IRANIAN JOURNAL OF NUCLEAR MEDICINE

Iranian Journal of Nuclear Medicine is a peer-reviewed journal, covering basic and clinical nuclear medicine sciences and relevant applications such as molecular imaging, functional and metabolic investigation of disease, radiobiology, dosimetry, radiopharmacy, radiochemistry, instrumentation and computer sciences, etc. The journal was established by Research Center for Nuclear Medicine, Tehran University of Medical Sciences in 1993 and is published in cooperation with the Iranian Society of Nuclear Medicine. "Iran J Nucl Med" is a fully access journal and publication in this journal is totally free.

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INSTRUCTION TO AUTHORS

Aims and Scope

Iranian Journal of Nuclear Medicine is a peer-reviewed biannually journal of the Research Institute for Nuclear Medicine, Tehran University of Medical Sciences, covering basic and clinical nuclear medicine sciences and relevant application. The journal has been published in Persian (Farsi) from 1993 to 1994, in English and Persian with English abstract from 1994 to 2008 and only in English language form the early of 2008 two times a year. The "Iran J Nucl Med" is indexed and abstracted in the world-known bibliographical databases including SCOPUS, ESCI (Emerging Sources Citation Index), EMBASE, EBSCO, DOAJ, ISC, Index Copernicus, IMEMR, SID, Google Scholar, Ulrichsweb™, ROAD, Sherpa Romeo, EuroPub, MIAR, CIVILICA, ABCD Index, Scientific Indexing Services, Electronic Journals Library, Academic Resource Index, CiteFactor, Magiran. The journal has an international editorial board and accepts manuscripts from scholars working in different countries.

Manuscript submission

There are no charges for publication in this journal and all manuscripts should be submitted via journal URL: http://irjnm.tums.ac.ir

Conditions and Ethics

Manuscripts are considered with the understanding that they are submitted solely to the "Iran J Nucl Med" and have not been published elsewhere previously either in print or electronic format, and are not under consideration by another publication or electronic medium. Submission of an article for publication implies the transfer of the ***copyright*** from the authors to the "Iran J Nucl Med" upon acceptance. The final decision of acceptance rests with the Editor. Authors are responsible for all statements made in their papers. All accepted papers become the permanent property of the "Iran J Nucl Med" and you may not modify copy, distribute, transmit, display, or publish elsewhere without written permission from the "Iran J Nucl Med". Authors should refrain from contacting the mass media about papers that are being peer reviewed or in press; the Editor reserves the right to withdraw an article from publication if it is given media coverage at any stage of the review/publication process.

Ethical considerations will be taken into account in the assessment of papers that have experimental investigations of human or animal subjects. Authors should state in the Methods section of the manuscript that informed consent was obtained from all human adult participants and from the parents or legal guardians of minors and an appropriate institutional review board approved the project. Those investigators without such review boards should ensure that the principles outlined in the Declaration of Helsinki have been followed.

Manuscript categories

Original articles

These include controlled trials, interventional studies, studies of screening and diagnostic tests, outcome studies, cost-effectiveness analyses, and large-scale epidemiological studies. Each manuscript should clearly state an objective; the design and methodology; the essential features of any interventions; the main outcome measures; the main results of the study; a discussion placing the results in the context of published literature; and the conclusions which can be drawn based on the study. The text should not exceed 4000 words, the number of tables, figures, or both should not be more than six, and references not more than 40.

Review articles

These are, in general, invited papers, but unsolicited reviews, if of good quality, may be considered. Reviews are systematic critical assessments of literature and data sources pertaining to clinical topics, emphasizing factors such as cause, diagnosis, prognosis, therapy, or prevention. The text should not exceed 6000 words, the number of tables, figures, or both should not be more than ten, and references not more than 120. All articles and data sources reviewed should include information about the specific type of study or analysis, population, intervention, exposure, and test or outcomes. All articles and data sources should be selected systematically for inclusion in the review and critically evaluated, and the selection process should also be described in the paper.

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Case reports will be accepted only if they deal with a clinical problem that is of sufficient interest. The text should not exceed 2500 words; the number of tables, figures, or both should not be more than four; references should not be more than 25.

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Commentaries on current topics or on papers published elsewhere in the issue. Length should not exceed 2000 words; tables or figures are allowed only exceptionally; references should not be more than 40.

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Letters discussing a recent article in the "Iran J Nucl Med" are welcome and should be sent to the Editorial Office by e-mail <irjnm@sina.tums.ac.ir> within 6 weeks of the article's publication. Letters that do not refer to an "Iran J Nucl Med" article may also be considered. The text should not exceed 1000 words, have no more than two figure or table, and 10 references.

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Manuscripts submitted to the "Iran J Nucl Med" should meet the following criteria: the content is original; the writing is clear; the study methods are appropriate; the data are valid; the conclusions are reasonable and supported by the data; the information is important; and the topic has general medical interest. Manuscripts will be accepted only if both their contents and style meet the standards required by the "Iran J Nucl Med".

Manuscript preparation

Authors should refer to a current issue of the "Iran J Nucl Med" and to the Uniform Requirements for Manuscripts Submitted to Biomedical Journals for guidance on style. Use Arabic numerals for numbers above nine, for designators (e.g. case 5, day 2, etc) and for units of measure; numbers should be spelled out if below 10, at the beginning of sentences, and for fractions below one. Manuscripts should be word-processed double-spaced.

The manuscript (complete with tables and figures) should be submitted via journal URL: http://irjnm.tums.ac.ir

The manuscript should be accompanied by the following statements, signed by all the authors: "No work resembling the enclosed article has been published or is being submitted for publication elsewhere. We certify that we have each made a substantial contribution so as to qualify for authorship and that we have approved the contents. We have disclosed all financial support for our work and other potential ***conflicts of interests***." Use System International (SI) measurements only, except when "Dual report" is indicated in the SI unit conversion table. Use generic names of drugs, unless the specific trade name of a drug used is directly relevant to the discussion. When generic names are not available, brand names which take an initial capital can be used. In Original articles, the maker of the study drug must be given. Do not use ***abbreviations and symbols*** in the title or abstract and limit their use in the text. Standard abbreviations may be used and should be defined on first mention in the text unless they are the standard units of measurement. In general, terms should not be abbreviated unless they are used repeatedly and the abbreviation is helpful to the reader.

Peer review and publication processes: All manuscripts are considered to be confidential. They are peer reviewed by at least 2 anonymous reviewers selected by the Editorial Board. The corresponding author is notified as soon as possible of the editor decision to accept, reject, or require modifications. If the manuscript is completely acceptable according to the criteria set forth in these instructions, it is scheduled for the next available issue. A computer print out is sent to the corresponding author for ***proof reading*** before publication in order to avoid any mistakes. Corrections should be marked clearly and sent immediately to the journal office. The corresponding author will be supplied with 2 free issues. Once published, all copies of the manuscript, correspondence and artwork will be held for 6 months before disposal.

Arrangement

Title page-This page should contain (1) the title, (2) names and surnames of authors, with their degrees [maximum two] and affiliations; if an author's affiliation has changed since the work was done, list the new affiliation as well, (3) the full address, phone and fax numbers, and e-mail address of the corresponding author, and (4) a short running head of no more than 40 characters.

Abstract-The abstract should not exceed 250 words for structured (Original articles, Review articles) unstructured abstracts (Case reports). The abstract should be concise, summarizing the purpose, basic procedures, main findings (giving specific data and their statistical significance, if possible), and principal conclusions of the investigation. Abstract headings should be as follows: Objective, Design, Setting, Patients (or Participants), Interventions (if any), Main outcome measures, Results, and Conclusions (for Original articles); Objective, Data sources, Study selection, Data extraction, Data synthesis, and Conclusions (for Review articles); or Objective, Participants, Evidence, Consensus Process, and Conclusions (for Consensus statements).

Key words-At the end of the abstract, authors should provide no more than five key words to assist with cross-indexing of the paper. Key words should be taken from Medical Subject Headings (MeSH) list of *Index Medicus* (http://www.nlm.nih.gov/mesh/MBrowser.html).

Introduction-The rationale for the study should be summarized and pertinent background material outlined. The Introduction should not include findings or conclusions.

Methods-These should be described in sufficient detail to leave the reader in no doubt as to how the results are derived.

Results-These should be presented in logical sequence in the text, tables, and illustrations; repetitive presentation of the same data in different forms should be avoided. This section should not include material appropriate to the Discussion. Results must be statistically analyzed where appropriate, and the statistical guidelines of the International Committee of Medical Journal Editors should be followed.

Discussion-Data given in the Results section should not be repeated here. This section should consider the results in relation to any hypothesis/es advanced in the Introduction. This may include an evaluation of methodology and of the relationship of new information to the existing body of knowledge in that field. Conclusions should be incorporated into the final paragraph and should be commensurate with-and completely supported by-data in the text.

Acknowledgement-All contributors who do not meet the criteria for authorship should be covered in the acknowledgement section. It should include persons who provided technical help, writing assistance and departmental head who only provided general support. Financial and material support should be acknowledged.

References-Number references in the order they appear in the text; do not alphabetize. References should follow the Vancouver style and should appear in the text, tables, and legends as Arabic numerals in parenthesis. Journal titles should be abbreviated in accordance with *Index Medicus*. Authors are responsible for the accuracy of references and must verify them against the original documents.

The following are sample references:

Standard journal article
List all authors when there are six or fewer; when there are seven or more, list the first six, then "et al" :
Mackness MI, Mackness B, Durrington PN, Fogelman AM, Berliner J, Lusis AJ, Navab M, Shih D, Fonarow GC. Paraoxonase and coronary heart disease. Curr Opin Lipidol. 1998 Aug;9(4):319-24.

As an option, the month and issue number may be omitted.
Halpern SD, Ubel PA, Caplan AL. Solid-organ transplantation in HIV-infected patients. N Engl J Med. 2002;347:284-7.

Article, no author given:
Cancer in South Africa. S Afr Med J. 1994 Dec;84(12):15.

Chapter in a book:
Phillips SJ, Whisnant JP. Hypertension and stroke. In: Laragh JH, Brenner BM, editors. Hypertension: pathophysiology, diagnosis, and management. 2nd ed. New York: Raven Press; 1995. p. 465-78.

Book, personal author(s):
Ringsven MK, Bond D. Gerontology and leadership skills for nurses. 2nd ed. Albany (NY): Delmar Publishers; 1996.

Book, editor(s) as author:
Norman IJ, Redfern SJ, editors. Mental health care for elderly people. New York: Churchill Livingstone; 1996.

Book, Organization as author and publisher:
Institute of Medicine (US). Looking at the future of the Medicaid program. Washington: The Institute; 1992.

Article in electronic form:
Morse SS. Factors in the emergence of infectious diseases. Emerg Infect Dis [serial online] 1995 Jan-Mar [cited 1996 Jun 5];1(1):[24 screens]. Available from: URL:
http://www.cdc.gov/ncidod/EID/eid.htm

Conference proceedings:
Kimura J, Shibasaki H, editors. Recent advances in clinical neurophysiology. Proceedings of the 10th International Congress of EMG and Clinical Neurophysiology; 1995 Oct 15-19; Kyoto, Japan. Amsterdam: Elsevier; 1996.

Conference paper :
Bengtsson S, Solheim BG. Enforcement of data protection, privacy and security in medical informatics. In: Lun KC, Degoulet P, Piemme TE, Rienhoff O, editors. MEDINFO 92. Proceedings of the 7th World Congress on Medical Informatics; 1992 Sep 6-10; Geneva, Switzerland.

Tables and figures

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Do not submit tables as photographs. Number tables consecutively in the order of their first citation in the text and supply a brief title for each. Give each column a short or abbreviated heading. Place explanatory matter in footnotes, not in the heading.

All non-standard abbreviations used in each table should be defined in the footnotes, in alphabetical order. Statistical measures of variations such as standard deviation, standard error of the mean, or confidence interval should be identified in headings. Vertical rules and horizontal rules should be omitted. Ensure that each table is cited in the text.

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Illustrations include photographs, photomicrographs, charts, and diagrams, and these should be camera-ready. Professional medical illustrators should be consulted when figures are prepared; freehand or typewritten lettering is unacceptable. Letters, numbers, and symbols should be clear and of sufficient size to retain legibility when reduced. The diagram should not lose clarity on reduction; it is

generally simplest to aim for a 50% linear reduction. Titles and detailed explanations should be confined to legends and not included in illustrations. Number illustrations consecutively in the order of their first citation in the text. Photographs of persons must be retouched to make the subject unidentifiable, and be accompanied by written permission from the subject to use the photograph.

The Final Checklist

The authors must ensure that before submitting the manuscript for publication, they have taken care of the following:

1- Title page should contain title, short running title, name and surname of author/co-authors, their qualifications, designation and institutions they are affiliated with and mailing address for future correspondence, e-mail address, phone and fax number.
2- Abstract in structured format up to 250 words.
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4- Do not submit tables as photographs. Make sure for heading of the table, their number.
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6- Disclosure regarding source of funding and conflict of interest if any besides approval of the study from respective Ethics Committee/Institution Review Board.
7- Covering Letter
8- Copyright Transfer Form

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We further attest that we have herein disclosed any and all financial or other relationships that could be construed as a conflict of interest and that all sources of financial support for this study have been disclosed and are indicated in the acknowledgments.

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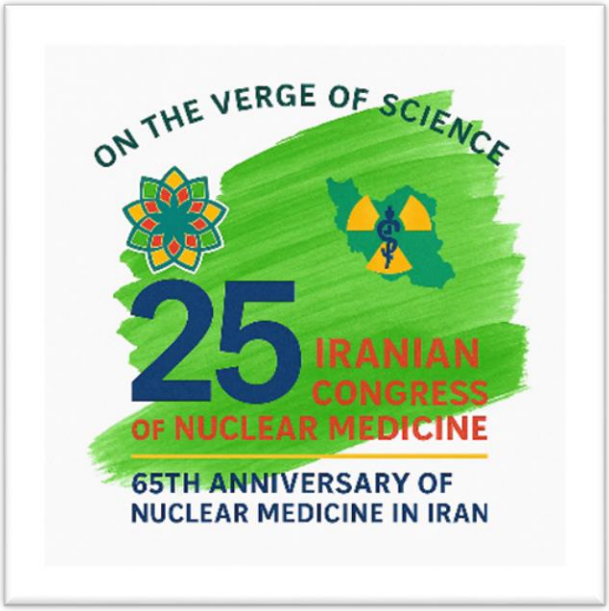


Abstracts*

The 25th Annual Iranian Congress of Nuclear Medicine
April 30 - May 2, 2025
Tehran, Iran

***The abstracts published in this supplement have been edited by the Scientific Committee of the 25th Annual Iranian Congress of Nuclear Medicine and were not subject to the standard reviewing process of the "Iranian Journal of Nuclear Medicine".**

In the Name of God, the Compassionate, the Merciful
Dear Professors, Researchers, Colleagues, and Esteemed Guests

It is with immense pleasure that I welcome you to the 25th Annual Iranian Congress of Nuclear Medicine. This event stands as a vital platform for the convergence of scholars and professionals united by a shared commitment to advancing science and improving societal well-being. As the president of this congress, I am honored to address this distinguished gathering and express my sincere gratitude for your participation.

Nuclear medicine in Iran boasts a proud legacy spanning 65 years. From its early days, driven by the vision of pioneers despite modest resources, to its present stature as a leader in cutting-edge radiopharmaceutical development, targeted therapeutic technologies and precision medicine and molecular imaging reflect the relentless pursuit of excellence by Iranian scientists and clinicians. As we convene at this congress, we not only honor this storied past but also look forward to shaping a future defined by innovation and discovery.

By visualizing biological processes at the molecular level, we embrace technologies that allow for early detection and individualized therapy, so, we move beyond treating diseases in a general sense and instead begin to treat patients as unique individuals. This is the essence of personalized medicine—delivering the right treatment, to the right patient, at the right time.

With a legacy of over six decades in Iran, the theme of this year's congress, "The Edge of Medicine", offers a unique platform for scientific exchange, where traditional boundaries are redefined through innovation and scientific courage for transforming the way we diagnose and treat diseases. It is not just a theme—it is our path forward. It is the space where curiosity, courage, and care converge. May this congress inspire bold steps toward a future where science and humanity walk hand in hand.

This future calls for stronger collaboration among clinicians, scientists, engineers, and policy-makers as well as education of future experts.

I warmly invite you to actively participate in the sessions, and dialogues by national and international experts, enriching this event and advancing our shared mission.

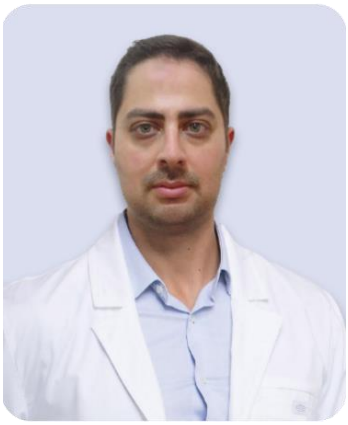
In conclusion, I extend my deepest appreciation to the Society of Nuclear Medicine and colleagues whose dedication has brought this congress to fruition and to the sponsors whose support has been invaluable. May this gathering mark a significant step toward the continued advancement of nuclear medicine and its service to humanity.

With best wishes for success and well-being,

Mahasti Amoui, MD

President of the 25th Annual Iranian Congress of Nuclear Medicine

In the name of Allah the Almighty



On behalf of the organizing committee, it is my great honor to extend a warm welcome to all distinguished participants, esteemed international guests, and renowned experts attending the 25th Annual Iranian Congress of Nuclear Medicine, taking place from April 30th to May 2nd, 2025, in Tehran. Nuclear medicine stands at the forefront of modern healthcare, revolutionizing diagnostics and therapy through cutting-edge advancements in molecular imaging and radiopharmaceuticals. This year's congress holds exceptional significance as we gather to explore groundbreaking innovations, share transformative research, and foster global collaborations that will shape the future of this dynamic field.

We are privileged to host an unparalleled assembly of world-class scientists, clinicians, and industry leaders, making this edition of the congress the most prestigious in its history. With an exceptional scientific program featuring high-profile international speakers, interactive workshops, and pioneering discussions, this event promises to elevate the standards of nuclear medicine not only in Iran but across the globe. The knowledge exchanged here will drive progress in personalized medicine, cancer theranostics, and neurological applications, reaffirming nuclear medicine's vital role in advancing human health. Together, let us embark on this remarkable journey of discovery and excellence. We look forward to your invaluable contributions and an inspiring congress.

Warm regards,

Dr Mohammadali Ghodsirad

Scientific and Executive Secretary

Dear Researchers, Distinguished Specialists, and Pioneers of Nuclear Medicine

It is a great honor and an optimistic sign that we are organizing 25th Annual Iranian Congress of Nuclear Medicine. This gathering is a unique opportunity to celebrate technological advancements in our field while reaffirming our commitment to serving society through innovative healthcare solutions.

Today, breakthroughs such as ultra-high-resolution molecular imaging, cell-targeting smart radiopharmaceuticals, and theranostic systems (combining diagnosis and therapy) exemplify nuclear medicine's potential to save lives. Tools like next-generation isotope therapy and technologies that minimize side effects are monumental strides toward precision, patient-centric care. Yet, our mission extends beyond innovation. Serving society through equitable access to advanced treatments, reducing healthcare costs, and public education on nuclear medicine's benefits is integral to our vision.

