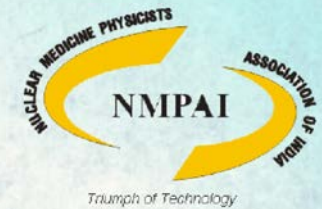




MANIPAL
ACADEMY of HIGHER EDUCATION
(Deemed to be University under Section 3 of the UGC Act, 1956)



NMPAICON 2020

**4th Annual Conference of
Nuclear Medicine Physicists Association of India**

**“Advancement in Nuclear Medicine:
Prospects and Challenges”**

29th February & 1st March, 2020

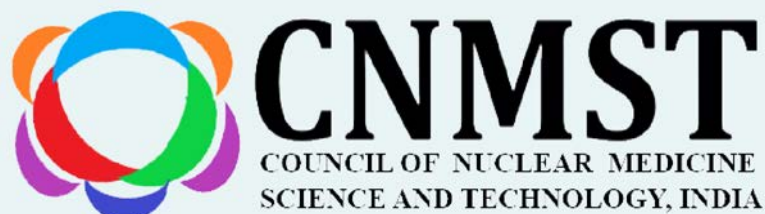
Venue: Dr. TMA Pai Halls, 1st Floor, MAHE, Manipal

Organised by: Department of Nuclear Medicine

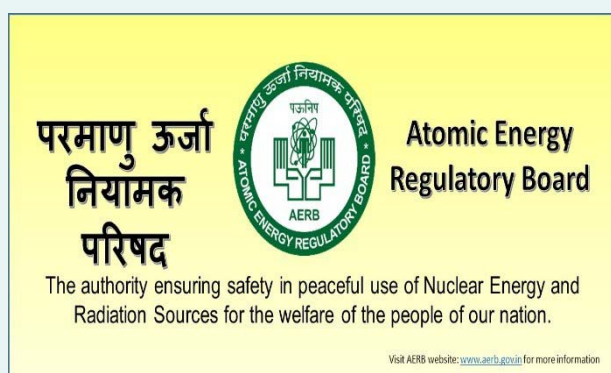
MCHP, MAHE, Manipal



“NMPAICON 2020 OUR PARTNERS -”



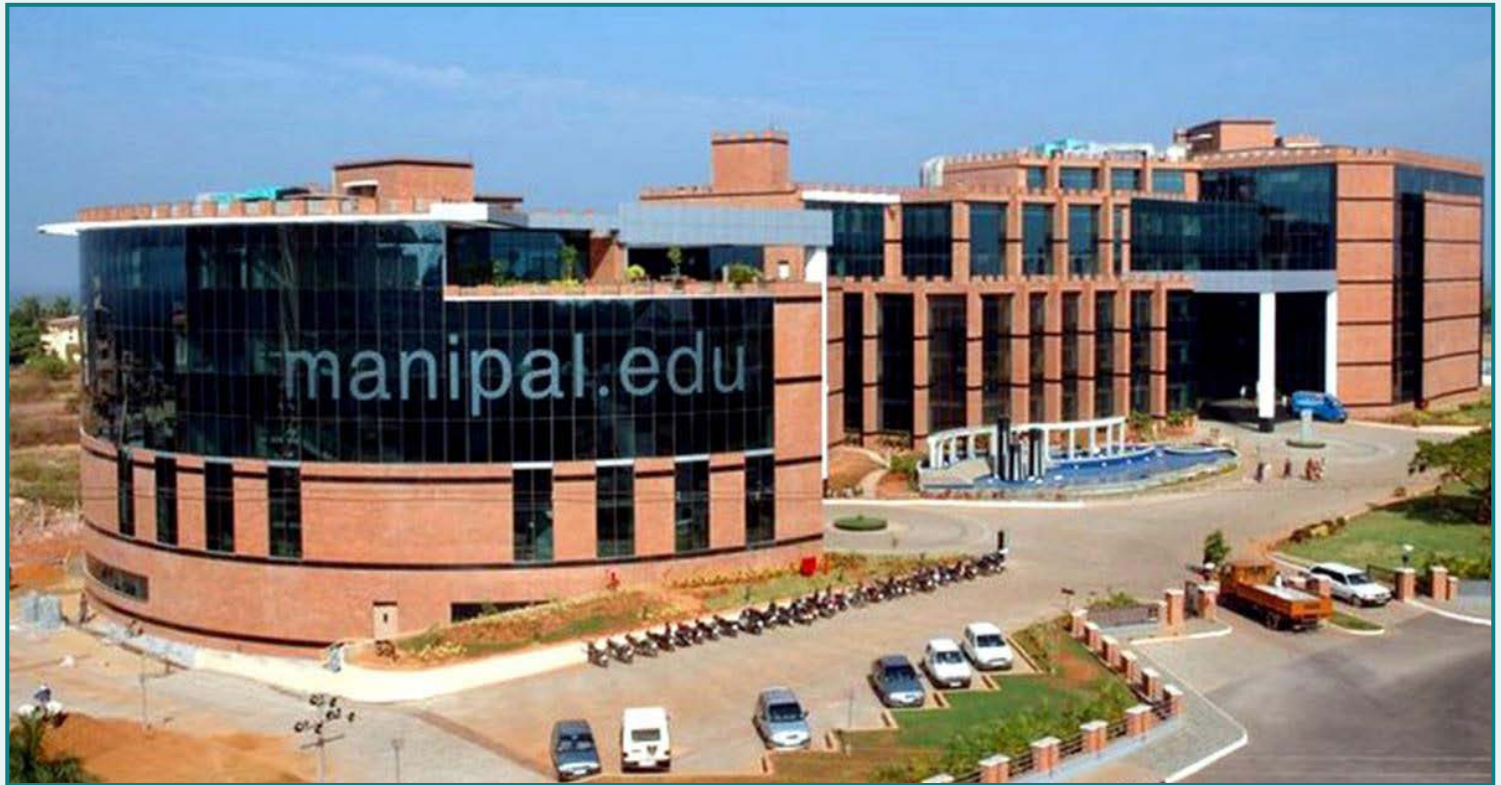
Nuclear Medicine
Targeting Tumors





MANIPAL ACADEMY OF HIGHER EDUCATION

Manipal Academy of Higher Education (MAHE) is synonymous with excellence in higher education. Over 28,000 students from 57 different nations live, learn and play in the sprawling University town.



It has nearly 2500 faculty and around 10000 other support and service staff, who cater to the various professional institutions in health sciences, engineering, management, communication and humanities. MAHE has been imparting world-class education for over 60 years. The University has off-campuses in Mangalore, Bangalore, Jaipur and Sikkim and off-shore campuses in Dubai (UAE) and Melaka (Malaysia). It has been accorded the status of "The Institute of Eminence" by the Ministry of Human Resource Development (MHRD) in the year 2018. Situated at the rocky yet lush green hinterland of the Malabar coast, students from over 57 countries study here. It is home to one of the best libraries and one of the finest anatomy museums in the world and what more; it has fully equipped campuses, research centre of national repute and above all a perfect harmony with nature.

MANIPAL COLLEGE OF HEALTH PROFESSIONS

The Manipal College of Health Professions was established in 1999 as the first institution in India exclusively dedicated to the education of Allied Health Professionals.

The school envisions training healthcare professionals who can create a difference in the quality of life of individuals, both physically and mentally. Manipal College of Health Professions is ranked number three amongst Allied Health Colleges in India. MCHP has been rated as 'Excellent' by the Rehabilitation Council of India (RCI), the statutory body under the Ministry of Social Justice and Empowerment, Government of India in April, 2008. The Ministry of Health; Sultanate of Oman has approved the school for the training of its nationals in the regular and bridge programs. The Ministry of Health, Government of India has considered the school as the model for its proposed National and Regional Institutes of Allied Health Sciences (NIAHS and RIAHS).

DEPARTMENT OF NUCLEAR MEDICINE

The Department of Nuclear Medicine at Kasturba Medical College, MAHE was established in 1985 and is concerned with the diagnostic and therapeutic use of radionuclides. The department carries out a wide range of Gamma Camera and PET CT diagnostic procedures and common radionuclide therapy procedures in Nuclear Medicine. In addition to routine diagnostic and therapeutic work, personnel are also frequently involved in clinical trial works, quality assurance and research which is constantly evolving as an integral part of the health care system. The department is one of the centres in India for training of Nuclear Medicine Technologists for radiation safety in radionuclide therapy. Along with the academics the department also arranges and take part in other co-curricular activities like sports, celebrations of various events and functions. Its programs, BSc NMT, MSc NMT and PhD are approved by the regulatory body AERB (Atomic Energy Regulatory Board) India.



NUCLEAR MEDICINE PHYSICISTS ASSOCIATION OF INDIA



“My success will not depend on what A or B thinks of me. My success will be what I make of my work”- HOMI.J. BHABHA

Nuclear Medicine Physicists Association of India was established in year 2007 to promote, protect and safeguard the interests and future of the Nuclear Medicine Physicists/Technologists fraternity and fulfill its duties towards the society. As a society they will undertake scientific projects & knowledge – based activities for the advancement and dignity of medical radioisotope technology, radio pharmacy & radiation protection techniques. They encourage and develop meaningful co-operation amongst persons engaged in the field of Nuclear Medicine, directly or indirectly on all subjects connecting with and involving of their common good. NMPAI provides a forum to represent and express advancement issues to the appropriate authorities, to institute, encourage, develop and progress all kinds of scientific research relating to Medical Radioisotope technology, Radiopharmacy & Radiation protection techniques. NMPAI is actively conducting National level conferences and workshops. The first NMPAICON was held in 2017 at Kolkata, The second was held at Mumbai 2018 and the Third in 2019 at Delhi.

NMPAICON 2020 Manipal- Conference Highlights

4th ANNUAL CONFERENCE OF NUCLEAR MEDICINE PHYSICIST ASSOCIATION OF INDIA

THEME: ADVANCEMENTS IN NUCLEAR MEDICINE: PROSPECTS AND CHALLENGES

Scientific Programme DAY 1: 29th February, 2020 (Saturday)

Conference Hall 1

TIME

07:45am - 08:45am	REGISTRATION AND BREAKFAST
08:45am -09:30am	OPENING CEREMONY
09:30am - 10:15am	Hal Anger Oration : Dr. B. R Mittal
10:15am- 11:00am	Ernest Lawrence Oration : Mr. Ashish K Jha
TEA BREAK	

SCIENTIFIC SESSION 1: Emerging Trends In Nuclear Medicine Imaging Technology: A Clinical Perspective

11:20 am - 11:40am	Dr. G Rijju
11:40am - 12:00	Dr. Jay Kumar Rai
12:00 - 12:20pm	Dr. Pushan Bhardwaj
12:20pm - 12:40pm	Dr. Aftab Hasan Nazar
12:40pm - 01:00pm	Dr. Sujith Rai

LUNCH

02:00pm - 02:20pm	Dr. Dhananjay Kumar Singh
02:20pm - 02:40pm	Dr. Priyanka Gupta
02:40pm - 03:00pm	Dr. Parul Thakral Dash
03:00pm - 03:20pm	Ms. Deepti Rathod
03:20pm onwards	POSTER SESSION

TEA BREAK

04:00pm -04:30pm	SCIENTIFIC QUIZ
04:30pm -06:30pm	GENERAL BODY MEETING
07:00 pm onwards	CULTURAL EVENING FOLLOWED BY GALA DINNER

Conference Hall 2

SCIENTIFIC SESSION 2: Evolving Landscape Of Radiation Detection Techniques And Instrumentation

11:20am - 11:40am	Mr. Radhakrishnan E. R.
11:40am - 12:00pm	Mr. Deepak Aheer
12:00pm - 12:20pm	Mr. Sachin Tayal
12:20pm - 12:40pm	Ms. Chanchala Kale
12:40pm - 01:00pm	Dr. Rajeev Kumar

LUNCH

SYMPOSIUM: Inter-professional Education Approach to Health and Patient Safety

01:45pm - 03:45pm	Dr. Ram Prasad V P
	Dr. Elsa Sanatombi Devi
	Ms. Rechal Nisha D'Souza
	Dr. Pankaj Tandon
	Dr. Anshu Rajneesh Sharma

Scientific Programme DAY 2: 1st March, 2020 (Sunday)

08:00am - 09:00am	BREAKFAST
09:00am - 09:30am	Keynote Address : Dr. Deepanjan Mitra

SCIENTIFIC SESSION 3: Quality Considerations in Education and Clinical Practice

09:30am - 10:00am	Prof. D. K. Dhawan
10:00am - 10:30am	Dr. Nand K. Relan
10:30am - 11:00am	Dr. Subhash Chand Kheruka
TEA BREAK	

SCIENTIFIC SESSION 4: Research Towards Technological and Clinical Advancement in Nuclear Medicine

11:15am -11:45am	Dr. Meera Venkatesh
11:45am - 12:15pm	Dr. Pradip Chaudhari
12:15pm - 12:45pm	Dr. Pardeep Kumar

LUNCH

01: 45 pm- 02:05pm	Dr. May Abdel Wahab
02:05pm - 02:25pm	Dr. N. Sridhar Goud
02:25pm - 02:45pm	Mr. Amit Nautiyal
02:45pm - 03:05pm	Mr. Raman Kumar Joshi
03:05pm - 03:25pm	Mr. Ankit Watts
03:25pm - 03:45pm	Mr. Sanny Bhushan Kumar
03:45pm - 04:05pm	Dr. Vijayta Chadha
04:05pm -05:00pm	VALEDICTORY AND CLOSING CEREMONY FOLLOWED BY HIGH TEA

MESSAGES

Subhash Chand Kheruka

President, Nuclear Medicine Physicists Association of India

Senior Scientist (Medical Physics)

Department of Nuclear Medicine

Sanjay Gandhi Post Graduate Institute of Medical Sciences

Rae Bareli Road, Lucknow (UP), India



Message

On behalf of the Nuclear Medicine Physicists Association of India, It gives me an immense pleasure to welcome you to the 4th Annual Conference of association (NMPAICON2020) in KMC Manipal during February 29th and 01st March, 2020.

The theme of the conference is “Advancements in Nuclear Medicine: Prospects & Challenges”. The scientific programme under this theme is designed in such a way that it will stimulate both scientific intellect and clinical knowledge in the field of diagnostic as well as therapeutic aspects of nuclear medicine starting from basic radiation physics, radiation protection to imaging and alpha therapy & beta therapy. I hope that this conference would provide a platform for fruitful interaction among delegates, exchanges of ideas, sharing information and experience among eminent faculties in the field of Medical Physics (Nuclear Medicine), Nuclear Medicine Clinics. Nuclear Medicine Radiopharmacy and Radiation Protection.

Nuclear Medicine Physics profession in India has long history and NMPAI was founded in 2007 with objective of encouraging the application of applied physics in Nuclear Medicine.

NMPAI always been in forefront in keeping the scientific spirit alive and organizing the professional and educational activities in various part of India.

I take this opportunity to sincerely thank all the delegates and faculties who have find valuable time to attend this conference in enhancing scientific acumen for each other.

I extend my best wishes to the organizer of this conference for great success.

With Warm Regards

A handwritten signature in blue ink, appearing to read 'Skheruka'.

Subhash Chand Kheruka



Dear Friends,

I am pleased to learn that 4th Annual Conference of “Nuclear Medicine Physicist Association of India” is being held at Manipal Academy of Higher Education (MAHE), Manipal on 29th Feb & 1st March 2020.

The design of the scientific program is rich in qualitative academic content. It is important to develop attitude towards research and evidence building in every scientific sphere. Our conference would be the major step towards this goal in the field of Nuclear Medicine Science and Technology.

I am sure that the deliberations and discussions that will be generated during this Conference will add to and deepen our understanding towards the advancement in Nuclear Medicine Science & Technology.

I wish all success to the organizing team and MAHE Management for their hard work and dedication in the support of NMPAI 2020 Conference. I am sure the forthcoming Conference will add to the list of successful ventures of NMPAI.

My best wishes to Organising team to make this Conference a milestone of achievement.

Rajnath Jaiswar
General Secretary



It gives me immense pleasure to send this message for the Souvenir being brought out on the occasion of 4th Annual Conference of NMPAI being hosted by organizing committee of Dept of Nuclear Medicine, MCHP, MAHE, Manipal. The theme chosen of “Advancements in Nuclear Medicine: Prospects & Challenges.” is indeed very appropriate, considering the various advancements in the field & important role of Nuclear Medicine in modern technology.

MAHE is a hub known for education and training, which attract more than thirty thousand students & professionals every year. I feel very proud to be an alumnus of a place known for its beautiful campus and perfect study destination.

The annual meet is a unique occasion to avail of the opportunity of renewing friendships, building up new relationships, to discuss matters of common interest and furtherance of knowledge through various scientific sessions, orations as well as mutual interaction.

NMPAI had always been in the forefront in uplifting the non-medical Nuclear Medicine professionals ie. Physicist and Technologist by various activities and understand the need of members across the country. Continuous efforts of present office bearers and members lead to recognition of NMPAI by various authorities.

I congratulate the members of organizing committee for bringing out this Souvenir and also express my thanks to those who have enriched this publication by various contributions.

I wish the conference all the success and send my congratulations to the organizing committee. I am sure the conference be a grand scientific extravaganza.

Amit Nautiyal

Amit Nautiyal
Secretary (HQ)
Nuclear Medicine Physicists Association of India

It gives us immense pleasure to welcome you all to NMPAI 2020, 4th annual conference of Nuclear Medicine Physicists Association of India, organized by the Department of Nuclear Medicine, Manipal Colleges of Health Professionals, MAHE.



Since 2017, NMPAI has organized national conferences every year, bringing together academicians, physicians, allied health care professionals and scientists to deliberate ideas on Advancements in Nuclear Medicine and co-ordinate the sustained developments in this field. This year the theme of the conference is focusing on

“Advancements in Nuclear Medicine: Prospects and Challenges.” It would be relevant to mention that this would be the first time we are seeing participation from international speakers and good variety of student oriented scientific events at the conference in form of quiz and poster competition. Parallel scientific presentations and symposium have been organized for the first time in an NMPAI conference. This is an opportunity to interact with some of the best minds on the subject and therefore, I hope the conference will stimulate the participants' thinking towards ways to overcome the challenges faced in the field that could otherwise undermine efforts at achieving inclusive growth.

I look forward to meeting you at the conference and participating in this rewarding experience.


25/02/2020

Best wishes, -

Dr. Shivanand Bhushan

Organizing Chairperson, NMPAI 2020

Ms Sibi Oommen

Assistant Professor

Department of Nuclear Medicine

Manipal College of health professions

MAHE, Manipal



Dear All,

On behalf of the organizing committee and Manipal College of Health Professions, MAHE, I do welcome you all to the 4th National Conference of NMPAI to be held on the 29th February and 1st March 2020.

This event aims to update the knowledge of our students, budding scientist, physicians and other allied healthcare professionals in the Advancement of Nuclear Medicine: Prospects and Challenges.

Nuclear Medicine, an integral part of modern healthcare has witnessed significant technological breakthrough in the diagnostic and therapeutic domains. Thus this conference will be a platform to deliberate and exchange global ideas to strengthen the sustained growth of Nuclear Medicine.

The two day conference program encompasses diverse sessions on new technological advancements and challenges associated with Nuclear Medicine clinical practice, Nuclear Medicine Education, Radiopharmacy, Radiation protection and dosimetry, Nuclear Medicine physics and instrumentation etc.

I extend my warm welcome to all delegates hoping the most benefits from this grand gathering at our institute. Much thanks are endorsed to our valuable team, colleagues, national and international resource persons who have spent much time, dedication and efforts to make this conference a great success.

A handwritten signature in dark ink, consisting of a stylized 'S' followed by a checkmark-like flourish.

Ms. Sibi Oommen

Dr. G. Arun Maiya

Dean, Manipal College of Health Professions (MCHP)

Manipal Academy of Higher Education

Manipal – 576 104.



Dear All,

On behalf of Manipal College of Health Professions (MCHP), I cordially welcome you to Manipal.

MCHP, which is nearly 20 years old, is the largest institution for Allied Health Professionals, providing quality academic and clinical experience to its faculty and students through innovative and interdisciplinary research and through strong alumni bonding. The institute started with 3 academic programs in the year 1992 and at present we have 17 departments offering undergraduate and post graduate programs, super-speciality and PhD programs having students from 23 countries.

It gives me immense pleasure to know that department of Nuclear Medicine, Manipal College of Health Professions is organizing NMPAI professional body conference on February 29th and March 1st 2020, where the speakers will be deliberating on the central theme of the conference, 'Advancements in Nuclear Medicine: Prospects and Challenges'

I hope eminent speakers will cover the theme in virtual reality from different perspectives that will definitely offer suitable solution to the global issue pertaining to nuclear medicine.

Eventually I express my special thanks and appreciation to all. I wish NMPAICON 2020 all the best for its success.

Sincerely,

Dr. G Arun Maiya

Dean, MCHP

गुंटूर नागेश्वर राव
G. NAGESWARA RAO
अध्यक्ष
CHAIRMAN



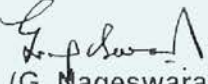
MESSAGE

It gives me immense pleasure to know that 4th Annual Conference of Nuclear Medicine Physicist Association of India (NMPAICON-2020) is being organised by Manipal Academy of Higher Education, Manipal during February 29 to March 1, 2020.

