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A Review of Tumor Markers and Their Clinical Applications among Iraqi Cancer Patients

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Abstract

Understanding the fundamentals of pathophysiology, testing methods, the causes of tumor marker levels that are outside of the normal range, and the evidence-based role of tumor markers in malignancy is essential in clinical practice, as these parameters play an increasingly important role in all facets of cancer, from screening to post-treatment continuation. This is an auxiliary tool for making a diagnosis. In actuality, there is no such thing as an optimal tumor marker. Tissue, bodily fluids, or serum may all be tested for this. There are 4 major classes of experimental applications: screening (early detection), confirmatory diagnosis, prediction, and recurrence/response to treatment. In certain situations, levels of serum can be utilized in determining the stage of disease, prognostication, or response to therapy. The majority of markers of blood tumors are utilized in clinical practice for disease monitoring. It is possible to identify disease recurrence before radiological evidence of illness is seen due to the high levels of tumor markers in the blood. Examining tumor markers' significance for cancer patients. Researchers had believed that this might be a valuable tool for screening cancer patients and diagnosing the disease at an early stage, before symptoms appear, because tumor cells release biomarkers that can be tested in blood and other bodily fluids.

Key words: Tumor markers, serum tumor markers, malignancy, metastasis.

Introduction

When normal cells or cancer cells in the body respond to malignancy or certain non-cancerous situations, they generate chemicals that are known as tumor markers. Normal and cancer cells both generate tumor markers, but cancer cells produce them in greater quantities. These molecules can be found in tumor tissue, stool, urine, and blood. Tumor markers have become an attractive method for detecting and diagnosing cancerous diseases. When it comes to screening, diagnosing, prognosticating, evaluating therapeutic response, and tracking cancer recurrence, each tumor marker has a unique profile of use **[1].** If there were an ideal tumor marker, it would be able to identify even the tiniest tumors while being highly specific to a certain form of cancer. However, the efficacy of biomarkers is limited due to the lack of tumor markers with these important properties. Although biomarkers are expected to indicate only one type of cancer, some biomarkers are utilized in several forms of cancer. None of the tumor markers alone is diagnostic. Biomarkers that are useful in benign and malignant conditions **[2].**

The level of tumor markers indicates cancer, but it is not sufficient alone. Therefore, the tumor markers are always utilized with other examination and diagnosis methods, such as, for example, endoscopy, ultrasound, positron emission tomography (PET-CT), and computed tomography (CT) **[3].**

There are many types of tumor markers that can be detected in the fluids of the body, such as blood. In this review, we are clarifying some of these biomarkers and classifying them according to chemical structures, like proteins, Enzymes, Hormones, Carbohydrate antigens, and circulating tumor cells (CTCs) **[4].**

The goal of this study is to provide enough context for the prudent use of commonly utilized serum cancer indicators. There are many types of tumor markers; we will present some types of cancer biomarkers that are specific to each type of cancer.

Tumor markers for urinary bladder cancer

According to the annual report of the Iraqi cancer registry, it is appreciated that bladder cancer in Iraq for the year 2022 was recorded (8.4%, 6.4/100,000 MP) for males **[5].** Early identification improves prognosis for bladder cancer, a prevalent urological malignancy that needs long-term follow-up due to its high recurrence rate. Bladder cancer (BC) is one of the most common tumors worldwide and is the common cancer in males and females. Because of its constant interaction with BC tissues, urine is thought to be a better biomarker for tumor information than other samples. As an adjunct to cystoscopy, cytology of urine is now the gold standard for urinary marker testing **[6].** Two protein-based urine indicators have been authorized by the Food and Drug Administration (FDA). **Nuclear matrix protein 22 (NMP22) and bladder tumor antigen (BTA),** and **cell-based urinary markers (UroVysion and Immunocyte/uCyt).** Both the quantitative BTA test (BTA-TRAK) and the qualitative BTA test (BTA-Stat) have been recently authorized by the FDA for use in the first diagnosis of BC **[7]. BTA Stat** is a point-of-care fast immunochromatographic assay that yields findings in about 5 minutes, whereas the BTA-TRAK is an enzyme-linked immunosorbent test (ELISA) **[8].** Three monoclonal antibodies—**19A211, LDQ10, and M344**—are provided via the FDA-approved immunofluorescence test Immuno Cyt/uCyt+. These antibodies identify cancer-related antigens in urine-exfoliated cells of urothelia, including a high-molecular-weight carcinoembryonic antigen and the bladder mucin antigens **[9].** Through the use of multiprobe fluorescence in situ hybridization (FISH), the UroVysion assay enables the identification of four chromosomal copy number alterations that are characteristic of urothelial carcinoma. These include aneuploidy involving chromosomes 3, 7, and 17, along with deletion of the 9p21 locus within the

