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ASSOCIATION OF MEDICAL PHYSICISTS OF INDIA

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Editorial

Northern Chapter of Association of Medical Physicists of India which is popularly referred in acronyms as AMPI-NC was expanded from erstwhile U.P. – Delhi Chapter of AMPI last year incorporating nine states of India namely J&K, Himachal Pradesh, Haryana, Delhi, U.P., Uttaranchal, Rajasthan, Punjab and Madhya Pradesh. Thus, it is the biggest chapter of AMPI unarguably in the term of geographical arca. The foremost aim for the expansion was to present a regional forum to those AMPI members who were not covered under any chapter earlier. However, the challenges for a larger Chapter lies in establishing a live and meaningful communication among the scattered members over a vast area and to help them regarding their regional issues (if any) so that the Chapter may serve as a regional cohesive group. Keeping this in mind AMPI-NC in its first general body meeting in February 2008 at Kamala Nehru Memorial Hospital, Allahabad resolved to start a newsletter titled Medical Physics Chronicle. We wish the Chronicle to be the common thread running through us and uniting all of us for a cause i.e., to foster the feeling of fraternity. Let's make the Chronicle a vehicle for academic as well as personal information like our achievements, profile of a department, regarding vacancies, movements of the members to new institutions, reports of completed and on-going research projects, information regarding fellowships, conferences, workshops, gist of the already published papers, proposals for combined projects, information regarding relevant web-sites etc. The erstwhile U.P. - Delhi Chapter of AMPI published a newsletter in 1990's. It was a unique feature of the Chapter that time. AMPI-NC is determined to continue the unique legacy in its new avatar. Let's contribute our mite to this commitment.

Medical Physics Chronicle send warm wishes for a Happy, Prosperous and Fulfilling 2009 and best wishes for the forthcoming festivals of Republic Day (26th January), Milad-Un-Nabi (10th March), Holi (11th March) and Good Friday (10th April) to its readers.

Dr. Pratik Kumar

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NANO TECHNOLOGY AND CANCER

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Incidence of cancer is increasing day by day and today cancer is second largest killing disease next to cardiac diseases. If the increase in incidence of cancer continues at the present rate then by 2025, cancer will be the first and major cause of death. In 2005 cancer killed more than 70 lac people all over the world and about 6 lac people in India which is 12.5 % of all deaths and it is more than the total deaths caused by HIV/ AIDS, tuberculosis, and malaria. It is estimated that 1 crore 60 lac people will be suffering from cancer by 2020 and more than 60 % of them will be from newly industrialized and developing countries especially china and India. Therefore cancer is a public health problem world over.

Despite of tremendous development and innovation in science and medical field, cancer is still treated as dreaded disease and for general public cancer means end of life. **Cancer is curable/ treatable if diagnosed at an early stage of disease.**

Diagnostic imaging modality and resolution

Modality	Resolution	Typical imaging time	Radiation dose
Plane X - ray	< mm	< 1 sec	low
Mammography	< mm	< 1 sec	High
Computed Tomography (CT)	mm	Few seconds	High
SPECT and PET	0.5 – 1 cm	10 – 30 minutes	High
Digital Radiography	mm	< 1 sec	low
MRI and MRS	mm	10 – 40 minutes	Nil

The seven warning signals of cancer

1. **C**hange in bowel or bladder habits
2. **A** sore that does not heal
3. **U**nusual bleeding or discharge
4. **T**hickening or lump in breast or elsewhere
5. **I**ndigestion or difficulty in swallowing
6. **O**bvious change in wart or mole
7. **N**agging cough or hoarseness of voice

appears only when cancer process has progressed, culminated into tumor manifesting the symptoms, by that time, its too late. There is no diagnostic or imaging tool in practice at present that can detect the cancer at molecular/ very early initial stage. There is no specific tumor marker (except CA-125, PSA), which can detect malignant transformation in human body at molecular level. The present diagnostic system such as digital X- rays, mammography, CT, PET, MRI etc has resolution up to 1 mm tumor size or more whereas the dimensions of cell is less than a micrometer i.e. tumor of size 5 mm may have hundred thousand of cells and many a times when tumor grows to a size which can be detected by the modern imaging system it get metastasized. Moreover because of the cost and radiation hazards these modern imaging techniques cannot be used for routine/ frequent screening of large population.

