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Review Article

Aspects of Spontaneous Regression of Oncological Tissue

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Abstract

Spontaneous regression of a malignant tumor is the phenomenon of disappearance of cancer cells without any treatment. Spontaneous regression of a malignant tumor is associated with the mechanisms of apoptosis (the natural process of self-destruction of cells); immune system reactions; the impact of the tumor microenvironment; genetic factors, such as epigenetic modifications of oncogenes, tumor suppressors; hormonal reactions; the actions of various cellular proteins: cytokines, growth factors. The article discusses the process of spontaneous initiation of regression of a malignant tumor in the process of regulation by the balance of antitumor and inflammatory signals. Spontaneous regression of a malignant tumor is activated in clinical conditions that enhance the body's immune response and increase its ability to recognize and destroy cancer cells. This requires fine-tuning of the immune system. Correct enhancement of the immune response and increase in the body's ability to recognize and destroy cancer cells during spontaneous regression of malignant tumors establishes lymphocytic and plasmatic infiltration of dying tumor tissue and its environment. Studying data on spontaneous regression of cancer cells provides valuable information that can be used to improve treatment approaches. Identifying the mechanism that triggers spontaneous regression of cancer tumors will allow them to be destroyed promptly.

Keywords: malignant tumor; tumor suppressors; oncological tissue; immune cells

1. Introduction

The history of studying and describing spontaneous regression of malignant tumors spans several centuries and is a fascinating aspect of the development of oncology and immunology. It is extremely rare (less than 1 in 100,000 cancer cases). The first documented case occurred in the 13th century. This story tells of a young priest, Saint Peregrine, who developed a bone tumor that disappeared on its own. Since then, the disappearance of a tumor without the necessary treatment has been called Peregrine's syndrome.

The first documented cases of spontaneous regression appeared in medical literature in the 17th-18th centuries. At that time, doctors noted cases where tumors disappeared in some patients without any treatment. In 1636, the French surgeon and anatomist Antoine Lavoisier described a case of regression of stomach cancer in a patient.

In the 19th century, doctors and researchers began to systematically document cases of regression of various tumors. In 1866, the English surgeon John Harrison first used the term "spontaneous regression" to describe this phenomenon. In 1889, the French pathologist Bertrand Guillaume described cases of regression of melanoma and other tumors, associating them with immune mechanisms.

In the 20th century, an in-depth study of the immunological aspects of regression began. In the 1950s and 1960s, the first hypotheses about the role of the immune system in the destruction of tumor cells appeared. In the 1970s and 1980s, research confirmed the importance of immune processes and immunotherapy methods began to develop. In recent decades, thanks to the development of molecular biology and immunotherapy, significant progress has been made in understanding the causes of spontaneous regression. In 2018, scientists, for example, received the Nobel Prize in Physiology or Medicine for discoveries related to the mechanisms of immune regulation and cancer immunotherapy. Current research continues to examine cases of regression to find new ways to stimulate the immune response against tumors.

Stories of spontaneous regression serve as inspiration for the development of new cancer treatments, including immunotherapy, vaccines, and gene technologies [1-5]. Studying these cases helps to understand the body's natural mechanisms of fighting tumors and to develop personalized approaches to therapy. In general, the history of spontaneous regression of malignant tumors is a path from isolated observations to a deep understanding of the role of the immune system, which continues to evolve today, opening up new approaches to the treatment of cancer. For example, regression of a malignant tumor by regulating the balance of antitumor and proinflammatory signals. This is a complex process that depends on the interaction of various cellular and molecular mechanisms in the tumor microenvironment. Spontaneous regression of malignant tumors has attracted much attention from researchers in order to

understand the mechanisms of natural antitumor processes and develop natural therapeutic strategies.

Let's consider the processes that can trigger regression:

1. Activation of antitumor immune responses, when cytotoxic T lymphocytes, natural killer cells (NK cells), M1 macrophages and other effectors predominate in the tumor microenvironment, they are able to suppress tumor growth and trigger its regression.

