Radiation therapy uses carefully targeted and regulated doses of high-energy radiation to shrink, eliminate cancer cells or tumors. It is a local treatment, meaning that it targets only the tumor, while sparing surrounding healthy tissue.

At American Oncology Institute (AOI), we use cutting-edge radiation oncology techniques and devices as part of a comprehensive treatment plan.

**HIGHLIGHTS OF OUR TREATMENT**

**TrueBeam Radiotherapy System:** TrueBeam uses a patented High-Intensity Mode that delivers therapy with unparalleled accuracy - 4D CT images, and speed – 60% faster than other accelerators. AOI is equipped with the most advanced variant of this technology, called TrueBeam STx, which allows doctors to target deep-seated tumors.

The machine uses cutting-edge imaging technology to capture images of a tumor, even when it moves during natural breathing patterns. It uses these images to confirm that the radiation beams are always targeting the tumor. And, because tumors aren’t perfectly round, TrueBeam STx can alter the shape of the radiation beam to match the shape of the tumor. This may decrease the amount of radiation to healthy tissue that surrounds the tumor.

**Calypso:** The Calypso System performs real-time tumor tracking to keep targets in the path of the radiation beam at all times, leading to better clinical outcomes for patients. AOI has introduced the ground-breaking Calypso technology to Southeast Asia.

**Image Guided Radiation Therapy (IGRT):** Is used for tumors located in areas that may change between treatments due to movements while breathing. IGRT uses repeated imaging scans. Radiation oncologists adjust the dosage delivered based on any small changes that may have taken place since the time of the patient’s last treatment.

**Intensity Modulated Radiation Therapy (IMRT):** Delivers radiation through the use of hundreds of tiny radiation beam-shaping devices, called collimators which allow to target and deliver varying doses of radiation to different areas of the tumor in a meticulous way to spare greater portions of surrounding healthy tissue, leading to fewer side effects.

**Rapid Arc:** A rotational form of IMRT which is 4 times faster in delivering radiation. Reduced daily treatment time translates into better patient comfort.

**Stereotactic Radiosurgery (SRS):** Delivers a very high dose of radiation in a single fraction. It is most commonly used to treat brain or spinal tumors.

**Stereotactic Body Radiation Therapy (SBRT):** SBRT is selected for small, isolated tumors throughout the body such as cancers in the lung and liver.

**Brachytherapy:** Radioactive particles known as seeds about the size of a rice grain are placed near the tumor site. American Oncology Institute is equipped with high dose rate (HDR) brachytherapy.

High end technology, international protocols and trained manpower enable American Oncology Institute to provide precision cancer treatment.
Lung cancer is broadly divided into 2 major types - small cell and non small cell (NSCLC). Both the types differ in their ways of presentation, have different treatment regimens and differ in their outcomes. Small cell cancer is the more aggressive of the two.

Major changes over the last few decades have been seen with the management of NSCLC. There are a number of mutations which are commonly identified in NSCLC, the common actionable ones being EGFR, ALK and ROS. All patients with metastatic NSCLC must be screened for these potential mutations. These mutations are commonly seen in never smokers, women and Asians.

Approximately 30-50% of cases in East Asia are positive for EGFR mutations. Erlotinib, Gefitinib and Afatinib are TKIs approved as first line therapy for patients with EGFR positive tumours. Average time to develop resistance to TKI therapy is 9-13 months and is due to T790M mutation. Osimertinib is recommended as 2nd line for patients with EGFR T790 M mutation.

ALK gene rearrangements are seen in approximately 7% patients with NSCLC, in younger men who are non-smokers incidence of ALK positivity increases to 30%. Crizotinib is approved as first line therapy with ALK positive lung cancers with responses rates of >60% and average progression free survival of 7 to 12 months. Second generation ALK inhibitors like Ceritinib & Alectinib are approved for ALK positive metastatic NSCLC after progression on Crizotinib.

