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Cancer Treatment Modalities: An Overview

Tadikonda Rama Rao[1], Kuppirala Sangeetha[2], Dumpalagattu Jesintha[2], Daggula Teja[2]

[1]Professor and Principal, CMR College of Pharmacy, Hyderabad, Telangana, India.
[2]Student, Department of Pharm. D, CMR College of Pharmacy, Hyderabad, Telangana, India.

Corresponding Author: Tadikonda Rama Rao

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ABSTRACT

A substantial worldwide health burden is posed by cancer, a group of diseases marked by unchecked cell proliferation and metastasis to other body parts. Every organ and tissue it affects has a different pathophysiological process and clinical manifestation. To treat and manage cancer, a variety of conventional therapy techniques are available. However, as tumor cure accounts for more than 60% of all ongoing experimental trials worldwide, new cancer treatment alternatives are constantly being investigated. The type of cancer, the tumor's location, and its stage of advancement all affect how well a treatment works. Among the most common and conventional forms of treatment include radiotherapy, chemotherapy, radiation-based surgical instruments, and surgery. Modern techniques include stem cell therapies, dendritic cell-based immunotherapy, hormone-based therapy, and anti-angiogenic modalities. The various conventional and innovative treatment approaches for various cancer kinds are covered in this review.

Keywords: cancer, cell proliferation, metastasis, organ, tissue

INTRODUCTION

Cancer has a hereditary component. Early on in the development of tumors, oncogenesis expression is a significant event. Oncogenes can be triggered by either cellular proto-oncogenes (which are often benign) changing into oncogenes or by tumor viruses infecting cells. Tumors then develop from a single cell's oncogenic change. There are tumors that can spread to other places of the body and escape from their original location. We call this process metastasis. With the use of the Rous sarcoma virus, solid tumors, or sarcomas, might spread from one animal to another. Genetic material, in this case viral DNA, could be added to or expressed by normal cells, resulting in tumors [1]. Depending on their complexity, stage, and location, the majority of cancer types still only have surgical excision, chemotherapeutic targeting, high-intensity photon-beam radiation, hormone therapy, and contemporary immunotherapy as treatment options. Despite their genetic differences, all patients with the same form of cancer usually receive the same course of treatment [2]. These additional illnesses may affect therapy efficacy, tolerance, and life expectancy. Other factors, such as comorbidities, may have a different impact on treatment decisions in older adults than in younger adults. These factors include differences in social support networks, sensory impairment, cognitive changes, lower educational attainment, and potentially lower health literacy. Additionally, older persons could have different priorities than younger adults, such

as being less inclined to compromise quality of life in favor of survival [3].

TYPES OF CANCERS DIAGNISIS AND TREATMENT

1. BREAST CANCER

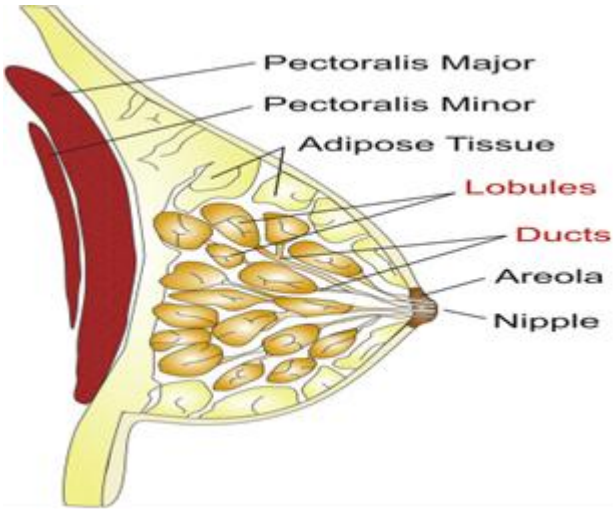

Figure 1: Breast cancer [4]

One of the most prevalent malignant tumors nowadays is breast cancer (BC), and according to recent data from CA-cancer magazine, the incidence rate is rising annually. The increase rate is about to 0.3% annually. The one that in light of population increase, researchers estimate that by 2050, there will be roughly 3.2 million new BC cases year worldwide. More significantly, as the number of BC patients rises globally, the afflicted patients are also often younger in age. The aforementioned circumstance is caused by a variety of elements, including age, family history, lifestyle settings, and more [5].

Breast milk is the source of malignant breast tissue because it nourishes milk ducts and lobules. Breast cancer comes in two varieties: ductal carcinomas and lobular carcinomas. Out of all the tumor kinds, invasive ductal carcinoma accounts for around 70% of instances, whereas invasive lobular carcinomas account for 15% to 20%. The five stages of breast cancer are I, II, III, IV, and 0 (also known as "Ductal Carcinoma in Situ"). These stages are based on the size and distribution of the breast tumor or lump [6].

