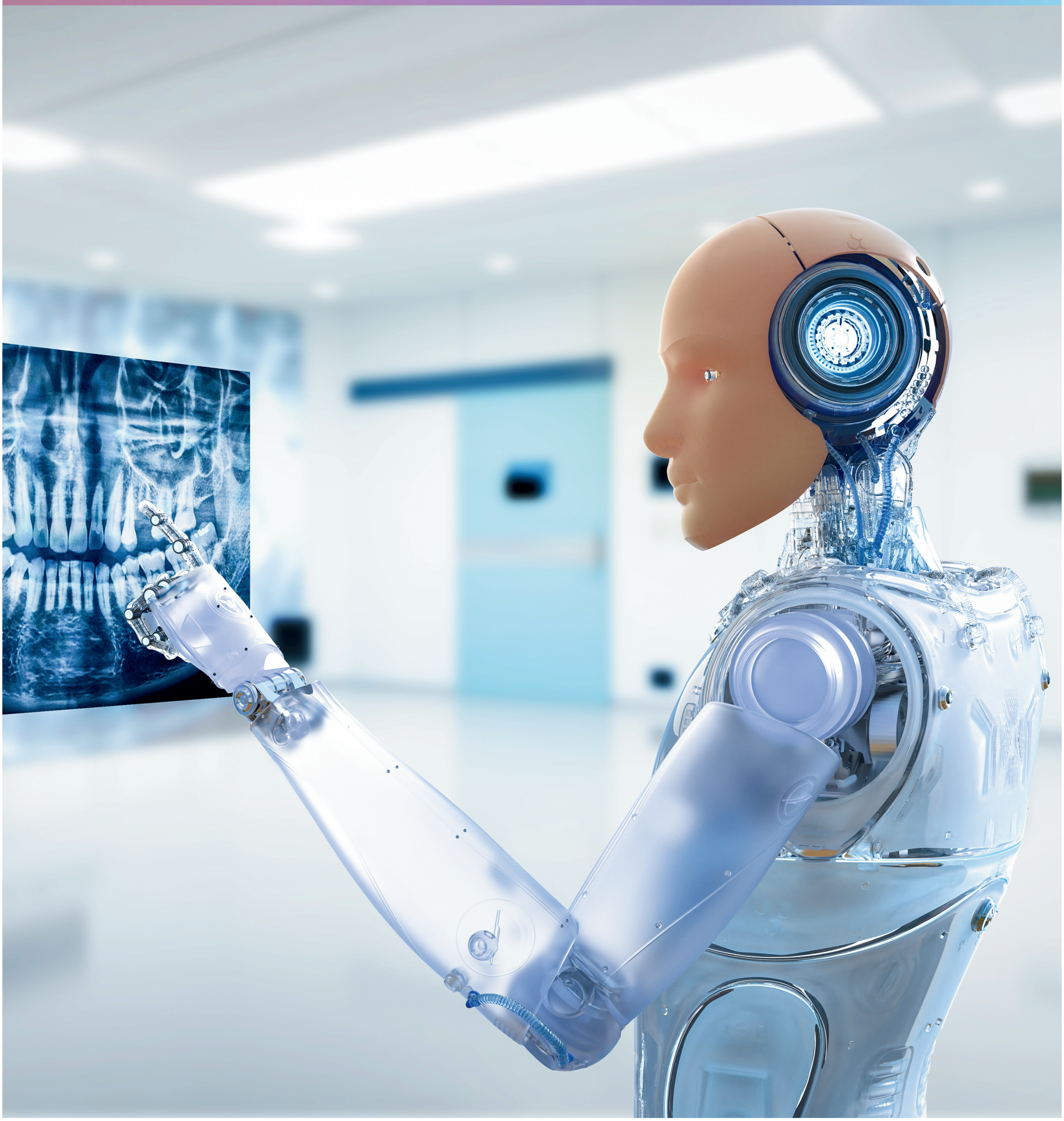
Since 2004 For free Circulation

ISRRT
INTERNATIONAL SOCIETY OF RADIOGRAPHERS & RADIOLOGICAL TECHNOLOGISTS

Radiographers' Journal

The official magazine of Society of Indian Radiographers (SIR)
Published by Radiographers' Association of Maharashtra (RAM)

March 2025



Editorial

Shankar K. Bhagat
Editor-in-chief, Radiographers' Journal

Pioneering the Future of Radiography

Welcome to another edition of the Radiographers' Journal. As technology advances, radiography continues to evolve, shaping the future of patient care. The dynamic nature of our profession requires continuous learning, adaptation, and innovation. This issue highlights key advancements, leadership strategies, and emerging technologies that are redefining medical imaging and patient management.

Key Topics in This Issue

Effective communication is essential in healthcare leadership. In this issue, we examine how strong communication skills enhance team collaboration, patient care, and organizational success. Additionally, we explore advancements in low-dose radiography, ensuring a balance between image quality and radiation safety, as well as updated regulatory standards for radiation protection, which are crucial for maintaining best practices in medical imaging.

Innovations such as photon-counting detector CT, helium-free MRI, and AI in radiology are revolutionizing the industry. Photon-counting CT enhances image resolution while reducing radiation exposure, while helium-free MRI offers a sustainable alternative to traditional MRI systems, addressing concerns about the global helium shortage. AI in radiology is improving workflow efficiency, image interpretation, and diagnostic accuracy, highlighting the importance of embracing technological advancements in the field.

We also explore the role of radiographers in interventional radiology, emphasizing their expanding responsibilities in ensuring patient safety and procedural success. Furthermore, coronary CT angiography continues to gain significance in cardiovascular imaging, offering a non-invasive approach to diagnosing coronary artery disease. Another exciting development covered in this issue is high-intensity focused ultrasound, which presents a promising therapeutic application in tumor ablation and neurological disorders.

Moreover, advanced imaging techniques such as MRI myocardial mapping provide detailed tissue characterization, enhancing diagnostic precision for cardiac conditions. The use of computed tomography and MRI in brain mapping is also expanding, providing critical insights into neurological disorders and cognitive function. As these imaging modalities evolve, radiographers must stay at the forefront of new techniques to maximize diagnostic accuracy and patient outcomes.

The Future of Radiological Technologists

The future of radiology is filled with opportunities and challenges. As AI, hybrid imaging techniques, and personalized medicine become more integrated into clinical practice, radiological technologists must continuously expand their expertise to remain at the forefront of the profession. Lifelong learning, specialization, and collaboration with other healthcare professionals will be key to adapting to these changes and delivering high-quality patient care.

Moreover, with the increasing reliance on molecular imaging-guided therapy, radiographers will play an essential role in precision medicine, tailoring imaging techniques to individual patient needs. As the profession evolves, radiographers must take an active role in research, education, and the implementation of new technologies to enhance diagnostic accuracy and treatment outcomes.

As automation and AI continue to reshape workflows, radiographers must also embrace new roles that go beyond traditional imaging. This includes developing expertise in image post-processing, quality assurance, and patient-centered care. Ethical considerations surrounding AI-driven diagnostics will also require radiographers to maintain a balance between technological advancements and human oversight, ensuring the highest standards of safety and professionalism in medical imaging.

Engage with Us

We encourage our readers to engage with the discussions presented in this issue, share their insights, and contribute to the ongoing advancement of radiography. Your feedback on these articles is invaluable in shaping future editions of this journal.

Additionally, we welcome article submissions for our upcoming issue. If you have research findings, case studies, or expert perspectives that contribute to the growth of radiography, we invite you to submit your work for consideration. Your contributions help foster knowledge-sharing and professional development within our community.

We hope you find this issue insightful and inspiring. As we move forward, let us embrace innovation, enhance our skills, and work together to shape the future of radiography.

13th State Conference of Radiographers' Association of Maharashtra

The 13th State Conference of the Radiographers' Association of Maharashtra was successfully held on 16th March 2025 at HCG Manavata Hospital, Nashik. The prestigious event was inaugurated by **Mrs. Devyani Pharande,** MLA of Nashik Central Constituency, in the presence of esteemed dignitaries, medical professionals, and association members.

The occasion was further honored by the presence of officials from the **Society of Indian Radiographers,** including Mr. Sunil Chavan, Co-chairman, Mr. Vilas Bhadane, President, and Mr. Jagdish Jagtap, Secretary General, whose participation added great significance to the event.

The conference witnessed enthusiastic participation from students representing various colleges, who demonstrated their presentation skills through engaging paper and poster presentations. Additionally, renowned experts in the field of radiography delivered insightful sessions on the latest advancements in medical imaging, emerging trends, and best practices.

The event served as an exceptional platform for knowledge-sharing, networking, and professional development, further reinforcing the association's commitment to the advancement of radiography in Maharashtra.



















































TECHCON 2025










TECHCON BANK


One Stop Shop
Products & Solutions
AMS
Cath Lab
Radiation Protection
C-ARM
PACS
Dental Solutions
CBCT
OPG
X - Ray
Computed Radiography
Digital Radiography
CT Scan
MRI
Ultrasound
X-Ray Accessories

The Critical Role of Effective Communication in Healthcare Leadership: Enhancing Patient Care, Team Collaboration, and Organizational Success

Anamika Sharma, Anna Subba, Wilson Hrangkhawl, Medical Imaging Technology,
Dept. of Allied Health Professions, Sikkim Manipal Institute of Medical Sciences, Sikkim Manipal University

Introduction

In healthcare settings, communication is not just a skill but necessity for achieving clinical excellence and operational efficiency. It forms the foundation of all care delivery activities such as inter professional teamwork, patient education, and decision-making. It underpins every aspect of care delivery, including interdisciplinary teamwork, patient education, and informed decision-making. For healthcare leaders, communication is central to guiding teams, resolving conflicts, and driving organizational change. Research indicates that strong communication skills among leaders significantly improve patient outcomes and enhance team cohesion (Garon, 2020). This paper analyzes the different functions of communication in healthcare leadership and how it affects organizational performance.

The Role of Communication in Healthcare Leadership and Management

Facilitating Informed Decision-Making: Effective communication is essential for making informed decisions in healthcare. It enables the exchange of accurate information, fosters collaboration, and ensures that all stakeholders are well-informed. Leaders who encourage open communication create an environment where team members feel empowered to share their insights and contribute to evidence-based decision-making. Research by O'Daniel and Rosenstein (2021) revealed that teams with effective communication channels experienced a 23% improvement in decision-making accuracy, which significantly reduced medical errors.

Promoting Team Collaboration and Cohesion: Multidisciplinary collaboration is critical for addressing the diverse and complex needs of patients. Effective communication strengthens teamwork by fostering mutual respect and seamless interaction among healthcare professionals, including physicians, nurses, allied health staff, and administrative personnel. Manser (2020) highlighted that communication breakdowns are responsible for nearly 70% of sentinel events in healthcare organizations. Leaders who implement structured communication protocols, such as the SBAR (Situation, Background, Assessment, Recommendation) model, ensure that vital information is conveyed clearly and efficiently.

Enhancing Patient-Centered Care: Patient-centered care relies heavily on effective communication between healthcare providers and patients. Leaders who prioritize training programs focused on empathy and active listening equip their teams to communicate complex medical information in accessible ways while addressing patient concerns. A meta-analysis by Epstein and Street (2020) demonstrated that strong patient-provider communication leads to better adherence to treatment plans, higher satisfaction rates, and improved clinical outcomes. By embedding communication strategies into the organizational culture, leaders create an environment where patients' preferences and values are respected.

Conflict Resolution and Building Organizational Cohesion: Highly stressful health care environments will lead to conflict based on diverse professional perspectives or competing priorities. Good communication offers leaders the skills to identify, resolve, and address conflicts in a positive way. Brinkert (2021) confirmed that leaders applying conflict resolution tactics like the Thomas-Kilmann model are better able to cope with disagreements, rebuild trust, and maintain harmony in their organizations. A culture of open communication also allows employees to share issues freely and practice collaborative problem-solving.

Leaders must manage the speed of technological change, evolving regulatory landscapes, and patient expectations in the context of organizational change and innovation in healthcare. Communication is critical to describing a vision for change, addressing stakeholder fears, and creating a shared commitment to innovative practice. Kotter (2021) indicates that projects with leaders who prioritize communication have a 65% higher success rate. Leaders can be effective in driving transformation and decreasing resistance by actively involving stakeholders at each stage.

Challenges in Communication for Healthcare Leaders

Effective communication is a cornerstone of healthcare leadership, yet leaders often face significant obstacles in maintaining clear and consistent communication within their organizations. These challenges can undermine collaboration, patient safety, and organizational efficiency if not addressed. Below are three key challenges faced by healthcare leaders:

1. Hierarchical Structures and Power Dynamics

The majority of healthcare organizations operate under tight hierarchical structures, which may stifle open channels of communication. Frontline staff may feel discouraged or intimidated when trying to bring up issues or report concerns, particularly with senior management. This hesitation will lead to underreporting critical events, thus compromising patient safety and organizational progress. Okuyama et al. (2020) emphasize in their study how hierarchical boundaries dampen transparency in healthcare settings and the need for leaders to create an open environment in which all voices are heard.

2. Time Constraints and Increased Work Demands

Healthcare settings are characterized by their speed and high expectations, where leaders and personnel are frequently prioritizing multiple competing demands at once. The urgency of clinical decision-making, with the high patient volume, constrains time for reflective or thoughtful conversation. The time constraint could lead to miscommunications, lost information, and potentially harmful medical errors that undermine the quality of patient care. Leaders must balance a delicate need to meet urgent operational demands with ensuring that important information is shared effectively among teams.

3. Variety in Modes of Communication and Cultural Variances

Healthcare teams are increasingly heterogeneous, consisting of practitioners from a wide diversity of cultural backgrounds with their own styles of communication and expectations. Diversity enriches the working environment but can be a barrier to teamwork if not well managed. Cultural or linguistic misunderstandings are likely to lead to communication breakdown and less cohesive teams. Schiavo (2020) highlights the need to acquire cultural competence for leaders, with approaches that value and recognize varied communication styles and build bridges among team members.

Strategies to Overcome Communication Challenges

Healthcare leaders can take proactive steps to address these challenges and foster effective communication within their organizations:

1. Implementing Standardized Communication Protocols

Systematic approaches such as SBAR (Situation, Background, Assessment, Recommendation) or Team STEPPS provide a standardized model for information sharing, reducing confusion and enhancing clarity in high-pressure situations (Abraham & Pieroni, 2021). Use of these tools ensures that critical information is communicated accurately, improving patient safety and team coordination.

2. Encouraging Psychological Safety

Building a culture of psychological safety is vital in making employees feel they can speak freely. Leaders must work towards building a culture in which people feel free to posit concerns, provide feedback, and report mistakes without fear of punishment (Edmondson, 2020). This helps build trust and enhance cross-team collaboration.

3. Facilitating Continuing Instruction in Communication Skills

Continuing professional development training in communication skills has the potential to equip healthcare professionals with the competencies required to manage complex interpersonal interactions effectively. Leadership development training in active listening, empathy, and conflict resolution can render leaders and their staff more communicatively competent (Boissy et al., 2020).

4. Utilizing Technology

Digital tools like electronic health records (EHRs), secure messaging apps, and telecommunication networks enable seamless sharing of information across various teams and locations. The use of technology in communication processes allows leaders to streamline processes, improve collaboration, and bridge gaps in the exchange of information (Kripalani et al., 2020).

Impact of Effective Communication on Organizational Outcomes

Effective communication is a powerful tool that shapes the success of healthcare organizations, influencing patient outcomes, staff morale, and public perception. When leaders prioritize clear and transparent communication, they create a ripple effect that benefits every aspect of the organization. Here are three key ways effective communication impacts organizational outcomes:

1. Enhanced Patient Safety and Quality of Care

Good communication is needed to ensure patient safety and high-quality care. Better communication by healthcare teams reduces the frequency of adverse events, medication errors, and sentinel events. The Joint Commission (2020) identified that communication breakdowns are among the leading causes of preventable medical mistakes in healthcare settings. By creating a culture that supports timely and accurate communication, coordination of care can be improved and patients' well-being preserved.

2. Increased Employee Satisfaction and Retention

Open communication creates a positive work environment in which employees are valued, respected, and encouraged. Managers who encourage open communication and listen to their workers build a culture of teamwork and trust. Such a practice leads to improved job satisfaction, reduced burnout, and higher employee retention. Shanafelt et al. (2021) observe that when employees are valued and appreciated, they are more committed and motivated towards their work and hence contribute to organizational stability.

3. Enhanced Organizational Reputation and Patient Trust

Healthcare organizations that prioritize effective communication build stronger relationships with their patients and communities. Transparent interactions and patient-centered care create positive experiences that foster trust and loyalty among patients. These experiences not only enhance the organization's reputation but also lead to increased patient referrals and long-term growth. Lee & Daugherty (2020) highlight how organizations known for their commitment to clear communication often enjoy greater public confidence and a competitive edge in the healthcare industry.

Conclusion

Effective communication is integral to healthcare leadership and management. By prioritizing transparency, empathy, and structured protocols, leaders can foster collaboration, improve patient outcomes, and drive organizational success. As healthcare systems evolve, investing in innovative communication strategies will be crucial for navigating challenges and achieving sustainable improvements.

References

·Abraham, J., & Pieroni, R. E. (2021). Enhancing communication protocols to improve patient safety in healthcare settings. Journal of Healthcare Quality Research, 45(3), 245–257. https://doi.org/10.1016/j.jhqr.2021.04.002

·Boissy, A., Windover, A. K., & Gilligan, T. (2020). Communication skills training for healthcare professionals: Bridging gaps in patient-centered care. Journal of General Internal Medicine, 35(1), 142–150. https://doi.org/10.1007/s11606-019-05375-8

·Brinkert, R. (2021). Conflict resolution strategies in healthcare: A review of best practices. Health Communication Journal, 38(4), 401–412. https://doi.org/10.1080/10410236.2021.1865536

·Edmondson, A. C. (2020). Psychological safety in healthcare: Fostering a culture of openness and trust. Health Affairs, 39(2), 159–167. https://doi.org/10.1377/hlthaff.2020.0015

·Epstein, R. M., & Street, R. L. (2020). The impact of patient-provider communication on healthcare outcomes: A systematic review. Patient Education and Counseling, 103(1), 12–18. https://doi.org/10.1016/j.pec.2020.10.024

·Garon, M. (2020). Effective communication and leadership in healthcare organizations: A conceptual framework. Journal of Nursing Management, 28(3), 351–359. https://doi.org/10.1111/jonm.12947

·Kotter, J. P. (2021). Leading change in healthcare: Communication strategies for successful implementation. Journal of Organizational Change Management, 34(2), 215–229. https://doi.org/10.1108/JOCM-09-2020-0273

·Lee, T. H., & Daugherty, B. (2020). Building trust through effective communication in healthcare. Health Services Management Research, 33(3), 199–208. https://doi.org/10.1177/0951484820933434

·Manser, T. (2020). Teamwork and communication in healthcare: Lessons from aviation. British Medical Journal, 370, m3200. https://doi.org/10.1136/bmj.m3200

·Okuyama, A., Wagner, C., & Bijnen, B. (2020). Addressing hierarchical barriers to improve communication in healthcare: A qualitative study. BMC Health Services Research, 20(1), 233. https://doi.org/10.1186/s12913-020-05102-8

·O'Daniel, M., & Rosenstein, A. H. (2021). Impact of interdisciplinary communication on clinical decision-making. Journal of Interprofessional Care, 35(4), 409–417. https://doi.org/10.1080/13561820.2021.1921837

·Schiavo, R. (2020). Health communication in multicultural settings: Navigating diversity in healthcare delivery. Health Communication Quarterly, 34(2), 123–135. https://doi.org/10.1080/10410236.2020.1741127

·Shanafelt, T. D., Goh, J., & Sinsky, C. A. (2021). The impact of effective communication on clinician burnout and job satisfaction. Mayo Clinic Proceedings, 96(2), 345–357. https://doi.org/10.1016/j.mayocp.2020.11.015

QUIZ to Recapitulate

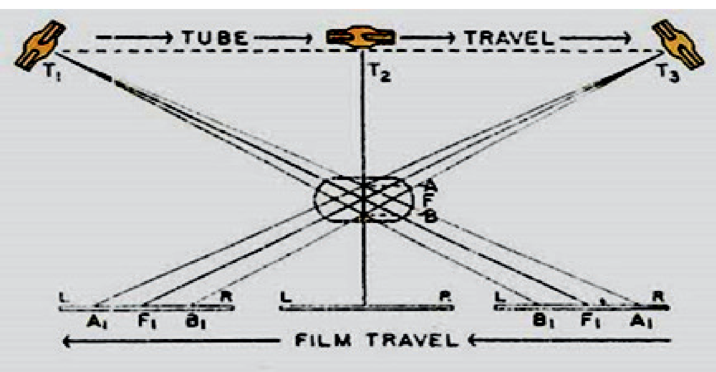
Pawan Kumar Popli, Chief Technical officer-Radiology (Retd.), AIIMS, New Delhi

1. Heel effect can be noticed on which side of x-ray tube ?

2. Which x-ray tubes are used to produce pulsating x-rays?

3. Identify the vessels

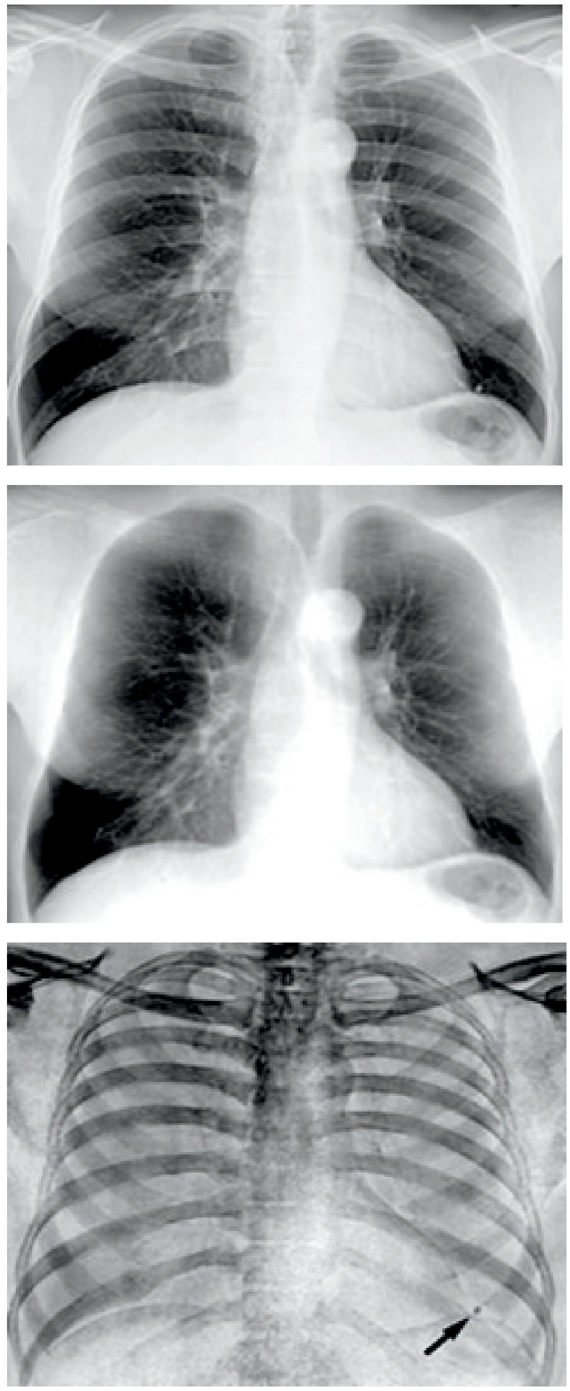
4. Identify the procedure



5. Which catheter is used for flush aortogram ?

7. In which modality air/gas bubbles are used as contrast medium?

6. Name the technique



8. Which type of solution BaSO4 forms in water ?

9. Name the largest sesamoid bone of body.

10. Which is the commonly used non-screen radiography film?

- Please send your answers through email on **pkpopli@gmail.com**
- Correct answers will be published in the next issue.
- **Best 3 participants** (early birds and correct) **in each month will get the prizes.**
- If required /requested by participants more details about any question can be provided in upcoming issues under title **"Your Requests"**

Advancements in Low-Dose Radiography: Balancing Image Quality and Radiation Safety

Firdous Nazir, Radiographic Technologist, Govt Medical College, Anantnag, Jammu & Kashmir

Introduction

The discovery of X-rays by Wilhelm Roentgen in 1895 revolutionized medical imaging. Since then, radiography has become one of the most widely used diagnostic tools in medicine. From detecting fractures to diagnosing lung diseases and cancer, X-ray imaging has played a crucial role in healthcare. However, X-rays belong to the category of ionizing radiation, which can cause cellular damage and increase the risk of cancer when exposure is excessive or prolonged.