These drugs are not associated with conventional chemotherapy side effects like vomiting, hair loss and fall in counts. They can cause acne, diarrhea and mouth ulcers. These drugs are generally well tolerated and easy to administer. A lot of research is going on in the field of small molecule inhibitors and newer TKIs have been developed for those patients who develop resistance to primary TKIs. With all this innovation survivals in metastatic lung cancers have improved remarkably and patients are experiencing a good quality of life.

Patients with these positive mutations can be treated with oral Tyrosine kinase inhibitors (TKI) rather than intravenous chemotherapy. TKIs are small molecules given as tablets which control and stop the cancer cell growth. Those patients with these mutations have better benefits and outcomes with TKI than conventional chemotherapy. The drugs used commonly are Erlotinib and Gefitinib for EGFR positive patients and Crizotinib for ALK positive patients.

With the advent of these drugs survivals in metastatic lung cancers have drastically improved from 6-9 months to more than 24 months. Patients have to take the tablet daily and are managed for side effects and are evaluated at periodic intervals (every 3 months) with CT/PET scans to assess response. Those patients who do well are continued on the TKI till progression.

A 53-year-old lady presented in September 2013 with headache and altered mental status. Her MRI brain showed multiple brain parenchymal masses in both cerebral & cerebellar lobes with surrounding edema, largest in RT temporo-occipital lobe measuring 7 x 5 x 3.5 cms with mild line shift to left and uncal herniation distorting mid brain. She had a PET-CT suggestive of a large mass measuring 8 x 5.4 cms in upper lobe of left lung with SUV 20, numerous bilateral lung nodules and Medialstinal lymphadenopathy.

Biopsy from the lung mass revealed moderately differentiated Adenocarcinoma. Molecular testing for EGFR, ALK & ROS was sent and she was positive for EGFR mutation with Exon19 deletion. She underwent whole brain radiation with 37.5 gray in 15 fractions from 16/9/13 to 5/10/13. She was then started on Erlotinib, until now. Her last brain MRI was done on 13/9/2016. She remains stable with lesions in left and right frontal lobes, right occipital lobe and left inferior cerebellum. PET-CT done on 10/2016 showed stable LUL lung lesion of size 2.3 x 1.5 cm and few right lung nodules. She remains completely asymptomatic to date. She is able to cook and take care of her family.

In the recent years, there has been a major paradigm shift in management of non-small cell lung cancer (NSCLC). Molecular testing for EGFR, ALK & ROS1 mutation are recommended for all non-squamous NSCLC and squamous cell carcinomas if they are never smokers.

Non-small cell lung cancers harbouring EGFR mutation have response rates of 60% with EGFR TKIs (Tyrosine kinase inhibitors).
A 59-year-old man was presented with a history of nasal bleeding for two weeks duration. Diagnostic nasal endoscopy performed by the ENT surgeon showed evidence of left ethmoid sinus tumor. Biopsy was suggestive of differential diagnosis of high-grade neuroendocrine carcinoma versus sino-nasal undifferentiated carcinoma. Patient was referred to us for oncological management. Biopsy slides and blocks were reviewed along with IHC (Immunohistochemistry) at our Institute and the final impression was High grade neuroendocrine tumor.

PET-CT (Figure 1): Intensively FDG avid (SUV max: 12) heterogeneously enhancing soft tissue mass lesion (3.6 x 3.4 x 3.1 cm) involving left ethmoidal sinus. The lesion is seen eroding medial wall of left orbit with mild intraorbital extension (seen partially encasing medial rectus muscle), extension into right ethmoidal sinus, superiorly seen eroding cribriform plate with minimal intracranial extension, posteriorly seen partially extending into left sphenoid sinus, superiorly via the olfactory groove with minimal intracranial extension into the left basi-frontal lobe.

MRI: 4 x 2.8 x 3.1 cm enhancing solid mass lesion within the left ethmoid sinus, extending laterally into the left orbit partially encasing the medial rectus muscle, medially into the contralateral ethmoid sinus, posteriorly into the sphenoid sinus, superiorly via the olfactory groove with minimal intracranial extension into the left basi-frontal lobe.