Role of Nuclear medicine in the healthcare industry is indispensable in terms of its unique non-invasive physiological imaging which cannot be acquired by any other imaging modality in today's era. With the advancement in the imaging technology, overall usage of nuclear medicine procedures is expanding rapidly. Advances in nuclear medicine can significantly accelerate, simplify, and reduce the cost of delivering and improving health care. Collaboration in the field of nuclear medicine among academic institutions, medical centres, and other involved industries will lead to new applications of nuclear technologies to improve disease diagnosis, treatment approaches, drug development, and basic research. In the context of increasing use of nuclear medicine along with advanced imaging technologies, organising this Conference on "**Advancements of Nuclear Medicine: Prospects and Challenges**" is going to be very useful for brainstorming interactions among the professionals in Nuclear Medicine. Radiation safety while handling unsealed sources in nuclear medicine is another very important area which need to be deliberated during such meetings to arrive at Safe Standard Practices and safe disposal of the effluents arising out of the Nuclear Medicine use. Atomic Energy Regulatory Board is actively engaged with the professional bodies for promoting the safe use of radiation with due compliance to regulatory requirements.

This event is a great opportunity for all professionals and students associated with the nuclear medicine to discuss the advancement in their field at greater length. I hope the scientific presentations, discussions and academic deliberations will help to broaden the perspectives to address and generate new ideas for enhancing the radiation safety in Nuclear Medicine Practices.

I wish the event a great success!


(G. Nageswara Rao)

Conveners & Core Committee Members



CHIEF CONVENER

Dr. Arun G. Maiya
Dean,
MCHP, MAHE, Manipal



CO- CHIEF CONVENER

Dr. Sabu K M
Associate Dean,
MCHP, MAHE, Manipal

CO- CHIEF CONVENER

Dr B. Rajashekhar
Former Dean,
MCHP, MAHE, Manipal



CONVENER CUM CHAIR PERSON

Dr Shivanand Bhushan
Associate Professor,
Nuclear Medicine
MCHP, MAHE, Manipal



ORGANIZING SECRETARY

Mrs Sibi Oommen
Assistant Professor,
Nuclear Medicine
MCHP, MAHE, Manipal

CHAIRPERSON FUND AND FINANCE

Dr.Sanjay Bharati
Assistant Professor (Senior Scale)
Nuclear Medicine
MCHP, MAHE, Manipal



CHAIRPERSON SCIENTIFIC PROGRAMS

Dr. Rozy Kamal
Assistant Professor,
Nuclear Medicine
MCHP, MAHE, Manipal



CHAIRPERSON LOGISTICS & HOSPITALITY

Mrs. Vasumathi
Assistant Professor (Senior Scale) ,Nuclear Medicine
MCHP, MAHE, Manipal



CHAIRPERSON RECEPTION & REGISTRATION

Krishnaprabha
Assistant Lecturer,
Nuclear Medicine
MCHP, MAHE, Manipal



*We have a very
dedicated group of
students that serve in
this program and deserve
a big pat on the
back for their hard work
and dedication*





NMPAICON 2020 MANIPAL

4th ANNUAL CONFERENCE OF NUCLEAR MEDICINE PHYSICIST ASSOCIATION OF INDIA

THEME: ADVANCEMENTS IN NUCLEAR MEDICINE - PROSPECTS & CHALLENGES

Scientific Programme DAY 1: 29th February, 2020 (Saturday)

CONFERENCE HALL 1

TIME			
07:45am - 08:45am	REGISTRATION AND BREAKFAST		
08:45am - 09:30am	OPENING CEREMONY		
09:30am - 10:15am	Hal Anger Oration Dr. B.R. Mittal, Prof. and Head, Department of Nuclear Medicine and PET, PGIMER, Chandigarh Topic: Nuclear Medicine: The Artful Amalgamation of Medicine & Physics		
10.15am- 11: 00am	Ernest Lawrence Oration Mr. Ashish K Jha, Scientific Officer, Tata Memorial Hospital Mumbai Topic: Artificial Intelligence in Imaging Leading to Personalized Treatment in Oncology		
TEA BREAK			
SCIENTIFIC SESSION 1: Emerging Trends In Nuclear Medicine Imaging Technology: A Clinical Perspective			
	SPEAKER	TOPIC	CHAIR
11:20 am - 11:40am	Dr. G Rijju HOD, Dept. of Nuclear Medicine and Molecular imaging, KIMS Hospital, Trivandrum	PET based RT planning- New Paradigm in Radiotherapy Planning	Dr. B. R. Mittal, Prof. Meera Venkatesh & Dr. Anshu Rajneesh
11:40am - 12:00	Dr. Jay Kumar Rai Consultant at Balco Medical Centre, Raipur Chattisgarh	Tc99m-PSMA - An available cost-effective, alternative for prostate cancer evaluation. : our institutional initial experience	
12:00 - 12:20pm	Dr. Pushan Bhardwaj Consulting Physician, Dept. of Nuclear Medicine and Molecular Imaging, Singapore General Hospital, Singapore	Evolution in human use of Radioiodine: important contribution of early years	
12:20pm - 12:40pm	Dr. Aftab Hasan Nazar Assistant Professor, Dept. of Nuclear Medicine, SGPGI, Lucknow	Optimization of radiation protection to patients undergoing nuclear medicine procedure: A physician Perspective	
12:40pm - 01:00pm	Dr. Sujith Rai Assistant Professor and Consultant (Nuclear Medicine) Head of PET-CT services, AJ Hospital and Research Centre, Mangalore	Tailoring Various I.V. Contrast CT Protocols In PET-CT Imaging	
LUNCH			
02:00pm - 02:20pm	Dr. Dhananjay Kumar Singh Assistant Professor, Dept. of Nuclear Medicine, Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow, UP, India	Total Body PET: A New Technological Advancement	Dr. D. K. Dhawan & Dr. Nand K. Relan
02:20pm - 02:40pm	Dr. Priyanka Gupta Medical Physicist, AIIMS, Delhi	Rhenium-188 : Current Clinical Applications	
02:40pm - 03:00pm	Dr. Parul Thakral Dash Clinical Research Officer, Dept. of Nuclear Medicine and PET-CT Fortis Memorial Research Institute, Gurgaon	Alpha therapy : New horizons	
03:00pm - 03:20pm	Ms. Deepti Rathod RSO and Nuclear Medicine Physicist, AJ Hospital and Research Centre, Mangalore	Gallium-68 Radiopharmaceutical: Where do we stand now?	
03:20pm onwards	POSTER SESSION		
TEA BREAK			
04:00pm - 04:30pm	SCIENTIFIC QUIZ		
04:30pm - 06:30pm	GENERAL BODY MEETING		
07:00 pm onwards	CULTURAL EVENING FOLLOWED BY GALA DINNER		





NMPAICON 2020 MANIPAL

4th ANNUAL CONFERENCE OF NUCLEAR MEDICINE PHYSICIST ASSOCIATION OF INDIA

THEME: ADVANCEMENTS IN NUCLEAR MEDICINE - PROSPECTS & CHALLENGES

Scientific Programme DAY 1: 29th February, 2020 (Saturday)

CONFERENCE HALL 2

TIME			
SCIENTIFIC SESSION 2: Evolving Landscape Of Radiation Detection Techniques And Instrumentation			
	SPEAKER	TOPIC	CHAIR
11:20am - 11:40am	Mr. Radhakrishnan E. R. Chief Technologist, Dept. of Nuclear Medicine and RSO-II , Kovai Medical Centre and Hospital Limited, Coimbatore	Intrinsic Flood Field Uniformity- Tip and Trick	Dr. Pradip Chaudhari & Dr. Subhash Kheruka
11:40am - 12:00	Mr. Deepak Aheer Medical Physicist, Army Hospital Research and Referral, New Delhi	Advancements in Medical cyclotron and its future	
12:00 - 12:20pm	Mr. Sachin Tayal Nuclear Medicine Physicist Dept. of Nuclear Medicine, Kailash Cancer Hospital and Research Centre, Vadodara,Gujarat	Technological development in radiation detectors	
12:20pm - 12:40pm	Ms. Chanchala Kale Nuclear Medicine Technologist Kokilaben Dhirubai Ambani Hospital & Research centre, Mumbai	Nuclear Medicine Technology: past, present and Future	
12:40pm - 01:00pm	Dr. Rajeev Kumar PET Radiochemist, AIIMS, NEW DELHI	Cyclotron basics and its operations	
LUNCH			
	SYMPOSIUM: Inter-professional Education Approach to Health and Patient Safety		
01:45pm – 03:45pm	Dr. Ram Prasad VP MAHE - FAIMER Faculty	Importance of interprofessional Education and Practice in Medical diagnostics and therapeutic health care delivery	
	Dr. Elsa Sanatombi Devi MAHE - FAIMER Faculty	Medication safety an Inter Professional Education approach	
	Ms. Rechal Nisha D'Souza Assistant Professor, Medical Physics MCHP, MAHE, Manipal	Safety attributes for planning the radiation emergency response for handling unsealed radiation sources	
	Dr. Pankaj Tandon Head, TSS, Radiological Safety Division AERB, Mumbai	Radiation emergency handling in Nuclear Medicine and preparedness	
	Dr. Anshu Rajneesh Sharma Chief Consultant and Head Dept of Nuclear Medicine, Kokilaben Dhirubhai Ambani Hospital and Medical Research Institute, Mumbai	Handling medical emergency in radiopharmaceutical administered patients	





NMPAICON 2020 MANIPAL			
4th ANNUAL CONFERENCE OF NUCLEAR MEDICINE PHYSICIST ASSOCIATION OF INDIA			
THEME: ADVANCEMENTS IN NUCLEAR MEDICINE - PROSPECTS & CHALLENGES			
Scientific Programme DAY 2: 1st March, 2020 (Sunday)			
CONFERENCE HALL			
TIME			
08:00am - 09:00am	BREAKFAST		
09:00am - 09:30am	KEYNOTE ADDRESS Dr. Deepanjan Mitra Consultant, Dept of Nuclear Medicine & PET CT Molecular Imaging Unit AMRI Hospital (Dhakuria) Kolkata, India		
	SCIENTIFIC SESSION 3: Quality Considerations in Education and Clinical Practice		
	SPEAKER	TOPIC	CHAIR
09:30am - 10:00am	Prof. D. K. Dhawan Professor, Dept of Biophysics, Punjab University, Chandigarh	Future of nuclear medicine education and research in India: Prospects and challenges	Dr. Anshu Rajneesh & Dr. Pankaj Tandon
10:00am – 10:30am	Dr. Nand K. Relan Clinical Director of Nuclear Medicine Physics, Associate Professor of Radiology, Health Sciences and Biomedical Engineering, Stony Brook University Medical Centre, Stony Brook, New York	Nuclear Medicine Physics: Prospects of Education in USA	
10:30am - 11:00am	Dr. Subhash Chand Kheruka Senior Scientist, Dept of Nuclear Medicine, SGPGIMS, Lucknow, UP, India	Importance of Quality Control in Nuclear Medicine	
TEA BREAK			
SCIENTIFIC SESSION 4: Research Towards Technological and Clinical Advancement in Nuclear Medicine			
11:15am -11:45am	Dr. Meera Venkatesh Former Director of Division of Physical and Chemical Sciences in the Department of Nuclear Applications, IAEA	Trends in the use of Radioisotopes in Nuclear Medicine and the Vital Role of Physics	Dr. Pankaj Tandon & Dr. Nand K Relan
11:45am – 12:15pm	Dr. Pradip Chaudhari Scientific Officer 'G' Comparative Oncology Program & Small Animal Imaging Facility, Advanced Centre for Treatment, Research & Education in Cancer (ACTREC), Tata Memorial Centre Navi Mumbai	Radiation safety and protection in pre-clinical in vivo studies	
12:15pm – 12:45pm	Dr. Pardeep Kumar Assistant Professor of Radiochemistry, Department of Neuro-imaging and Interventional Radiology, NIMHANS, Bengaluru, Karnataka	Radio-synthesis, standardization of 11C-methionine using two different precursors and PET imaging characteristics in glioma	
LUNCH			





NMPAICON 2020 MANIPAL			
4th ANNUAL CONFERENCE OF NUCLEAR MEDICINE PHYSICIST ASSOCIATION OF INDIA			
THEME: ADVANCEMENTS IN NUCLEAR MEDICINE - PROSPECTS & CHALLENGES			
Scientific Programme DAY 2: 1st March, 2020 (Sunday)			
CONFERENCE HALL			
TIME	SPEAKER	TOPIC	CHAIR
01:45pm- 02:05pm	Dr. May Abdel Wahab Director of Division of Human Health, IAEA	Quality Management at the Division of Human Health, IAEA	Dr. Dhananjay Kumar Singh & Dr. Pradip Chaudhari
02:05pm - 02:25pm	Dr. N. Sridhar Goud Research Fellow of Radiochemistry, Department of Neuroimaging and Interventional Radiology, NIMHANS, Bengaluru	Synthesis, 18F-Radiolabeling and Galectin-1 Targeting Novel 4, 7-Disubstituted Coumarins as Apoptosis Inducing Agents	
02:25pm - 02:45pm	Mr. Amit Nautiyal Scientific officer and RSO, Department of Nuclear Medicine and Molecular Imaging, MPMMCC, TATA Memorial Centre, DAE, Govt of India	Influence of various parameters on the accuracy of Radionuclide Therapy dosimetry results	
02:45pm - 03:05pm	Mr. Raman Kumar Joshi Radiochemist Cyclotron Department of Neuroimaging and Interventional Radiology, NIMHANS, Bengaluru	Development and standardization of a new method for detection of radiochemicals and chemical purity of PET radiopharmaceuticals (11C - Methionine)	
03:05pm - 03:25pm	Mr. Ankit Watts Medical Physicist, Department of Nuclear Medicine and PET, PGIMER, Chandigarh	Image Based PET dosimetry – “Maiden Indian experience at PGIMER”	
03:25pm - 03:45pm	Mr. Sanny Bhushan Kumar Nuclear Medicine Physicist and RSO, Balco Medical Centre (Vendanta Medical Research Foundation) Atal Nagar, Raipur, Chattisgarh	Application of Non-radioactive Pharmaceuticals in Nuclear Medicine Procedure	
03:45pm - 04:05pm	Dr. Vijayta Chadha Chairperson, Centre for Nuclear Medicine, Assistant Professor in Nuclear Medicine, Institute for Emerging Areas in Science and Technology, Panjab University, Chandigarh	An epigenetic connection to off targeted effects of radiation – Relevance to estimation of potential risk	
04:05pm -05:00pm	VALEDICTORY AND CLOSING CEREMONY FOLLOWED BY HIGH TEA		



SPEAKERS' ABSTRACT:

SCIENTIFIC SESSION 1: Emerging trends in nuclear medicine imaging technology: a clinical perspective

PET BASED RT PLANNING -NEW PARADIGM IN RADIOTHERAPY PLANNING

Rijju G

Dept of Nuclear Medicine and Molecular Imaging ,KIMS Hospital, Trivandrum ,INDIA

Radiation therapy (RT) plays an important role as a non-invasive therapy. Irradiation should precisely target the entire tumour and aim to minimise the size of microscopic extensions of the cancer, as well as minimize radiation damage to normal tissues. CT is not always the best modality to identify the target volume because it is limited to discriminate between the tumour and adjacent soft tissues. PET-CT is becoming more and more important in various aspects of oncology. Until recently it was used mainly as part of diagnostic procedures and for evaluation of treatment results. With development of personalized radiotherapy, volumetric and radiobiological characteristics of individual tumour have become integrated in the multistep radiotherapy (RT) planning process. Standard anatomical imaging used to select and delineate RT target volumes can be enriched by the information on tumour biology gained by PET-CT. In this presentation the current and possible future role of PET-CT in radiotherapy treatment planning is being discussed. In the nearby future PET-CT will be an integral part of the most radiotherapy treatment planning procedures in an everyday clinical practice. Apart from a clear role in radiation planning of lung cancer, with forthcoming clinical trials, more evidence is obtained for the optimal use of PET-CT in radiotherapy planning of other solid tumours.

TC99M-PSMA - A AVAILABLE COST-EFFECTIVE, ALTERNATIVE FOR PROSTATE CANCER EVALUATION. -- OUR INSTITUTIONAL INITIAL EXPERIENCE.

Rai JK

Balco Medical Centre, Raipur, CG, INDIA

Introduction: We aimed to assess the performance of Tc-99m PSMA SPECT/CT for primary staging of prostate cancer and following biochemical recurrence.

Material & Methods: We prospectively done the Tc99m PSMA SPECT-CT in histopathologically confirmed prostate cancer patients referred to nuclear medicine. PSMA-SPECT/CT was done in primary prostate cancer patients for staging & also in patients with biochemical recurrence. Conventional imaging was performed depending upon clinical need & affordability of patients. Results were accessed & compared. Overall the positivity rate of Tc99m-PSMA SPECT for primary site, lymph nodes, & bone lesions and local recurrence are accessed.

Results & Discussion: PSMA-SPECT/CT showed higher sensitivity for diagnosing the primary site, lymph nodes, & bone lesions and local recurrence, then conventional imaging.

By use of conventional imaging modalities, it is difficult to detect recurrent lesions in prostate cancer patients who have undergone biochemical relapse, as well as it is difficult to have accurate primary staging of prostate cancer & staging post prostatectomy, especially in patients with low prostate-specific antigen (PSA) levels. Emerging literature shows that Tc99-PSMA SPECT is an alternative to PSMA-PET which utilizes cheaper, and much more prevalent SPECT scanners with potentially similar detection rates to PSMA-PET.

Conclusion: PSMA-SPECT/CT imaging could detect more metastatic lesions and achieve a higher primary detection rate than conventional imaging modalities at different serum PSA levels in prostate cancer & in patients who had undergone biochemical relapse.

The use of this technology will help to decrease the cost of PSMA scans and potentially increase the availability in India.

EVOLUTION IN HUMAN USE OF RADIOIODINE: IMPORTANT CONTRIBUTION OF THE EARLY YEARS

Bharadwaj P

Department of Nuclear Medicine and molecular imaging, Singapore General Hospital, Singapore

Radioiodine (RAI) is the first theranostic agent to diagnose and treat thyrotoxicosis and differentiated thyroid cancer effectively. The presentation will highlight the sequence of events in the field of physics, chemistry and biology that lead to the use of Radioiodine for the first time in a hyperthyroid patient in March 1941 and also seek to find out the pioneers in this field, not just physicians, emphasizing the historical importance of the collaboration of physicians and physicists in Nuclear Medicine. The contribution of some of the real pioneers in the field of nuclear thyroidology, had been deliberately neglected in the past and this presentation will highlight the contribution of a particular doctor from the Massachusetts General Hospital in establishing the medical uses of Iodine -131 and identify the circumstances under which his contribution was overlooked and he was denied a well-deserved enduring legacy that the discovery of the medical uses of RAI had created. The narrative will shed light on the critical contributions that would be needed in the road to advancement of Nuclear Medicine and challenges associated with the same

OPTIMISATION OF RADIATION PROTECTION TO PATIENTS UNDERGOING NUCLEAR MEDICINE PROCEDURE: A PHYSICIAN PROSPECTIVE

Nazar AH

Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, INDIA

Till the time, there is much talk about radiation protection among health care professionals. Patients are also important part while discussing about radiation protection. Many a time radiological and nuclear medicine investigations are requested by the referring physicians which are, in fact either not needed at all, or having less potential to solve clinical question or actually investigations are ill timed. These all scenarios leads to unnecessary radiation burden to patients as well as consume human, machine, time resources. Sometimes investigation request by the referring physician are merely due to lack misunderstanding of biological & physical concept of nuclear medicine.

These are actually our duties to inform, explain and educate referring physicians about these concepts. We nuclear medicine professionals should actually work as gate keeper of radiation protection measurements. That will lead to optimisation of use of radiation in medical fields for the betterment of patients care.

TAILORING VARIOUS I.V. CONTRAST CT PROTOCOLS IN PET-CT IMAGING

Rai S

A.J Hospital & Research Centre, Mangalore, INDIA

Background:

Conventionally, use of CT in PET-CT imaging was limited to attenuation correction and lesion localization. However, the need was felt to provide complete diagnostic CT information in a single PET-CT investigation and hence various contrast protocols used in CT Imaging have now been adopted in PET-CT Imaging. The modern nuclear medicine professional must be well conversant with the use of these contrast CT protocols.

Single Phase Protocol:

Acquisition of whole body contrast CT imaging is started at around 55-60 seconds post contrast injection.

Multiple phase Protocol:

Triple phase Liver Protocol

Liver Arterial phase: 15-20 seconds post injection or immediately after bolus tracking. This is phase when the contrast is still in the arteries and has not enhanced the liver.

Liver Portal Phase: 45-50 seconds post injection or 25-30 seconds after bolus tracking. This is the phase when portal vein enhancement is seen.

Whole body Venous phase: 55-60 seconds post injection or 35-40 seconds after bolus tracking whole body CT is acquired. . In this phase, the liver parenchyma enhances through blood supply by the portal vein.

Dual Phase Pancreatic Protocol:

Late Arterial phase: 35-40 seconds post injection. In this phase the normal pancreatic glandular tissue enhances optimally whereas a pancreatic malignancy does not. This phase gives good tumor to normal pancreatic parenchyma differentiation.

Whole body Venous phase: 55-60 seconds post injection whole body CT is acquired.

Dual Phase Organ-Specific Protocol:

Similar to pancreatic protocol, any organ or lesion can be evaluated for late arterial and venous enhancement which gives a measure of the tissue vascularity.

Thus, adoption of these contrast CT protocols helps us provide additional diagnostic CT information and reduces the need for patient to undergo separate multiphase or single phase contrast CT.

TOTAL BODY PET: A NEW TECHNOLOGICAL ADVANCEMENT

Singh DK

Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow (UP), INDIA

The development of positron Emission Tomography is full of technological advancement and mathematical algorithms. Although this development was initially very slow due to limited computational capability. Initially, days Positron emission radioisotopes, C-11 labeled to Carbon Monoxide study were performed using a GM counter. Although GM counter has very poor detection efficiency and insensitive especially at the high energy level, GM counter was the predominant instrument used for the external detection of gamma rays.

The development and further advancement of PET in the last five decades took place in phase manner as a result of advances in Physics, mathematics, computer, Chemistry and Modern Biology.