This risk has led to increasing efforts to develop Low-dose radiography Techniques that balance safety with high-quality imaging. Over the last two decades, several technological advancements have been introduced to achieve this goal, including:

- AI-driven image enhancement
- Photon-counting detector technology
- Automatic exposure control systems
- Hybrid imaging techniques (e.g., ultrasound + X-ray, MRI + CT)

By incorporating these innovations, radiologists and radiographers can **reduce radiation exposure without compromising diagnostic accuracy**

Understanding the Risks of Radiation Exposure

Before diving into the latest advancements, it is crucial to understand why reducing radiation dose is so important. Ionizing radiation has both deterministic and stochastic effects on human tissues:

- **Deterministic effects:** These occur when radiation dose exceeds a certain threshold, leading to immediate damage such as skin burns, tissue necrosis, or cataracts.
- **Stochastic effects:** These occur even at low doses and include Long-term risks like cancer and genetic mutations.

Particularly vulnerable groups include:

- Pediatric patients whose developing tissues are more sensitive to radiation.
- Pregnant women, where exposure can affect fetal development.
- Patients requiring multiple imaging studies, such as those undergoing long-term cancer monitoring.

Because of these risks, the guiding principle in radiography is ALARA (As Low As Reasonably Achievable)—ensuring that imaging is performed with the lowest possible radiation dose while maintaining diagnostic quality.

Technological Innovations in Low-Dose Radiography

AI-Assisted Image Enhancement: One of the most significant breakthroughs in radiology is the integration of artificial intelligence (AI) into imaging workflows. AI algorithms can enhance the quality of low-dose images, making them comparable to standard-dose images while using significantly less radiation.

How AI Works in Radiography

Noise Reduction: AI-powered deep learning algorithms can filter out noise in low-dose images, preserving essential details without increasing radiation.

Super-Resolution Imaging: AI models trained on high-resolution images can reconstruct clearer images from low-dose scans.

Automated Abnormality Detection: AI can flag suspicious areas in an image, reducing the need for repeat scans and additional radiation exposure.

Studies have shown that **AI-assisted low-dose CT scans** can reduce radiation dose by 30-70% while maintaining diagnostic accuracy.

Photon-Counting Detector Technology: Traditional energy-integrating detectors (EIDs) used in X-ray and CT imaging absorb X-ray photons and convert them into electrical signals. However, these detectors have limitations in distinguishing between different energy levels of X-rays, leading to higher radiation requirements for better image contrast.

Advantages of Photon-Counting Detectors (PCDs)

Photon-counting detectors represent a paradigm shift in radiography:

Better Image Resolution: PCDs count individual photons, allowing for sharper and more detailed images.

Lower Radiation Dose: By efficiently utilizing X-ray photons, PCDs require significantly lower exposure levels.

Improved Soft-Tissue Contrast: PCDs reduce image noise and improve differentiation between tissues, making them particularly useful in oncology and vascular imaging.

Research indicates that PCD-based CT scans can achieve up to a 40% dose reduction Compared to conventional systems, making them one of the most promising innovations in low-dose imaging.

Adaptive Exposure Control and Dose Modulation: Modern radiographic equipment uses **Automatic exposure control (AEC)** and **dose modulation algorithms** to optimize the amount of radiation based on the patient's body size, age, and specific imaging needs.

How Dose Modulation Works

- In CT imaging, automated tube current modulation (ATCM) adjusts X-ray intensity dynamically based on body region density.
- In X-ray imaging, real-time feedback systems analyze image quality and adjust exposure accordingly, ensuring the lowest possible radiation dose.

Clinical benefits:

- For pediatric patients, exposure is automatically reduced while maintaining diagnostic accuracy.
- For obese patients, exposure is increased only where necessary to prevent unnecessary repeats.
- For skeletal imaging, radiation is minimized when soft-tissue contrast is not a priority.

This technology has led to an average dose reduction of 20-50% across different imaging modalities.

Hybrid Imaging Techniques for Dose Reduction: Hybrid imaging combines **multiple imaging modalities** to minimize the use of ionizing radiation while improving diagnostic accuracy.

Examples of Hybrid Imaging

1. Ultrasound-Guided Radiography: In musculoskeletal and abdominal imaging, ultrasound can be used to assess soft tissues first, reducing unnecessary X-ray scans.

2. MRI and Low-Dose CT Fusion: In neurological and oncological imaging, combining MRI with low-dose CT scans provides high-resolution anatomical details while minimizing radiation exposure.

3. Fluoroscopy-Guided Procedures with AI Assistance: AI algorithms can predict anatomical structures, allowing radiologists to reduce real-time fluoroscopy exposure by 50-70%.

By integrating these approaches, hybrid imaging strategies are reducing overall radiation exposure across many medical fields.

4. Clinical Impact of Low-Dose Imaging: Improved Safety for Vulnerable Populations

Pediatric radiology: AI-enhanced low-dose techniques have significantly reduced radiation exposure in children while maintaining diagnostic reliability.

Pregnancy imaging: Low-dose digital radiography (LDR) and hybrid imaging approaches help minimize fetal radiation exposure.

Advancements in Cancer Diagnosis and Treatment

- Low-dose CT (LDCT) for lung cancer screening has become standard practice, reducing radiation risks while maintaining high sensitivity for early detection.
- AI-assisted MRI-CT fusion imaging allows oncologists to track tumor progression with minimal radiation exposure.

Cost-Effectiveness and Workflow Efficiency

- AI-driven low-dose imaging reduces the need for repeat scans, lowering hospital costs and improving patient throughput.
- Photon-counting detectors improve workflow efficiency, reducing scanning time and enhancing radiologists' diagnostic confidence.

Challenges in Implementing Low-Dose Radiography

Despite these advancements, some challenges remain:

1. High Initial Costs: Implementing photon-counting detectors and AI software requires significant investment, limiting access in lower-resource settings.

2. Regulatory and Ethical Considerations: AI-assisted diagnostics must comply with strict FDA and international regulations before being widely adopted.

3.Training and Adaptation: Radiologists and radiographers need specialized training to integrate AI and low-dose techniques into daily practice.

4. Data Security and Privacy Risks: As medical imaging shifts to cloud-based AI analysis, ensuring secure patient data management becomes a priority.

Despite these hurdles, ongoing research and technological advancements are expected to make low-dose radiography more accessible and widely accepted in the coming years.

Conclusion

Low-dose radiography is shaping the future of medical imaging by balancing radiation safety with diagnostic accuracy. The integration of AI-assisted imaging, photon-counting detectors, adaptive exposure control, and hybrid imaging techniques is significantly reducing radiation exposure while enhancing patient care.

As these technologies continue to evolve, the goal is to achieve ultra-low-dose imaging without compromising image quality. By adopting these innovations, radiology can move towards a safer, more efficient, and patient-centered approach to medical imaging.

Installation Ceremony of Office bearers of Radiographers' Association of Maharashtra for the Year 2025-26

Venue: Hotel Surya, Nashik Date: 15th March 2025

The Installation Ceremony of the Office Bearers of the Radiographers' Association of Maharashtra for the year 2025-26 was held on 15th March 2025 at Hotel Surya, Nashik. The event witnessed the presence of esteemed dignitaries, association members, and professionals from the radiography field.

During the ceremony, the newly appointed office bearers officially took charge of their respective roles:

- Mr. Narendra Wagh – President
- Mr. Rajendra Potdar – Vice President
- Mr. Abhijeet Pagare – General Secretary
- Mr. Rana Randhir Kumar – Treasurer

The association members congratulated the new leadership team and expressed their confidence in their ability to work towards the betterment of radiographers across Maharashtra. The event concluded with a vote of thanks and a commitment to advancing the association's mission for the year ahead.

Regulatory Standards and Guidelines for Radiation Protection

Seerat Manzoor, Tutor, BEE ENN College of nursing, Jammu University
(PG student, Dept. of Radiology and Imaging Technology, Longowal Group of Colleges, Derabasi, Chandigarh)

Abstract
The use of radiation is important in different medical procedures, and to ensure a high level of good medical practice, radiation protection (RP) should be seen as a very important subject.

This review article examines the various regulatory standards and guidelines established for radiation protection across different sectors. It highlights the importance of these regulations in safeguarding public health and the environment from the harmful effects of ionizing radiation. The article discusses key organizations involved in setting these standards, such as the International Atomic Energy Agency (IAEA) and the World Health Organization (WHO), and outlines the principles of radiation protection, including justification, optimization, and dose limitation.

Method:
A systematic search was performed, using Google scholar, PubMed, Radiopaedia, hand scanning journals and the internet. Data was retrieved from all of the research studies that were included in this analysis. The investigation was carried out on a conceptual level.

Keywords:
Radiation hazards, radiation protection, ionizing radiation.

Introduction:
Radiation protection, also known as radiological protection, is defined by the International Atomic Energy Agency (IAEA) as "The protection of people from harmful effects of exposure to ionizing radiation, and the means for achieving this". Exposure can be from a source of radiation external to the human body or due to internal irradiation caused by the ingestion of radioactive contamination. Ionizing radiation is commonly utilized in both industry and medicine, but it can pose a significant health risk by causing microscopic damage to living tissues. There are two primary categories of health effects associated with ionizing radiation. At high exposure levels, it can lead to "tissue" effects, known as "deterministic" effects because they are certain to occur, typically measured in grays and can result in acute radiation syndrome. In contrast, low-level exposures may lead to statistically increased risks of radiation-induced cancer, referred to as "stochastic effects" due to the uncertainty of their occurrence, which are conventionally measured in sieverts. Soon after the discovery of X-rays by Roentgen in 1895 and of natural radioactivity by Becquerel in 1896 it became apparent that ionizing radiation was not only useful for the diagnosis and treatment of disease but also harmful to human tissues.

Radiation safety is a concern for patients, physicians, and staff in many departments, including radiology, interventional cardiology, and surgery. Radiation emitted during fluoroscopic procedures is responsible for the greatest radiation dose for medical staff. Radiation from diagnostic imaging modalities, such as computed tomography, mammography, and nuclear imaging, are minor contributors to the cumulative dose exposures of healthcare personnel.

However, any radiation exposure poses a potential risk to both patients and healthcare workers alike. Radiation protection aims to reduce unnecessary radiation exposure with a goal to minimize the harmful effects of ionizing radiation. In the medical field, ionizing radiation has become an inescapable tool used for the diagnosis and treatment of a variety of medical conditions. As its use has evolved, so have the cumulative doses of lifetime radiation that both patients and medical providers receive. Most radiation exposure in medical settings arises from fluoroscopic imaging, which uses x-rays to obtain dynamic and cinematic functional imaging.

Formal radiation protection training helps reduce radiation exposure to medical staff and patients.

The purpose of radiation protection is to provide an appropriate level of protection for humans without unduly limiting the beneficial actions giving rise to radiation exposure. Radiation protection is to prevent the occurrence of harmful deterministic effects and to reduce the probability of occurrence of stochastic effects (e.g. cancer and hereditary effects). Radiation hazards to humans are well documented .To minimize their risks, international and national organizations have been established to set guidelines for safe handling of radiations.

Fundamental to radiation protection is the avoidance or reduction of dose using the simple protective measures of time, distance and shielding. The duration of exposure should be limited to that necessary, the distance from the source of radiation should be maximized, and the source or the target shielded wherever possible. To measure personal dose uptake in occupational or emergency exposure, for external radiation personal dosimeters are used, and for internal dose due to ingestion of radioactive contamination, bioassay techniques are applied.

There are three basic principles of radiation protection in ICRP international commission on radiological protection):
justification, optimization, and dose limitation:

Justification, involves an appreciation for the benefits and risks of using radiation for procedures or treatments. Physicians, surgeons, and radiologic personnel all play a key role in educating patients on the potential adverse effects of radiation exposure. The benefits of exposure should be well known and accepted by the medical community. Often, procedures that expose patients to relatively higher doses of radiation—for example, interventional vascular procedures—are medically necessary, and thus the benefits outweigh the risks.

Optimization, The As Low as Reasonably Achievable (ALARA) principle, defined by the code of federal regulations, was created to ensure that all measures to reduce radiation exposure have been taken while acknowledging that radiation is an integral part of diagnosing and treating patients. Any amount of radiation exposure will increase the risk of stochastic effects, namely the chances of developing malignancy following radiation exposure. These effects are thought to occur as a linear model in which there is no specific threshold to predict whether or not malignancy will develop reliably. For these reasons, the radiologic community teaches protection practices under the ALARA principle.

Dose limitations (never exceed dose limits), The normal exposure of individuals resulting from all relevant practices should be subject to dose limits to ensure that no individual is exposed to a risk that is judged to be unacceptable.

Dose Limitations

Part of the Body	Occupational Exposure	Public Exposure
Whole body (effective dose)	20 mSv / year (averaged over 5 consecutive years; 30 msv in any single year)	1msv/year
lens of eyes (equivalent dose)	150 mSv / year	15msv/year
Skin (equivalent dose)	500 msv / year	50msv/year
Extremities hands and feet (equivalent dose)	500 msv / year	-----------

For pregnant radiation workers, after declaration of pregnancy 1 mSv on the embryo/fetus should not exceed.

Occupational Exposure - Radiation Exposure to worker involved in a practice in which he/she is exposed due to handling of radioactive source or radiation generating equipment.

Public Exposure - Radiation Exposure to public due to above practices.

Basic Three Factors for Radiation Protection (Working Personnel & Public)

Time:

- Exposure from radiation source is directly proportional to time
- Reduce period of exposure to radiation to reduce the dose received from source.

Distance:

- Increase distance from source to decrease exposure rate.
- $I_1 d_1^2 = I_2 d_2^2$ (Inverse square law)
- Double the distance from the source; dose-rate falls to ¼ the original value.
- Halve the distance from the source; dose-rate increase to 4 times the original value.
- More the distance from source -Lesser the radiation

Shielding:

- Use an appropriate shielding material or protection devices
- Shielding reduces exposure rate:

$$I = I_0 e^{-\mu t}$$

μ - linear attenuation coefficient of shielding material
t – Thickness of shielding material
I0 – Initial exposure rate
I – Exposure rate after transmission from shielding material

Use large shielding thickness (High Z materials eg Lead, Steel, Concrete, etc) - reduce the exposure rate of gamma/X-ray radiation.

Conclusion:

Personnel stand near patients for long times, and angulated geometries with C-arm equipment may result in high personnel doses from backscatter. For all procedures, judicious applications of time, distance, and shielding affect dose. Appropriate use includes collimating properly, optimizing beam-on time, minimizing distances between image intensifier and patient, ensuring sufficient distance between patient and x-ray tube, and optimizing exposure rates for image quality and dose. Although dose limits typically regulate maximum whole-body dose, protective

clothing worn by fluoroscopists reduces personnel risks; weighting factors can be applied to estimate effective dose equivalent. Pregnant personnel have lower limits, which apply only with voluntary declaration of pregnancy. With appropriate precautions, fetal doses can typically remain within recommended limits without changes in occupational tasks. Radiation workers in each state must ensure that regulations are appropriate.

Refrences:

1. LS Taylor,HO Wyckoff - CriticalReviews in Environmental Science ..., 1972 - Taylor& Francis
2. FR Council- Washington, DC: Govern-ment ..., 1960 - 19january2021snapshot.epa.gov
3. M Edwards- Radiographics, 1991 - pubs.rsna.org
4.OP Lakhwani, V Dalal, M Jindal, A Nagala - Journal of clinical orthopaedics ..., 2019 - Elsevier
5.A Martin, S Harbison, K Beach, P Cole - 2018 - taylorfrancis.com
6.POLópez, G Rajan,EB Podgorsak - Radiation Oncology Physics:A ..., 2005 - Citeseer
7. F Shannoun,M Blettner... - Deutsches ärzteblatt ..., 2008 - pmc.ncbi.nlm.nih.gov
8. JE Martin- 2006 - books.google.com
9.WR Hendee, FM Edwards - Seminars in nuclear medicine,1986 - Elsevier
10. QC Meisinger, CM Stahl, MP Andre... - AmericanJournal of ..., 2016 - ajronline.org
11. KR Kase - Healthphysics, 2004 - journals.lww.com
12. MAS Sherer,PJ Visconti, ER Ritenour, KW Haynes - 2021 - books.google.com
13. N Hamzian, S Asadian... - Journal of biomedical ..., 2022 - pmc.ncbi.nlm.nih.gov
14. GB Saha - Radiation Safety in Nuclear Medicine: A Practical ..., 2023 - Springer
15. A Durán,SK Hian, DL Miller, J Le Heron... - Catheterization and ..., 2013 - WileyOnline Library
16. CJ Martin,DG Sutton, CM West... - ... Radiological protection, 2009 - iopscience.iop.org
17. M Voytchev,R Radev - 2018 - osti.gov
18. DA Marichal, T Anwar, D Kirsch, J Clements... - Journal of Vascular and ..., 2011 - Elsevier
19. R Alipoor, G Mousavian, A Abbasnezhad... - Journal of Advanced ..., 2015 - jabs.fums.ac.ir
20. J Lochard,MC Grenery-Boehler - Nuclear L. Bull., 1993 - HeinOnline


Hospital

The WHO Executive Board at its 156th session, decided to maintain The International Society of Radiographers and Radiological Technologists in official relations with WHO. This new cycle will last until 2028. ISRRT would like to thank the WHO for working closely with the radiographers on various aspects of the quality and safety of the practice, which benefit the patients worldwide.

World Health Organization

20, AVENUE APPIA – CH-1211 GENEVA 27 – SWITZERLAND – TEL CENTRAL +41 22 791 2111 – FAX CENTRAL +41 22 791 3111 – WWW.WHO.INT

Tel. direct:
Fax direct:
E-mail: nonstateactors@who.int

In reply please refer to:

Your reference: EB156(41)

Mr Dimitris Katsifarakis
Chief Executive Officer
The International Society of Radiographers and Radiological Technologists
207 Providence Square
Mill Street
London SE1 2EW
Royaume-Uni de Grande-Bretagne et d'Irlande du Nord

5 March 2025

Dear Mr Katsifarakis,

I am pleased to inform you that at its 156th session in February 2025, the Executive Board of the World Health Organization (WHO) decided to maintain The International Society of Radiographers and Radiological Technologists in official relations with WHO. In making the decision, the Executive Board commended the continuing dedication of your entity in supporting the work of WHO. Please find attached a copy of the decision (Document EB156(41)).

Dr Ferid Shannoun (shannounf@who.int), from the Environment, Climate Change and Health Department, serves as the WHO Designated Technical Officer (DTO) for our official relations. In this capacity Dr Shannoun is the focal point for effective implementation of the agreed activities, co-development and validation of annual reports and sharing of information with relevant departments within WHO.

Kindly note that implementation will be reviewed by the Executive Board in January 2028, according to the triennial schedule.

I look forward to our continuing collaboration towards WHO's mission to promote health, keep the world safe and serve the vulnerable.

Yours sincerely,

L. Al Atlassi

Loubna Al Atlassi
Head of Unit
Due Diligence and Non-State Actors
Office of Compliance and Risk Management and Ethics

ENCL: Decision EB156(41) – EB156_39 Annex 2
CC: Director of Department and Designated Technical Officer (DTO)

PRISM (Panimalar Radiology and Imaging Scientific Meet) – 2025

PRISM (Panimalar Radiology and Imaging Scientific Meet) – 2025 was a highly successful National level Radiology conference organized by the "Department of Radiodiagnosis, Panimalar Medical College Hospital & Research Institute and Panimalar College of Allied Health Sciences", held on 20th & 21st February 2025 at Panimalar Medical College Auditorium

The PRISM - 2025 theme was "Cardiac Imaging"
The vibrant organizing team consisted off:
Organizing Chairman – Prof. Dr. C. Ilamparuthi, Dean, Panimalar Medical College Hospital and Research Institute
Co-Chairman - Dr. Surapaneni Krishna Mohan, Vice Principal & Professor, PMCHR&RI & Prof.Dr. R. Sabaratnavel, Medical Superintendent.
Organizing Secretary – Prof. Dr. Anita. S, Head of Radiodiagnosis.
Joint Secretaries - Dr. Gopinath G., Associate Professor of Radiodiagnosis, and Mr. V. Sivaprakash., Assistant Professor and RSO.

