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The Current Scenario Of Clinical Pharmacy In Oncology: A Conceptual Perspective

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Abstract

Imagine such a vast effect of a disease that its name starts being used to describe any chronically painful and abnormal process—cancer. Millions of individuals worldwide are afflicted by cancer, a complex disease that has several potential causes, including genetics, lifestyle, and environmental factors. For the greatest results, it necessitates early detection and treatment. A major part of pharmaceutical and therapeutic research is dedicated to identifying cancer biomarkers, novel cancer-treatment drugs, and other strategies. Clinical pharmacy is one such field Clinical pharmacy focuses on optimising medication therapy and improving patient outcomes in cancer treatment by collaborating with healthcare providers and patients to develop individualised treatment plans. It also has a crucial function in managing the side effects of cancer drugs and ensuring medication safety. With the advent of innovative genomic, transcriptomic, and proteomic studies, genetic engineering tools and techniques, and detection platforms like microarray, HPLC, and MS, we can surely reach closer to a world that is adept at treating cancer.

Keywords- oncology, clinical pharmacy, genomic, proteomic, transcriptomic, cancer drugs.

Introduction

The emergence of chemotherapeutics in the 1940s opened avenues for the future development of the field of clinical oncology and pharmacy in oncology. The discovery of nitrogen mustards during World War I introduced a new approach to cancer treatment. Antimetabolites such as aminopterin and amethopterin disrupt folate synthesis and interfere with DNA replication, leading to the development of more drugs targeting DNA replication and other cellular targets. Combination therapy, which first came into existence in the 1960s, significantly improved patient outcomes, especially in leukaemia, where it produced the first cures. Cancer drugs target DNA replicating enzymes, such as topoisomerases and polymerases, to inactivate the root causes of cancer proliferation and growth. (Shewach & Kuchta, 2009).

Analytical approaches have been used to determine cytotoxic cancer drugs in diverse forms over the last 30 years. Initially, LC-UV was used to study inter-drug relationships, toxicity, and formulations. Mass spectrometry was created to aid in pharmacokinetics, pharmacodynamics, and targeted therapies. Recently, there has been an emphasis on the safe handling of cytotoxic medications and their environmental impact. With the introduction of novel chemotherapeutic therapies such as compounds of biological origin, hormones, and molecular targeting compounds, we now need to focus on the use of these therapies in practise (Nussbaumer et al., 2011). The emergence of molecularly targeted medications has paved the way for personalised medicine, which gives cancer patients more

effective and less hazardous treatments based on their individual genetic alterations. This technique may also hasten drug approval and minimise the low success rate of cancer medicines in phase III clinical trials. To accomplish this, there is a growing demand for adaptive trial designs that incorporate laboratory validated and clinically approved biomarkers. These biomarkers can help doctors choose which patients to treat, predict therapeutic success or failure, and show substantial correlations between target modulation and clinical outcomes. They can also be used to track the evolution of tumour biology throughout treatment and identify changes in response to treatment. In the future, we may be able to use systems or network biology approaches to predict patient outcomes based on the dynamic structure of the epigenetic, genetic, and protein signalling networks. Ultimately, this could lead to a paradigm shift in cancer management towards a more molecular and target-specific approach, allowing for faster approval of targeted therapies and progress towards personalised cancer medicine (Yap et al., 2010).