I envision a future where every patient — regardless of geography or socioeconomic status — receives the best care, This vision can only be realized through the collective efforts of researchers, clinicians, and healthcare advocates like you.

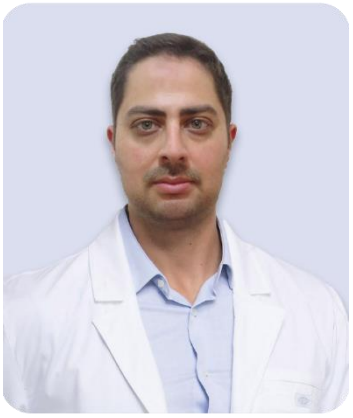
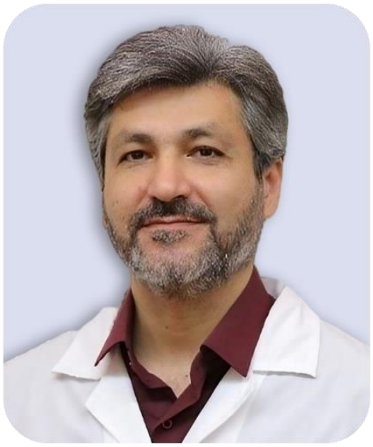
May this conference not only showcase progress but also ignite actionable steps to transform millions of lives.

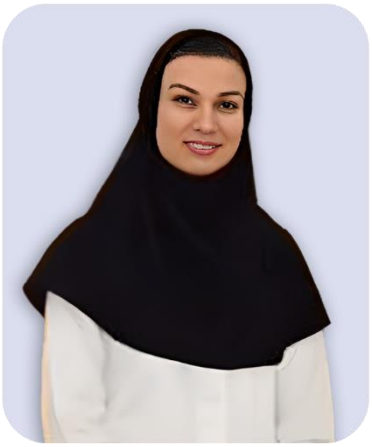
Sincerely,

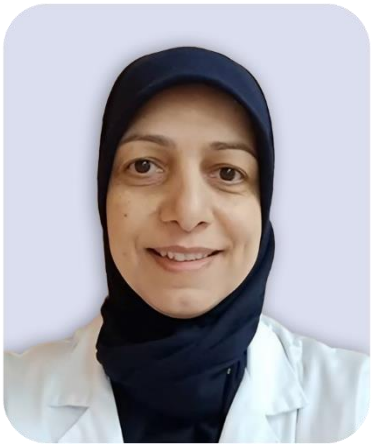
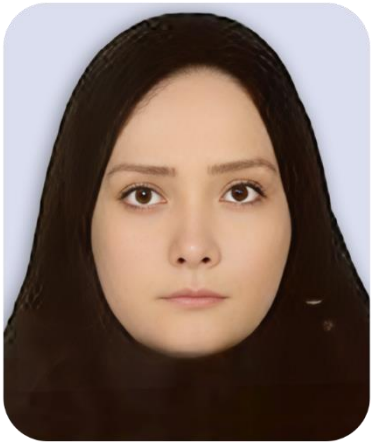
S.K. Razavi,

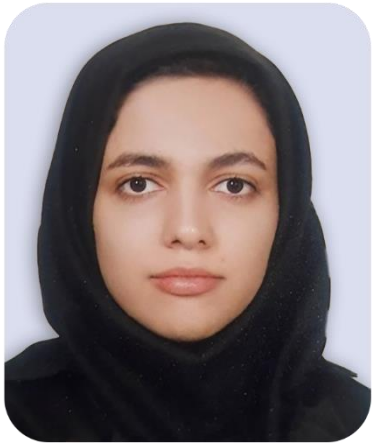
President of Iranian Society of Nuclear Medicine

Executive & Scientific Committee

Executive and scientific secretary of the 25th Annual Iranian Congress of Nuclear Medicine Head of PET-CT sessions **Dr. Mohammadali Ghodsirad** Assistant Professor of Nuclear Medicine, Shahid Beheshti University of Medical Sciences	
President of the congress Head of Board review sessions **Dr. Mahesti Amoui** Associate Professor of Nuclear Medicine, Shahid Beheshti University of Medical Sciences	
Head of cardiology sessions **Dr. Ghasem Razie** Nuclear medicine specialist, Shahid Beheshti University of Medical Sciences	

Head of thyroid cancer session **Dr Babak Shafie** Assistant Professor of Nuclear Medicine, Shahid Beheshti University of Medical Sciences	
Head of the treatment sessions **Dr Ghasem Divaband** Assistant Professor of Nuclear Medicine, Shahid Beheshti University of Medical Sciences	
Head of conventional nuclear medicine session **Dr. Samaneh Husseinzadeh** Assistant Professor of Nuclear Medicine, Shahid Beheshti University of Medical Sciences	

Head of International Division **Dr. Marzieh Nejabat** Senior physician at the Department of Radiology and Nuclear Medicine, Division of Nuclear Medicine and Molecular Imaging, Medical University of Vienna	
Head of the Physic Hall **Dr. Mohamadreza Divband** Professor of Physic, Shahid Beheshti University of Medical Sciences	
Head of the Radiopharmacy Hall **Dr. Sepideh Khoshbakht** Assistant Professor of Radiopharmacy, Shahid Beheshti University of Medical Sciences	

Head of Youth Committee **Dr. Mohadesseh Bayat** Assistant professor of Nuclear Medicine, Shahid Beheshti University of Medical Sciences	
Head of Dedicated Prostate cancer Imaging **Dr. Emran Askari** Assistant Professor of Nuclear Medicine, Mashhad University of Medical Sciences	

A1 Capability of primary production of used iodine radioisotopes in nuclear medicine in Iran

Somayeh Akbarikaradeh[1], Samira Rezaei[2], Seyed Mahmoud Reza Aghamiri[1], Ali Norouzi Aghbash[3]

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[2]Department of Reactor Engineering, Shahid Beheshti University, Tehran, Iran
[3]Iran Advanced Technologies Company, Atomic Energy Organization of Iran, Tehran, Iran

Theranostic, a promising modern concept, is a combination of diagnostic and therapeutic effects that has been used to optimize and personalize the treatment of many cancer patients. Several studies have shown that targeted delivery of radioactive iodine to the tumor site with a high residence time at the tumor site. There are 37 isotopes of iodine. The most common radioactive iodines used for medical applications are iodine-123, iodine-124, iodine-125, and iodine-131. The present review has expressesed the application of radioiodinated radiopharmaceuticals which have played an important role in nuclear medicine. The main gamma emission peak of I-123 (half-life of 13.22 h), 159 keV, makes it suitable for SPECT imaging. I-125 (half-life of 59.4 days) has mainly X-ray energy emission at 27 keV. I-131, a beta-emitting isotope (606 keV) and a half-life of 8.02 days, is used for radiotherapy. I-131 emits gamma photons that can be used for SPECT imaging. I-124 as a positron emitter and with a half-life of 4.18 d is used for PET imaging of thyroids and parathyroid. The therapeutic effect of the I-124 radionuclide is based on the Auger electrons and is localized within several nanometers. Given the wide applications of iodine isotopes in nuclear medicine, it is essential to produce them domestically. To achieve this goal, the Iran Advanced Technologies Company affiliated with the Atomic Energy Organization of Iran has been able to isolate the stable isotopes tellurium-130, tellurium-124, and tellurium-125, as well as xenon-124, to produce widely used medical radioisotopes, including iodine-131, iodine-123, iodine-124, and iodine-125.

Keywords: Theranostic; Radioactive iodine; Medical radioisotopes

A2 ^{177}Lu-FAPI-2286 therapy in refractory metastatic breast cancer: Clinical and imaging outcomes in three patients with extensive disease

Masoumeh Chehrara[1], Ghasemali Divband[2], Leila Hassanzadeh[1], Nastaran Khodakarim[3], Nahid Nafissi[4]

[1]Department of Nuclear Medicine, School of Medicine, Rajaie Cardiovascular, Medical & Research Center, Iran University of Medical Sciences, Tehran, Iran
[2]Department of Nuclear Medicine, Jam Hospital, Tehran, Iran
[3]Department of Internal Medicine, School of Medicine, Hazrat-e Rasool General Hospital, Iran University of Medical Sciences, Tehran, Iran
[4]Department of Breast, Rasoul Akram Hospital Clinical Research Development Center, Iran University of Medical Sciences, Tehran, Iran

Introduction: ^{177}Lu-FAPI-2286 targets fibroblast activation protein, delivering beta radiation to advanced solid tumors. This study evaluates the clinical and imaging responses of ^{177}Lu-FAPI-2286 in three patients with treatment-resistant metastatic breast cancer.
Methods: Three female patients with refractory metastatic breast cancer were treated with ^{177}Lu-FAPI-2286. Patient 1 (41, triple-negative breast cancer) received one cycle for skin and pleural involvement. Patient 2 (34, post-mastectomy TNBC) underwent two cycles alongside radiotherapy and immunotherapy for FAPI-avid metastases. Patient 3 (35, bilateral invasive ductal carcinoma) completed five cycles with Trastuzumab-deruxtecan for extensive breast and lymph node metastases. Treatment responses were assessed using pre- and post-treatment FAPI PET/CT scans, along with clinical evaluations of pain, functional status, and quality of life.
Results: All three patients showed significant uptake of ^{177}Lu-FAPI-2286 on post-treatment SPECT scans, indicating effective targeting of fibroblast activation protein. Patient 1 discontinued treatment after one cycle due to severe pain and disease progression. Patient 2 stopped therapy after two cycles due to bone marrow suppression and progressive disease. Patient 3 experienced significant pain reduction and improved function after the first cycle, with substantial healing of skin lesions and decreased lesion burden after five cycles, meeting partial response criteria.
Conclusion: The therapeutic efficacy of ^{177}Lu-FAPI-2286 in refractory metastatic breast cancer varies with treatment duration and cancer phenotype. Patients with aggressive types like TNBC showed minimal benefit from short courses, while non-TNBCs receiving five cycles demonstrated significant clinical and imaging improvements, suggesting a potential threshold effect for efficacy.

Keywords: ^{177}Lu-FAPI-2286; Breast cancer; Radioligand therapy

A3 The impact of tumor morphology on absorbed doses in ^{177}Lu-PSMA-617 therapy

Milad Peer-Firozjaei[1], Ali Shabestani Monfared[2], Mohammad Reza Deevband[3], Mohammad Ali Tajik-Mansoury[4], Mehrangiz Amiri[5]

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Introduction: This study investigates the impact of tumor morphology, as a radiomic feature, on absorbed dose using Monte Carlo simulations.
Methods: Four patients undergoing ^{177}Lu-PSMA-617 therapy (approx. 200 mCi) were included. SPECT imaging was performed 24 hours post-injection to analyze tumor volumes (0.1–1 mL). To examine how morphology affects the cross-absorption of tumors from the outside, sphericity and surface area of tumors, as morphology-based radiomic features were extracted following segmentation. Patient segmented images were then input into the GATE simulation environment for dosimetric analysis. Tumor absorbed dose rates per unit activity, as indications of S-Value, were calculated from the simulations.
Results: Our results showed that, for a given approximately fixed tumor volume (±4 to 20 percentage difference at each group), the absorbed dose rates per unit activity can increase by up to three times for sphericity values increasing from 0.4 to 0.88, and for surface areas ranging from 1,000 to 70,000 mm². These findings indicate the cross-fire effect in enhancing tumor irradiated area from the surrounding by changing effective area under irradiation.
Conclusion: Our findings highlight the significance of incorporating tumor morphology into S-value calculations to achieve more accurate measurements of tumor absorbed dose. Computational methods such as the MIRD formalism, which calculates S-values based on tumor volume, need to be modified to take tumor morphology into account—especially for beta emitters due to their higher cross-fire effect.

Keywords: ^{177}Lu-PSMA-617; Tumor morphology; Absorbed doses; Monte Carlo; Radiomics

A4 PET-MRI for prostate cancer detection

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Introduction: PET/MRI is a relevant application field for prostate cancer management, offering advantages in early diagnosis, staging, and therapy planning. Hybrid PET/MRI scans outperform either technique alone for identifying tumors in high-risk patients with suspected prostate cancer. Hybrid PET/MRI scanners were introduced about 15 years ago to leverage the advantages of both methods.
Methods: In this study, 15 articles published from 2014 to 2024, which were in the form of original research and systematic review were examined. The study used the keywords Positron emission tomography (PET), Magnetic resonance imaging (MRI), Prostate cancer.
Results: Despite drawbacks such as higher costs, longer acquisition time, and the need for skilled personnel, the technical integration of PET and MRI provides valuable information for detecting primary tumors, identifying metastases, and characterizing the disease, leading to more accurate staging and personalized treatment strategies. As precision medicine gains importance in oncology, PET/MRI's multiparametric data can tailor treatment plans to individual patients, providing a comprehensive assessment of tumor biology and aggressiveness for more effective therapeutic strategies.
Conclusion: PET/MRI adoption has been slow, but ongoing technological advancements and AI integration might overcome challenges and improve clinical utility.

Keywords: Positron emission tomography; Magnetic resonance imaging; Prostate cancer

A5 [^{68}Ga]Ga-CXCR4 PET/CT imaging in high-grade glioma for assessment of CXCR4 receptor expression

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Introduction: Gliomas account for 75 % of primary malignant CNS tumors. High-grade glioma (CNS WHO grades 3 and 4) have an unfavorable treatment response and poor outcome. CXCR4 is a G protein-coupled receptor that plays an important part in the signaling pathway between cancer cells and tumor microenvironment.In this study, we evaluate the potential value of [^{68}Ga]Ga-Pentixafor as a PET/CT CXCR4-probe for invivo assessment of CXCR4 expression in patients with high-grade glioma and its correlation with tumor grade.
Methods: [^{68}Ga]Ga-CXCR4 PET/CT was performed in the prospective single-center study in treatment-naïve biopsy-proven patients with high-grade glioma. The acquired images were analyzed qualitatively and semi-quantitatively
Results: A total of 26 patients (mean age: 53.3±14.4 years, 11 women, 15 men) were enrolled. CNS WHO grade 3 pathology was seen in 19 % (5/26) of the sample. The patient-based sensitivity of ^{68}Ga-CXCR4 was 96.2 %. Overall, 28 pathologic lesions were detected, leading to a lesion-based sensitivity of 96.4 %. The median (IQR) SUVmax of grade 4 lesions was substantially greater than the grade 3(3.03(2.5–3.7) vs. 1.51(1.2–1.8), p = 0.0145).)
Conclusion: This new application for [^{68}Ga]Ga-Pentixafor PET tracer exhibits excellent visual and semi-quantitative diagnostic properties.

Keywords: [^{68}Ga]Ga-CXCR4 PET/CT; High-grade glioma; Pars-Cixafor

A6 An overview of the Pars-GalluGen generator and its improvement

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Introduction: Gallium-68 with a half-life of 68 minutes is obtained from a generator containing germanium-68 with a half-life of 271 days (^{68}Ge/^{68}Ga generator). During the last years in Iran, Pars Isotope Company has produced ^{68}Ge/^{68}Ga generators (named Pars-GalluGen generator). After producing the first generation of Pars-GalluGen generators, Pars Isotope developed a second generation based on SnO2-TiO2 resin matrix.
Methods: All quality control tests for PARS-GalluGEN generators were done according to European Pharmacopoeia.
Results: The first generation of Pars-GalluGen generators was eluted with 5 ml of 0.6 M hydrochloric acid. As mentioned, the second generation is based on SnO2-TiO2 resin matrix. This generator was eluted with 3 ml 0.1 M hydrochloric acid. PARS–GalluGEN generators eluted more than 700 times in 9 month and the elution yield is > 65%. The radionuclide purity of ^{68}Ga was 99.9% and the radiochemical purity of 68Ga was 99.9. Although ^{68}Ge breakthrough slightly increased over time, but always remained <0.0001%. Iron and zinc were detected as metal impurities in the eluent, but both were 0.1g/GBq.
Conclusion: The obtained results indicate Pars-GalluGen generators have all the specifications of the European Pharmacopoeia for use and PARS-GalluGEN 70 has the highest ^{68}Ga output activity of ^{68}Ge/^{68}Ga generators in the world.

Keywords: Pars-GalluGen generator; ^{68}Ge/^{68}Ga Generator; Gallium-68

A7 Hybrid PET/MRI system for myocardial viability assessment post-myocardial infarction

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Introduction: After myocardial infarction (MI), some of the cells involved encounter decreased blood flow. These cells are viable and may regain their function following revascularization. Precise assessment of myocardial viability is crucial to provide an appropriate treatment pathway. While F-18 fluorodeoxyglucose positron emission tomography (FDG PET) and late gadolinium enhancement magnetic resonance imaging (LGE MRI) are separately useful for myocardial cell viability evaluation, anatomical imaging of MRI and functional and molecular imaging of PET are combined in PET/MRI imaging. We aim to give an overview of the assessment of myocardial viability by cardiac PET/MRI.
Methods: We conducted an extensive search across electronic databases, including PubMed, Medline, Embase, Google Scholar, and ResearchGate, and explored the available English-language literature. The mesh terms were "positron emission tomography," "magnetic resonance imaging," "myocardial viability," and "myocardial infarction."
Results: Investigations suggest that the PET/MRI system provides an accurate assessment of myocardial viability. In a study, 28 patients with MI underwent PET/MRI for assessment of regional FDG uptake and LGE transmurality, and a high concordance between FDG PET and LGE MRI regions and better improvement in follow-up was observed. About 20% of imaging was discrepant, which didn't have much of an improvement after revascularization. Also, another study confirmed an agreement between FDG PET and MRI findings.
Conclusion: In general, studies indicate that hybrid PET/MRI system is a strong tool with high-quality imaging acquisition that can predict suitable tissues for revascularization after MI. this system is expected to supply great development in treatment techniques.

Keywords: Positron emission tomography; Magnetic resonance imaging; Myocardial viability; Myocardial infarction

A8 Biological evaluation of ^{99m}Tc-labeled nanoparticles in an animal model for lymphoscintigraphy

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Introduction: Lymphoscintigraphy is a method that has been employed to delineate the regional draining lymph node basins using radiolabeled compounds. This procedure has been utilized extensively for the evaluation of internal mammary and internal iliac lymph nodes, in addition to the definition of dermal lymphatic flow. Several radiopharmaceuticals have been developed for lymphoscintigraphy. In Europe, only two agents are available as commercial products and licensed for use in lymphoscintigraphy: ^{99m}Tc-colloid albumin and ^{99m}Tc-sulfur colloid. Albumin, as the most predominant protein in plasma, is a suitable clinical application because of several advantages: high biocompatibility, biodegradability, non-immunogenicity, and safety. This protein is labeled with ^{99m}Tc by several functional groups in its structure. There are a variety of methodologies were employed in the fabrication of albumin-based nanoparticles. In preparation of nanoparticles based on chemistry, chemical additives are used. In contrast, the methods based on physics employ physical factors such as temperature and pressure.
Methods: In this study, human serum albumin nanoparticles (HSA nanoparticles) were prepared using the desolvation method. Produced HSA nanoparticles were radiolabeled using technetium-99m as an imaging agent. Radiolabeling yield, radiochemical purity, and accumulation of labeled nanoparticles in sentinel lymph nodes in rats were investigated.
Results: The radiolabeling yield of radiolabeled nanoparticles was more than 99%. Radiochemical purity of radiolabeled nanoparticles was more than 85% during 24 hours. Imaging studies of ^{99m}Tc-nanoparticles showed accumulation of nanoparticles in lymph nodes.
Conclusion: According to the imaging results, ^{99m}Tc-labeled HSA nanoparticles are a suitable agent for lymphoscintigraphy.