nuclei of exfoliated urinary urothelial cells. This cell-based molecular screening technique has received recommendation and approval from the U.S. Food and Drug Administration (FDA) for the revealing and monitoring of urothelial malignancies **[10].**

Tumor markers for breast cancer

The Iraqi cancer registry reported an alarmingly high incidence of breast cancer in 2022, with 21.2% of men and 19.6% of females affected (or 39.2% of all females) **[5].** Of all cancers, breast cancer is the second most prevalent and the fifth deadliest. Both hereditary and environmental factors contribute to its development. A variety of potential breast cancer risk factors. There is a wide variety in the clinical presentation of breast cancer patients **[11].** Clinical trials most often use **carcinoembryonic antigen (CEA),** a member of the family of cell surface glycoproteins, as a tumor marker. Cancers of the colon, stomach, lungs, and breast may all be detected with this tumor marker **[12]. CA 15-3** is an antigen known as mucin (MUC) that contains carbohydrates. Using the gene product CA 15-3 as a tumor marker for breast cancer is made possible by the high expression of the MUC1 gene in malignant breast cancers. This marker was so named because of the correlation between its chemical structure and the detection analysis that was created for it. Antibodies utilized in immunoassays for these antigens are denoted by the numerals 15-3. Screening for breast, lung, ovarian, liver, and colon cancers, among others, is possible using blood CA 15-3 concentrations. On the other hand, false positive findings were also found in cases with benign breast and liver illnesses **[13].** One tumor marker for breast cancer is **CA27.29**, a protein antigen that contains carbohydrates. Another name for it is breast carcinoma-associated antigen. Generated by the MUC-1 gene. Eighty percent of breast cancer patients had elevated CA 27-29 levels, indicating a strong association between the two diseases. Patients with ovarian cysts, benign breast, liver, or renal diseases, or other cancers may also have CA 27.29. **[14].**

Successful tumor markers in breast cancer include **estrogen receptors (ER) and progesterone receptors (PR).** Cellular development, proliferation, and differentiation in breast tissue are regulated by the ER and PR. The two most significant physiologic markers for therapy response in breast cancer, ER and PR, both have prognostic relevance. It is believed that cellular oncogenes, namely the **human epidermal growth factor receptor (HER)**, overexpress themselves and contribute significantly to cancer progression. Human epidermal growth factor receptor-2 (HER-2), also known as HER-2 neu/HER, is a member of the oncogene family. **[12]. GP88**, or progranulin, is the biggest member of a family of growth modulators that includes cysteine-rich polypeptides. It is an 88 kDa glycoprotein. Research in the lab has linked GP88 to drug resistance and shown that it promotes cell survival, invasion, and proliferation **[15].** The first gene to be designated as a tumor inhibitor was **P 53**. One of its functions is to prevent the spread of cancer by destroying aberrant cells. Coding mutations in (p53) have been found in breast cancer, according to many studies, and this is now recognized as a common **[16]. Cathepsin D** is an aspartyl endopeptidase that is classified as lysosomal. In order to digest other lysosomal endopeptidases and exopeptidases, it splits proteins into several polypeptide pieces. A short arm of chromosome 11 contains the cathepsin D gene. Retinoic acid, tumor necrosis factor alpha, growth factors, and steroid hormones all have a role in controlling its expression. A number of cancer types have cathepsin D as an independent prognostic factor. Researchers discovered that cathepsin D concentrations in breast cancer and many other types of malignancies had a predictive value **[17]. Nestin** has discovered a biological protein that aids in the detection and treatment of breast cancers with a high degree of aggressiveness.