As can be expected, the last decade has seen significant investment in oncology medications, but future growth will be dependent on public-sector funding in basic research, integrative healthcare, and regulatory changes. Cancer medications have a comparable success rate to other medications but fail at a higher rate during phase III testing, leading to higher average development expenditures. R&D costs for oncology medications are determined by a variety of factors, including discovery costs, manufacturing R&D expenditures, and medical testing supplies. Improved prioritisation of experimental cancer medications for phase II to phase III testing may result in significant benefits. (DiMasi & Grabowski, 2007). Figure 1 shows the various modules in various specializations:
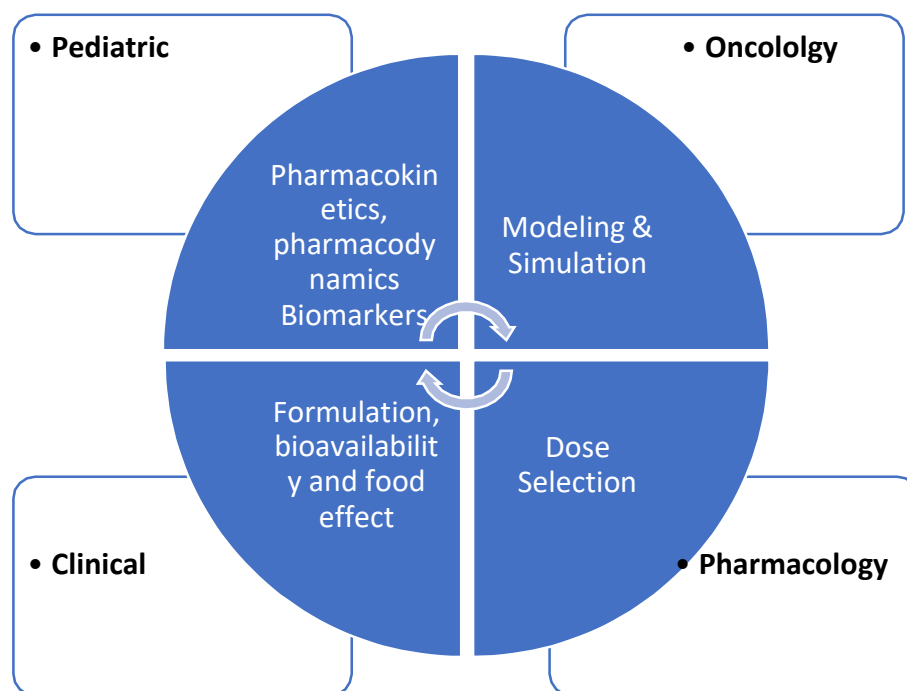
Figure 1 Various Modules in Various Specializations

Source: www.researchgate.com

Literature Review

Numerous natural compounds have shown potential as anticancer agents and may be useful in cancer treatment and prevention. However, more research is needed to fully comprehend their action mechanisms and efficacy in humans. These have been discussed by Nobili et al. (2009). For example, curcumin, resveratrol, epigallocatechin-3-gallate (EGCG), lycopene, and sulforaphane These can be tubulin and topoisomerase inhibitors or chemopreventative compounds from natural sources such as plants, microbes, and marine organisms. Curcumin (from turmeric) has anti-inflammatory and anti-cancer properties, while Resveratrol (from grapes and berries) inhibits cancer cell growth and induces apoptosis; EGCG (in green tea) promotes apoptosis; Genistein (from soy) has antiestrogenic and antioxidant effects; Lycopene (from tomato) has antioxidant and anticancer properties; Sulforaphane (from cruciferous vegetables) has antiestrogenic and antioxidant effects. Another class of cancer drugs are anti-angiogenic drugs, i.e., they prevent the formation of new and leaky blood vessels, which is one of the hallmarks of cancer. These include but are not limited to bevacizumab, sorafenib, sunitinib, pazopanib, and axitinib. "Bevacizumab" is a monoclonal antibody that neutralises vascular endothelial growth factor (VEGF), while sorafenib, sunitinib, pazopanib, and axitinib are smaller drugs that inhibit tyrosine kinases like VEGF receptors. They have demonstrated clinical efficacy in many different cancers, including lung, breast, colon, renal, and liver cancer. However, the clinical use of anti-angiogenic drugs is also concerned with a range of harmful effects, including hypertension, proteinuria, bleeding, and gastrointestinal perforation, which require careful management (Gougis et al., 2017).