Keywords: Lymphoscintigraphy; Nanoparticles; ^{99m}Tc-labeled nanoparticles

A9 Assessment of repeatability and in vitro short-term precision among different DEXA bone densitometer

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Introduction: Dual-energy X-ray absorptiometry (DEXA) is a reliable, non-invasive method for assessing osteoporosis risk. To evaluate the performance of various DEXA devices, in-vitro short-term precision (IV-STP) and repeatability tests were conducted following the International Society for Clinical Densitometry (ISCD) guidelines.
Methods: Twenty-two DEXA devices from six brands (Hologic, Norland, Lunar, Stratos, BM Tech, and Osteo-Sys) available in the Iranian market were tested. For each model, three to four devices were evaluated using a Norland-manufactured lumbar phantom and Plexiglas plates as simulated soft tissue. IV-STP was assessed through two repeated scans conducted on separate days, with five scans at each time point. Repeatability was measured via 30 consecutive scans of the phantom with varying Plexiglas thicknesses, and deviations from the mean were reported using the least significant change percentage (LSC%).
Results: The LSC% for IV-STP ranged from 0.09% to 1.26%, and for repeatability, from 0.44% to 4.62%. All devices met ISCD's clinically non-significant threshold (LSC% < 5.3%), but six devices exceeded the recommended threshold for phantom studies (LSC% < 3%). These included one Horizon, one Discovery, one Norland, two Osteo-Pro Max, and one Lunar device.
Conclusion: Regular calibration and quality control of DEXA systems are crucial for ensuring accurate osteoporosis diagnostics. While most devices performed within acceptable standards, attention is needed for models exceeding phantom study thresholds.

Keywords: Bone densitometry; Dual-energy; X-ray absorptiometry; In vitro short-term precision; Repeatability

A10 Correlation of functional parameters and ECG characteristics with the presence of LBBB septal artifact in SPECT MPI

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Introduction: Left bundle branch block (LBBB) is a relatively common pattern in ECG which can be associated with a decrease in septal perfusion in SPECT MPI. Therefore, in this study, the correlation of LV functional parameters and QRS width with the presence of septal artifact in SPECT MPI of patients with LBBB was investigated.
Methods: All patients who were referred to the nuclear medicine department for SPECT MPI during a 6-month period were examined and those patients who met the diagnostic criteria of LBBB in ECG without evidence of MI in the SPECT MPI were included. For all patients dipyridamole stress test was performed. Functional data of patients were extracted using QGS / QPS software. The QRS width was also measured based on baseline ECG.
Results: Totally 100 patients with LBBB were included. Septal hypoperfusion was seen in 70% of patients. The mean width of the QRS in the group of patients with and without septal defect was 136mSe and 133mSe, respectively which were not statistically different. However, a significant statistical difference in mean PSD, PHB, and entropy ($P < 0.05$) was seen between the patients with and without LBBB septal artifact. The mean rank of PSD, PHB, and entropy was higher in the patients with septal defect.
Conclusion: These results show that the presence of a septal defect is significantly associated with dyssynchrony parameters of SPECT MPI like PSD, and PHB, which may indicate the more prominent role of mechanical dyssynchrony versus electrical dyssynchrony as evident by QRS width in the mechanism of LBBB septal artifact in SPECT MPI.

Keywords: Left ventricular branch block; Dyssynchrony; Septum perfusion; Cardiac scan

A11 Comparison of the planar images findings and split renal function with SPECT or SPECT/CT images in the [^{99m}Tc]Tc-DMSA renal cortical scintigraphy

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Introduction: [^{99m}Tc]Tc-DMSA renal scintigraphy is an accurate method for assessing SRF. While different acceptable acquisition methods including planar, SPECT, and SPECT/CT are suggested, this study aims to compare these methods of SRF results in subgroups. Moreover, the findings of planar images were compared with the findings of SPECT or SPECT/CT images.
Methods: This study evaluates all patients who were referred for a [^{99m}Tc]Tc-DMSA scan for 6 months (75 patients). For all patients, SPECT or SPECT/ldCT as well as posterior and anterior static images were obtained. The SRF was calculated based on the 2D-ROIs in planar images (SRF-planar) and 3D-VOIs in SPECT (SRF-SPECT) and SPECT/CT images (SRF-SPECT/CT). The SRF was compared between different methods. Then both planar images and SPECT or SPECT/CT images were reported separately by a nuclear medicine specialist and findings were compared with each other.
Results: A comparison of SRF between the three methods revealed no significant difference in total patients. Then the data were divided into kidneys with and without scar, and the difference between the SRF-planar and SRF-SPECT was significant in both subgroups. Another subgroup analysis on the kidneys with decreased SRF-planar (below 45%) showed a significant statistical difference in the SRF-SPECT/CT and SRF-SPECT. In 29 patients the SPECT or SPECT/CT images changed the findings of the planar images.
Conclusion: This study revealed that quantification of the SRF could be different according to the method of acquisition, especially in those patients with abnormal kidneys. This emphasizes the importance of using the same method of acquisition for each patient in serial imaging.

Keywords: [^{99m}Tc]Tc-DMSA; SPECT; Renal cortical scintigraphy; Split renal function

A12 Scintimammography as a complementary tool for distinguishing benign and malignant breast masses in young patients

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Introduction: Breast cancer remains a leading cause of mortality among women worldwide. While ultrasound is commonly used to detect breast masses in young patients, its ability to differentiate between benign and malignant lesions is limited, especially in dense breast tissue. This study investigates the potential of scintimammography as a complementary diagnostic tool to improve the characterization of suspicious breast masses identified by ultrasound in young women.
Methods: A total of 123 patients aged 18–35, presenting with breast masses classified as BI-RADS III and IV on ultrasound, were enrolled in the study. Among them, 134 breast masses were evaluated. Patients underwent scintimammography following the injection of ^{99m}Tc-MIBI (15–20 mCi). Radiopharmaceutical uptake was scored on a scale of 0 to 3, and these scores were subsequently compared with histopathological results obtained from biopsies.
Results: The study revealed a statistically significant correlation between scintimammography uptake scores and pathological findings ($p = 0.001$). Using a cutoff score of 2, scintimammography demonstrated high diagnostic accuracy, with a sensitivity of 96% and specificity of 92% for detecting malignant masses.
Conclusion: Scintimammography proves to be a valuable adjunct to ultrasound in distinguishing benign from malignant breast masses in young patients with dense breast tissue. Its high sensitivity and specificity suggest its potential as a reliable complementary diagnostic method in this population.

Keywords: Scintimammography; Biopsy; Breast masses; Young patients

A13 Missing links of nuclear medicine: New answers to old questions in oral and maxillofacial surgery

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Introduction: In recent years, nuclear medicine has become one of the most valuable imaging techniques in oral and maxillofacial surgery, serving not only for diagnosis and staging but also for developing treatment plans and follow-up protocols for various cancerous, inflammatory and developmental conditions. Additionally, nuclear medicine holds a unique position in the treatment of several benign and malignant diseases.
Methods: We conducted a thorough review of the literature for revealing missing links of nuclear medicine and the field of oral and maxillofacial surgery.
Results: Because of different educational curriculum and training pathways, nuclear medicine specialists may be unfamiliar with different treatment options and diseases classification and management in the field of oral and maxillofacial surgery and a maxillofacial surgeon's understanding of the benefits and drawbacks of each nuclear medicine modality is essential for their everyday practice, which may not be enough.
Conclusion: We want to highlight the significant role of nuclear medicine in diagnosing and treating pathologies in the oral and maxillofacial regions, alongside its novel indications and limitations in the routine practice of oral and maxillofacial surgeons.

Keywords: Nuclear Medicine; Lymph node metastases; Oral squamous cell carcinoma, Condylar hyperplasia; Facial asymmetry; Orthognathic surgery

A14 ^{99m}Tc-Labeling of targeted nanoparticles for tumor imaging

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Introduction: Albumin nanoparticles are one of the most promising carriers for delivering drugs, diagnostic and therapeutic agents, and radionuclides to tumor tissues. These features are because of their cost-effective preparation methods, biocompatibility, and safety of this kind of nanoparticle. Methionine uptake and its metabolism play a significant role in tumor growth and make it a metabolic target for cancer therapy. Normal cells can produce enough methionine from homocysteine, 5-methyltetrahydrofolate, and vitamin B12 to meet their growth needs. However, exogenous methionine is necessary for the survival of many cancer-cell types because their methionine cycle flux and cellular methylation levels are noticeably higher than those of normal cells. So, methionine is a beneficial agent for tumor targeting.
Methods: In this study, human serum albumin nanoparticles (HSA nanoparticles) were prepared by desolvation method, and then the nanoparticles were loaded by methionine. Targeted HSA nanoparticles were radiolabeled using technetium-99m as an imaging agent. Radiolabeling yield, radiochemical purity, stability, and tumor uptake in rats bearing C6-glioma tumors were evaluated.
Results: The radiolabeling yield of labeled targeted HSA nanoparticles was more than 95%. Radiochemical purity and human-serum stability of labeled targeted HSA nanoparticles were determined to be more than 75% in 24 hours. In vivo evaluations in rats bearing C6-glioma tumors have displayed urinary excretion and good tumor uptake of labeled nanoparticles. The obtained results of targeted HSA nanoparticles have shown greater tumor uptake over time than HSA nanoparticles.
Conclusion: This research showed that targeted HSA nanoparticles can be a good candidate for tumor imaging

Keywords: Tumor imaging; HSA nanoparticles; Technetium-99m

A15 In vitro and in vivo evaluations of an ^{188}Re-labeled somatostatin analog

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Introduction: Tyr3-octreotide (TOC), one of the somatostatin analogs, was introduced in clinical uses for treating tumors expressing neuroendocrine receptors. This somatostatin analog is synthesized by placing a tyrosine into the third position of the octreotide sequence. It could attach to various bifunctional chelators and label with imaging or therapeutic radionuclides. ^{188}Re, a high-energy beta-emitting radionuclide (2.2 MeV with 11 mm tissue penetration), is an attractive candidate for various therapeutic applications. Also, it has a gamma emission (155 keV-15%), which allows imaging and dosimetry of radiopharmaceuticals. The preferred production method for high-activity ^{188}Re is through ^{188}W/^{188}Re generator by the decay of ^{188}W with a half-life of 69.4 days.
Methods: In the present study, ^{188}Re-labeling of Tyrosine3-octreotide was carried out via HYNIC as a chelator and Tricine as a coligand. Labeling yield and stability in human serum were determined using RTLC and HPLC analysis methods. Binding to the surface receptors and internalization were assessed using the C6 glioma cell line. Also, biodistribution studies in rats bearing C6 tumors were evaluated.
Results: The radioconjugate demonstrated a specific activity of 8.60 ± 0.76 MBq/nmol and > 90% (n=3) of radiolabeling yield. The results indicated a substantial internalization of the radioconjugate into glioma cells, with high tumor-to-muscle ratios at various time points (post-injection) in rats bearing C6 tumors, although the stability of the radioconjugate in human serum decreased over time.
Conclusion: These findings indicate that ^{188}Re-HYNIC-TOC could be a viable treatment option for tumors that express somatostatin receptors.

Keywords: Tyr3-octreotide; ^{188}Re; Tumor; Therapy

A16 Improving the quality of low-dose single-photon emission computed tomography (LDCT) images using deep learning algorithms and 3D sparse representation for cardiac imaging

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Introduction: Cardiac Computed Tomography (CCT) is recognized as a precise and reliable tool for diagnosing coronary artery disease and planning or guiding surgical interventions. Although the image quality of CCT is generally high, the associated radiation doses can significantly increase the risk of cancer.
Methods: Read We conducted an extensive search across electronic databases, including Pubmed, Medline, Embase, Google scholar and Researchgate, and explored the available English-language literature. The mesh terms were "Low-Dose Single-Photon Emission Computed Tomography (LDCT)", "The latest cardiac imaging methods" and "Cardiac Computed Tomography (CCT)".
Results: Numerous methods have been proposed to obtain Low-Dose Single-Photon Emission Computed Tomography (LDCT) images. However, speckle noise and streak artifacts generated during the Filtered Back Projection (FBP) reconstruction process are non-uniformly distributed across the image, making their precise modeling challenging. Recently, three-dimensional (3D) Super-Resolution (SR) processing has been used to enhance low-dose cardiac CT images. The use of 3D SR sparse representation in processing low-dose cardiac CT images has significantly improved the clarity of vascular structures and reduced background noise. This method preserves the contrast of soft and hard tissues, enabling more accurate detection of calcified plaques and silent ischemia regions.
Conclusion: LDST offers greater safety for patients by using lower radiation doses, making it a preferable option for radiation-sensitive individuals. This method does not require contrast injection and is highly effective for evaluating cardiac function, such as blood flow and tissue metabolism. However, LDST has lower spatial resolution and diagnostic accuracy for small lesions or vascular plaques compared to CCT.

Keywords: Low-Dose; Single-Photon Emission Computed Tomography; Cardiac Computed Tomography; Deep learning algorithms

A17 Repeated rest phase of myocardial perfusion SPECT: A new approach to rule out the false positive of transient ischemic dilation

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Introduction: Transient ischemic dilation (TID), a well-established high-risk marker in patients with abnormal single photon emission computed tomography (SPECT), provides incremental diagnostic value. TID refers to the temporary enlargement of the left ventricle during stress testing; however, this marker can yield false positive findings in some circumstances. This study evaluated the efficacy of a repeated rest phase in reducing false-positive TID diagnoses.
Methods: In this study, patients aged 18 years and older underwent myocardial perfusion SPECT at the Nuclear Medicine Department of Kurdistan University of Medical Sciences, from 2020 to 2024. After the standard rest phase (75–90 minutes post-radionuclide administration), a repeated rest phase (30–60 minutes) was performed, resulting in a total rest phase duration of 105–150 minutes. Quantitative parameters, including left ventricular ejection fraction (LVEF), end-diastolic volume (EDV), summed stress score (SSS), summed rest score (SRS), and summed motion score (SMS), were analyzed using SPSS v.22.
Results: Our findings indicated that out of 612 patients underwent myocardial perfusion SPECT diagnosed as TID, which after repeating the rest phase 45±4.86 minutes, 347 patients' TID disappeared (as false positive). Among them, LVEF, end EDV, SSS, STS, and SMS were higher than 45% (p=0.01), 36.07±6.01 (p=0.005), <4 (p=0.01), <3 (p=0.05), and <5 (p=0.045), respectively.
Conclusion: Repeating the rest phase exactly after standard rest phase, by 30–60 minutes, significantly reduces false-positive TID diagnoses, enhancing the diagnostic utility of myocardial perfusion SPECT. This approach reclassified 56.7% of TID cases as normal, underscoring its clinical potential. Further randomized trials are recommended to standardize rest-phase protocols.

Keywords: SPECT; Transient ischemic dilation; Myocardial perfusion imaging; Repeated rest phase

A18 Role of nuclear medicine in bile leak detection after liver transplantation

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Introduction: Liver transplantation is an accepted procedure in patients with end-stage liver disease, and one of the hospitals involved in liver transplantation in Iran is Firoozgar Hospital (IUMS). Among the most important postoperative complications is bile leakage, which can lead to severe infections, graft dysfunction and mortality if not diagnosed. Adequate management of the disease depends on early and accurate diagnosis. Hepatobiliary iminodiacetic acid (HIDA) scanning is a nuclear imaging modality useful in evaluating biliary function and identifying bile leaks. This technique provides real-time images of biliary clearance from liver to biliary system, applying technetium-99m-labeled iminodiacetic acid derivatives. Unlike traditional modalities such as ultrasound and computed tomography (CT), which primarily evaluate structural changes, HIDA scans provide functional information that helps identify subtle or occult bile leaks that could be overlooked.
Methods: In the current study, we encountered three post-liver transplantation patients suspected of having bile leaks based on clinical symptoms and non-diagnostic results of other imaging modalities at the Nuclear Medicine Department of Firoozgar Hospital (IUMS). HIDA scans were performed to evaluate biliary integrity. One patient in the three cases had confirmed bile leakage, highlighting the importance of HIDA scans for detecting bile leaks following liver transplantation.
Results: Our results are consistent with previous studies regarding the role of HIDA scanning in diagnosing bile leaks post-liver transplant.
Conclusion: Due to its non-invasiveness and high diagnostic yield, we suggest that HIDA scans should be included in the diagnostic approach of patients in whom a bile leak is suspected if traditional imaging returns inconclusive results.

Keywords: Liver transplantation; ^{99m}Tc-HIDA scan; Bile leak; Nuclear medicine; Hepatobiliary imaging

A19 Lymphoscintigraphy in bladder cancer: A single-center study assessing the efficacy of sentinel node biopsy in predicting pelvic lymph node involvement

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Introduction: This study aims to evaluate the detection rate of lymphoscintigraphy in bladder cancer, as well as the rate of false negative results in sentinel lymph node (SLN) biopsy for this condition.
Methods: This prospective study included 35 patients who underwent lymphoscintigraphy within 24 hours before surgery via planar and SPECT/CT imaging of the abdominopelvic region. The detection rates for each component of lymphoscintigraphy were assessed separately, and the pathology results of the pelvic and SLNs found during surgery, were compared to determine the false negative rate of SLN biopsy, both on a patient basis and a pelvic side basis.
Results: Among the 35 patients, which included 30 males and 5 females, a total of 56 SLNs were identified. SLNs were detected using the gamma probe in 24 out of 35 patients (68%), while SPECT/CT and planar imaging identified sentinel lymph nodes in 18 out of 35 patients (51%). In the subset of 7 patients with involved lymph nodes across 9 hemipelvises, SLNs were detected in 4 patients and 4 hemipelvises. The analysis of the false negative rate revealed that, on a patient basis, it was 1 out of 4 patients (25%), while on a hemipelvis basis, it was 0 out of 3 hemipelvises (0%).
Conclusion: Lymphoscintigraphy in muscle-invasive bladder cancer is a feasible technique; however, it requires appropriate facilities to optimize its utility. If validated through extensive studies, it is anticipated that this approach could reduce morbidity by allowing for targeted resection of SLNs in the hemipelvis.

