

REVIEW ARTICLE

CHALLENGES FACED BY A RADIOGRAPHER DURING PEDIATRIC IMAGING

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Abstract- In pediatrics, radiographic imaging is a very important diagnostic technique, for evaluating different abnormalities, but it comes with several challenges. Pediatric radiography is a valuable tool because, to obtain images, specialized imaging exposure methods are necessary for different organs. The proper knowledge and high expertise are needed to evaluate the properly detailed radiographs, and most significantly, it needs particular attention for radiation protection while using ionizing radiation. Pediatric radiography is challenging and needs special training for technologists to understand the psychology of the child, technologists should gain the trust and cooperation of the child duration the entire examination, It starts with the initial encounter between the patient and the technician, which lasts forever and creates the foundation of a fruitful connection. Images acquired during pediatric radiography must have good contrast, and resolution with no-repeat examinations to prevent the harmful effects of radiation. The radiation principle should be followed i.e., Justification, Optimization, and Dose Limits while using ionizing radiation in the medical field.

Index Terms- Pediatric imaging; radiation protection; immobilization devices, technical parameters

I. INTRODUCTION

A specialization of radiology called pediatric radiography deals with the imaging of health and medical treatment for newborns, young children, and

teenagers from birth to the age of 14. (fourteen). For the assessment and identification of various problems, radiographic examinations are becoming a crucial component of the healthcare system. This involves using a range of imaging techniques, including X-rays, CT scans, magnetic resonance imaging, and ultrasonography, albeit some of these techniques may expose patients to ionizing radiation that is hazardous to their health. The usage of imaging modality has rapidly increased due to the development of new technologies and the quick advancements in imaging technology.^{1,2}

Pediatric Imaging and Challenges

Good Environment

The crucial stage in pediatric radiography is to acquire good quality images and gain the trust and cooperation of the child. The Children require a good stimulating atmosphere that easily catches their attention. The environment and atmosphere should be friendly and free from noise and patients feel tranquil. For illustration, the walls of the room should be bright colored, the walls should be designed with paintings and images, and the toys, play characters, and cartoons should be placed in the room.³

Many experts advise using suitable diversionary strategies to lessen the child's worry and anxiety. In the x-ray room, projectors can be utilized as a distraction tactic. Any electrical equipment that is being used needs to be handled with care, and it should be made sure that the electrical lines are not

trailing across the room and that the equipment is placed in a secure location.

The important part is to gain the trust of a child, which begins at the first meeting with the child or patient; makes a bond of a successful relationship, and increases the success rate of examination.

Not all technologists enjoy working in such conditions where patients are not cooperative, movement is one of the biggest problems. The technologist must be conscientious and dedicated individuals who enjoy working with pediatric patients and have sufficient patience.

Technologists must be kind and sympathetic and understand the intellectual and emotional maturity of both normal and retarded children of various ages. Only then can they function such that when they have completed the examination, the child is happy and the parents are pleased.

Successful radiographic studies are dependent on two things

- The attitude and approach of radio technologists to a child.
- The radiographer must have good knowledge of radiologic equipment and its use.

While coming for an examination most children are accompanied by parents. It is important to follow the protocol:

- Proper introduction of yourself as the technologist.
- Proper instructions should be followed given by the pediatrician or physician.
- Explain the proper procedure and what your needs will be during an examination.

The behavior of children in the new environment is not joyful, the patient is unfamiliar with the environment and it is normal that the child starts crying, fear, and may show resistance. The radiology technologist must-have skills to communicate to the parent or caretaker of the child to normalize the environment, the technologist should communicate

and convey a clear message in a language that they can comprehend, and precisely what he or she intends to perform in the examination. Radiology technologists must make or try to build a friendly atmosphere of trust in the waiting room before entering the radiographic examination room. This is achievable while talking with the parent or caregiver and, if the child's participation cannot be obtained, with the use of immobilization devices as the last option. The parent is present in the room as an observer, providing encouragement and solace just by being there. The parent participates by helping to immobilize the child.

The patient feels comforted by the parent or caregiver's presence in the examination room. The parent participates by helping to immobilize the child.