Inauguration Ceremony and Honouring of Dignitaries - "Well begun is half done!"
A splendid inaugural function kick-started the 2-day program, and the stage was honoured by the presence of esteemed dignitaries, Dr. P. Chinnadurai, Secretary & Correspondent, Panimalar Group of Institutions and Dr. C. Sakthikumar, Director, Panimalar Group of Institutions

The academically rich scientific program was the main attraction of the conference, featuring expert lectures by unmatched professionals in the field of Cardiac Radiology.

A total of 135 abstracts were received from both students and faculties, 69 topics were selected by the Scientific Committee as competitive abstracts; these included poster and oral paper presentations under both UG and PG category.

Prof. Dr. Babu Peter, Head of Radiology, Barnard Institute of Radiology, MMC, Chennai, and Senior Consultant Radiologist, Kauvery Hospital, Chennai

Dr. Karthikeyan, Senior Consultant and Head of Radiology, SIMS Hospital

Dr. Suryaprakash, Associate Professor of Cardiology, PMCHRI.

Prof.Dr. Venkateshwaran, Head of Radiology, ACS Medical College.
Prof.Dr. Arumugam, Head of Cardiology, Govt.Kilpaulk Medical College

The PG Oral & Poster presentation were judged by Dr. Sachin SB (Panimalar Medical college Hospital), and Dr. Victor R Lazar (SRM Medical College Hospital)

The UG oral presentations were judged by Mr. V. Sivaprakash (Panimalar College of Allied Health Sciences) and Mr. Murugesh E (Govt. Medical College, Omandurar)

The UG poster presentations were evaluated by Mr. Venkataramana (Global Hospital) and Ms. R. Ramiya (Panimalar College of Allied Health Sciences), ensuring fair assessment and recognition of outstanding research.

Another prominent highlight of PRISM 2025 was an extremely engaging & challenging grand quiz competition, which was both tested the participants' knowledge as well as educated them in radiology and imaging technology. This was moderated by Mr. V. Sivaprakash and Dr. Aasini Maria Geogina from Panimalar College of Allied Health Sciences, the event featured eight teams named after legendary scientists.

To reduce the monotony and to keep the young minds continuously interested, A Dance Competition was also held as part of the conference; this program turned out to be another memorable highpoint, and was well appreciated by the students and faculties.

"What we learn today, we learn to remember forever"

PRISM 2025 concluded with a fitting Valedictory ceremony marking the successful end of a grand academic feast. The enthusiastic participation and achievements of participants, speakers, and organizers were appreciated, with awards and certificates presented by Dr. C. Sakthikumar (Director, Panimalar Group of Institutions) and Dr. C. Ilamparuthi (Dean, Panimalar Medical College Hospital & Research Institute).

Valedictory Ceremony - 1st Prizes

Oral presentation: PG Category:
G.B. Manoj Kumar – Chettinad Academy of Research and Education, Chennai

Oral Presentation: UG Category:
C.H. Manjula – SRM Institute of Science and Technology, Kattankulathur.

Poster Presentation PG Category:
Nandha Kumar A & Karthick J – Govt. Kilpauk Medical College and Hospital, Chennai

Poster Presentation UG Category: Shiva Krishna Kurva & Mounika Aithagani – Malla Reddy University, Hyderabad

Quiz Competition:
Panimalar College of Allied Health Sciences, Chennai

The capable organizing team - Dr. Anita S. (Organizing Secretary), Joint Secretaries - Dr. Gopinath G., and Mr. Sivaprakash. V were appreciated for successfully and smoothly pulling off a massive academic event with over 600 delegates from 32 institution of various states.

A unifying moment captured during the conference's valedictory ceremony, this picture brings together distinguished guests, enthusiastic participants, esteemed speakers, and the tireless organizing team.

With a huge sense of satisfaction, PRISM organizers are signing off!

Photon-counting Detector - Computed Tomography

Mani Pratap Singh, Unnati Pant, Vanshu Saxena, M. Sc. Research fellows, **Amit Bisht, Mamta Verma,** Asst. professors, College of Paramedical Sciences, Teerthankher Mahaveer University, Moradabad, UP.

Introduction

A novel CT technology called photon-counting detector computed tomography (PCDCT) has been authorized by the US Food and Drug Administration. It addresses many of the drawbacks of traditional energy-integrated detectors (EIDs).

It converts incident X-ray photons into electrical signals by using semiconductor materials. This special review paper examines the advantages from a therapeutic stand point utilization of this technique in numerous radiological subspecialties.

Conventional EID Technology

The mechanism behind conventional CT detectors is called indirect conversion, and it works by converting x-ray photons into visible light, which is then detected by a photodiode and transformed into a signal electrical.

- A shower of secondary visible light photons is produced by the scintillator when x-ray photons strike it.
- This kind of detector is typically referred to as an EID since the output signal is proportionate to the total energy deposited by all observed x-ray photons.
- Typically, a detector bank is made up of many rows, each with about 900 detector elements and thin septa separating them.
- The entire amount of x-ray energy deposited in the detector during each measurement interval is measured by each detector element.
- A shower of secondary visible light photons is produced by the scintillator when x-ray photons collide with it.
- These are taken in by a photodiode composed of a semiconducting substance, which calculates the overall energy and quantifies the quantity of light that comes in placed over the course of a measurement interval, as opposed to the energy of a single x-ray photon.

PCD technology

Figure 1 shows A schematic representation of energy integrating and photon-counting detectors.

Instead of requiring a scintillator layer like EIDs do, PCDs use a direct conversion method for x-ray detection. The substance used in semiconductor detectors directly creates electron-hole pairs from x-ray photons. Electronic signals are produced by electrons traveling to and being collected by the anode of a semiconductor with a bias voltage provided throughout.

Positive and negative charges are quickly drawn apart in a cloud when an incident x-ray is absorbed by a semiconductor. An electronic readout circuit records the electrical pulse that the moving charges produce in the wires that are connected to the electrodes.

The most common semiconductor materials used in PCDs are cadmium telluride or cadmium zinc telluride, although other materials such as silicon and gallium arsenide also have been used.

Every photon that strikes the detector element causes an electrical pulse to be produced, the height of which is based on the energy the photon deposits.

The detector's electronics system counts the quantity of pulses with heights over the predetermined cutoff point.

The threshold is set at levels that are higher than the electronic noise level but lower than pulses generated by incoming photons

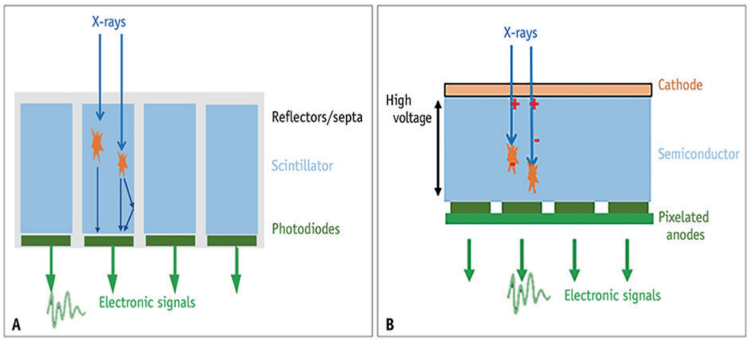


Figure1-Schematic comparison of conventional EIDs and PCDs

Artifacts

Beam hardening artifact

Gray-scale PCD images are more susceptible to beam-hardening artifacts than are conventional EID images owing to their equal energy weighting of photon.

Reconstructed high-energy photon-counting CT images showed reduced beam-hardening artifact contamination when compared to the reconstructed image using every photon that was detected.

Dual energy CT also allows for beam-hardening reduction by using material decomposition and by evaluating high monochromatic energy images. However, the performance of photon counting CT is expected to be better owing to improved spectral separation.

Metal artifact

One of the many causes of metal artifacts is extreme beam hardening. Using standard CT, periprosthetic darkness brought on by photon hunger, beam hardness, or other factors may simulate prosthesis loosening scatter and edge effects.

Photon-counting CT may provide a more accurate assessment of prosthesis loosening because it reduces beam-hardening artifacts and does not require electronic noise, and higher spatial resolution.

Algorithms for reducing metal artifacts that depend on the various energy bins of photon-counting CT.

Blooming artifact

Beam hardening is not the only factor affecting CT blooming objects. The visualization of the vessel lumen next to calcified plaques, the vasculature near bony structures, and implanted stents, coils, and devices is deteriorated by these artifacts. Multi energy photon counting CT may be able to lessen blooming through of enhanced material decomposition and spatial resolution.

Benefits of Photon-Counting Detectors and Effect on Clinical Applications

Higher/Improved Spatial Resolution

In lung and musculoskeletal imaging, the capacity of CT to scan broad body regions while concurrently presenting small structures is essential for many diagnostic tasks.

Therefore, increased PCD-CT spatial resolution may help with a variety of pulmonary and musculoskeletal imaging diagnostic tasks. For instance, because of its better spatial resolution, PCD-CT shows subtle and nuanced imaging abnormalities linked to interstitial lung disease.

Additionally, PCD-CT enhances the visibility of bronchial walls and higher-order bronchi

Regarding musculoskeletal and pulmonary applications, the using thinner slice and higher resolution reconstruction kernels can improve the visualization of tiny structures.

Low dose CT imaging of the musculoskeletal system benefits from PCDs' intrinsic higher spatial resolution than that of EIDs.

Low-dose CT scans, for example, are routinely been out during the multiple myeloma workup to detect lytic bone lesions and myeloma aftereffects including pathologic fractures.

Using an ultra-high-resolution mode, PCDCT images can be obtained at comparable scanning dosage levels.

High-resolution PCD-CT can also be useful in the identification, delineation, and characterisation of renal stones. sharper reconstruction of PCD-CT images Greater spatial resolution from thinner slices and kernels results in a better depiction of tiny renal calculi.

Due to restrictions in spectral separation and spatial resolution, one of the difficulties with dual-energy CT is accurately displaying and characterizing tiny renal calculi.

Figure 2 shows the dual-energy analysis allowed determination of stone composition.

Kidney stone

Another area of interest where spatial resolution plays a very important role is in the imaging of small bony structures, specifically the temporal bone improved spatial resolution of PCD in this setting provides improved visualization of critical anatomic structure.

Figure 2 - Cinematic three-dimensional volume-rendered image enhances the visualization of stone morphology and composition.

Improved iodine signal

Compared to EID CT, PCD-CT offers better iodine contrast at the same tube potential along with the advantages of multi-energy display and material disintegration. Because PCD CT eliminates the down weighting of low-energy photons that happens with EID X-ray detectors, the iodine signal is improved Shown in the **Figure 3(a).**

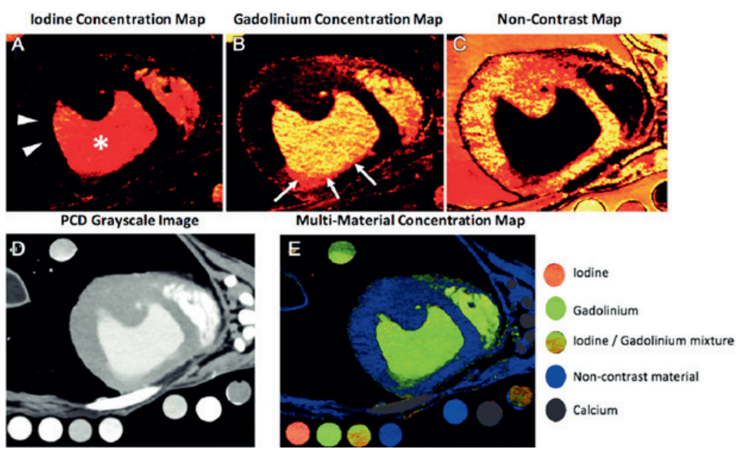


Figure 3 - multi k-edge material decomposition of PCD CT image of canine heart.

Multi-Energy Imaging

Gout assessment and virtual non-calcium images for bone oedema are two multi-energy CT reconstructions relevant to musculoskeletal imaging.

Dense cortical bone and trabeculae make the medullary cavity of bone a challenging site to evaluate on CT.

For example, localized medullary lesions of myeloma and bone oedema following severe damage are frequently hidden using standard CT scans.

Noise Reduction and CNR Improvement

Because of the way that photons of different energies interact, an ideal PCD can produce images with less image noise than an ideal EID possess a weight. High-energy photons contribute comparatively more to the overall signal than do low-energy photons since an EID assesses the total absorbed x-ray energy. This weighting does not result in optimal CNR because the tissue contrast is low at high energies.

Where there is the greatest contrast between tissues, photons with low energies may be given the greatest weight to maximize CNR in the image shown in **Figure 4.**

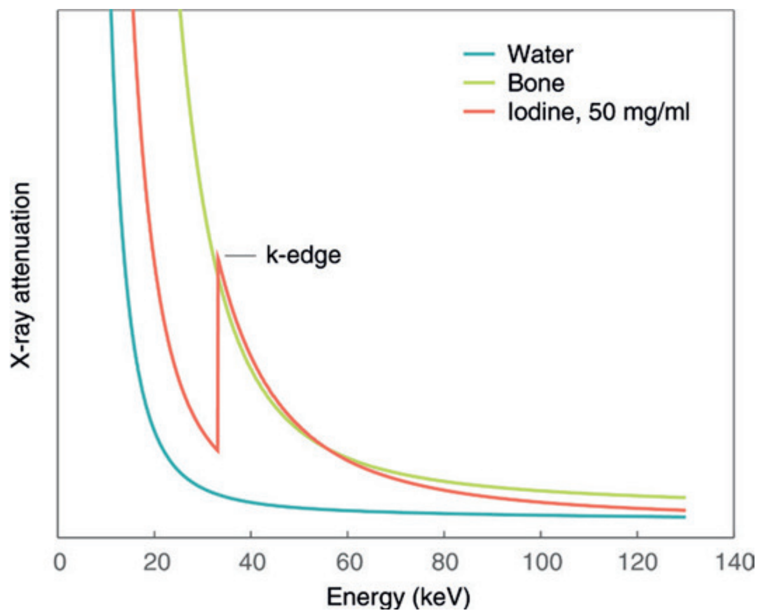


Figure 4 - Graph shows attenuation coefficient as a function of energy for water, bone, and iodinated contrast agent (50 mg iodine per millilitre).

Radiation Dose Reduction

Pediatric patients benefit greatly from a few PCD-CT applications. Higher spatial resolution and contrast-to-noise ratio make anatomical features more visible structures in smaller patients while maintaining higher dose efficiency, allowing for additional dosage reduction.

With the high-resolution mode of PCD-CT, radiation dose can be decreased by 20%–30% without sacrificing image quality.

A tin filter can be used in some traditional EID CT systems to modify the energy spectrum of the polychromatic X-ray tube.

This allows for a significant dose reduction for non-contrast diagnostic activities by eliminating low-energy photons and increasing the number of photons that pass through the patient.

Artifact Reduction

Reduction of common picture abnormalities such as metal, calcium blooming, beam hardening, and streaks is another clinical benefit of PCD-CT. For Photon hunger and electrical noise are common causes of streak and shading errors, as well as high attenuating body regions of large patients.

These effects can be significantly minimized for PCDs with numerous energy thresholds since PCDs remove electronic noise bins, images with varying intensities Different attenuation qualities are represented using bins.

High energy bin images in PCD-CT show less beam hardening artifacts compared to low energy bin images and standard CT images with all X-ray photons.

Additionally, metal artifact reduction can be accomplished by employing an external tin filter in conjunction with X-ray beam shaping to combine high energy bin pictures or alternatively, by using VMIs with high energy.

Advantages

Higher image quality, reduce contrast agent volume, reduce radiation dose, reduces artifacts.

Limitations

In adequate spatial resolution, poor precision in identifying tiny, low-contrast features, and irregular spectral information availability.

conclusion

Due to its distinct interaction mechanics, PCD CT is a developing technique that offers several advantages over traditional EID detector technology. Notably, it is dose-efficient, has excellent spatial resolution, and is energy discriminating. skills. A whole-body research PCD CT system has been utilized to demonstrate several clinical benefits in human patients, in addition to several preclinical systems. Commercialization of this technology is still primarily restricted by the need for large-scale, cost-effective production of high-quality PCDs.

Nonetheless, more investigation and advancement of PCD technology is undoubtedly needed to use the benefits of PCDs both theoretical and empirical in therapeutic settings.

Reference

·Korean J Radiol. 2022 Sep;23(9):854-865. English https://doi.org/10.3348/kjr.2022.0377.
·https://doi.org/10.1148/radiol.2018172656

Unable to perform X-ray, Indian radiographer suspended in UK

Naomi Canton

London: A radiographer from Kerala has been suspended from practising in Britain for six months after a panel found she was unale to do basic procedures like X-raying a hand or foot that a radiographer "straight out of training would be able to do", and that she was putting the health of UK patients at risk.

Smitha Johny, an Indian national, had declared her first language as English on her application to be registered with the health and care professionals council in 2021.

She had also declared English as her first language on her application to work as a radiographer at a private hospital in Surrey, where she started working in Jan 2023. She had also claimed to have 23 years of experience.

However, the health and care professions tribunal service foundshe struggled to communicate with patients and colleagues in English, was unable to answer basic questions about radiography process, could not identify basic anatomy, did not follow required guidelines, was unable to set a up an X-ray machine, failed a mandatory life support course, and misrepresented her experience.

When her managerpresented himself as a patient for a hip X-ray, she pointed the machine towards his knee, not his hip, which was a radiation breach causing unnecessary exposure, which could cause cancer. At her three-month review in April 2023, she said she was "more like a manager in her previous role" and had worked at the hospital reception desk in India. She also said she had worked with CT scanners and not X-rays. She was then told she would be put on authorised leave that could leave to termination. On April 24, 2023 she resigned.

Calibration Laboratory

For Radiation Monitoring Instruments & Dose Calibrators

India's first and only comprehensive calibration facility for any brand of Radiation Survey meter, Contamination Monitor, Pocket Dosimeter, Area Zone Monitor and Radioisotope Dose Calibrator.

We are recognized by Atomic Energy Regulatory Board (AERB) and Accredited by N.A.B.L.

NABL ACCREDITED
Certificate No. CC-1027

We offer complete solution for service, repairs and recalibration for any brand or type of RMIs and Dose Calibrators. We are specialized and factory trained and have the required infrastructure to repair Pressurised Ion Chamber Survey Meters.

Salient Features:

- Calibration reminder services
- Pickup and drop facility for RMIs
- Routine turnaround recalibration time is 5-6 days from any part of country
- Before sending the instrument, please make sure about the working condition, to avoid delays
- Calibration Validity: Two Years
- ISO9001:2015 Certified
- ISO/IEC 17025 Certified

Radimage Healthcare India Pvt. Ltd.

(An ISO 9001 : 2015 Certified Company)
G-236, Sector-63, Noida - 201 303 (INDIA)
Telefax: +91 120 4263270, 2406096, 2406097
• www.radimageindia.com • radimagehealthcare@gmail.com
(A Meditronix Corporation Group Company)

Design to Print #9250671670

5th CME Program on Radiology Imaging and Rehabilitation – A Synergistic Approach to Hearing Health

The 5th Continuing Medical Education (CME) Program on Radiology Imaging and Rehabilitation – A Synergistic Approach to Hearing Health was successfully organized by the University School of Physiotherapy & Radiology, Rayat Bahra University, Mohali Punjab on March 4, 2025, in observance of World Hearing Day. The event aimed to promote interdisciplinary collaboration by integrating radiology, audiology, rehabilitation, and physiotherapy to enhance awareness and improve hearing health care. The program was designed to provide expert insights, interactive discussions, and awareness sessions focusing on advancements in hearing care, preventive strategies, and rehabilitation techniques to address hearing impairments effectively.

This significant event was held under the visionary leadership of Honourable Chancellor Sd. Gurvinder Singh Bahra, Chairman of Rayat Bahra Group of Institutions and Bahra Hospital, whose unwavering support has been instrumental in advancing healthcare education and research. The event was graced by Sh. Jasbir Singh Bunty, Senior Deputy Mayor of Chandigarh, as the Chief Guest. In his address, he emphasized the critical role of early diagnosis and the importance of a multidisciplinary approach in managing hearing disorders. Additionally, Prof. (Dr.) S.K. Bansal, Dean Academics, Mr. Sahil Kapoor, senior Vice president, RBU and Dr. Dharamvir, Assistant Professor, ENT, PGIMER, Chandigarh, played key advisory roles in ensuring the event's academic and professional significance. Dr. Dharamvir also served as the keynote speaker, delivering an insightful address on emerging trends and technological advancements in hearing health, imaging modalities, and rehabilitation techniques. The event witnessed active participation from approximately 200 delegates.

The Organising Chairperson of the event, Prof. (Dr.) Lalit Kumar Gupta, Dean of the University School of Physiotherapy & Radiology, played a pivotal role in organizing and overseeing the program. Under his guidance, the event was meticulously planned to ensure a comprehensive and engaging learning experience for all participants. The Organizing Committee, led by Ms. Mamta Panda, Ms. Tamanna, and Varshdeep Kour as Organizing Secretaries, along with Ms. Sandhya and Ms. Mohini Gupta as Co-Organizing Secretaries, ensured the event's smooth execution through their dedicated efforts.

The program commenced with a formal inauguration ceremony, reflecting the rich academic and cultural heritage of Rayat Bahra University. The ceremony began with honoring the esteemed guests, followed by the traditional lamp lighting and Saraswati Vandana, symbolizing the pursuit of knowledge and wisdom.

The Welcome and Inaugural Speech was delivered by Prof. (Dr.) Lalit Kumar Gupta, who emphasized the importance of interdisciplinary collaboration in hearing health and highlighted the significant role of radiology and physiotherapy in the early diagnosis and rehabilitation of hearing impairments. The Chief Guest, Sh. Jasbir Singh Bunty, delivered an insightful speech focusing on policy-driven approaches, early intervention, community and social awareness programs that can significantly reduce hearing disabilities.

Following the inauguration, the scientific sessions featured a series of talks and interactive discussions led by students. These sessions covered a wide range of topics related to hearing health, imaging techniques, and rehabilitation approaches. The discussions highlighted the importance of imaging techniques such as X-ray, CT, and MRI in diagnosing hearing disorders, along with the role of physiotherapy and rehabilitation in treating balance and auditory processing disorders.