2. COLORECTAL CANCER

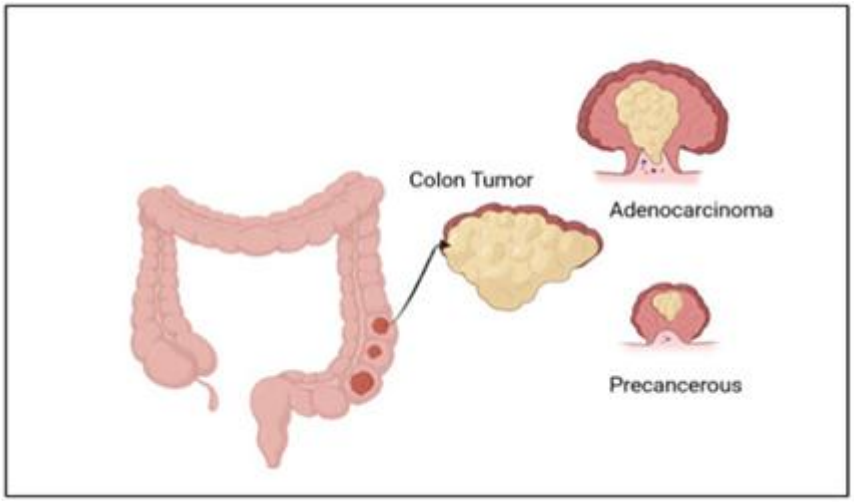

Figure 2: Colorectal Cancer [7]

Locally advanced colorectal cancer is detected in less than half of cases and is a complicated disease with many genetic or somatic alterations. In order to improve the precision of colorectal cancer diagnosis and predict the disease's progression, liquid biopsies must be used [8].

Approximately 60–70% of colorectal cancers are being diagnosed at an advanced stage. The 5-year survival rate may rise to 73% (now 65%) and the death rate might be lowered to 60% if the healthy population was routinely screened annually. Numerous organizations, including the American Cancer Society (ACS), the American College of Physicians (ACP), the American College of Gastroenterology (ACG), and the U.S. Preventive Services Task Force (USPSTF), have released guidelines for colorectal screening. Colonoscopy, colon capsule, flexible sigmoidoscopy, computed tomographic colonography (CTC), and non-invasive stool tests like the plasmic SEPT9 gene test, fecal immunochemical test (FIT), fecal DNA test, and guaiac fecal occult blood test (gFOBT) are among the tests available for the screening of colorectal cancer [9].

3. LUNG CANCER

Lung cancer is the most common cause of cancer-related deaths. The American Cancer Society (ACS) projects that there will be 125,070 lung cancer deaths and 234,590 new cases in the US in 2024. 2011 saw the launch of the National Lung Screening Trial (NLST), one of the biggest multicenter randomized lung cancer screening programs in the world. When it comes to lung cancer screening, NLST evaluated the accuracy of low-dose lung computed tomography (LDCT). Lung cancer death constituted the main outcome. LDCT screening decreased lung cancer mortality by 20%, according to the study's findings. The USPSTF's recommendation for screening for lung cancer was based on the results of the NLST [10].

When diagnosing lung cancer using chest radiography, the sensitivity for detecting a tumor is about 1 cm in diameter, which already contains more than 109 cells and may cause disruptions to the vascular and bronchial epithelia. CT is superior to conventional tomography or plain radiography for identifying peripheral lung lesions. Compared to plain radiography, spiral CT scans can continually collect data, which allows for a quicker scanning duration, less radiation exposure, and better diagnostic accuracy. These days, CT is frequently used for lung cancer screening, either alone or in conjunction with other adjunct tests such sputum cytology. A patient's chance of subsequently getting lung, thyroid, or breast cancer also rises with low-dose radiation exposure, particularly if they have several CT scans [11].

4. BLADDER CANCER

The most common cancer of the urinary tract is bladder cancer (BCa), and it is the ninth most common cancer for men. This cancer is substantially more common in males than in females. Smoking is the most important risk factor for bladder cancer, causing about half of all bladder cancers in both men and women [12].

Microscopic or extensive hematuria is the most important indication of BCa. Urothelial bladder cancer (UBC) restricted to the mucosa (NMIBCa—non-muscle invasive disease) is diagnosed in 75% of cases if the bladder tumor is detected. The remaining 25–30% of patients have metastases or deeper bladder wall invasions from BCa (also known as muscle-invasive disease, or MIBCa) [13].