Further the cancer treatment modalities being practiced presently viz, Surgical Oncology, Radiation Oncology and Medical Oncology cannot specifically target only the malignant cells, these modalities; despite of all precautions produce damage and side effects in normal tissue/organ/system.

Therefore there is quest for developing a technology, which can detect the cancer/ malignant deformation in a cell at a molecular level and at the same time treat the cause of malignant deformation at cellular level without causing any damage to normal healthy cells surrounding it.

Nanotechnology offer's a great opportunity to study and interact with normal and cancer cells in real time, in vivo, at the molecular and cellular scales – at the earliest stage of cancer process. Before I dwell upon the role of Nanotechnology in cancer, I want to through some light on nanotechnology.

Nanometer is 1 billionth of a meter

$1\ nm = 10^{-9}$ meter

One nanometer approximately the thickness of bunch of 1 lac human hair. To make it simple the diameter of smallest atom i.e. hydrogen is 0.1 nm and the diameter of human cell is 10,000 – 20,000 nm. Nanoscale devices are one hundred to ten thousand times smaller than human cells. They are similar in size to large biological molecules such as enzymes and receptors. As an example, hemoglobin, the molecule that carries oxygen in red blood cells, is approximately 5 nanometers in diameter. Nanoscale devices smaller than 50 nanometers can easily enter most cells and less than 20 nanometer can move out of blood vessels as they circulate through the body. Because of the small size of the Nanoscale devices which can readily interact with biomolecules on both surface of cells and inside of cells. Nanotechnology is being used in various fields such as to study behavior of matter, in semiconductor and electronic industry especially to monitor wafer defects.

Detection of cancer at an early stage is a critical step in improving the cancer treatment outcome. However presently the detection and diagnosis of cancer usually depends upon manifestation of disease into symptom or change in cell/ tissues that are detected by modern imaging technology, physical examination and clinical judgment. We do not want to wait for malignancy to progress and manifests in symptoms or detected by present diagnostic tools but would like to make it possible to detect cancer when the earliest molecular changes takes place long before the imaging technology or physical examination is effective. Here, a role for Nanotechnology in cancer to detect and diagnose the disease process at cellular/ molecular level as biological processes, including events that lead to cancer occur at the Nanoscale at and inside cells. Nanotechnology offers a wealth of tools that are providing cancer researchers with new and innovative ways to diagnose and treat the

cancer. Nanotechnology will help in targeted drug delivery, carrying large doses of chemotherapeutic agents or therapeutic genes into malignant cells while sparing healthy cells.

The specific Nanotechnology tools being developed for diagnostic are

The cantilever technology

Nanoscale cantilevers are tiny bars fixed at one end and the other end is floating which is engineered to bind to only molecules associated with cancer. When the cancer associated molecules binds the floating end of cantilever, the changes in surface tension cause the cantilever to bend. By monitoring this process even a very low concentration of molecules associated with cancer are detected there by detecting earliest molecular events in the development of cancer

Nanopores technology

This technology makes use of tiny holes that allow DNA to pass through one strand at a time and will detect the DNA sequencing. This technology focuses on reading the genetic code on single strand of DNA to detect errors that may lead/ trigger to cause cancer. By passing the DNA through nanopores the shape, size and electrical properties of each base [adenine, cytosine, guanine, thymine] on the strand, which are unique for each of these four bases making up the genetic code, can be mapped/ decode/ readout to detect the error in the code known to be associated with cancer.

Nanotube technology

Nanotubes are smaller than nanopores. The carbon rod nanotubes are about half the diameter of molecule of DNA and using these carbon nano tubes, the molecular change as well as location in DNA/ genes, mutation associated with cancer are detected.

Quantum dot technology

Quantum dots are very very tiny crystals having dimension of a nanometer. The quantum dots are introduced into human body filled in latex beads designed to bind to specific DNA sequences. When the crystals are stimulated by ultra violet light they emit the different color light and by analyzing the spectrum of light the DNA sequencing is encoded and the sequences of DNA that are associated with cancer are detected at molecular level. Center for Cancer Nanotechnology Excellence [CCNE] researchers have developed a self-illuminating quantum dots adding proteins to quantum dot surface that can reveal its presence without an external light source.