The program concluded with a valedictory function, where the contributions of speakers, organizers, and participants were recognized and appreciated. Adding a celebratory touch, the event featured engaging cultural performances, showcasing the vibrant artistic talent of students. The performances not only entertained the audience but also reflected the rich cultural diversity of the university.

A significant contribution to the event's great success was made by the RBU Event Club, which played a crucial role in managing and coordinating various aspects of the CME. The club actively assisted in venue arrangements, logistics, and event scheduling, ensuring that all sessions proceeded seamlessly.


RAYAT-BAHRA
UNIVERSITY


RAYAT-BAHRA
UNIVERSITY


CME PROGRAM


RAYAT-BAHRA
UNIVERSITY


RAYAT-BAHRA
UNIVERSITY
Organises
5th CME PROGRAM


RAYAT-BAHRA
UNIVERSITY
5th CME PROGRAM


RAYAT-BAHRA
UNIVERSITY
5th CME PROGRAM

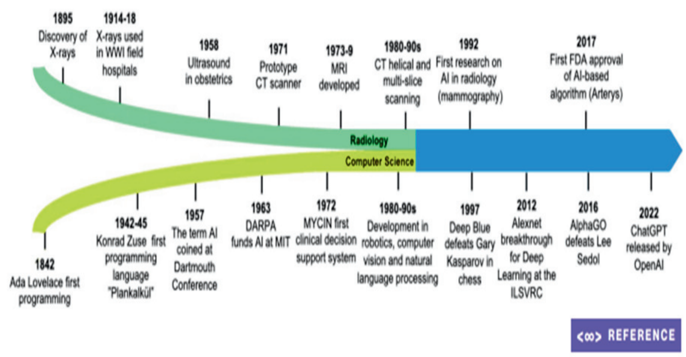

RAYAT-BAHRA
UNIVERSITY
UNIVERSITY SCHOOL OF PHYSIOTHERAPY & RADIOLOGY
Organises
5th CME PROGRAM
RADIOLOGY IMAGING & REHABILITATION

Fundamentals of AI in Radiology – Part 1

Ramesh Sharma, Chief Technical Officer (Rtd) NCI AIIMS Delhi

Artificial Intelligence (AI): a field within computer science focused on creating solutions capable of performing tasks that are typically associated with human intelligence. It is a broad term that encompasses a wide range of technologies, and even a basic rule-based model can be considered a form of AI. Artificial intelligence (AI) is a rapidly growing field, influencing every aspect of our lives, including the way we practice medicine. Healthcare workers should keep up with the pace of digital development to advance the field.

Brief History : Ada Lovelace conceptualised the first programming in 1842, marking the birth of computer science In 1895, William Conrad Roentgen discovered the first X-ray, leading to the emergence of radiology as a specialty. Krizhevsky et al., won the ImageNet challenge in 2012 with AlexNet, a convolutional neural network, and the field of Deep Learning has skyrocketed. First AI-based algorithm is cleared by FDA in 2017 and officially entered to clinical setting..



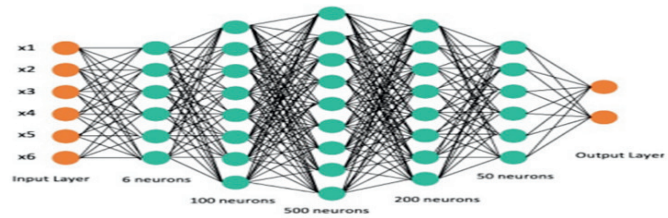
Adapted from Clin Transl Sci (2020) 13, 216–218; doi:10.1111/cts.12704

Basic Fundamental Terms

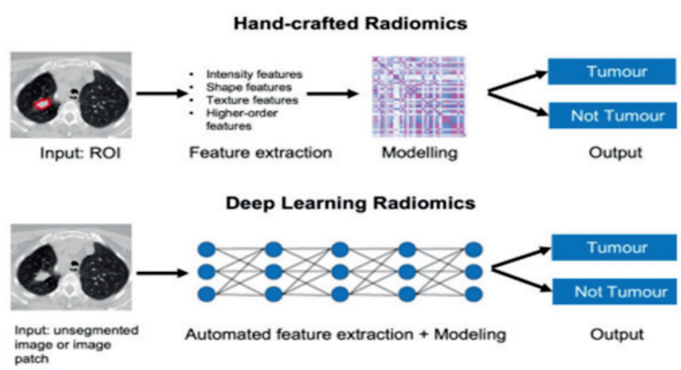
Machine Learning (ML): a subset of AI that revolves around the creation of algorithms capable of learning from data and making predictions. However, these algorithms still rely on human supervision. ML is not a new concept within the AI field. In computer vision, traditional ML algorithms often entail image processing and explicit feature extraction.

Deep Learning (DL): a subset of ML that utilises neural networks to learn patterns in data. It is considered a relatively new field within AI and has experienced a surge in popularity in recent years. Training a DL model usually requires large amounts of data and computational resources due to the complexity of neural network architectures. Nowadays, that's feasible thanks to graphic cards specialised in matrix operations.

Artificial Neural Network (ANN): a type of machine learning algorithm that mimics the structure and function of the human brain. They contain multiple neurons organised in hierarchical layers. The layers closest to the input layer are responsible for processing and transforming the input data to extract relevant features, whereas the output layer is responsible for the final output.



Deep neural network (DNN): a specific type of neural net - work composed of multiple intermediate layers (i.e., hidden layers). They can be used to train powerful models based on large amounts of data. Radiomics: refers to extracting quantifiable and minable features from medical images. It is a rapidly growing research field and mostly applied in the field of oncological imaging.Depending on whether one uses hand-crafted or deep learning approaches, the radiomics workflow may include clinical and imag - ing data curation, image pre-processing, image segmentation, feature extraction, model develop - ment, and model validation.



References : The Future of Medical Device Regulation: Innovation and Protection (pp. 77-90). Cambridge: Cambridge University Press. doi:10.1017/9781108975452.007 / Artificial Intelligence in Medical Imaging: Opportunities, Applications and Risks | SpringerLink.

Radiographers' Journal invites

concerned articles.

Publication should be in MS word format.

Mail your articles on

shankar.bhagat@gmail.com

Role of Radiographers in Interventional Radiology: Responsibilities, Safety, and Patient Care

Ariya Jamatia, Balahun Khasain, Sajana Subba, Bsc RIT Students, **Lalruatfela** Visiting faculty,
Dept. of Radio Imaging Technology, Regional Institute of Paramedical and Nursing Sciences, Aizawl, Mizoram

Interventional Radiology is a medical specialization that involves performing a range of imaging procedure to obtain images of the inside of the body. IR is a medical specialty that performs minimally invasive treatments using radiologic imaging for procedure guidance. These include imaging techniques such as X-rays, MRIs (magnetic resonance imaging) scans, fluoroscopy, CT (computed tomography) scans and ultrasounds. Interventional radiology treatment have become the primary methods of care for a variety of conditions, offering less risks, less pain and less recovery time, compared to open surgery.

The role of radiographer in Interventional radiology is responsible for obtaining and setting up all instruments and equipment that may be needed for a procedure. In addition, duties such as patient positioning, imaging patients, and resolving equipment issues. Radiographers need to have and use knowledge of human anatomy, radiation safety, interventional supplies, and equipment operation.

Radiographers in IR undergo advanced specialist training and work alongside consultants and nurses to provide and control the imaging during minimally invasive image guided procedures. These include:

Preparation of Imaging Equipment
In interventional radiology, a radiographer's primary role regarding preparation of imaging equipment is to ensure the proper setup and function of the imaging system, including fluoroscopy and angiography machines, by calibrating settings, positioning the equipment appropriately, and loading necessary materials like guidewires, catheters, and contrast media, all while adhering to radiation safety protocols to facilitate the interventional radiologist's procedures during a patient's examination.

Pre-procedure checks:
1. Equipment Inspection: Verify that all imaging equipment is in good working condition.
2. Quality Control: Perform quality control checks on imaging equipment to ensure optimal image quality.
3. Radiation Safety: Ensure that all radiation safety measures are in place, including radiation monitoring devices.

Preparation of Specific Equipment
1. Fluoroscopy Unit: Prepare the fluoroscopy unit, including setting up the C-arm, positioning the image intensifier, and adjusting the radiation exposure factors.
2. Ultrasound Machine: Prepare the ultrasound machine, including setting up the transducer, adjusting the imaging parameters, and ensuring proper probe sterilization.
3. CT Scanner: Prepare the CT scanner, including setting up the scanner, adjusting the imaging parameters, and ensuring proper patient positioning.
4. Angiography Suite: Prepare the angiography suite, including setting up the angiography table, positioning the C-arm, and adjusting the radiation exposure factors.

Patient Positioning
Radiographers are responsible to accurately place the patient on the imaging table in a specific position that allows the interventional radiologist optimal visualization of the targeted anatomy during a procedure, ensuring clear imaging while minimizing radiation exposure to the patient and staff by utilizing proper positioning techniques.
Precise positioning: Following the radiologist's instructions, the radiographer carefully positions the patient to precisely target the area of interest, considering the specific anatomy involved in the procedure.
Maintaining stability: Ensuring the patient remains still during the procedure by utilizing immobilization devices or techniques to obtained accurate information and reduce the radiation exposure.

Importance of Patient Positioning
1. Accurate Imaging: Proper patient positioning ensures accurate imaging and diagnosis.
2. Procedure Success: Correct patient positioning is crucial for successful interventional procedures.
3. Patient Safety: Proper positioning reduces the risk of complications and ensures patient safety.

Image Acquisition
As radiographers, image acquisition is to operate the imaging equipment, ensuring optimal image quality is obtained during minimally invasive procedures by accurately positioning the patient, selecting appropriate imaging parameters, and minimizing radiation exposure while maintaining clear visualization for the interventional radiologist; this includes utilizing fluoroscopy to guide procedures in real-time and capturing static images when necessary.

Equipment expertise:
Understanding how to adjust equipment parameters like image brightness, contrast, and field of view to provide clear visualization of the procedure area during real-time manipulation of instruments.

Patient positioning:
Precisely positioning the patient to achieve the best image quality while considering the procedure being performed and minimizing radiation exposure.

Technical knowledge: Selecting appropriate imaging techniques (e.g., fluoroscopy, digital subtraction angiography) based on the procedure and utilizing advanced features of the imaging system.

Image quality assessment: Continuously monitoring image quality during the procedure and making adjustments as needed to ensure accurate visualization of anatomy and devices.

Communication with the radiologist: Maintaining clear communication with the interventional radiologist throughout the procedure to quickly respond to requests for image adjustments or specific views.

Pre-Image Acquisition Checks:

1. Verify patient identity: Ensure correct patient identification and procedure details.

2. Review imaging protocol: Review the imaging protocol to ensure correct imaging parameters.

3. Prepare imaging equipment: Prepare the imaging equipment, including setting up the C-arm, positioning the image intensifier, and adjusting the radiation exposure factors.

Collaboration with Medical Team

As a radiographer in interventional radiology, collaboration with the medical team is a critical part which involves actively assisting the interventional radiologist during procedures by positioning the patient, operating imaging equipment, monitoring radiation levels, providing real-time image feedback, and communicating critical information to ensure patient safety and successful procedure completion, all while maintaining a strong understanding of the procedure being performed and the patient's clinical status.

Radiation Safety

Radiation safety is a concern for patient, physician, and staff in radiology departments.

Radiation safety aims is to reduce unnecessary radiation exposure with goal to minimize the harmful effect of the ionizing radiation.

Principle of radiation protection:

1)Time: Exposure from the radiation source is directly proportional to time, therefore, the exposure is to be kept as short as possible to reduce the dose received from source.

2) Distance: the dose of radiation varies inversely as the square of distance, inverse square law is applied which state that the dose get reduced by increasing the distance.

3) Shielding: Uses of appropriate shielding material such as lead, concrete helps reducing the dose exposure.

For the radiation safety of the patient the ALARA principle is followed,

ALARA (AS Low As Reasonably Achievable) : According to the ICRP (Publication 103) the system of Radiation protection is based on the following three principles:

Justification: The process of examination should be justified, and the exposure from radiation should be beneficial for the patient.

Optimisation: The dose to the occupational workers shall be kept as low as reasonably achievable (ALARA) and dose to the patient should be optimized.

Dose limits : The normal exposure of individual resulting from all relevant practice should be subject to dose limits to ensure that no individual are exposed to a risk that is judged to be unacceptable.

Documentation

In interventional radiology, a radiographer's primary role in documentation is to accurately record details of the procedure, including patient information, imaging parameters, catheter placement, contrast administration, any complications encountered, and the final procedural outcome, ensuring clear communication between the interventional radiologist and other healthcare providers involved in the patient's care.

Types of Documentation

1. Patient Records: Maintain accurate and up-to-date patient records, including medical history, procedure details, and radiation doses.

2. Procedure Documentation: Document procedure details, including the type of procedure, imaging modalities used, and any complications or adverse reactions.

3. Image Documentation: Document image acquisition and storage, including image quality, radiation doses, and any image-related complications.

4. Radiation Dose Documentation: Document radiation doses and exposure times to ensure accurate records and compliance with regulatory requirements.

Patient Safety and Comfort

Pre-Procedure Safety Measures:

1. Patient Assessment: Evaluate patients for potential risks and complications.

2. Informed Consent: Obtain informed consent from patients, explaining the procedure, risks, and benefits.

3. Medical History: Review patients' medical history, including allergies, medications, and previous surgeries.

During Procedure Safety Measures

1. Monitoring: Continuously monitor patients' vital signs, including heart rate, blood pressure, and oxygen saturation.

2. Radiation Safety: Implement radiation safety measures, such as using the lowest possible radiation dose and minimizing exposure time.

3. Sterility: Maintain a sterile environment to prevent infections.

Post-Procedure Safety Measures

1. Recovery: Monitor patients during the recovery period, ensuring they are stable and comfortable.

2. Pain Management: Provide adequate pain management, using medications and other interventions as needed.

3. Follow-Up Care: Provide clear instructions for follow-up care, including medication management and wound care.

Comfort Measures

1. Communication: Communicate clearly and compassionately with patients, addressing their concerns and anxieties.

2. Anxiety Reduction: Use anxiety-reducing techniques, such as deep breathing, relaxation, and distraction.

3.Comfortable Positioning: Position patients comfortably during procedures, using pillows, wedges, and other supportive devices.

4. Warmth and Hygiene: Ensure patients' warmth and hygiene needs are met, providing blankets and toileting facilities as needed.

Conclusion

Interventional Radiology (IR) plays a crucial role in modern medicine, offering minimally invasive procedures guided by advanced imaging techniques such as fluoroscopy, ultrasound, CT, and MRI. Radiographers in IR are essential team members, responsible for preparing imaging equipment, ensuring precise patient positioning, acquiring high-quality images, collaborating with medical professionals, and maintaining strict radiation safety protocols. Their expertise in image acquisition and radiation protection helps minimize patient risk while maximizing procedural success. Additionally, accurate documentation and a strong focus on patient safety and comfort contribute to better healthcare outcomes. As IR continues to evolve, radiographers remain integral in advancing medical imaging and interventional procedures, ensuring high standards of patient care and safety.

Reference

1. Martin, M. L., Reuter, S. R., & Martin, M. J. (2004). Practical Interventional Radiology of the Hepatobiliary System. Thieme Medical Publishers.
2. Martin, M. J., & Carr, S. (2019). Interventional Radiology Procedures in Biopsy and Drainage. Springer.
3. Baert, A. L., & Knauth, M. (2011). Interventional Radiology: Handbook of Clinical Neurology. Elsevier.
4. Valji, K. (2015). The Practice of Interventional Radiology, With Online Cases and Video. Elsevier Health Sciences.
5. McLachlan, C. S. (2016). Radiographic Imaging and Exposure. Mosby.
6. Goldman, L., & Schafer, A. I. (2019). Goldman-Cecil Medicine (25th ed.). Elsevier.
7. Bushberg, J. T., Seibert, J. A., Leidholdt, E. M., & Boone, J. M. (2011). The Essential Physics of Medical Imaging (3rd ed.). Lippincott Williams & Wilkins.

Honoring a Legacy: Shri S. Panduranga Reddy being felicitated by the Society of Indian Radiographers – SIR Telangana Chapter on his retirement at Gandhi Hospital, Hyderabad. 28.02.2025

MED FUTURE
A HUB FOR MEDICAL EXCELLENCE
CONFERENCE AND EXHIBITION

by

ASSOCIATION OF HEALTHCARE PROVIDERS INDIA

CONFERENCE VENUE

5TH - 6TH SEPT 2025

NOVOTEL JAIPUR CONVENTION CENTRE, JAIPUR

CONFERENCE THEME

"Innovating Medical Education & Training: Shaping the Future of Healthcare"

in association with :

SI

www.medfutureindia.com

INTRODUCTION

The inaugural MedFuture India Conference is set to become a groundbreaking platform for healthcare education and innovation in India. Organized by AHPI, this event marks the beginning of a transformative journey aimed at elevating the standards of medical education and training across the nation. With a focus on fostering collaboration and sharing cutting-edge insights, the conference will offer valuable perspectives on emerging medical technologies, industry trends, and future opportunities.

The MedFuture India Conference is set to act as a catalyst for transformative change in the healthcare industry, paving the way for a more innovative and future-ready approach to medical training.

ABOUT AHPI:

Association of Healthcare Providers (India) represents the vast majority of healthcare providers in India. The Association of Healthcare Providers (India)'s vision is to have a healthy India, encompassing society, community and common man at grass root. The Association of Healthcare Providers (India) envisions a healthy India, with a focus on improving the well-being of society, communities, and individuals at the grassroots level.

AHPI represents more than 20,000 hospitals and healthcare institutions across India. Its goal is to unify healthcare providers to work collaboratively with the government and society to enhance the well-being of the common man and build a healthier India.

AHPI organizes a wide range of conferences, events, and workshops focused on the healthcare sector in India bringing together healthcare professionals, policymakers, and industry leaders to address the latest developments, challenges, and opportunities in hospital management, healthcare delivery, and policy.

These events serve as a platform for dialogue, Knowledge sharing, and the development of solutions to the challenges facing India's healthcare system. They are a key resource for hospital providers striving to stay ahead in a rapidly evolving healthcare landscape.

ABOUT MEDFUTURE INDIA CONFERENCE

Discover how advancements like AI, VR, and simulation-based learning are revolutionizing medical education and training for healthcare professionals. This year's theme "Innovating Medical Education & Training: Shaping the Future of Healthcare" focuses on equipping providers with the skills to deliver effective, compassionate, and tech-enabled care. Emphasizing global healthcare access, resilience, and collaborative practices, the conference paves the way for a future-ready healthcare workforce.

CONFERENCE AGENDA :

- **Integrating Technology in Medical Education:**
  - Role of Artificial Intelligence in Medical Training
  - Simulation-Based Learning for Clinical Skills
  - E-learning Platforms and Digital Resources in Medical
- **Faculty Development Programs for Excellence:**
  - Global Best Practices in Faculty Training and Mentorship
  - Leadership and Management Training for Faculty
  - Evaluation and Feedback Mechanisms for Faculty
- **Competency-Based Medical Education (CBME):**
  - Principles of Competency-Based Education
  - Assessment Models for Competency-Based Education
  - Integration of CBME into Existing Curricula
- **Curriculum Design with Patient Safety and Quality:**
  - Incorporating Patient Safety Modules into Medical Education
  - Quality Improvement Training for Medical Students
  - Using Data to Drive Curriculum Changes for Safety and Quality
- **Research and Innovation in Medical Training:**
  - Creating a Research-Driven Culture in Teaching Hospitals
  - Encouraging Innovation through Medical Hackathons and Incubators
  - Publishing Medical Research: Guidelines and Global Best Practices
- **Global Accreditation and Benchmarking:**
  - The Benefits of Accreditation for Teaching Hospitals
  - Benchmarking Performance Against Global Best Practices
  - Challenges and Solutions in Meeting Global Accreditation Standards

WHO WILL JOIN AS DELEGATES ?

- **Medical and Healthcare Professionals**
  Doctors (All Specialties), Nurses and Nurse Practitioners, Medical Technologists (e.g., Radiologic Technologists, Ultrasound Technologists, ECG Technologists), Clinical Laboratory Technologists, Pharmaceutical Researchers, Clinical Instructors, Healthcare Trainers and Coaches.
- **Medical Researchers and Academics**
  Medical Researchers, Clinical Researchers, Translational Researchers, Public Health Researchers, Laboratory Researchers, Medical Educators, Medical School Professors, Faculty Members from Universities, Curriculum Developers, Simulation Trainers, Medical Training Course Instructors, Health Educators.
- **Healthcare Administrators and Policy Makers**
  Healthcare Administrators and Managers, Healthcare Law Experts, Healthcare Recruitment Professionals, Policy Makers and Government Officials, Healthcare Industry Leaders.
- **Healthcare Education and Training Professionals**
  Medical Education Coordinators, Teaching Staff from Medical Colleges and Universities, Clinical Instructors, Healthcare Trainers and Coaches, Simulation Trainers.
- **Medical Students and Future Professionals**
  Medical Students and Residents.
- **Professional Associations and Societies**
  Professional Associations and Societies (e.g., medical societies, nursing associations, pharmaceutical associations).

Venue Insights:

The AHPI's Conference will be conducted at Novotel Hotel, Jaipur, Rajasthan.

How to reach?

- The Jaipur International Airport is located 9.8 Kms away from the Novotel Hotel.
- The Jaipur Railway Junction is located 17.4 Kms away from the Novotel Hotel.

To Register For The Conference

visit : **medfutureindia.com/conference**

Registration Charges		
Early Bird Registration	until 30th June 2025	INR 3000/- +18% taxes
Post Early Bird Registration	1st July 2025 onwards	INR 4000/- + 18% taxes

Note : 20% Group Discount applicable for 3 or more participant from the same organization

SPONSORSHIP PACKAGES

TITLE SPONSOR

INR 15,00,000 Plus Taxes (Exclusion)

Deliverables

- Formal recognition as Guest of Honor during the Conference Inauguration.
- Hosting of one session named after the Title Sponsor
- Allocation of a dedicated speaking slot during the Conference.
- Prominent display of the company logo on the main conference backdrop.
- Inclusion of the logo on all conference materials and the event website.
- Two full-page advertisements in the AHPI annual report.
- Logo presence in all email communications to the AHPI database.
- Endorsements in conference media releases and PR activities.
- Promotional video (3 minutes video to be provided by Sponsors) played during all breaks.
- Ten complimentary delegate passes for the MedFuture India Conference

PLATINUM SPONSOR

INR 10,00,000 Plus Taxes (Maximum 2)

Deliverables

- Allocation of a dedicated speaking slot during the Conference.
- The Platinum Sponsor will sponsor one session, named after them.
- One full-page advertisement featured in the AHPI annual report.
- Company logo prominently displayed on the main conference backdrop.
- Logo included on all conference materials and the event website.
- Promotional video (3 minutes video to be provided by Sponsors) played during all breaks.
- Logo featured in all email communications to the AHPI database.