MDR (also called multi-drug resistance) is a common occurrence in cancer cells due to the excess expression of ABC ("ATP-binding cassette") transporters like Pgp, MRP1, and ABCG2. These transporters cause the efflux of cytotoxic drugs from cancer cells, leading to the evolution of transporter inhibitors. The "Pgp hypothesis" of improving chemotherapy efficacy by inhibiting

transporter-mediated efflux remains unproven. Pgp and ABCG2 may play important roles in cellular defense from xenobiotics and cytotoxins. (Tamaki et al., 2011). Nanotechnology has revolutionised drug delivery and combination therapies by offering improved pharmacokinetic profiles for drug-loaded nanoparticles. Nanocarriers are increasingly being used to co-encapsulate several therapeutic compounds and synchronise their delivery to diseased cells. Combinatorial nanoparticle preparations have been effective in withdrawing multidrug resistance (MDR) from cancer models by co-delivering combinations of chemopreventative agents and chemotherapy agents. MDR in cancer can result from upregulated levels of transmembrane drug efflux pumps, pro-survival mutations, and deregulated apoptotic signalling. Nanoparticles that use both MDR modulators and cytotoxic drugs can sensitise drug-resistant cancer cells to chemotherapy. These include "efflux pump inhibitors, pro-apoptotic compounds, and MDR targeted siRNA compounds" (Hu & Zhang, 2012).

Current cancer treatments suffer from several limitations including lack of specificity, high toxicity, hydrophobicity of certain chemotherapeutic agents, and short half-lives. These issues result in undesirable side effects, noncompliance, and difficulties in administration. Fortunately, nanotechnology has provided another solution through the development of nanoparticles, particularly liposomes, that effectively deliver chemotherapeutic agents. Liposomes offer several advantages such as improved selectivity, reduced toxicity to normal tissues, increased solubility of hydrophobic drugs, and prolonged release of agents. Some examples of anticancer drugs that have been formulated into liposomes for delivery include doxorubicin, paclitaxel, and irinotecan. They can also be used to deliver siRNA, a type of genetic material that can be used to silence cancer-related genes. For instance, just like bevacizumab, siRNA targeting VEGF reduced tumour-associated haemorrhage and tumour-associated microvascular density by a comparable amount. A new development is the use of polymers and rugs together (Yingchoncharoen, Kalinowski, & Richardson, 2016). In the 1970s, the idea of covalently attaching water-soluble polymers to chemotherapeutic agents was proposed to modulate their pharmacokinetics and achieve active targeting with a homing moiety. This led to the development of polymer-drug complexes, which have shown advantages over parent drugs in clinical trials, such as lesser side effects, heightened medicinal efficacy, and improved patient compliance. Long-circulating polymers produce an enhanced penetrability and retention, leading to increased therapeutic efficacy. "Poly (l-glutamic acid)-paclitaxel" has reached Phase III clinical trials and is estimated to be the first synthetic polymer-drug conjugate to reach the consumers (Li & Wallace, 2008).

Targeted cancer treatment is a type of cancer therapy that focuses on explicit molecules or pathways involved in the growth and metastasis of cancer cells. It is considered the future of cancer treatment due to its potential to provide more effective and less toxic treatments for patients. It can be combined with other treatments, such as chemotherapy or radiation, to further enhance treatment outcomes. As our understanding of the molecular mechanisms driving cancer continues to improve, the improvement of new targeted therapies is likely to portray an increasingly important role in the war against cancer. Both the molecules that target specific proteins or receptors and antibody conjugated nanoparticle systems as described in this review above are examples under the umbrella term targeted therapy (Padma, 2015). Another component is cancer biomarkers that identify various changes in the body, such as mutations, DNA methylation, miRNA levels, and CTCs, can help predict the prognosis of cancer patients. Predictive biomarkers, on the other hand, use molecular diagnostics to identify biomarkers that are currently used in clinical practice for personalized cancer therapy for five diseases: CLL, breast, colon, lung cancer, and skin cancer or melanoma. These biomarkers are used to estimate the advanatges of targeted therapy, and examples include tyrosine kinase inhibitors for CLL and

