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PEDIATRIC RADIOGRAPHY: CHALLENGES AND REMEDY

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ABSTRACT

Pediatric imaging plays a critical role in modern healthcare by facilitating timely and accurate diagnoses in young patients. However, it presents distinct challenges that require specialized techniques to ensure both effective and safe diagnostic practices. This review explores the complexities of pediatric radiography, emphasizing the need for a child-friendly environment and effective communication strategies to foster trust and cooperation between healthcare providers, children, and their guardians. Key considerations include the heightened sensitivity of children to ionizing radiation, underscoring the importance of adhering to the ALARA (As Low As Reasonably Achievable) principle and prioritizing non-ionizing imaging modalities, such as ultrasound and MRI, when appropriate. The review also highlights essential practices, including the use of shielding, collimation, and Automatic Exposure Control (AEC) systems to minimize radiation exposure. Furthermore, the importance of skilled radiologic technologists and specialized training in pediatric imaging is discussed, along with the role of immobilization devices and sedation to ensure patient compliance when necessary. As pediatric radiology continues to evolve, integrating innovative strategies will be key to optimizing diagnostic outcomes while safeguarding the health and well-being of young patients.

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INTRODUCTION

Diagnosis and imaging are the most important part of healthcare system. The imaging modalities like X- ray, CT, MRI, USG, Fluoroscopy and many more are used in almost all healthcare system throughout the world. Among all, Radiological examination became most essential and crucial role in assessment, imaging and diagnosis of various pathologies and abnormalities . Despite of the use of radiation, Due to the rapid advances in technology both the number and variety of radiological applications are dramatically increasing.

The imaging modalities can be used in all age category patients including neonates to the old age. Pediatric radiography is a specialized branch of radiological investigation or imaging radiography which deals with the patients or population including newborns, young children, and teenagers from birth to the age of 14. The use of different imaging modalities is extremely helpful in pediatric care and helps in initiating appropriate and timely treatment.

However, despite the significant benefits of pediatric imaging, performing radiographic procedures on children presents unique challenges. Imaging pediatric patients is far more complex than it may appear in theory due to the physical, developmental, and psychological differences between children and adults. These challenges affect both radiologic technologists and radiologists,

requiring specialized skills, equipment, and techniques to achieve high-quality diagnostic images while minimizing risks, particularly radiation exposure.

Various efforts need to be made to provide effective and quality pediatric imaging services. Some general and unique problems are faced by different healthcare systems and persons in providing these services have been discussed subsequently.

METHODS

This article utilizes a comprehensive review of current literature and best practices in pediatric radiography to examine the challenges and strategies in providing effective imaging services for children. Key factors such as environmental challenges, radiation protection, and the use of immobilization devices are discussed. The review also highlights the importance of training healthcare workers in pediatric radiography, ensuring they have the necessary skills to manage the unique needs of children. Additionally, the article reviews various technologies and tools, such as automatic exposure control (AEC) systems, quality assurance (QA) protocols, and sedation methods used in pediatric imaging.

RESULTS AND DISCUSSION

Challenges In Pediatric Imaging

Environmental Challenges: The first step to obtaining a good quality images in children is to building their trust and cooperation, both prior to and during the investigation and examination.[2] The first challenge every healthcare unit faces while doing any pediatric imaging is the Environment. Children are too hard to handle and they are unable to co-operate during any kind of imaging or investigation especially when they are at a completely new surrounding and environment. Their age, lack of comprehension about the necessary actions, the intricacy of the process, discomfort, anxiety about the unfamiliar and the equipment, and the staff may be the reasons for this.

Creating a child-friendly environment is essential in pediatric radiography to help reduce anxiety and ensure a smoother imaging process. Children, especially young ones, require an atmosphere that is engaging and comforting, which can help distract them during procedures and make them feel more at ease. A well-designed space that captures a child's attention and promotes a sense of calm is key to improving their overall experience.

The physical environment should be inviting, with bright, cheerful colors on the walls to catch the child's attention and create a positive atmosphere. Decorative elements, such as colorful paintings, playful imagery, and characters from cartoons or toys, can significantly enhance the room's appeal. These elements not only make the space visually stimulating but also serve to distract children, reducing stress and helping them stay calm during imaging procedures. In addition to wall art, incorporating children's books, interactive toys, or even a small aquarium in the waiting area can further enhance the environment.[3]. These features provide additional distractions for children, especially while waiting for their appointment, keeping them entertained and relaxed. A soothing and pleasant environment not only alleviates the stress that can come with medical procedures but also contributes to better cooperation, ensuring more accurate and successful imaging outcomes. Every staff and workers present in that room have to be careful when using electrical equipment. We need to make sure they are put in a safe place and also we should avoid having wires from the devices spread across the room. [1]

In general the successful investigation and radiography mostly depend on two things

- The way of approaching of the technologist towards the children and the attitude of the technologist
- The technologist should have all knowledge about the imaging modality, the procedure and how to use different modalities

Technologists must be kind. Whenever pediatric patient and children comes to healthcare department they are always accompanied by their guardian especially with parents. So for better co-operation and the technologist should follows some protocols

1. Give a proper introduction as the technologist to the parents as well as the children
2. Proper instructions should be followed which was given by the pediatrician or physician.

3. Explain the proper procedure and what your needs will be during an examination.

The hospital and the imaging department is a complete new place for the children so it is normal that they might feel upset or scared. It's normal for them to cry, be afraid, or not want to cooperate. The technologist needs to be good at talking to both the child and the parent. He/ She should explain the whole procedure and things clearly using words that everyone understands. Before going to the procedure room where, the technologist should make the waiting area friendly and comfortable. They can talk to the parent or caregiver to help with this. Sometimes, if there is quite impossible to cooperate with the children, they might need to use immobilization devices to keep the child still during the whole procedure.