GOLD SPONSOR

INR 5,00,000 Plus Taxes (Maximum 3)

Deliverables

- Designated speaking opportunity during the Conference
- One full-page advertisement included in the AHPI annual report.
- Company logo prominently displayed on the main conference backdrop.
- Logo featured on all conference materials and the event website.
- Logo included in all email communications to the entire AHPI database.

SILVER SPONSOR

INR 2,00,000 Plus Taxes (Maximum 5)

Deliverables

- A half page advertisement featured in the AHPI Annual Report.
- Prominent display of the company logo on the main conference backdrop.
- Company logo included on all conference materials and the official website.
- Logo featured in all rounds of email communications sent to AHPI database.

FOR CONFERENCE
AHPI (Association of Healthcare Providers India)
Email: contact@ahpi.in | abhatia@servintonline.com
Contact no : +91 - 88003 48582, +91 - 93502 30863

ORGANISED BY

AHPI Partner Associations


BLUENEEM®
BLUENEEM® UROLOGY
YOUR FELT NEEDS PARTNER
BLUENEEM® INTERVENTIONAL SYSTEMS
YOUR INNOVATION PARTNER
BLUENEEM PEDIATRIX
OUR KIDS DESERVE THE BEST
CLINICIANS' TRUSTED PARTNER
EXPLORE COMPLETE PRODUCT RANGE
LEADER IN DESIGN, DEVELOPMENT AND END-TO-END MANUFACTURING OF MINIMALLY INVASIVE MEDICAL DEVICES
OPTICORE
BIOPSY GUN - FULLY AUTOMATIC
CYTOCORE
BIOPSY GUN - SEMI AUTOMATIC
TRACER™
HYDROPHILIC GUIDEWIRE
+91 80 2976 1335/36
+91 97399 72854, 97399 72855
contact@blueneem.com
marketing@blueneem.com
CE 0123
TÜV SÜD

Role of Computed Tomography (CT) and Magnetic resonance Imaging in Brain Mapping

Kritika Sharma, MSc. MIT, Bapubhai Desaibhai Patel Institute of Paramedical Sciences, Charotar University of Science and Technology, Anand, Gujarat
Dr. Dolly A Sharma, Professor, Dept. Medical Radiology and Imaging Technology, Institute of Allied Health Sciences, Silvassa, Dadra & Nagar Haveli and Daman & Diu

Introduction

Current neuroimaging approaches limit human investigations on early brain development. Conventional brain mapping tasks result in significant participant attrition in low task engagement and excessive head motion. Despite, several anatomical and functional approaches are now available to map the human brain in both health and disease state. In the past two decades, there has been significant progress in imaging the human brain and estimating the location of essential functional networks without invasive procedures. While these approaches have traditionally focused on preserving eloquent brain functions like movement and language, there is a growing interest in mapping cognitive and emotional networks as well. Indeed, these methods have been applied to patient with neurologic and psychiatric diseases, resulting in a growing understanding of the pathophysiology of diseases like, epilepsy, cerebrovascular disease, neoplasms, neurodegenerative diseases, mental illness, and addiction. In fact, these novel approaches are now widely used for preoperative planning and monitoring of pharmacologic or surgical therapies, including transplantation. Observing the reorganization of the human nervous system after acute injury, cerebral infarction or head trauma, or during a progressive degenerative process, such as Alzheimer's or Parkinson's disease, may provide new insights and methods in the rapidly expanding of neuro rehabilitation. MRI (Magnetic resonance imaging) provides logistical issues for imaging, whereas functional near infrared spectroscopy has restricted picture quality due to sparse sampling. Moreover, resting state functional MRI (rs-fMRI) is a non-invasive imaging modality that measures spontaneous low frequency blood oxygen level-dependent signal fluctuations at rest to infer neuronal activity. There is growing interest in mapping there functions in patients with various neurological disease.

Role of Computed Tomography in Brain Mapping and its Function:

A critical neuroimaging method for brain mapping is computed tomography (CT) scanning, which produces fine-grained pictures of the tissues and structures of the brain. Through the use of X-ray technology, this non-invasive process produces cross-sectional pictures, or slices, of the brain that may be shown in two dimensions. Rotating X-ray beams are used in CT scans of the brain to get pictures from various perspectives. A computer processes the gathered data to create finely detailed pictures that can show a variety of brain diseases, including tumours, bleeding, structural abnormalities, and traumas. Contrast agents can be used with or without CT scans to improve the visibility of certain brain regions. CT scans are instrumental in visualizing the anatomy of the brain. They are essential for identifying diseases including strokes, brain injuries, and tumors because they aid in the identification of structural anomalies such tumors, hemorrhages, and lesions. A number of disorders that impair brain function can be identified by CT imaging, such as symptoms of trauma or stroke, arterio venous malformations (abnormal blood vessel development), and hydrocephalus (fluid accumulation). Determining therapy strategies and actions need this knowledge. Neurosurgeons can receive assistance in the planning and execution of procedures from the comprehensive pictures generated by CT scans. CT scans aid in accessing difficult regions of the brain during operations by offering a clear picture of its anatomy. Additionally, CT scans are used to track the efficacy of therapies for illnesses such as brain tumors, enabling necessary modifications to therapy. Even while CT scans offer great anatomical information, to get a complete picture of brain activity and connections, they are frequently combined with additional imaging modalities like MRI and PET scans. This multimodal method improves brain mapping efforts' accuracy [1] [2].

Advantages of CT in Brain imaging:

CT scans are a recommended option in many clinical situations because they provide a number of important advantages for brain mapping. The principal advantages are as follows:

1. Speed: CT scans are far quicker than MRI scans, which is important in emergency scenarios like stroke or trauma. Fast picture collection enables prompt diagnosis and perhaps life-saving action.

2. Cost effectiveness: In general, CT scans cost less than MRI scans. For many people and healthcare facilities, CT is a more affordable alternative because of this benefit.

3. Motion tolerance: The sensitivity of CT scans to patient movement is lower, which can be a major problem while imaging. Clearer pictures are produced as a result of the short scan period, which lowers the possibility of motion artefacts.

4. Bone Imaging: When it comes to imaging bone structures, CT is very useful. It enables a thorough assessment of skull fractures and other anomalies that may not be as easily seen with MRI.

5. Compatibility with medical devices: Individuals, who have metal implants, including cochlear implants or pacemakers, can safely have CT scans performed; but, because MRIs employ magnetic fields, they should not have MRIs performed on these individuals.

6. Comprehensive imaging: With the ability to examine bone, soft tissue, and blood arteries all at once, CT scans offer a thorough picture of the brain and its surrounding structures. This capacity is useful for the diagnosis of a number of illnesses, including as vascular anomalies, tumors, and hemorrhages.

7. No residual radiation: A CT scan is a safe alternative for diagnostic imaging as it leaves the patient's body radiation-free [2] [3].

Disadvantages of CT in Brain imaging:

Although useful for brain mapping, CT scans have a number of drawbacks that may reduce its efficacy and safety. The primary negatives are as follows:

1. Radiation exposure: Patients getting CT scans are exposed to ionising radiation, which increases their chance of getting cancer in the long run. This danger is especially significant for youngsters and those who need several scans.

2. Lower soft tissue contrast: CT scans are less detailed when it comes to soft tissues than MRIs. This restriction may make it more difficult to identify some types of brain abnormalities, such mild lesions or meningeal inflammation.

3. Artefacts and Misinterpretation: Artefacts can skew CT scans, making important features difficult to see. Furthermore, the thoroughness of CT results can occasionally result in misunderstandings, where a normal scan could cause doctors to ignore potentially important further diagnostic testing.

4. Limited Diagnostic Capability: Without further testing, CT scans cannot identify the type of a lesion (benign vs. malignant) since they cannot offer histological information. Due to this restriction, diagnosis may become dependent on imaging alone, which may not always be reliable.

5. Anxiety and Discomfort: Certain individuals may experience anxiety due to the loud nature of the scanning process. Although this isn't as problematic as an MRI, it can still have an impact on how comfortable the patient is during the process.

6. Allergic Reactions to Contrast Agents: The use of contrast dye carries a risk of allergic responses, which might vary in severity. Certain individuals could feel uncomfortable after receiving a contrast substance injection.

7. Indiscriminate Use: In clinical practice, there is a propensity to rely too much on CT scans, which might result in pointless scans that expose patients to radiation without clearly demonstrating any diagnostic advantages [4] [5].

Role of Magnetic Resonance Imaging in Brain Mapping and its Functions

Brain mapping greatly benefits from the use of magnetic resonance imaging (MRI), especially from its functional variation, known as functional MRI (fMRI). By identifying variations in blood flow and oxygenation that arise in response to neuronal activity, this cutting-edge imaging method enables scientists and medical professionals to see brain activity.

Functional MRI (fMRI): By monitoring the Blood Oxygen Level Dependent (BOLD) signal, which represents variations in blood flow linked to neuronal activity, fMRI plays a crucial role in our knowledge of brain function. Functional magnetic resonance imaging (fMRI) detects the increased blood flow that occurs when a particular brain region is stimulated. This allows for the mapping of functional regions that are responsible for different cognitive activities, including language, memory, and motor abilities. Besides, fMRI makes it possible to pinpoint the brain areas that are engaged in particular cognitive functions. Researchers may identify which brain regions are active by giving individuals tasks to complete while having fMRIs, which helps localize cognitive processes like language and memory. In clinical settings, fMRI is being utilized more and more to map important brain regions prior to neurosurgery treatments. As part of this process, eloquent cortical areas that are essential for speech and movement are identified. This helps to influence surgical design and reduces the possibility of functional damage following surgery. MRI methods are essential for studying and diagnosing neurological conditions. For example, fMRI can identify patterns of connection in diseases such as epilepsy, Alzheimer's disease, and autism spectrum disorders, which can be helpful in the diagnostic and therapy planning stages. Resting state MRI enables the mapping of intrinsic brain networks by capturing the brain in its default state while not performing certain activities. It improves knowledge of the interactions and communication between various brain areas, which is essential for understanding intricate cognitive behaviors [6] [7].

Advantages of MRI in Brain imaging

1. Non Invasive: Since MRI doesn't use ionizing radiation, it's a safer choice for follow-up exams in clinical and healthy populations.

2. High Resolution: With the use of functional data and precise anatomical pictures provided by MRI, a complete picture of the structure and function of the brain may be obtained.

3. Versatility: MRI is a flexible technique in medical diagnostics since it may be used for purposes other than brain mapping, such as evaluating a range of disorders affecting the brain and other organs [8].

Disadvantages of MRI in Brain mapping

There are a number of drawbacks to MRI, especially functional MRI (fMRI), which may affect how useful and accessible it is for brain mapping. These are the main disadvantages:

1. Limited availability and high cost: MRI equipment are not as commonly available as other imaging modalities like CT scans. Additionally, MRI tests tend to be more expensive, which might limit access for some patients and healthcare institutions.

2. Long acquisition time: More acquisition time is needed for MRI scans, particularly fMRI, than for other imaging methods. If the patient is unable to stay still, this might result in motion artefacts, which are essential for getting high-quality pictures.

3. Patient discomfort: The small, confined area of an MRI scanner causes claustrophobia in many of its patients. Their inability to stay still throughout the scan may be hampered by this pain, which would further degrade image quality.

4. Sensitivity to motion: Because fMRI is so sensitive to head motion, the picture quality may be harmed. Patients who are in pain, nervous, or disoriented may find it difficult to follow instructions and stay still.

5. Limitations with implants: Due to intense magnetic fields that may interfere with some metallic implants or equipment or pose safety issues, patients may not be good candidates for magnetic resonance imaging (MRI). This restricts the use of MRI to a certain group of patients.

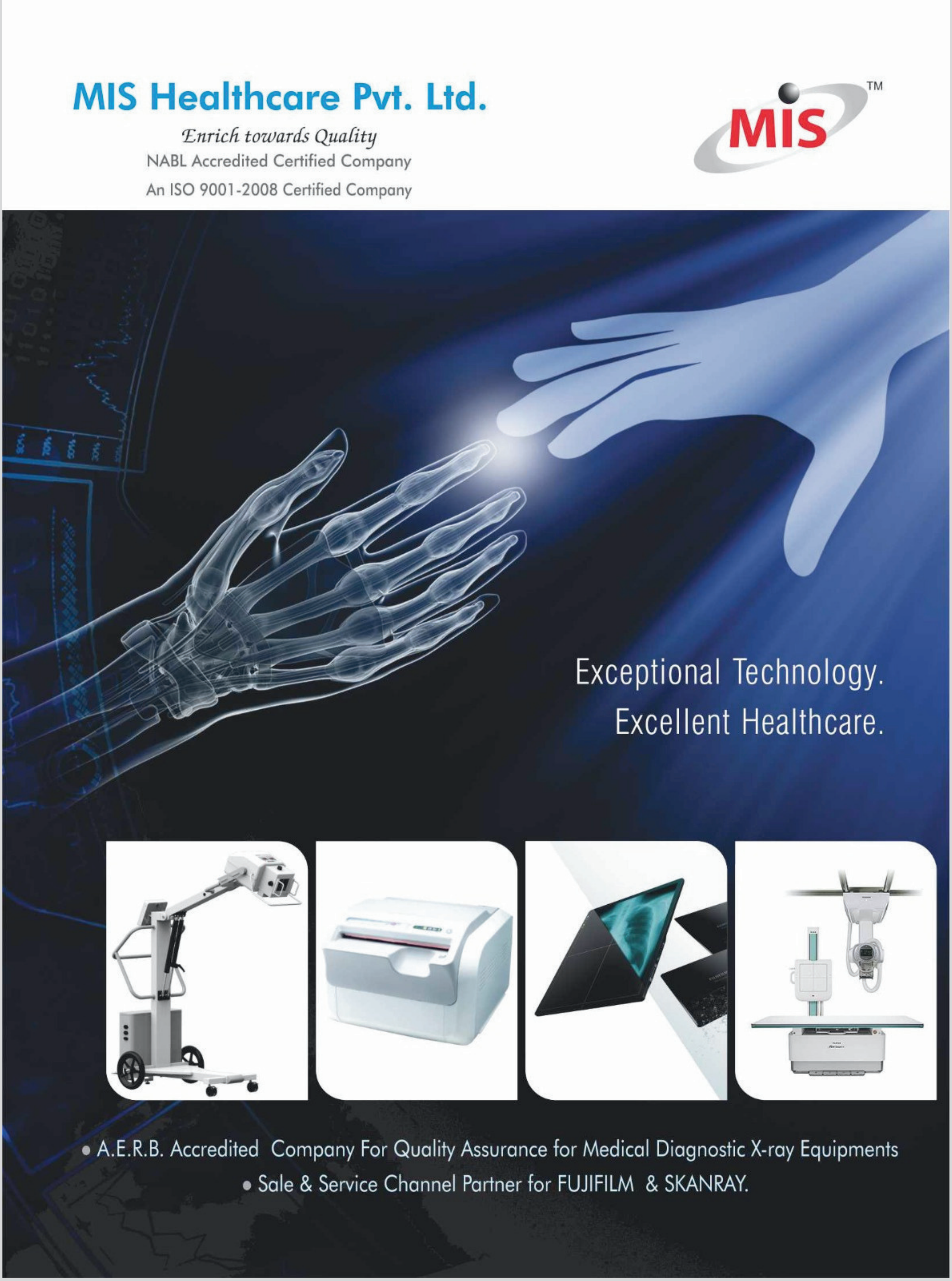
6. Incidental findings: Due to its great sensitivity, MRIs can discover unintentional abnormalities that aren't always clinically meaningful. Patients may experience needless worry as a result, and further testing that may not be necessary may be ordered.

7. Potential for allergic reaction: Allergy responses are possible with gadolinium-based contrast agents, albeit they are uncommon in magnetic resonance imaging examinations. This is especially worrying for those who have renal problems.

8. Limitations in diagnosing certain conditions: Diagnosis might become more challenging when MRI is unable to clearly differentiate between distinct forms of brain tissue, such as malignant tumor and edema (swelling) [9] [10].

References:

1.Patel PR, De Jesus O. CT Scan.
2.Crna, R. N. M. What to know about CT head scans.
3.Exploring the Brain: Is CT or MRI Better for Brain Imaging? (2024, May 23). UCSF Radiology.
4.Fred HL. Drawbacks and limitations of computed tomography: views from a medical educator. Tex Heart Inst J. 2004; 31(4):345-8.
5.Belliveau, J. W., Kwong, K. K., Kennedy, D. N., Baker, J. R., Stern, C. E., Benson, R., Chesler, D. A., Weisskoff, R. M., Cohen, M. S., & Tootell, R. B. (1992). Magnetic Resonance Imaging Mapping of Brain Function: Human Visual Cortex. Investigative Radiology, 27, S59–S65.
6.Advancements in Brain Mapping with MRI. (2023, November 9). Eastern Diagnostics.
7.Lam, P. (2023, June 8). What to know about MRI scans. Brain MRI. (n.d.).
8.Brain MRI. (n.d.). Radiologyinfo.org.
9.Functional MRI (fMRI). (n.d.). Radiologyinfo.org.


MIS Healthcare Pvt. Ltd.
Enrich towards Quality
NABL Accredited Certified Company
An ISO 9001-2008 Certified Company
MIS™
Exceptional Technology.
Excellent Healthcare.
• A.E.R.B. Accredited Company For Quality Assurance for Medical Diagnostic X-ray Equipments
• Sale & Service Channel Partner for FUJIFILM & SKANRAY.

Coronary CT Angiography

Boddupally Suresh, Rso, Care Hospitals, Malakpet, Hyderabad

Introduction

Chest pain is the most common symptom of coronary artery disease (CAD), Addressing this burden demands timely and cost-effective diagnostic tools. Coronary computed tomography angiography (CCTA) is a crucial CAD assessment diagnostic modality. This non-invasive approach proves invaluable for patients with low to intermediate pre-test probabilities of ischemic heart disease.

It circumvents the hazards associated with invasive procedures and expedites assessments for patients at intermediate risk of CAD. Given the minute dimensions and dynamic nature of epicardial coronary arteries, CCTA relies on precise spatial and temporal resolutions. Spatial resolution determines the smallest distinguishable distance between two points, while temporal resolution dictates how rapidly images of moving structures can be captured.

Anatomy and Physiology

A thorough understanding of coronary anatomy is imperative to interpret CT coronary angiograms accurately.

Normal Coronary Anatomy

The left main artery takes its origin from the posterior left aortic cusp. It usually measures 1 to 2 cm long and bifurcates into the left anterior descending artery (LAD) and left circumflex artery (LCx). In 0.41% of patients, the left main artery is absent, and both the LAD and LCx arise individually from the left aortic cusp. The LAD exits to the left of the pulmonary artery and travels down anteriorly in the anterior interventricular groove. Major branches from the LAD include septal perforators, which supply the anterior two-thirds of the interventricular septum, and diagonal branches, which supply the lateral wall of the left ventricle (LV). The LCx turns back into the left atrioventricular groove and gives branches called the obtuse marginal (OM), which supplies the lateral aspect of the LV. The LCx, through its course, is covered by the left auricle. In one-third of cases, the left main artery trifurcates into the LAD, LCx, and ramus intermedius, which runs between the course of LAD and LCx, supplying the anterolateral wall of the LV. The right coronary artery (RCA) originates from the anterior aspect of the right aortic cusp. The RCA runs forward into the right atrioventricular groove (AV) until the crux (a point of intersection of the right AV groove and posterior interventricular groove) divides into the posterolateral branch and the posterior descending artery (PDA). Normally PDA arises from the RCA, leading to right dominant circulation, whuich is the most common. In a left-dominant system, the PDA arises from the LCx. Co dominant circulation is a rarity.

Indications

As per the Society of Cardiovascular Computed Tomography 2021 Expert Consensus Document on Coronary Computed Tomographic Angiography, the following are the appropriate utilities of CCTA in patients with CAD.

- CCTA in native vessels for evaluation of stable coronary artery disease.
- CCTA for evaluation of stable coronary artery disease post-revascularization.
- CCTA for evaluation of stable coronary artery disease using fractional flow reserve or CT perfusion.
- Valvular heart disease and low risk for CAD
- Nonischemic cardiomyopathy and low risk for CAD
- Coronary artery anomalies
- Scar assessment in patients who cannot undergo cardiac MRI

Contraindications

There are generally no absolute contraindications to performing a CCTA. However, a history of a severe anaphylactic reaction to iodinated contrast precludes a repeat contrast administration. The following are the relative contraindications.

- Acute thyroid storm
- Pregnancy
- Renal insufficiency
- Patients on radioactive iodine therapy
- Hemodynamic instability
- Acute decompensated heart failure

Preparation

Key facts to consider for the preparation of CCTA include the following:

- Informed consent should be obtained before the start of the CCTA.
- The patient should have no solid food for 4 hours before the exam.
- Liquid food may be continued.
- The patient should have no caffeine for 12 hours before the test.
- (IV) access18-gauge catheter.
- The ideal heart rate for CCTA image acquisition is 60 beats per minute or less. An oral beta-blocker is typically administered 2 hours before the test, which can be supplemented with intravenous beta-blocker administration at the time of the test. Oral metoprolol tartrate at 50 to 100 mg is typically used as a pre-medication. Alternatives include oral atenolol, IV esmolol, calcium channel blockers, and ivabradine.
- Non-steroidal anti-inflammatory drugs should be held 24 to 48 hours before the study to reduce the risk of contrast nephropathy. Glucophage should be held for 48 hours after the procedure. Nitrates vasodilate coronary arteries and improve visualization of coronary arteries and stenoses when given 5 minutes before CCTA image acquisition. Typically, 400 to 800 micrograms of sublingual nitroglycerin are used for this effect.