gastrointestinal tumours, EML4-ALK fusion inhibitors for lung cancer, HER2/neu blockage in breast cancer, and EGFR inhibition in EGFR-mutated lung cancer (Kalia, 2015). An important parallel aspect is the service of palliative care, which should always go hand-in-hand with clinical oncology and pharmacology. Palliative care includes symptom management, psychological and emotional support, and spiritual care for people with advanced cancer or other life-restrictive illnesses, with the goal of improving their quality of lifestyle and reducing suffering. These patients who are hospitalised or outpatients should receive specialised palliative care services early in the course of the disease, timed to coincide with ongoing healing. The best course of action is to take patients to multidisciplinary palliative care experts, and services that may supplement current initiatives. Doctors may suggest palliative care services to close relatives and friends who are caring for patients with early-stage or advanced cancer (Ferrell et al., 2017).

Objective

To measure the current scenario of clinical pharmacy in oncology

Methodology

This study is descriptive in nature in which the data were obtained from the 199 respondents which includes patients who have been diagnosed with cancer, healthcare professionals in oncology and clinical pharmacists. A checklist question was used to analyze and interpret the data. In a checklist question respondents choose "Yes" or "No" for all the questions.

Data Analysis and Interpretations:

Table 1 The Current Scenario of Clinical Pharmacy in Oncology

SL No.	The Current Scenario of Clinical Pharmacy in Oncology	Yes	% Yes	No	% No	Total
1	The development of personalized medicine has increased the need for individualized medication management plans.	173	86.93	26	13.07	199
2	The integration of technology has transformed oncology care and the role of clinical pharmacists.	169	84.92	30	15.08	199
3	The demand for clinical pharmacy services in oncology is expected to continue to grow in the coming years.	165	82.91	34	17.09	199
4	Clinical pharmacists may play a critical role in educating patients and their families about cancer treatments and potential side effects.	147	73.87	52	26.13	199
5	Clinical pharmacy in oncology is a dynamic and evolving field that requires ongoing education and training.	157	78.89	42	21.11	199
6	Clinical pharmacy has become an essential component of oncology care.	189	94.97	10	5.03	199

7	Clinical pharmacists have adapted their practices to ensure safe and effective medication management during the pandemic.	153	76.88	46	23.12	199
8	Clinical pharmacists in oncology work closely with oncologists to optimize cancer treatment plans and minimize adverse effects.	181	90.95	18	9.05	199

Table 1 shows the current scenario of clinical pharmacy in oncology. It was found that around 94.9% respondents accept that clinical pharmacy has become an essential component of oncology care, clinical pharmacists in oncology work closely with oncologists to optimize cancer treatment plans and minimize adverse effects (90.9%), development of personalized medicine has increased the need for individualized medication management plans (86.9%), the integration of technology has transformed oncology care and the role of clinical pharmacists (84.9%), demand for clinical pharmacy services in oncology is expected to continue to grow in the coming years (82.9%), clinical pharmacy in oncology is a dynamic and evolving field that requires ongoing education and training (78.8%), clinical pharmacists have adapted their practices to ensure safe and effective medication management during the pandemic. (76.8%) and clinical pharmacists may play a critical role in educating patients and their families about cancer treatments and potential side effects (73.8%).

Conclusion

Cancer is a serious and uncontrolled disease, which has thus far remained like an ongoing investigation. In spite of the improvement made in cancer research, there are still questions that need to be addressed, such as understanding the complex interactions between different omics and developing effective treatments for all types of cancer. Further research and collaboration among scientists and clinicians are needed to overcome these challenges. Ongoing research and clinical trials continue to provide hope for improved outcomes and ultimately a cure. In conclusion, targeted cancer treatment has emerged as a promising approach for the treatment of many types of cancer. The identification of prognostic and predictive biomarkers has allowed for a personalised approach to cancer treatment, leading to improved outcomes and reduced side effects. Additionally, the advancements in multi-omic studies have revolutionised cancer research and enabled the identification of new biomarkers and therapeutic targets. A lot has been achieved, and a lot remains unsolved or unaccounted for. However, with the advent of clinical oncology and the identification of novel pharmaceuticals, this field is advancing every day, and soon we shall witness first-hand the benefits of it.

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