Keywords: Muscle-invasive bladder cancer; Lymphoscintigraphy; Radical cystectomy; SPECT/CT; Sentinel lymph node

A20 Simulation of ultra-light gamma radiation shielding using micro-scale metal foams: A GATE Monte Carlo study

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Introduction: In nuclear medicine facilities, radiation shielding is essential for minimizing unwanted exposure to both the public and medical personnel. One of the most effective ways to reduce radiation exposure is by using shielding materials with a high effective atomic number. However, the heavy weight of traditional shielding materials limits their practicality. This research explores the feasibility of using metal foam as a gamma radiation shield, aiming to reduce weight while maintaining protective efficiency,
Methods: In this study, open-cell lead metal foams with 30%, 76%, and 94%porosity and hole sizes of 0.6mm, 0.3mm, and 75µm were examined using the GATE Monte Carlo simulation.
Results: The results indicate that for lead foam with a 0.6 mm hole diameter, transmitted events are 15.85% higher than bulk lead of the same weight, demonstrating reduced attenuation. In contrast, for 0.3 mm and 75 µm hole diameters, transmission decreases by 22.89% and 40%, respectively. Despite the higher density of bulk lead, metal foam with 76% and 94% porosity enhances radiation attenuation due to its complex porous structure and multiple scattering effects. Furthermore, a comparison of mass attenuation coefficients shows a 10% decrease for the 0.6 mm hole diameter foam, while the coefficients for 0.3 mm and 75 µm hole diameters increase by 37% and 340%, respectively.
Conclusion: The results indicate that as the porosity of metal foams increases, the intensity of transmitted radiation decreases, and the mass attenuation coefficient increases. These findings underscore the potential of metal foams for lightweight, high-performance radiation shielding.

Keywords: Metal foam; GATE; Monte Carlo; Radiation shielding

A21 Comparison of radiolabeled peptide uptake in prostate cancer: A narrative review

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Introduction: Prostate cancer (PC) is one of the most common malignancies among men worldwide. It poses significant clinical challenges due to its variable progression and response to treatment. Numerous studies have investigated the use of radiolabeled peptides in PC and have demonstrated varying degrees of success in targeting PC cells. Despite the advancements, there is a lack of comprehensive reviews comparing the uptake of different radiolabeled peptides in PC. This narrative review aims to fill this gap by comparing and identifying the most promising agents.
Methods: A comprehensive literature review utilized databases such as PubMed and Google Scholar, concentrating on research published within the preceding decade. Articles were chosen according to established inclusion criteria, thereby omitting studies related to cellular and animal experimentation and review articles.
Results: The review discusses the effectiveness of various radiolabeled peptide uptakes in PC. The right radiopharmaceutical should be selected for each patient based on the patient's involvement, tumor stage, and tumor metastasis.
Conclusion: The narrative review concludes a significant need for ongoing research to refine the use of radiolabeled peptides in PC, aiming for improved diagnostic and therapeutic outcomes.

Keywords: Radiolabeled peptides; Prostate cancer; Peptide uptake

A22 [^{18}F]Biotin-FDG: A promising radiotracer for targeted tumor imaging

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Introduction: Recently, [^{18}F]-FDG has been investigated as a prosthetic group to facilitate fluorine-18 incorporation into biomolecules. Biotin shows promising potential for tumor imaging due to its selective accumulation in tumors via highly expressed vitamin transporters. Thus, this study focuses on the biological evaluation of [^{18}F]Biotin-FDG as a novel tumor imaging radiotracer.
Methods: [^{18}F]Biotin-FDG was synthesized by conjugating biotin hydrazide with [^{18}F]-FDG in methanol and glacial acetic acid at 85 °C for 90 minutes. The radiochemical purity was assessed using radio-TLC with C18 as the stationary phase and an ammonium acetate:methanol mixture (1:1) as the mobile phase. The log P value was determined using the n-octanol/water partition method, and in vitro stability was examined in different buffer systems at 37 °C for 120 minutes. Gamma spectrometry and half-life measurements confirmed the radionuclidic identity and purity. Biodistribution and imaging studies were performed in normal and 4T1 tumor-bearing BALB/c mice at 30 and 60 minutes post-injection (p.i.). Blocking experiments were conducted to evaluate specificity.
Results: [^{18}F]Biotin-FDG was synthesized with high radiochemical purity (98%, log P = -0.54 ± 0.072) and stability in various media. Gamma spectrometry confirmed the identity and purity of the radionuclide (RNP ≅ 100%, half-life = 109.2 ± 1.03 min). Biodistribution studies revealed high renal excretion and tumor uptake of 3.56 ± 0.22 %ID/g at 30 min p.i. Finally, blocking studies demonstrated a >50% reduction in tumor uptake, indicating high specificity.
Conclusion: [^{18}F]Biotin-FDG displayed good radiochemical properties, high specificity, and suitable imaging characteristics, making it a promising candidate for targeted tumor imaging.

Keywords: [^{18}F]FDG; Biotin; [^{18}F]Biotin-FDG; Tumor imaging; PET scan

A23 Comparison of technetium-99m labeled amino acids for tumor diagnosis by SPECT imaging

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Introduction: Labeled amino acids as radiotracers that use amino acid metabolism as an imaging target have been especially designed and tested, and are associated with initial success and potential for future use. Here, we compared in vitro and in vivo characteristics of the technetium-99m labeled amino acids tyrosine and methionine with the aim of developing radiotracers for single-photon emission computed tomography (SPECT) imaging.
Methods: In order to prepare labeled amino acids, HYNIC chelator conjugated amino acids were prepared and their technetium-99m labeling were done with the help of co-ligands. They were compared throw quality controls and biological evaluations studies in labeling yield, stability, lipophilicity, main elimination wrought and tumor uptakes in animal.
Results: The radiotracers were prepared with high labeling yield and radiochemical purity of more than 90%. Stability in saline and human serum was confirmed after TLC and HPLC analysis. The in vivo biodistribution parameters showed that the uptakes in the kidneys and liver were different from that of other organs. Animal biodistribution data showed favorable tumor uptake 1-hour post injection for both radiotracers. While greater hydrophilicity was observed for 99mTc-methionine, tumor uptake values for 99mTc-tyrosine were comparable to those for 99mTc-methionine, demonstrating their ability to discriminate between tumor tissue and background.
Conclusion: Our results showed that these radiotracers can accumulate in the tumor for SPECT imaging. They can be used as a radiopharmaceutical for the treatment of cancer tumors, especially glioma tumors, after labeling with beta-emitting radionuclides.

Keywords: Technetium-99m; Amino acids; Imaging; Tumor

A24 Quality control evaluation and in vivo biodistribution studies of flavonoid derivate labeled with technetium-99m as radiotracer for cancer SPECT imaging

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Introduction: This study explores the synthesis, evaluation, and application of technetium-99m-labeled triazolophenylchroman flavonoid derivatives as radiopharmaceuticals for diagnosing and treating colorectal cancer. Focused on advancing nuclear medicine, the study emphasizes the therapeutic and imaging potential of flavonoid-based compounds while addressing challenges in radiopharmaceutical development.
Methods: Flavonoid derivatives were synthesized and labeled with technetium-99m using established protocols. Characterization involved thin-layer chromatography and radiochemical purity assessments. Biological efficacy was tested through in vitro assays on colorectal cancer cells and in vivo biodistribution studies in animal models. Pharmacokinetic analyses evaluated tissue distribution, metabolism, and clearance.
Results: The labeled compound achieved >97% radiochemical purity and stability under optimal conditions. Structural moieties enhanced tumor-targeting specificity, improving diagnostic imaging accuracy. In vivo studies revealed rapid tissue distribution, with peak tumor uptake at 120 minutes and minimal retention in healthy organs. Low protein binding (6%) and high hydrophilicity facilitated efficient clearance, reducing off- target effects.
Conclusion: The technetium-99m-labeled flavonoid derivative demonstrated exceptional tumor selectivity, stability, and pharmacokinetic properties, positioning it as a promising diagnostic agent. Its rapid uptake and clearance profile minimize toxicity risks, while hydrophilicity enhances bioavailability. These findings underscore the potential of flavonoid-based radiopharmaceuticals in clinical oncology, particularly for non-invasive cancer imaging. Future research should focus on scaling synthesis, optimizing therapeutic efficacy, and validating results in human trials to bridge preclinical and clinical applications.

Keywords: Technetium labeling; Flavonoid derivative; SPECT; Nuclear imaging; Biodistribution

A25 From the lab to the clinic: First in-house production of [^{18}F]Florbetapir in Iran for PET neuroimaging of Alzheimer's disease

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Introduction: The detection and quantification of β-amyloid (Aβ) plaques via PET imaging is a fundamental tool in early diagnosis of Alzheimer disease (AD). Among available tracers, [^{18}F]Florbetapir is widely used for Aβ imaging, but its availability is limited due to reliance on commercial suppliers. Herein, the first in-house production of [^{18}F]Florbetapir in Iran is reported, enabling domestic PET neuroimaging while maintaining international quality standards.
Methods: A multi-step in-house synthetic route was developed by an Iranian company for the precursor (E)-2-(2-(2-((5-(4-(bis(tert-butoxycarbonyl)amino)styryl)pyridin-2-yl)oxy)ethoxy)ethoxy)ethyl 4-methylbenzenesulfonate. Nucleophilic [^{18}F]fluoride substitution was used for radiolabeling, followed by HPLC purification. The entire process, from precursor synthesis to final radiotracer formulation, was performed under strict in-house quality control (QC) protocols. Radiochemical purity and stability tests were performed, and micro-PET imaging in transgenic AD mice was conducted.
Results: The in-house synthesized [^{18}F]Florbetapir precursor achieved a radiochemical yield of 20±5%, carried out in Pars Isotope Company, comparable to established commercial formulations. The radiotracer exhibited high stability (>93% intact at 10 hours), strong cortical uptake (SUVmax = 3.67 ± 2.68), and a favorable target-to-background ratio (1.1 ± 0.3). Pharmacokinetic evaluation revealed similar clearance kinetics to [^{18}F]Florbetapir, with rapid elimination from non-target tissues and minimal white matter retention.
Conclusion: This study reports the first successful in-house production of [^{18}F]Florbetapir in Iran, marking a significant milestone in domestic radiopharmaceutical self-sufficiency. The radiotracer's imaging performance was comparable to commercial AV-45, supporting its clinical feasibility for routine PET imaging of AD. This achievement opens new possibilities for cost-effective, locally produced radiotracers, reducing reliance on external suppliers while maintaining global imaging standards.

Keywords: [^{18}F]Florbetapir; In-house production, β-amyloid PET imaging; Alzheimer's disease; Neuroimaging

A26 Optimizing the process of production and purification of the radiopharmaceutical fluoroestradiol (^{18}F-FES) using SPE technique for the detection of estrogen hormone receptors

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Introduction: Estradiol, also known as 17β-estradiol, is a form of estrogen and is one of the hormones in females. Due to the elevated levels of estrogen Receptors in certain breast cancer cells, this information is utilized to assess the degree of cancer progress and the effectiveness of treatment.
Methods: Using the charged particle accelerator, the Cyclone® KIUBE cyclotron located at the Cyclotron Radiopharmaceutical Production and Development Center, the oxygen-18 isotope is bombarded with proton particles with an energy of 18 MeV and the radioisotope fluorine-18 is produced. The precursor is labeled with fluorine-18 in a dry acetonitrile solvent. The labeling procedure is carried out at a temperature of 130 degrees for a duration of 8 minutes. Subsequently, the solution in the reactor is evaporated, and the hydrolysis solution is transferred to the reactor. The hydrolysis process is conducted at a temperature of 125 degrees for a duration 6 minutes. Upon cooling, 10 ml of distilled water is introduced into the reactor and the resulting mixture is passed through purification columns (WAX, HLB, C18 and Alumina).
Results: The labeling efficiency is roughly 35-40%. The final product is diluted with normal saline solution to reach a volume of 30 ml. This product is injected intravenously at a dosage of 111-222 Mega-Becquerel's for each patient.
Conclusion: The FES molecule acts as a PET tracer targeting estrogen receptor (ER) in breast cancer, which has been suggested for identifying this form of the disease. This tracer attaches to ER with great affinity and its in vivo uptake is effective and specific in animal studies.
Keywords: Fluoroestradiol; Estrogen; Cyclotron; Labeling; PET scan; Nuclear medicine

A27 Radioiodine therapy in patients with differentiated thyroid cancer and end-stage renal disease

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Introduction: While radioiodine (RAI) treatment is an integral component of therapy for most patients with differentiated thyroid cancer, those undergoing hemodialysis represent a less-studied subgroup. Concerns regarding the facilities and contamination associated with hemodialysis, as well as dosimetry in these patients, necessitate further exploration. This paper aims to provide guidance on these important issues.
Methods: We conducted hemodialysis in a patient with end-stage renal disease and performed blood sampling at multiple time points to evaluate dose reduction. Additionally, we assessed the dialysis machine by sampling its rinse liquid. Furthermore, to conduct a structured review of the literature, we utilized the Arksey and O'Malley framework. As of January 2025, we searched the literature in Scopus, PubMed, Web of Science, and Google Scholar, including all published articles in English from the year 2000 onward. We imposed no limitations regarding study design or country region.
Results: In our experience with an anuric patient, we observed that blood dose levels significantly decreased following a single dialysis session, which lasted approximately 4 hours with a blood flow rate set at 406 ml/min. The data indicated a significant effect of hemodialysis on dose reduction and a decrease in toxicity; however, there were no concerns regarding iodine contamination in the hemodialysis machine used.
Conclusion: Radioiodine therapy can be safely administered to patients with end-stage renal disease; however, the patient's urinary output status should be taken into account, along with their regular dialysis schedule.

Keywords: Radioiodine therapy; Thyroid cancer; Total thyroidectomy; Hemodialysis; Chronic kidney disease

A28 Predicting lesion absorbed doses in [^{177}Lu]Lu-PSMA-617 radioligand therapy using pre-treatment PET/CT images radiomic features and clinical biomarkers with machine learning approach

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Introduction: Personalized dose estimation for prostate-specific membrane antigen (PSMA)-targeted radioligand therapy (RLT) is recommended but challenging to implement in clinical practice. This study developed a pretreatment planning framework using machine learning (ML) to predict lesion absorbed doses (ADs) in metastatic castration-resistant prostate cancer (mCRPC) patients undergoing [^{177}Lu]Lu-PSMA-617 RLT. The model integrates pretherapy [^{68}Ga]Ga-PSMA-11 PET/CT radiomic features (RFs) and clinical biomarkers (CBs).
Methods: Pretherapy PET/CTs from 20 patients (130 lesions) were analyzed. Planar scans at ~4h, 48h, and 72h, along with a SPECT/CT at ~48h post-RLT (6.8 ± 0.4 GBq), were used to calculate time-integrated activity coefficients (TIACs). Lesions delineated on PET/CT were transferred to co-registered SPECT/CT for dosimetry using Monte Carlo GATEV9.1 simulations (MIRD formalism). Following image preprocessing, RFs were extracted via LIFExV7.4.0, and recursive feature elimination (RFE) selected non-redundant variables. eXtreme Gradient Boosting predicted posttherapy mean lesion ADs per injected activity, with leave-one-out cross-validation (LOOCV) assessing performance.
Results: The mean RLT-delivered lesion ADs was 2.36±2.10 Gy/GBq (range: 0.05-13.72 Gy/GBq). The model achieved RMSE=0.83 Gy/GBq, MAPE=0.51 Gy/GBq, and R^2=0.62 using RFs alone. Incorporating CBs (PSA, ALP) improved performance (RMSE=0.72 Gy/GBq, MAPE=0.45 Gy/GBq, R^2=0.73).
Conclusion: Integrating CBs with pretherapy PET/CT RFs has the potential to predict lesions ADs of RLT. These predictive models can refine clinical decision-making by tailoring treatment strategies with individual patient profiles, particularly optimizing dose escalation protocols within the precision medicine framework. Further validating these findings in an independent cohort and increasing the sample size is essential for their clinical application in personalizing RLT.

Keywords: Theranostics; Dosimetry; [^{68}Ga]Ga-PSMA-11 PET/CT; [^{177}Lu]Lu-PSMA-617; Radiomics; Machine-learning

A29 Development of a high-performance whole-body PET scanner using monolithic-like BGO crystals: A GATE Monte Carlo study

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Introduction: Positron emission tomography (PET) is an advanced medical imaging technique that enables the high-sensitivity visualization of metabolic activity. It plays a crucial role in diagnosing diseases by detecting the distribution of radiotracers within the body. This study aims to develop an innovative design of detector crystals, called monolithic-like crystals, for PET scanners focusing on maximizing sensitivity while maintaining high spatial resolution.
Methods: A GATE Monte Carlo simulation was used to design and evaluate a whole-body (W-B) PET scanner featuring 16 detector heads, each measuring 16×35cm². The scanner employs monolithic-like BGO detector crystals with dimensions of 1×1×1.6cm³. Performance was assessed using NEMA NU2-2018 standards, including sensitivity, scatter fraction, and spatial resolution. The scanner's performance was compared with existing systems, and point source sensitivity at the center of the FOV was validated against an analytical model.
Results: The simulated point source sensitivity closely matched the analytical model, with a maximum difference of 3.9%. The W-B scanner achieved sensitivities of 17.87 and 15.84 kcps/MBq at the center and at a 10cm radial offset, respectively. The scatter fraction was measured 29.1%. The average spatial resolution at the center was 2.39mm. Compared to the Siemens Biograph Vision, the W-B scanner exhibited 8.3% and 9.2% higher sensitivity at the center and at a 10cm radial offset, respectively, and achieved a 37.5% improvement in average spatial resolution.
Conclusion: The proposed PET scanner with monolithic-like BGO crystals demonstrated superior sensitivity and spatial resolution compared to existing systems, highlighting its potential for enhanced PET imaging.

Keywords: PET; Monolithic-like crystals; Monte Carlo simulation; NEMA standards; GATE

A30 Evaluation and optimization of the OSEM reconstruction algorithm for accurate tumor volume estimation in a beating heart within the XCAT Model using GATE software

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Introduction: The partial volume effect (PVE) occurs when a tumor or small structure in an image blends with surrounding tissues, causing an inaccurate representation of its dimensions. This happens when a small tissue region lies within a larger pixel, and its signal is influenced by adjacent tissues.
Methods: In this study, the accuracy of tumor dimension detection was evaluated using the OS-EM algorithm with 2 and 4 subsets. The imaging system was simulated using GATE 7.2 software. A beating heart containing a tumor was modeled using XCAT software to create a female phantom with a beating heart, followed by tumor creation. Binary files were converted to DICOM using XMedCon and combined via MATLAB. Tissues surrounding the heart and tumor were removed, and seven transaxial slices containing the tumor were extracted. The file format was changed to .mhd for compatibility with GATE. Reconstruction was performed using OSEM with 2 and 4 subsets via CASTOR software.
Results: The results showed that increasing iterations and subsets improved image quality metrics, with PSNR increasing and SSIM approaching 1. In OSEM with 2 and 4 subsets, image noise rose until iterations 27 and 13, respectively, then decreased. Image contrast improved up to iterations 16 and 8 before declining. The optimal image, preserving tumor dimensions accurately, was achieved at iterations 18 (2 subsets) and 9 (4 subsets).
Conclusion: These findings suggest that higher subsets allow optimal images in fewer iterations.