Nanotechnology is not only useful in detecting cancer at molecular level but also treating cancer at molecular level. Nanotechnology researchers/ investigators at various laboratories across the world especially at Center for Cancer Nanotechnology Excellence [CCNE] based at Stanford University, USA, have focused the Nanotechnology to create therapeutic agents that target specific cells and deliver the toxins/ chemotherapy drugs in controlled, time released manner.

Scientists are trying to create single agents that are able to detect the cancer as well as deliver the treatment. Ultimately researchers are aiming at a nanoparticles which will circulate through the human body, detect cancer associated molecular change, assist in imaging of the molecule, release a therapeutic agent and then again monitor the effectiveness of the treatment / procedure. Numbers of nanoparticles that facilititates the targeted drug delivery are under development. One such nanoparticle with potential to link treatment with detection is known as dendrites. A useful character of dendrimers is their branching shape which gives them vast amount of surface area to which nanotechnologists can attach therapeutic agents or other biologically active molecule or radioisotope. A single dendrimers can carry a molecule that recognizes the signals of cell death. Researchers hope to manipulate dendrimers to release their contents only in the presence of certain trigger molecules associated with cancer. Following drug release the dendrimers may also report back whether they are successfully killing their targets or not. Another recent invention in nanotechnology is nanoshells minuscule of silica beads coated with gold. Because of their tiny size, nanoshells will preferably concentrate in cancer lesion sites. The physical selectivity occurs through a phenomenon called **E**nhanced **P**ermeation **R**etention. [**EPR**]. Scientists have designed the nanoshells to carry molecular conjugates to the antigens that are expressed on cancer cells themselves or in the tumor microenvironment. By manipulating the thickness of nanoshell coating, scientists have designed beads to absorb specific wavelengths of light. The most useful nanoshells are those that absorb near infrared light, which can easily penetrate several centimeters of human tissues. The absorption of infrared light by nanoshells creates an intense heat, which kills the cancer cell.

According to Prof. Hongjie Dai of Stanford University , one of the longstanding problem in medicine is how to cure cancer without harming normal body tissue. He found nanotechnology quite simple and amazing and they have developed a weapon that kills cancer using intrinsic property of Nanotubes. The researchers did this by taking advantage of the fact that, unlike normal cells, the surface of cancer cells is covered with receptors for a vitamin known as **folate.** They coated the Nanotubes with folate molecules making it easy for them to pass into cancer cells but unable to bind with normal cells.

In coming 8 – 10 years it is hoped that this technology will be practical for diagnosis and treating and follow up of treatment of cancer at molecular level. Of the five top priorities of National Institute of Health [NIH], USA, nanomedicine is on top priority and their goal is to speedup the movement of research discoveries in nanotechnology from bench to bedside. National cancer Institute

[NCI], USA has dramatically enhanced their ability to apply the nanotechnology effectively to detect cancer, deliver targeted therapeutics and monitor the effectiveness of cancer interventions. Dr. Vadim Backman's work in colon cancer diagnostics is one of the most exciting advancement in nanomedicine is funded by NCI. He has invented a new way to detect cancer even before it is formed. His technique is called as **F**our **D**imensional **E**lastic **L**ight **S**cattering **F**ingerprinting [4D-ELF], this method uses a tool called a light spectrometer to measure biological tissues. Normal light microscope can have resolution of 300 – 400 nm but the technology used by Dr. Backman can see the structure of cell to a resolution of 30 – 40 nm. The important discovery made at Nanoscale structure of cells changes before cancer forms

in the human body, before they form a polyp.
The nanotechnology research in cancer will make the technology available for
- Imaging agents and diagnostics that will allow clinicians to detect cancer in its earliest stages – at molecular level.
- System that will provide real time assessment of therapeutic and surgical efficiency for accelerating clinical translation.
Targeted devices to deliver therapeutic agents directly into cancer cells.

