

CANCER TREATMENT - TRADITIONAL VS. MODERN APPROACHES

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Abstract: *The landscape of cancer treatment has evolved significantly over the years, transitioning from traditional methods to more advanced and targeted therapies. Historically, cancer treatments mainly included surgery, radiation and chemotherapy. These methods, while effective, often come with severe side effects and limited precision. In contrast, modern treatments such as immunotherapy, targeted therapy, and personalized medicine offer more precise and less invasive options. These innovations not only improve survival rates but also enhance the quality of life for patients. The shift from broad-spectrum treatments to more personalized and precise therapies marks a significant milestone in oncology, offering hope for more effective and less debilitating cancer care.*

Keywords: Cancer treatment

INTRODUCTION

Cancer is a dreadful disease and can occur on any part of the human body when there is irregular and uncontrolled cell division and growth. Any cell type can undergo this phenomenon but in general the heart is resistant to developing cancer; however, if cancer that begins in the heart is most often sarcoma, a type of cancer that originates in the soft tissues of the body [1]. Heart cancer (malignant primary cardiac tumor) is extremely rare. Surprisingly there are no known cases of malignant or benign tumors of the eye lens, though lens epithelium continues to divide and produce lens fibers throughout life [2].

Due to a variety of reasons cancer is triggered:-

Genetic inherited mutations such as BRCA [1-3].

*Environmental: carcinogen exposure from tobacco smoke, radiation and UV rays, etc. [4]

*Epigenetic: the way cells express themselves can also change even in the absence of a direct mutation just by external factors around us [5-7]

*Infections: cancer causing pathogens such as HPV and HepB [8]

*Lifestyle: poor diet, smoking, drug & alcohol abuse [9-10]

*Age: cancer risk increases with age because immunity, in general, goes down and the body becomes weak/frail [11,12]

*Hormonal imbalance [13,14]

* Exposure of light (15-26).

*Imbalance of gut microbiota (27).

The transformed cells are clever and develop mechanisms to camouflage themselves from the

body's natural defenses- a process known as "immune evasion". Interestingly enough, these modified cells also have the ability to acquire a different metabolism in order to support tumor initiation and progression, ultimately leading to widespread metastases and death [28,29].

Cancer treatment: Selecting the best treatment option depends on the type and stage of the cancer and has always been considered one of the most critical and vital themes for clinicians.

Traditional Cancer Treatments include:

***Surgery:** until a decade ago, surgery used to be the primary method of treating cancer. Surgical resection of the tumor and some surrounding healthy tissue to ensure no cancer cells are left behind can be effective if the tumor is localized and not yet metastasized [30]. However, this is an invasive procedure and comes with risks such as infection and complications from anesthesia.

***Radiation Therapy:** The principle here is to use high doses of ionizing radiation to kill cancer cells and shrink tumors [31]. While this has proven to be an effective method, radiation therapy can also damage healthy cells, leading to side effects. Of note, repeated doses / treatment with radiation can also lead to mutations – one of the causes of cancer.

***Chemotherapy:** using chemical drugs (either single drug or a cocktail) has been a standard treatment for many years and still continues to be [32]. However, much like radiation therapy this also affects healthy cells, leading to side effects, most commonly, hair loss, nausea, and fatigue.

Changes in treatment paradigm: Recently, several new trends have emerged, promising a better outlook for cancer therapy. Oncology research and development has seen an increasing focus on targeted drugs with innovative mechanisms of action for treatment of cancers over the last decade.

***Immunotherapy:** A promising treatment that has become the main method for cancer treatment.

Immunotherapy includes cancer vaccines, monoclonal antibodies, and adoptive cell therapy. These types of treatment are designed to stimulate the patients' own immune system to combat the tumor with agents that focus on two immune checkpoints – CTLA4 (cytotoxic T-lymphocyte associated protein 4) and PD-1 (programmed cell death protein 1) [33]. However, many patients don't respond to treatment or develop resistance.

***Combination therapy:** Combining immunotherapy with other treatments, such as epigenetic therapy, can improve therapeutic effects.

***Targeted therapy:** It first became available in the late 1990s, and is currently a very active research area with scientists discovering new mechanisms of action to target tumor cells. Prominent examples are small molecules such as tyrosine kinase inhibitors (Gleevec) and monoclonal antibodies which specifically bind to a target protein on the surface of cancer cells (Herceptin). Recently, a class of biologics called T-cell engagers (Tarlatab) are being developed which act by forming a bridge between the cancer cell and T cells to cause cytotoxic killing of tumor cells.