Technique

CCTA protocols typically involve an initial non-contrast, low-radiation dose phase. This non-contrast portion of the study can yield high-quality data about cardiac anatomical structures that may not be as adequately visualized with other noninvasive imaging modalities, eg, trans-thoracic echocardiography (TTE) or cardiac magnetic resonance imaging (MRI).

Calcium scores are classified into 4 risk assessment categories based on their values, with values higher than 400 score, warranting invasive coronary angiogram.

Calcium scores are determined by assigning a weighted density score to the location of calcium with the highest attenuation, measured in Hounsfield units during the initial non-contrast phase of a CCTA, and then multiplying it by the area of calcification.

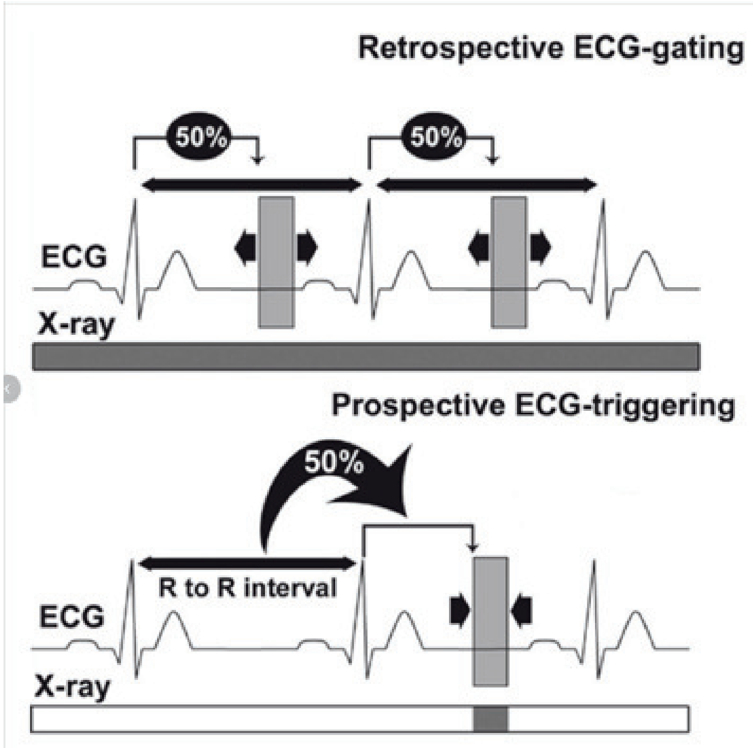
During diagnostic CCTA procedures, most adults require 50 to 120 mL of iodinated contrast, injected at a rate of 5 to 6 mL/s.

Biphasic injection protocols are employed to prevent streak artifacts caused by high concentrations of contrast on the right side of the heart. This involves injecting contrast followed by saline.

The scanning time and infusion rate determine the total volume of contrast required. Typically, 80 mL of contrast at a rate of 5 mL/s is used for a coronary study using a biphasic injection protocol, followed by 40 mL of saline at the same rate.

Image Acquisition

The initial phase of image acquisition in CCTA entails the acquisition of scout images, conventionally obtained as low-energy scans with a tube voltage of 120 kV and an amperage of 35 mAs. Two cardinal methods of cardiac image acquisition are retrospective and prospective. Retrospective acquisition involves imaging at 10% intervals throughout the cardiac cycle, The radiation exposure is maintained at 100% during phases critical for coronary artery evaluation. Prospective reconstruction restricts radiation exposure to a predefined phase of each cardiac cycle, often at 75% duration, offering substantial radiation reduction and thus favored. Prospective electrocardiogram (ECG)-triggered acquisition aligns X-ray tube activation with mid-diastole, further minimizing exposure. Suboptimal heart rates permit end-systole utilization. Irregular rhythms or high heart rates prompt retrospective ECG gating.



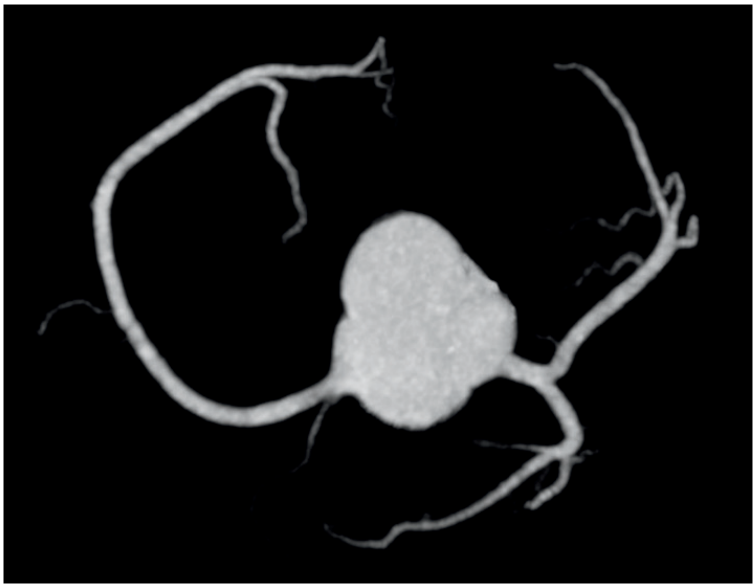
Retrospective ECG gating vs. prospective ECG triggering. The two main techniques for cardiac CT ECG synchronization are displayed. In the upper panel, we can observe retrospective ECG gating. It is based on spiral continuous X-ray delivery at low pitch while recording the ECG track. Afterwards the operator is able to arbitrarily decide which phase of the cardiac cycle is worth reconstructing. In the lower panel, we can observe the prospective ECG triggering. It is based on sequential scanning (also called "step and shoot" mode). Radiation is delivered only within the phase of the cardiac cycle that has been decided prior to the initiation of the scan. It requires very low heart rate (HR) and/or very high temporal resolution to guarantee adequate image quality

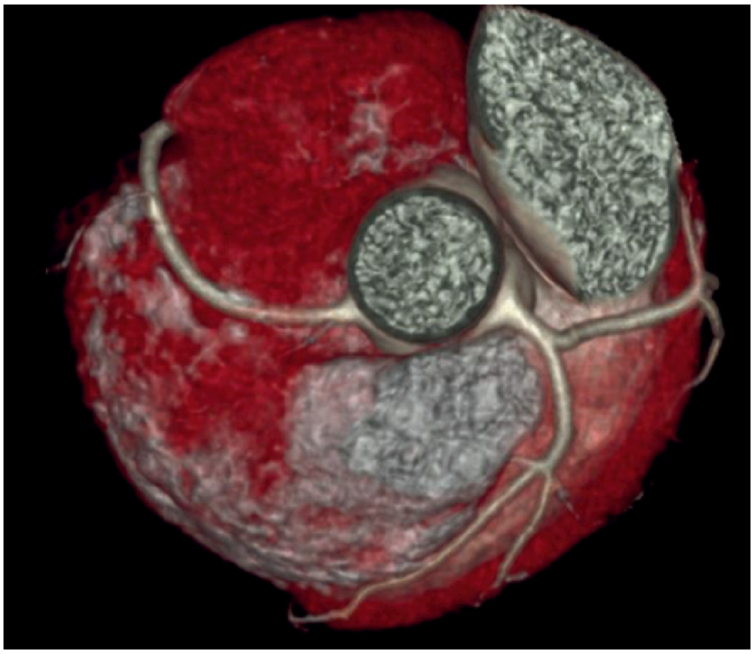
Post-Processing

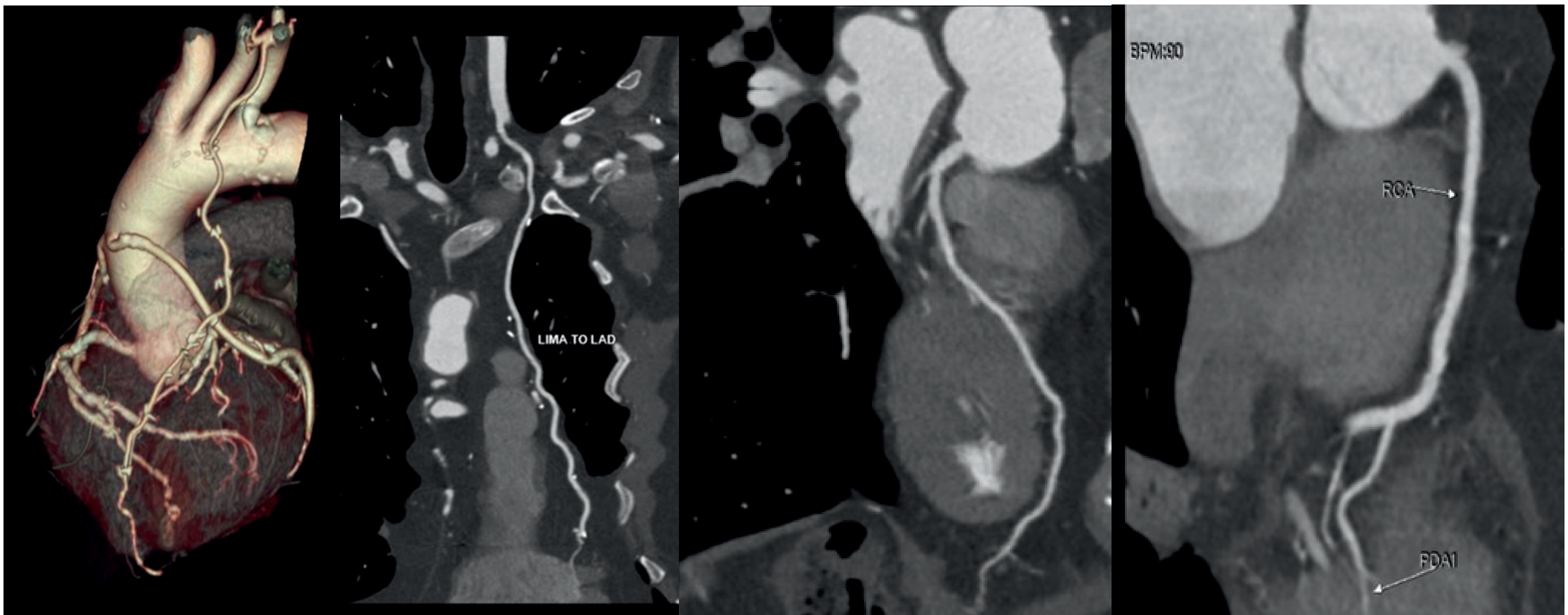
The reconstruction of axial data is a critical step in assessing coronary arteries, cardiac function, and non-coronary structures. It is essential to analyze and edit the rhythm to evaluate coronary health to avoid ectopic beats. The optimal phase of the cardiac cycle is then carefully selected, and the appropriate kernel and reconstruction parameters are determined. Both maximum intensity projection (MIP) and multiplanar reformats (MPR) are utilized to assess stenosis, with coronary stenosis being re-evaluated in another cardiac phase to ensure accuracy.

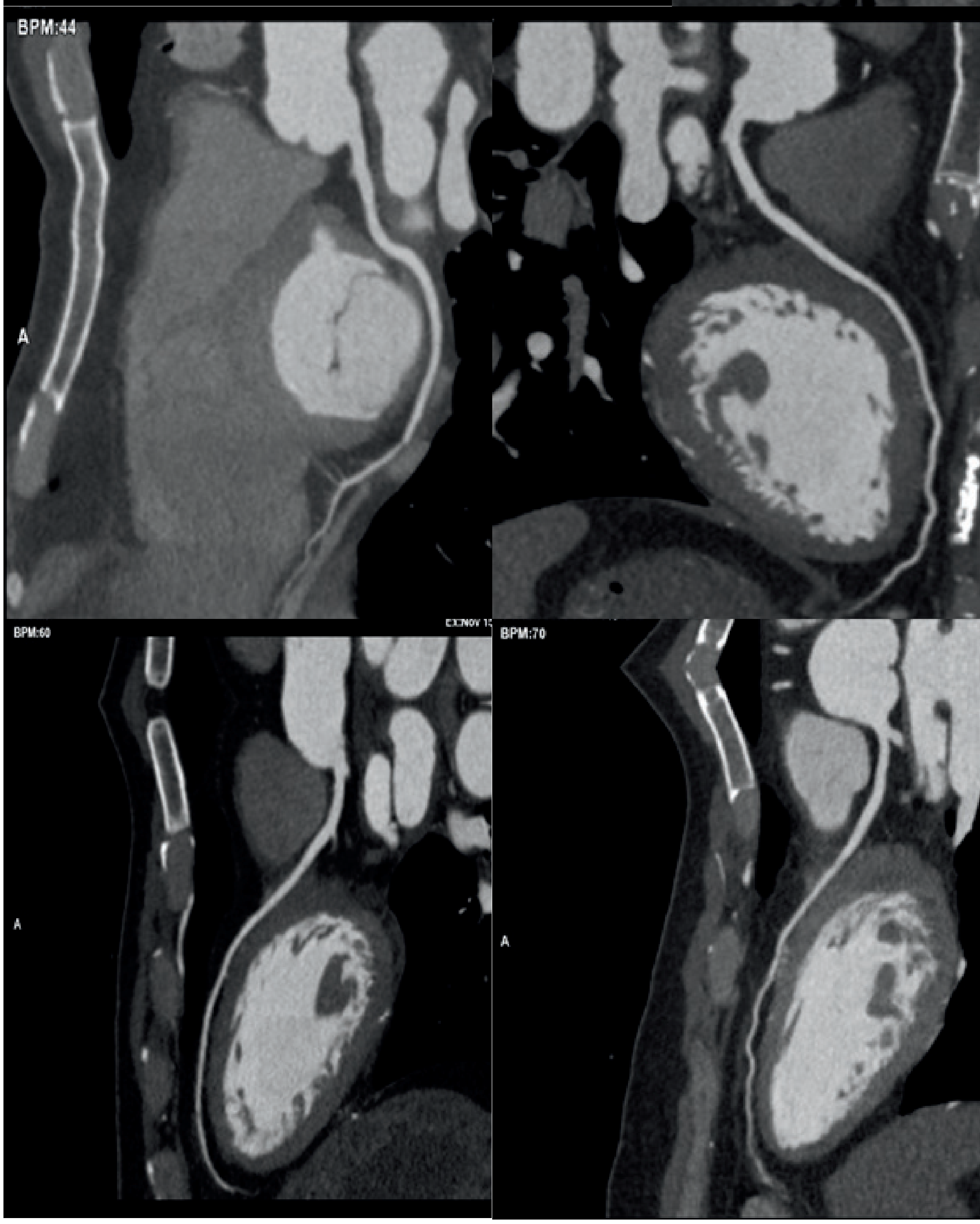
For patients with irregular R-R intervals, like those with atrial fibrillation, selecting a specific phase of the R-R interval can lead to the reconstruction of different cardiac cycle phases and artifacts. To address this, the ECG is edited by selecting the phase using a specific time duration from the preceding R wave.

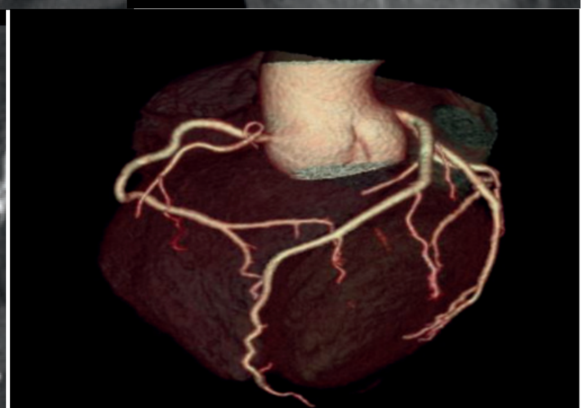
The late-diastole phase (60%-80% of the R-R interval) is typically chosen for coronary evaluation. However, in some cases, a systolic phase (35% of the R-R interval) is selected to minimize motion artifacts, as motion is the least at this systole stage.











New Technique in High Heart Rate CT Coronary Angio

Scanning heart rate is ideally 60 to 70 bpm in acquiring good image quality.

Now we have started a new technique called long breath hold technique.

In this technique patient is instructed to hold the breath for at least 12 sec.

Variation in this technique is to adjust the pitch and rotation time as well as an increase the contrast flow rate.

Patient is asked to practice breathe holding before the test. It is important to check at least 4 times for compliance before we start the scan.

Adequate breath hold can be checked after acquiring plain study.

After confirmation regarding breath holding contrast acquisition is started. In this technique we acquired good image quality at 100 bpm also.

Conclusion

CCTA has made itself an integral aspect of cardiac imaging in a safe and non invasive manner in day to day practice, especially in cases pertaining to coronary artery disease. A standardised pattern of acquisition is followed around the world with few localised protocols for ease of procurement. We have identified few local such acquisition techniques, which are beneficial in cases with irregular heart beats, ectopics etc which in turn help in procuring near prescribed image resolution compared to standard protocols.

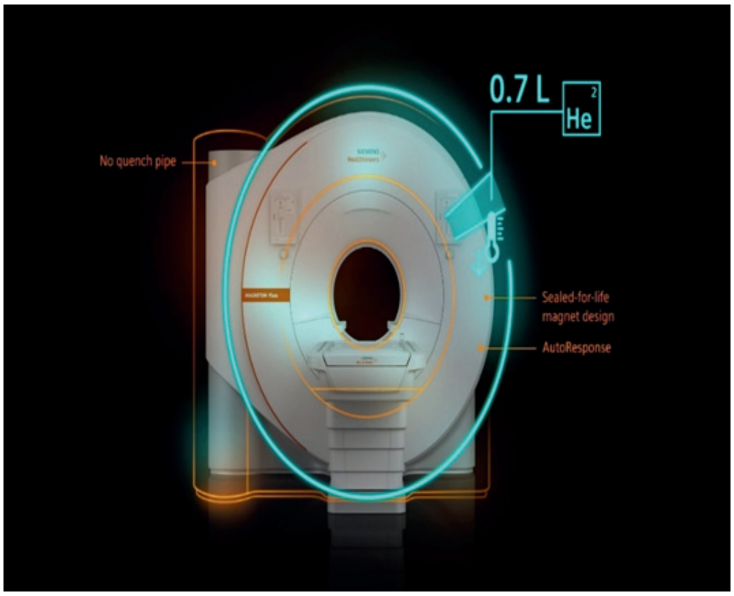

COMING SOON

Helium Free MRI

Sonu Kumar, Harsh Maurya, M. Sc. Research fellows, **Deepak Katiyar, Raushan Kumar,** Asst. professors,
College of Paramedical Sciences, Teerthankher Mahaveer University, Moradabad, UP.

Introduction

With its ability to provide finely detailed images of the inside components of the human body, magnetic resonance imaging, or MRI, has long been a mainstay of medical diagnosis. However, the superconducting magnets in conventional MRI scanners have been largely cooled by liquid helium. Helium-free MRI scanners are becoming a revolutionary way to tackle the problems caused by helium scarcity and environmental issues as we enter a new era of medical technology. With their increased accessibility, lower costs, and increased efficiency, these cutting-edge scanners promise to completely transform the medical imaging industry. They mark a substantial advancement in the area. As we go into the realm of helium-free MRI, we'll examine the factors that led to this technical revolution and its profound effects on patients, healthcare professionals, and the larger medical community.



Its first 1.5 Tesla platform without a quench pipe and with a closed helium circuit for magnetic resonance imaging. The Dry Cool method has lowered the quantity of liquid helium needed for cooling to 0.7 liters from as much as 1,500 liters, saving money and resources. in the case of an emergency shutdown, the quench pipe was required to securely permit cold helium to escape from the building directly into the sky. The new device, which has a 60 cm bore size, is suitable for all MRI applications. Shorter measuring times and better image quality are made possible by the widespread application of artificial intelligence-based image reconstruction. Siemens' second MRI platform that uses Dry Cool technology and is essentially helium-free is called Magnetom Flow. Thanks to its small size less than two meters in height, a footprint of only 24 square meters, and the absence of a quench pipe requires less installation work and expenditures than many other 1.5T scanners. It is frequently only feasible to install conventional systems in buildings due to their size and weight. since a result, patients can feel more at ease and save time. MRI creates high-definition images of a patient's brain, important organs, or soft tissue using superconducting magnets that have been cooled to minus 452 degrees Fahrenheit. Thousands of liters of liquid helium extracted from the earth's crust are needed in order to maintain the current clinical use of MRI magnets at that low temperature.

Problems with traditional MRI Technology Depend on Helium

Liquid helium is needed in massive amounts in conventional MRI scanners in order to keep the superconducting magnets at cryogenic temperatures.

Limited supply

Due to limited and decreasing global helium sources, MRI providers face rising pricing and accessibility issues.

Complexity operations

MRI operations become much more complex and expensive when a cryogenic apparatus and constant helium supply are maintained.

Liquid Helium's function in MRI:

The superconducting magnet at the heart of an MRI machine is usually constructed from coils of wire, most frequently niobium-titanium. These wires need to be chilled to nearly zero degrees Celsius, or 4 Kelvin, in order to become superconducting—that is, capable of transmitting electricity without encountering any resistance. The magnet's ability to produce a powerful, steady magnetic field in this superconducting state is crucial for MRI scans to provide high-quality images.

Only liquid helium, which has a boiling point of 4.2 Kelvin, can bring the magnets down to this crucial temperature. For many years, liquid helium has been an essential part of MRI technology, enabling superconducting magnets to run continuously. Liquid helium is used in hundreds to thousands of liters by conventional MRI equipment.

The crisis in the world's Helium supply:

Despite being the second most common element in the cosmos, helium is surprisingly uncommon on Earth. Usually, it is taken out of natural gas reserves, but this is an expensive and resource-intensive procedure. Since helium is so scarce, it is regarded as a non-renewable resource, and worries over its depletion have been intensifying in recent decades.

The issue in the availability of helium has been caused by a number of variables. First, helium is needed for purposes much beyond magnetic resonance imaging

(MRI). Further taxing the limited supply is the use of helium in welding, electronics manufacture, scientific research, and space exploration. The availability of helium can be directly impacted by changes in natural gas output, which can result in price volatility and supply shortages.

Hospitals and diagnostic centers are facing financial strain, especially in low-resource environments, as a result of the growing cost of liquid helium and the corresponding operational expenses of MRI machines.

The Helium-free systems differ from conventional MRI systems in following ways; -

Helium is utilized in very small levels.

According to Philips, a normal MRI system requires 1,500 liters of helium, whereas their helium-free system only uses 7litres.

complete sealing surrounding the helium system.

in order to prevent the helium from heating out over time. This avoids the helium system's expensive recharges.