2. Dominance of antitumor signals, when antitumor cytokines (e.g., interferons, interleukins) begin to predominate over inflammatory ones, this stimulates apoptosis of cancer cells and suppresses their proliferation.

3. Modulation of the microenvironment associated with changes in the cells of the microenvironment, such as a decrease in the level of inflammatory cytokines (e.g., IL-6, IL-17) and an increase in antitumor factors (e.g., IFN-γ), create conditions for tumor suppression.

4. Immune reconfiguration, which leads to a switch in the immune response from an inflammatory to an antitumor mode - this is, for example, the activation of immune system actors that promote the removal of tumor cells.

5. Immune therapies (e.g., immunomodulators, immune checkpoint blockade) can enhance antitumor signals, causing tumor regression even when the initial balance is maintained.

In general, tumor regression is triggered when antitumor mechanisms begin to dominate, suppressing the growth and survival of cancer cells. This can occur naturally or with the help of therapies that shift the balance towards enhancing the immune response and immune suppression of the tumor. Immune enhancement technologies are aimed at increasing the efficiency of the immune system in recognizing and destroying cancer cells. The main methods and approaches in this area are: immunotherapy using monoclonal antibodies, vaccines against tumor antigens, stimulation of dendritic cells (DC), the use of immunomodulators and cytokines, genetic engineering of immune cells (CAR-T, TCR therapy), the use of nanotechnology to deliver antigens to tumor sites, the combination of several technologies to synergistically enhance the immune response. These technologies allow not only to activate the immune system, but also to direct it to specific tumor antigens, increasing the chances of successfully destroying cancer cells with minimal side effects. For a more accurate understanding of the situation, it is necessary to take into account the specific type of tumor, its molecular profile and the clinical state of the patient's immune system.

2. Studies of spontaneous regression of cancer tumors in Russia, the USA and China

Research into spontaneous regression of malignant tumors in Russia is an important area in oncological science aimed at understanding the mechanisms of natural disappearance of tumor processes without therapeutic intervention. Russian clinics and research centers have recorded cases of regression of various types of cancer, such as melanoma, kidney cancer, lung cancer, lymphoma, and others. Blokhin Cancer Research Institute or P.A. Herzen Cancer Research Institute conduct observations and analyze cases of spontaneous regression. Some studies are related to the analysis of the immune status of patients who have experienced regression.

Research into spontaneous regression in the United States is an important area that helps to understand the body's natural mechanisms of fighting cancer and also contributes to the development of new therapeutic approaches. Despite the rarity of this phenomenon, its study continues to be relevant for oncological sciences and the National Cancer Institute (NCI, USA). National databases and registries of cancer cases in the United States are being formed, for example, SEER. Conferences and symposia on oncology and immunology are held. Research results are published in the Journal of Clinical Oncology, Cancer Research.

Spontaneous regression of malignant tumors in China is an important area of oncology research aimed at understanding the mechanisms that lead to spontaneous reduction or disappearance of tumors without specific treatment. A number of rare cases of spontaneous regression of various types of malignant tumors, such as gastric, liver, lung and other cancers, have been recorded in China. These cases are analyzed to identify common features associated with immune, genetic and microbiological factors. Research is being conducted in China to identify biomarkers of the immune response that can predict spontaneous regression. Research contributes to the identification of biomarkers that predict the likelihood of regression. Genetic changes in patients with regressing tumors are analyzed, including mutations, expression of suppressor genes and immune factors. In some cases, activating mutations or expression of immune regulators that contribute to tumor suppression are found. Studies are examining the role of infectious agents (e.g., viruses such as HPV or hepatitis B) that may stimulate immune mechanisms that cause regression. The influence of diet, environmental conditions, and other factors specific to China is also being studied. The general trend in China is toward increased attention to the immunological and molecular aspects of spontaneous regression

3. Natural, social and everyday means and mechanisms of spontaneous regression of malignant tumors

Natural, social, and everyday means and mechanisms of spontaneous regression of malignant tumors are complex and not fully understood phenomena in which a tumor shrinks or disappears without targeted medical intervention. Let's consider them in more detail.