Adult stem cells in the brain and other organs contain the intermediate filament protein nestin. The basal and myoepithelial layers of the mammary gland are now tested for nestin, which was formerly thought to be a marker of neural progenitors. Nestin may also serve as a diagnostic tool for basal cell carcinoma in the breast **[18].** The secretory protein known as **Human Epididymal Protein 4 (HE4)** was first identified in the epididymal cells of humans. Evidence of HE4 expression has been found in a wide variety of healthy human tissues. A variety of malignancies, including those of the gynecological, lung, and gastrointestinal systems, have shown an increase in HE4 expression. In addition, breast ductal cancer expresses the HE4 **[19].**

Tumor marker for brain, central nervous system tumor (CNS)

The Iraqi cancer registry reported that in 2022, brain and central nervous system (CNS) tumors affected 5.4% of the population, or 5 per 100,000 people. The corresponding percentages for males were 6.6%, or 5 per 100,000 people, and for females, it was 4.6%, or 5 per 100,000 people **[5].** Cancers of the brain and central nervous system (CNS) rank high among the most deadly forms of human cancer. The influence of genetic readiness is significant. Various environmental elements, including low-frequency electromagnetic waves, chemical agents, brain trauma, cigarette smoke, alcohol, and infections, are considered risk factors. The likelihood of central nervous system cancers may be increased by a gene-environment interaction, which is the result of a combination of hereditary and environmental variables **[20].** The many types of tumor indicators seen in the brain and central nervous system include **molecular biomarkers, circulating extracellular vesicles (EVs), circulating cell-free microRNAs (cfmiRNAs), circulating free DNA (cfDNA), and circulating tumor cells (CTCs) [21].** On chromosome 10q26, you may find molecular indicators such as O-6 methylguanine-DNA methyltransferase (MGMT). According to reports, the **O-6 methylguanine-DNA methyltransferase** plays a role in DNA repair by preventing cell death by reversing DNA alkylation and eliminating the guanine-alkyl group **[22].**

Among the many physiological reactions and signaling pathways activated by **epidermal growth factor receptor (EGFR)** are migration, proliferation, survival, and tumor development. An EGFR variant III (EGFRvIII) mutation, produced by a histone alteration on its enhancer gene on chromosome 7p12, is one of the most frequently seen EGFR modifications in brain tumors **[23].** The enzyme **isocitrate dehydrogenase (IDH)** is primarily responsible for catalyzing oxidative decarboxylation; its encoding is located on chromosome 2 **[24].** Tumor cells that have spread from the original tumor to other parts of the body may be found in the blood, cerebrospinal fluid, and urine as circulating tumor cells (CTCs). The capacity of epithelial tumor cells to spread is determined by CTC. **[25].** The term "circulating tumor DNA" (ctDNA) refers to DNA fragments that are released into the circulation as cancer tissue breaks down. In healthy individuals, circulating tumor DNA (ttDNA) is mostly derived from genomic DNA during inflammatory responses or cell death. **[26].** The post-transcriptional phase of gene expression control is completed by microRNAs (miRNAs), which are noncoding RNA molecules that degrade or block target messenger RNAs (mRNAs). Both normal and cancerous tissues rely on microRNAs for homeostasis and intercellular communication. Tumor cell proliferation, death, and differentiation are the mechanisms through which microRNAs (miRNAs) exert their effects.**[27, 28].** Both cancerous and noncancerous cells release tiny vesicles into the extracellular fluid that are encased in a lipid bilayer. Some of the things they transport include proteins, lipids, and nucleic acids such

as DNA, messenger RNA, and noncoding RNA. "Exosomes" is another name for them. They control the release of biological substances that alter the molecular activity of recipient cells and facilitate communication between cells. Cancer cells secrete exosomes that include biomarkers unique to tumors and may identify the main characteristics of tumors. **[29, 30].**

