

Advances in early diagnosis and treatments of kidney cancer

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Abstract. Kidney cancer, as an extremely important part of cancer, is also a serious health problem in today's society, characterized by uncontrolled growth of malignant cells in the kidneys. This article provides a comprehensive review of the etiology, clinical manifestations, diagnostic methods, and various treatment methods of cancer. This article analyzes the types, hazards, and causes of kidney cancer based on global cancer population data, and emphasizes the importance of detection through imaging technology and magnetic resonance imaging. According to the current progress in targeted therapy and immunotherapy in the medical field, cancer has been well controlled. But currently, medical technology is still unable to completely cure cancer. Therefore, this study aims to contribute to the continuous efforts to improve the diagnosis and management of this life-threatening disease, to popularize treatment methods for more patients and to reduce people's panic rate towards cancer. At the same time, this article proposes that future research directions should focus on the early diagnosis and treatment of kidney cancer in order to continue to improve the survival rate of kidney cancer patients.

Keywords: Kidney cancer, diagnosis methods, biotechnology.

1. Introduction

Cancer is an extremely complex disease that involves abnormal cell growth and division in the body. These abnormal cells can form tumors and may invade surrounding tissues or even spread to other parts, which is called metastasis. Cancer can occur in almost any bodily organ or tissue, so there are many different types of cancer, each with its unique characteristics and treatment methods. At the same time, this directly leads to cancer becoming the three major causes of death worldwide.

The global population estimation of cancer is usually based on current epidemiological data and trends. However, it should be noted that these estimates may be influenced by many factors, including population structure, lifestyle, advances in medical technology, and improvements in prevention and control measures. Compared to developing countries, there are more complex relationships between cancer and developed countries, which involve many factors, including health standards, lifestyles, medical facilities, environmental factors, and socioeconomic factors.

According to data, about 1918030 new cancer instances are predicted to manifest in the United States in 2022. Prostate cancer, lung cancer, and colorectal cancer will account for nearly 1/2 (47.5%) of new male cancer instances in the United States, with prostate cancers accounting for 27.3%. For women, breast cancer, lung cancer, and colorectal cancers account for 51% of all cancer cases, and breast cancer instances account for almost 1/3. In 2022, the United States expects 609360 humans to die from cancer.

The pinnacle three cancer deaths in males had been lung cancer, prostate cancer, and colorectal cancer, and in females had been lung cancer, breast cancer, and colorectal cancer [1].

This research report selects kidney cancer, especially renal cell carcinoma (RCC), as the research object. Incidence rate and mortality: It is estimated that in 2021, more than 76000 Americans will be diagnosed with kidney cancer and cancer, and about 13780 people will die of this disease. RCC accounts for a significant portion of these cases, with clear cell histology being the most common type. This study aims to use data analysis to explain the advantages of imaging technology and magnetic resonance imaging technology in order to popularize the risk factors, etiology, and prevention prediction of renal cell carcinoma, improve patients' quality of life and survival rate, and help patients find suitable treatment methods. Cancer is no longer incurable, and patients can calmly face it and receive timely treatment.

2. Examples of kidney cancer

2.1. Risk factors for RCC

The known risk factors for Renal Cell Carcinoma (RCC) are smoking, obesity, and hypertension. In addition, RCC also has a genetic impact, with one of the most common diseases being Von Hippel Lindau (VHL) disease. In genetics, it is caused by autosomal dominant inheritance. VHL disease, as the name suggests, is related to its specific VHL gene mutations. The VHL tumor suppressor protein (pVHL) plays a crucial role in cell oxygen sensing by targeting hypoxia-inducible factors for ubiquitination and proteasome degradation. And it makes it easy for individuals to clear cellular RCC and other vascular lesions [2]. It should be noted that this lesion may not only occur in renal cell carcinoma but may accumulate in multiple organs. For example, VHL can affect the cerebellum, retina, and spinal cord as hemangiomas. It may also affect the appearance of cell tumors or renal cysts [3]. In addition, it also involves hereditary papillary renal cell carcinoma syndrome, hereditary leiomyomatosis renal cell carcinoma, Birt-Hogg-Dubé syndrome, and so on. They and VHL syndrome are both caused by mutations in related genes. For individuals carrying mutated genes, the risk of developing cell cancer is as high as 70%.