1. Natural mechanisms of spontaneous regression:

- Immunological response of the body: activation of the immune system, which recognizes and destroys cancer cells. In some cases, the immune response can be enhanced by natural factors, such as infections or inflammatory processes.

- Viral infections: some viruses can stimulate the immune system or cause an immune response that promotes tumor regression.

- Genetic and molecular factors: natural changes in the genetic material of tumor cells, leading to their apoptosis (programmed death).

- Hormonal changes: in some patients, a decrease in the levels of hormones that stimulate tumor growth can lead to regression.

- Changes in the tumor microenvironment: decreased blood supply or changes in metabolic conditions that negatively affect tumor cell growth.

2. Social means and mechanisms:

- Social and psychological influences: severe psychological stress or changes in lifestyle may have an indirect effect on the immune system and the body as a whole, although there is little scientific evidence of a direct effect on regression.

- Social support: having family and community support may improve overall health and stimulate internal mechanisms of the body that promote regression.

3. Household and natural remedies:

- Diet and lifestyle: some studies suggest that proper nutrition, giving up bad habits, and physical activity may indirectly help strengthen the immune system and create conditions for regression.

- Folk remedies and herbal medicine: in some cultures, certain herbs and natural preparations are credited with causing tumor regression. However, scientific evidence for their effectiveness is limited and requires caution.
- Hydration and detoxification: Supporting the overall health of the body through proper nutrition and hydration can have a beneficial effect on immune regression mechanisms.

4. Genetics of spontaneous regression of malignant tumors

Investigation of the genetic mechanisms of this process is important because it helps us understand the factors that contribute to the natural control of tumor growth and may open up new avenues for the development of innovative therapeutic strategies. It is currently assumed that spontaneous regression is associated with a complex of genetic changes and interactions between tumor cells and their surrounding microenvironment.

Genetic mutations that increase the expression of antigens on the surface of tumor cells can activate the body's immune response, which leads to their destruction. For example, changes in genes responsible for antigen presentation (e.g., HLA genes) improve the recognition of tumor cells by the immune system.

Mutations that activate genes responsible for apoptosis (programmed cell death), such as p53, can promote the self-destruction of tumor cells. When these changes occur at critical gene points, tumor growth stops or regresses. Genetic instability in tumor cells can lead to mutations that make the cells more susceptible to internal or external factors that cause their death.

Genetic changes in tumor cells interact with the microenvironment - the inflammatory response, immune cell activation, cytokine secretion and other factors. For example, the activity of genes encoding cytokines can enhance the immune response and promote tumor regression. Current research uses sequencing methods, microarrays and genomic analyses to identify genetic markers of spontaneous regression. In some cases, mutations are found in genes associated with immune regulation, apoptosis or cell growth control.

The genetics of spontaneous regression in malignant tumors remains an active area of research. Understanding the specific genetic changes that underlie this phenomenon may help in the development of new therapies aimed at mimicking natural tumor suppression mechanisms. In the future, the integration of genetic data with immunotherapeutic approaches promises to improve the effectiveness of cancer treatment.

The genetic state of a regressing cancer tumor is characterized by changes in the genetic material that contribute to the reduction or disappearance of the tumor. Typically, this includes, first, an increase in the number of mutations that lead to disruption of the growth and division of cancer cells, second, genetic changes that cause apoptosis (programmed cell death), third, damage to or loss of oncogenes responsible for stimulating tumor growth. Fourth, increased activity of tumor suppressor genes that suppress the growth of cancer cells, fifth, genetic instability that can lead to further damage to the genetic material and, in the case of regression, to a decrease in tumor clonal lines. In general, the genetic state during regression indicates a decrease in oncogenic activity and restoration of control over cell growth.