NEW ICRP RECOMMENDATIONS – ICRP 2007

Dr S C Jain, Ex Scientist 'F', DRDO

The commission maintains the earlier basic principles of radiological protection, which applies to all exposures to ionizing radiation from any source, regardless of its size and origin. The commission now recognizes three types of exposure situations which replaces the previous categorization into practices and interventions. These three exposure situations are intended to cover the entire range of exposure situations. The three situations are:

1. Planned exposure situations, which involves the planned introduction and operation of sources. This type of exposure situation includes: Decommissioning, disposal of radioactive waste, rehabilitation of the previously occupied land, practices in operation
2. Emergency exposure situations, which are unexpected situations such as those that may occur during the operation of a planned situation, or from a malicious act, requiring urgent attention. Emergency exposure situations may require consideration of emergency preparedness and emergency response.
3. Existing exposure situations, which are exposure situations that already exists when a decision on control has to be taken, such as natural background radiation, residues from past practices that were operated outside the Commission's recommendations and long term contamination resulting from an accident.

Recent recommendations of ICRP-2007 (Report No. 103)

The summary of the recent ICRP recommendation issued for implementing radiological safety in the working environment is given herewith. A worker is defined by ICRP as any person who is employed whether full time, part time, or temporarily, by an employer and who has recognized rights and duties in relation to occupational radiological protection. A member of public is defined as any individual who receives an exposure that is neither occupational nor medical. A large range of different natural and man-made sources contributes to the exposure of members of the public. At radiation doses below 100 mSv in a year, the increase in the incidence of stochastic effects is assumed by the commission to occur with a small probability and in the proportion to the increase in radiation dose over the background dose. The application of LNT (Linear-No-Threshold) model is recommended to be the best possible practical approach to managing risk from radiation exposure. The commission considers that the LNT model remains a prudent basis for radiological protection at low doses and low dose rates. The probabilistic nature of stochastic effects and properties of the LNT model make it impossible to derive a clear cut distinction limit between 'safe' and 'dangerous' exposure and this creates some difficulties in explaining the control of radiation risk. The major policy implication of the LNT model is that some finite risk, however small, must be assumed and a level of protection established based on what is deemed acceptable. This leads to the commission's system of protection with its three fundamental principles of radiological protection as given in ICRP-60.:

- **Justification:** Any decision that alters the radiation exposure situation should do more good than harm. This means that, by introducing a new radiation source, by reducing existing exposure, or by reducing the risk of potential exposure, one should achieve sufficient individual or social benefit to offset the detriment it causes.
- **Optimization of protection:** The likelihood of incurring exposures, the number of people exposed, and the magnitude of their individual doses should all be kept as low as reasonably achievable, taking into account economic and societal factors.
- **Application of dose limits:** The total dose to any individual from regulated sources in planned exposure situations other than medical exposure of patients should not exceed the appropriate limits recommended by the ICRP (Table 1).

The ICRP considers that certain exposures should be deemed to be unjustified without further analysis, unless there are exceptional circumstances. These include the following:

- Increasing, by deliberate addition of radioactive substances or by activation, the activity of products such as food, beverages, cosmetics, toys and personal jewelry or adornments.
- Radiological examination for occupational, health insurance, or legal purposes undertaken without reference to clinical indications, unless the examination is expected to provide useful information on the health of the individual examined or in support of important criminal investigations. This almost always means that a clinical evaluation of the image acquired must be carried out; otherwise, the exposure is not justified.
  Medical screening of asymptomatic population groups involving radiation exposure, unless the exposed advantages for the individual examined or for the population as a whole are sufficient to compensate for the economic and societal costs, including the radiation detriment.

The medical use of radiation should be justified, although that justification lies with the medical profession rather than with the government or regulatory authorities. The principal aim of the medical exposures is to do more good than harm to the patient, subsidiary account being taken of the radiation detriment from the exposure of the radiological staff and of other individuals. The responsibility of the justification of the use of a particular procedure falls on the relevant medical practitioners. The principle of justification applies at three levels in the use of radiation in medicine. ICRP-2007 (103) has revised the radiation weighting factors (W_R) and Tissue Weighting factors (W_T) The Radiation weighting factors

Table 1. Maximum dose constraints recommended for workers and members of the public for all types of exposure situations that can be controlled