The inducing gene of the Hereditary Renal Cancer—MET (cellular-mesenchymal to epithelial transition factor) gene also occurs in many types of tumors, such as lung cancer. Although there are currently no specific research reports to assess its risk, people with the HPRC-MET significantly increase the risk of developing renal cell carcinoma compared to the general population. The predominant type of cancer in this population is type 1 papillary renal-cell carcinoma. Renal cancer with hereditary leiomyomatosis has a high degree of malignancy and strong invasiveness, and its main mutated gene is familial hypercholesterolemia (FH). Individuals carrying such mutated genes are estimated to have a 15% risk of developing renal cell carcinoma. It is mainly type 2 papillary cell carcinoma. The final BHD syndrome is induced by folliculin (FLCN). It is estimated that individuals carrying such genes have a 25% higher risk of developing renal cell carcinoma. Its main histological type is the pathological characteristics of eosinophil cells and chromophobe cells. Epidemiological studies have shown that there is a certain association between type 2 diabetes and the risk of renal cancer, especially in women. This means that women with type 2 diabetes may be more likely to suffer from kidney cancer, although the specific causes and mechanisms still need further research. Interestingly, metformin is a drug commonly used to treat type 2 diabetes. Research has shown that metformin may have a certain inhibitory effect on kidney cancer. It can induce the decline of renal cancer cells and prevent their progression in the cell cycle, thereby slowing down tumor growth [4].

2.2. Diagnostic methods for RCC

Unfortunately, patients with kidney cancer can be greatly affected in their daily lives. As is well known, as long as it is a malignant tumor, it will recur and metastasize. Once this malignant tumor metastasizes, it belongs to an advanced stage of cancer. At this point, its impact on patients is mainly on their lifespan. At the same time, it can also cause a high economic burden in the medical process. In addition, having

kidney cancer actually has a significant impact on the kidney function. The kidney serves as the main organ for detoxification and excretion in the body. For example, the renal tubules and glomeruli are severely affected during water reabsorption. This may lead to systemic edema, hematuria, and even anemia, as well as interference with metabolism in patients.

It is easy to cause excessive anxiety and panic for people after being diagnosed with kidney cancer. Research has shown that improper psychological cues can also accelerate the spread of cancer tumors, even transitioning from benign to malignant. In fact, cancer can be roughly divided into three stages: early, middle, and late. The doctor will classify the condition based on the size of tumor cells in the patient's body, the degree of infiltration, whether there is distant metastasis and the severity of the condition. As an early-stage cancer, tumors during this period are relatively small and have not yet spread to surrounding tissues or metastasized to distant areas. Numerous data indicate that at this time, relevant treatment can greatly suppress the condition and have a good prognosis. For mid to late-stage cancer, the situation is indeed not so optimistic. Because the tumors during this period are large and spread to other organs, with extensive metastasis, even receiving treatment at this time can greatly affect the quality of life. From this, it can be seen that renal cell carcinoma should be diagnosed and treated early.

However, due to the lack of clinical manifestations of early onset in renal cell carcinoma, laboratory and imaging examinations have become crucial. The laboratory tests mainly include blood tests and urine tests. According to the above, renal cancer patients may experience hematuria symptoms [5]. Therefore, if the results of urine routine examination indicate hematuria, further imaging examinations of the urinary system are needed to clarify the cause of hematuria. Blood tests often mainly involve whole blood cell count, hemoglobin red blood cell sedimentation rate, lactate dehydrogenase, and so on. However, it should be noted that even if laboratory tests show positive results, most of them are non-specific, which does not fully diagnose kidney cancer. At this point, it is necessary to combine imaging examinations such as ultrasound, CT scan, and magnetic resonance imaging to detect renal masses with very small diameters. Among them, ultrasound is cost-effective and suitable for use in fixed-cycle physical examinations. CT scanning is the main tool for the clinical staging of renal cell carcinoma, especially for renal masses containing cystic components. It can help doctors grade Bosniak [6]. Finally, magnetic resonance imaging can be used for contrast agent allergies or pregnant patients, and its detection accuracy for tumors with a diameter of less than 2cm is even higher than CT. Therefore, if people only want to test for cancer in their daily physical examinations, low-cost ultrasound examination is the first choice. The main tool for clinical staging of renal cell carcinoma is CT scanning. The final most accurate MRI is suitable for use by pregnant women.

2.3. Application of emerging biotechnology in RCC

Despite significant progress in cancer treatment methods over the past few decades, chemotherapy remains the main method of cancer treatment. Different agents can be distinguished based on their different effects and chemical structures. For example, anti-metabolic agents are used to interfere with cellular metabolic processes, such as DNA and RNA synthesis. Alkylation agents can damage DNA, and prevent cell division and growth. Mitotic spindle inhibitors can inhibit mitosis and lead to cell death. Topoisomerase inhibitors: affect the topological structure of DNA and prevent DNA repair and synthesis [7]. It should be noted that multi-drug resistance (MDR) may occur during the chemotherapy process due to the wide variety of drugs. MDR refers to the resistance of cancer cells to various chemotherapy drugs, which limits the therapeutic effect. MDR can be caused by various mechanisms, including increased drug efflux: certain tumor cells can express specific protein pumps (such as P-glycoprotein), which can pump chemotherapy drugs out of the cells and reduce drug concentration within the cells. For the increased metabolism of exogenous substances, cells may increase the rate of metabolism of chemotherapy drugs, thereby reducing the effective concentration of drugs. Growth factors refer to some cancer cells that may overexpress growth factors, promoting growth and division, thereby reducing the effectiveness of chemotherapy. Increased DNA repair ability: Cells may enhance their ability to repair DNA damage, thereby reducing drug-induced DNA damage. Genetic factors refer to gene mutations, amplification, and epigenetic changes in cancer cells that can affect the sensitivity of cells to