5. How do plasma and lymphocyte infiltration ensure spontaneous regression of a malignant tumor

Plasma and lymphocytic infiltration play an important role in the mechanisms of spontaneous regression of a malignant tumor by activating and supporting the antitumor immune response. Let us consider how exactly these types of immune infiltrate contribute to this process: 1. Lymphocytic infiltration:

- T-lymphocytes (especially cytotoxic CD8+ T-cells) recognize tumor antigens and destroy cancer cells through cytotoxic action.

- T-helpers (CD4+ T-cells) enhance the immune response by activating cytotoxic lymphocytes and macrophages, and also promote the production of cytokines that enhance antitumor activity. - Regulatory T-cells (Tregs), if their activity is limited or reduced, allow for a more effective antitumor immune attack.

2. Plasma infiltration:

- Involves the activity of B lymphocytes, which differentiate into plasma cells and produce antibodies against tumor antigens.

- Antibodies can bind tumor cells, marking them for destruction by other components of the immune system, such as through antibody-dependent cellular cytotoxicity (ADCC).

- In addition, antibodies can neutralize growth factors or secreted products of the tumor, attenuating its progression.

3. Synergy:

- The interaction of lymphocytes and plasma cells creates an immune microenvironment favorable for the destruction of tumor cells.

- These immune components contribute to the development of an inflammatory response microenvironment that inhibits tumor growth and spread.

4. Mechanism of spontaneous regression:

- When the immune system successfully recognizes cancer cells, a powerful immune response is triggered, including lymphocyte and plasma infiltration.

- As a result, tumor tissue is destroyed, its volume is reduced, and, in some cases, complete regression occurs.

Thus, active lymphocyte and plasma infiltration create an immunological barrier against tumor growth, which leads to spontaneous tumor regression. Successful interaction of these components and their effective functioning are key factors in the natural suppression of malignant processes.

6. How the immune system generates and activates lymphocyte and plasma cell infiltration

The immune system generates and activates lymphocyte and plasma cell infiltration in response to inflammatory or pathological processes through complex mechanisms involving activation of immune cells, cytokines, and chemokines [6-8]. The main steps in this process are: 1. Pathogen or injury recognition:

- Antigens associated with infection or tissue injury are recognized by dendritic cells and other antigen presenting cells.

2. Immune cell activation:

- Recognition activates T cells and B cells, which begin to proliferate and differentiate.

3. Cytokine and chemokine release:

- Immune cell activation is accompanied by the release of cytokines (e.g., interleukins, interferons) and chemokines (e.g., CXCL9, CXCL10, CCL2).

- These molecules create concentration gradients that attract additional immune cells to the site of inflammation.

4. Migration of lymphocytes and plasma cells:

- Lymphocytes and plasma cells migrate through blood and lymphatic vessels into tissues, where they are activated.

- Adhesion molecules (e.g., selectins, integrins) and chemokines play an important role in the migration process.

5. Tissue infiltration:

- In tissues, lymphocytes and plasma cells form an infiltrate, which can be localized in certain areas (e.g., lymphoid follicles).

- Lymphocytes perform cytotoxic activity, coordinate the immune response, and plasma cells produce antibodies.

6. Maintenance and regulation of infiltration:

- The constant formation and maintenance of the infiltrate is regulated by the balance between inflammatory and anti-inflammatory factors.

- Tissues can create a microenvironment favorable for local activation and proliferation of immune cells.

Thus, the formation and activation of lymphocytic and plasmatic infiltration is the result of the interaction of cells, molecules and signaling pathways aimed at eliminating oncology, as well as regulating the inflammatory process. To do this, it is necessary to study the clinical history of the formation of oncology and the reaction of the body's systems.

7. Clinical history of neutralization of malignant tumor

The clinical history of neutralization of a malignant tumor is a sequence of diagnostic and therapeutic measures aimed at eliminating or controlling a malignant neoplasm. Below is a general overview of the stages of such a history:

1. Diagnostics:

- Clinical examination: detection of tumor signs (e.g., enlarged lymph nodes, presence of tumor formations).

- Laboratory tests: blood test, biochemical parameters, tumor markers.