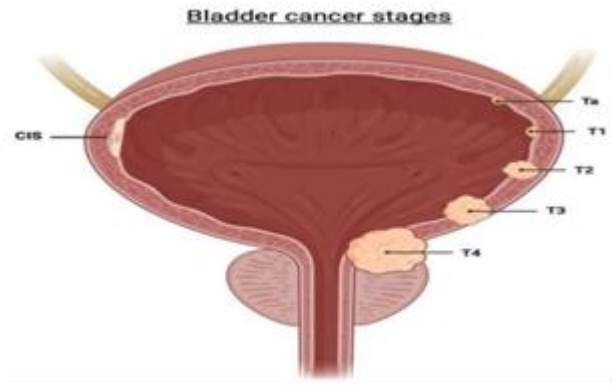

Figure 3: Bladder Cancer

TABLE 1: FDA-approved urinary biomarker tests for the diagnosis and monitorinBladder cancer [14].

Test	Biomarker	Availability
Bladder Chek®	Nuclear matrix protein 22 (NMP22)	Point of care test
Immuno Cyt®	Carcinoembryonic antigens and sulphated mucin glycoproteins	Laboratory-based immunocyte oflourescence test
NMP22® Bladder Cancer Test	Nuclear matrix protein 22 (NMP22)	Laboratory-based ELISA test
BTA Stat	Human complement factor H-related protein (hCFHrp)	Point of care test
BTA TRAK	Human complement factor H-related protein (hCFHrp)	Laboratory-based ELISA test
UroVysion®	Aneuploidy of chromosomes 3, 7, or 17 and the loss of the 9p21 locus	Laboratory-based fluorescence in situ hybridisation (FISH) test

5. HEPATIC CANCER

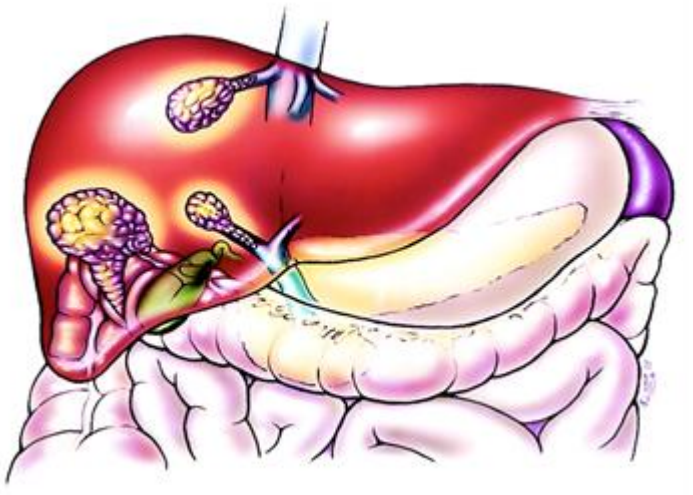

Figure 5: Hepatic Cancer [15]

The most prevalent form of primary liver cancer and the fourth leading cause of cancer-related mortality globally is hepatocellular carcinoma (HCC) [16].

Nowadays, around 90% of primary liver malignancies are hepatocellular carcinomas (HCC), which is a serious global health issue. two HCC is caused by a number of risk factors, including cirrhosis, non-alcoholic fatty liver disease, increased alcohol-related liver disease, viral infections, and genetic hemochromatosis [17].

Abdominal ultrasonography and alpha-fetoprotein (AFP) biomarker testing are common screening methods for HCC.

Because it is widely available and reasonably priced, abdominal ultrasonography is the favored imaging modality over magnetic resonance imaging (MRI) and computed tomography (CT). Abdominal ultrasonography has an early HCC detection sensitivity of about 45%. AFP biomarker testing along with additional screening could increase the detection rates of HCC. Serum glycoprotein AFP is linked to liver cancer when it is elevated. More than 400–500 ng/mL of AFP is indicative with HCC.

The current guidelines for diagnosing hepatocellular carcinoma include tissue biopsy, which has been highly advised prior to transplantation in cases where imaging is ambiguous, as well as imaging using CT, MRI, and ultrasound. Although tumor biopsies have 100% specificity and positive predictive value, their sensitivity can range from 66% to 93%, depending on the size of the nodule and needle. This makes it less trustworthy to rule out a diagnosis using biopsy [18].

6. BRAIN CANCER

Figure 6: Brain Cancer [19]

A brain tumor is an uncontrollably abnormal development of brain cells. Human functioning may be impacted by any unexpected development because, depending on the part of the brain involved, the human skull is a hard and volume-restricted structure. Furthermore, it could spread to other organs, endangering human functions even more. Planning an efficient course of treatment is made possible by early cancer identification, which is essential for the healthcare industry [20].