Tumor marker for lung tumors

In both sexes, lung cancer ranked highest with 7.3% of cases (6.8/100,000 P), 12.2% of cases (9.3/100,000 MP) in men, and 3.8% of cases (4.2/100,000 FP) in females **[5].** The death rates from pulmonary carcinoma, a kind of diffusion cancer, have risen sharply in many nations, especially industrialized ones, during the last half-century. A staggering 1.1 million people lose their lives to lung cancer every year as a result of this terrible illness **[31].** Many biomarkers, such as **pro-gastrin-releasing peptide (Pro-GRP), carcinoembryonic antigen (CEA), neuron-specific enolase (NSE), cytokeratin fragment (CYFRA21-1), CA19-9, and squamous cell carcinoma antigen (SCCA)**, have been discovered to have a connection between the occurrence and progression of lung cancer **[32].** If tumor biomarkers can be confirmed and diagnosed early on, lung cancer therapy results may be improved. Pulmonary cancer diagnosis and detection may be made more successful with the accurate early identification of tumor biomarkers. The NACB recommendations for laboratory medicine in lung cancer include **carbohydrate antigen 125 (CA125)** as a standard marker **[33].**

Tumor marker for thyroid cancer

Thyroid cancer ranked sixth in males (6.1%, 5.7/100,000 P) and ninth in females (8.4%, 9.2/100,000 FP) among all malignancies **[5].** Over the last decade, thyroid cancer has climbed steadily in occurrence, eventually becoming the fourth most common disease in females **[34].** The following tests are considered priority for the diagnosis of thyroid neoplasms: ultrasonography, fine-needle aspiration, cytology, and blood thyroid hormone levels **[35].** The protein expression of 16 biomarkers in thyroid carcinomas are: **human telomerase reverse transcriptase (hTERT), basic fibroblast growth factor (bFGF), fragile histidine triad (FHIT), Hector Battifora mesothelial-1 (HBME-1), p16, p53, pituitary tumor-transforming gene (PTTG), C-myc, chemokine receptor CXCR4), proliferating cell nuclear antigen (PCNA), E-cadherin, peroxisome proliferator-activated receptor gamma (PPARγ), vascular endothelial growth factor (VEGF)-C, and Matrix metalloproteinase (MMP) 2, MMP9,** have been recommended as tumor markers for the detection, diagnosis and follow-up of different types of thyroid carcinomas **[36].**

Tumor marker for colorectal cancer

Males had 9.2% (7.1/100,000 MP) colorectal cancers and 6.8% (6.5/100,000 FP) colorectal cancers as the top ten malignancies in both sexes **[5].** The prevalence of colorectal cancer has been on the rise in recent years, particularly among those aged 30 to 50. From 8.6 per 100,000 in 1992 to 12.5 per 100,000 in 2015, a 45% increase overall, incidence rates among younger individuals began to rise in the early 1990s **[37].** Some places where tumor markers have been found include tumor tissue itself, lymph nodes, bone marrow, peripheral blood, and even urine and feces. **Cerebrospinal fluid (CEA), carbohydrate antigen (CA 19.9), tumor-associated glycoprotein-72 (TAG-72), tissue polypeptide specific antigen (TPS), and hematopoietic growth factors (HGF-s)** are among the numerous colorectal cancer markers that are recognized and utilized in clinical practice **[38].**