Keywords: Partial volume effect; PET imaging; OSEM algorithm; Tumor detection accuracy

A31 Surface dosimetry in Re-188 therapy: A new approach based on image processing and comparison with VARSKIN software

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Introduction: Accurate dosimetry calculations are crucial for effective surface radiopharmaceutical therapy. This study presents a novel computational method for determining key parameters such as initial activity (A0), skin dose (D_skin), and treatment time (T_calc). The method integrates image-based tumor surface detection, scale calibration, and automated segmentation for precise area estimation.
Methods: The proposed approach incorporates depth-dependent correction factors, improving accuracy beyond VARSKIN software. Implemented in Python, it employs OpenCV and PyQt6 for image processing, optimizing dosimetric parameter calculations while reducing errors.
Results: Comparative analysis shows high accuracy, with discrepancies below 7% for treatment time and skin dose
Conclusion: Key advantages include enhanced precision in tumor area estimation, automated dose calculation, and improved usability. Future work will focus on extending the model for cumulative dose calculations and dose distribution analysis. This study contributes to advancements in computational dosimetry for Rhenium-188 therapy, improving treatment planning and patient outcomes.

Keywords: Surface dosimetry; Rhenium-188 therapy; Computational dosimetry; VARSKIN comparison; Dose calculation

A32 Impact of ^{177}Lu/^{225}Ac heterogeneous distribution on cellular DNA damage

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Introduction: This study investigates the effect of heterogeneity in Ac-225 and Lu-177 radiation on absorbed dose distribution and DNA damage (SSBs and DSBs) at the cellular level using the GEANT4 Monte Carlo code. Validation of the code was achieved by comparing simulated γH2AX foci numbers with experimental data from Lu-177 and Bi-213 irradiation of MCF7 cells.
Methods: The Geant4-DNA toolkit (version 11.3) was used to model MCF7 cells as ellipsoids with semi-axes of 7.01 ± 0.33 µm, 2.50 ± 0.25 µm, and 5.30 ± 0.26 µm. DNA damage was calculated based on energy deposition and free radical interactions for Ac-225 and Lu-177 irradiation, with energy spectra derived from MIRD data. A Python-based DNA repair model incorporated four primary DSB repair pathways and simulated γH2AX formation using Michaelis-Menten kinetics. Both uniform and non-uniform radionuclide distributions were considered, with non-uniformity modeled using a log-normal distribution (mean = 0, standard deviation = 0.1-0.5). Validation of the Geant4-DNA code included comparisons with prior studies.
Results: Monte Carlo simulations showed strong agreement with experimental γH2AX data (p-value < 0.05). For Lu-177, absorbed dose, dose distribution, and DNA damage remained unaffected by increased activity heterogeneity. However, for Ac-225, increased heterogeneity reduced absorbed dose and DNA damage (SSBs and DSBs), while maintaining uniformity of dose distribution (p-value < 0.05).
Conclusion: Non-uniform activity distribution significantly affects therapeutic outcomes for alpha-emitting radionuclides like Ac-225 at the cellular level. Analyzing radionuclide activity distribution within cells or tumors is crucial for optimizing treatment planning in radiopharmaceutical therapy.
Keywords: Lu-177; Ac-225; Heterogeneity distribution; DNA damage

A33 Evaluating the impact of percutaneous ethanol ablation on psychological stress in thyroid cancer patients

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Introduction: The Percutaneous Ethanol Ablation – PEA is known as a nonsurgical method in the treatment of thyroid tumors and the other lesions in canser patients. Despite the widespread use of this method in the treatment of cancer, its mental effects are not sufficiently investigated. This study aims to examine the impact of the PEA on psychological stress in canser's patient and its relationship of with nuclear medicine.
Methods: In this systematic review, an advanced search was conduct using these keywords: Percutaneous Ethanol Ablation", "Psychological Stress", "Thyroid cancer PubMed, Scopus, Google Scholar. Inclusion criteria were articles published in the past five years and free access to the article text. Gray literature was included, and after removing duplicate items and critiquing them using relevant tools, the studies were analyzed. Ethical considerations and potential biases in the selection process were analyzed, and findings were reported according to PRISMA guidelines.
Results: A total of 47 studies from Asian, European and United States countries were analyzed. The results show that PEA has various effects on patients' psychological stress. Some studies reported anxiety and improved quality of life, while others observed increased stress, especially in patients experiencing side effects from their treatment. Differences in the effects of PEA on psychological stress were observed in different countries.
Conclusion: Generally, this study emphasizes that it is essential to pay attention to the psychological aspects and provide social support in the treatment process and future research should examine these effects more precisely.

Keywords: Percutaneous ethanol ablation; Psychological stress; Nuclear medicine; Non-surgical treatment; Thyroid cancer

A34 Simulation and determination of absorbed dose distribution for ^{177}Lu-FAPI-2286 in two breast cancer patients using GATE Monte Carlo code

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Introduction: Lutetium-177 labeled Fibroblast Activation Protein Inhibitors (^{177}Lu-FAPI) have emerged as a potent theranostic agent in the management of advanced breast cancer. By leveraging the high affinity of FAPI for fibroblast activation protein, this agent enables precise tumor targeting and delivery of beta radiation from lutetium-177, thereby enhancing therapeutic efficacy while minimizing collateral damage to healthy tissues. However, accurate dosimetry is crucial to optimize treatment outcomes by maximizing absorbed doses to tumors and minimizing exposure to at-risk organs.
Methods: This study involved two female patients aged 35 and 36 years with triple-negative and HER2-positive breast cancer, respectively, who underwent dosimetry assessment for treatment with [^{177}Lu]Lu-FAPI-2286. To evaluate the biodistribution and absorbed doses, serial planar scintigraphy was performed at 3, 48, and 72 hours post-injection. Additionally, SPECT/CT imaging was conducted at three days post-injection to determine cumulative activity in tumors and organs. For two consecutive treatment cycles, we used the Monte Carlo simulation code GATE to calculate the absorbed dose specifically to the kidneys.
Results: The kidneys were identified as critical organs at risk. Using Monte Carlo simulations, we calculated 0007

kidney absorbed doses per GBq administered for two treatment cycles. In Cycle one, doses were 0.675±0. Gy/GBq (36-year-old). In Cycle two, these decreased to 0.513±0.0002 Gy/GBq and 0.802±0.0005 Gy/GBq respectively.
Conclusion: The integration of Monte Carlo-based dosimetry in targeted molecular therapies involving ^{177}Lu-labeled radiopharmaceuticals offers a significant advancement by enabling voxel-level absorbed dose calculations. This approach accounts for tissue inhomogeneities and non-uniform source distributions, thereby enhancing precision in treatment planning.

Keywords: Lutetium-177; FAPI-2286; Dosimetry; Monte Carlo simulation; Breast cancer; Radiopharmaceuticals

A35 Attention-residual block for diagnosis of bone metastasis on bone scintigraphy images in patients with breast and prostate cancer

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Introduction: Bone scintigraphy is a common imaging method for detecting bone metastases, but its low resolution and the similarity between metastatic and benign lesions make interpretation challenging. This can delay diagnosis and increase costs. Deep learning algorithms have shown great success in medical imaging tasks, and in this study, we developed an attention-based deep learning model combining residual and attention blocks to improve the automatic detection of bone metastases from cancerous patients.
Methods: We designed a classifier combining residual blocks and CordAtt attention blocks, with 7 consecutive residual blocks where the last four incorporate attention to select important features. This approach prevents gradient issues and enhances feature extraction by capturing both spatial and channel-wise attention. Each bone scan view was independently processed through the network, and their individual losses were combined and backpropagated. The model's performance was evaluated using various metrics.
Results: The algorithm achieved an accuracy of 0.948, a sensitivity of 0.9393, an F1-Score of 0.9393, and an AUC of 0.9469. Without data augmentation, the results were lower, with an accuracy of 0.883, a sensitivity of 0.8181, a specificity of 0.9318, an F1-Score of 0.8570, and an AUC of 0.875. Additionally, our model demonstrated strong performance on ambiguous cases, correctly classifying the majority and only mis-labeling 2 out of 43 ambiguous cases.
Conclusion: Combining CordAtt and residual blocks enables the diagnosis of bone metastases and their distinction from benign and healthy lesions using bone scintigraphy images alone, without relying on complementary imaging like CT, MRI, or PET.

Keywords: Deep learning; Attention modules; Image classification; Convolutional neural networks; Bone metastasis

A36 Enhancing diagnostic sensitivity of ^{131}I-MIBG scans using optimal transport theory

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Introduction: Radioiodinated metaiodobenzylguanidine (^{131}I-MIBG) has been extensively used for neuroblastoma imaging, but diagnostic scans have lower sensitivity than post-therapy scans for detecting metastatic disease. This is partly due to insufficient contrast-to-noise ratio (CNR) in diagnostic scans, especially for small lesions. This study proposes an image enhancement technique using optimal transport theory to improve CNR and sensitivity in ^{131}I-MIBG diagnostic scans.
Methods: Optimal transport theory, which compares probability distributions while preserving metric structure, was applied to ^{131}I-MIBG images to generate enhanced outputs. Unlike conventional filtering or deep learning-based denoising methods, this approach processes individual images without reliance on external training datasets, leading to precise and reliable enhancements. The method was evaluated on six diagnostic scans by comparing the number of detectable lesions pre- and post-enhancement with reference post-therapy scans.
Results: Among 71 lesions observed on post-therapy scans, 30 were detectable on pre-enhancement diagnostic scans, whereas 58 were identified after enhancement (p=0.038). Enhanced diagnostic scans also revealed a lesion in one case that was missed pre-enhancement but evident in post-therapy images. Additionally, post-enhancement diagnostic images exhibited a significantly superior CNR compared to pre-enhancement scans (14.21 ± 5.81 vs. 4.72 ± 3.63; $p < 0.001$).
Conclusion: The use of optimal transport theory significantly enhances the sensitivity and image quality of diagnostic ^{131}I-MIBG scans. This method enables better lesion detection, which is crucial for accurate staging and treatment planning in neuroblastoma patients. Improved diagnostic performance facilitates the prescription of more effective therapeutic doses.

Keywords: ^{131}I-MIBG scan; Image enhancement; Lesion detectability; Optimal transport theory

A37 One-step image-space correction of PET attenuation and scatter using a residual attention U-net: A multicenter study

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Introduction: Accurate attenuation and scatter correction remains a significant technical challenge in PET or PET/MR systems without integrated CT or transmission sources, particularly with rising concerns about ionizing radiation exposure in total-body PET imaging. This study introduces a deep learning framework to simultaneously address these corrections in image space, eliminating dependence on attenuation maps and iterative scatter simulations.
Methods: This study proposed residual attention U-Net architecture to directly transform non-corrected PET images into attenuation- and scatter-corrected PET images. Residual blocks enabled deeper feature extraction, while attention gates focus on significant features within the data. This approach eliminates the need for generating attenuation maps and iterative scatter simulation in sinogram space, offering a streamlined, one-step solution. The model was trained and validated on 242 paired pre- and post-correction PET scans from the ACRIN-NSCLC-FDG-PET multicenter trial. Performance was quantified against conventional methods using peak signal-to-noise ratio (PSNR), multi-scale structural similarity index (MS-SSIM), and Pearson correlation coefficient (PCC).
Results: The model achieved superior image quality with a PSNR of 30.45 ± 4.21 dB and MS-SSIM of 0.94 ± 0.041, demonstrating strong agreement with traditional correction ($PCC \approx 0.94$). Corrected images exhibited reduced noise, preserved tissue contrast.
Conclusion: By eliminating the need for attenuation map generation from transmission scans and scatter simulations, this approach reduces radiation exposure risks. The one-step image-space correction allows for broader adoption of low-dose protocols while maintaining diagnostic accuracy.

Keywords: PET; Attenuation correction; Scatter correction; Deep learning

A38 Data-driven approaches to breast cancer diagnosis: Integrating image-processing techniques with multi-criteria decision-making

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Introduction: Breast cancer remains a leading cause of mortality, emphasizing the need for early and accurate diagnosis. This study explores data-driven methodologies that integrate advanced image processing with multi-criteria decision-making to enhance diagnostic precision.
Methods: Mammographic images were pre-processed using enhancement and segmentation techniques to extract critical features. These features were then fed into a multi-criteria decision-making framework that evaluated several diagnostic parameters concurrently, enabling a comprehensive assessment of malignancy likelihood.
Results: The integrated approach yielded promising performance improvements, notably in sensitivity and specificity. Compared to traditional diagnostic methods, the system demonstrated reduced false-positive and false-negative rates. This indicates that combining image processing with decision-making models can significantly refine diagnostic outcomes.
Conclusion: The findings suggest that data-driven approaches integrating image processing and multi-criteria decision-making provide a robust framework for breast cancer diagnosis. This methodology not only enhances detection accuracy but also offers potential for clinical application in early screening protocols. Future work will focus on algorithm refinement and validation using larger, more diverse datasets to further improve diagnostic reliability.

Keywords: Breast cancer; Data-driven approaches; Image processing techniques; Multi-criteria decision-making

A39 Study of the use of hydrogel-based brachytherapy using ^{188}Re-DTPA for the treatment of small pulmonary tumors

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Introduction: Hydrogel-based brachytherapy using ^{188}Re-DTPA can a novel approach for the treatment of small lung tumors, enhancing localized radiation delivery . This study investigates the feasibility, dosimetry, and therapeutic efficacy of hydrogel-based 188Re brachytherapy through Monte Carlo simulations. The hydrogel serves as a biocompatible carrier, enabling precise placement and controlled release of 188Re, a beta-emitting isotope with suitable penetration depth for small tumors.
Methods: A Monte Carlo simulation was performed to model the radiation dose distribution of rhenium-188-DTPA embedded in hydrogel within a simulated lung tumor environment. The absorbed dose was analyzed at various depths to evaluate treatment uniformity and safety.
Results: The simulations demonstrated that hydrogel-based rhenium-188 brachytherapy achieved a highly localized dose within the tumor, with minimal exposure to adjacent lung tissue. The hydrogel effectively controlled isotope dispersion, ensuring a sustained therapeutic effect while reducing off-target radiation exposure
Conclusion: The findings support hydrogel-based brachytherapy as a promising alternative to traditional radiation therapy for small pulmonary tumors. Its advantages include reduced toxicity, enhanced dose conformity, and improved patient compliance.

Keywords: Hydrogel-based brachytherapy; Small lung tumor; ^{188}Re-DTPA; Monte Carlo simulation

A40 Presentation on nuclear medicine with a focus on artificial intelligence

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Introduction: Nuclear medicine, a pivotal branch of medical science, utilizes radioactive isotopes and ionizing radiation for diagnosing and treating various diseases, including cancers, cardiovascular diseases, and neurological disorders. This presentation delves into the latest advancements in nuclear medicine, emphasizing the integration of artificial intelligence (AI) to enhance diagnostic accuracy and therapeutic outcomes
Methods: The methodology for this presentation involved a comprehensive review of recent scientific literature and clinical studies in the field of nuclear medicine. We analyzed data from peer-reviewed journals, clinical trial results, and case studies to identify the latest advancements and trends. Special attention was given to the integration of AI in nuclear medicine, including its applications in medical image analysis, personalized medicine, and radiopharmaceutical development
Results: The results highlight significant advancements in nuclear medicine, particularly in the development of new radiopharmaceuticals like Lu-177 DOTATATE, which has shown promising results in treating neuroendocrine tumors. AI has proven to be a valuable tool in enhancing diagnostic accuracy through advanced image analysis and in optimizing treatment plans through personalized medicine
Conclusion: Nuclear medicine has revolutionized the treatment of complex diseases, with innovations like radioimmunotherapy and Lu-177 DOTATATE providing promising outcomes. AI has emerged as a powerful tool, improving accuracy in diagnosis and treatment. Despite existing challenges, ongoing research and development hold the potential to transform patient care and improve the lives of millions worldwide.

Keywords: Nuclear Medicine; Artificial intelligence; Radiopharmaceuticals

A41 Recent advances in nuclear medicine: from diagnosis to targeted treatment of diseases

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Introduction: Nuclear medicine is one of the most advanced branches of medical sciences, employing radioactive substances for imaging, diagnosis, and treatment of diseases. While this technology has been used for decades in diagnosing conditions such as cancer, cardiovascular disorders, and neurological diseases, recent developments in imaging technologies and novel radiopharmaceuticals have significantly enhanced its potential
Methods: This review synthesizes data from recent studies and clinical trials to evaluate the advancements in nuclear medicine. A comprehensive literature search was conducted using databases such as PubMed, Scopus, and Web of Science, focusing on articles published between 2020 and 2024.
Results: The advancements in nuclear medicine have led to significant improvements in both diagnostic accuracy and therapeutic outcomes. The integration of PET-CT imaging with radiopharmaceuticals such as fluorodeoxyglucose (FDG) has demonstrated high sensitivity and specificity in detecting various cancers, neurological disorders, and cardiovascular diseases
Conclusion: Nuclear medicine plays a crucial role in diagnosing and treating complex diseases such as cancer, neurological disorders, and cardiovascular conditions. Recent advancements in PET-CT imaging, novel radiopharmaceuticals, and targeted therapies like SIRT and Lu-177 have improved diagnostic precision and treatment efficacy.

Keywords: Nuclear medicine; Radiopharmaceuticals; Molecular imaging; Targeted therapy

A42 Radiation safety in modern medical imaging and therapy: Bridging gaps between technology, training, and clinical practice

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Introduction: The article begins by addressing the fundamental principles of radiation protection and explores the challenges associated with the use of portable X-ray devices, modern radiotherapy techniques such as Intensity-Modulated Radiation Therapy (IMRT), and the management of radiation risks in clinical settings.
Methods: This section covers the fundamental principles of radiation protection, including the concepts of justification, optimization, and dose limitation as recommended by the International Commission on Radiological Protection (ICRP).
Results: This section outlines future research directions, including the integration of advanced technologies such as artificial intelligence (AI) and big data analytics in radiation protection. It also provides practical recommendations for improving safety protocols, training healthcare workers, and updating regulatory guidelines.
Conclusion: The review concludes by emphasizing the importance of a multidisciplinary approach to radiation protection, integrating principles from medical physics, engineering, and clinical practice.

Keywords: Artificial intelligence; Interventional radiology; Ultrasound safety; Radiation safety

A43 An overview of the application of artificial intelligence in nuclear medicine

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Introduction: Introduction: Artificial intelligence (AI) has emerged as a transformative technology in healthcare, with significant potential to revolutionize nuclear medicine. Objective: This study aims to explore the applications of AI in nuclear medicine, focusing on its role in image reconstruction, disease detection, and treatment planning. The objective is to evaluate how AI can address current challenges in nuclear medicine, such as data complexity, diagnostic accuracy, and workflow efficiency.
Methods: A comprehensive review of recent literature encompassed studies and advancements in AI applications for nuclear medicine. Key areas of focus included machine learning (ML) and deep learning (DL) techniques applied to positron emission tomography (PET), single-photon emission computed tomography (SPECT), and radiopharmaceutical therapy. Case studies and experimental results were analyzed to assess the performance and limitations of AI-driven solutions.
Results: Results: AI has demonstrated significant improvements in nuclear medicine, particularly in image reconstruction and analysis. DL algorithms enhanced the accuracy of PET and SPECT image interpretation, reducing noise and improving diagnostic precision. AI also facilitated the automation of routine tasks, such as tumor segmentation and quantification, leading to faster and more consistent results. Additionally, AI-enabled predictive models showed promise in tailoring radiopharmaceutical therapies to individual patients, optimizing treatment efficacy, and minimizing side effects.
Conclusion: Artificial intelligence, as a powerful tool in nuclear medicine, has been able to significantly improve the accuracy of diagnosis, treatment effectiveness, and data management. However, there are challenges, such as the need for quality data, ethical issues, and the interpretability of algorithms.