- Instrumental methods:

- Ultrasound examination (US) - Computed tomography (CT)

- Magnetic resonance imaging (MRI)

- Positron emission tomography (PET)

- Biopsy and histological examination to determine the type and stage of the tumor.

2. Treatment planning:

- Determination of the stage of the disease according to TNM or other systems.

- Selection of an appropriate treatment method: surgery, chemotherapy, radiotherapy, targeted therapy, immunotherapy.

3. Treatment:

- Surgery - removal of the tumor and surrounding tissue.

- Radiation therapy - exposure to radiation to destroy cancer cells.

- Chemotherapy - use of cytostatics to destroy cancer cells.

- Targeted and immunotherapy - individualized approaches aimed at specific tumor features.

4. Monitoring and evaluation of effectiveness:

- Regular control studies to detect relapses or metastases.

- Evaluation of clinical response according to RECIST or other criteria.

5. Neutralization and restoration:

- In case of successful treatment - supportive therapy and rehabilitation.

- In case of relapse - retreatment or palliatieve measures to relieve symptoms.

The clinical history of neutralization of a malignant tumor is an individual process that requires an interdisciplinary approach and consideration of the characteristics of each patient.

8. Clinical material on the treatment of oncological diseases

Cancer treatment case reports contain a wealth of data and cases that demonstrate successful diagnostic, treatment, and follow-up care for patients with cancer. They are typically used for teaching, research, and improving treatment strategies. The main components of cancer treatment case reports are listed below:

1. Case reports:

- Description of the medical history (anamnesis, symptoms, diagnostic data).

- Diagnostic steps (research methods, biopsy results, imaging).

- Treatment plan (surgery, chemotherapy, radiotherapy, hormonal or immunotherapy).

- Treatment outcomes (absence of disease signs, long-term remission, quality of life).

2. Statistical data:

- Recovery rates by tumor types and stages.

- Long-term results and survival.

- Recurrence and metastasis rates.

3. Protocols and recommendations:

- Standards and algorithms for treating various oncological diseases.

- Tactics for managing complex cases and complications.

4. Types of therapy and their effectiveness:

- Surgical methods with descriptions of successful cases.

- Chemotherapy and radiotherapy with examples of complete tumor regression.

- Hormonal and immunotherapy with clinical confirmation of effectiveness.

5. Personal experience of clinicians and researchers:

- Descriptions of successful interventions and their analysis.

- Study of factors contributing to cure.

6. Methods of monitoring and prevention:

- Screening programs allow detecting cancer at early stages.

- Preventive measures increase the chance of a full recovery.

This material is widely used in oncological practice, scientific publications, training courses and conferences to increase the level of knowledge and improve the treatment results of cancer patients.

9. Collection of oncological clinical material

Collection of oncological clinical material from medical institutions where the patient was treated includes the following steps and recommendations:

1. Obtaining patient consent:

- Ensure that the patient's written consent is obtained for the collection and use of his/her medical information in accordance with the requirements of the legislation on the protection of personal data and medical confidentiality.

2. Determining the list of institutions:

- Make a list of all medical institutions where the patient was treated (oncology centers, clinics, hospitals, diagnostic laboratories, etc.).

3. Requesting medical documentation:

- Contact each institution with an official request for the provision of medical records, diagnostic protocols, test results, discharge summaries, medical histories and other necessary materials.

- Specify the purpose of collection, timeframe and right to review.

4. Organizing data transfer:

- Ensure secure transfer of medical data (e.g. via secure electronic channels, encrypted media or postal service with tracking).

5. Keeping records of collected material:

- Create a system for recording received documentation (inventory list, registration numbers, date of receipt).

6. Ensuring confidentiality:

- Comply with the requirements for the protection of personal data and medical confidentiality during storage and processing of information.

7. Analysis and use of material:

- Use the collected material in accordance with the objectives of the study or clinical analysis, observing ethical standards and regulatory documents.

It is important to remember that the collection and processing of medical information must comply with national legislation (for example, the Federal Law of the Russian Federation "On Personal Data" and other regulatory acts in the field of healthcare).