The first breakthrough was given by Brownell who has been working on the technique of Coincidence counting of annihilation pairs and further various attempts to improve sensitivity and resolution, different designs of positron cameras were developed.

The early system was limited by under-sampling and the lack of Attenuation Correction, later it was overcome by electric collimation, and it demonstrated the advantages of tomographic imaging.

The first Camera reported in 1963 for Brain tumor imaging, and over the next ten years, various developments were held. After the introduction of a CT scanner in it helped to propel PET into its modernization and simultaneous advancing in radiochemistry helped the rapid development of PET scanner.

Common standard PET System has evolved to provide (A). Spatial Resolution of 4-5 mm, (B). Large Field of View, (C). Three-dimensional imaging capabilities with electronic Collimation.

Since it is a trade-off between the number of detected decay events, imaging time and absorbed dose, every Clinician desired to have high SNR in the final Image, but constant on administrative activity. A further limitation is that small FOV and challenging to acquire dynamic data from all the tissue of Interest. Current PET Scanner have extremely poor sensitivity (less than 1 %) because of limited FOV and less no. of (3 to 5 %) available signal can be collected.

Total Body PET has addressed all the existing limitations. It allows maximum detection of the radiation emitted from the body. Total Body PET long FOV (200cm) leads to an approximately 40 fold increase in the effective sensitivity for imaging to the patient. The ability to acquired unique kinetic data with a total body PET scanner system and conduct research that directly coverage with the growing focus on system Medicine.

Total Body PET Scanner open the new horizon to expand current and more importantly open new translational application for PET and open the opportunities for further advancement in increase sensitivity by improving design and reducing dead space and thickness of detector material. Also, concerns inevitably focus on the ultimate cost to benefit ratio for the total Body PET imaging.

RHENIUM-188: CURRENT CLINICAL APPLICATIONS

Gupta P

All India Institute of Medical Sciences, AIIMS, New Delhi, INDIA

Rhenium is a third-row transition metal having chemical similarity with technetium due to which many technetium analogues can be labeled with Rhenium for several specific applications. The two main isotopes of rhenium that are of clinical use are Re-186 and Re-188. Simple extraction method of Re-188 from long lived Tungsten-188/Rhenium-188 generator makes it easily and routinely available enabling its more widespread use, overcoming all the procurement issues associated with Re-186. Another advantage of Re-188 is its high specific activity as compared to Re-186. Rhenium-188 finds its current clinical role in many therapeutic applications like bone pain palliation with Re-188-HEDP (first generation rhenium radiopharmaceutical) and Re-188(V)-DMSA (second generation rhenium radiopharmaceutical), labeled antibodies and peptides for tumour therapy with Re-188-RC-160, endovascular radiation therapy with Re-188 perrhenate and Re-188 MAG3 (second generation) filled angioplasty balloons to inhibit coronary restenosis following high pressure angioplasty, Re-188-HDD-Lipiodol and Re-188-DEDC-Lipiodol for non-resectable hepa-tocellular carcinoma, and Re-188 tin colloid for treatment of arthritis (radiation synovectomy). Recent research has also shown the utility of Re-188 microspheres for liver cancer and Re-188 radioactive patches for treatment of Basal cell carcinoma, Squamous cell carcinoma and Ke-loids with excellent response.

ALPHA THERAPY: NEW HORIZONS

Dash PT

Dept. of Nuclear Medicine and PET-CT, Fortis memorial research institute, Gurgaon, INDIA

Background

Men with castration resistant prostate cancer, especially those with visceral metastases and have failed second line anti androgen therapy and docetaxel chemotherapy have limited options of therapy. Targeted alpha therapy with ²²⁵Ac PSMA-617 has shown good and durable responses in most patients in many recent studies. The authors report here their initial experience with targeted ²²⁵Ac- DKFZ -PSMA-617 alpha-therapy, to analyze the therapeutic efficacy and toxicity profile, and also attempt to assess the difference in the duration of tumour control in patients with bone only metastases versus those with visceral metastases. Also, we estimated the radiation exposure to the occupational worker with pocket dosimeter during the handling of α -emitter: Ac-225, used for targeted α -therapy (TAT) of neuroendocrine tumors (NET) and castration resistant prostate cancer (CRPC) patients. The dose rates from the patients at different distances and at different time points after therapeutic injection were also evaluated.

Materials and methods: Twenty patients with castration resistant prostate cancer with progressive disease following at least one taxane based chemotherapy received ²²⁵Ac-PSMA between April 2017 and June 2019. At least 2 doses of ²²⁵Ac PSMA-617 were administered to the patients at a dose of 100 KBq/Kg Body weight at intervals of 8 weeks. Prostate-specific antigen (PSA) and blood cell count were measured every 4 wks post therapy. ⁶⁸Ga PSMA PET/CT was used for baseline staging and imaging follow-up at least 8 weeks following the last dose of ²²⁵Ac-PSMA therapy. Follow-up included the duration of PSA response and radiological progression free survival. Quality of life responses were measured at 8 weeks following the 1st dose of Ac225 therapy, subsequently at 8 weeks following each of the subsequent doses, and at 8 weeks thereafter till the date of censure/progression or death.

Radiation exposure to nuclear medicine personnel at chest and extremity levels were assessed for different tasks such as elution, dispensing, injecting and collecting blood samples etc. Radiation levels were measured at a distance of 1cm and at 1m from the patients immediately after, and at 1, 2, and 4h after the administration of ^{225}Ac -peptide.

Results: 16 of the 20 (80%) patients showed evidence of a more than 50% fall in S. PSA levels. 10 of the 16 patients showed evidence of a more than 50% fall in PSA after the 1st dose itself. The median rPFS was 6.9 months. Median survival for the overall study population at 600 days (19.7 months) follow up was 7.7 months. 9 of the 20 patients were alive at the time of censorship. The survival estimates were worse in patients with a PSA level more than 100. Relatively poorer outcomes were seen in patients with lung and liver metastases compared to bone and non-visceral involvement with a median PFS of 11.5 months in patients with bone and lymph node-only disease, 4.6 months in men with any visceral metastases with 3.7 months for those with liver metastases. The ^{225}Ac PSMA-617 therapies were well tolerated with no serious treatment emergent adverse effect. The most common adverse effect was xerostomia. All patients had an improvement in the quality of life with the principal improvements being in pain relief. There were no haematological toxicity or nephrotoxicity seen.

The external doses incurred by a radiopharmacist during synthesis, by physicians during injection, by technologists during imaging and nurses during sample collection at the chest level were measured using the pocket dosimeter and were found to be in the range of 2-7 $\mu\text{Sv/procedure}$. The extremity doses were in the range of 1-14 $\mu\text{Sv/procedure}$. The dose rate at 1m from ^{225}Ac -radiopharmaceutical injected patients immediately after therapy was in the range of 0.02-0.03 $\mu\text{Sv/MBq.h}$.

Conclusions: ^{225}Ac -PSMA-617 is a safe and tolerable treatment option for mCRPC that demonstrates marked anti-tumor activity with improvement in quality of life even in patients of metastatic CRPC who have been previously treated with taxane based chemotherapy. Significant improvements in survival and quality of life could be achieved even in patients with visceral disease who have otherwise very limited options. Further studies in a clinical trial setting are essential for further assessing the effects of this very encouraging modality. The external radiation doses to the occupational workers involved in different procedures were far below the dose limits prescribed by the Regulatory Authority (20mSv/yr).

GALLIUM-68 RADIOPHARMACEUTICALS: WHERE DO WE STAND NOW?

Rathod D

A.J. Hospital & Research Centre, Mangalore, INDIA

Gallium-68 is a promising emerging positron emitting radionuclide used in PET imaging. It is produced using $^{68}\text{Ge}/^{68}\text{Ga}$ generator. Gallium-68 has a half-life of 68 min while its parent Germanium-68 has a half life of 271 days.

Gallium-68 is most often utilized in radiopharmaceuticals for oncology diagnostics, however its potential has also been demonstrated in non-oncological imaging such as inflammation and infection.

Moreover, some therapeutic radionuclides resemble coordination chemistry of Ga(III) thus facilitating the radiotheranostic development wherein the pre-therapeutic imaging and radioligand therapy are conducted

with the same vector molecule exchanging the imaging and therapeutic radionuclides. Few clinically used ⁶⁸Ga-labeled radiopharmaceuticals include; **⁶⁸Ga-PSMA -11**: an excellent imaging agent for metastatic as well as recurrent prostate cancer overexpressing Prostate-Specific Membrane Antigen (PSMA) is type-II transmembrane protein. Its sensitivity is good even at low PSA levels and sub-centimeter sized lesions and provides a good tumor-to-background contrast; **⁶⁸Ga-DOTA-NOC / ⁶⁸Ga-DOTA-TOC/ ⁶⁸Ga-DOTA-TATE** for localization of somatostatin expressing well differentiated neuroendocrine tumors; **⁶⁸Ga- DOTA-exendin-4** for imaging of GLP-1R-expressing tumors located on beta cells which are overexpressed on insulinomas, which are insulin-secreting neuroendocrine tumors; **⁶⁸Ga-Pentixafor** for imaging of chemokine receptor CXCR4 expression in multiple myeloma, lymphoma and solid tumors; **⁶⁸Ga-DOTA Substance P** for glioma imaging by targeting NK-1 receptor system; ⁶⁸Ga- Citrate for infection imaging; **⁶⁸Ga-DOTAZOL/⁶⁸Ga BPAMD** for evaluation of skeletal metastases. The advantages of this new bone imaging PET tracer are the very high target to soft tissue ratio and fast clearance. **⁶⁸Ga- Fibroblast Imaging** uses quinoline-based PET tracers that act as Fibroblast activation protein (FAP) inhibitors which are overexpressed in cancer-associated fibroblasts of several tumor entities. It has demonstrated promising results preclinically and in a few clinical cases. There are several other ⁶⁸Ga radiopharmaceuticals with good potential for clinical translation that are currently under research.

SCIENTIFIC SESSION 2: Evolving landscape of radiation detection techniques and instrumentation

INTRINSIC FLOOD FIELD UNIFORMITY-Tip and Trick

Radhakrishnan ER.

KMCH, Coimbatore, INDIA

The gamma camera is the most widely used imaging device in nuclear medicine since its invention by Hal O. Anger. The gamma camera accurately measure the distribution of radioactivity within the human body which has localized in an organ of interest and the production of images with the best diagnostic quality. The performance parameters are the common part of a routine gamma camera quality assurance (QA) programme.

The purpose of QA is to detect changes in the performance of a gamma camera system that may adversely affect the interpretation of the result. There are many factors that contribute to the final image quality, Viz flood field uniformity, resolution, linearity, the hard copy devices etc.

Flood field Uniformity test is the most common gamma camera QA procedure, suggested by the National Electrical Manufacture Association (NEMA) , the International Atomic Energy Agency (IAEA) and the International Electro technical Commission (IEC).

The Intrinsic Flood filed Uniformity (IFU) test of a gamma camera is a measure of the response of the gamma camera to a uniform flux of radiation from a point source when the collimator is removed.

There are two type of IFU (1) intrinsic calibration and (2) intrinsic verification. Many parameter will effect the IFU namely, point source volume, activity, room temperature, relative humidity, power supply to the PMT, background radiation, photo peak setting, distance from the source to the detectors & counts collected. For an ideal SPECT gamma camera the non uniformity should be less that $\pm 5\%$

ADVANCEMENTS IN MEDICAL CYCLOTRON AND ITS FUTURE

Aheer D

Army Hospital Research & Referral, New Delhi and Seimens Healthineers, INDIA

A cyclotron is a type of particle accelerator, the most extensive and complicated apparatus constructed & invented by Ernest O. Lawrence between 1929–1930 for which he was honored with Nobel prize in 1939. It occupies an exceptional position in nuclear physics and artificial radionuclide production. A cyclotron accelerates the charged particle based on the Lorentz force principle. The journey of cyclotron started from a 4-inch(1MeV) small sample model to advanced 1000 MeV Cyclotron. Cyclotron is not a simple electrical instrument, it consists of assemblies like Ion source, RF system, Magnet, Vacuum system, extraction, target assembly etc. Cyclotrons are useful in particle research and also to produce medically useful artificial radionuclides having a short half-life of 2 minutes (oxygen 15) to the long half-life of 270.8 days (Ge 68) and activities of several GBq. Advancements in the Medical cyclotron include fixed energy up to 70 MeV, Fixed energy to variable energy, with AVF and Deep Valley design, superconducting magnets, Bunkers replaced with Self-shielded cyclotron reduced the space requirement, positive Ion cyclotron modified to Negative ion source increasing beam efficiency from 75% to 100%, Dual Bombardment and multiple extraction beam port leading to high yield and production of multiple radionuclides simultaneously. The Development of targets from gas, solid to liquid making radio-chemistry preparations simpler to meet the commercial requirements. Latest advancements available from the industry is a one-stop solution right from F18 production, FDG synthesis, Quality assurance & dispensing at a single click.

TECHNOLOGICAL DEVELOPMENT IN RADIATION DETECTORS

Tayal S

Kailash Cancer Hospital & Research Centre, Muni Seva Ashram, Goraj,Vadodara, Gujarat

One of the important parameters, when working in a radiation area is the quantitative evaluation of amount of radiation. This quantification is achieved with the help of various radiation detectors. Most of the oldest radiation detectors were based on the effects produced by a charged particle passing through a gas with primary modes of interaction involving ionization and excitation of gas molecules along the particle track. With the passage of time, there has been great advancement in radiation detection technology and currently most of the gas-based detectors are being replaced by solid state semiconductor or plastic scintillators due to low cost and ease of operation. To enlist a few of the major breakthrough we have now semiconductor LiInP2Se6 based material for the direct detection of thermal neutrons at room temperature, the EXPLORER (Extreme Performance Long axial Research scanner) a 194-cm-long PET/CT scanner which is a three-dimensional medical imaging device that can cover the entire human body at once. with increased sensitivity, followed by the Gas Electron Multiplier (GEM) constituting a powerful addition to the family of fast radiation detectors; originally developed for particle physics experiments and the WELL detector, a new type of position-sensitive gas proportional counter produced using advance Printed Circuit Board (PCB) technology.

NUCLEAR MEDICINE TECHNOLOGY: PAST, PRESENT AND FUTURE

Kale C

Kokilaben Dhirubhai Ambani Hospital & Research Center, Mumbai, INDIA

Nuclear Medicine is a clinical medical specialty that uses radioactive tracers to study physiologic, biochemical and cellular processes for diagnosis, therapy and is exploring research applications as well. The practice of it has markedly changed in last few years. The procedures which were common earlier, are no longer in practice. It is gradually evolving into molecular imaging.

Radiopharmaceuticals : The radiopharmaceuticals(Rps) available earlier were few, and many of the common procedures performed earlier are no longer offered eg renal scans with ^{131}I -orthoiodohippurate; lung scans with ^{133}Xe , and thyroid imaging with ^{131}I . A significant aspect of nuclear medicine that has disappeared from the repertoire is radioimmunoassay (RIA). Various new procedures and Rps have been incorporated like TRODAT and Hynictoc labeled with $^{99\text{m}}\text{Tc}$. While $^{99\text{m}}\text{Tc}$ and F18-FDG remains the workhorse Rps for SPECT and PET respectively, several new Rps in use are $^{99\text{m}}\text{Tc}$ UBI(Ubiquitin) to detect infection, ^{13}N ammonia, for cardiac PET, ^{18}F -FET, ^{18}F -DOPA, ^{18}F -MISO, ^{11}C methionine, F18-PSMA(DCFYL) for cancer detection or neurological purpose. Availability of ^{68}Ga -Ga 68 generator made easy to synthesize ^{68}Ga dotanoc and ^{68}Ga -PSMA. A lot of research and preclinical studies are going on and soon many more rps labeled with Ga 68 and other r.n will be available.

Instrumentation: From rectilinear scanners to today's SPECT camera and development of PET scanner, it's a long journey and, with the recent addition of CT, we are able to create co registered anatomic and functional images.

- Both SPECT-CT and PET-CT modalities have undergone technological sophistication over last few years.
- Next-generation SPECT cameras with cadmium zinc telluride (CZT) detectors lower patient radiation dose and shorten exam times.
- In future CZT can be used for whole body imaging replacing conventional NaI crystal gamma camera.
- Digital PET CT offer twice the sensitivity, quantitative accuracy, and improved resolution.
- PET-MR and Whole body PET CT(uExplorer) may change nuclear medicine scenario in future.
- Use of PET-CT scanning for radiotherapy planning has rapidly increased.

Therapy and Dosimetry: A number of radionuclides, such as iodine-131 (^{131}I), phosphorous-32 (^{32}P), strontium-90 (^{90}Sr), and yttrium-90 (^{90}Y), have been used successfully for the treatment of many benign and malignant disorders.

Recently, introduction of new radionuclides and radiopharmaceuticals have significantly improved the treatment and management of metastatic bone pain and neuroendocrine tumors and other malignant or non-malignant tumors .

- o PRRT (Peptide Receptor radionuclide Therapy) uses ^{90}Y DOTATATE/toc, ^{177}Lu DOTATATE to treat NET.
- o Radium-223 RaCl_2 an alpha emitter is a calcium mimetic, target areas of osteoblastic metastases, without having significant impact on bone marrow.
- o ^{177}Lu PSMA for Prostate cancer
- o TAT targeted alpha therapy, ^{125}Ac , ^{223}Ra , Bismuth for treating micro metastases or single cell leukemia.

Dosimetry : Calculations of absorbed dose to individual administered with Rps can be done by method MIRD. Recent advances in imaging technology (e.g (SPECT) and (PET) image-based dosimetry) allow precise determination of the dose absorbed (accurate quantification) to the targeted tumors and critical organs for pre-therapeutic treatment planning (individual patient-based). Image-based dosimetry prior to targeted radionuclide therapy will be an essential part soon.

“Theranostic is a combination of therapeutic and diagnostic using the same molecule or similar molecules labeled with different radioisotopes or same radioisotopes with different dosages. ^{131}I and $^{99\text{m}}\text{Tc}$ is one such pair. ^{68}Ga and ^{177}Lu is another example. Radionuclide that emit photons that can be imaged as well as particles that can be used for treatment are under development.

There is tremendous scope for research in Nuclear Medicine. Many preclinical and clinical studies are under evaluation. We are now expecting exponential growth and introduction of many newer and better studies to help making diagnosis and treatment with excellent results in future.

CYCLOTRON BASICS AND ITS OPERATIONS

Kumar R

AIIMS, NEW DELHI, INDIA

Cyclotron is a type of particle accelerator invented by Ernest O. Lawrence in 1930 at the University of California, Berkeley and patented in 1932. Lawrence was awarded the 1939 Nobel Prize in Physics for this invention. It is based on a combination of RF acceleration and bending of charged particles in a magnetic field. This way the same electrode is used over and over again to give acceleration to the particles. Lawrence built the first cyclotron in 1931 and it produced protons of 1.25 MeV. In a conventional cyclotron the charged particles move in two semicircular metal containers called dees (because of the D shaped electrodes). In most of the modern medical cyclotrons there are four gaps with four pie shaped dees instead of two. The particles pass through the same acceleration gap many times with increasing radius before they acquire the desired energy. The entire accelerating system is maintained at high vacuum (10^{-6} to 10^{-8} Torr) and the dees are housed in a vacuum chamber. Hydrogen gas is passed through an arc current to produce the ion source for acceleration in the cyclotron. The ion source is pulled towards the centre of dee structure by applying a positive bias voltage. A high voltage ($>36\text{ kV}$) is applied to the dee structure with the help of an oscillator. The ion located at the center is thus attracted towards a dee that happens to be at opposite potential at that particular moment. As the magnetic and electric fields (in dees) in the cyclotron are at right angles to each other the ion beam moves in a circular path inside the hollow dees. In present scenario negative ion cyclotron accepted everywhere in the medical field.

Parts of Cyclotron

Ion source system

Ion source is axially mounted and produces a negative ion. The ion source contains two tantalum cathodes located equidistant from an anode. A potential gradient between the cathodes and anode ionizes the hydrogen gas supplied to this region of the ion source. The ionized gas forms the plasma from which negative ions are extracted, it is pulled with a positive bias voltage for acceleration.

Radio frequency (RF) System

The RF system is the most important and sensitive components of the cyclotron, which supplies an alternating high potential difference to the dee structure, which in turn imparts energy to the H⁻ ions. The structure is composed of four pie-shaped electrodes, which are mounted in the magnet valleys and supported by dee-stems extending down from mounting plates at the top of the magnet yoke.

Vacuum system

The vacuum system consists of a vacuum chamber contained within the magnet yokes. There are mechanical and diffusion pumps, which help both in creating and maintaining, desired vacuum in the tank by constantly removing gas from the ion source and other particles from surfaces inside the vacuum chamber. The vacuum is necessary in the main acceleration region of the cyclotron to maintain the desired acceleration to the ion beam without any loss of ions and their energy.

Magnet system

The magnet system provides the bending force that confines the beam to the circular orbit centered between the upper and lower magnet poles. The magnet system includes the upper and lower magnet yokes with integral pole pieces, the magnet coil, and the magnet power supply. Applying current to the coil mounted between the upper and lower magnet yokes energizes the magnet. The field generated by the magnet coil is concentrated in the small gap between the upper and lower poles where the beam is accelerated. Each magnet pole consists of four pie shaped wedges extending from the yoke toward the opposing pole. These pie-shaped wedges are called hills. Each of the recessed regions between adjacent hills is termed a valley region.

Target system

The target system consists of target body, target changer, collimator assembly and target material. The target body holds the target material during irradiation and is usually made of silver for ¹⁸F production. Titanium and Niobium are treated as good target body for better yield. During target irradiation the beam passes through a vacuum isolation window, helium cooling space, the target window and finally the target material. The target changer assembly controls the movement of the selected target into bombardment position and accommodates as many as 8, 4 or 2 targets in RDS system. The collimator, and a carbon disk of less than 1 cm central hole, is mounted at the exit before the vacuum window inside the cyclotron.