Keywords: Nuclear medicine; Artificial intelligence; Machine learning; Deep learning

A44 The Role of ^{68}Ga-FAPI PET/CT in detecting endometriosis: A potential complementary imaging modality

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Introduction: Endometriosis is a prevalent gynecological condition that affects approximately 10% of women of reproductive age, significantly impairing their quality of life. Previous studies have highlighted the biodistribution of the 68Ga-labeled FAPI tracer, frequently revealing intense uptake in the uterus. In this context, our objective is to assess the utility of ^{68}Ga-FAPI-46 PET/CT as a tool for the evaluation of endometriosis.
Method: A 28-year-old woman presenting with symptoms suggestive of endometriosis, including dysmenorrhea, underwent transvaginal ultrasound (TVS) and magnetic resonance imaging (MRI) for the evaluation of endometriosis. Additionally, to aid in further assessment and surgical planning, a ^{68}Ga-FAPI-46 PET/CT scan was performed.
Results: Transvaginal ultrasound (TVS) and magnetic resonance imaging (MRI) both revealed a right ovarian endometrioma. The ^{68}Ga-FAPI-46 PET/CT confirmed a large right adnexal cyst displaying peripheral FAPI uptake, with a maximum standardized uptake value SUVmax of 9.5. Additionally, two FAPI-avid left adnexal nodules were identified, with an index SUVmax of 9.6, suggestive of endometriosis. Subsequently, a follow-up MRI was performed for further observation, which did not detect any corresponding findings in the left ovary.
Conclusion: This case highlights the potential utility of ^{68}Ga-FAPI PET/CT as a complementary imaging modality for the evaluation of endometriosis. In this instance, ^{68}Ga-FAPI PET/CT not only confirmed the lesions previously identified by other imaging modalities but also detected more additional lesions, demonstrating their added diagnostic value, especially for accurate surgical planning.

Keywords: ^{68}Ga-FAPI-46; PET/CT; Endometriosis

A45 Preparation and preliminary evaluation of 3BP-227 radiolabelled with ^{68}Ga and ^{177}Lu as a potential theranostic agent in Iran

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Introduction: In recent years, nuclear medicine has witnessed extensive research on new peptide receptors labeled with diagnostic and therapeutic radiopharmaceuticals. The objective of this study is to introduce NTR1 antagonists, specifically 3BP-227, along with its radiolabeled compound. Notably, this marks the first time such a radiotheranostic couple—using ^{177}Lu/^{68}Ga—has been explored in Iran.
Methods: All the chemicals utilized in this study were prepared by Pars Isotope Company. 68Ga was freshly extracted from the ^{68}Ge/^{68}Ga generator. An activity amount of 40-50 mCi of 68Ga was added to 40-50 µL of the 3BP-227-DOTA composition, which was dissolved in 400-500 µL of HEPES buffer solution. The mixture was then heated to a temperature of 95 We procured ^{177}Lu from RIAR JSC. The process involved adding an activity amount of an activity amount of 50-60 mCi of ^{177}Lu to 40-50 µL of the 3BP-227-DOTA composition. This composition was dissolved in a solution containing gentisic acid buffer and sodium acetate, after which it was heated to a temperature of 95°C. Finally, quality control evaluation was performed using reversed-phase thin-layer chromatography (RTLC).
Results: The RTLC results showed that the radiochemical yield of ^{68}Ga/3BP-227 was over 97%. The RTLC spectrum for ^{177}Lu/3BP-227 indicated a labeling rate exceeding 80%.
Conclusion: This study explored the labeling of the novel target 3BP-227 with the radiotheranostic couple ^{177}Lu/68Ga. Moreover, the high yield of the resulting labeled compound suggests that 3BP-227/^{177}Lu/^{68}Ga possesses favorable characteristics as a promising theranostic agent for personalized nuclear medicine.

Keywords: Neurotensin receptors; ^{177}Lu; ^{68}Ga; 3BP-227; Theranostic

A46 Radiation absorbed dose evaluation of ^{177}Lu-EDTMP radiopharmaceutical in man based on biodistribution data in Wistar rats

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Introduction: Bone metastases are common in patients suffering from various primary cancers. They are the advanced stage of solid malignant tumors. Bone-avid beta-emitting radiopharmaceuticals such as lutetium-177-ethylenediaminetetramethylene phosphonic acid ([^{177}Lu]Lu-EDTMP) are effectively utilized for bone pain palliation.
Methods: The radiation absorbed dose of [^{177}Lu]Lu-EDTMP radiopharmaceutical was evaluated for adult men based on biodistribution data in Wistar rats. The Medical Internal Radiation Dosimetry (MIRD) dose calculation method and the Sparks and Aydogan methodology were applied.
Results: About 46% of the injected activity is accumulated on the surface of the trabecular and compact bones. Radiation absorbed doses of red bone marrow and osteogenic cells were estimated at 1.07 and 6.16 mGy/MBq, respectively. The maximum administrated activity was obtained at 27 MBq/kg (0.73 mCi/kg) of body weight with about 11.64 Gy absorbed dose of bone surface for a 70 kg adult man. The effective dose of [^{177}Lu]Lu-EDTMP radiopharmaceutical was estimated at 0.23 mSv/MBq and the urinary bladder wall and kidneys absorbed doses were evaluated at about 0.20 mGy/MBq and 0.09 mGy/MBq, respectively.
Conclusion: This study indicated that [^{177}Lu]Lu-EDTMP radiopharmaceutical can provide palliative care for bone metastases with low undesired doses to other normal tissues.

Keywords: [^{177}Lu]Lu-EDTMP; Bone metastasis; Radiation absorbed dose; MIRD method; Effective dose

A47 Challenges and opportunities in the application of alpha-emitting radioisotopes: The role of nanotechnology

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Introduction: Alpha-emitting radioisotopes, with their high energy and short range, are promising for cancer therapy but pose challenges, including toxicity and effective delivery. Nanotechnologies, with their tunable size, high surface reactivity, and targeting ability, offer potential solutions. This paper explores these challenges and presents novel strategies.
Methods: A literature review was conducted using PubMed, Scopus, and Web of Science (2015–2024) with keywords: "alpha-emitting radioisotopes," "nanotechnologies," "cancer therapy," "targeting," "toxicity," and "radioisotope production."
Results: Targeted Alpha Therapy (TAT) effectively destroys cancer cells with minimal damage to healthy tissue. While radioisotopes like ^{223}Ra and ^{211}At show promise, challenges in systemic administration persist. Nanotechnologies enhance biodistribution, stability, and tumor specificity, offering solutions for these limitations.
Conclusion: Nanotechnologies act as carriers, improving radioisotope targeting and reducing toxicity. They also enhance production, storage, and transport by increasing stability. While promising, further research is needed to maximize their potential in cancer treatment.

Keywords: Alpha-emitting radioisotopes; Nanotechnology; Targeted alpha therapy; Radionuclide therapy

A48 Favorable palliative effect of ^{177}Lu-FAPI-2286 in two breast cancer patients with refractory bone pain

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Introduction: This report presents two patients with breast cancer who developed skeletal metastases despite undergoing various treatment regimens. The emergence of refractory pain in these patients prompted the exploration of novel therapeutic options like ^{177}Lu-FAPI-2286 for bone palliation therapy. In our experience, ^{177}Lu-FAPI-2286 emerged promising in providing pain relief and improving the quality of life.
Methods: Both patients underwent ^{99m}Tc-FAPI-46 scintigraphy to assess FAPI uptake in their skeletal metastases. Based on favorable uptakes, they were treated with ^{177}Lu-FAPI-2286. Pain levels were assessed using the visual analogue scale (VAS) before and after treatment, and patients were monitored for any adverse events following the radiopharmaceutical administration.
Results: The first case was a 36-year-old woman who experienced significant pain relief four days after receiving her first cycle of radio-ligand therapy, reaching a pain-free status for 40 days (VAS reduced from 7 to 1). A second cycle was administered after a 7-week interval, resulting in pain relief as well (VAS decreased from 6 to 2) lasting for 80 days. The only adverse event was grade III thrombocytopenia. In the second case, a 31-year-old female reported significant pain reduction starting on the second day after treatment. VAS decreased from 7 to 2, and persisted for one month without any adverse events.
Conclusion: Our experience demonstrates the potential of ^{177}Lu-FAPI-2286 as an effective palliative treatment for patients with skeletal metastases from breast cancer expecting shorter life span, by providing rapid and significant pain relief and even may in further studies prove to enhance the survival rate.

Keywords: Bone pain palliation therapy; ^{177}Lu-FAPI-2286; Theranostics; Breast cancer, ^{99m}Tc-FAPI-46

A49 ^{177}Lu-FAPI-2286 therapy in a patient with radio-iodine refractory papillary thyroid carcinoma: A favorable clinical and biochemical response

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Introduction: We report a 38-year-old man with radio-iodine refractory papillary thyroid carcinoma (RAIR PTC) with diffuse bilateral lung metastases and debilitating respiratory symptoms who experienced significant relief from symptoms and showed a positive biochemical response after undergoing a single cycle of ^{177}Lu-FAPI-2286 therapy
Methods: A pre-treatment ^{99m}Tc- FAPI-46 scan showed diffuse uptake throughout both lungs. The patient underwent a single cycle of treatment with 200 mCi of ^{177}Lu-FAPI, followed by post-treatment scans at 24 and 72 hours after injection.
Results: post-treatment scans showed favorable FAPI uptake in both lung metastatic lesions. After treatment, there was a significant decline in serum thyroglobulin levels, accompanied by a remarkable improvement in symptoms, leading to near-complete resolution.
Conclusion: This case highlights the potential of ^{177}Lu-FAPI-2286 therapy as an effective treatment option for RAIR PTC patients.

Keywords: Differentiated thyroid cancer; ^{177}Lu-FAPI-2286; Fibroblast activation protein inhibitor; Radionuclide therapy

A50 Integrating [^{18}F]-FMISO PET/CT and streamlined qBOLD MRI for hypoxia mapping in glioblastoma: Comparative evaluation and predictive modeling using machine learning

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Introduction: Hypoxia plays a critical role in determining the prognosis and therapy response of cancer, particularly in aggressive tumors such as Glioblastoma Multiforme (GBM). This study aims to evaluate and compare the diagnostic accuracy of [^{18}F]-FMISO PET/CT and [^{18}F]-FET PET/CT in identifying hypoxic regions in newly diagnosed glioblastoma. To enhance hypoxia mapping and characterization, we also integrate the novel streamlined quantitative blood-oxygen-level-dependent (sqBOLD) MRI technique, which offers a non-radioactive alternative for assessing tissue oxygenation through the calculation of the oxygen extraction fraction (OEF). Additionally, we explore the potential of Hypoxia-Image-Guided Radiotherapy (HIGRT) by combining PET and MRI data to improve targeted treatment planning.
Methods: This retrospective study included newly diagnosed GBM patients undergoing ^{18}F-FMISO PET/CT, ^{18}F-FET PET/CT, and sqBOLD MRI. Imaging parameters such as SUVmax, tumor-to-background ratio (TBR), and oxygen saturation (SatO2) were analyzed. Additionally, 18F-FLT PET/CT was performed post-radiotherapy to assess proliferation changes. Machine learning models were utilized to predict hypoxia and treatment outcomes based on multimodal imaging data.
Results: ^{18}F-FMISO PET/CT demonstrated superior accuracy in identifying hypoxic regions compared to ^{18}F-FET PET/CT. sqBOLD MRI showed a strong correlation with FMISO PET-derived hypoxia maps. Machine learning models integrating PET and MRI data achieved a prediction accuracy of 90% for hypoxia-related outcomes.
Conclusion: ^{18}F-FMISO PET/CT remains superior to ^{18}F-FET PET/CT for hypoxia detection. Integrating sqBOLD MRI and PET enhances diagnostic precision and facilitates targeted HIGRT, improving patient outcomes. Machine learning models further optimize predictive accuracy, advocating for multimodal imaging in clinical practice.

Keywords: Glioblastoma; Hypoxia; PET/CT; Magnetic resonance imaging

A51 ^{18}F-NaF PET for detection of bone metastases in lung cancer: Accuracy, cost-effectiveness and impact on patient management

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Introduction: Bone metastases (BM) are observed in many cancers in their advanced stages (Stage IV). The skeleton is a common site for distant metastases in lung cancer. Given the limited survival outlook following BM diagnosis and the high costs of thoracic surgery, rapid and accurate detection of BM is crucial.
Methods: Read we conducted an extensive search across electronic databases, including PubMed, Medline, Embase, Google scholar and Researchgate, and explored the available English-language literature. The mesh terms were "F-18 NaF PET", "Diagnosing bone metastasis" and "bone scintigraphy (BS)".
Results: The skeletal uptake of the positron emitter F-18 sodium fluoride (NaF) relies on the exchange of hydroxyl ions in hydroxyapatite crystals and serves as an indicator of bone metabolic activity. The excellent soft tissue clearance and high affinity for the bone matrix, combined with the enhanced sensitivity of modern positron emission tomography (PET) scanners, enable highly sensitive whole-body screening for BM. For the detection of BM, F-18 NaF PET has been shown to be significantly more accurate than planar bone scintigraphy (BS). Due to the superior diagnostic accuracy of F-18 NaF PET imaging, clinical management was altered in a number of patients, eliminating unnecessary surgeries and radiotherapy.
Conclusion: It is important to note that there is only limited experience with the use of F-18 NaF PET. The risk of false-positive interpretations of F-18 PET scans may arise from the misinterpretation of benign lesions or false positives due to trauma or bone infection.

Keywords: ^{18}F-NaF PET; Diagnosing bone metastasis; Bone scintigraphy; Lung cancer

A52 Novel applications of ^{18}F-FDG PET/MRI in the diagnosis and management of hematologic cancers

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Introduction: Positron emission tomography (PET) and magnetic resonance imaging (MRI) scans have been in the field of clinical imaging for over 3 decades. However, the PET/MRI compound is the newest compound in non-invasive diagnostic molecular imaging.
Methods: Read We conducted an extensive search across electronic databases, including Pubmed, Medline, Embase, Google scholar and Researchgate, and explored the available English-language literature. The mesh terms were "Positron emission tomography (PET)", "Magnetic resonance imaging (MRI)" and "Fluorine-18 Fluorodeoxyglucose) PET/MRI".
Results: In hematological oncology, PET/MRI applications have been primarily investigated on the amount of F18-FDG (Fluorine-18 Fluorodeoxyglucose) PET/MRI in lymphoma and myeloma. Although not yet a standard test, there are several applications that PET/MRI may find useful. In lymphoma, F18-FDG PET/CT imaging is the standard of care in the management of the vast majority of patients. Since MRI provides a better assessment of soft tissue in many areas there is growing evidence that it supports its use as an anatomical component of choice alongside F18-FDG PET. The combination of F18-FDG PET and MRI can significantly increase the diagnosis, especially in the detection of extracorporeal involvement, that is, bone marrow. Thus, F18-FDG PET/MRI may eventually become selective hybrid imaging in radiation-sensitive populations as well as patients requiring lifelong imaging follow-up or active monitoring.
Conclusion: Finally, F18-FDG PET/MRI has the potential to be standard care imaging in lymphomas with variable F18-FDG avidity, i.e. lymphoma of lymphoid tissue associated with mucus. F18 - FDG PET/MRI is not currently standard imaging for multiple myeloma, however it may soon become a routine in managing multiple myeloma if available.

Keywords: Positron emission tomography; Magnetic resonance imaging; Fluorine-18 Fluorodeoxyglucose; Hematologic cancers

A53 Comparison of ^{68}Ga-DOTA-LM3 and DOTATATE-labeled somatostatin analogues in the preclinical study in C6 cell line

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Introduction: Targeted radiopharmaceuticals have emerged as promising tools for cancer diagnosis and therapy. In this study, we report the initiation of the preclinical phase for DOTA-LM3, a somatostatin receptor antagonist, labeled with Gallium-68 and Lutetium-177 for targeted radionuclide therapy.
Methods: The high radiochemical yield (>95 %) was achieved for Ga-dota-lm3 and Lu-dota-Lm3 which were stable up to 2h and 7 days respectively. In vitro cellular uptake, binding profile and blocking assay of [^{68}Ga]Ga-DOTA-LM3 was determined on C6 glioma cells.
Results: Additionally, biodistribution and imaging studies were conducted in both normal and tumor-bearing mice (C6 glioma model). Comparative analysis with [^{68}Ga]Ga-DOTATATE demonstrated higher tumor uptake of [^{68}Ga]Ga-DOTA-LM3 in primary (the Kidney/ tumor ration = 6 and 13 respectively); and metastatic lesions (the Kidney/ tumor ration = 0.3 and 0.3 respectively), indicating improved targeting efficiency of [^{68}Ga]Ga-DOTA-LM3 in Primary tumors. Furthermore, imaging results successfully visualized metastatic lesions, confirming significant radiotracer accumulation. These findings suggest that DOTA-LM3 has superior tumor-targeting properties compared to DOTATATE, supporting its potential for neuro-oncological theragnostic applications and warranting further translational studies.
Conclusion: The biodistribution of both radio drugs were similar with low intestinal uptake in [^{68}Ga]Ga-DOTA-LM3. The results indicated that Ga-dota-lm3 has potential to be considered as a new theragnostic agent in Glioma tumors.

Keywords: DOTA-LM3; DOTATATE; C6 glioma cells; Biodistribution

A54 New ^{68}Ga-labeled peptide targeting FAP with improved kinetic profile

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Introduction: Fibroblast activation protein (FAP) is overexpressed on cancer-associated fibroblasts (CAFs). It has emerged as a promising target for theranostic applications in oncology. Several FAP-targeting radiopharmaceuticals have been developed, demonstrating high tumor uptake and acceptable clinical outcomes. The present study aims to identify a new FAP-targeting tracer with improved kinetic properties for potential therapeutic applications.
Methods: Base on docking scores, the best cyclic peptide-DOTA targeting FAP was synthesized using solid-phase peptide synthesis. Then, freshly eluted ^{68}GaCl3 was used for radiolabeling of peptide. After quality control, radio-stability tests (in saline and human serum) was performed. Finally, the biodistribution study was conducted in HEK293 tumor-bearing Nude mice xenografts after injection of 100µCi of radiopeptide at 1 h post-injection.
Results: The synthesized peptide (purity > 99%) was identified by LC-Mass and high-performance liquid chromatography (HPLC). The best labeling conditions (RCP > 98%) was as follows: 15 µg peptide, 35 mCi activity, 90°C, pH 4 and 10 min incubation time. The radiopeptide was appropriately stable in saline (98%) and serum (97%) during 4 h. The biodistribution study in tumor-bearing model revealed high tumor uptake (2.81%ID/g) and minimal off-target accumulation (4.26%ID/g in kidneys, 0.12%ID/g in liver). The tumor-to-background ratio was improved compared to previous FAP-targeting tracers.
Conclusion: The developed ^{68}Ga-labeled FAP-targeting peptide with excellent tumor selectivity, kinetic pattern offers an admirable peptide-based platform for radiolabeling using therapeutic radionuclides such as lutetium-177 (^{177}Lu) and actinium-225 (^{225}Ac). Further investigations are ongoing for its use in targeted cancer therapy.