Specialized Equipment

Pediatric-specific tools and infrastructure must have a few unique features. Teenagers who are the size of adults may occasionally require different or different equipment. The tools are simple to use and handle, making it possible to quickly gather diagnostic data (images). When required, image viewing and workflow stations provide quick image transmission to the Picture archiving and communication system (PACS), facilitating radiologists' audits and reporting.

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Not all technicians take pleasure in working with children; many grow agitated by the young children's lack of participation and the length of the pediatric examination.

Quality assurance

Quality assurance plays an important factor in the case of pediatric radiography. Acquisition of optimum quality images is important during radiography which requires the high expertise or skills of technologists and the function of imaging equipment to its maximal capacity. Many juvenile illnesses can be diagnosed with a skillful display of tissue features (anatomical detail) and subtle alterations. The best performance is ensured by regular quality assurance programs and examinations, which frequently call for ongoing calibration of this equipment. ³Protocols must be

double-checked to make sure no diagnosis is overlooked.

Radiation protection

The optimization of protection in pediatric patients during examination requires the use of specific protocols tailored to the patient's age, size, weight, and region of interest being examined.

To ensure that excess ionizing radiation exposure is reduced, clinical departments might take several steps., even in the absence of national dose reference values for pediatric exams. The IR(ME) regulations place a strong emphasis on the need for "justification and optimization", the technique of radiation protection must include radiographic exposures as a critical step. They also underline that no examination should be conducted if it does not directly affect patient care. Unfortunately, doctors who are not conversant with contemporary imaging procedures continue to seek unneeded exams, and questions have been raised regarding the degree of radiological technique training now provided in undergraduate medical programs¹³.

If the patient is exposed to ionizing radiation during diagnostic radiography, radiation protection must be maintained at a level of the lowest tolerable risk. We must minimize hazards to patients and employees by upholding the radiation protection principle, which calls for justification, optimization, and reduction of radiation exposures.⁴

Box-1: Definition

Justification	No practice involving exposure to radiation until there are more benefits than risks involved with the examination
Optimization	As Low As Reasonably Achievable (ALARA), states that whenever it is possible use low exposure settings (kVp, mAs) to minimize the radiation dose and risks associated with it.
Dose Limitation	The amount of ionizing radiation exposure should not go over the point at which the danger from radiation is

regarded as intolerable. National Radiation Protection Board (1994), ¹⁴ modified.
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Patient positioning

Inadequate or bad radiographic picture quality is most frequently caused by inaccurate and improper placement during pediatric tests, although this should not be used as a justification for poor image quality.¹⁵ A lesser degree of picture quality could, under certain conditions, be acceptable for some clinical purposes. The clinical question being addressed determines whether a picture is acceptable for use as a diagnosis. However, unless it has been purposefully created and is linked to a lower radiation dosage for the patient, worse image quality cannot be justified.

Protective shielding

For all types of pediatric scans, it is important to use proper shielding. Lead rubber shields can be used to protect organs of body in immediate proximity. According to experimental data, using 0.25 mm lead rubber equivalent at the field edge can reduce the gonadal dosage by up to 40% when employing exposures between 60 and 80 kV.

Immobilization device

An immobilization device is a device that is used to ensure that the patient should remain still during the examination, without any movement that can cause blur to the image. Patient motion is of two types voluntary and involuntary. Immobilization techniques are used to minimize voluntary motion, while intrinsic motions are best controlled by extremely short exposures. The shaping of this device must be able to maintain the patient's position. Immobilization devices include:

- ❖ Tam-em board
- ❖ Pigg-O-Stat
- ❖ Sandbags
- ❖ Velcro strips
- ❖ Tapes

❖ Towels

Immobilization procedures used correctly enhance picture quality, shorten test times, and reduce the need for follow-up exams.

Proper immobilization may require the use of adhesive tape, foam rubber blocks, wedges, sheets towels, diapers, stretch gauze bandages, orthopedic stockinette, and wood blocks.