10. Clinical material of spontaneous regression of malignant tumor

Clinical material of spontaneous regression of a malignant tumor includes documents, samples and data obtained during observations, diagnostics and pathomorphological examination of cases when a malignant tumor decreased or disappeared without specific treatment. Such material is important for studying the mechanisms of regression and searching for factors contributing to this phenomenon. Let us consider the main components of clinical material:

1. Historical data and clinical observations:

- Description of initial symptoms, diagnostics and tumor size.

- Dynamics of changes in tumor size, including regressions.

- Dates and results of examinations (ultrasound, CT, MRI).

- Presence of concomitant diseases or factors that could influence regression (infections, inflammations).

2. Results of visual examination methods:

- Photographs and images confirming tumor decrease or disappearance.

- Display of visualization data before and after regression.

3. Biopsy materials:

- Tissue samples taken before and after regression.

- Histological preparations to assess the presence of residual tumor cells or their complete disappearance.

- Immunohistochemical studies to detect the activity of immune cells (lymphocytes, macrophages, dendritic cells).

4. Molecular and cytogenetic data:

- Analysis of genetic material to detect changes in tumor cells.

- Detection of expression of cytokines, growth factors, immune markers.

- Studies to detect viruses or other agents associated with regression.

5. Immunological studies:

- Blood tests for immune markers, presence of antibodies [9].

- Assessment of the patient's immune status.

- Serum tests to detect factors that stimulate the immune response.

6. Clinical protocols and follow-up data:

- Records of the patient's condition dynamics [10].

- Long-term data on relapses or complete disappearance of the tumor.

- Treatment before and after regression, if any.

- Example of clinical material: A patient diagnosed with melanoma was found with a 4 cm tumor node. After several months of observation without therapy, the tumor decreased to 0.5 cm and completely disappeared according to visual examinations. Biopsy after regression showed lymphocyte infiltration, no active tumor cells. Immunological tests revealed increased activity of T-lymphocytes. This material allows for pathomorphological and immunological comparison and conclusions about the mechanisms of regression.

11. Reorientation of cancer cell division towards regression

Reorientation of cancer cell division to regression involves changing the behavior of cancer cells from active division and growth to a state in which they begin to reduce their activity, suppress growth, and possibly return to a more differentiated or even reversible state. This approach is one of the promising areas in oncology aimed at inhibiting tumor progression and restoring normal tissue functions. Let us consider the mechanisms and approaches associated with reorientation of cancer cell division to regression:

1. Genetic reactivation of differentiation mechanisms: restoration of the activity of genes responsible for differentiation, which leads to a decrease in proliferation and a more “normal” state of cells.

2. Modulation of signaling pathways: the use of drugs or methods aimed at suppressing pathways that stimulate division (for example, Wnt, Notch, Hedgehog signaling pathways) and activating pathways leading to regression and differentiation.

3. Epigenetic therapy: the use of substances that change DNA methylation and histone modification, which helps to “reprogram” cells and reduce their malignant properties.

4. Induction of apoptosis and cell cycle arrest: drugs that activate programmed death mechanisms and inhibit division, which helps to reduce the size of the tumor.

5. Use of differentiating factors: the introduction of growth factors or molecules that stimulate differentiation, which transfers cancer cells to a more mature, less aggressive state.

6. Regenerative and immune mechanisms: stimulation of the immune system, which helps to recognize and eliminate cancer cells or suppresses their growth.

Reorientation of cancer cell division to regression is a complex and multi-stage process that requires an integrated approach, including genetic, epigenetic and pharmacological methods. An important aspect is to understand the molecular triggering mechanisms that regulate malignant cell behavior in order to develop effective therapeutic strategies aimed at stopping progression and returning cells to a more normal state.

12. Genetic mechanisms of initiation

Genetic priming mechanisms are processes by which activation or regulation of gene programs leads to the initiation and development of specific cellular or organismal functions. They provide precise control over gene expression, which is essential for the development, adaptation,

and function of an organism. The main aspects of genetic priming mechanisms include:

1. Transcription initiation:

- Turning on gene promoters and regulatory elements that allow RNA polymerase to begin mRNA synthesis.