Maximum constraint (effective dose, mSv in a year)	Situation to which it applies
100	In emergency situations, other than for saving life or preventing serious injury or preventing catastrophic circumstances, and for public evacuation and relocation; and for high levels of controllable existing exposures
20	For situations where there is direct or indirect benefit for exposed individuals, who receives information and training, and monitoring or assessment. It applies into occupational exposure, For circumstances such as sheltering, iodine prophylaxis in accidents and for comforters and carers to patients undergoing therapy with radio-nuclides.
1	For situations having social benefit, but without individual direct benefit, and there is no information, no training, and no individual assessment for the for the exposed individuals and in normal situations
0.01	Minimum value of any constraint

remain unchanged for photons, electrons, muons, alpha particles, fission fragments and heavy ions. For protons and charged particles, it has reduced to 2 from previous value of 5; for neutrons, its value is a function of its energy. The major changes in tissue weighting factors are for gonads reduced to 0.08 from 0.20; for breast its value increased from 0.05 to 0.12. The tissue weighting factors for bladder, liver, oesphagus and thyroid are reduced to 0.04 from 0.05; brain and salivary glands have been assigned a value of 0.01 each. The remainder tissues {Adrenals, Extra-thoracic (ET) region, Gall bladder, Heart, Kidneys, Lymphatic nodes, Muscles, Oral mucosa, Pancreas, Prostate, Small intestine, Spleen, Thymus, Uterus/cervix}are assigned a value of 0.12 in place of 0.05.

Dose Limits (ICRP-2007)

Dose limit apply only in planned exposure situations but not to medical exposures of patients. Within a category of exposure, occupational or public, dose limit apply to the sum of the exposures from sources related to practices that are already justified. For occupational exposure, ICRP continues to recommend that the limit should be expressed as an effective dose of 20 mSv per year, averaged over defined 5 years period (100 mSv in 5 years), with the further provision that the effective dose should not exceed 50 mSv (30 mSv in India, AERB) in a single year. For eye lens, the limit is 150 mSv/year and for hands & feet and skin, the limits are 500 mSv/year. For public exposure in planned exposure situations, the limit should be expressed as an effective dose of 1 mSv in a year. The dose limits for other specific organs are one-tenth of that to occupational worker. However, in special circumstances a higher value of effective dose could be allowed in a single year, provided that the average over defined 5-year period does not exceed 1 mSv per year.

Other important aspects of new recommendations for health effects attributed to radiation in the dose range up o around 100 mSv (as single or annual doses) for the purposes of radiological protection are:

- A dose and dose rate effectiveness factor (DDREF) of ICRP-60 recommendations is retained for radiological protection purposes; the effect of introducing the possibility of a low-dose threshold for cancer risk is judged to be equivalent to that of an uncertain increase in the value of DDREF.
- Based on cancer incidence data, detriment adjusted risk coefficients have been changed from 6.0×10^{-2} Sv^{-1} to 5.5×10^{-2} Sv^{-1} for whole population and from 4.8×10^{-2} Sv^{-1} to 4.1×10^{-2} Sv^{-1} for adult workers.
- Detriment adjusted probability coefficients for heritable disease upto the second generation are changed from 1.3×10^{-2} Sv^{-1} to 0.2×10^{-2} Sv^{-1} for whole population and from 0.80×10^{-2} Sv^{-1} to 0.10×10^{-2} Sv^{-1} for adult workers.
- Cancer induction to the children following in-utero exposure is judged to be no greater than that following exposure in early childhood.
- Genetic susceptibility to radiation-induced cancer involving strongly expressed genes is judged to be too rare to appreciably distort estimates of population risk; the potential impact is common but weakly expressing genes remains uncertain.
- Dose responses for radiation-induced tissue reactions (deterministic effects) in adults and children are, in general, judged to have true dose threshold which result in the absence of risk at low doses; further consideration of the extent of the dose threshold for cataract induction (visual impairment) is recommended.
- Dose responses for in-utero radiation-induced tissue reaction, malformations and neurological effects are also judged to show the dose threshold above around 100 mSv; uncertainty remains on the induction of IQ deficits but at low doses the risk is judged to be no practical significance.
- Risks of non-cancer disease at low doses remain most uncertain and no specific judgment is possible.