MANAGEMENT

Nowadays, chemotherapy, radiation, targeted therapy, immunotherapy, and surgery (as well as its related ablation therapies) are common cancer treatments. Each of these treatments has a different possibility for cure, which varies depending on the kind, stage, and performance level of the patient, among other factors. For solid malignancies in their early stages, surgery alone may be curative [21].

Cancer is treated using the traditional methods of surgery, radiation, and chemotherapy. Some forms of cancer are curable no matter when they are detected, and some are only curable if they are caught at any early stage [22].

BREAST CANCER

Surgery

Both mastectomy with or without rapid reconstruction and breast-conserving surgery (BCS) are proven local treatments for early invasive breast cancer. Locoregional recurrence rates (LRR) and

distant metastasis rates have decreased in recent decades due to the widespread use of systematic treatments. The 10-year LRR of BCS followed by RT was 5% for triple-negative breast cancer (TNBC) and 2-4 percent for estrogen receptor (ER) and human epidermal growth factor receptor-2 (HER-2) positive breast cancer, which is comparable to the LRR following mastectomy in early breast cancer [23].

LUNG CANCER

Chemotherapy, chemoradiotherapy, targeted therapy, immunotherapy, antiangiogenic therapy, and combination therapy are among the treatments used to treat lung cancer. In addition to the therapies listed above, adjuvant therapy and neoadjuvant therapy are also used to treat stage II–IV illness. In certain situations, these treatments can be used to verify whether surgery was successful or not, or they can be used in conjunction with surgery to produce better outcomes. In addition, the primary treatment for stage I illness is surgery. This study outlines the biological characteristics of lung cancer, diagnostic techniques, and medications or other substances now utilized in targeted therapy, immunotherapy, chemoradiotherapy, chemotherapy, antiangiogenic therapy, and combination therapy. We anticipate that this evaluation will serve as a guide for lung cancer clinical treatment [24].

COLORECTAL CANCER

Radiation therapy: Neoadjuvant treatment, which includes chemotherapy and radiation therapy, has been suggested for rectal cancer and has successfully decreased tumor burden for cancers in the intermediate and advanced stages. Improving overall survival and lowering the risk of local recurrence are the main goals of radiation treatment. Though it does not increase overall survival, preoperative radiation appears to be more successful than postoperative therapy in lowering local recurrence. The question of which of the two adjuvant radiotherapies—short-course radiotherapy (RT) and long-course RT—was superior was never resolved. Acute toxicity rates are higher with long-course RT than with short-course RT, although there are no appreciable variations in the incidence rates of late side effects [25].

BLADDER CANCER

The first-line treatment for individuals with NMIBC is TURBT. Adjuvant therapies are unfortunately required due to the high rate of progression and recurrence following TURBT. Chemotherapeutic drugs, often mitomycin-C (MMC), or immunotherapeutic agents, such BCG, are administered either alone or in different combinations. Intravesical chemotherapy is a procedure that is greatly underutilized, but in patients with tumors that have a low risk of progression and recurrence, a single dosage administered on the same day after TURBT dramatically decreased the risks of tumor recurrence by 39%. High-grade NMIBC and CIS are typically treated with intravenous BCG [26].

HEPATIC CANCER

Researchers have recently concentrated on creating drugs that target HCC. Angiogenesis is the target of various medications, including sunitinib, brivanib, linifanib, vatalanib, TSU-68, cediranib, bevacizumab, and ramucirumab. The MEK1/2 competitive inhibitor selumetinib, the mTOR antagonist everolimus, the epidermal growth factor receptor inhibitors erlotinib and lapatinib, and the multikinase inhibitors nintedanib and regorafenib were among the other treatments in development. Nevertheless, none of these drugs have been proven to be successful or authorized for the treatment of HCC, and all are still undergoing preclinical and early clinical research [27].

BRAIN CANCER

Surgery

For primary brain tumors, the safest course of treatment is surgical excision of the tumor followed by chemotherapy and

radiation. Surgical intervention has been linked to the following benefits: maximum incision, reduced mass impact, reduced tumor burden, improved diagnosis, and a higher likelihood of longer survival [28].

CONCLUSION

Cancer is a broad category of diseases with distinct pathological, clinical, and therapeutic features that are all defined by unchecked cell proliferation. To differentiate between cancer types and subtypes and ensure proper treatment planning, an accurate differential diagnosis based on histological, molecular, and imaging evaluations is necessary. The kind, stage, and molecular features of the cancer determine the treatment options, which can include surgery, chemotherapy, radiation, immunotherapy, targeted therapy, or a mix of these. As personalized medicine develops further, there is hope for less harmful and more successful treatments, which will eventually increase cancer patients' quality of life and survival rates.

Declaration by Authors

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