- Activation of transcription factors that bind to DNA and stimulate gene expression.

2. Epigenetic regulation:

- Modifications to DNA (e.g., methylation) and histones that can activate or repress gene regions.

- These changes can start or stop gene programs in response to internal and external signals.

3. Signal transduction mechanisms leading to genetic activation:

- External signals (hormones, growth factors, stress) activate intracellular cascades, which in turn activate transcription factors and initiate the expression of the desired genes.

4. Activation of alternative splicing:

- A mechanism that allows the creation of different protein variants from one gene in response to conditions, which can trigger specific functions.

5. Mechanisms of regulation during development and differentiation:

- The genetic program triggers the development of certain cell lines or structures based on the sequence of gene activation and suppression.

6. Key regulatory genes:

- Special genes encoding transcription factors and regulatory proteins that trigger entire cascades of gene expression necessary to perform specific functions.

In general, genetic triggering mechanisms ensure the precise and timely inclusion of the necessary genes, which is the foundation for development, adaptation and maintenance of homeostasis in the body.

Genetic mechanisms that trigger spontaneous regression of malignant tumors are an area that remains poorly understood and raises many questions among scientists and clinicians. However, there are some hypotheses and suggestions regarding possible genetic and molecular factors that may contribute to this rare phenomenon. The main hypotheses regarding the genetic mechanisms that trigger spontaneous regression include:

1. Activation of apoptosis (programmed cell death): genetic changes that stimulate apoptosis in tumor cells may lead to their spontaneous destruction. This may be due to the activation of growth inhibitory genes or the suppression of oncogenes.

2. Modification of genes that regulate the immune response: genetic variations that increase the efficiency of immune mechanisms, such as the activity of T-lymphocytes or natural killers, may facilitate the recognition and destruction of cancer cells, initiating regression.

3. Epigenetic changes: modifications to DNA and histones that regulate gene expression can lead to the suppression of oncogenic pathways or the activation of genes responsible for the immune response and cellular control.

4. Genetic mutations causing cellular instability: in some cases, mutations can lead to a deterioration in the ability of tumor cells to survive or reproduce, which contributes to their regression.

5. Genetic predisposition and hereditary factors: modern research in the field of oncogenomics and immunogenomics continues to search for molecular markers and genetic causes that could explain this phenomenon.

13. Hormonal triggering mechanisms

Hormonal triggering mechanisms are processes in which certain hormones regulate the onset and development of various physiological functions or processes in the body. They ensure the coordination of the activity of organs and systems, as well as the adaptation of the body to various external and internal influences. The main triggering mechanisms of hormonal processes include:

1. Reflex mechanisms based on feedback:

- Negative feedback: an increase in the level of a hormone suppresses its secretion, which prevents excess.

- Positive feedback: an increase in the level of a hormone increases its secretion.

2. Hormonal rhythms and stimulation:

- Circadian rhythms (daily cycles) regulate the secretion of hormones at a certain time of day.

- External stimuli (light, temperature, stress) can trigger hormonal reactions.

3. Hormonal interactions and cascades: some hormones stimulate or inhibit the secretion of other hormones, creating a cascade mechanism for triggering processes (for example, the hypothalamic-pituitary system triggers the thyroid gland through thyrotropin-releasing hormone and TSH).

4. Neurohumoral mechanisms: nerve impulses can stimulate or inhibit the secretion of hormones, for example, in stressful situations or in response to irritants.

5. Mechanisms triggered in response to changes in the internal environment: for example, a decrease in blood glucose levels causes the release of glucagon, which triggers processes of increasing glucose levels.

Together, these mechanisms ensure accurate and timely regulation of body functions in the spontaneous regression of a malignant tumor, maintaining homeostasis and adaptation to changing conditions.

14. Microwave triggering of spontaneous regression of malignant tumors

Microwave induction of spontaneous regression of malignant tumors involves the use of microwave technology to affect tumor tissue in order to stimulate its destruction. Certain microwave parameters can activate the body's immune mechanisms or cause damage to tumor cells, which in turn can lead to their spontaneous disappearance.