There is no need for a vent or quench stack.

For these low-helium, sealed systems. Because there is no longer a need to worry about how to exhaust the system outside the building, this can drastically lower the cost of stack construction and enable MRI rooms to be placed anywhere.

These systems should be less expensive and a more sustainable and economical choice for MRI equipment if they can produce high-strength MRI fields without requiring liquid helium for super cooling.

The MRI's Future

A major advancement in medical imaging technology is represented by helium-free MRI. Future research and development should yield even more sophisticated and effective solutions that lessen their negative effects on the environment and increase the accessibility of MRI services.

MRI cooling system:

Superconducting magnet coils in helium-free MRI systems are cooled using a range of methods that do not require liquid helium utilizing a coolant that is cooled by a specialized device known as a cryocooler, such as water or liquid helium.

Cryocooler refrigerators: The magnet coils can be cooled by direct conduction using a cryocooler refrigerator unit.

M**icro-cooling technology:** A tiny quantity of liquid helium that is contained inside the magnet is used in micro-cooling technology.

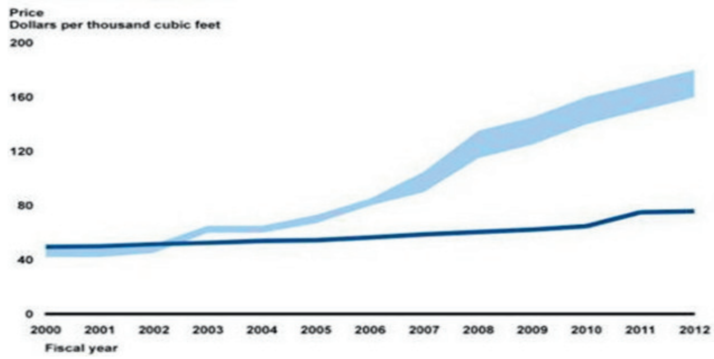
Mechanical refrigerators: Cool the magnets with cooling water and electricity. Like air conditioners, these coolers use a fixed amount of helium gas that is compressed and inflated in a closed circuit.

Superconducting magnets in MRI scanners are cooled by helium, a rare and non-renewable material. For cooling, traditional MRI scanners may need more than 1,000 liters of liquid helium. By lowering the requirement for helium, helium-free MRI devices can lower expenses.

The lack of helium: an increasing problem for MRI

Growing Demand: Price volatility and supply problems have resulted from the growing demand for helium worldwide across a number of industries, including medical imaging.

Limited Availability: Because it is a non-renewable resource and is produced primarily in a few places across the world, helium is susceptible to supply chain interruptions and geopolitical unrest.



Environmental Issues: Concerns about sustainability in the field of medical imaging are raised by the extraction and transportation of helium, which contributes to greenhouse gas emissions.

Cost Consequences: Access to MRI services may be restricted due to fluctuating helium costs and possible shortages, which present serious financial difficulties for healthcare providers.

Principle of Helium free MRI

Superconductors at High Temperatures:

Modern high-temperature superconducting materials that can function at greater temperatures are used in helium-free MRI scanners, which do not require liquid helium cooling.

Cooling Systems Without Cryogen:

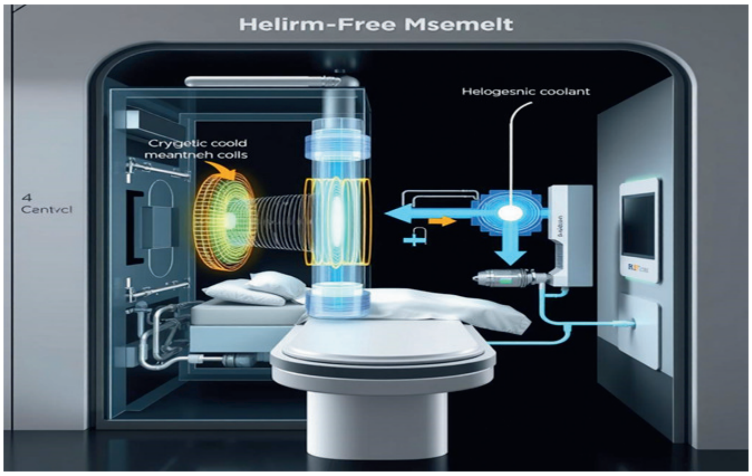
To achieve the necessary low temperatures without the use of liquid helium, these systems use cutting-edge cooling technologies like closed-loop refrigeration systems or pulse tube cryocoolers.

Small Magnet Style:

The MRI system's overall size can be decreased while preserving or even enhancing image quality thanks to engineers' creation of more efficient and compact magnet designs.

Complex Software Algorithms:

In helium-free MRI systems, sophisticated image reconstruction techniques and AI-powered software improve image quality and shorten scan durations.



Advantages

Lower Operating Expenses: For medical facilities, removing the requirement for frequent helium refilling drastically reduces continuing operating costs.

Increased Dependability: Helium-free MRI scanners have higher uptime and require less maintenance because there is no chance of helium leaks or quenches.

Reduced Footprint: Helium-free systems' modest size makes them easier to deploy in cramped areas, which could expand the number of facilities that can provide MRI services.

Disadvantage: The following are some technological restrictions on helium-free MRI magnets:

Power usage: Magnets that don't use helium need a lot of cryocooler power.

Size: Due to their energy requirements, small-bore scanners use the majority of helium-free magnets.

The Benefits of Blue Seal Helium-Free Magnetic Resonance Imaging Technology

Helium is an essential part of magnetic resonance imaging (MRI) systems because it cools the superconducting magnets that provide the magnetic fields that create images. The magnets lose their superconducting qualities and the scanner malfunctions if there is insufficient cooling.

Additional problems with helium include:

Lack of supply: Helium is a non-renewable resource that is getting harder to get.

Environmental impact: Helium manufacturing has an effect on the environment.

Cost: Helium is getting more expensive.

Geopolitical variables, shipping, and supply chain problems can all have an impact on

Advancement in cryogenic and magnet technology

Superconductors at High Temperatures : novel materials that eliminate the requirement for costly liquid helium cooling by preserving superconducting at higher temperatures.

Effective Cryocoolers : cutting-edge cryogenic systems that don't need a constant supply of helium to maintain the necessary low temperatures.

Improved Electromagnetic Architecture : sophisticated gradient and magnetic field engineering to provide excellent imaging results without the need of helium.

Clinical Use Cases and Applications

Clinical applications

Neurological imaging:

When it comes to high-resolution brain scans, helium-free MRI systems are excellent, which helps with neurological condition monitoring and diagnosis.

musculoskeletal system:

Orthopedic injuries and disorders can be assessed with the help of these devices, which offer precise vision of joints, bones, and soft tissues.

Cardiovascular Imaging :

With the use of helium-free MRI technology, physicians can perform sophisticated cardiac imaging to assess heart function and identify cardiovascular anomalies.

Uses in Oncology :

Accurate magnetic resonance imaging (MRI) scans can help with cancer diagnosis, staging, and follow-up, which can improve patient outcomes.

Cost-effectiveness and Operational Efficiency

Reduce Maintance:

Helium-free MRI scanners require less maintenance and downtime because they don't require helium refills or as many cryogenic systems.

Energy Efficiency:

Helium-free MRI systems that use innovative cooling methods may use less energy and have lower running expenses.

Flexibility in sitting:

By doing away with the requirement for specialist helium infrastructure, MRI scanners can be installed in medical facilities with greater flexibility.

Timeline summary of the MRI machine's liquid helium

1980: MRI scanners with two cryogen chambers - an internal containing liquid helium, and an external containing liquid nitrogen.

1990: MRI scanners adopted Gifford McMahon cryo- coolers, eliminating the nitrogen, which led to a decrease in helium consumption.

2000: Zero boil-off magnets are introduced allowing for operation of the MRI machine with minimum helium loss.

2015: GE presents their Freelium technology which decreased the helium required to 20 liters. However, this technology was not FDA approved

2018: Zero boil-off magnets are standard in MRI and Philips develops a helium free magnet called Blue Seal.

1980: MRI scanners with two cryogen chambers - an internal containing liquid helium, and an external containing liquid nitrogen.

1990: MRI scanners adopted Gifford McMahon cryo- coolers, eliminating the nitrogen, which led to a decrease in helium consumption.

2000: Zero boil-off magnets are introduced allowing for operation of the MRI machine with minimum helium loss.

2015: GE presents their Freelium technology which decreased the helium required to 20 liters. However, this technology was not FDA approved

2018: Zero boil-off magnets are standard in MRI and Philips develops a helium free magnet called Blue Seal.

Conclusion:

MRI technology using zero liquid helium is a revolutionary development in diagnostic imaging. These devices solve the problems of helium shortage and growing expenses by doing away with the requirement for liquid helium, providing an MRI technology that is more economical, ecologically friendly, and sustainable. The potential advantages for healthcare are significant, despite the fact that there are still obstacles in the way of this technology's development and use.

Zero-He MRI systems are expected to be fundamental to medical imaging in the future as research and development proceed, guaranteeing that MRI technology is sustainable, dependable, and affordable for future generations.

References

1. T. C. Cosmus and M. Parizh, “Advances in whole-body MRI magnets,” IEEE Trans. Appl. Supercond., vol. 21, no. 3, pp. 2104–2109, Jun. 2011.

2. E. Kostrov, A. Bagdinov, E. Demikhov, T. Demikhov, V. Lysenko, and N. Piskunov, “Performance test of a G-M cooler in magnetic field,” Phys. Procedia., vol. 67, pp. 440–444, 2015.

3. A. Rybakov et al., “1.5 T cryogen free superconducting magnet for dedicated MRI,” IEEE Trans. Appl. Supercond., vol. 26, no. 4, Jun. 2016, Art. no. 4400403

Congratulations

Congratulations to Garapati Wisdom Chowdary on being appointed as a member of the Andhra Pradesh State Allied and Healthcare Council under the Medical Radiology, Imaging & Therapeutic Technology Profession category

MRI Myocardial Mapping (T1, T2 & T2* Mapping)

Mohammad Umar Zakee, M. Sc. Research fellow, **Amit Bisht, Raushan Kumar,** Asst. professors,
College of Paramedical Sciences, Teerthankher Mahaveer University, Moradabad, UP.

Introduction

Newly developed diagnostic method called myocardial mapping has become a vital resource for assessing heart problems. It plays an important role in the diagnosis and treatment of heart conditions by offering insightful information about the characteristics and functions of the tissue. This cutting-edge strategy is centred around three essential techniques: T1 mapping, T2 mapping, and T2* mapping.

T1 Mapping: T1 mapping aids in the early detection of problems such as myocardial fibrosis, inflammation, or oedema by enabling physicians to assess the characteristics of the cardiac tissue. By measuring the cardiac muscle's rate of relaxation following a radiofrequency pulse, it provides a detailed picture of tissue health **(Fig-1A)**.

T2 Mapping: T2 mapping is the gold standard for identifying myocardial deem or inflammation. This method successfully highlights areas with excess water content, a sign of certain heart problems, by measuring the transverse relaxation time of tissues **(Fig -1B)**.

T2* Mapping: This is especially important when iron overload is present because it shows where parts of the heart have deposits of iron that might cause cardiomyopathy or other heart problems. It makes early intervention possible in order to avert serious health repercussions **(Fig-1C)**.

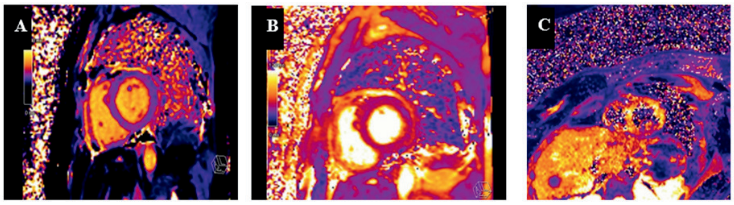


Figure-1 (A) T1 Mapping (B) T2 Mapping (C) T2* Mapping

Indication

1. Heart failure and unexplained troponin elevation
2. Suspected myocardial disease and masses
3. Congenital heart disease
4. Cardiac amyloidosis
5. Inflammation or edema
6. Myocardial fibrosis
7. Heart iron deposits
8. Cardiomyopathy
9. Myocarditis

Contraindications

1. Any implant that is activated by electricity, magnetism, or mechanical means (such as hearing aids, cochlear implants, insulin pump biostimulators, neurostimulators, and cardiac pacemakers).
2. Clippings for intracranial aneurysms (unless they are titanium)
3. Pregnancy (to be evaluated in terms of risk vs. benefit)
4. Ferromagnetic staples or clips for surgery
5. A metallic object in the eye
6. Bullets or metal shrapnel

Preparation

1. Prior to entering the scanning room, the patient must provide a sufficient signed consent form.
2. Request that the patient take out all metal items, such as wallets, keys, coins, magnetic-strip cards, jewellery, hearing aids, and hairpins.
3. Have the patient take off their clothes and put on a hospital gown.
4. For breath hold scans, tell the patient to hold their breath; for gated scans, tell them to breathe gently. It's best to teach the patient two or three times prior to the scan.
5. Before the procedure, ask the patient to use the loo.
6. When it comes to placing the blue tooth receiver and ECG electrodes, according to the manufacturer's instructions.
7. Before attaching the ECG electrodes, the relevant area must be shaved if the chest is covered in hair.
8. Use an abrasive gel to thoroughly clean the ECG contact area.
9. Patients who are claustrophobic may be escorted into the scanning room by a staff member or a family member after receiving the appropriate safety screening.
10. Provide earplugs and headphones so you can talk with the patient.
11. Assist the patient with inquiries and explain the procedure
12. Take note of the patient's weight.

Positioning

1. The patient should be positioned supine with their head towards the magnet (head first supine).
2. As mentioned above and in compliance with the instructions provided by the manufacturer, place the patient over the spine coil and attach the ECG electrodes.
3. Examine the ECG's quality using the scanning terminal's integrated ECG display. Adjust the electrodes if the signal is not consistent and satisfactory.
4. Cover the chest with the body coil or the special cardiac coil.
5. Using straps, firmly tighten the coil to avoid respiratory artefacts.
6. Place cushions beneath your head and legs to enhance your comfort.
7. Place the laser beam localizer in the middle of your chest, above your nipples.

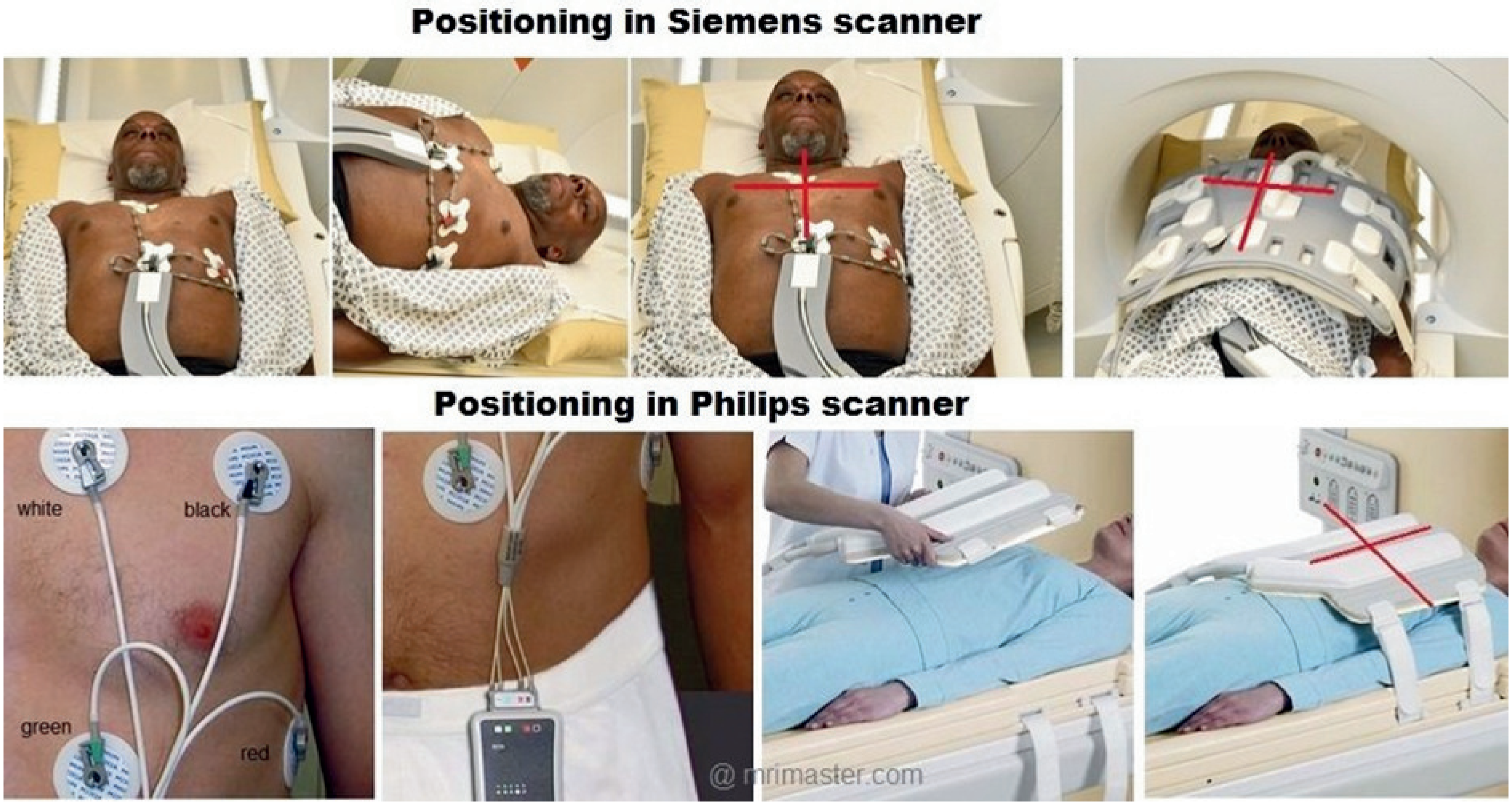


Figure 2 Positioning of ECG MR compatible leads in 2 different scanners

T1 Mapping

Using the T1 relaxation time of distinct tissues, T1 mapping is a useful technique that can be used to identify and describe different disease states within the myocardium. The length of time it takes for a nucleus to return to thermodynamic equilibrium along the B0 magnetic field direction is known as the T1 relaxation time, or longitudinal relaxation time. How soon excited protons release their energy into the surrounding environment determines a tissue's particular T1 value. Temperature, viscosity, size, form, and strength of the magnetic field are some of the variables that affect these T1 values.

Establishing normal T1 values for healthy cardiac tissue utilising the specific MRI scanner being used for mapping is essential to ensuring accurate myocardial T1 mapping. It is important to remember that age and gender are two examples of variables that can affect native T1 levels. Deviations from normal T1 readings are frequently the result of pathological events that alter the water composition or local molecular environment of tissues. Mapping approaches make use of color-coded maps to distinguish between diseased situations and normal cardiac tissue in order to visualise these changes **(Fig-3)**.

T1 mapping measures T1 relaxation periods at several time points following an initial preparation pulse using an inversion recovery technique. Look-Locker **(LL)**, Modified Look-Locker Sequence **(MOLLI)**, and Saturation Recovery Single-Shot Acquisition **(SASHA)** are the three main categories of T1 mapping techniques. The Modified Look-Locker sequence (MOLLI) is the most widely utilised T1 mapping sequence.

Look-Locker (LL): This method measures the inversion time (TI) after the first inversion pulse and takes numerous images throughout the recovery curve with different TI values. But this method has drawbacks: each image captures the heart at a different stage of the cardiac cycle, which causes considerable in-plane and through-plane motion artefacts that skew T1 mapping. As a result, more contemporary methods have mostly superseded it.

The Modified Look-Locker Sequence (MOLLI): is a contemporary method designed to get over the Look-Locker technique's drawbacks. Over the course of three to five heartbeats following the inversion pulse, MOLLI periodically obtains single-shot photos during diastole.

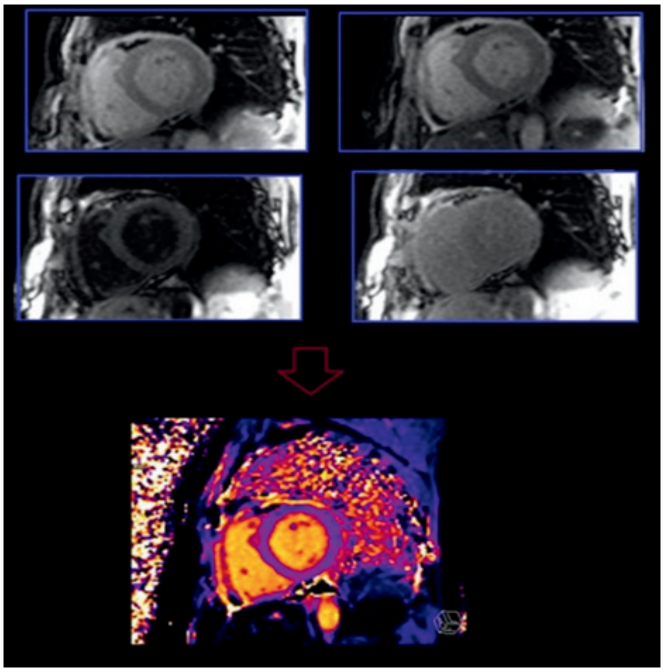


Figure 3 T1 Native Mapping in Short-Axis View

T2 Mapping

T2 mapping uses tissue-specific T2 relaxation times, or transverse relaxation times, to identify and describe a range of pathological events that take place in the heart. In normally healthy tissues, many pathological situations might cause changes in the T2 relaxation time. For example, some diseases can cause myocardial oedema, which raises the water content in healthy cardiac tissues and lengthens T2 relaxation durations. Establishing the baseline normal cardiac T2 values particular to each scanner is crucial, much like T1 mapping. Myocardial imaging uses two main types of T2 mapping sequences: bright-blood T2-preparation pulse-based sequences and dark-blood turbo spin-echo (TSE) sequences **(Fig-4)**.

