



Precision Medicine & Personalized Oncology

Dr. Neeraj Grover¹, Dr. Upma Tomar², Dr. Kanika Bhalla Prabhat³, Dr. Nancy Verma⁴

¹Prof. & HOD, Department of Oral and Maxillofacial Pathology and Oral Microbiology, Santosh Dental College and Hospital, Santosh Deemed to be University, Ghaziabad

²Sr Lecturer, Department of Oral and Maxillofacial Pathology and Oral Microbiology, Indraprastha Dental College, Sahibabad

³Reader, Department of Oral and Maxillofacial Pathology and Oral Microbiology, Santosh Dental College and Hospital, Santosh Deemed to be University, Ghaziabad

⁴Sr Lecturer, Department of Oral and Maxillofacial Pathology and Oral Microbiology, Santosh Dental College and Hospital, Santosh Deemed to be University, Ghaziabad

Corresponding author: Dr. Neeraj Grover, Prof. & HOD, Department of Oral and Maxillofacial Pathology and Oral Microbiology, Santosh Dental College and Hospital, Santosh Deemed to be University, Ghaziabad

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Abstract

Precision medicine is a newer modality for patient treatment as it assists clinicians to choose mode of treatment based on the genetic profile of the patient as well as stage of the disease. Primary aim of Precision medicine is to provide “the right treatment to the right patient at the right time.” It will be based on advanced research done on genomics and other omics however it also based on biomarkers, functional tests, and imaging. Molecular diagnostics is the backbone of precision medicine approaches. Hence in current scenario, a change of opinion is required to take complete benefits of precision medicine to handle the global burden of cancers. Recent advances of liquid biopsy emerging a powerful tool being a non-invasive way of determining prognosis of certain malignancies. Liquid biopsies which based upon microRNAs, cell free DNAs, circulating tumor cells and other adoptive cellular therapies, are recent trends in precision oncology that exert a great impact on personalized oncology.

Here, we review the recent advances in precision medicine and its beneficial effects in the field of oncology.

Keywords: personalized cancer therapy; precision medicine; targeted therapy, genomics, Liquid biopsy

Introduction

Precision medicine (PM) is the customization of treatment, which is based on personal genomic profile of that particular patient.¹ Genetic profile is the base of precise therapy, referred as personalized medicine. Precision medicine is a newer mode of patient treatment.² It is concerned as targeted therapy for genetic diseases, infectious diseases and tumours, which can be based on detection at the molecular profile of the patient to the targeted prevention and treatment of that particular individual, to choose treatment modalities.³ A vast knowledge of these molecular and cellular mechanisms will assist in the customization of potentially promising clinical trials which based also on combination therapies to target mainly neoplastic diseases, with the help of tumor immunity.⁴ Primary significance of PM is, it is customized on person's unique genetic profile makes them susceptible to certain diseases and is increasing our ability to predict which medical treatments will be safe and effective for certain patient populations. This is the more effective approach toward in

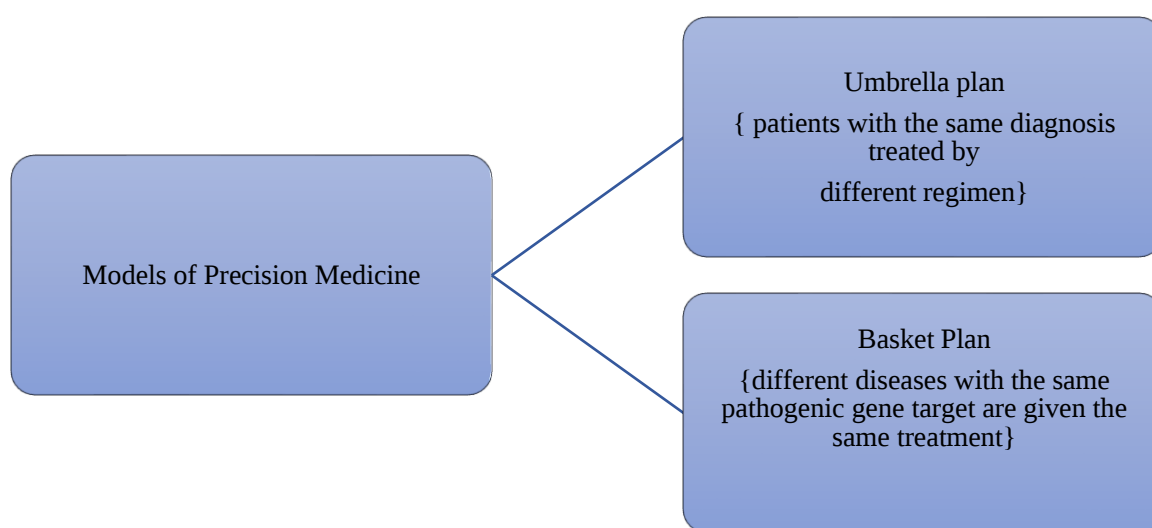
which physicians can select a customized treatment protocol based on a patient's molecular profile, so that optimum and successful treatment can achieve along with negligible side-effects.¹