Extraction system

The extraction system consists of one, or two beam extractors that intercept the accelerated beam with a carbon foil, which strips the loosely bound electrons from the hydrogen nuclei. Once stripped of electrons, the positively charged beam arcs outward toward the exit port and target. The dual beam option allows two extractor foils to be moved into the beam path, thus splitting the beam between two targets.

Basics Principle of Cyclotron

A cyclotron accelerates charged particles outwards from the center along a spiral path. The particles are held to a spiral trajectory by a static magnetic field and accelerated by a rapidly varying (radio frequency) electric field

A cyclotron accelerates a charged particle beam using a high frequency alternating voltage which is applied between two hollow "D"-shaped sheet metal electrodes called "dees" inside a vacuum chamber. The dees are placed face to face with a narrow gap between them, creating a cylindrical space within them for the particles to move. The particles are injected into the center of this space. The dees are located between the poles of a large electromagnet which applies a static magnetic field B perpendicular to the electrode plane. The magnetic field causes the particles' path to bend in a circle due to the Lorentz force perpendicular to their direction of motion.

If the particles' speeds were constant, they would travel in a circular path within the dees under the influence of the magnetic field. However a radio frequency (RF) alternating voltage of several thousand volts is applied between the dees. The voltage creates an oscillating electric field in the gap between the dees that accelerates the particles. The frequency is set so that the particles make one circuit during a single cycle of the voltage. To achieve this, the frequency must match the particle's cyclotron resonance frequency

$$f = \frac{qB}{2\pi m}$$

Where B is the magnetic field strength, q is the electric charge of the particle and m is the relativistic mass of the charged particle. Each time after the particles pass to the other dee electrode the polarity of the RF voltage reverses. Therefore, each time the particles cross the gap from one dee electrode to the other, the electric field is in the correct direction to accelerate them. The particles' increasing speed due to these pushes causes them to move in a larger radius circle with each rotation, so the particles move in a spiral path outward from the center to the rim of the dees. When they reach the rim a small voltage on a metal plate deflects the beam so it exits the dees through a small gap between them, and hits a target located at the exit point at the rim of the chamber, or leaves the cyclotron through an evacuated beam tube to hit a remote target.

SYMPOSIUM: Inter-professional Education Approach to Health and Patient Safety

IMPORTANCE OF INTER PROFESSIONAL EDUCATION AND PRACTICE IN MEDICAL DIAGNOSTICS AND THERAPEUTIC HEALTH CARE DELIVERY

Ramprasad V P

MFILPE faculty, MAHE, MANIPAL, INDIA

The aim of this presentation is to address the issues and concerns regarding Inter Professional Education and Collaboration in Medical Diagnostics and Therapeutic Health Care Delivery.

Establishing Inter professional Education and Collaboration as one of the cornerstone of clinical practice not only takes time but also requires an equal amount of perseverance and dedication from the Medical diagnostics and Therapeutic Health Care Delivery personnel.

BACKGROUND

Inter professional education can be defined as occasions when two or more professions learn about, from, and with each other to improve collaboration and the quality of care. Personnel from Medical Diagnostics and Health care Delivery systems should also take part in Inter professional education and collaboration as there is a clear correlation between systemic health and Medical Diagnostics and Therapeutic Health Care delivery. Inter professional Education is the framework on which a model needs to be elaborated upon in order to provide a comprehensive and wholesome treatment to the public.

Adopting these practices will teach us many skills like teamwork, communication, professionalism and also the confidence to manage all patients. It also strengthens the medical system and improves the treatment for the patient and is based on a healthy understanding and respect for a multi-disciplinary approach while enabling sharing of professional perspectives and resources.

There are numerous advantages of Inter professional Education and Collaboration such as : Promotes professionals to work in diverse situations, exposing them to a variety of patients; Sharpens a professional's critical thinking skills that enable to serve in multidisciplinary healthcare teams; Encourages everyone to develop understanding and respect for the other healthcare professionals and to complement each other to act as a single, working unit; Lays emphasis on evidence-based care, stressing on risk assessment and its subsequent management. Also helps in improving the professional's knowledge, attitude and confidence in working with such cases.

The practice of Inter professional Education and Collaboration is a very complex one, but at the heart of it, lie four very basic principles.

1. Respect for Inter professional Practice.
2. Responsibilities of a professional working in a multidisciplinary team.
3. Effective communication between the members of the team.
4. A collective effort by the group.

Such a team, should work in absolute cohesion so that errors are avoided and there is establishment of a common goal. Each member of the team should acknowledge the professional prowess of the other members as well and whatever decision is taken by the team should be a unanimous one in order to provide the best possible treatment for a patient. Eventually, the practice of Inter professional Education and Collaboration will not be limited to just being learnt in classrooms but will be practiced in clinical scenarios with enhanced efficiency, and we need to be prepared to receive it appropriately.

MEDICATION SAFETY- AN IPE/IPP APPROACH

Devi ES

MCON, MAHE, Manipal, INDIA

In the medical world today, drugs are strategic health care resources. The major roles of the health care professional is to prescribe, dispense and administer medication. Understanding the pharmacodynamics and pharmacokinetic,

their dosages, action mechanism, possible side effects and specific educational responsibility plays a vital role in preventing adverse events and reactions. Pharmacology subject is taught in the undergraduate program but emphasis is placed on theoretical and not applied pharmacology. Drug dosage calculations are crucial issues in errors and medication comes not in the same quantity made for the right prescription. Underdoing and overdosing are frequent clinical issues with error which may or may not be reported and rationalized prescription of medication is a vital component in health care for better compliance. Health care system needs drug safety monitoring system and requires placement of standard protocols and procedures that are a must in the clinical scenario in regard to medication of various forms and strengths. Despite all efforts, a non-punitive form of reporting need to be encouraged as nurses are many time held accountable for the errors in patient care. To closely work with the pharmacy practice team. Medicine and nursing to analyze and deliver drug safety awareness among the health care professionals is the utmost responsibility of Interprofessional education and practice.

Objective of the session

- To encourage positive attitude towards Interprofessional education and practice among health sciences professionals for patient safety and quality care
- Why IPE/IPP in medication management?
- Orient students towards error free prescription
- Safer approach to medication dispensing
- Rights of patient in medication administration
- Legal liabilities in errors
- Aptitude skills for reducing errors in calculation

IPE/ IPP team Formation

- Medicine
- Pharmacology/ pharm D
- Nursing
- Allied Health sciences

Medication errors

- Recent Johns Hopkins study claims more than 2,50,000 people in the U.S. die every year from medical errors. Other reports claim the numbers to be as high as 4,40,000.
- Medical errors are the third-leading cause of death after heart disease and cancer.
- Advocates are fighting back, pushing for greater legislation for patient safety.
- Medication errors in top 10 killers (WHO, 2011)
- Medication errors- Incidence, causes, prevention strategies in Indian Care setting (H Patel et al, JSS Mysore, India, 2013)

Complex health care system

- Medicine used to be simple, ineffective and relatively safe; now it is complex, effective and potentially dangerous

IPE/ IPP team formation/ roles and responsibilities

A. Errors in prescription errors

Illegible handwriting leading to-

- wrong indication
- Wrong medicine
- Wrong dose

Types of prescribing errors	Example
Wrong dose	A 3 year old patient weight 10 Kgs was prescribed Ceftriaxone 250 mg IV BID instead of the correct dose of 500mg IV in the treatment of meningitis
Wrong route	Diclofenac sodium 75 mg was prescribed to be given through IV instead of correct route of administration
Incomplete prescription	Paracetamol suppositories missing essential information about dose, frequency and route of administration
Inappropriate indication	Both Dexamethasone 8mg IV stat and dexamethasone 8 mg IV QID for 3 days were prescribed for the treatment of severe Croup, while dexamethasone 8mg QID for 3 days was unnecessary
Wrong dose forms	Amoxicillin syrup 125mg/5ml was prescribed instead of the correct dosage form is suspension
Wrong frequency	Ampicillin 30 mg intravenous was prescribed four times a day instead of the correct frequency of twice a day for a day old baby

Dispensing errors – Possibilities

- Handwriting: Poorly written, illegible Prescriptions
- Drug with similar names
- Zeros and Decimal Points
- Metric and Apothecary systems
- Abbreviations
- Poorly written or incomplete prescriptions
- Workload, Fatigue and stress.
- Interruptions and distractions
- Miscommunications
- Poor design of work place and workflow pattern

Pharmacy's roles and responsibilities

- Ensure correct entry of the prescription
- Confirm that the prescription is correct and complete
- Beware of look-alike, sound-alike drugs (LASA)
- Be careful with zeros and abbreviations. ...
- Organize the workplace
- Reduce distraction when possible
- Focus on reducing stress and balancing heavy workloads
- Take time to store drugs properly
- Check prescriptions thoroughly
- Patient counselling

Nurses' roles in medication administration

- Ensure the rights of medication administration
- Follow proper medication reconciliation procedures.
- Double check—or even triple check—procedures.
- Have the physician (or another nurse) read it back.
- Consider using a name alert.
- Place a zero in front of the decimal point.
- Document everything.
- Ensure proper storage of medications for proper efficacy.
- Learn your institution's medication administration policies, regulations, and guidelines.
- Consider having a drug guide available at all times.

Patient's rights: discussion

Take home message

- Prescription errors & Medication errors are major problem but underreported
- Medication reporting system & ADR reporting system & education (IPE) can help in reducing problem
- Team members' roles and responsibilities to be clear and concise
- Good IPR and communication skills are key to reduce errors

Safety attributes for planning the radiation emergency response for handling unsealed radiation sources

D'SOUZARN

MCHP, MAHE, INDIA

Radiotherapy is a modality of medical treatment using ionizing radiation such as gamma rays (emitted from radioactive source), high energy X-rays (generated by medical accelerator) and particle therapy using Hadron Therapy Accelerator (e.g. Proton/ Carbon Ion based). There are two types of radiation source namely sealed sources and unsealed sources. Radiation sources are widely used in medicine, industry, and agriculture. Nuclear Medicine is the specialty that utilizes unsealed radioisotopes in the form of radio-pharmaceuticals to investigate disorders of anatomy, physiology and patho-physiology for diagnosis and/or treatment of diseases. Radioisotopes in unsealed form used to carry out diagnostic and therapeutic operations in nuclear medicine practices have a potential for radiation contamination and exposure. Therefore, adequate care in ensuring safe handling of radioisotopes is required to be taken while carrying out Nuclear Medicine procedures. Radiation accidents which can commonly be occurred in nuclear medicine facilities are spillage of radio-pharmaceuticals, mis-administration of radiopharmaceuticals to patient, and loss of sources in the department or in transit. Accidents cause personnel exposure, internal and external contamination. So RSO and License must prepare an emergency response plan as well as Emergency Response Committee which includes NMP, RSO, Physicist, Lab Assistant, Administration in charge and Electronics Instrumentation expert as members. The incident reports of the emergencies must be documented, submitted to AERB and the immediate actions must be carried out as per the safety guidelines given by the regulatory body.

RADIATION EMERGENCY HANDLING IN NUCLEAR MEDICINE AND PREPAREDNESS

Tandon P

TSS, Radiological safety division, Atomic Energy Regulatory Board, Govt. Of India, MUMBAI, INDIA

Introduction: In nuclear medicine, large amounts of unsealed radionuclides are used for diagnosis of diseases and in the treatment of cancer and abnormalities. Any error, carelessness, absence/failure of safety facility/equipment, may lead to an accident or mishap. An accident is an unintended event or mishap, the consequences of which are not negligible from the radiation protection or safety point of view. It is an unplanned abnormal event leading to loss of control over the source of radiation with actual or potential consequences for person's safety and /or impact on the environment. Some of the examples of emergency situations that may arise in nuclear medicine department are:

- Spillage of radio-pharmaceuticals,
- Mis-administration of radio-pharmaceuticals to patient, and
- Loss of sources in the department or in transit.

An accident in a nuclear medicine laboratory may cause personnel exposure, internal/external contamination or both. Hence, it is essential that a sufficient level of emergency preparedness be ensured in the department. For this purpose, the licensee and RSO together should devise and implement an emergency response plan. Use of possible means, methods and facilities available in the department should prevent the accident. Observing simple and minor practices can prevent a number of accidents. There are two other types of mishaps that can be envisaged in nuclear medicine and are beyond the control of the radiation worker. These are:

- Vomiting of radio-pharmaceutical by the patient,
- Death of a patient with administered radio-pharmaceuticals in the body.

While working with radio-pharmaceuticals, spillage can take place due to tilt of vial containing radio-pharmaceutical, leakage from the syringe or splash of liquid. Some time, vomiting of administered radio-pharmaceutical by the patient results in spread of radioactivity.

General Methods of Prevention of Accidents:

The accident of spillage and mis-administration can be avoided by preparing Standard Operating Procedure (SOP) of practice in the department, putting it in practice and educating the staff by the RSO in radiation safety of personnel, patient, members of public and the environment. Effort should be taken to inculcate safety culture in the department which is one of the most important thing today apart from any other procedures being followed in the department. The RSO should identify emergency situations and assess the causes and probabilities of occurring accidents in critical and normal situations in the department. Appropriate counter measures should be planned for each type of situation to avoid accidents. Any accident, happening in the department should be attended to immediately and reported to other staff members, head of the institution and AERB by the RSO. In addition, the following steps should also have followed in general.

- There should be adequate number of trained staff available in the department to carry out the emergency plan,
- The personnel/staff should be instructed to exercise care in respective areas to avoid situations that may lead to an accident,
- All radiation monitoring, measuring instruments and safety devices should be routinely checked and kept in working condition. Handling equipment e.g. tongs, forceps, etc., should be kept in ready access,
- A proper inventory of radioisotopes received, used, in stock and disposed off should be maintained.

Emergency Response Team:

Handling of emergency involves variety of actions and involvement of persons in different fields. Thus, it is a teamwork. In many medical institutions, a team of experts, sometimes referred as the Emergency Response Committee, is formed. Each member of the team or committee is assigned specific responsibilities. These persons should be familiar with the workings in the institution so that co-ordination among them can be assured. The Emergency Response Committee should consist of the following officials:

- Authorized Nuclear Medicine Physician
- Physicist
- Laboratory assistant
- Radiation Safety Officer (RSO)
- Administrative personnel
- Electronic instrumentation expert
- Emergency Director

Death of Patient Administered with Radiopharmaceuticals:

In case of death of a patient with therapeutic quantity of radio-pharmaceuticals in the body, the body should be released to relatives only when the levels of activity in the body is within the permissible limit for cremation, burial, post-mortem or balming, prescribed by AERB. If the level of activity is higher than the prescribed limits, the body should be kept in morgue for decay of the activity and should be released when the levels come down to the prescribed limits, which will take lot of time and not the practical solution. If the-situation demands immediate release of body, the organs with accumulated activity be removed before the release, again the same may be possible only when the death takes place immediately after the administration of the activity else it would not be an option because the activity with the elapsed time got distributed in the whole body. Further, it should be ensured that the amount of activity, even after removal of vital organs containing radioactivity, at the time of release of body does not exceed the limit. The removed organs with radioactivity should be disposed as per the disposal rules.

Conclusion: Modern medicine would be impossible without ionizing radiation. Diagnostic and therapeutic nuclear medicine are a few of the technologies that have revolutionized medical diagnosis and treatment. Radiation's benefits for human health can be measured in thousands of lives saved and even greater numbers of persons whose quality of life has been improved each year by these technologies. Even though the use of ionizing radiation in medicine offers enormous benefits, however, it also poses potential risks to patients, medical personnel, and the general public. Thus, apart from its safe use on patients, the risk potential associated while handling should be envisaged and handling of the same should have been appropriately documented and implemented.

SCIENTIFIC SESSION 3: Quality Considerations in Education and Clinical Practice

FUTURE OF NUCLEAR MEDICINE EDUCATION AND RESEARCH IN INDIA: PROSPECTS AND CHALLENGES

Dhawan DK,

Department of Biophysics, Centre for Nuclear Medicine and Medical Physics at Panjab University, Chandigarh, INDIA

The talk will focus on the status of nuclear medicine education, research and training in India. There will be deliberation on the developing status of nuclear medicine in India, the role of nuclear medicine physicists, academicians and radio-pharmaceutical scientists in promoting clinical service, education and research in India.

NUCLEAR MEDICINE PHYSICS: PROSPECTS OF EDUCATION IN USA

Relan NK,

Stony Brook University Medical Center, State University of New York

Medical physics covers four areas of specialization: nuclear medicine physics, diagnostic radiologic physics, radiation oncology (therapeutic) physics and medical health physics. Clinical medical physicists work with radiations and/or radiation producing devices and are responsible for safety and quality of imaging and therapeutic technology. The advances in these technologies continue to increase year after year. There has been a strong interest among several organizations to standardize the medical physics curriculum and promote a consistent quality education and training of clinical medical physicists who play an important role in healthcare. The focus of this talk will be to discuss an overview of medical physics and particularly nuclear medicine physics education and training in USA.

IMPORTANCE OF QUALITY CONTROL IN NUCLEAR MEDICINE

Kheruka SC

Department of Nuclear Medicine, SGPGIMS, Lucknow (UP)

Nuclear medicine is critically dependent on the accurate, reproducible performance of clinical radionuclide counting and imaging instrumentation. Quality control (QC), which may be defined as an established set of ongoing measurements and analyses designed to ensure that the performance of a procedure or instrument is within a predefined acceptable range, is thus a critical component of routine nuclear medicine practice. An extensive series of parameters has been developed over the years for acceptance testing and performance characterization of γ -cameras, SPECT and PET scanners, and other nuclear medicine instrumentation. And detailed data acquisition and analysis protocols for this purpose have been promulgated by the National Electrical Manufacturers Association (NEMA), the American Association of Physicists in Medicine (AAPM), IAEA, IEC and other regulatory, advisory, and professional organizations.

Proper record keeping greatly facilitates detection of gradual deterioration of performance over an extended period of time, by analyzing the results for degradation and initiating corrective action when necessary.

A baseline set of quality control results should be recorded, after a thorough evaluation of the system at installation and acceptance testing, to serve as a reference for the life of the equipment. These can be used as a basis for developing detailed protocols for individual systems and models of equipment.

As advances in medicine occur at a rapid rate, the review and update of guidelines, such as these, should take place at regular intervals and should be considered to be part of the quality assurance process.

SCIENTIFIC SESSION 4: Research Towards Technological and Clinical Advancement in Nuclear Medicine

TRENDS IN THE USE OF RADIOISOTOPES IN NUCLEAR MEDICINE AND THE VITAL ROLE OF PHYSICS

Venkatesh M,

Retired-Director, IAEA

The field of nuclear medicine, which has a long history of more than seven decades, has grown along the path, with several spurts of growth along the way, owing to the availability of new radiopharmaceuticals – new radioisotopes as well as new targeting molecules. For example, the easy and affordable availability of F-18 around the end of last century (although F-18 was one of the radionuclides proposed and studied much long ago) along with the spectacular results of the F-18 labelled glucose; and the research on bio-active/ cellular binding peptides such as somatostatin followed by

The research to develop new radiopharmaceuticals continues with zeal, with the availability of powerful affordable cyclotrons, the unique unequivocal role of nuclear medicine in targeted therapy, availability of a range of therapeutic particle emitting radionuclides (such as radiolanthanides, Y-90, alpha emitters etc.) and other factors such as the improved quality of patient management with fusion imaging and accurate dose calculations.

Between the lab bench to the bedside of the patient, for every new potential radiopharmaceutical, a series of studies to prove the efficacy and usefulness need to be carried out, which takes a long time; and here, the role of radiation/medical physics is a crucial one. The unambiguous proof that the nuclear medicine procedure using the specific radiopharmaceutical is beneficial to the patient, relies on many factors, among which the dose calculations are very important.

In this context, the increasing practice of 'Theranostics' (using a pair of radionuclides either of the same element or of similar chemical properties for diagnosis and therapy, in order to be able to perform accurate dosimetry, which although has been practiced since long ago albeit not under the name of 'theranostics', has received a lot of attention with the availability of a wide range of radionuclides, both for diagnosis, especially for PET imaging and for therapy), is very relevant for the role of radiation/medical physicists. In addition, accurate dosimetric calculations when multiple radionuclides (for example, as a mixture of Re-188 and Re-186) are administered, would enable larger scope of therapeutic radiopharmaceuticals application. Another area that could benefit from the contributions of dosimetric calculations, is in the new methods of producing well known radionuclides such as Tc-99m (which witnessed a huge shortfall during 2007-2010 periods, and still is a focus of many discussions). The direct production of Tc-99m using cyclotrons has received much attention and the uncertainties regarding the radionuclidic impurities and their contributions towards patient dose are still points of concern and debates. Synergistic working of all branches of specialties related to nuclear medicine, lead to new very effective patient care and deserves encouragement.