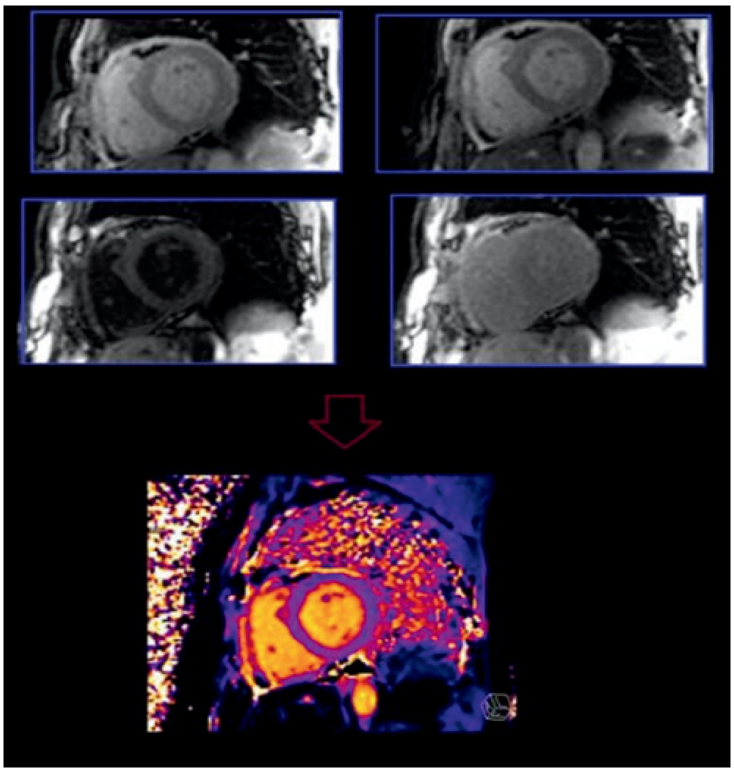


Figure 4 T2 Mapping in Short-Axis View

T2* Mapping

T2* mapping is a technique that makes use of a tissue's T2* time to detect and describe different pathological processes that occur within the heart. It is mainly used to identify cardiac iron overload, which can be present in diseases like sickle cell disease and hemochromatosis inherited from the mother. The Bright-Blood Gradient Echo technique and the Black-Blood Gradient Echo technique are two unique T2* mapping methods that are frequently employed (Fig-5).

Multiple gradient echo pictures are obtained at 1.5T using varying echo durations (TEs) ranging from 2 to 18 ms in the Bright-Blood Gradient Echo technique. On the other hand, the Black-Blood Gradient Echo scans use a similar method but suppress the blood pool by adding more double inversion pulses. With this method, homogenous cardiac pictures with outstanding contrast between the heart and surrounding tissue are produced.

According to the interpretation of the T2* values, mild to moderate iron loading is suggested by a range between 10 and 20 ms, whereas a T2* more than 20 ms shows the lack of cardiac iron overload. T2* levels below 10 signify a significant iron overload in the heart.

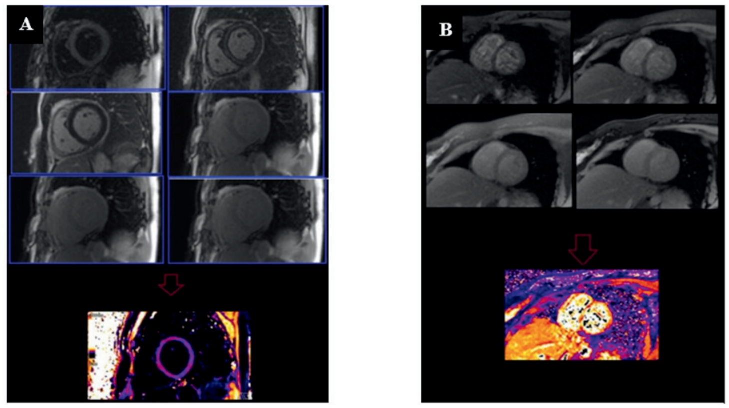


Fig-5 (A) T2* Black-Blood Mapping (B) T2* Bright Blood Mapping

Protocol Sequences

1. Localizer
2. T2 TRUE FISP Bright Blood Axial
3. 2-Chamber Localizer
4. Short-Axis Localizer
5. 4-Chamber CINE
6. Left 2-Chamber CINE

Conclusions

In summary, these parametric mapping techniques enhance our understanding of cardiac tissue properties and aid in diagnosing various myocardial conditions. Each of these mapping methods offers a non-invasive means of determining the composition of cardiac tissue and identifying certain pathological alterations:

T1 Mapping aids in extracellular volume measurement and fibrosis detection.

T2 mapping is useful for detecting inflammation and myocardial oedema.

T2 Mapping* is essential for identifying myocardial iron excess.

Combining these mapping methods facilitates the diagnosis and treatment of a range of cardiac disorders by offering a thorough evaluation of myocardial health.

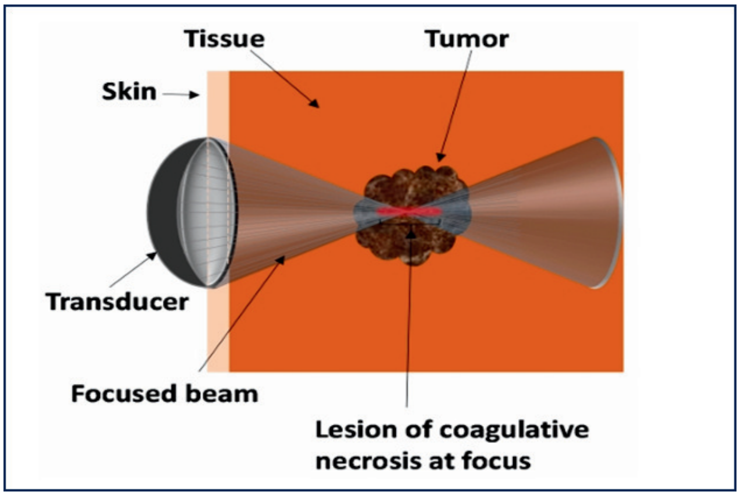
References

1. MRI cardiac T1 mapping. (2023, September 11). MRI master. https://mrimaster.com/t1-mapping-t2mapping-t2-star-mapping/
2. Myo Maps. (n.d.). Retrieved July 10, 2024, from https://www.siemens-healthineers.com/en-in/magnetic-resonance-imaging/options-and-upgrades/clinical-applications/myomaps

Exploring the Therapeutic Potential of High-Intensity Focused Ultrasound: Innovations in Tumor Ablation and Neurological Disorders

Somnath Teli, M.Sc. Research Fellow, NIMS University, Jaipur Rajasthan

Introduction : A wide range of energies, including radiofrequency currents, microwaves, lasers, thermal conductor sources, and ultrasound, have been employed in clinical practice for thermal ablation of tissues. Deeper tissue therapy, better focus on the target tissue due to its tiny wavelengths, and exact control over the location and shape of energy deposition are just a few of the significant advantages that ultrasound offers. One of the first clinical uses of ultrasound was to heat tissues. When it was discovered that the high-intensity ultrasonic waves used to locate submarines during World War II heated up and killed fish, it was first identified. Researchers attempted to direct ultrasonic waves onto bodily tissues as an alternative to ablative techniques as early as the 1940s. Continuous developments in imaging, physics, and engineering during the last 20 years have made it possible to precisely focus ultrasonography on deeper bodily targets. One of the more active research fields among non-ionizing ablation techniques, including lasers and microwaves, is high intensity focused ultrasound (HIFU) 2 of 21. Magnetic resonance devices like lasers and microwaves are typically used to direct, evaluate, and track HIFU treatment.



Magnetic resonance imaging (MRI) or ultrasound imaging are typically used to guide, evaluate, and track HIFU treatment. Magnetic resonance-guided focused ultrasound (MRgFUS) and high-intensity focused ultrasound (HIFU) have recently shown promise as non-invasive soft tissue ablation techniques. These techniques are now employed to, handle thousands of patients worldwide, with MRgFUS being suggested as a substitute for a variety of surgical techniques. In order to prevent the tissue vasculature from affecting the degree of cell death, the energy provided during HIFU treatment must be sufficient to rapidly raise the tissue temperature to a cytotoxic level. For cell response with prolonged inflammation and histological evidence of fat necrosis in the surrounding normal fatty tissue, heat coagulation by HIFU is preferred. Compared to tumour tissues, large blood arteries appear to be more susceptible to the blood flow's heat energy from the vessel wall causes the tumour to be safely abated. If any important blood vessels are harmed during ablation, deadly problems could possibly arise. This is crucial in cases where surgically excising a tumour is not advised and ultrasonography ablation poses a risk due to the tumours near proximity to critical blood arteries. In addition to giving a quick summary of the present state of research, this article attempts to introduce the physical principles of HIFU, including its heating and mechanical (cavitation) effects in the body. This article attempts to give a concise summary of the current clinical therapeutic elements of HIFU as well as an introduction to its physical principles, including its heating and mechanical (cavitation) effects in the body.

Technology and Principles: The HIFU beam can target a specific location with an upper size limit of roughly 3–4 cm for tumours and pass-through surrounding skin and tissues without causing damage. A HIFU transducer's concentrated beam on a tumour is seen schematically in Figure 1. HIFU generates a concentrated ultrasonic beam that can target a localised region with a maximum size limit of roughly 3–4 cm in diameter for tumours, while also safely passing through surrounding skin and tissues. diagram of an HIFU transducer that targets a tumour with a focussed beam. A concentrated ultrasonic beam created by HIFU penetrates the surrounding skin and tissues to necrotise a specific area (tumour), which could be located deep into the tissue. The tissues. Lesion coagulative necrosis results from the impacted area at the beam's focal point, which is seen in red in the picture. There is a very clear separation between living and dead cells when the tumour is destroyed. The distance separating completely damaged cells from healthy tissue is not more than 50 um.

The fundamental concepts behind HIFU-induced tissue damage are ultrasound-induced cavitation damage and tissue coagulative thermal necrosis caused by the absorption of ultrasound energy during tissue transmission (thermal e et cetera). The heat produced by HIFU can cause the exposed tissue's temperature to rise quickly to over 60 °C, which, when it lasts longer than one second, causes immediate and irreversible cell death in most tissues. The highly focused ultrasound beam produces extreme heat, it reduces the possibility of harming tissues outside the focused region. Thermal tissue damage brought on by exposure to high temperatures increases exponentially with temperature and approximately linearly with exposure duration. The mechanical effect is another mechanism that is engaged in HIFU ablation. Cavitation and other mechanical effects are only produced by intense sonic pulses. Cavitation can produce microstreaming jets of liquid, extremely high temperatures and pressures, and high shear stress, all of which can lead to cell wall pitting. If the medium is primarily liquid and has free motion, microscopic streaming may result from the movement of the liquid, which may trigger cell death. The nuclei of these apoptotic cells are self-destructed with destruction of deoxyribonucleic acid (DNA) by endonucleases.

Devices and Guidance: The two primary components of HIFU equipment are a piezoelectric ultrasound transducer, which is used to deliver the therapeutic ultrasound beam. The most common type of transducer is a concave focussing transducer, which has a fixed aperture and focal length. Other types of transducers include phased array transducers, which consist of multiple piston transducers arranged on the truncated surface of a spherical bowl or a flat transducer/fully populated phased array

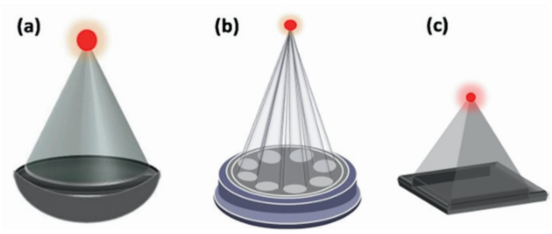


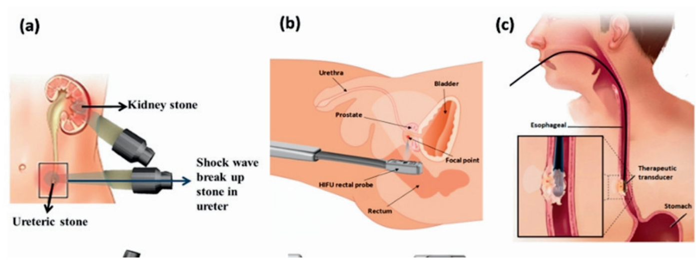
Figure 2. (**a**) Schematic of a concave focusing transducer and (**b**) an arranged multiple piston transducer or the atruncated surface of a spherical bowl (**c**) fully populated phased array.

Sonography and Magnetic Resonance Imaging (MRI) are the imaging modalities that have been used for treatment monitoring. The second major component of HIFU is the imaging modality used for guidance. Real-time imaging during therapeutic procedure is essential to ensure the safety and efficiency of the treatment. depict schematics of standard MRI-guided focused ultrasound (MRgFUS) and ultrasound-guided focused ultrasound (USgFUS) systems that are applied to the target through the skin for HIFU and extracorporeal shock wave therapy (ESWT), respectively.

With its great sensitivity and anatomical resolution for tumour detection, MRI provides precise planning for the targeted and treated tissue. Additionally, the thermal dosage can be calculated using MR thermometry, and an anatomical image of the region where the temperature approaches cytotoxic levels can be superimposed. With a temperature accuracy of 1 °C, spatial resolution of 1 mm, and temporal resolution of 1 s during HIFU treatment, it offers closed-loop control of energy deposition. MRI is better than sonography for obese patients because it is not constrained by fat tissue and can provide temperature data within seconds of HIFU exposure. However, MRI is costly, time-consuming, and can underestimate temperature due to its spatial and temporal effects, MRgFUS is good for monitoring the temperature that is temporally generated in the tissue, but not for assessing the tissue lethal thermal dose.

The advantage of ultrasound imaging over MRgFUS is that it is more convenient, mechanically compatible, and provides the same form of energy for image guidance as used for therapy. It also offers the benefit of real-time acoustic window verification with sonography, meaning that if the target region is not visualised by ultrasound imaging before and during HIFU therapy, it is unlikely that HIFU therapy will be effective in that particular region. The ablated target region is not visible on stand n instances of substantial prostate enlargement, the attainment of profound lesions is realized through either the creation of lesions across two distinct strata or by employing an extended focal length [9]. In the context of an interstitial transducer, rather than concentrating the probe, a planar transducer is typically utilized, wherein the coagulation of the targeted volume is accomplished through the rotational movement of the probe [15]. Once the probe is positioned, a full 360° rotation can be performed under the guidance of fluoroscopy or magnetic resonance imaging, after which the transducer can be relocated to facilitate the production of an additional contiguous ring of ablation. This apparatus is also applicable for the treatment of biliary and esophageal malignancies, as well as for conducting bloodless partial nephrectomies [9]. Interstitial devices may be derived from ultrasound technologies that are applicable through percutaneous, laparoscopic, or catheter-based methodologies. Ultrasound devices that are catheter-based may be inserted within

Evaluating Tissue Accessibility for Ultrasound Imaging: Depending on the targeted organ's ultrasonic accessibility, there are three ways to apply HIFU to the human body. External or extracorporeal transducers apply HIFU to the skin through an acoustic window when the organ is easily accessible, like the kidney. However, in some situations, such as prostate cancer, a transrectal transducer may need to be implanted into the body. In order to treat oesophageal and biliary ductal tumours, interstitial probes are being developed. These probes are put near the tumour and injected into the body through the mouth. Because the incident energy is dispersed over a vast area of skin using an extracorporeal device, the apparatus is equipped with an extensive aperture and an elongated focal length, which serve to mitigate the acoustic intensity at the entry point of the wavefront, thereby preventing dermal thermal injury. Furthermore, the apparatus necessitates the coupling of the acoustic energy to the epidermal surface through the application of a coupling medium, such as a gel or water-filled balloon, along with an appropriately designated entry point on the skin to ensure that the transmitted focused beam is not obstructed by any intervening gaseous material.



Transrectal and interstitial transducers typically function at elevated frequencies and diminished power levels, thereby enabling their application from reduced proximities to the target region. The apparatus engineered for transrectal application has integrated both therapeutic and imaging transducers within the transducer probe's head, featuring a fixed yet adjustable focal point that can be mechanically repositioned to facilitate the treatment of a larger volume of tissue (Figure b). Prostate ablation is accomplished by generating adjacent lesions in close proximity to one another, while the ultrasound power is modulated to regulate the length of the lesions Imagine using tiny ultrasound tools, like catheters, right next to or even inside the area we want to treat. This lets us heat and shrink large tumors or problem areas. We can also use them inside blood vessels or the heart. While these procedures, which take about 10-30 minutes, are a bit more involved than using ultrasound from outside the body, they're much better at focusing the energy exactly where it's needed. Researchers are working on using these catheter-based ultrasound devices to treat things like prostate cancer, uterine fibroids, liver tumors, and bone problems in the future The beam size of a -6 dB HIFU system at its focal region is normally 1-3 mm in width and roughly 10 mm in length, depending on the geometric size and acoustic properties of the transducers utilised in an HIFU system. However, HIFU can be used to diagnose and cure a 1 cm malignant tumour. The use of a phase correction procedure in the HIFU system, as is done with ultrasound imaging systems, addresses the issue of tissue inhomogeneity in the abdominal-pelvic region (such as in uterine fibroids and renal tumours) or transcranial usage, which may result in focal beam distortion or a decrease in focussing ability in deep-seated tissues

The transducers used in the HIFU system are moved physically or electronically in discrete steps and fired at each location until the outcome is a confluent zone of cell killing when a bigger volume needs to be targeted for ablation. In general, the application-specific treatment depth and the intended rate of heating needed for treatment determine the therapeutic ultrasound frequency. The penetration depths of lower frequencies are higher than those of higher frequencies. For deep treatments (like transcranial applications) or high absorption scenarios, frequencies as low as 0.5 MHz have been employed; for superficial treatments (like prostate applications), frequencies as high as 8 MHz have been employed. It has been discovered that the most effective frequencies for heat deposition are those near 1 MHz

Current Clinical Applications: HIFU is a non-invasive, extracorporeal, and non-ionizing cancer treatment method used for treating solid tumors, metastatic diseases, and non-tumorous conditions like prostate hypertrophy, making it the only non-invasive technique for primary solid tumors. The use of hepatocellular carcinoma (HCC) is rapidly growing, with studies using animals and human subjects published for treating various cancers. HIFU has been shown to be effective in treating benign and malignant solid tumors, as well as throm biolysis, arterial occlusion, haemostasis, and drug and gene delivery. Studies have also been conducted on hepatocellular carcinoma, renal cell carcinoma, pancreatic cancer, sarcomas, urinary bladder tumors, and prostate carcinoma. Non-invasive alternatives to surgery, such as radiofrequency ablation, ethanoic injection, and HIFU, have gained interest as alternatives or adjunct treatments to surgery. Animal models have been used to assess HIFU devices, and further studies have shown accurate placement of ablation sites.

Malignant Tumors: Successfully applied to cancers such as liver, breast, pancreas, and prostate cancer, providing non-invasive alternatives to surgery or chemotherapy.

Non-Malignant Applications: Includes treatment of uterine fibroids, prostate hypertrophy, Parkinson's Disease, and other conditions.

Future Potential:

Vessel Blockage by HIFU - Doctors are exploring a new way to use focused ultrasound, called HIFU, to block blood vessels. This could be really helpful in situations like stopping dangerous bleeding from tangled blood vessels (arteriovenous malformations) or even cutting off the blood supply to tumors to shrink them. Think of it like using sound waves to gently close off the pipes feeding a problem area. However, we still need to figure out the exact strength of the ultrasound and how it interacts with different sizes and speeds of blood flow to make sure it works reliably. We also need to keep a close eye on any potential long-term side effects to make sure it's safe for patients.

Blood-Brain Barrier Disruption - HIFU's cavitation-mediated mechanical disruption capability makes it a desirable method for locally opening the blood-brain barrier (BBB); Cavitation bubble-induced BBB disruption can be accomplished more effectively with HIFU+ injected microbubbles (ultrasonographic (US)contrast agent) or with very high HIFU exposure, which may result in blood vessel rupture or occlusion. With an HIFU power of less than 0.1% of the necessary thermal coagulation, the latter method can concentrate energy, mediate bioeffects, and open up the BBB in a matter of seconds. Preclinical research has demonstrated proof-of-concept outcomes that allow for the safe transport of massive, complex biologic substances into brain tissue while temporarily disrupting the blood-brain barrier. After treatment, the created opening usually heals in 6–24 hours.

Stroke and Thrombolysis - Currently, thrombolytics and surgery are used to treat intracerebral haemorrhage. In order to prevent craniotomy, HIFU provides the capacity to liquefy blood for easier aspiration, which can lessen clot burden and bulk impact. High-power HIFU's inertial cavitation effect can effectively lyse blood clots without the need to inject microbubbles, and it has recently been hypothesised that transcranial HIFU may be able to induce therapeutic cerebral vasodilation, which could eventually be used to treat patients with subarachnoid haemorrhage. This is because over 90% of intracerebral haemorrhage clots liquefy within seconds. Additionally, cerebral vasospasm, various cerebrovascular illnesses, and other cerebral ischaemic disorders may be clinically treated with HIFU.

Conclusions: In all therapeutic uses of ultrasound, both thermal and non-thermal (cavitation) effects are crucial. Although the side effects of these two methods of action may be advantageous in therapeutic applications, they are avoided in diagnostic ultrasonography uses due to the possibility of biological harm. Both the thermal and non-thermal effects of ultrasound are enhanced when the ultrasonic beam can be focused to a tiny area that is only a few millimetres in size. This causes cell necrosis and ablation at the applied focal point. Because of this, ultrasound is a great non-invasive therapeutic ablation method for deep-seated body targets. A less intrusive method of treating cancer, HIFU therapy reduces patient discomfort and hospital stay duration. According to preliminary research, HIFU has a strong potential for clinical acceptability and is generally safe and clinically successful. Before HIFU is used more widely, additional research is needed to determine its long-term medical benefits, technological issues, and therapy delivery. This is especially important in the fields of oncology and the brain. With better imaging in the future, the range of HIFU applications could grow. One of the best imaging guide techniques is MRgFUS. Further research with longer-term follow-up is necessary, though.

Advertising in Radiographers' Journal

Advertise your business or market your product on "Radiographers' Journal" - monthly ebulletin.

Radiographers' Journal is circulated electronically to thousands of Radiographers across the globe and posted on Social media platforms.

Mobile: +91 93220 35920
Email: shankar.bhagat@gmail.com
Website: www.radiographers.org

Monthly Tariff for Advertisement

- Full page - Rs. 3000/-
- Half page - Rs. 1500/-
- Quarter page. - Rs. 1000/-

For **yearly subscription of advertisement 50% discount in above charges**

To book your advertisement call on **+91 9322035920**