Tumor marker for liver cancer

In terms of tumors overall, hepatic carcinoma ranks sixth, and fatality rates related to the disease have been steadily rising. On a global scale, around 750,000 new instances of hepatic cancer are reported annually. The vast majority of hepatocellular carcinomas (HCCs) are hepatic cellular carcinomas, with a 90% occurrence rate. **[39].** The aggressive invasion, quick progression, and poor prognosis of HCC pose risks to people's health. In the early phases of their illness, patients do not exhibit any noticeable symptoms. Those who have been diagnosed are already in the last stages of the disease. Consequently, a highly accurate diagnostic procedure is very important for reducing disease mortality and increasing patient survival time. **[40].** In order to effectively manage hepatocellular carcinoma (HCC), it is crucial to measure tumor biomarker levels. As tumor indicators unique to HCC, **prosthetic implantation thrombin (DCP), alpha-fetoprotein (AFP), and the Lens culinaris agglutinin A-reactive fraction of alpha-fetoprotein (AFP-L3)** have been suggested. **[41].**

Tumor marker for pancreatic cancer

The incidence of pancreatic ductal adenocarcinoma (PDAC), a kind of cancer, is on the rise in both men and women. The death rate for PDAC is still significant, which is unfortunate since it differs from other malignancies **[42].** The fourth or fifth most prevalent cause of cancer mortality is pancreatic cancer (PC), a deadly form of the disease **[43].** Longer survival rates are associated with earlier PC diagnoses. Serum biomarkers, including as **microRNAs and cancer antigens like carbohydrate antigen 19-9 (CA 19-9),** may be utilized to diagnose PC. Also, PC patients' chances of survival and tumor recurrence may be predicted using certain of these indicators, such CA19-9 **[44].**

Tumor marker for ovarian cancer

The percentage of ovarian cancer in Iraqi women was (4%, 4.4/100,000 FP) **[5].** There were 295,000 new instances of ovarian cancer in 2018, killing over 180,000 women globally. While 90% of women with early-stage (I, II) ovarian cancer will survive five years, only 20% to 40% of women with advanced-stage (III, IV) ovarian cancer will make it that far.

The overall 5-year survival rate for individuals with ovarian cancer remains low, despite therapy breakthroughs; this makes it the second most deadly gynecological tumor **[45].** When it comes to ovarian cancer identification and treatment, tumor biomarkers are crucial. Numerous ovarian cancer markers have been the subject of extensive and intensive studies. **Cancer Antigen 125 (CA125),** also known as Carbohydrate Antigen 125, has been the most important marker when it comes to ovarian cancer screening, detection, and management during the last forty years. Ovarian cancer cells surface with CA125, a glycoprotein with a high molecular weight. Serum samples from patients with ovarian cancer include this antigen, which is shed by these individuals. Elevated serum CA125 levels are found in 50% of type I ovarian malignancies in their early stages and in 92% of type II ovarian cancers in their advanced stages **[46].**

Tumor marker for uterus cancer

The uterus cancer in Iraqi women were reported as (3.1%, 3.3/100,000 FP) **[5].** At 8.7 cases per 100,000 women and 1.8 deaths per 100,000 men, endometrial cancer is the most frequent malignancy affecting the female reproductive system. Unfortunately, there is currently no accepted way to diagnose this cancer, even though it causes a great deal of death and illness. The primary focus should be on doing the appropriate assessment when symptoms arise, since this disease manifests in its early stages. Atypical uterine bleeding is experienced by 75-90% of endometrial cancer patients during this period **[47].** There are now non-invasive, inexpensive, and quick

alternatives to conventional tumor spread detection technologies, including X-ray, ultrasound, and computed tomography. **Cancer Antigen 125 (CA-125) and carcinoembryonic antigen (CEA)** are two tumor markers that may be studied using these approaches **[48].**