AN EPIGENETIC CONNECTION TO OFF TARGETED EFFECTS OF RADIATION – RELEVANCE TO ESTIMATION OF POTENTIAL RISK

Chadha V,

Nuclear medicine at Institute for Emerging Areas in Science and Technology, Panjab University, Chandigarh, INDIA

With advancements in Ionizing radiation (IR) based diagnostic and treatment modality, the risk of radiation treatment-related complications is becoming a growing problem. It is well known that ionizing radiation (IR) causes reactive oxygen species (ROS) induced tumor cell destruction and the ROS so generated can create serious havoc if goes unchecked which ultimately results in excessive cell death. Like for targeted effects, redox mechanisms play a key role also in off-target effects (bystander effects, abscopal effects) through transmission of ROS and reactive nitrogen species (RNS). IR-induced genome instability has been well-documented in directly exposed cells as well as in distant 'bystander' cells. The mechanisms by which it arises remain obscure and, recently these have been suggested to have epigenetic connections particularly with regard to conventional radiotherapy. However, there is a lack of evidence with regard to the epigenetic changes at off targeted sites following radionuclide therapy. So, investigation of the origin, propagation and other associated cues involved with these localized and systemic side-effects is of utmost importance in order to make radionuclide therapy more effective and to enhance its scope as a neoadjuvant therapy. Three major epigenetic phenomena for maintaining IR-mediated effects include DNA methylation, histone modifications and small RNA-mediated silencing. Since, epigenetic alterations are reversible in nature therefore future studies shall focus on investigating the phenomena occurring at the interface of the radionuclide and the nuclear material of cells and consequent epigenetic changes which may give crucial clue about its role in causing persistent side effects in patients who undergo radionuclide therapy. Further, the mode of systemic spreading of radiation induced damages to the distant sites via epigenetic changes can help in developing strategies and exploiting the role of newer epigenetic targeted drugs to yield long term beneficial effects.

QUALITY MANAGEMENT AT THE DIVISION OF HUMAN HEALTH, IAEA- BRIEF

WAHAB A,

International Atomic Energy Agency (IAEA), Vienna, Austria.

As an international organization, under the auspices of the United Nations, the International Atomic Energy Agency strives to enhance and promote nuclear technology in peace, health, and development.

The Division of Human Health lies on four main pillars delivering on goals pertaining to medical and scientifically rigorous education, clinical research, services, and Quality Management (QM). Ensuring educational, research, and service delivery aims are effective requires strong and concurrent QM processes. QM includes all the activities that organizations use to direct, control, and coordinate quality. These activities include formulating appropriately measurable objectives and outlining quality policy to be able to execute efficient outputs.

Effective QM entails competent planning, control, improvement, and assurance systems. The IAEA finds it imperative to deliver on accountable quality as the provision of equitable and good clinical services is dependent on high quality clinical practice. Providing the best possible service, at the lowest possible risk, and at adequate costs to all stakeholders, including the environment, is enabled using QM systems that ultimately allow for a healthier and satisfied populous.

Radiation Medicine facilities can demonstrate the levels of patient care they provide by following a process of self and external evaluation, and show a commitment to quality care with continuous and systematic processes of internal and external audits. The IAEA's QUANUM project aims to help Member States to implement QM systems within their clinical, technical, radiopharmaceutical, medical physics, and radiation safety procedures. The multidisciplinary contributions that fulfil the goals of the IAEA's Division of Human Health are held to high standards and are evaluated using the QUANUM checklist, ultimately compiling a comprehensive overview of inputs, processes, outputs, and outcomes. With 73 audits in 36 countries completed thus far, the Division is consciously acting on quality recommendations while encouraging and supporting Member States to do so also.

RADIOSYNTHESIS, STANDARDIZATION OF 11C-METHIONINE USING TWO DIFFERENT PRECURSORS AND PET IMAGING CHARACTERISTICS IN GLIOMA.

Kumar P,

Department of Neuroimaging and Interventional Radiology (NIIR), National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru, Karnataka, India.

Introduction- Dynamic imaging in Positron emission tomography (PET) allows to study diagnose metabolic changes in the human body. 11C-MET has gained clinical significance as methionine uptake has been identified as one of the critical factors in tumor growth.

Objective: To synthesize 11C-MET using two different precursors and study the image characteristics.

Methods: 11C-MET was synthesized using the standard method in FX2C module where 11CO₂ was trapped and converted to 11C-CH₄ which further undergoes iodination at high temperature to form 11C-CH₃I (methyl iodide). 11C-CH₃I was further reacted with precursor loaded on to the C18 sep-pak cartridge. In the study, we have used two type of precursors i.e. L- homocysteine thiolactone hydrochloride (ABX, Germany- Precursor-1) and L-homocysteine (Sigma-Aldrich, USA – precursor-2). The first precursor was dissolved in 0.1N Ethanolic sodium hydroxide and latter one in 0.01N Ethanolic sodium hydroxide. 400 µL of the precursor was loaded on C18 cartridge and eluted via using 6 mL of 0.05 sodium dihydrogen phosphate. The radiochemical purity was evaluated by Radio-HPLC and other quality control tests were performed. Around 7 ± 2 mCi of the 11C-MET was injected intravenously in to the patients and dynamic imaging was acquired on Siemens biograph mMR (PET-MR) and acquisition was carried out for 60 min. The images were processed and analysed visually.

Results: The radiochemical purity of the 11C-MET synthesized from L- homocysteine thiolactone hydrochloride and L-homocysteine showed 89 ± 5% (n = 15) and 96 ± 2% (n = 3) of L-11C-MET. The images showed a significant difference in the distribution of the 11C-MET synthesized from precursor-2. A significant reduction in the background has been observed and sharp uptake seen in the lesion/tumor area. L-homocysteine is a better precursor than L-homocysteine thiolactone, may be due to influence of lactone/base and the ethanol/water ratios. But still we need more data to validate it.

Conclusions: 11C-MET was synthesized with high radiochemical purity and L-homocysteine yields higher yield of 11C-L-MET which increased the tumor/background ratio.

INFLUENCE OF VARIOUS PARAMETERS ON THE ACCURACY OF RADIONUCLIDE THERAPY DOSIMETRY RESULTS

Nautiyal A,

Tata Memorial Centre, Mumbai

Accuracy & reliability of absorbed dose calculations in therapeutic Nuclear Medicine is directly related to the accuracy of the activity concentration estimates obtained from each of the imaging time points. An increasing number of clinical dosimetry protocols currently include SPECT/CT imaging studies because of their superior accuracy. Multi SPECT/CT based imaging technique known to be best because of all necessary corrections i.e. attenuation, scatter and over-lapping activity contribution. Various technical parameters influence the quantitative accuracy of dosimetry are mainly related to technique used, data acquisition, data processing, photon attenuation, Compton scatter, collimator detector response & activity quantification. There are various methods & techniques available for the time integrated activity and absorbed dose estimation in an organ i.e. TLD method, Planar imaging method, hybrid dosimetry method, multi SPECT/CT based dosimetry, Voxel based dosimetry, point kernel method and Monte Carlo simulation technique. For example imaging based technique is time consuming which leads to severe burden to the patient & department facilities and strongly depends upon system hardware and software. Similarly, there is always underestimation of dose calculated by TLD method because of attenuation between organ and TLD. Simulation technique-based dosimetry simulates the number of disintegrations within patient body using patient's transmission and emission images. Moreover, each simulation takes long time to process depending on hardware system of computer. Activity quantification in planar scans is known to have many limitations, mostly due to organ/background overlapping and inability to perform accurate attenuation correction leads to overestimation of activity. Multi planar acquisition along with single SPECT was suggested as an alternative of planar based dosimetry, however major drawback of hybrid dosimetry is choice of time point for SPECT imaging, which affects the quantitative results. Choice of collimator in imaging studies is an important parameter influencing the dosimetry results. If the collimator septa are not thick enough, a large number of photons that penetrate or scatter in the collimator septa will be detected, resulting in decreased image contrast, degradation of spatial resolution and increased image artifacts, leading to difficulties in accurate activity distribution quantification. Medium Energy collimators are preferable for Lu-177 imaging because of their lower septal penetration of the high-energy photons emitted by Lu-177. On the other hand, although high-energy collimators have better sensitivity than ME collimators for 208-keV photons of Lu-177 but they have inferior spatial resolution due to their wider collimator holes. For therapeutic isotopes i.e. I-131, Lu-177, thicker scintillation crystal provides higher sensitivity than the standard 3/8" crystal which decreases the statistical noise in the image for any given acquisition time and activity. For a thinner crystal, the probability of a 208 keV or 364 keV photon passing through the crystal increases, thereby increasing the contribution from backscatter to main image counts. Filtering is another parameter influencing the absorbed dose estimates. In order to avoid bias in the activity determination, one should check & verify that the total counts in the projections or in the reconstructed image remains unchanged after filtering. Dead time (DT) is another factor limiting the accuracy of dosimetry analysis. If the DT effects are modest, care must be taken to estimate them, especially for scans performed shortly after the therapeutic injection. One way of solving the dead time problem is to perform a series of phantom experiments with gradually decaying activity, using the same acquisition protocol as used for patient studies. Analysis of count losses in these phantom images can be used to establish DT correction factors. Furthermore, accurate quantification requires compensation for image degrading factors. Iterative reconstruction methods, such as the maximum likelihood expectation maximization

(MLEM) algorithm and the ordered subsets expectation maximization (OSEM) algorithm provide the ability to compensate for these effects, and are thus typically used and are recommended. Another most important factor altering the number of photons that fall on the gamma camera detector is photon attenuation. Photon attenuation mainly depends upon organ & body tissue thickness. However, accurate attenuation correction must be based on patient specific attenuation maps. Thereafter, the use of scatter correction is utmost important in dosimetry studies, in order to this correction techniques like triple-energy-window, dual energy window can be used. Another imaging parameter which impact the quantitative accuracy is source to collimator distance. Apart from all these parameters, system calibration factor has import role in activity quantification. The camera system must be carefully calibrated using a radioactive source with a well-determined therapeutic activity. Moreover, quantification using VOI and ROI can lead to underestimation or overestimation of organ activity. During delineation of organ, activity quantification can be underestimated due to partial volume effect (PVE). Due to limited resolution of system, PVEs also blur the boundaries of regions of organ which makes determination of their exact location difficult, thus imposing uncertainties on activity measurements. Technique used for the curve fitting & time integrated activity estimation ie. least square analysis, mono-bi exponential or trapezoidal integration can also lead to variation in cumulative activity and absorbed dose estimation. Hence proper selection of technical parameters like Collimator selection, crystal thickness, selection of number of time points, imaging time, integration of time activity data and & necessary corrections like scatter correction, background activity correction, Attenuation correction, dead time correction, resolution recovery is utmost important to determine more reliable and reproducible dosimetry results.

DEVELOPMENT AND STANDARDIZATION OF A NEW METHOD FOR THE DETECTION OF HEMICAL AND CHEMICAL PURITY OF THE PET RADIOPHARMACEUTICAL (11C-METHIONINE)

Joshi RK,

National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru, Karnataka, India.

Introduction: In Radiopharmacy the Quality control is very important and the foremost step before considering a molecule is good for the patient administration.

Objective: To assess the Enantiomeric impurity by HPLC in the 11C-Methionine preparation.

Method: Carbon-11 was produced at on-site cyclotron (GE Pettrace 860) by bombarding nitrogen gas containing 1% oxygen with protons at current 30 μ A for 20 min $\{^{14}\text{N}[\text{p}, \alpha]^{11}\text{C}\}$ to transfer 1200 ± 50 mCi of $^{11}\text{C}\text{-CO}_2$ in to the FX2C module. In module, $^{11}\text{C}\text{-CO}_2$ was reacted with hydrogen gas at 350°C in presence of nickel catalyst. $^{11}\text{C}\text{-CH}_4$ is trapped on Carboxen (60-80 mesh) under N_2 liq. cooling at -75 °C whereas un-reacted $^{11}\text{CO}_2$ and H_2O vapors were trapped on the traps (ascarite and sicapent respectively). $^{11}\text{C}\text{-CH}_4$ was released and underwent iodination to form $^{11}\text{CH}_3\text{I}$ at 7400C which recirculated in the loop and trapped on porapak trap at room temperature until reached to maximum activity. After reaching the maximum activity it is released from the porapak trap at 190 0C with Helium flow through V17 directly over the unconditioned C18 sep-pak cartridge containing precursor L-homocysteine thiolactone hydrochloride. $^{11}\text{CH}_3\text{I}$ reacted with the precursor to form $^{11}\text{C}\text{-methionine}$ which was eluted with 0.05 sodium dihydrogen phosphate (5 mL). Radio-TLC was performed on TLC

scanner with a speed of 2 cm/min using Water/Ammonia/Methanol (1:5:15). The HPLC (Dionex, ICS- 5000+, +, California, USA), having UV/Vis and radio-detector was done using mobile phase consists of acetonitrile (0.1% trifluoroacetic acid) and water (0.1% trifluoroacetic acid), starting with 5% acetonitrile (0-5 min), 5% to 100% acetonitrile (5-20 min), then 100% acetonitrile (20-25 min) and again at 5% acetonitrile (25-30 min).

For 11C-methionine HPLC shown two peaks of L- and D-isomers were seen and were confirmed by the retention times of standards L- and D-Methionine. The Chemical impurities were analyzed by Gas chromatography (GC Scion 436 GC, Netherlands) having flame ionization detector (FID). The Endotoxicity was checked in the portable test system (Endosafe® nexgen- PTSTM, United States).

Results: L- and D-isomers were identified by HPLC with UV and radiometric detectors. The percentage of L-11C-methionine was $89 \pm 5\%$ at 12 ± 0.6 min and D-11C-methionine was $3.5 \pm 0.5\%$ at 5.5 ± 1.5 min. The retention time of methyl iodide was 16.4 ± 0.5 min. The Ethanol content was <500 ppm in the final preparation. The product was found to be endotoxin free.

Conclusion: L-11C-methionine was prepared with high specific activity, sterile and used for glioma patients.

IMAGE BASED PET DOSIMETRY – “MAIDEN INDIAN EXPERIENCE AT PGIMER”

Watts A,

Department of Nuclear Medicine & PET, PGIMER, CHANDIGARH, INDIA

Over the past couple of decades, PET/CT imaging using various radiopharmaceuticals has come up as mainstay workup for oncology patients. And with ever going research in development of new radiopharmaceuticals, internal dosimetry to various organs has become a crucial aspect in determining effective radiation doses to the patients and further getting FDA or various other approvals.

With the advent of 68Ga/177Lu- as a promising theranostic pair, PET/CT based image based dosimetry provides valuable estimates in regards to absorbed doses to the tumor and doses to various other non-target organs. These dose estimates give a handful of information about the prediction of activity of β -emitting radionuclides to be administered. Radiation induced toxicity is another significant information derived from the image based dosimetry data. These data can also be extrapolated to estimate radiation doses as well as organ absorbed doses to the children.

We are the first institute in the country to have experience on PET/CT Image based dosimetry analysis. We have designed protocols with 5-time point sequential PET/CT imaging for dosimetry calculations. Olinda-based Hermes Hybrid dosimetry software has been used to compute absorbed doses to various organs as well as whole body effective doses. We have hands on experience with both 18F based and 68Ga radiopharmaceutical's based dosimetry analysis.

Synthesis, 18F-Radiolabeling and Galectin-1 Targeting Novel 4, 7- Disubstituted Coumarins as Apoptosis Inducing Agents

Goud SN,

Department of Neuroimaging and Interventional Radiology (NI & IR), National Institute of Mental Health and Neuro Sciences (NIMHANS), Bangalore 560 029, India.

Introduction: Human Galectin-1 is expressed in various normal and pathological conditions and has multiple functions with a wide range of biological activity. Galectin 1(Gal-1), a human homodimeric lectin protein of 14KDa, is implicated in many signaling pathways, immune responses associated with cancer progression, neurological conditions, and immune disorders. Gal-1 has Carbohydrate Recognition Domain (CRD), which is selective towards β -galactosides in the body. The overexpression of Gal-1 has been reported in many cancer types like the brain, breast, osteosarcoma, lung, prostate, melanoma, etc. Hence, the Gal-1 is considered as a promising molecular target for the development of new therapeutic drugs for cancer.

Methods: A new series of 4, 7-disubstituted coumarin derivatives (7a-y) have been synthesized as galectin-1 targeting apoptosis inducing agents and evaluated for their in vitro cytotoxic potentials against a panel of selected human cancer cell lines namely, Brest (MCF7), Ovarian (SKOV3), Prostate (PC-3 & DU145) and normal embryonic kidney (HEK293T) cells, using MTT assay. Using 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay [5]. The GE Tracer-lab FX2N synthesis module was used for ^{18}F radiolabeling studies. Characteristic apoptotic assays like Acridine orange/Ethidium bromide, DAPI staining, cell cycle, annexin V and Mitochondrial membrane potential studies were performed for the most active compound. Furthermore, Gal-1 inhibition was confirmed by ELISA, in-silico and fluorescence spectroscopy studies.

Results: Compound 7q exhibited a significant growth inhibition against prostate cancer (PC- 3 & DU145) cell lines with an IC_{50} value of $7.45 \pm 0.03 \mu\text{M}$, $8.95 \pm 0.17 \mu\text{M}$ respectively. Further, the target compound 7q was radiolabeled with fluorine-18 [^{18}F] to be used as a novel PET radiotracer for imaging of tumors via targeting galectin-1, using appropriate reaction conditions in the GE Tracer-lab FX2N synthesis module. The purification of the [^{18}F] radiolabeled compound [^{18}F]-7q was successfully achieved with 60% ethanol. The radiochemical purity was greater than 95 % and residual solvent limits of DMF was 87 ± 3 ppm as analyzed by HPLC, TLC & GC analytical methods. The apoptosis studies confirm the inhibition of cell proliferation with morphological changes like cell shrinkage, blebbing and cell wall deformation, increasing the ROS levels, and loss of mitochondrial membrane potential by Acridine orange/Ethidium bromide staining, Hoechst-33342 staining, H2DCFDA staining, annexin V-FITC/PI, and JC-1 staining methods. In flow cytometric analysis, 7q selectively arrested the sub-G1 phase of the cell cycle in a dose-dependent manner. In Gal-1 ELISA studies, compound 7q efficiently reduced the levels of Gal-1 protein in a dose-dependent manner with an IC_{50} value of $100 \mu\text{M}$. The binding constant (K_a) of 7q with Gal-1 was observed as $1.3 \times 10^4 \text{ M}^{-1}$ by fluorescence spectroscopy. The molecular docking studies clearly showed possible interactions and the pharmacokinetic (ADMET) properties of compound 7q with Gal- 1. Hence, novel 4, 7-disubstituted coumarins could be a potential cytotoxic and PET imaging agents via Gal-1.

Conclusion: This study demonstrated that the target compound 7q could be the potential lead molecule for the cancer cases by targeting Gal-1 protein.

APPLICATION OF NON-RADIOACTIVE PHARMACEUTICALS IN NUCLEAR MEDICINE

KUMAR SB,

Dept of Nuclear Medicine, Balco Medical Centre, Raipur.

Procedure

Abstract:

A variety of pharmaceuticals are commonly used as an intervention in patients who undergo nuclear medicine diagnostic tests. Pharmacologic interventions play an vital role in nuclear medicine by providing additional information which help in diagnosis of diseases. Such pharamacology intervention allows to functional evaluation of the organ in diseases condition and reduces the diagnostic imaging time. However, these pharmaceuticals used in nuclear medicine are not without adverse effects which must be familiar to those who administer them as intervention. The scope of practice of the nuclear medicine professional demands knowledge and understanding of application/indications, contraindications, warnings, precautions, dose, proper use, drug interactions, and adverse reactions for each medication to be used.

Key Words: Intevention in brain, Intervention in GIT, Baptopril, Cholecystokinin, Cimetidine,

POSTER ABSTRACTS:

TRACK 1: NUCLEAR MEDICINE CLINICAL PRACTICE: NEW TECHNOLOGICAL ADVANCEMENTS AND CHALLENGES

A COMPARISON BETWEEN 99mTc – UBIQUICIDIN AND 99mTc-METHYLENEDIPHOSPHONIC ACID BONE SCAN FOR PROSTHETIC LOOSENING EVALUATION.

1* Aadhavan P1, Arnold V J1, Radhakrishnan E R1, Kingsley F R1, Pandiyan A1, Surya B1, K K kamaleswaran1, Shinto A2

1 Kovai Medical Center and Hospital, Coimbatore, India

2 Apollo Proton Cancer Centre, Chennai, India

*Lead Speaker

Introduction: The prosthetic evaluation was developed specifically to provide functional outcome measures in prosthetics that are more turned to prosthesis related changes in quality of life. Uptake of 99mTc MDP in a bone scan depends upon two factors via the vascularity and the local osteogenesis. Thus there are two distinct pathophysiology for the positivity bone scan, one related to the delivery of the radiotracer to the site of the lesion and other with the incorporation of the radiotracer with the hydroxyapatite crystal of the bone. 99mTc-ubiquicidin is a synthetic cationic antimicrobial peptide that preferentially binds to bacterial cell membrane at the site of infection. Aim: To compare 99mTc – Ubiquicidin and 99mTc-Methylenediphosphonic acid bone scan for prosthetic loosening evaluation”.

Materials and methods: Thirty patients with suspected prosthetic evaluation of hip joint and knee joint were selected for this study. First a routine three phase bone scan done with 99mTc –MDP Blood flow, blood pool and delayed images of SPECT are done respectively. Followed by 99mTc ubiquicidin scan was performed for the patient with 15 – 20 mCi of 99mTc ubiquicidin was injected intravenously. A 10 min dynamic study was followed by spot views of the suspected region of infection and corresponding normal areas (liver, kidney) at 60 and 120 minutes. Whole body anterior and posterior images were also acquired. Compared the two scan of 99mTc-MDP three phase bone scan and 99mTc – ubiquicidin for prosthetic evaluation of hip joint and knee joint. Comparison done on the basis of the increased tracer uptake in blood pool imaging. If the Three phase bone scan has increased uptake and 99mTc –ubiquicidin scan also has increased uptake but in geographically descendant location or in a different pattern then this scan is considered positive for septic infection. In comparison, if the three phase blood pool scan has increased uptake and the ubiquicidin scan has no uptake then this scan is considered negative suggesting aseptic loosening.

Results: The combination of 99mTc-MDP and ubiquicidin scans correctly identified infective loosening in 15 of 16 patients (true positive). Aseptic loosening scans finding were noted in 9 of 14 patients. So the PPV, NPV, Sensitivity and specificity were 75%, 90%, 93.75% & 64.2% respectively.