***Cell and Gene therapy** has the potential to revolutionize the concept of cancer therapy [34]. With the advent of recent bioinformatics technologies and genetic science, it has become possible to identify, diagnose and determine the potential treatment using gene delivery technology. Several approaches have been developed and experimented *in vitro* and *in vivo*, including: naked nucleic acids based therapy, targeting micro RNAs, targeting telomerase, cell mediated gene therapy, CAR-T cell [35] and CRISPR [36] / Cas9 based therapy.

* **Nanotechnology:** Nanomedicine is another emerging trend in cancer therapy. It involves the use of nanoparticles to deliver drugs directly to cancer cells, improving the effectiveness of treatment and reducing side effects [37-40].

Multidisciplinary approaches: Other trends in cancer therapy include cell and gene therapies, antibody-

drug conjugates (ADCs), bi/multispecific antibodies, naked nucleic acids-based therapy, oncolytic virotherapy and suicide gene-based therapy.

- * Light therapy [15-26]
- * Hormone therapy [13,14]
- * Faecal microbiota transfer technology: Cancers can be effectively managed by treatments like chemotherapy, immunotherapy, radiotherapy, etc. Initial trails for Faecal Microbiota Transplant (FMT) therapy are promising one and suitable alternative for immunological, pharmacological and radiological therapies without any what so ever side effects [41].

Utilization of modern technology and digitalization have also had a profound impact on not only treatment but diagnoses of cancers [37,38]. For example, liquid biopsies, an alternative to surgical biopsies, allow non-invasive sampling of blood to detect cancer, monitor tumors, and track mutations. It involves testing a sample of blood to detect cancer cells or pieces of DNA from tumor cells. Liquid biopsies can help doctors understand the genetic makeup of a tumor, track changes over time, and personalize treatment strategies [42]. It would be remiss not to mention how artificial intelligence (AI) can be used to create digital twins of patients, analyze imaging data, and tailor radiation doses.

Although new treatments and personalized medicine offer a whole new concept in cancer treatment, implementing personalized medicine faces several significant challenges, such as:

- * Data management and privacy
- * Cost and accessibility
- * Infrastructure and resources
- * Regulatory and ethical issues
- * Education and training of healthcare professionals
- * Standardization and quality control
- * Patient engagement and awareness
- * Integration into clinical practice

Addressing these challenges requires a collaborative effort from healthcare providers, policymakers, researchers, and patients to fully realize the potential of personalized medicine [43].

CONCLUSION

Estimates provided in the IQVIA report (Global Oncology Trends 2024: Outlook to 2028) published May 28, 2024, indicate that the incidence of cancer will rise significantly through the middle of the century worldwide. In parallel, breakthrough therapies in new areas of science are accelerating. Increasing numbers of diagnosed and treated patients along with changes

Table 1: Comparison highlighting the significant advancements in cancer treatment, emphasizing the shift towards more precise, effective and patient-friendly approaches.

Aspect	Traditional Cancer Treatments	Newer Treatment Approaches
Types	Surgery, Radiation, Chemotherapy	Immunotherapy, Targeted Therapy, Personalized Medicine
Precision	Broad-spectrum, affects both cancerous and healthy cells	Highly specific, targets cancer cells with minimal impact on healthy cells
Side Effects	Severe, including nausea, fatigue, hair loss	Reduced, more manageable, fewer systemic effects
Mechanism	Physical removal, radiation damage, chemical toxicity	Immune system activation, molecular targeting, genetic tailoring
Personalization	One-size-fits-all approach	Tailored to individual genetic profiles and tumor characteristics
Effectiveness	Variable, often requires combination therapies	Higher success rates, especially in specific cancer types
Quality of Life	Often compromised due to side effects	Improved, with focus on maintaining normalcy
Innovation	Established, with incremental improvements	Rapid advancements, incorporating latest research and technology
Cost	Generally lower, but varies	Often higher, but potential for long-term savings due to effectiveness

in treatment paradigms and expected growth in spending in this area will trigger many complex challenges over the next several years.

Nonetheless, the evolution from traditional to modern cancer treatments represents a profound shift in oncology. While older methods like surgery, significant drawbacks, including severe side effects and limited specificity. Modern advancements such as immunotherapy, targeted therapy, and personalized medicine have transformed the landscape, offering more precise, effective, and less invasive options. These new treatments not only improve survival rates but also enhance the quality of life for patients by minimizing side effects and tailoring approaches to individual needs. The ongoing innovation in cancer treatment continues to bring hope, promising a future where cancer care is more personalized, effective, and compassionate. The field of cancer therapy is rapidly evolving, with new trends and as research continues, we can expect further advancements that will revolutionize cancer treatment.

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