Tumor marker for prostate cancer

The occurrence of prostate cancer in Iraqi men was (8.5%, 6.5/100,000 MP) **[5].** The majority of men will get prostate cancer at some point in their lives. As of late, it's responsible for 29% of all cancer diagnoses and 13% of all cancer deaths in males, making it the second leading cause of cancer mortality overall. Adenocarcinoma of the prostate is often diagnosed under the microscope by looking for certain characteristics of glandular development, which accounts for over 98% of all prostate cancer cases. Urologists may get prognostic information about prostate cancer by stratifying it based on histological characteristics using the Gleason score, the most utilized grading methodology **[49]. PSA** measurement is the gold standard for prostate cancer diagnosis**.** The use of PSA has significantly decreased metastases and deaths due to prostate cancer. That is to say, apart from prostate cancer, other conditions (such as benign prostate enlargement or inflammation of the gland) may cause blood PSA levels to rise **[50].** Microribonucleic acid (microRNAs) have been shown to have a role in the control of several cellular processes since the era of molecular investigations for the detection of prostate cancer. The abnormal miRNA levels in the cell were found to be associated with cancer progression in humans **[51].** Biomarkers for prostate cancer in urine include **Annexin A3, Matrix metalloproteinases, Deoxyribonucleic acid markers, and Glutathione S-transferase π [52].**

Tumor marker for leukemia

The top ten cancers in both genders were Leukemia (4.7%, 4.3/100,000 P). In males, the rate was (6.5%, 4.9/100,000 MP), and in females, it was (3.4%, 3.7/100,000FP) **[5].**

One kind of cancer that affects youngsters is leukemia. Acute lymphoblastic leukemia (ALL), chronic lymphoblastic leukemia (CLL), acute myeloid leukemia (AML), and chronic myeloid leukemia (CML) are the four primary types of leukemia. CML is among the most prevalent and fatal malignancies **[53].** In an anaerobic environment, the cytoplasmic enzyme lactate dehydrogenase (LDH) converts pyruvate to lactate. Lymphatic illnesses, including non-Hodgkin and Hodgkin disease, are associated with elevated LDH levels; however, non-Hodgkin lymphoma (NHL) has a greater degree of LDH activity than HL **[54].** By storing iron-soluble and non-toxic ferritin, the cell is protected from oxidative processes. Ferritin is present in the majority of human tissues, including the liver, spleen, and small intestine; it is present in lower amounts in the kidneys, placenta, heart, and skeletal muscles **[55].** Serum ferritin levels are elevated in individuals with acute leukemia, such as acute myeloid leukemia (AML) and acute lymphoblastic leukemia (ALL), prior to therapy **[56].** A peptide hormone that stimulates cell growth, regeneration, and reproduction, growth hormone (GH) is also called somatotropin hormone. The protein has 191 amino acids. Several types of cancer, including prostatic, breast, gastric, large bowel, and lung cancers, are associated with high levels of growth hormone **[57].**

Tumor marker for skin cancer

The top ten cancers in both genders were skin (3.6%, 3.3/100,000 P). In males (4.8%, 3.6/100,000 MP) and in females (2.8%, 3.1/100,000 FP) **[5].** The development risk and prognosis of melanoma may be better assessed with the use of prognostic indicators. Melanoma oncogenesis is driven by a complex

of different molecular abnormalities, which have recently been discovered. The most up-to-date molecular data suggest that melanoma is best understood as a diverse set of diseases characterized by unique molecular abnormalities in signaling, adhesion, cell death, differentiation, and cell cycle control **[58]. Molecular chaperone heat shock protein 90 (Hsp90)** was expressed in melanomas compared with primary tumors and metastatic tumors **[59]. Vascular involvement**, mitotic rate and increased tumor thickness, are associated with Osteopontin and the **Regulator of G protein signaling 1 (RGS1) [60, 61], HER3** is related with increased proliferation of cell, tumor development, and reduced survival in humans **[62],** Melanoma thickness was connected with decreased levels of inhibitor of growth 4 (ING4) **[63],** A predictive indicator for predicting patient prognosis, Inhibitor of growth 3 (ING3) reduced nuclear expression **[64].**