The case was discussed in multi-disciplinary International Tumour Board meeting with participation from our international faculty from Pittsburgh, US and our tumor board team. In view of intracranial extension, it was decided to offer definitive chemoradiation.

TrueBeam Rapid Arc based radiotherapy was planned along with concurrent cisplatin and etoposide. Radiotherapy planning was extremely challenging as the lesion was extending into the orbit, which made sparing of retina and optic nerve from high-dose radiotherapy very difficult. Hence, an adaptive planning approach was considered wherein, after delivery of 20 fractions of radiotherapy, re-planning was done taking into account the debulked tumor volume for the remaining dose of radiotherapy (Figure 2). Hence in this way, we could achieve retinal and optic nerve sparing in order to reduce the chances of impaired vision due to radiotherapy. Three months follow up PET-CT scan (Figure 3) showed complete resolution of the lesion. Clinically patient does not have any vision impairment.

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As we all are aware, in medicine, an early diagnosis and proper guidance is the key to a successful outcome. A good CBC is a very basic but crucial tool in doing so. In the western world, the cure rate for cancerous as well as non-cancerous blood and bone marrow disorders is around 80-90%. Though we have access to the best available world class diagnostic and therapeutic resources, most patients are diagnosed in an advanced stage leading to a less than desired outcome.

In my clinical practice, I have seen cases where an early diagnosis of blood cancer is missed and unnecessary expensive investigations done, even though the CBC is giving a direct clue to proceed in a very specific direction. At times blood products are transfused where the case could have been managed without them by treating the underlying etiology. In terms of disease prevention, information is power. The objective of this article is to guide us about various aspects of the Complete Blood Count (CBC) such as their components, normal role in our body, their origin and when to get an expert opinion.

**CBC is not only limited to Haemoglobin, WBC/TLC, and Platelets:**
I have seen plenty of CBC reports, which report only these three parameters and this gives only partial information. The truth is that we should see various other parameters like RBC indices (helps in case of anaemia), differential counts (help in fever, pancytopenia, blood cancer, high WBC count). The cost will not be greatly increased if all parameters are included. The information one gets will justify the additional cost.

**CBC is not the definitive test?**
Based on the clinical presentation and the CBC report we can decide the future course. Sometimes the next step is to do a bone marrow aspiration and biopsy or at times specialized investigations like flowcytometry, IHC markers etc. are needed.

**Bone marrow, Lymph nodes & CBC are closely related with each other:**
The hematopoietic stem cells (mother cells/seed) which reside in the bone marrow serve as the factory for all cell components of the CBC. Except for the lymphocytes all other components of CBC do not require any training to do their function and so remain in the blood stream throughout their life cycle. The lymph nodes are the structures where lymphocytes get trained (as in an army camp) to fight various organisms in their life cycle. The lymph nodes are the structures where any training to do their function and so remain in the blood stream.

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Bone marrow, Lymph nodes & CBC are closely related with each other: Bone marrow, Lymph nodes & CBC are closely related with each other: Bone marrow, Lymph nodes & CBC are closely related with each other:

**Examples of common cases where a CBC has helped in saving lives, as well as money.**

1. **Hyperleucocytosis due to blood cancer is mostly accompanied with anaemia and thrombocytopenia:** Avoid PRBC transfusion and concentrate on lowering WBC and increasing Platelets.

2. **Pancytopenia due to acute promyelocytic leukemia, hairy cell leukemia and aplastic anaemia:** has one of the best prognosis currently if diagnosed and managed on time.

3. **Looking into differential counts can avoid bone marrow and PET-CT examinations which are costly and painful procedures and need to be used judiciously.**

**Ocassions where an in-depth study of the CBC becomes important:**
Weakness, lack of appetite, weight loss, looking pale, persistent or recurrent fever, bleeding, low back pain, nodular swelling in neck, arm pit, groin; abdominal fullness, unilateral or bilateral swelling of any limbs

**Be Alert, Be Aware.**

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