Microwave regression is one of the methods of influencing cancer cells based on the effect of high-frequency electromagnetic waves (microwaves), which cause a thermal effect and destroy tumor tissue. The main mechanisms and processes associated with the activation of the destruction of cancer cells under the influence of microwaves are described below:

1. Heat generation (thermal effect):

- Microwaves cause vibrations of water molecules and other polar substances inside tumor cells and surrounding tissues, which leads to the release of heat, raising the temperature to levels that cause thermal damage to cells (above 42 ° C).

- High temperature causes protein coagulation, destruction of cell membranes and organelles, which leads to necrosis (uncontrolled cell death).

2. Damage to the cellular structure:

- Rapid heating causes denaturation and aggregation of proteins, disruption of membrane integrity and damage to internal cell structures.

- DNA and RNA degradation occurs, which prevents cell recovery and reproduction.

- Thermal exposure causes damage to the vessels that feed the tumor, which contributes to hypoxia and cell death.

- Coagulation of blood vessels prevents the flow of oxygen and nutrients.
- In addition to thermal exposure, microwaves can cause the formation of free radicals, damage to membranes and activate apoptosis (cell death).

Microwave regression requires precise control of parameters (frequency, power, exposure time) to maximize the destruction of cancer cells while minimizing damage to surrounding healthy tissue.

15. Psychooncology in spontaneous regression of malignant tumor.

Psycho-oncology is an interdisciplinary field that studies the influence of psychological factors on the development, course and prognosis of oncological diseases, as well as the role of psychotherapy in the treatment of cancer patients. In the context of spontaneous regression of a malignant tumor, this approach is of particular importance, since some cases of regression are associated with psychosomatic and psychological aspects. Within the framework of psycho-oncology, the following mechanisms are considered:

- Stress and emotional status: chronic stress, depression or anxiety states can affect the immune system, which in turn can contribute to tumor regression.

- Psychotherapy and positive thinking: the use of psychotherapy methods, as well as the formation of positive attitudes and changes in the psychological state can contribute to the improvement of immune functions.

- Molecular and physiological mechanisms: it is assumed that psychological interventions can activate immune responses or affect the endocrine system, which contributes to tumor regression.

In modern oncological treatment, the integration of psycho-oncological approaches helps improve the quality of life of patients, reduce stress levels and increase their psychological resilience, which can have a beneficial effect on the treatment of the disease [11-12].

16. Conclusion

The molecular basis for spontaneous cancer regression is unknown. In people who have spontaneously regressed cancer, most of these regressions were usually associated with the occurrence of acute infections, which are known to often lead to an increase in body temperature and, therefore, to some extent, to stimulation of the immune system.

Stimulation of a strong immune response at the onset of tumor formation should play an important role in people with certain genetic profiles. Further studies investigating the relationship between genetics and stimulation of the immune response will provide an answer to the question of how to identify tumors capable of spontaneous regression. It is necessary to stimulate the immune system and apply microwaves to tumors based on their genetic makeup.

All spontaneously regressing tumors show a genetic profile characterized by downregulation of certain metabolic processes, including the MYC gene, which is associated with cancer formation. Cancer first spreads rapidly and then regresses, and the causes and processes of recovery are very individual for each patient.

Infiltrating immune cells form intercellular aggregates and cause necrotic rupture of tumor cells, eliminating tumor cells within a few hours after tumor transplantation. Genetic studies believe that this unique response of activated immune cells to tumor cells is caused by a dominant mutation, to determine the immunological components of tumor rejection; to determine the antitumor spectrum of tumor rejection, to determine the genes affected by the mutation.

A set of progressive medical approaches, methods and technologies allows us to penetrate and record new data on spontaneous regression of cancer tissue [13-16]. Motivated artificial intelligence, based on processing the required set of test data, will determine the readiness of the body's vital systems for spontaneous regression of malignant tumors [17].

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