Methods

A structured review of articles published in peer-reviewed journals /PubMed indexed journals between year 2016 and 2023. The key words relevant to Precision medicine and its significance on cancer- treatment selected, as the search terms. The following keywords were included: personalized cancer therapy; precision medicine; targeted therapy, genomics, Liquid biopsy All full text articles, such as research articles, review articles, as well as blogs were reviewed.

Role of Precision medicine in the field of Oncology

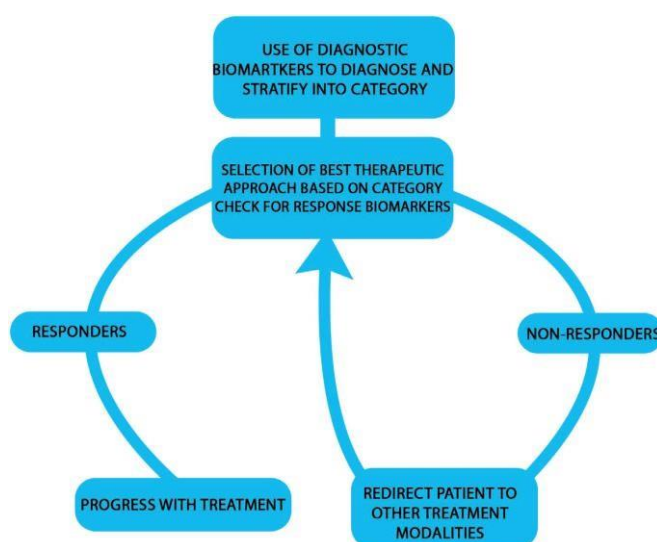
Precision medicine is the newer modality of treatment with optimum results in the field of cancer treatments and early diagnosis. According to the National Cancer Institute, precision medicine is “a form of medicine that based on the genomic-information of a person to diagnose and treat disease.”⁵ Genomic-profile of an individual is an essential key to customize precise therapy, also referred as personalized medicine. Conception of precision medicine in the field of oncology works against of the principle of ‘one-size fits all’ cancer therapeutics approach. The reason behind this approach is complexity of the body's defence mechanism and their activation under various physiological as well as pathological conditions are some of the reasons for variation in the treatment approach among different patient for a common pathologic condition. Due to the diversity in immune-system, result may vary in response to therapy. Therefore, utilization of genetic profile as determinant-factor is the best treatment approach among the multiple traditional options which works on different mechanisms with different risks, and efficacy. Based on heterogeneity in tumour-microenvironment and genetic mutations, there are two main models on which precision medicine can act: the basket plan and umbrella plan.³



Precision medicine is customized to provide successful staple in tumour prevention, diagnosis, screening, treatment, and other aspects.³ Recent advances in the field of molecular biology and medicine is the essential feature in the field of precision-medicine. Recent advancement in liquid biopsies, which analyse cells free DNA, cancer-tumor cell, or vesicles, are isolated from the blood to determine the genetic profile of that patient and heterogenic behaviour of that particular neoplasm, which later on used in determination of precision-medicine of that particular patient, to fight against cancer.⁶ Hence, improved accessibility of molecular technologies through lower costs and gaining knowledge in assaying the genetic-information has assists in management of all tumors. On the other side, even of the same type, but same type of tumor in different individual has unique properties that affect their growth, treatment response, spread, and prognosis.