Conclusion: The 99mTc-ubiquicidin is a progressing tool for diagnostic of septic loosening in prosthetic evaluation for loosening in patients.

SIGNIFICANCE OF PATIENTS' ARM POSITION AND DELAYED PET-CT IMAGING IN BRAIN LESION DETECTION

aNiha, aBabu M, bBhushan S, bFonseca K, bRai JK

aBalco Medical Centre, Raipur, Chhattisgarh

aDepartment of Nuclear Medicine Manipal College of Health Professions

Manipal Academy Of Higher Education, India

AIM: To assess the suspicion of brain lesion in delayed brain PET-CT images and importance of patient arm positioning.

MATERIALS REQUIRED: Patients with suspected brain lesion were studied. All patients underwent a whole body 18F-FDG PET-CT scan and delayed brain PET CT images with arms down position were acquired by using Biograph horizon Siemens PET-CT scanner.

PROCEDURE: Patients with known case of primary cancer having a high probability of secondary brain metastases were injected with 185-296 MBq of 18F-FDG. Contrast enhanced 18F-FDG PET-CT images were acquired after 45 -90 mins of F18 FDG injection. Delayed image of brain with hands placed downward was acquired after contrast whole body PET-CT as contrast takes 3-4 mins to reach the brain.

RESULT: Better delineation of brain lesion were detected in delayed brain PET CT images with arms down position.

CONCLUSION: It is necessary to acquire a delayed brain study with arms down position in primary cancer patients, as the probability of having brain lesion is on the higher side.

“TARGETED ALPHA THERAPY– A COMPARATIVE ANALYSIS WITH BETA THERAPY”

*Misra A, Menon S, Zongpa T, Nayak G, Panduranga V, Bagewadi N

Department Of Nuclear Medicine, MAHE, Manipal

*Lead Speaker

Introduction – A biomolecule that is specific to a target combined with a radionuclide that delivers a cytotoxic payload promises a specific way to wipe out cancer cells. The new approach is to use the short range and highly cytotoxic alpha radiation from alpha emitters to achieve improved efficacy and therapeutic gain. Hereby we review the importance of Targeted Alpha Therapy (TAT) and compare it with Targeted Beta therapy for ovarian cancers.

Areas Covered – We will discuss about the properties and limitations of some promising Alpha emitter radionuclides. Some general considerations like radiolysis, radiation induced bystander effect and distribution of recoil daughters in the body. The review will also focus on dosimetric aspects, vectors for TAT and their roles in different malignancies. The effectiveness, toxicity and prognosis will be reviewed by taking an example of Ovarian cancer.

Results - (TAT STUDY 1) Administration of ^{211}At -MX35 F(ab')₂ allows good tumor uptake in order to achieve therapeutic doses without significant toxicities. The estimated absorbed dose to the peritoneum was $15.6 \pm 1.0 \text{ mGy}/(\text{MBq}/\text{L})$. (TAT STUDY 2) Six dose levels (7.4, 9.6, 12.6, 16.3, 21.1, 27.4 MBq/m²) of ^{212}Pb -TCMC-trastuzumab were well tolerated. No late renal, liver, cardiac, or other toxicity was noted up to 1 year. Tumor marker studies in ovarian cancer patients showed a trend of decreasing cancer antigen (CA 72-4) and tumor growth with increasing administered radioactivity.

(BETA THERAPY) Patients in the active treatment arm received a single intraperitoneal dose of 25 mg of 90Y-muHMFG1 (target dose 666 MBq/m²). In the study 104 patients experienced relapse compared with 98 patients in the standard treatment (cytoreductive surgery and platinum- based chemotherapy) arm. Active therapy (90Y-muHMFG1) was associated with occasional grade 3 or 4 thrombocytopenia and neutropenia and grade 1 or 2 GI symptoms. 90Y-muHMFG1 therapy did not extend patient survival.

Conclusion – By reviewing all the above cases it is clear that α -RIT is superior to β -RIT in terms of efficacy within the tolerance dose. So, the use of alpha therapy in clinical settings should be expanded.

UTILITY OF ADDITIONAL PET-MRI PELVIC FUSION IN Ga68-PSMA PET-CT SCANS IN PATIENTS OF CARCINOMA PROSTATE

**Hariharan. K, SIMONS, Rao NS, KUMAR K*

*Nuclear Medicine Department, Apollo Hospitals,
Chennai, Tamil Nadu.*

**Lead Speaker*

OBJECTIVES:

Positron Emission Tomography and Magnetic Resonance Imaging in Prostate emerges as an important imaging tool that especially holds true in cancer patients as morbidity is more in such patients.

The advent of PET-MRI has added morphofunctional information from the standard of reference MRI to accurate molecular information from PET.

METHODS:

PET-CT of 32 patients were acquired in Siemens Biograph MCT (40 slice) after 60 minutes of Intravenous injection of Ga68 – PSMA to the patients referred for primary staging of prostate with appropriate camera parameters. The images were then reconstructed by means of Iterative Reconstruction.

MRI screening of pelvis were acquired in Philips 1.5 Archiva using appropriate computer settings.

The obtained MRI images were fused with PET images by the Software Syngovia using visual and automatic alignment.

RESULTS :

Out of 32 Ga68-PSMA patients who underwent MRI screening of pelvis, in 14 patients, lesions were appreciated in MRI where CT showed negative corresponding to Ga68 uptake in PET. In 10 out of 32 patients lesions were noted in both CT and MRI. 8 patients were found to be negative.

Thus with PET MRI fused images, higher number of lesions were noted more specifically due to better resolution of MRI.

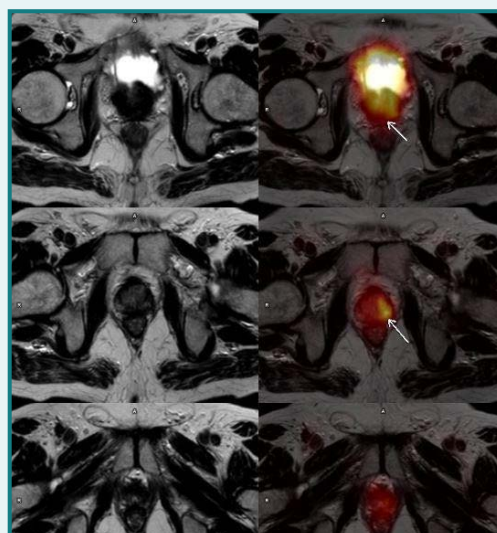
INFERENCE :

Combining the physiological information obtained in PET images with that of the quantitative and high precise anatomical information obtained in MRI,

PET-MRI together is established as a widespread discovery in this field.

PET and MRI in tandem provides excellent soft tissue contrast and molecular information with no additional radiation burden to the patient.

PET MRI FUSED IMAGE.



131I LABELLED LIPIODOL FOR UNRESECTABLE HEPATOCELLULAR CARCINOMA THERAPY: INITIAL CLINICAL EXPERIENCE

1*Prabhu M1, Arnold V J1, Radhakrishnan E R1, Kingsley F R1, Pandiyan A1, Surya B1, K K kamaleswaran1, Shinto A2

1 Kovai Medical Center and Hospital, Coimbatore, India

2 Apollo Proton Cancer Centre, Chennai, India

*Lead Speaker

Introduction:

More than 80% of hepatocellular carcinoma tumours (HCC) are unresectable at presentation because of the multicentric nature of the disease or the severity of liver disease. Arterially administered lipiodol is preferentially retained by HCC and has been used as a vehicle for delivery of therapeutic agents to the tumour.

Aim

To present the experience with 131I-labelled lipiodol in the treatment of unresectable HCC

Methods:

A group of 10 patients with unresectable HCC was treated with 4.44 – 9.99 GBq (120-270 mCi) of 131Iodine lipiodol treatment was administered. The outcome of treatment in these patients was evaluated for clinical tolerance, liver function tests, alpha-fetoprotein (AFP) levels and changes in tumour size & enhancement pattern on contrast enhanced computed tomography (CECT) scans for follow up imaging at 3 months & 6 months

Results:

Complete response for two patients, partial response for 6 patients & progressive decrease in two patients.

Conclusion:

Intra-arterial 131I treatment was very well tolerated. A reduction in AFP levels and tumour size occurred in the patients and resulted in a 50% probability of survival of 19 months. Further examination of the value of this treatment in phase II and III studies is required.

“PARATHYROID: 99MTC MIBI VS 18F-CHOLINE”

*Joycie S, Krishnapriya D, PGIMER, Chandigarh, India

Msc Nuclear Medicine (2nd Year), PGIMER, Chandigarh.

*Lead Speaker

Objective: To compare the diagnostic ability of 99mTc MIBI and 18F choline to detect parathyroid adenomas in hyperparathyroid patients.

Method: Parathyroid images with 99mTc MIBI (dual phase) SPECT/CT and 18Fch PET/CT acquired for patients who presented with symptoms of hyperparathyroidism were included in this study. The clinical data, scan findings and acquisition protocol were collected retrospectively. 18F-Choline was synthesized in NEPTIS module using commercially available ABX cassette and 99mTc MIBI was prepared using cold kit supplied by CMR. The early image was acquired 5min post IV injection of 555MBq 99mTc-MIBI, followed by early SPECT/CT and delayed imaging was done 1 hr post IV injection in Symbia T16 and Discovery 670 DR. Regional images of neck and mediastinum were acquired in 3D mode 60 min after IV injection of 150MBq 18F-choline in Discovery 710 PET/CT and MIDR PET/CT. Comparative analysis of acquired images of both the studies was done.

Results: Twenty patients in whom 99mTc MIBI dual phase parathyroid imaging as well as 18Fch PET/CT was done were included. Among these thirty percent were found negative for parathyroid adenoma in 99mTc MIBI SPECT/CT but found positive in 18Fch PET/CT study.

Conclusion: 18F-choline PET/CT study was evaluated to be more sensitive to detect parathyroid adenomas when compared with 99mTc-MIBI dual phase SPECT/CT study.

ANALYZING THE PARAMETERS AFFECTING THE ESTIMATION OF GLOMERULAR FILTRATION RATE USING 99M TC- DTPA THROUGH GATES METHOD

*** kaur M, PGIMER, CHANDIGARH, INDIA**

***Lead Speaker**

Objective: To compare the variation in the (GFR) obtained using various methods of kidney depth estimation and positions of the background ROIs in a conventional gamma camera.

Method: Data was retrospectively analyzed from 17 patient subjected to GFR estimation with 99mTc-DTPA (Diethylene Triamine Penta Acetic acid) using Gates method in a gamma camera (Symbia T16, Siemens Healthineers, USA) and 3 sample plasma sampling. kidney depth estimation using Emory, Standard & Itoh methods with a standard infrarenal background ROI. Effect of perirenal background ROIs on the split renal function was also analyzed. The GFR obtained by plasma sampling was considered as reference standard.

Result: Of the 17 patients, 7 patients had reduced GFR ($<90\text{ml/min}$), 10 had GFR in normal range ($>90\text{ml/min}$) by plasma sampling. Three methods correlated showed significant positive correlation with plasma sampling based GFR ($p < 0.05$). The mean ($\pm$ SD) GFR by the plasma sampling, standard, itoh and emory methods were $98.2(\pm 29.0)$, $81.6 (\pm 28.7)$, $97.3 (\pm 33.9)$ and $96.2 (\pm 32.9)$ respectively. The mean GFR values obtained using the standard method were lower compared to the plasma sampling-based values ($p = 0.001$) while no significant difference using Emory and Itoh methods obtained. Kidney depth estimated with Itoh and emory methods were not significantly different ($p = 0.131$ (left kidney), $p = 0.758$ (right kidney)). No significant difference in the split renal function with a standard infrarenal or perirenal ROI ($p = 0.395$ - right kidney, $p = 0.338$ - left kidney).

Conclusion: Emory and Itoh methods both show comparable GFR values to multiple plasma sampling. Choice of background ROI does not significantly effect the split renal function.

DEVELOPMENT AND THE NEW CHALLENGES OF BRAIN PET IMAGING TECHNOLOGY: OVERVIEW

*** Rattan R, Rana N, Watts A, B R Mittal, PGIMER, CG, INDIA**

***Lead Speaker**

Positron emission tomography (PET) gives unique information about the human brain. The brain imaging using whole-body positron emission tomography (PET) can be improved with the change in imaging modalities like matrix size which can give improved resolution and sensitivity. However, it has been seen that whole-body PET are not optimized for imaging small structures in human brain. Several PET devices are available that are specifically designed for this task. These are called dedicated PET scanners. These devices can be used alone or as magnetic resonance (MR) compatible inserts. There are different performance characteristics, desired capabilities and cost for designing different brain scanner. Recent advances can significantly impact future developments in brain PET instrumentation, but it is associated various new challenges in brain PET imaging technology.

There is significant progress by different manufacturing companies and research groups in designing dedicated PET units; however, emerging research is promising even greater accuracy and precision and therefore, imposing more drawbacks with respect to the intrinsic performance of PET systems. Continuous efforts are being made to integrate new research in designing various imaging detectors and their readout systems. Dual-modality imaging is done now days (eg. PET with CT or PET with MRI) which provides more promising information. However, combining PET with MRI is scientifically challenging because of the involvement of high magnetic fields. Thus, many different design paths have been and continued to be developed. It cannot be said which design will be used in future to give best results, but the continual research will lead to auspicious results definitely.

Conclusion: We at PGIMER recently trying to standardize various reconstruction parameters by doing various Phantom & Clinical studies.

RE-188 SKIN PATCH FOR THE TREATMENT OF KELOIDS AT PGIMER CHD.

****Vandita, Shukla J, Chhabra A, pandey S, Vasta R, B.R Mittal, PGIMER, CG, INDIA***

****Lead Speaker***

INTRODUCTION: Keloids are benign skin tumors developed as fibrotic scars during wound healing process at trauma or surgery site.

MATERIAL AND METHOD: Re-188 colloid was prepared with preform colloid and freshly eluted Re188 from Commercially available W-188-Re-188 generator to elute ReO₄ using 0.9% NaCl. Trace of the keloid lesion to be 65treated, was taken and was replicated on graph paper for area, size and dose calculation and also on cellulose based adsorbent sheet for patch preparation. Re-188 colloid was then applied on patch, dried and laminated. The prepared patch was fixed by using micropore adhesive tape on surface of keloid lesion for 4 hrs.

RESULT: Scar size and elevation was significantly reduced in patients in addition to relief in symptoms like pain and itching.

CONCLUSION: Customized Re188 skin patches were successfully prepared. Symptomatic and clinical response were observed in all patients.

INFLUENCE OF ANTIOXIDANTS ON THERAPEUTIC OUTCOME IN RADIATION THERAPY: A SYSTEMIC REVIEW

****Ahad T***

Nuclear Medicine Technology, Manipal College of Health Professions (MCHP), MAHE, Manipal(576104), Karnataka, India.

****Lead Speaker***

Abstract: High doses of dietary antioxidants enhance the effect of irradiation on cancer cells. After reviewing the research investigations both preclinical and clinical published in this regard, it appears that enhancement of radiation damage by dietary antioxidant micronutrients depends upon the dose of radiation, dose and types of antioxidants, treatment period and type of tumor cells. It has been studied that Vitamins A, C and E, and carotenoids may protect normal cells against radiation damage, but may enhance the effect of irradiation on cancer cells.

On the contrary, it has been also studied that Dietary antioxidants such as vitamin E (atocopherol) when given in a single low dose shortly before irradiation reduce the effectiveness of x-irradiation. Thus, results show that low doses of dietary

or endogenously made antioxidants given in a single low dose that does not affect the growth of cancer cells shortly before irradiation may protect cancer cells against radiation damage.

After so many clinical studies, it has been also reported that using high dose multiple antioxidants during radiation therapy has improved outcomes with no adverse effect on the efficacy of standard therapy. Thus, after reviewing the whole study, we draw to a conclusion that further research is required for determining the influence of antioxidants on therapeutic outcome in radiation therapy.

TRACK 3: RADIOPHARMACY

“REDUCTION IN SYNTHESIS DURATION OF ^{188}Re -TIN COLLOID FOR RADIOSYNOVECTOMY”

***Somani S, K Lavanya, Gupta P, Shamim SA**

Department of Nuclear Medicine, All India Institute of Medical Sciences, New Delhi, India

***Lead Speaker**

Introduction: Radiosynovectomy/radiosynoviorthesis(RS) is radionuclide therapy of joint synovitis or synovial processes by intra-articular injection of ^{188}Re -tin colloid. Rhenium-188 ($T_{1/2} = 16.98$ hours, $E_{\beta} = 2.12$ MeV) is a generator produced beta emitting radionuclide. Rhenium-188 is labelled to form tin colloid which is used for radiosynovectomy of medium to large joints. The whole synthesis procedure of ^{188}Re tin colloid takes approximately 3 hours which includes 2 hours of boiling.

Objective: The main purpose of our study was to determine if the duration of boiling time can be reduced to 1 hour 30 minutes and whether this would affect the radiolabelling efficiency and particle size of the colloid.

Method: ^{188}Re -perrhenate was obtained from an alumina based $^{188}\text{W}/^{188}\text{Re}$ generator freshly eluted with saline. Two vials (each with 12 mg SnCl_2 and 0.4 ml of 0.1 N HCl) were prepared and 3 ml (20mCi) of ^{188}Re -perrhenate was added in each of the vials. Then the vials were kept in hot water bath, one vial for 2 hrs and the other for 1 hrs 30 mins. At the end of the specific time of boiling of each vial they were kept at room temperature for cooling. pH was then adjusted to 7 by adding adequate 0.2 M sodium phosphate buffer (pH=8) solution. Then it was centrifuged for 20 minutes at 4°C temperature at 3000 RPM. After the centrifuge, the supernatant was discarded and the remaining colloid pellet was resuspended in 1 ml of distilled water. The activity of both the colloid solutions were measured to determine the radiolabelling efficiency of ^{188}Re tin colloid at different boiling times. Both the colloidal solution were also analysed by Transmission Electron Microscopy (TEM) to determine the particle size of colloid.

Result : It was found that the amount of activity in both the vials (2hrs boiling time vs 1 hrs 30 min boiling time) were almost similar i.e., 14.3mCi and 14.1mCi respectively. The results of TEM showed the range of particle size of colloid in both the colloidal solutions to be similar i.e., 30- 150 μm in 2 hrs boiling time vs 35-140 μm in 1 hr 30 min boiling time. Also there was no clumping of colloid particles and they were evenly distributed in both the colloidal solution.

Conclusion: Reduction in the boiling time from 2 hours to 1 hour 30 minutes during the synthesis of ^{188}Re -tin colloid has no effect on radiolabelling efficiency as well as on the particle size of colloid.

Therefore, the boiling time can be reduced from 2 hrs to 1 hr 30 minutes. Thus, reducing the total synthesis procedure by half an hour.

[18F]DPA-714 as a tracer for PET imaging of pro-inflammatory marker TSPO to study HIV Associated neuronal tissue damage

1*Sridharan, V.R., 2Shacka, J.J., 3Lapi, S.E., 3McConathy, J.E.

1 Department of Nuclear Medicine, MCHP, MAHE, Manipal, India

2 Department of Pharmacology, Neurology Division, UAB, USA

3 Department of Radiology, UAB, USA

***Lead Speaker**

Objective: HIV-associated neuronal tissue damage is associated with chronic neuroinflammation as a result of infection of the central nervous system with the HIV. This is due to the persistent expression of the HIV Tat protein that is expressed in microglia and astrocytes. This immune response activates glial cells in the brain causing upregulation of the mitochondrial membrane protein, translocator protein (TSPO), which is also upregulated in many other neuroinflammatory disease conditions. This process of neuroinflammation involves a physiological response resulting in loss of neurons and synapses eventually leading to neurodegeneration and neurocognitive decline. [18F]DPA-714 is a specific tracer of TSPO which is proposed as a biomarker of neuroinflammation. Our study aims to investigate the potential of [18F]DPA-714 to monitor TSPO overexpression linked neuronal damage in HIV+ patients overexpressing TSPO via positron emission tomography (PET).

Methods: 73 HIV+ patients aged above 50 years were imaged for TSPO expression using [18F]DPA-714. Images were acquired on a GE Signa 3T PET/MRI. For in vitro studies, mixed glial cell cultures obtained from HIV+ transgenic mice models, were analyzed for TSPO expression using western blot analysis and fluorescence immunocytochemistry. Synaptophysin expression in hippocampal neuronal cultures was measured to correlate TSPO expression with synaptic damage.

Results: PET-analyses showed a clear uptake of [18F]DPA-714 in cerebral cortex at specific sites overexpressing TSPO indicating overexpression of TSPO in HIV+ patients. In vitro western blot analysis and immunocytochemistry showed correlated overexpression of TSPO and reduced synaptophysin levels in glial and hippocampal cultures respectively.

Conclusion: From the results obtained in this study, [18F]DPA-714 which specifically binds to TSPO, a protein strongly linked to synaptic damage, could be investigated for potential use in detecting sites of synaptic damage neurodegeneration in common neuroinflammatory conditions.

PHYSIOLOGIC UPTAKE OF 18F-FDG IN NORMAL TESTIS

***Suman A1, Muthu G S2, Parida G K2, Mitra S1.**

Meherbai Tata Memorial Hospital, Jamshedpur 831001, India. Tata Main Hospital, Jamshedpur 831001, India.

***Lead Speaker**

Objectives: To assess the physiologic uptake of testes in 18F-FDG PET-CT scans.

Methods: The testicular uptake of 18F-FDG expressed as the standardized uptake value (SUV), was measured on PET-CT images in 205 men with no known testicular pathology from July 2019 to Dec 2019 in our centre. Ratio of SUVmax of testis to SUVmax of muscle (T/M ratio) and to SUVmax of liver (T/L ratio) were calculated using SUVmax of right adductor muscle and liver respectively. The T/M and T/L ratios were statistically correlated with age and blood glucose level.