Radiation Protection Strategies

Despite of most effective and accurate diagnosis the harmful effect of ionizing radiation used in some imaging modalities can't be denied. Children are more sensitive to radiation because of increased mitotic activity and longer life expectancy and are more radiosensitive than a middle aged adult by a factor of up to 10. Also Children are two to three times more susceptible to radiation for the development of leukemia, and adults exposed to radiation during childhood have increased probability of developing breast or thyroid cancer. [6]

Protect the pediatric patient from harmful effect of the ionizing radiation is the most important task now a days. After reviewing the all literature included in the study we found some recommendation that should be follow by the operator and technologist.

- ALARA (As Low As Reasonably Achievable) principle should be followed in every single case of pediatrics. The dose should be optimized as much as possible to got an optimum image quality. Proper shielding should be done whenever necessary.
- Appropriate imaging modality should be used depending on the clinical indication (Should use non ionizing modalities like USG and MRI whenever necessary)
- CT scan should be avoid as much as possible if there is no such indication because CT has a great amount of radiation that can affect the child
- Except for trauma cases MRI should be used for imaging of the pediatrics instead of CT

General Consideration For Pediatic X Ray

There are some methods and general issues that should be implied during any kind of pediatric imaging

- AEC device should be used
- Additional filters should be applied
- Grid should be avoid because it increase the patient dose
- Proper collimation should be used
- Proper shielding should be given to patient
- Proper factors must be applied with proper positioning to avoid repeat radiographs

AEC

AEC Stands for automatic exposure control. AEC systems use detectors positioned in the X-ray beam path present behind the patient to monitor and calculate the amount of radiation transmitted through the body. In pediatric radiography, AEC systems help tailor the exposure to the child's specific size, age, and clinical requirements, reducing the risk of over- or under-exposure and enhancing patient safety.

Training Of Workers

In the field of paediatric radiology, the role of skilled radiologic technologists is paramount to ensuring accurate diagnostic outcomes while minimizing risk to young patients. Paediatric imaging presents unique challenges due to the physical and emotional differences between children and adults. Radiologic technologists must not only possess a strong understanding of imaging techniques but also demonstrate exceptional communication skills to help children feel comfortable and safe during the

procedure. It is important to assign only experienced and proper trained staff to get a good quality image. The technologist should have proper knowledge about the machine and procedure. Also the reporting radiologist must be an expert in interpret the pediatrics image to give a good report by looking the image. [1]

Quality Assurance

QA (Quality Assurance) plays a key role in pediatric imaging. To get a high quality radiograph or image it is important that the operated machine is giving its optimum performance. Regular quality check and quality assurance are important to maintain high performance. [1]

Patient Positioning

The most common reason for bad radiograph in case of pediatric patient is improper and wrong positioning. Positioning paediatric patients accurately in radiology involves using positioning aids that are suitable for their age, applying immobilization techniques when needed, enlisting child life specialists to help reduce anxiety and promote cooperation, utilizing clear and concise communication with both the child and caregiver, and providing specialized training for technologists who work with paediatric cases.

Uses Of Different Immobilization Device

Immobilization device is a type of device that is used in different diagnostic imaging department to ensure that the patient should remain still during the whole diagnostic procedure without any kind of movement that can cause any kind of blurring in radiograph. In general there is two types of patient motion that are Voluntary and Involuntary motion the immobilization device cant reduce involuntary motion but it can reduce the voluntary motion of the patient. The different type of immobilization devices that are used in case of pediatric patient are:

1. Pigg-O-stat
2. Tam-em Board
3. Sandbags
4. Valcro strips
5. Tapes
6. Towels

Figure 1. Pigg-o-stat (A), Tam-em-Board (B), Sandbags (C)

The proper use and implantation of immobilizing procedure helps to increase the image quality and reduce any kind of blurring in the radiograph. It also reduce the time also the follow up procedures.

Sedation And Anaesthesia

In most critical cases when the patient is not cooperate at all sedation or anaesthesia medication are given to patient. In long procedure such as MRI where remain still for a half an hour or more is quietly hard for any pediatric child so in those cases sedation are given in the presence of a experienced anaesthetic technologist. In some cases if there is severe trauma in any body region in those cases also sedation were applies to comfort the patient

CONCLUSION

In conclusion, pediatric imaging poses particular difficulties that call for specialized methods to guarantee efficient and secure diagnostic processes. Developing a child-friendly atmosphere and using effective communication techniques are important steps in creating a supportive environment that will win the trust and cooperation of young patients. A crucial part of this process is played by radiologic technologists, who must possess the necessary knowledge, patience, and skill in both technical and interpersonal interactions with children and their guardians. Given the heightened sensitivity of children to ionizing radiation, radiation protection is a fundamental concern in pediatric imaging. Adhering to the ALARA (As Low As Reasonably Achievable) principle is essential in minimizing radiation exposure while ensuring diagnostic accuracy. When feasible, non-ionizing imaging modalities, such as ultrasound and MRI, should be prioritized to further reduce risk. In addition to these measures, the use of appropriate radiation protection techniques such as shielding, collimation, and Automatic Exposure Control (AEC) devices plays a crucial role in safeguarding young patients from unnecessary radiation.

As pediatric radiology continues to evolve, the integration of innovative technologies and strategies will be critical in improving diagnostic outcomes. Ensuring the holistic well-being of pediatric patients involves not only optimizing imaging techniques but also creating a supportive, child-friendly environment, fostering effective communication, and minimizing stress during procedures. Ultimately, the continued advancement of pediatric radiology will depend on a balanced approach that prioritizes both medical efficacy and patient safety, while striving to protect the long-term health of young patients.

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