GAMMA KNIFE STEREOTACTIC RADIOSURGERY

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Gamma knife stereotactic radiosurgery is an advance technique for treating intra cranial tumors and vascular malformations. The Gamma-knife is not a knife at all. Yet, its 201 intersecting beams of gamma radiation are its like knife edges and offer the extreme precision surgery, sparing tissues adjacent to the target, with out single incision or

associated risk. Based on preoperative radiological examinations, such as CT / MR scans or angiography, the unit provides highly accurate irradiation of deep-seated targets using the multiple collimated ionizing cobalt gamma radiation beam impinging at the chosen isocenter in the target volume.

Clinical Indications for application of Gammaknife Radiosurgery

- Intracranial tumors as: Acoustic neuromas, Chordomas, Pituitary adenomas, Craniopharyngiomas, Meningiomas, Chondrosarcomas, metastases etc.
- Vascular malformations including Arteriovenous malformations.
- Other Indications - In addition to the above mentioned indications, clinical experiences exists in the treatment of functional disorders such as trigeminal neuralgia, intractable pain, Parkinson's disease, essential tremors and epilepsy. More recently positive results have been seen in the treatment of psychoneuro dysfunctions such as obsessive-compulsive disorders.

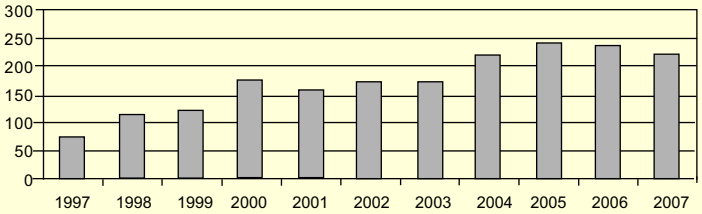


Figure : Gamma Knife SRS Procedures at AIIMS (1997-2007)

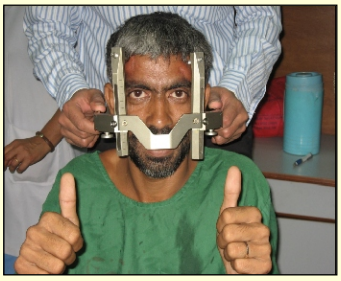
What are benefits of the gamma knife treatment?

Non-Invasive Treatment Modality: The gamma knife stereotactic radiosurgery is non invasive and because there is no incision, complications such as infection, hemorrhaging or spinal fluid CSF leakage (as associated with surgery) does not occur.

Safe and Effective Treatment: The treatment gives good results, often comparable to comparable microneurosurgery. In some patients, it is a better option than microneurosurgery. Each of the 201 gamma beams is focused at the target and only where they intersect, a strong dose of radiation is delivered. However, each narrow beam in itself is weak and therefore does not affect normal brain tissue.

Shorter Hospitalization and faster recovery: Hospital stay is normally overnight and patient can return home and resume their pre-oparative life style almost immediately after treatment. By comparison, conventional surgery would require intensive care, 10-14 days hospitalization and 4-6 weeks of convalescence.

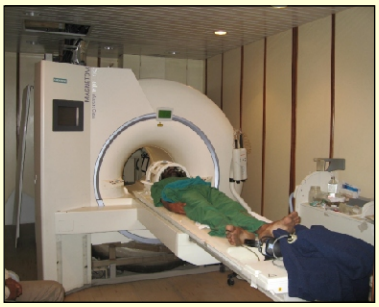
Gamma knife treatment consists of four stages: Frame fixation, Diagnostic imaging, Treatment planning and the treatment delivery.



STAGE 1. Frame Fixation

The patient arrives at the hospital in the morning of the treatment or the night before and the Leksell Stereotactic Coordinate Frame is fixed to the patient head. This is mostly done under local anesthesia. The frame provides the basis for target coordinate determination.

STAGE 2. Diagnostic Imaging



A scan of the head is then taken to localize the target. Imaging can be either by MRI, CT and/or Angiography. A series of image are taken and then transferred to the Treatment Planning System; Leksell Gamma Plan. The target is localized and its three dimensional coordinates (XYZ) are determined

STAGE 3. Treatment Planning

The target and/or the field is then tailored to fit the target volume which require to irradiate and the dosimetric calculations, evaluation and graphical presentation is then perform, on series of images transferred with the help of an advance computer system (TPS).

