occur both with a decrease in GFR and with preservation of the excretory function of the kidneys. Clinically, Fanconi syndrome (SF) is most often observed - dysfunction of the proximal tubules with impaired reabsorption of bicarbonates, amino acids, glucose and inorganic phosphate. The main manifestations include non-diabetic glucosuria, phosphaturia, and renal tubular acidosis. Ifosfamide and platinum are the most commonly induced cytotoxic agents of SF, while imatinib is the most common cause of hypophosphatemia [7].

Some drugs (such as cisplatin) can also cause the development of a "salt-wasting kidney" with damage to the proximal tubules and the loop of Henle. As a result of a violation of the reabsorption of water, sodium, potassium, magnesium, polyuria is noted with increased excretion of the listed ions, expressed by a decrease in the total volume of fluid, orthostatic hypotension [3].

Immune checkpoint inhibitors are drugs that prevent the tumor from hiding from the natural attacks of the immune system. Normally, a woman's immunity recognizes and destroys the very first malignant cells in the mammary gland, preventing tumors from developing. Unfortunately, a tumor can hide signs of malignancy and masquerade as healthy tissue. It is this disguise that inhibitors of the checkpoints of the immune response recognize and remove. This group includes drugs against various tumor molecules. Cancer vaccines stimulate the development of natural specific immunity. This is a strictly individual type of treatment; doctors use tumor components and patient's leukocytes to make a vaccine [9].

Nanotechnology is also being used to fight cancer. Nanoparticles deliver imaging compounds (at the diagnostic stage), phototherapy compounds, or drugs (at the treatment stage) to tumor cells.

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