chemotherapy drugs. Overcoming MDR is one of the important challenges in cancer treatment. Researchers are exploring various strategies, including developing new drugs, changing drug delivery methods, adjusting treatment plans, and understanding patients' genotypes and phenotypes for personalized treatment [8].

3. Discussion

Considering that many patients and their families nowadays are concerned that even after receiving treatment, they still cannot improve their condition and instead exacerbate the economic burden. This research report advocates seeking medical treatment in legitimate hospitals, avoiding biased advertising and indiscriminate drug purchases, which not only waste money but also valuable time for patients. When treating, let alone casually using alternative therapy. A study by Yale University in the United States revealed that using alternative therapy increases the risk of death for patients by 1.5 times compared to ordinary cancer patients, resulting in a tragic outcome of financial and personal deprivation. When the condition stabilizes after treatment, do a good job in life management and assist with treatment through-life management. The Health Commission issued the "Dietary Guidelines for Malignant Tumor Patients" in 2017, suggesting that cancer patients should diversify their diet, eat foods rich in minerals, proteins, and vitamins, and drink less alcohol. In addition, moderate exercise is also necessary. It is recommended to engage in moderate-intensity exercise for at least 150 minutes per week and strength training twice a week. Establish a positive attitude, and if the patients have cancer, they must have a good attitude. Since cancer is already irresistible, it is even more important to cooperate with doctors to treat it properly. A good relationship can help enhance the body's immune system and enhance its ability to fight cancer. And to establish a positive attitude, one must have a good attitude when suffering from cancer. Since cancer is already irresistible, it is even more important to cooperate with doctors for proper treatment. A good mindset helps to enhance the body's immune system and enhance its ability to fight cancer. The most important thing is to treat cancer rationally. Although the current medical level is not yet able to defeat cancer, cancer is no longer an incurable disease and is no longer incurable.

The study used databases from the World Health Organization and the Pan American Health Organization to collect cancer mortality statistics from seven Latin American countries, including Argentina, Brazil, Chile, Colombia, Cuba, Mexico, and Venezuela, from 1970 to 2015. Here are some important findings and data.

Overall trend: In these seven countries, except that women in Argentina are affected by breast cancer, the overall cancer mortality rate in all countries shows a downward trend. The situation in Cuba: Cuba has one of the highest cancer incidence rates among the seven countries in 2019. The cancer mortality rate for males is 136.9 per 100000 people, while for females it is 90.4 per 100000 people. The situation in Mexico: In comparison, Mexico has the lowest cancer mortality rate, with 63.8 males per 100000 and 61.9 females per 100000.

The most intuitive is the decrease in mortality rate: from 1990 to 2019, cancer mortality rates in various countries generally showed a downward trend. For example, the cancer mortality rate in Argentina has decreased by about 18%, Chile by about 26%, Colombia by about 14%, Mexico by about 17%, and Venezuela by about 13%. These decline rates are equivalent to avoiding nearly 500000 deaths from cancer [9]. Research shows that among 137804 patients, during an average follow-up of 8.4 years, the all-cause mortality rate decreased across all age groups from 1998 to 2018. This indicates that prevention, early diagnosis, and treatment measures for cancer may have been successful to some extent during this time period, helping to reduce the mortality rate of cancer patients [10].

4. Conclusion

The continuous advancement of medical technology and treatment methods can improve the success rate of cancer patients' treatment. New treatment methods, surgical techniques, and medications may help prolong the survival of patients.

Wider cancer screening and early diagnosis can help detect cancer in the early stages, with a higher chance of successful treatment. Early treatment is usually more effective. Lifestyle and health awareness,

increasing public awareness of health and improving lifestyle, such as quitting smoking, eating a healthy diet, and losing weight, may help reduce certain risk factors related to cancer. Cancer prevention and control plans, the government and health agencies may have implemented a series of cancer prevention and control plans, including measures such as education, vaccination, cancer screening, and early treatment, to reduce cancer mortality rates. Overall, this downward trend is a positive sign that some progress has been made in the field of cancer prevention and treatment. However, further efforts are needed, especially in the early diagnosis and treatment of cancer, to continue improving the survival rate of cancer patients. This also highlights the importance of cancer research and public health initiatives to continue reducing cancer mortality rates.

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