Tumor marker for lymphoma

The top ten cancers in both genders were Non-Hodgkin Lymphoma (3.5%, 3.2/100,000 P). In males the rate was were (4.6%, 3.5/100,000 MP), and in females, it was (2.7%, 2.9/100,000 FP) **[5].** The lymphoproliferative malignancies known as non-Hodgkin's lymphomas (NHLs) exhibit a wide range of characteristics and outcomes. There is a wide range of NHLs, from mild to aggressive lymphomas, in terms of severity. In contrast to aggressive NHLs, which may quickly kill if not treated, less aggressive NHLs often have a longer survival rate **[65].** Histological subtypes of NHLs include hairy cell leukemia, B-cell prolymphocytic leukemia, plasma cell myeloma/plasmacytoma, mantle cell lymphoma, follicular lymphoma, nodal marginal zone B-cell lymphoma, B-cell chronic lymphocytic leukemia, diffuse large B-cell lymphoma, Burkitt's lymphoma, splenic marginal zone lymphoma, lymphoplasmacytic lymphoma, and. In addition, there are various subtypes of NHLs that can be identified by histology **[66]. CA-125** has been suggested to be utilized as a prognostic indicator for NHLs **[67].**

Lymphoma patients' malignant grade and progression-free survival are inversely correlated with CA125 expression levels. The most prevalent form of NHL is diffuse large B-cell lymphoma (DLBCL). Common blood indicators of NHL include **Lactate Dehydrogenase (LDH)** and **β2 microglobulin (β2MG)**. Independent prognostic indicators for DLBCL include high LDH and β2-MG levels, and studies have shown that LDH level predicts tumor load **[68].**

Conclusions

Through this simple review of the biomarkers that are specific to different types of cancer, we can clearly see the importance of these markers in diagnosing and monitoring the disease, as well as the usage of some of these biomarkers in screening for the early detection of tumors, performing cancer diagnostics, calculating cancer prognoses, evaluating cancer therapy efficacy, and identifying cancer recurrence.

Supplementary Material

None.

Author Contribution

Abeer. M. Hussain, was the author responsible for writing - review and editing.

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Conflict of interest

None.

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مقالة :معلمات الأورام وتطبيقاتها السريرية لدى مرضى السرطان العراقيين

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الخلاصة

يُعد فهم أساسيات الفيسيولوجيا المرضية، وطرق الاختبار، وأسباب ارتفاع مستويات معلمات الورم عن النطاق الطبيعي، والدور المُثبت علميًا لمعلمات الورم في مرض السرطان، أمرًا بالغ الأهمية في الفحوصات السريرية، إذ تلعب هذه المعايير دورًا متزايد الأهمية في جميع جوانب السرطان، بدءًا من الفحص وحتى متابعة العلاج. تُعدّ هذه المعايير أداةً مساعدةً للتشخيص. في الواقع، لا يوجد ما يُسمى بمعلمة الورم المثالية. يُمكن فحص هذه المعلمات في الأنسجة، سوائل الجسم، أو المصل. هناك أربعة أنواع رئيسية من الفحوصات السريرية: الفحص (الكشف المبكر)، والتشخيص المؤكد، والتنبؤ، وتكرار المرض/الاستجابة للعلاج. في بعض الحالات، يمكن استخدام مستويات معلمات الاورام في المصل لتحديد مرحلة المرض، والتنبؤ بمستوى المرض، أو الاستجابة للعلاج. من الممكن تحديد عودة المرض قبل ظهور أي دليل إشعاعي عليه، وذلك بفضل ارتفاع مستويات معلمات الورم في الدم. فحص معلمات الورم له اهمية بالغة لمرضى السرطان. اعتقد الباحثون أن هذه المعلمات قد يكون أداة قيّمة لفحص مرضى السرطان وتشخيص المرض في مرحلة مبكرة، قبل ظهور الأعراض. لأن الخلايا السرطانية تطلق هذه المعلمات السرطانية التي يمكن اختبارها في الدم وغيره من سوائل الجسم.

الكلمات المفتاحية: معلمات الورم، معلمات الورم في مصل الدم، مرض السرطان ، انتشار المرض.