STAGE 4. Radiation Treatment

After completion and verification of planning the treatment is performed. The patient is positioned on the gamma knife machine couch and the stereotactic frame is then attached to one of the four collimator helmets which has 201 apertures to allow to pass the well collimated fine radiation beam directed with great accuracy and precision.

In general the duration of the treatment is 1 to 2 hours. The patient is awake through out the procedure and can communicate with the associated staff through a two-way intercom system. After treatment, the patient can return to there pre-operative lifestyle immediately.

The gamma knife treats tumors and malfunction with virtually no side effects. Its precision and limited mechanical and electrical motions permit treatment with unparalled accuracy. It is often the only option for deep-seated and critically located lesions. Treatment is done in a single session.

MOVERS and SHAKERS

Dr. Gurpreet Singh, PhD has joined as Post Doctoral Fellow at University of Greifswld, Greifswald, Germany.

Dr. Senthamizhchelvan Srinivasan PhD has joined as Post Doctoral Fellow, Department of Radiology and Division of Nuclear Medicine, School of Medicine, Johns Hopkins University, Baltimore, Maryland, USA.

BACK TO BASICS

MPS Mann, Consultant Medical Physicist, New Delhi

A man of 70 kg walks up to his 8th floor office 27 meters high in 30 seconds. We all do this to strengthen our heart. Have you ever wondered how much work was done in this exercise?
Take Acceleration due to gravity @9.8 ms^{-2}
Let us calculate Force of attraction
F = 70 kgx 9.8 = 686 Newtons

Of the earth for this employee Work done
E = 686 Nx 27 m = 18,522 Nm = 18,522 joules

Power developed P = 18,522 J/30 sec
= 617.4 $J\,m^{-1}$
= 617.4 Watts

You can also see in Horse Power = 617.4 W/746 W
(746 W=1 HP) = 0.827 HP

Close to 1 HP. This is tremendous work done and it is probably for the Olympians to attempt. Public at large is advised to walk comfortably.

PET-CT

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PET CT: Whys and wherefores

In the recent Era of Medicine **PET** (Positron Emission Tomography) technology, together with its FDG tracer, has been extensively used as a diagnostic modality for evaluating tumours: head and neck tumours, pulmonary nodules, gastro-oesophageal cancers, differentiation between pancreas chronic inflammation and cancer, colorectal cancers, ovarian cancers, detection of bone marrow metastases, melanomas, Hodgkin disease and non-Hodgkin lymphoma. Disease extension (staging), chemotherapy or radiotherapy treatment response, radiotherapy treatment planning and actual possibilities of surgery can also be evaluated. PET has made its greatest contribution in the diagnosis of neurodegenerative diseases. There is a growing body of evidence supporting the use of FDG for the differentiation of malignant from benign diseases, staging and grading of malignant diseases, differentiating recurrent or residual disease from therapy induced changes, and monitoring of the response to therapy. Depending on the clinical question and type of equipment available, the FDG imaging procedure may include:

A. Limited field tomographic images:
These are usually performed when critical abnormalities are likely to be localized in a known region of the body (e.g. brain for brain tumors, upper torso and neck for head and neck cancers)

B. Whole-body (WB) tomographic images:
These are usually performed to survey the entire body in search of areas of abnormal FDG accumulation. In most tumors, WB imaging is limited to the trunk (from inguinal region up to the base of the skull). Imaging of the lower extremities is only performed in case of known tumor involvement in the legs or in malignant melanoma with a primary tumor localized in the lower extremities.

C. Attenuation correction:
This method is used for estimating emission photon attenuation may be either:

1. **Measured attenuation correction (transmission imaging):** A set of corresponding images is acquired with an external source of radioactivity. This can be performed prior to injection of the tracer ("cold transmission") or afterwards ("hot transmission").
2. **Calculated attenuation correction**: typically used in brain imaging, where an estimated attenuation correction based on the emission data may be used instead of actually acquiring transmission data. The new frontier in medical imaging technology is in combined modality systems, or fusion imaging. On this leading edge are the new hybrid imaging devices that combine **CT** (Computed Tomography) scanner and Positron Emission Tomography (**PET**) scanner functions. CT scanners employ a well-established technology, using X-rays taken at regularly spaced angles around the body to produce computer-generated graphic projections and anatomic slices of the region of interest. Because the imaging technique uses X-rays, the imaging is sensitive to bone and hard structures but relatively insensitive to soft structures. Diagnostic CT images provided excellent patient geometry and scale but show only structure with no information as to function.