Results: The mean age of 205 men was 57 ± 15 y (range 17~84) and mean blood glucose level was 119.0 ± 27.2 mg/dl (range 64 ~ 222). The mean SUVmax of testes was 2.44 ± 0.54 (range 0.7~4.0) and mean SUVpeak was 2.3 ± 0.5 (range 0.7~3.7). The mean value of T/M and T/L ratio were 3.45 ± 1.1 (range 1.1~6.9) and 0.93 ± 0.25 (range 0.35~2.21) respectively. Mild negative correlation was noted between the T/M ratio with age ($r = -0.16$) and with blood glucose ($r = -0.16$). Similarly mild negative correlation was seen between T/L ratio with age ($r = -0.26$) and with blood glucose ($r = -0.12$). The laterality index ($|L - R| / (L + R) \times 2$) in 205 men was 0.023 ± 0.017 (0.006–0.04). There was a minimal negative correlation between the SUVmax with age ($r = -0.11$). However, there was no significant correlation between the mean SUV and blood glucose ($r = -0.04$).

Conclusions: The mean SUVmax of testes was 2.44 ± 0.54 in ^{18}F -FDG PET-CT scan of healthy men. The FDG uptake of testis was mildly correlated with age and blood glucose level.

Presenting/Submitting author

MODIFIED CHITOSAN-COATED MAGNETIC NANOPARTICLES: EXCLUSIVELY FOR THE DELIVERY OF ^{32}P TO HEPATOMA CELLS

1*Anushree, U., 1Shetty, S., 2Kumar, R., and 1#Bharati, S.

1 Department of Nuclear Medicine, MCHP, MAHE, Manipal.

2 Department of Nuclear Medicine, AIIMS Jodhpur.

#Correspondence to: sanjay.bharati@manipal.edu

*Lead Speaker

Background: Radionuclides used in radiation ablation therapy of hepatocellular carcinoma (HCC) lack self-targeting and face challenges in homogenous dose distribution. ^{32}P , a potent β emitter with several desirable features of co-ordination with cellular biomolecules can easily overcome the challenge of dose distribution. However, a major hindrance in this direction is to effectively deliver ^{32}P into target tissue. This study is an attempt to successfully synthesize modified chitosan coated magnetic nanoparticles (MNPs) for the delivery of ^{32}P to HCC cells.

Objective: Designing a polymer- ligand coated MNPs for the delivery of ^{32}P to hepatoma cells.

Materials and Methods: Chitosan was modified through phosphorylation with 85% orthophosphoric acid to form phosphorylated chitosan (PC). Phosphorylated chitosan was then grafted with ligand lactobionic acid (LBA) to obtain phosphorylated, galactosylated chitosan (P-GC). An in-situ synthesis apparatus was designed and P-GC coated magnetic nanoparticles were synthesized by the method of co-precipitation. P-GC coated magnetic nanoparticles were characterized for compositional and conformational properties.

Results: FTIR, NMR and Mass spectra of P-GC revealed successful addition of phosphate and LBA to chitosan. Nanoparticle tracking analysis P-GCMNPs revealed a narrow range of hydrodynamic size distribution. Transmission electron microscopy unveiled spherical shape and smaller particles optimal for receptor mediated delivery into hepatoma cells.

Conclusion: ^{32}P labelled galactosylated chitosan-coated magnetic nanoparticles can be synthesized through similar mechanism and aimed to target hepatoma cells.

Assessment of Renal Toxicity of Bhasma Formulation in Mouse Model Using ^{99m}Tc -DTPA Renal SPECT

Mohanty B1, Kambli D1, Chavare A2, Chowdari P3, Gota V3, Bellare J2, Chaudhari P1, ACTREC, Mumbai.

*Lead Speaker

1 Comparative Oncology Program & Small Animal Imaging Facility, Advanced Centre for Treatment, Research & Education in Cancer, Tata Memorial Centre, Navi Mumbai-410 210

2 Department of Chemical Engineering, IIT Bombay, Mumbai 400 076, India

3 Dept. of Clinical Pharmacology, Advanced Centre for Treatment, Research & Education in Cancer, Tata Memorial Centre, Navi Mumbai-410 210

Introduction: Bhasma, Ayurvedic medicinal preparations, are prepared using herbs and minerals on following long iterative procedures.. The end point of this iterative procedure is mainly judged by the traditional tests specifying physical appearance. The safety and toxicity of Ayurvedic formulations is a major concern due to gap in drug evaluations in traditional and modern medicine. Traditional medicine is gaining importance due to its treatment efficacy and ease of administration for several human diseases. The attempt was made to evaluate renal toxicity of Bhasma formulation using advanced functional tool such as ^{99m}Tc -DTPA Renal SPECT (Single Photon Emission Computed Tomography).

Objective: To study renal toxicity of Bhasma formulation mice using preclinical ^{99m}Tc -DTPA Renal SPECT imaging.

Materials and methods: Swiss albino mice were randomized prior to ^{99m}Tc -DTPA (diethylenetriaminepenta-acetic acid) renal scan. The formulation was administered orally and scanning was performed on 28th day post administration. Animals were fasted for 2h before scanning. Scan was performed under anesthetized using 2-3 % isoflurane and oxygen. ^{99m}Tc -DTPA was administered intravenously through lateral tail vein using PE10 (Becton Dickinson) customized catheter. After injection tracer accumulates in kidneys and clears out to the urinary bladder. Imaging was performed with single head SPECT system (Flex Triumph, Gamma Medica Ideas). Dynamic acquisition was performed for 30min and images were analyzed using PMOD image analysis software 3.2. (PMOD Technologies, Switzerland). ROIs (regions-of-interest) were drawn separately around the whole body, left & right kidney, urinary bladder, a region for background correction) at various time intervals (3, 5, 9 and 10 min) for renal scan. Percent retention in kidney at 30mins post injection was determined.

Results: Observations suggest that oral administration of Jasadbhasma continuously affected the renal percentage uptake significantly. In case of the treated group with intermediate preparation does not affect renal clearance significantly. In this study the role of anupan was also studied which showed significant change in renal uptake between treated group with anupan and Jasadbhasma. The dynamic SPECT images at various time points of in JB12X groups showed impaired pattern of DTPA clearance. No abnormality was observed in renal histopathology and biochemical examination.

Conclusion: Dynamic SPECT has been employed for mice in the present study, which offers a novel approach to visualize and quantify renal function non-invasively in animals administered with ayurvedic preparations. The bhasma formulation used has altered renal function indicating further reconfirmation by detailed toxicological studies. The sensitive technique such as SPECT imaging for assessment of renal function has not been reported for evaluation of bhasma formulations. This method describes a promising approach to investigate traditional formulations using advanced tools.

COMPARISON BETWEEN MANUAL LABELLING OF 68GA-DOTANOC WITH ITG AND ITHEMBA GENERATOR: A PRELIMINARY STUDY

1 Kuriakose T T, Arnold V J1, Radhakrishnan E R1, Kingsley F R1, Pandiyan A1, Surya B1, K K kamaleswaran1, Shinto A2*

1 Kovai Medical Center and Hospital, Coimbatore, India

2 Apollo Proton Cancer Centre, Chennai, India

**Lead Speaker*

INTRODUCTION

Gallium-68 DOTANOC binds to the somatostatin receptors that are seen on the surface of Neuro endocrine tumour. By injecting the tracer into patients, PET-CT scans can be done to visualize the tumours. There are two methods of labelling DOTANOC. The manual and the generator based methods are commonly used to label the DOTANOC with ^{68}Ga .

AIM: To compare the manual labelling of ^{68}Ga -DOTANOC with ITG and ithemba generator types.

MATERIALS AND METHOD: Total 40 samples were used to compare the radiochemical purity of the manual labelling of ^{68}Ga -DOTANOC with ITG and ithemba generator types. The required materials are $^{68}\text{Ge} - ^{68}\text{Ga}$ generator, solvents like 0.5 M HCL. In case of Ithemba generator the solvent used TiO_2 [Titanium oxide] and in ITG generator SiO_2 [silicon dioxide] is used. Manual labelling was done as follows;

ITHEMBA GENERATOR: Ga-68 is eluted from the generator by using 4 ml of 0.6M HCL in fraction method [best 1 ml will be used for preparation] directly to clean vial (reaction vial). Required amount of HEPES buffer is transferred to the reaction vial to adjust pH [4-4.5]. The pH is checked with a pH paper. The vial is sealed with aluminium cap and mixed well. The vial is incubated at 90°C in a water bath for 10 minutes. It is allowed to cool for few minutes and QC is carried out.

ITG GENERATOR: Ga-68 is eluted from the generator by using 4 ml of 0.6M HCL in fraction method [best 1 ml will be used for preparation] directly to clean vial (reaction vial). Required amount of Sodium acetate buffer is transferred to the reaction vial to adjust pH [4-4.5]. The pH is checked with a pH paper. The vial is sealed with aluminium cap and mixed well. The vial is incubated at 90°C in a water bath for 10 minutes. It is allowed to cool for few minutes and QC is carried out.

RADIOCHEMICAL PURITY TEST:

The radiochemical purity of ^{68}Ga DOTA NOC was determined by ITLC SG as stationary phase and , acetonitrile : Water (1:1 as a mobile phase. The procedure is done by adding a point source of the radiopharmaceutical in a ITLC SG strip. The strip is then kept immersed in the respective solvent [as acetonitrile: water] in a test tube and it is kept undisturbed until the solvent reaches the desired mark in the strip. Then the strip is dried completely and the upper and lower zone is separated and Strips were analyzed by well counter (capintec well counter). The counts are obtained and the radiochemical purity is verified by the formula. Percentage purity = $\text{SF}/(\text{SF} + \text{PS}) \times 100$ where SF-Solvent front and PS-Point source.

Results: Average Radiochemical purity of manual labelling of ITG generator and ithemba generator were $96.02 \pm 0.54 \%$ and $97.81 \pm 0.32 \%$ respectively. There is no statistical difference between radiochemical purity of manual labelling and two generator types ($p > 0.05$).

Conclusion: Our study suggests that there was no significance difference between radiochemical purity of manual labelling and two generator types. Moreover ithemba generator gives better radiochemical purity.

“68GA-PENTIXAFOR – MILLENNIUM MOLECULE : AN OVERVIEW”

***Monika, Watts A, Chuttani S, Arora D, Maxwell V, Thakur S, Singh B, PGIMER, CG, INDIA**

***Lead Speake**

Introduction - Gallium – 68 is a positron emitting radioisotope that is produced from Ge68/Ga68 generator. The short physical half-life of 68Ga ($t_{1/2} = 68$ min) enables improved dosimetry and repeat imaging, making these agents ideal for clinical use. Gallium-68 is a generator-eluted, short-lived radionuclide decaying 89% through positron emission (energy of 1.92 MeV). 68Ga has versatile chemistry & can easily be labelled with various peptides using different chelators, Some of the commonly used 68Ga peptides are- 68Ga-DOTATATE, Ga68-DOTANOC, Ga68-PSMA etc. Recently a CXCR4 specific peptide – Pentixafor introduced into clinic for various oncological conditions. We were the first centre in Asia to produce it & take into clinical studies using Scintomics Automatic synthesising module (Procured under DST-FIST grant, Govt of India).

Materials and Methods – 68Ga is obtained from ITG 68Ge/68Ga Generator (GMP).

The 68Ge-68Ga generator was eluted with 4 mL 0.05 M HCl for labeling. For testing, the generator was eluted with 6 ml 0.05M HCl collecting 1 ml fractions to determine 68Ga activity, elution yield and profile.

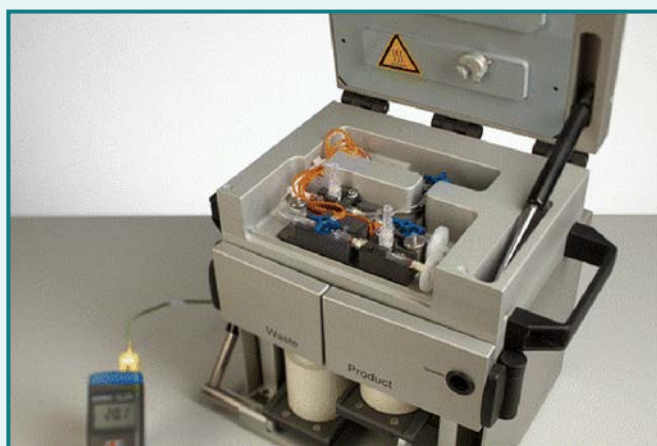
Prepurification of the eluent is needed to obtain high 68Ga labeling yields (>90, which is based on a modified Dodecyl-3,4,5-trihydroxybenzoate hydrophobically bounded on an Octadecyl modified silica resin (C-18).

Labelling of 68Ga-PENTIXAFOR

Materials and method for preparation –

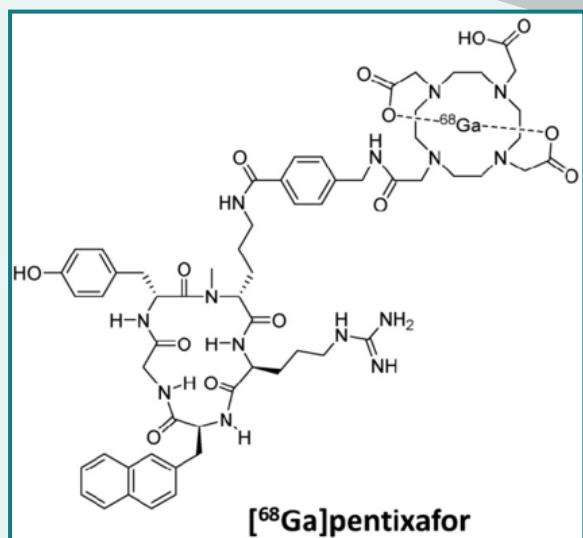
The labelling is kit based on the automatic module with various reagents.

The reagents are tested for bioburden and bacterial endotoxin. The kit contains the following components:



1. Cassette for synthesis of ^{68}Ga peptides.
2. PS-H Cartridge
3. 5M Sodium Chloride solution
4. Ethanol
5. Ethanol/Water (1:1)
6. Phosphate buffered Saline
7. 1.5M HEPES Buffer solution
8. Water for Injections

The automatic labelling was carried out with inbuilt sequence .



A radioconjugate composed of a synthetic, cyclic pentapeptide analog of stromal-cell derived factor-1 (CXCL12), which is a ligand for chemokine receptor C-X-C type 4, that is radiolabelled with the ^{68}Ga use for imaging CXCR4-expressing cells. Upon administration of ^{68}Ga -pentixafor, the pentixafor moiety targets and binds to CXCR4-expressing cancer cells.

RESULTS AND CONCLUSIONS – An experience of over 3 years of synthesise of ^{68}Ga -Pentixafor: Complete labelled process takes 34 minutes and final volume of product is 16 ml. The radiolabelling efficiency is approximately around 72 %. The radiolabelled probe has versatile application in more than 27 human tumors. We have explored its role in Carcinoma of Lung, Breast, Multiple Myeloma, Glioblastoma multiforme (GBM), Hepatocellular Carcinoma (HCC).

“ ^{18}F -PSMA – AN CYCLOTRON BASED ALTERNATIVE FOR GENERATOR BASED (^{68}Ga -PSMA)”.

** Sharma P, Watts A, Singh H, B R Mittal, PGIMER, CG, INDIA*

**Lead Speaker*

Prostate specific membrane antigen (PSMA) is highly expressed in prostate cancer. The prostate-specific membrane antigen (PSMA) targeted positron-emitting-tomography (PET) tracer ^{68}Ga -PSMA shows good results in the detection of prostate cancer. But due to several disadvantages of Ga^{68} as a radiolabel, including short half-life and non-ideal energies, and due the superior characteristics of ^{18}F , ^{18}F labelled analogs are developed. ^{18}F -PSMA-1007 was selected among several ^{18}F -PSMA-ligand analogues because it demonstrated high labelling yields, high tumor uptake and fast, non-urinary background clearance. Here, we describe the biodistribution of ^{18}F -PSMA-1007 in patients.

Material & Methods: A preliminarily study using ^{18}F -PSMA-1007 was done in Four patients with histopathological proven prostate cancer. Similar number of patients ($n=4$) of ^{68}Ga -PSMA was included in the study. Both studies were acquired post 1 hour of injection of respective radiopharmaceuticals. LYSO based PET/CT – (Discovery, GE, USA) was used to scan the patients. Whole Body contrast enhanced CT (120Kev, 250mAs) was acquired followed by 7-8 bed position PET (2min/bed for ^{18}F & 3/min ^{68}Ga). To study and compare the Biodistribution of both the radiopharmaceuticals was Standardized uptake values (SUV max) were calculated for each of the following organs i.e. brain, lacrimal glands, salivary glands, lungs, heart, aortic arch, liver, pancreas, intestine, kidneys ,bladder, prostate, gluteal muscle and bone.

Results: Both radiopharmaceutical showed excellent localization in the target organ (Prostate) but 18F-PSMA edged over its 68Ga-PSMA by relatively very low mean SUVmax values in the urinary bladder (4.02 vs 10.56). Rest of increased and comparable normal uptake was seen in salivary glands (SUVmax-24.6 vs 15), Liver (11.5 vs 11.3), Spleen (17.7 vs 11.1), Pancreas (13.2 vs 15.7) in 18F-PSMA & 68Ga-PSMA respectively.

Conclusion: 18F-PSMA is a cyclotron produced good alternative for all the sites that don't have 68Ge-68Ga Generator, as this can be procured from a commercial cyclotron site. 18F-PSMA outscores over its 68Ga twin in terms of relative SUVmax values in the urinary bladder, allowing clear interpretation of the prostatic bed without much interference of radioactive urine.

SET OF FLUORINE 18 LABELED RADIONUCLIDES PRODUCED AT PGIMER, CHANDIGARH

***Rajeshwari R, Jenab, Watts A, Shukla RVJ, B R Mittal**

Department of Nuclear Medicine, PGIMER, SECTOR 12, CHANDIGARH.

***Lead Speaker**

OBJECTIVE: To elaborate on variety of Fluorine 18 labelled radiopharmaceuticals produced at the Department of nuclear medicine, PGIMER, Chandigarh.

INTRODUCTION: Fluorine-18 labelled radiopharmaceuticals are frequently used in PET in both clinical and preclinical research. F-18 decays by positron emission with the half life of 109.7 min, 635 keV positron energy. Its versatile chemistry and simple and efficient labelling procedures allows direct and indirect introduction of F-18 into molecules of interest. The combination of moderate resolution and sensitivity of PET imaging with validated radiopharmaceuticals allows interpretation of biological functions and disease diagnosis as follows:

S.No.	F-18 LABELLED RADIOPHARMACEUTICAL	MECHANISM OF UPTAKE	PRECURSOR	YIELD	TIME OF PRODUCTION
1	F-18 FDG	Based upon enhanced glycolysis by action of glucose transporter proteins, tumor mitochondria help to trap F-18 FDG into the cell.	Mannose triflate	>60%	25 min
2	F-18 FET	Transported into tumor cells by L-amino acid transporter.	Tert-butylester(TET)	15-20%	50 min
3	F-18 FCH	Incorporates into tumor cells through an active carrier mediated transport mechanism for choline, phosphorylated intracellularly by choline kinase, yielding a phosphoryl derivative, integrated into cell membrane as phosphatidylcholine.	Dibromomethane, dimethylamino ethanol.	15-20%	50 min

4	F-18 FDG	Bind with high affinity to active extracellular prostate specific membrane antigen, overexpressed glycoprotein in prostate cancer.		30-40%	40 min
5	F-18 FLT	Uptake of tracer by proliferating cells in pyrimidine salvage pathway mostly during S-phase.	N-Boc thymidine	30-40%	55 min
6	F-18 FDOPA	Transported into neuroendocrine cells via large neutral amino acid transporter protein linked to glycoprotein CD98.	1-Imidazolidinecarboxylic acid,2-(1,1-dimethylethyl)-5-[[2-fluoro-5-formyl-4-(phenylmethoxy)phenyl]methyl]-3-methyl-4-oxo-,1,1-dimethylethyl ester.	10%	1 hour,33 min
7	F-18 FES	Estrogen analogue & can measure ER binding in primary & metastatic sites.	MMSE	20%	1 hour
8	F-18 FMISO	After radiolabelled nitroimidazole enters cell via blood flow,redox reactions occur under action of xanthene oxidase. Non hypoxic cells: reduced nitro group can be oxidized into original substance. Hypoxic cells:reduced nitro group cant be oxidized rather stably combine with cellular components permanently.	MMSE	20%	1 hour

CONCLUSION: With Fluorine 18 being the backbone of PET technology. We at PGIMER, being the premier institute of the country, produce more than half dozen of 18F labelled radiopharmaceuticals in the clinics & research.

DIELECTRIC CONTRAST ENHANCING PROPERTIES OF CHITOSAN-COATED MAGNETIC NANOPARTICLES: IN-VIVO AND IN-VITRO

***Qsee H.S 1, Anushree U1, Shetty S1, Kumar R2 & Bharati S1**

1Department of Nuclear Medicine, Manipal College Health Professional, Manipal Academy of Higher Education, Manipal 576104, India

2Department of Radiotherapy and Oncology, Kasturba Medical College Manipal, Manipal Academy of Higher Education, Manipal 576104, India

***Lead Speaker**

Abstract

Dielectric spectroscopy is a technique known to diagnose diseases based on the dielectric contrast of the tissues. In the present study, chitosan-coated magnetic nanoparticles (CMNPs) were investigated for their potential use as a dielectric contrast enhancing material for dielectric spectroscopy. Magnetic nanoparticles were synthesized by co-precipitation method and coated with chitosan. The morphological and magnetic characteristics of the synthesized particles were assessed using DLS, FE-SEM and FTIR spectroscopy. The in-vivo dielectric contrast enhancing property of CMNPs was evaluated in male BALB/c mice. Male BALB/c mice were divided into control and CMNP groups. CMNP and control group animals were given single intravenous injection of CMNPs (15mg/kg body weight) and saline respectively. Uptake of CMNPs in the liver was assessed using cellular iron staining and tissue dielectric data was captured using a four-pin silver electrode probe with 10 data points within a frequency range of 4 Hz- 1 KHz. CMNPs have spherical morphology and hydrodynamic diameter ranging from 100-120 nm. A significant increase in tissue conductivity was observed in the regions of CMNPs uptake. Tissue permittivity was also significantly affected by the deposition of CMNPs in hepatic parenchyma.