Hence, due to advances in cancer research, there has been a revolutionary improvement in cancer treatment.⁵ This development has resulted in exploring multiple treatment options to improve treatment against cancer and increase overall patient survival rates along with reducing adverse effects of drugs and patient drug resistance.⁷ In cancer research, precision medicine involves understanding the genomic or phenotypic nature of cancer-specific to an individual and developing customized treatment options to such persons that directly target the cancer cells and revolutionized cancer treatment.

The overview of functioning of precision medicine in oncology presented in Flow-chart- 1.²



Flow chart:1 - representing application method of precision medicine.⁸

Steps to determine Precise Medicine

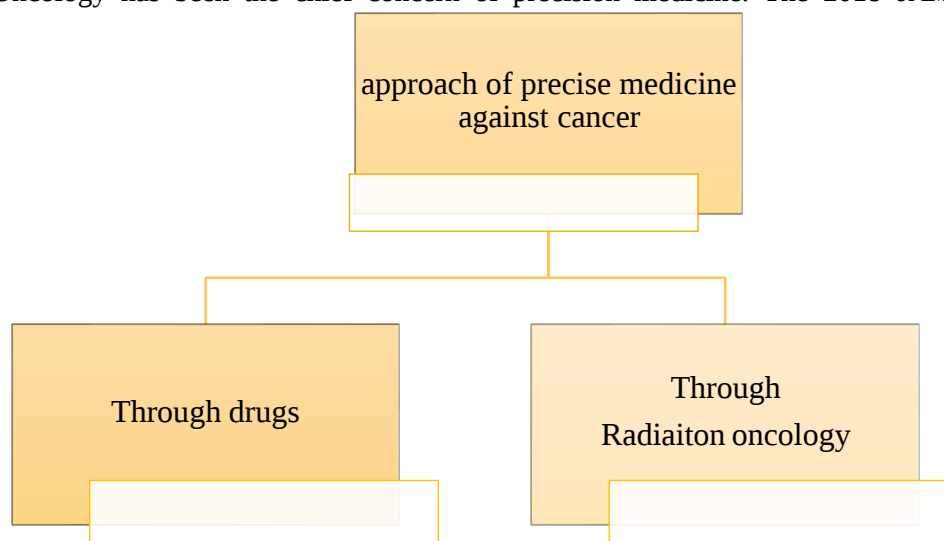
Data Collection

Data-collection is essential for precision medicine. It usually obtained from different people, through different sources, via different channels and from different devices to increase the genetic variation.⁸ Genomic-based information is necessary to determine precise therapy. Studies in the field of precision medicine research usually works on relevant data types such as radiographic interpretation (CT, PET, Ultrasound and MRI), biological data (serum, plasma and urine value), molecular as well as genomic data (nucleotide sequences), proteomic profiling data (mass spectrometry), digital pathology data, other clinical parameters (blood pressure, heart rate and insulin level) and clinical data (death/survival data, demographics and medical-based questionnaire) and others.² Advances in liquid biopsies, have gained popularity for their utilization in throwing light on genetic profile of tumors and metastatic tissues.⁹ The molecular characterization of tumors is another significant feature for the clinical application of individualized treatment strategies.¹⁰

Genomic and personalized medicine database

A database is customized which includes structured information or data in a computer and will be introducing some of the database of personalized or precision medicine. Popular data bases are- *Humangene mutation database (HGMD)* and *Clinical genome database (CGD)* in the field of clinical and genomic medicine; they combines relevant medically genomic data with recent interventions.² Access of information in Precision medicine information (clinical data) is extremely crucial and confidential, hence only authorized persons have the right and use the specified data for diagnostic, therapeutic and research purpose. By this way, precise medicine functions as, both at the disease level—targeted only neoplastic cells without providing any harmful effect to normal cells, and at the molecular level—by altering or intervening any cell signalling pathway. However, some drugs functions more precisely comparatively others.¹¹