Keywords: Fibroblast activation protein; ^{68}Ga-labeled peptide; Cancer

A55 Rare presentation of Baker's cyst in an infant: A case report

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Introduction: We report a popliteal synovial cyst, also known as Baker's cyst in a 15-month-old girl presented with right knee pain, swelling, and limping, without trauma or systemic illness.
Methods: Physical examination revealed low-grade fever, tenderness, and limited motion in the right knee. Ultrasonography indicated peri-articular inflammation and a 2mm effusion. Septic arthritis was ruled out due to normal complete blood count, erythrocyte sedimentation rate, and C-reactive protein levels. She was referred for arthritis evaluation, and a three-phase bone scan was performed using 296 MBq (8 mCi) of 99mTc-MDP, including perfusion and blood pool images of both knees, followed by delayed imaging at 180 minutes post-injection.
Results: The three-phase bone scan showed normal perfusion but asymmetrically decreased blood pool and delayed MDP uptake in the right knee suggesting joint disuse due to pain. Subsequent MRI evaluation revealed a complicated Baker's cyst associated with synovitis and arthritis. Thus, the findings of the bone scan might be due to the attenuation effect of the Baker's cyst and/or disuse resulting from pain.
Conclusion: Pediatric BCs are often idiopathic or arise from minor trauma but can also be related to conditions such as juvenile idiopathic arthritis (JIA) and hemophilia. Popliteal cysts are usually asymptomatic but can become complicated. MRI remains the gold standard for the diagnosis of BCs and for distinguishing them from other conditions. To our understanding, this is the first reported case of complicated BC in an infant, underscoring the need to consider rare causes of undiagnosed knee pain

Keywords: Baker's cyst; Tc-99m MDP; Bone scan; Popliteal synovial cyst; MRI

A56 Enhancing initial staging of a gastric cancer patient: The advantage of [^{99m}Tc]-FAPI-46 SPECT/CT over conventional CT

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Introduction: We present a 59-year-old man with gastric signet-ring-cell carcinoma, initially staged with contrast-enhanced CT, revealing gastric wall thickening, lymph nodes, and lung metastases.
Methods: The patient underwent a [^{99m}Tc]-FAPI-46 SPECT/CT scan. Sixty minutes after the injection of 740 MBq of [^{99m}Tc]-FAPI-46, whole-body scintigraphy was acquired in anterior and posterior projections.
Results: [^{99m}Tc]-FAPI-46 whole-body scintigraphy and SPECT/CT images demonstrated increased tracer uptake in the gastric lesion, pulmonary nodule, and lymph nodes, alongside new findings of skeletal metastasis, omental and peritoneal deposits, altering the staging and clinical management. The patient subsequently underwent diagnostic laparoscopy, during which diffuse peritoneal metastases in the bilateral sub-diaphragmatic, bilateral para-colic gutter and throughout the omentum as peritoneal carcinomatosis were observed. However, a retrospective analysis of the [^{99m}Tc]-FAPI-46 scan images revealed multiple very small nodules in the omentum that were not identified in the previous analysis.
Conclusion: Our findings highlight the superior utility of [^{99m}Tc]-FAPI-46 in accurately staging gastric cancer, which is critical for effective treatment planning, despite some limitations compared to diagnostic laparoscopy. The incorporation of [^{99m}Tc]-FAPI-46 as an adjunct imaging modality alongside conventional imaging techniques like contrast-enhanced spiral CT has the potential to alter staging and influence clinical decision-making in gastric cancer patients. This case also underscores the utility of [^{99m}Tc]-FAPI-46 SPECT/CT in the staging of gastric cancer and detection of occult metastatic lesions.

Keywords: ^{99m}Tc-FAPI-46; SPECT/CT; Gastric cancer; Contrast-enhanced CT

A57 Multifocal osteonecrosis in pediatric-onset systemic lupus erythematosus

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Introduction: We introduce a case of a 15-year-old girl with a three-year history of systemic lupus erythematosus (SLE), was referred for evaluation of persistent right hip pain and limping over the past two months, without trauma or fever.
Methods: A three-phase bone scan was performed including whole-body blood pool images at two minutes and delayed imaging at 180 minutes post-injection as well as subsequent SPECT/CT imaging.
Results: The scan revealed symmetrically increased blood pool and delayed MDP uptake in the bilateral shoulders, elbows, wrists, femoral heads, distal femora, proximal tibiae, and ankles. The corresponding SPECT/CT images revealed decreased bone density and serpiginous sclerotic changes in both elbows, femoral heads, distal femora, and proximal tibiae, with heterogeneous increased activity suggesting multifocal osteonecrosis. MRI correlation from both knee joints confirmed bone infarction.
Conclusion: MRI is the most sensitive and specific modality for early diagnosis of bone infarction. However, its high cost restricts its use to one or two symptomatic regions, limiting the evaluation of asymptomatic areas in suspected multifocal osteonecrosis. Therefore, whole-body bone scanning (WBBS) is a valuable supplementary tool for diagnosing and monitoring osteonecrosis, especially in cases of suspected multifocal involvement. SPECT/CT imaging provides additional anatomical details, such as geographic sclerotic changes. This case underscores the importance of high index of suspicion for osteonecrosis in SLE patients with persistent joint pain as well as the value of WBBS and SPECT/CT imaging in diagnosing suspected multifocal osteonecrosis.

Keywords: Osteonecrosis; Systemic lupus erythematosus; Corticosteroid therapy; ^{99m}Tc-MDP; SPECT/CT

A58 Diffuse ^{99m}Tc-FAPI-46 uptake in bone marrow: A case of primary myelofibrosis with superscan pattern on bone scintigraphy

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Introduction: We introduce a primary myelofibrosis case in which 99mTc-FAPI-46 scintigraphy unveiled diffuse uptake throughout the skeleton.
Methods: A 65-year-old woman with a history of bone pain, who was evaluated for worsening symptoms, including malaise, weight loss, and night sweats. Initial assessments revealed anemia, and elevated LDH, ESR, and CRP levels with splenomegaly and diffuse lytic/sclerotic changes in the skeleton. Whole-body 99mTc-MDP and 99mTc-FAPI-46 scans were performed. The scans aimed to differentiate potential etiologies of her symptoms, particularly focusing on hematologic disorders.
Results: whole-body 99mTc-MDP scan indicated markedly increased skeletal uptake, consistent with a superscan pattern. Subsequent 99mTc-FAPI-46 scanning revealed diffuse skeletal uptake along with focal splenic uptake. Bone marrow biopsy confirmed primary myelofibrosis.
Conclusion: This case highlights that FAPI can be beneficial in ruling out other causes of myelofibrosis. Our pioneering experience with 99mTc-FAPI-46 also appears comparable to the recently reported study with 68Ga-FAPI which demonstrated the efficacy of this modality in visualizing and quantifying myelofibrosis, establishing a direct correlation with disease progression and its potential value for prognosticationas, as both FAPI and MDP exhibit intense uptake indicative of advanced stages of the disease.

Keywords: Bone scan; ^{99m}Tc-FAPI-46; ^{99m}Tc-MDP; Myelofibrosis; Extramedullary hematopoiesis

A59 Assessing the effects of calcium and vitamin D supplements usage in preventing the bone mineral density loss for postmenopausal women

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Introduction: Osteoporosis, often referred to as a "silent disease," is characterized by reduced bone mass and structural deterioration, leading to decreased bone strength and an increased risk of fractures. Genetic and environmental factors contribute to its progression, with postmenopausal women being at higher risk. While calcium and vitamin D supplements are widely recommended to prevent osteoporosis and fractures, their efficacy in preventing bone mineral density (BMD) decline remains controversial. This study evaluates the impact of these supplements on BMD changes among postmenopausal women in a retrospective study conducted in Shiraz, Iran.
Methods: Bone Densitometry Center at Imam Reza Clinic in Shiraz was analyzed, focusing on those with follow-up BMD assessments. Demographic data, osteoporosis risk factors, and calcium/vitamin D supplementation history were extracted and categorized. The effect of supplementation was evaluated using the Mann-Whitney test, with significance defined as p-value < 0.1.
Results: The median (95% CI) annual BMD loss at the lumbar spine was 0.0000 g/cm²/year (-0.0019 to 0.0031) in the supplementation group and 0.0000 g/cm²/year (0.0000 to 0.0019) in the control group, showing no significant difference. At the femoral neck, the median (95% CI) annual BMD loss was 0.0029 g/cm²/year (0.0000 to 0.0043) for the supplementation group and 0.0035 g/cm²/year (-0.0019 to 0.0050) for the control group, again with no significant difference.
Conclusion: Calcium and vitamin D supplementation did not result in statistically significant benefits in Preventing BMD loss among postmenopausal women.

Keywords: Bone densitometry; Calcium supplement; Bone mineral density loss; Vitamin D

A60 The role of Gated SPECT imaging in the diagnosis of cardiac tamponade in an obese patient with pericarditis: A case report

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Introduction: Pericarditis is an inflammatory condition of the pericardium that often leads to pericardial effusion and can escalate to cardiac tamponade. Traditional diagnostic methods like echocardiography may be limited in obese patients. This case report highlights the utility of gated SPECT imaging in detecting cardiac tamponade effectively.
Methods: This case involved a 70-year-old man with chest pain. He underwent electrocardiography, troponin testing, coronary angiography, echocardiography, and gated SPECT imaging to assess for cardiac tamponade and pericardial effusion.
Results: Gated SPECT imaging revealed normal left ventricular wall motion and thickness, but significant photopenia surrounding the myocardium indicated possible pericardial effusion. In contrast, echocardiography provided poor image quality, delaying the diagnosis. A subsequent echocardiogram confirmed moderate to large pericardial effusion suggestive of cardiac tamponade. The patient was medically managed, leading to symptom improvement. This case underscores the value of using gated SPECT imaging as a supplementary diagnostic tool in obese patients when traditional echocardiography is inadequate.
Conclusion: This case illustrates the critical role of gated SPECT imaging in diagnosing cardiac tamponade in obese patients, where echocardiographic quality may be compromised. Timely identification and management of pericardial effusion are essential to prevent serious complications, highlighting the importance of multimodal imaging approaches

Keywords: Pericarditis; Cardiac tamponade; Gated SPECT imaging

A61 Prostate adenocarcinoma recurrence in the Vas deferens unveiled by ^{99m}Tc-PSMA-11 SPECT/CT imaging

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Introduction: We present a case involving a 77-year-old man with prostate cancer who underwent radical prostatectomy with negative surgical margins. After ten years without follow-up, his serum PSA level increased to 2.76 ng/mL, suggesting disease recurrence. Due to limited access to ^{68}Ga-PSMA PET/CT, evaluation of disease recurrence was conducted via ^{99m}Tc-HYNIC--11 SPECT/CT.
Methods: Whole body maging was performed after injection of 20 mCi ^{99m}Tc-HYNIC-11 along with delayed SPECT/CT imaging.
Results: The scan showed PSMA uptake in the bilateral vas deferens, a rare site for recurrence
Conclusion: While recurrence in the vas deferens has been previously reported using ^{68}Ga-PSMA PET/CT or PET/MR,the identification of bilateral vas deferens involvement as a rare site of recurrence using ^{99m}Tc-PSMA SPECT/CT highlights its potential even at low PSA levels, especially in low-income countries where access to PET/CT may be restricted.

Keywords: ^{99m}Tc-PSMA SPECT/CT; Biochemical recurrence; Prostate cancer; PSMA PET/CT; Vas deferens; Radical prostatectomy

A62 FAPI-avid lesions in the brain: A case report on ^{99m}Tc-FAPI-46 scintigraphy in glioblastoma multiforme

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Introduction: This report presents a 63-year-old man with transient global amnesia, urinary incontinence, and a visual field deficit. MRI revealed a heterogeneous mass in the left parieto-occipital lobe, diagnosed as glioblastoma multiforme (GBM). Following craniotomy, chemotherapy with temozolomide and radiotherapy were initiated. Two months after radiotherapy, MRI indicated possible tumor recurrence, leading to a change in treatment. Despite further interventions, the patient exhibited new-appearing symptoms and a significant increase in mass size. A review of the literature highlighted various FAPI-avid lesions in the brain, which prompted us to assess the FAPI avidity of GBM in our patient. Due to the unavailability of 68Ga-FAPI PET/CT, we employed 99mTc-FAPI-46 as a novel agent for conventional imaging. A review of the literature in various FAPI-avid brain lesions is also provided.
Methods: Whole body ^{99m}Tc-FAPI-46 whole body scan and SPECT/CT were performed.
Results: ^{99m}Tc-FAPI-46 scintigraphy showed FAPI uptake in the tumoral recurrence with favorable target to background ratio when compared to the contralateral brain hemisphere as the background.
Conclusion: Our experience demonstrates the potential of FAPI-based radiopharmaceuticals in evaluating recurrence and offering theranostic options for GBM. Also, this case suggests that 99mTc-FAPI-46 scintigraphy could be a novel and valuable alternative in regions with limited access to PET/CT imaging.

Keywords: Glioblastoma multiforme; ^{99m}Tc-FAPI-45 SPECT/CT; ^{68}Ga-FAPI-46 PET/CT; Brain tumors; Benign brain lesions

A63 Concealed in plain sight: Revelation of Spina Bifida Occulta on ^{99m}Tc-MDP whole-body bone scan and SPECT/CT

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Introduction: We present a case of spina bifida occulta identified through [^{99m}Tc]Tc-MDP scintigraphy.
Methods: An 11-year-old male presented with a two-month history of new-onset low back pain, with no preceding medical conditions or underlying diseases reported. The patient's lumbar pain was exacerbated by physical exertion. He was able to tolerate the pain without requiring analgesics. The patient denied any additional symptoms, including fever, nausea, vomiting, weight loss, or loss of appetite. Furthermore, he did not report any joint pain in other parts of the body. He also denied any history of trauma or recent fracture. There was no significant abnormal inflammatory markers on laboratory testing. Therefore, he underwent an initial diagnostic evaluation with a three-phase bone scan using ^{99m}Tc-MDP
Results: Initial diagnostic evaluation with a three-phase bone scan revealed a focal area of uptake posterior to the L5 vertebra, which was confirmed by subsequent SPECT/CT imaging to be a defect in the spinous process of the L5 vertebra, consistent with spina bifida occulta.
Conclusion: This case highlights the potential of bone scans to uncover missed diagnoses of spina bifida occulta, particularly in patients presenting with lumbar pain, and underscores the importance of careful attention to focal uptakes in the spinous processes of the vertebrae, which may otherwise be misinterpreted as traumatic and overlooked.

Keywords: Spina Bifida Occulta; Bone scan; Lumbar pain; SPECT/CT imaging; MRI

A64 ^{68}Ga-FAP-2286 in oncologic PET/CT imaging: A review of its role in early cancer detection

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Introduction: Early cancer detection is crucial for improved outcomes. This review aims to evaluate the diagnostic performance of ^{68}Ga-FAP-2286 PET/CT in the early detection of various cancers by targeting fibroblast activation protein (FAP) on cancer-associated fibroblasts. Its potential as a superior alternative to ^{18}F-FDG PET/CT, especially for lesions with low Fluorodeoxyglucose (FDG) ptake, is explored.
Methods: This review study examined 13 articles published from 2021 to 2025, including quantitative studies, meta-analyses, original research, and systematic reviews. Inclusion criteria were full-text availability and publication within the specified years, while case reports were excluded. Keywords used were: ^{68}Ga-FAP-2286, PET/CT, and Early Cancer Detection.
Results: Studies demonstrated significantly higher uptake of ^{68}Ga-FAP-2286 in primary tumours (median SUVmax 11.1 vs 6.9), lymph node metastases (median SUVmax 10.6 vs 6.2), and distant metastases compared to ^{18}F-FDG PET/CT, leading to improved image contrast. ^{68}Ga-FAP-2286 PET/CT visualised all primary tumours (46/46), while ^{18}F-FDG PET/CT missed 9. The lesion detection rate for involved lymph nodes (98% vs 85%) and bone and visceral metastases (95% vs 67%) was superior with ^{68}Ga-FAP-2286 PET/CT. In lung cancer, it showed better detection of lymph nodes (100% vs 78.8%) and bone metastases (100% vs 68.5%). ^{68}Ga-FAP-2286 also detected subcentimetre lymph nodes in urothelial cancer.
Conclusion: ^{68}Ga-FAP-2286 PET/CT shows promise for early cancer detection, particularly for small lesions and in cancers with low ^{18}F-FDG uptake, potentially improving staging and clinical decisions. Further research is needed to validate its role in routine clinical practice.

Keywords: ^{68}Ga-FAP-2286; PET/CT; Early cancer detection

A65 Long-term side effects of radiation exposure in interventional radiology patients

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Introduction: Interventional radiology (IR) procedures, while beneficial, expose patients to ionizing radiation, raising concerns about long-term side effects. Understanding these effects is crucial for patient care and safety. This article aims to examine the long-term side effects of radiation exposure in patients undergoing interventional radiology procedures, the methods used to evaluate these effects, and the strategies for minimizing the associated risks.
Methods: This review study examined 12 articles published from 2020 to 2025, including quantitative studies, meta-analyses, original research, and systematic reviews. Inclusion criteria were full-text availability and publication within the specified years, while case reports were excluded. Keywords used were: Interventional Radiology, Radiation Exposure, and Long-Term Side Effects.
Results: Long-term side effects include radiation-induced cataracts (with evidence suggesting risks even at low doses), increased risk of certain malignancies (extrapolated from studies on medical professionals and exposed populations), delayed skin injuries and chronic changes (ranging from erythema to necrosis), potential cardiovascular and neurological sequelae, and risks to the fetus from in utero exposure. Methodologies involve long-term follow-up, epidemiological studies, and dose monitoring. Incidence rates vary depending on the effect and procedure type.
Conclusion: Long-term radiation effects in IR patients are a significant consideration. While risks from individual procedures are often low, cumulative exposure warrants careful management. Future research should focus on prospective studies in IR patients to refine risk assessment and optimize radiation safety protocols for improved patient outcomes.