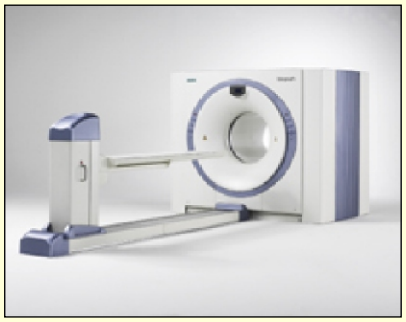

Figure 1 : PET/CT Scanner

PET scanners are a relatively new clinical technology, using the decay properties of injected, high-energy nuclear medicine isotopes to generate graphic projections of metabolic activity in a region of interest. Because the imaging technique is based on the detection of metabolic activity, it is very sensitive to living tissue but completely insensitive to rigid structures. PET scanning is becoming the method of choice in detection and classification of cancerous tumors because of their uncharacteristic high metabolic state. Diagnostic PET images provide excellent information about cancerous tumor size and response to treatment but lack the necessary patient landmarks to accurately locate the tumor for precise surgical or radiation oncology treatments.

Major medical imaging vendors are now introducing hybrid devices that combine the CT scanner functions and the PET scanner functions into a common gantry. Parallel-processing image analysis and volume-rendering computer systems have produced merged images that superimpose PET metabolism on CT structures. These images provide much more diagnostic information than either of the images viewed independently. *(To be Concluded)*

MOVERS and SHAKERS

Prof. A K Dixit has joined as Director, J K Cancer Institute, GSVM Medical College, Kanpur on 1st Feb 2009. Congratulations !!

POPULATION-BASED STUDY FINDS DIGITAL MAMMOGRAPHY EQUAL TO FILM

Rebekah Moan

Digital mammography is at least as good as screen-film mammography for detecting breast cancer, according to a population-based screening program study presented at the RSNA meeting by Irish researchers.

Dr. Niamh Hambly of the department of radiology at Mater Misericordiae University Hospital in Dublin and colleagues retrospectively reviewed the performance of full-field digital mammography for 26,593 women out of 163,031 women screened for breast cancer. The Irish National Breast Screening Program invites women between the ages of 50 and 64 for screening mammography every two years.

Though the program was implemented in 2000, it became the first fully digitized screening service in the world in April 2008. Hambly and colleagues performed a retrospective analysis on the women screened between January 2005 and September 2007 to compare the recall rate, biopsy rate, cancer detection rate, and positive predictive value for digital versus film. Results were presented at the 2008 RSNA meeting.

The researchers found a recall rate of 3.95% in women undergoing digital screening and 3.23% in those undergoing film screening. The cancer detection rate for digital was 6.24 per 1000 women and 5.48 per 1000 for film. Of the cancers detected by digital mammography, 22.3% were ductal carcinoma in situ. Of the cancers detected by screen-film mammography, 18% were DCIS. The positive predictive value for women recalled for assessment and subsequently diagnosed with cancer was 15.8% for digital and 16.9% for film, according to Hambly.

"This study shows the cancer detection rate is significantly higher in digital mammography. Both patient groups were drawn from the same population, and the only variable was mode of documentation," she said.

Digital is superior to screen-film mammography in women between the ages of 50 and 64, she said.

The findings intrigued session comoderator Dr. D. David Dershaw, director of breast imaging at Memorial Sloan-Kettering Cancer Center in New York City.

"I think it's valuable to have an increasing number of screening studies with digital that are all showing us essentially the same kinds of information: higher callback rate, higher diagnosis of cancer, much higher diagnosis of DCIS, and increased conspicuity of calcifications but really kind of a small difference between the two," he said.

(Taken from DiagnosticImaging.com)

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