After analytic research done on collected data, a customized therapy of precise medicine is made, which works via two approaches. Anti-cancer Drugs and Precision Medicine Oncology has been the chief concern of precision medicine. The 2018 *JAMA Oncology* study



concludes that, only 8% of patients with cancer are capable for approval for precision medications with a meagre 5% would be beneficiary among them. Although incremental survival gained by multiple drugs can also be checked on monthly basis.¹²

Radiation Oncology and Precision Medicine¹³

Technological advances and clinical research over the past few decades have given radiation oncologists the capability to personalize treatments for correct and effective radiation dose on the basis of genomic information and of course on clinical parameters. Elimination of tumor mass and sustain the healthy life can be obtained by this method. Approaches on which success of radiation oncology is based on are-genomic based measurement of radiation dose along with other treatment modalities.¹³

So, based on above discussion, advantages of precision medicine, tabulated in Table: 1

Advantages of precision medicine¹

- 1.Shifts the medical emphasis from reaction to prevention
- 2.Reduces trial-and-error prescribing
- 3.Reduce adverse drug reactions
- 4.Increases patient affinity to treatment
5. Reveals additional or alternative uses for drug candidates

Critical issues in the way of precision medicine⁸

Although newer precision medicine holds great potential to successfully cure of multiple disease especially neoplasm. But still there are some critical issues in the way of precision medicine before it can come to mainstream.⁸ Senior physicians which lack continuing medical education as well as their affinity for traditional methods of disease management are one of them. Sometimes tumor boards also face hurdles in interpretation of genomic results. Many times, as genomic sequencing takes longer time, disease may be progressed in advanced stage, so it would be too late to save the patient. Moreover, the treatments' complexity can't be ignored, which is another obstruction in this newer therapy. Cost of treatment is higher with precision medicine.⁵ Some of the most critical issues are tabulated in table:2

Dis-advantages of precision medicine:

1. Higher costs
2. Requires good data
3. Legal and ethical issues
4. Cost of genetic analysis per patient
5. The challenge of translating the acquired genetic datasets into clinical use

Conclusion

Precision Medicine is the ray of hope in the complex treatment of neoplasms. Generally, personalized medicine based on genomic data. Customization is the key to develop precision medicine for individual patient. Until then, a one approach for all cancer was the tradition. This has resulted in adverse reaction and variable treatment outcomes.

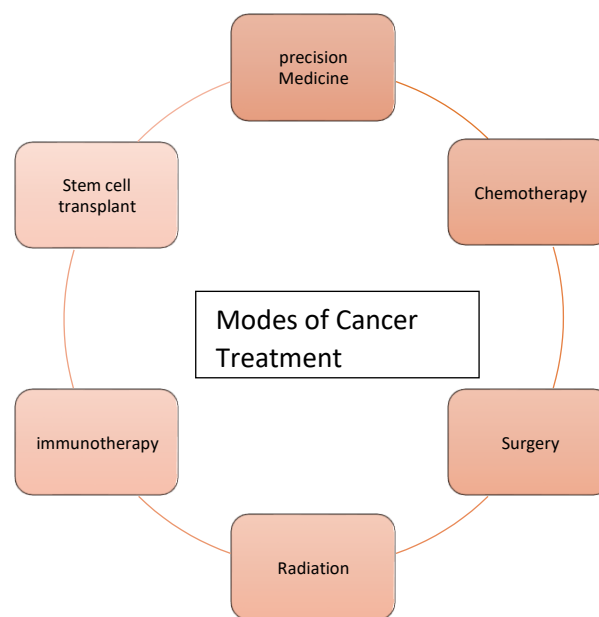


Fig: Treatment modalities of cancer in present scenario ⁵

Hence, the emergence of precision medicine and divergence from tradition ‘one size fits all’ proves beneficial in the management of neoplastic disease. Precision medicine based upon established biomarkers, functional tests, and imaging.

Nevertheless, for the successful management of neoplastic disease through precision medicine, genomic data among all races, nationality, gender, socioeconomic status, age, and geographical location is essential to develop a robust dataset for drug invention and customization of precision medicine.

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