CMNPs showed good tissue dielectric contrast enhancing property that could be utilized for early and better diagnosis of pathologies.

Keywords

Iron oxide nanoparticles, Impedance spectroscopy, Electrical impedance tomography, Relative permittivity.

THERAPEUTIC EFFICACY OF PSMA LABELLED RADIOPHARMACEUTICALS - A COMPARATIVE REVIEW

PN, Jain R, VA, Jhons J, *Khazi S

Manipal college of health professional (MCHP), MAHE, MANIPAL, KARNATAKA, INDIA

***Lead Speaker**

PSMA is a type 2 integral membrane glycoprotein with folate hydrolase and carboxypeptidase. With the several targeted approaches to examine prostate cancer using PSMA.

The aim of this contribution is to review the current role of PSMA as a marker for Prostate Cancer therapy. Prostate cancer is the second most common cancer in males worldwide and causes a estimated 90,000 deaths per year in Europe. Primary treatment for localized Prostate cancer is Radical Prostatectomy, following which salvage radiotherapy and Lymphadenectomy are the options with a curative approach in patients with residual or recurrent Prostate cancer. Radiopharmaceuticals with the same or similar mechanism of action or different other properties can be used to identify patients with Prostate cancer. Lutetium (Lu-177) has gained popularity as the therapeutic radionuclide of choice due to its desirable physical properties. Ideally, The emission characteristics of a therapeutic radionuclide should match the lesion size/volume to be treated to ideally focus energy within the tumor rather than the tissue surrounding the lesion. Lu-177 is a medium energy beta emitter (490 keV) with a maximum energy of 0.5 MeV and maximal tissue penetration of <2mm. The shorter beta range Lu-177 provides better irradiation of small tumors. The gamma emission from Lu-177 allows for ex vivo imaging and consequently the collection of information pertaining to tumor localization and dosimetry. Furthermore, Lu-177 has a relatively long physical half life of 6.73 days. It is these physical properties that allow for the delivery of high activities of Lu-177 PSMA to prostate cancer cells.

Currently several small molecule PSMA ligand with excellent in vivo tumor targeting characteristics are being investigated for their potential in theranostic applications in Prostate cancer. Therefore, numerous PSMA targeting tracers have been developed and (pre)clinically studied with promising results. However, many of these PSMA targeting tracers show uptake in healthy organs such as the salivary glands causing radiotoxicity. Further more, not all patients respond to PSMA targeted radionuclide therapy (TRT). This created the necessity of additional preclinical research studies in which existing tracers are pre-evaluated and new tracers are developed in order to improve PSMA- TRT by protecting the (PSMA – expressing) healthy organs and improving tumor uptake. In this review, we will give an overview of the recent preclinical research projects regarding prostate cancer – TRT using PSMA specific radiotracers which will give an indication of where the PSMA – TRT research movement is going and what we can expect in future clinical trials.

RADIOLABELLED NANOPARTICLES IN TARGETED CANCER THERAPY: ONE ARROW MULTIPLE HITS

1*Shetty, S., 2Anushree, U., 1Bhushan, S., 3Kumar, K. & 1Bharati, S.

1Department of Nuclear Medicine, MCHP, MAHE, Manipal.

2Department of Nuclear Medicine, AIIMS Jodhpur.

#Correspondence to: sanjay.bharati@manipal.edu

***Lead Speaker**

Introduction: Tumour tissues show diverse degree of heterogeneity with respect to differentiation, invasiveness and vascularity. Most of the therapeutics only target actively dividing cells neglecting other cells which can then regenerate after several years of therapy. Hence, heterogenous distribution and lack of self-targeting of radionuclides are among the major challenges. Recent advances in nanotechnology have led to the development of nanoparticles which can be flexibly tailored to address several hurdles in the way of drug delivery and effective treatment. This review deciphers the present status of radiolabelled nanoparticle based therapies and related challenges.

Objective: To discuss the current status of nanoparticle based delivery of radionuclides and their future applicability in effective oncological therapies

Methods: PubMed/Medline, Science Direct, Scopus, Web of Science and EMBASE databases were used to obtain the articles from the year 2000 to 2020. Studies were screened and relevant works were abstracted and analysed.

Discussion: In this review, we have discussed different types of radiolabelled nanoparticles and area where they being used for cancer diagnosis and treatment. Advantages and challenges in developing radiolabelled nanoparticles and summarizes the recent advances in the applications of radiolabelled nanoparticles for cancer diagnosis and treatment.

Conclusion: Our work endeavours to provide a basic interpretation of radiolabelled nanoparticles in diagnosis and treatment of cancer.

Keywords: Radiolabelled nanoparticles, cancer therapy and nanotechnology.

MO-99 CRSIS: ALTERNATIVE PRODUCTION METHODS OR COMPLETE TRANSITION TO POSITRON EMISSION TOMOGRAPHY

****Akshita P,***

Dept of nuclear medicine, MCHP, MAHE, MANIPAL, INDIA

****Lead Speaker***

More than 80% of all diagnostic procedures in the world are carried out every year using ^{99m}Tc ($T_{1/2} = 6 \text{ h}$) separated from ^{99}Mo ($T_{1/2} = 66 \text{ h}$). Currently, most ^{99}Mo is produced by the fission reaction of enriched ^{235}U in about nine research reactors around the world. However, an unscheduled shutdown of some of the reactors in 2008–2009 caused a shortage of ^{99}Mo worldwide. The shortage of ^{99}Mo due to the incident has triggered widespread discussions on the medium- and long-term supplies of ^{99}Mo . In fact, a variety of alternative methods to produce ^{99}Mo and/or ^{99m}Tc in reactors and accelerators have been proposed. Nagai and Hatsukawa proposed a new route of producing ^{99}Mo via the $^{100}\text{Mo}(n,2n)^{99}\text{Mo}$ (hereafter, $(n,2n)^{99}\text{Mo}$) reaction using accelerator neutrons produced by the $\text{C}(d,n)$ reaction using deuteron beams. However, there are various challenges associated with the production method such as those related to logistics, cost and waste disposal and other chemical and radionuclide impurities. Challenges associated are reactor and cyclotron based.

Conclusion:- Apparently, the future use of ^{99m}Tc and traditional nuclear medicine although debatable, PET completely replacing γ imaging seems unrealistic for a number of reasons. Although this may hold true for developed countries, it may not be feasible for the developing countries, given the fact that PET radiopharmaceuticals are 10 times more expensive than SPECT. Even if costs of ^{99}Mo production increase 5-fold, there is still a substantial margin. The expansion in availability of PET over the last 10 years has been based on a single radiopharmaceutical, ^{18}F -FDG and there is no appreciation of the complexity (and cost) of supply of a range of short lived, cyclotron produced PET radiopharmaceuticals. Generator production would alleviate this somewhat, but supply is only one part of the equation. Moreover, the equipment: PET scanners are more expensive and less flexible than γ cameras. While PET will likely continue to expand, I feel that the current ^{99}Mo shortage crisis will force scientific and political solutions that will ensure the future of ^{99m}Tc . Both SPECT and PET chemistry will be enriched by meeting this challenge.

TRACK 4: RADIATION PROTECTION AND DOSIMETRY

COMPARISON OF INTERNAL DOSE ESTIMATES OBTAINED USING ORGAN LEVEL, VOXEL S VALUE, AND MONTE CARLO TECHNIQUES – A COMPARITIVE REVIEW

*Mohammed a, PA, *Macha B, Sunny B, Narayanan A*

Manipal college of health professions(MCHP)

Manipal academy of higher education (MAHE), Manipal, Karnataka, India

**Lead Speaker*

Absorbed dose calculations for internal radionuclides are used to assess the stochastic and deterministic risks to normal tissues associated with diagnostic and therapeutic nuclear medicine procedures. Calculations are also used to assess efficacy for radionuclide therapy. Here we will be comparing three dose calculation methods that vary in complexity and in the accuracy of the dose estimates that they produce for four different radionuclides, ^{99m}Tc , ^{131}I , ^{177}Lu , and ^{90}Y . Doses calculated using Organ Level (OLINDA/EXM) software and the voxel S value technique are compared to the results obtained from Monte Carlo simulation, a reference standard for the purposes of this review.

OLINDA/EXM is used programs for organ-level dose calculations as activity is assumed to be uniformly distributed in source organs and the dose is assumed to be uniformly deposited throughout each target organ. The voxel S value approach considers activity distributions at the voxel level and calculates the corresponding voxelized dose distribution. Monte Carlo techniques use the known physics of photon and particle interactions with matter to simulate radiation transport. It is quite complicated and requires very long computation times.

Organ doses calculated by OLINDA/EXM were found to be in good agreement with Monte Carlo mean dose estimates and agreed reasonably well with Monte Carlo dose estimates with therapeutic agents (^{131}I , ^{177}Lu , and ^{90}Y). Monte Carlo simulation may not currently be feasible for routine patient dose calculations, voxel S values have been shown to produce nearly equivalent 3D dose distributions.

TUNGSTEN BASED RADIATION SHIELDING MATERIALS: A REVIEW ON ONGOING RESEARCH

****T Jacob.R. , Ahad.T***

***Department of Nuclear medicine, Manipal College of Health Professions (MCHP), MAHE
Manipal, Karnataka, India.***

****Lead Speaker***

ABSTRACT:

Attenuation or shielding of gamma radiation is an important component of radiation safety programs aiming to reduce personnel exposure to ionizing radiation. Lead is the most used material in nuclear technology as shielding material and collimator. Beside the good properties of lead such as relatively very cheap and easy to get and having high linear and mass attenuation coefficients, it is hazardous material for the people and environment. Therefore, some other materials have to be researched against lead related with its radiation shielding properties. Various researchers have suggested the use of tungsten/ tungsten composite materials based on different experimental studies, but also it has some advantages and disadvantages to its use. Tungsten is often recommended due to its highest mass and linear attenuation coefficients, high melting point, and low erosion for high energy threshold for sputtering. Furthermore, Tungsten composite materials like WC Co are used for high gamma radiation shielding applications because of its high density and favorable mechanical properties. Also the linear attenuation coefficients of WC Co are nearly same as that of lead. On the other hand, tungsten has some disadvantages like poor machinability, recrystallization and potential loss of melt layer during transient events. In addition, some problems/difficulties of using tungsten are due to its brittleness, hardness and heaviness. Thus, after studying the whole study, we come to a conclusion that further research is required to define that the tungsten composite materials like WC Co are the most promising shielding and collimator materials for the future gamma radiation applications.

“NEW SHIELDING MATERIAL FOR TRANSPORTATION OF RADIO-ISOTOPES”

****Naik Govenkar¹A.A, Tenzin Zongpa²B.B, Bhushan³C.C, Oommen⁴D.D***

MCHP, MAHE, Manipal

****Lead Speaker***

Abstract:

Objectives: Shipping of Radioactive Materials often consist of a risk of being accidentally broken during transportation to a radio pharmacy laboratory. This happens due to lack/ insufficient shock absorbent materials which can withstand an impact. Metal foam is an excellent material which can withstand a crash. It's similar to a Styrofoam(thermocool)which is used in day to day life in the transportation of electronics. Its cellular structure consists of a solid metal (usually aluminium) with gas-filled pores comprising a large portion of the volume. The pores can be sealed (closed-cell foam) or interconnected (open-cell foam).

Method: The radio-isotope will be Surrounded and cushioned by one layer of soft sponge and another layer of hard sponge. The next layer will consist of Styrofoam (thermocol). This layer will be reinforced by metal foam and lastly followed by a plastic layer.

Result: A comparatively strong carrier material which will be able to withstand any type of accidents during transportation.

Conclusion: An impact proof material in transportation of radio-active isotopes.

TRACK 5: NUCLEAR MEDICINE PHYSICS AND INSTRUMENTATION

ADVANTAGES OF DIGITAL PET-CT OVER CONVENTIONAL PET-CT

**Sibu.K, Mon SS, Indirani M, Rao NS*

*Nuclear medicine Department, Apollo Hospitals,
Chennai 600006, Tamilnadu.*

**Lead Speaker*

OBJECTIVES:

Positron Emission Tomography is being widely used for diagnosis, staging and follow up of various malignancies. Although PET-CT has revolutionized clinical management, it has some limitations in the technological aspect which has led to the advent of Digital PET-CT. Digital PET-CT has increased image quality and image sharpness over conventional PET-CT.

METHODS:

Conventional PET-CT: SIEMENS BIOGRAPH (mCT) has 40 sliced CT, 4mm sized LSO crystal, Photo Multiplier Tubes in quadrant sharing pattern. The software used for image processing is SYNGOVIA. Scan duration takes about 20-25 minutes with an activity of 6-12mCi. Time per bed is decided according to the activity injected and the time to injection [minimum-1min/bed] with a bed length of 10cm.

Digital PET-CT: SIEMENS BIOGRAPH VISION has 64 sliced CT, 3.2m sized LSO crystal, Silicon Based Photodiodes in 1:1 Coupling. The software used for image processing is SYNGOVIA. Scan duration takes about 10-15 minutes with an activity of 5-7mCi. Continuous bed motion with a speed of 40sec/bed.

RESULT:

Digital PET-CT takes less time for scanning, has increased image sharpness, image resolution and image quality.

The activity injected is less thus resulting in less radiation exposure to patients when scanned in Digital PET-CT.

INFERENCE:

With less timing duration for scan, better image spatial resolution, easily detectable small lesions, with increase in sensitivity.

The Digital PET-CT technology surpasses Conventional PET-CT in all aspects.

TRACK 6: MISCELLANEOUS

RESTORATION OF Tc-99m MDP WHOLEBODY BONE SCAN IMAGES USING RICHARDSON-LUCY ALGORITHM

**Sonker D, Pandey AK, Patel CD, Bal CS, Kumar R*

Department of Nuclear Medicine, All India Institute of Medical Sciences, New Delhi- 110029, India

**lead presenter*

Objective: To estimate and validate optimum value of Point Spread Function (PSF) and Number of iterations (NITERS) to restore Tc-99m MDP bone scan images using Richardson- Lucy algorithm.

Method: A set of 42 Tc-99m MDP bone scans acquired using LEHR collimator were included. Optimum value of PSF and NITERS were estimated as follows: Five images were processed with PSF [(size, sigma) : (3,0.5), (5,0.75), (7,1), (9,1.5), (11,1.5), (13,2)] and for each PSF, NITERS ranged from 1 to 10. The processed images were visually compared with its corresponding input image, and the value of PSF and NITERS that resulted in best image quality were considered as optimum value. For validation, all 84 images were processed with optimum values of the parameters estimated from previous step, and processed images were visually compared with its input image.

Results: PSF (5, 0.75) with NITERS = 10, PSF (7, 1) with NITERS = 10, **PSF (9, 1.5) with**

NITERS = 10, PSF (11, 1.5) with NITERS = 10 resulted in 10, 2, **46** and 26 best images respectively. Comparison of image processed with **PSF (9, 1.5) with NITERS = 10** and selected best image revealed same clinical details with slight difference in visual perception.

Conclusion: **PSF (9, 1.5) with NITERS = 10** was found to be the optimum value for restoring Tc-99m MDP bone scan images using Richardson-Lucy algorithm.

REMOVING BLADDER REGION FROM 99mTc-MDP BONE SCAN IMAGE USING SEMIAUTOMATIC ADAPTIVE THRESHOLDING METHOD

**Lavanya K, Pandey AK, Yashwariya, Sonker D, Patel CD, Bal CS and Kumar R.*

Department of Nuclear Medicine, All India Institute of Medical Sciences, New Delhi – 110029.

**lead presenter*

Objective: Completely or partially filled bladder region is often seen in 99mTc- MDP Bone Scan images. In this situation, the structures other than bladder are not clearly visualised; Nuclear Medicine physician finds difficulty to interpret this type of images. In this study we have used semiautomatic adaptive thresholding method for removing bladder region from the image. Method: Three hundred fourteen 99mTc- MDP bone scan studies were exported in DICOM

3.0 format. A PC based program (R Script) was written for processing and displaying these images. After inspecting 628 images, 48 images containing completely or partially filled bladder region were selected for further processing using semiautomatic adaptive thresholding

method. The resultant mask was used to remove bladder from the image. Two Nuclear medicine physicians verified the performance of the method by visually comparing the input image and its corresponding image (removed bladder region) and assigned score on a scale 1 to 5 [where 1 is for poor and 5 is for the excellent performance accuracy] for each image set.

Result: The input parameter of adaptive thresholding at which the images were segmented varied from image to image. Fifteen-time square window of sizes 100 and 50 provided the segmented image; and offset varied from 0.03 to 0.3. The segmentation accuracy was found to be 90-100% in 41 images, 80-90% accuracy in 6 images and 70-80% in 1 image.

Conclusion: In 85 percent (41 out of 48) cases the performance accuracy of the method was found to be greater than 90%. Hence semiautomatic adaptive thresholding can be used for removing bladder region from the ^{99m}Tc -MDP bone scan images.

PET RADIOPHARMACEUTICAL ADMINISTRATING MODULE- A PALISADE FOR NEW ERA

****Shetty MP; Babu PS; Vignesh; Vasumathi; Kamal R***

Dept. of Nuclear Medicine, Manipal College of Health Professions, Manipal Academy of Higher Education Manipal, INDIA

****Lead Speaker***

Background: Radiation safety is the main health concern among all professionals. With the rise in the use of positron emission tomography (PET) in nuclear medicine imaging, handling of PET radiopharmaceuticals, which is observed to contribute huge radiation doses to occupational personnel, is a matter of concern today. Growing emphasis on optimization of protection and safety to the occupational personnel is reflected in the evolution of rapid, remote and reliable handling systems. Although innovative devices and systems for remote handling of various operations associated with high radiation exposure have been developed; a fully automated radiopharmaceutical dose administration module has not been developed till date.

Introduction: Addressing the impact of radiation exposures to occupational worker and keeping the fundamentals of radiation safety in consideration we are proposing a new design. This is achieved by compiling all the salient points of newly available technological developments that could resolve the major concerns of radiation safety to the personnel, increasing the efficacy of work and expanding the patient throughput with minimal man power requirements.

Design and Concept: The design includes the use of compressor pump based pneumatic tube for the movement of radiopharmaceuticals to an automated dispenser and thermal camera based robotic injector system.

Technical Impact: It is observed from previous studies that a standalone automated dose dispensers has reduced the radiation dose to a ratio of 7:4 in personnel in comparison to shielding systems, thus the implementation of an automated PET radiopharmaceutical administration module not only overcomes the challenges of radiation burden but also serves the community with multiple benefits.

method. The resultant mask was used to remove bladder from the image. Two Nuclear medicine physicians verified the performance of the method by visually comparing the input image and its corresponding image (removed bladder region) and assigned score on a scale 1 to 5 [where 1 is for poor and 5 is for the excellent performance accuracy] for each image set.

Result: The input parameter of adaptive thresholding at which the images were segmented varied from image to image. Fifteen-time square window of sizes 100 and 50 provided the segmented image; and offset varied from 0.03 to 0.3. The segmentation accuracy was found to be 90-100% in 41 images, 80-90% accuracy in 6 images and 70-80% in 1 image.

Conclusion: In 85 percent (41 out of 48) cases the performance accuracy of the method was found to be greater than 90%. Hence semiautomatic adaptive thresholding can be used for removing bladder region from the ^{99m}Tc -MDP bone scan images.

PET RADIOPHARMACEUTICAL ADMINISTRATING MODULE- A PALISADE FOR NEW ERA

****Shetty MP; Babu PS; Vignesh; Vasumathi; Kamal R***

Dept. of Nuclear Medicine, Manipal College of Health Professions, Manipal Academy of Higher Education Manipal, INDIA

****Lead Speaker***

Background: Radiation safety is the main health concern among all professionals. With the rise in the use of positron emission tomography (PET) in nuclear medicine imaging, handling of PET radiopharmaceuticals, which is observed to contribute huge radiation doses to occupational personnel, is a matter of concern today. Growing emphasis on optimization of protection and safety to the occupational personnel is reflected in the evolution of rapid, remote and reliable handling systems. Although innovative devices and systems for remote handling of various operations associated with high radiation exposure have been developed; a fully automated radiopharmaceutical dose administration module has not been developed till date.

Introduction: Addressing the impact of radiation exposures to occupational worker and keeping the fundamentals of radiation safety in consideration we are proposing a new design. This is achieved by compiling all the salient points of newly available technological developments that could resolve the major concerns of radiation safety to the personnel, increasing the efficacy of work and expanding the patient throughput with minimal man power requirements.

Design and Concept: The design includes the use of compressor pump based pneumatic tube for the movement of radiopharmaceuticals to an automated dispenser and thermal camera based robotic injector system.

Technical Impact: It is observed from previous studies that a standalone automated dose dispensers has reduced the radiation dose to a ratio of 7:4 in personnel in comparison to shielding systems, thus the implementation of an automated PET radiopharmaceutical administration module not only overcomes the challenges of radiation burden but also serves the community with multiple benefits.

A decorative graphic in the top right corner consisting of several overlapping squares in shades of teal and grey, some with white outlines, arranged in a scattered pattern.

Bjmadan & Co.
New Delhi

Nuclear Medicine
Targeting Tumors

A solid teal horizontal bar at the bottom of the page.

www.nmpai.org