Keywords: Interventional radiology; Radiation exposure; Long-term side effects

A66 Comparison of I-131 ablation efficacy with 30 mCi and 100 mCi in Low-risk differentiated thyroid cancer patients: An analysis of Iranian patients

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Introduction: The proper dose of radioiodine-131 (RAI) for treating low-risk differentiated thyroid cancer (DTC) remains a topic of debate. This study compares the effectiveness of two different doses—30 mCi and 100 mCi—of RAI in an Iranian patient population and evaluates recurrence rates. We assume that higher post-surgical thyroid remnants in Iranian patients contribute to a lower ablation success rate with the lower 30 mCi dose.
Methods: This prospective study involved 100 patients with low-risk DTC who had undergone total thyroidectomy. 50 patients received 30mCi of RAI, while the other fifty received 100mCi. Patients were monitored for at least 12 months after treatment, with follow-up assessments including serum thyroglobulin (sTg) levels, whole-body iodine scans, and ultrasounds. Successful ablation was defined using a triple-negative criterion: sTg < 2 ng/mL, a negative WBIS, and a negative ultrasound. Additional factors influencing ablation success—such as the extent of surgery, baseline sTg levels, and iodine intake—were also analyzed.
Results: The study found that ablation success was significantly lower in the 30mCi group (48%) compared to the 100mCi group (80%) ($p < 0.05$). Patients who received 30mCi also had a higher recurrence rate (22%) than those in the 100mCi group (8%) ($p < 0.05$). A greater amount of post-surgical thyroid remnant tissue was observed in patients treated with 30 mCi, which contributed to the lower ablation success rate.
Conclusion: Among Iranian patients, a 30 mCi dose of RAI leads to significantly lower ablation efficacy and a higher recurrence rate, likely due to the presence of larger post-surgical thyroid remnants.

Keywords: Radioiodine ablation; Differentiated thyroid cancer; I-131; low-risk thyroid cancer; Ablation efficacy; Individualized dosimetry

A67 Optimization of prostate cancer treatment using Lu-177 and hafnium nanoparticles: A Monte Carlo study

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Introduction: In this research, we propose an innovative strategy to enhance prostate cancer treatment by combining Lutetium-177 (Lu-177) radiopharmaceuticals with Hafnium nanoparticles (HfNPs). Prostate cancer remains a leading cause of cancer-related mortality worldwide, highlighting the urgent need for more effective therapies. Lu-177 emits potent beta radiation and gamma rays at energies of 113 keV and 208 keV, closely matching the photoelectric absorption region, enabling targeted radiation delivery and potentially increasing therapeutic effectiveness specifically against prostate cancer.
Methods: We employed Geant4 Monte Carlo simulations to evaluate the therapeutic effectiveness of Lu-177 combined with HfNPs. Simulations were performed on prostate tumors treated with Lu-177 alone and combined with HfNPs at two clinically relevant activity levels (74 MBq and 148 MBq), selected based on clinical applicability and previous literature. Therapeutic outcomes were assessed by calculating the relative enhancement ratio (RER) and evaluating apoptosis in tumor cells.
Results: Our findings indicate that combining Lu-177 with HfNPs significantly enhances tumor cell apoptosis compared to Lu-177 alone. At 74 MBq, the relative enhancement ratio (RER) moderately increased to approximately 1.4, whereas at 148 MBq, the RER notably improved to around 2.1, demonstrating a clear dose-dependent therapeutic response.
Conclusion: This study demonstrates the promising potential of combining Lu-177 radiopharmaceuticals with Hafnium nanoparticles for targeted prostate cancer therapy. Utilizing Lu-177's inherent gamma radiation eliminates the need for specialized nanoparticle functionalities, simplifying the therapeutic approach. Future research should focus on experimental validation, biocompatibility, and clinical toxicity to optimize this innovative therapeutic method.

Keywords: Lutetium-177; Hafnium nanoparticles; Prostate cancer; Radiopharmaceutical therapy; Monte Carlo simulation

A68 Optimization of dual energy scatter correction for CZT SPECT using GATE Monte Carlo simulation toolkit

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Introduction: Cadmium Zinc Telluride (CZT) solid-state gamma cameras for SPECT imaging offer significantly improved energy resolution compared to traditional scintillation detectors. However, the photopeak resolution is often asymmetric due to incomplete charge collection within the detector. This results in many photopeak events being incorrectly sorted into lower energy bins, a phenomenon known as "tailing." These misplaced events contaminate the true scatter signal, potentially negatively impacting scatter correction methods that rely on spectral scatter estimates. Furthermore, because CZT detectors are organized into arrays, each individual detector element may exhibit varying degrees of tailing.
Methods: In this study, an optimized dual-energy window (DEW) scatter correction method was developed to mitigate position-dependent "tailing" effects in CZT SPECT imaging caused by incomplete charge collection. GATE Monte Carlo simulation were employed using point sources and Jaszczak / NEMA IQ phantoms to quantify tailing's impact on scatter and refine scatter ratio estimations within the two energy windows. The optimized DEW was then compared against traditional DEW and triple-energy window (TEW) methods. Performance was evaluated using contrast and signal-to-noise ratio (SNR) according to NEMA NU 1 2018 standards.
Results: The optimized dual-energy window method demonstrated a %14 contrast improvement compared to the traditional dual-energy window method and a %6.9 contrast improvement compared to the triple-energy window method. The SNR improved by %17 compared to the traditional DEW and by %28 compared to the TEW.
Conclusion: The optimized dual-energy window method demonstrates significant performance improvements in contrast and SNR, and is recommended as an effective scatter correction method for CZT-based SPECT scanners.

Keywords: Scatter correction; Monte Carlo; SPECT; Energy window

A69 The role of selective inhibitors including Selpercatinib and Pralsetinib in the treatment of thyroid cancer caused by rearranged during transfection mutation

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Introduction: RET (Rearranged during Transfection) proto-oncogene, which plays a critical role in the growth and progression of certain thyroid cancers (TC). Mutations in RET lead to its constitutive activation, driving uncontrolled cellular proliferation and carcinogenesis. This article examines pralsetinib and selpercatinib, two selective RET tyrosine kinase inhibitors (TKIs), which are used to treat advanced or metastatic medullary thyroid carcinoma (MTC).
Methods: Read we conducted an extensive search across electronic databases, including Pubmed, Medline, Google scholar and Embase, and explored the available English-language literature.
Results: In patients with distant metastases and progressive disease, systemic therapy is crucial to slow tumor growth and improve quality of life. Unlike follicular thyroid cells, C cells (which produce calcitonin) do not uptake radioactive iodine or respond to thyroid-stimulating hormone (TSH). Consequently, radioactive iodine therapy and TSH suppression are ineffective in MTC. Instead, TKIs targeting oncogenic signaling pathways, such as RET, are employed. Pralsetinib, another oral, once-daily selective RET inhibitor, has also shown efficacy in clinical trials. Its safety and effectiveness have been evaluated in patients with advanced or metastatic solid tumors harboring RET alterations, including RET-mutated MTC and RET fusion-positive thyroid cancer. A common adverse effect of TKIs is hypertension, which requires careful management to prevent cardiovascular complications and preserve quality of life.
Conclusion: These agents have demonstrated robust efficacy and favorable toxicity profiles in clinical trials, establishing them as novel therapeutic options for RET-altered thyroid cancers. Consequently, genetic testing for RET alterations is recommended prior to initiating systemic therapy.

Keywords: Pralsetinib; Selpercatinib; Tyrosine kinase inhibitors; Thyroid cancers; Medullary thyroid carcinoma

A70 Attenuation and scatter correction of brain PET image using GAN-based deep learning

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Introduction: Positron Emission Tomography (PET) is widely used in nuclear medicine for analyzing metabolic and functional activity. However, photon attenuation and scattering often affect its accuracy, degrading image quality and distorting quantitative analysis. In brain PET imaging, this issue is amplified due to complex structures like the skull and soft tissue. Correcting for attenuation and scatter (ASC) without additional CT or MRI scans is a challenging task.
Methods: This study presents a deep learning-based approach using a Pix2Pix Generative Adversarial Network (GAN) to correct non-attenuation-scatter-corrected (Non-ASC) PET images without requiring additional imaging data. The model was trained on 1,170 FDG-PET brain images from the TCIA ACRIN-NSCLC-FDG-PET data set. Preprocessing included resizing images to 128×128 pixels and normalization. Training was performed using the Adam optimizer (learning rate = 0.0001) for 100 epochs, with 10-fold cross-validation to improve generalization.
Results: The model achieved a mean squared error (MSE) of 0.0043, indicating minimal reconstruction error. A peak signal-to-noise ratio (PSNR) of 25.25 dB suggests strong signal preservation, and a structural similarity index (SSIM) of 0.9588 demonstrates high structural consistency between the corrected and reference images. Additionally, the best-trained model is loaded as the final model in the GUI for easy access and use.
Conclusion: The Pix2Pix GAN model effectively corrects attenuation and scatter artifacts in brain PET images, eliminating the need for auxiliary CT or MRI scans. This approach improves image quality and quantitative accuracy, with potential for other imaging modalities, such as SPECT or whole-body PET scans.

Keywords: Deep learning; Attenuation correction; Scatter correction; Generative adversarial network

A71 Pseudo-CT images generation from T1-weighted MRI images using U-Net neural network

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Introduction: With the rapid advancements in artificial intelligence and deep learning, the use of neural networks in processing medical images has significantly expanded. One of the successful networks in this field is U-Net, which, due to its unique architectural structure, demonstrates high capability in detecting and segmenting medical images. This article investigates the performance and accuracy of the U-Net network in generating pseudo-CT images from T1-weighted MRI images and compares these with actual CT images.
Methods: The performance of the U-Net network was evaluated by generating pseudo-CT images from T1-weighted MRI images. The generated images were compared with actual CT images using quantitative metrics, including Mean Squared Error (MSE), Mean Absolute Error (MAE), and Structural Similarity Index Measure (SSIM).
Results: The reported values for MSE, MAE, and SSIM were 0.047 ± 0.031, 0.144 ± 0.08, and 0.471 ± 0.239, respectively. These results indicate the high capability of the U-Net network in producing pseudo-CT images with high accuracy and reducing errors compared to actual CT images.
Conclusion: The findings suggest that pseudo-CT images generated by the U-Net network can serve as a reliable and stable alternative to traditional attenuation correction methods in integrated PET/MRI systems. This is particularly significant as MRI images inherently lack the ability to provide information on tissue attenuation coefficients.

Keywords: Deep learning; U-Net neural network; Pseudo-CT images

A72 Evaluation of radiomics based information to detect stenosis in gated myocardial perfusion imaging

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Introduction: Radiomics involves extracting large amounts of quantitative features from medical images and shows potential for predicting coronary artery disease (CAD) in Myocardial Perfusion Imaging (MPI) SPECT when combined with machine learning. This study evaluates the use of functional radiomics features from gated-single photon emission computed tomography (SPECT) to detect coronary artery stenosis as confirmed by coronary angiography (CA).
Methods: A dataset of 250 patients (average age 58.3, 40% male) who underwent both MPI SPECT and CA was analyzed. Patients with significant stenosis were identified based on CA reports. Left ventricular segmentation and quantification were performed using Cedars QPS/QGS 2015. Radiomics features were extracted through the SERA framework from four polar maps: end-diastole perfusion, end-systole perfusion, wall motion, and wall thickening. Feature selection was performed statistically, followed by a recursive feature selection algorithm. A support vector machine classifier assessed performance using metrics such as AUC, accuracy, precision, recall, and F1-score.
Results: Some radiomics features demonstrated strong performance, with the highest univariate AUC reaching 0.75. The most predictive features were derived from end-diastole perfusion and wall motion maps. The machine learning models achieved notable classification performance, with the highest AUC and accuracy reaching 0.78 and 0.81, respectively.
Conclusion: Radiomics features from gated-SPECT, particularly those related to end-diastole perfusion and wall motion, can enhance quantitative analysis in MPI scans. Coupled with machine learning, this approach shows promise for improving CAD prediction accuracy in MPI-SPECT.

Keywords: Gated scan; Myocardial perfusion imaging; Radiomics; Quantitative analysis

A73 The historical overview of nuclear medicine in Iran

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Nuclear medicine stands at the crossroads of physics, chemistry, biology, and medicine—an ever-evolving field that has transformed the way we diagnose and treat disease. Because of its interdisciplinary nature, tracing its exact origins is not straightforward. However, most historians agree that the roots of nuclear medicine lie between two landmark moments: the discovery of artificial radioactivity in 1934 by Irène and Frédéric Joliot-Curie, and the post-war era in 1946, when Oak Ridge National Laboratory began producing medical radionuclides. The story of nuclear medicine, however, begins even earlier. In 1896, Henri Becquerel discovered natural radioactivity—a breakthrough that opened the door to decades of innovation. By the 1930s, researchers were experimenting with newly developed cyclotrons to produce radioactive isotopes, pushing the boundaries of what medicine could achieve. These efforts culminated in a major milestone in 1951, when the U.S. Food and Drug Administration (FDA), cementing nuclear medicine's place in modern healthcare, approved the first radiopharmaceutical. This presentation offers a historical journey through the development of nuclear medicine, both globally and within Iran, highlighting the key scientific and clinical milestones that have shaped the field, as we know it today.

Keywords: History; Nuclear medicine; Iran

A74 Board review in general nuclear medicine: Selected case presentations

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With the rapid advancement of hybrid imaging and the growing clinical use of PET-based technologies, the role of conventional nuclear medicine in some clinical scenarios has undergone transformation. Nevertheless, several general nuclear medicine procedures continue to retain their value due to their unique diagnostic capabilities, accessibility, and physiological insights. This session presents a series of selected cases within general nuclear medicine, focusing on commonly performed but diagnostically significant procedures such as bone scintigraphy, gastrointestinal imaging, and renal scan. Through case-based discussion, key diagnostic features, clinical indications, interpretation pitfalls, and the continued relevance of these modalities will be highlighted. The aim is to emphasize the enduring utility of conventional nuclear medicine in the evolving landscape of diagnostic imaging and to provide a concise, practical review for board exam preparation and everyday clinical application.

Keywords: Nuclear medicine; Case presentation; Board review

A75 Report on the use of radiopharmaceuticals in the country in 2024

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Radiopharmaceuticals are a unique class of drugs that carry radionuclides capable of emitting ionizing radiation, playing a key role in both diagnosing and treating a wide range of diseases within nuclear medicine. The global radiopharmaceutical market is generally divided into two main categories: diagnostic and therapeutic. In Iran, the presence of more than 220 nuclear medicine centers, along with a strong community of professionals—including nuclear medicine physicians, radiopharmacists, physicists, technologists, and others—has created a solid foundation for continued progress in both clinical practice and research in this field. In this review, we take a closer look at the radiopharmaceutical market in last year, highlighting developments in Iran and placing them in the context of global trends.

Keywords: Radiopharmaceutical market; Nuclear medicine; Iran

A76 Nuclear medicine in pediatric renal and urinary imaging

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Dynamic renogram by Tc-99m MAG3, Tc-99m EC or Tc-99m DTPA (with or without diuretics), renal cortical scintigraphy by Tc-99m DMSA, radionuclide cystography (RNC) by Tc-99m pertechnetate or Tc-99m SC, and glomerular filtration rate (GFR) by Tc-99m DTPA, are diagnostic procedures of choice or complementary modalities in the work up of infants and children with urologic or nephrologic problems. Tc-99m MAG3 is especially useful in evaluation of renal function, including cortical, excretory and drainage phases, and has a unique role in differentiation obstruction from non-obstructed renal collecting system, being essential in surgical decision-making and post-surgery follow-ups. Tc-99m DMSA is particularly used for localizing kidneys and evaluation functional cortical anatomy, being highly sensitive for detection of scarring and infection. RNC is a valuable sensitive tool for assessment and management of vesicoureteral reflux. DTPA GFR evaluation is a direct method, being faster and more reliable than conventional eGFR for assessing renal function.

Keywords: Nuclear medicine; Pediatric; Renal scintigraphy

A77 Artifacts and pitfalls of Gated SPECT imaging

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Gated myocardial perfusion SPECT (GSPECT) is a widely recognized, non-invasive imaging technique essential in managing coronary artery disease (CAD). It serves key roles in diagnosis, risk assessment, prognosis evaluation, therapy monitoring, and determining myocardial viability, while also offering critical data on left ventricular (LV) systolic and diastolic function. However, because GSPECT captures intricate physiological dynamics, it is prone to artifacts and technical pitfalls that can cause misinterpretations—leading to false-positive or false-negative results. To reduce such errors, the imaging team (physicians, technologists, and staff) must have a deep understanding of these challenges. Recognizing potential issues related to patient-specific factors (such as cardiac anatomy), equipment constraints, and procedural execution can help prevent, identify, or correct artifacts. Therefore, both interpreting physicians and technologists must be knowledgeable about the origins and consequences of these artifacts to ensure precise and dependable diagnostic outcomes.

A78 Application of FAPI PET in malignancies

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Gallium 68–labeled fibroblast activation protein inhibitor (FAPI) PET is used based on the molecular targeting of the FAP, known to be expressed in the most cell population in tumor stroma, which is termed as cancer-associated fibroblasts. ^{68}Ga-FAPI exhibits rapid tracer accumulation in target lesions with low background, which results in favorable imaging characteristics. ^{68}Ga-FAPI-PET can be used in the clinical setting and enables to detect small primary or metastatic lesions, significantly in the brain, head and neck, liver, pancreas and gastrointestinal tract because of low tracer accumulation in these organs. As well as, the DOTA chelator allows coupling of the FAPI molecules with therapeutic emitters such as Lutetium-177 for theranostic applications. In this meeting we speaking about state of the FAP imaging, summarizes the current knowledge of relevant cancer biology, and highlights the latest findings in the clinical setting of ^{68}Ga-FAPI PET and other present FAPI tracers.

A79 PET Radiopharmaceuticals: Present situation and future rise

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PET radiopharmaceuticals are composed of PET radioisotopes plus active pharmacophore. The 511 keV gamma energy resulted from annihilation of positron are used in PET cameras for diagnosis of malignant and benign diseases. The results of imaging studies using PET radiopharmaceuticals have an important role in oncology such as; Detection and localization of unknown primary tumors, differentiating malignant from benign tissue/metastasis, Staging and re-staging, Monitoring response to therapy. The most important PET radioisotopes are F-18, Ga-68, C-11, Zr-89, I-124, etc. Active pharmacophores include small molecules, aptamers, amino acids, peptides, antibodies, antibody mimetic, nanoparticles. These molecules target cancer biomarkers (e.g; enzymes, receptors, and transporters) or biological process (e.g, energy metabolism, hypoxia, acidosis, and oxidative stress). Here the history of PET, PET radiopharmaceuticals that are presently in clinic and approved by US Food and Drug administration (FDA) or European medicines Agency (EMA), and future of PET radiopharmaceuticals are discussed.

A80 Applications of artificial intelligence in nuclear medicine and nuclear cardiology

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Artificial Intelligence (AI) is rapidly transforming the landscape of both nuclear medicine and nuclear cardiology, two fields that bridge advanced imaging technologies with precision diagnostics. In nuclear medicine, imaging techniques such as Positron Emission Tomography (PET) and Single Photon Emission Computed Tomography (SPECT) produce detailed, functional insights into the human body. AI algorithms—especially those based on machine learning and deep learning—are now key players in image reconstruction, automated analysis, quantitative measurement. These applications not only improve diagnostic precision and workflow efficiency but also pave the way for more personalized healthcare strategies. The synergy between AI and nuclear imaging not only enhances diagnostic precision but also streamlines clinical workflows. As AI continues to evolve, we can expect even more innovative applications—such as integrating multi-modal imaging data and real-time analysis—which promise to usher in an era of truly personalized medicine. In essence, AI is becoming the trusted guide in the labyrinth of nuclear imaging, illuminating patterns and insights that drive better patient care. This dynamic intersection of technology and medical science is only set to deepen, encouraging ongoing exploration into predictive models, integrated diagnostics, and beyond.

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