Compression bands and head clamps

Bands used for compression or retention are effective immobilization aids. However, when combined with sandbags, compression bands are more efficient and simpler to employ with babies and young children. An immobilization board is the best device suited for use on the horizontal radiographic table. When upright or erect radiography is necessary, the Pigg-o-Stat device should be used.

Technical Specifics

Policy guidelines have previously been established regarding acceptable quality diagnostic radiographs in pediatric imaging, to ensure the production of an adequate and uniformly acceptable image, that provides an accurate interpretation of the images, and that complies with the radiation protection principle using a reasonably low radiation dose (ALARA) per radiograph. Your aim can be attained by heeding the general rules and recommendations that follow:^{10,11}

- The use of modern digital imaging is recommended so that exposure factors can be optimized and repeats are avoided
- High-contrast films may provide images with a high level of resolution.
- Use of proper exposure parameters with automatic exposure controller
- Use of correct positioning, centering, collimation, and immobilization methods
- There should be proper departmental protocol regarding imaging of pediatric patients, only necessary and important radiographic examinations should be performed and routine radiography should be avoided, whenever possible, minimal projections with minimum

exposure settings must be used to visualize the area of interest.

X-ray exposure parameters

If there is a choice in focal point size, it should be made based on the focal point's ability to give the ideal exposure time and radiographic voltage selection at a certain focus-to-film distance (FFD). The smaller focal spot is not necessarily the best option.

Voltage

Pediatric exams are still done using low kV techniques despite the use of high kV techniques being advised. Short exposure periods can be employed with high voltages, but the extremely brief exposure times required for pediatric radiography exams can only be done with the use of a high-frequency (or 12-pulse) generator. When using older equipment, the installation of additional filtering may enable the use of high kV procedures with longer exposure durations.

Tube filtration

Most x-ray tubes are equipped with a 2.5 mm aluminum equivalent filter at the very least. Filtration reduces patient dose and enhances beam quality by absorbing low-energy photons coming from the anode. Even while high kV techniques are frequently preferred, not all generators can handle the brief exposure durations required. When the range of feasible mA values is confined and the minimum exposure time is 0.01 seconds or longer, it may be necessary to improve filtering to choose a suitable higher kV without significantly increasing film blackening. The minimal additional filtration recommended for pediatric tests is 1 mm of aluminum and 0.1 mm of copper, although this depends on the filtration already built into the tube and should be chosen locally. Instead of needing to place filtration within the x-ray tube permanently, the facility made it possible to add filtration to the tube as needed.

Anti-scatter grids

Most experts agree that anti-scatter grids are not essential when radiography examinations of newborns and young children are being conducted. Anti-scatter

grids are used during pediatric exams, which increases the radiation dosage for the kid. Therefore, if diagnostic radiographs of acceptable quality can be produced without them, their continued use should be questioned. The ability to swiftly remove and insert grids should be included in fluoroscopic equipment, and the need of using a grid while examining young infants should once more be called into question¹⁶.

Conventional radiography systems

Although the transition to the digital age is happening swiftly, many radiographic workplaces still use film/screen imaging systems, therefore it's crucial to think about their worth as a way to lower patient dosage. Low patient doses from high-speed systems, along with shorter exposure durations, reduce movement unsharpness.¹⁷

Computed radiography systems

A broad variety of exposure values may be employed with digital photography technology without considerably altering the apparent image quality. To guarantee a minimal patient dosage, the right exposure criteria must be defined and followed. To ensure that the noise in the picture is just low enough for the image quality to be diagnostically acceptable, the exposure setting (kV/mAs) combination should be enough.

Automatic brightness control

If unnecessary grids are not removed, or if the radiologist or radiographer improperly uses or applies their equipment skills, fluoroscopy can result in excessive patient doses. Turning off the automatic brightness control will stop the scanner from attempting to pierce the contrast, which is an easy way to reduce patient dosage when imaging a vast region containing a contrast agent. The patient can prevent receiving excessive dosages by taking this easy action.

European Guidelines on Quality Criteria for Diagnostic Radiographic Images in Pediatrics

According to these recommendations, whether a patient cooperates or not, patient posture must be correct and done properly before radiation treatment. The recommendations support the use of immobilization tools on newborns, young children,

and toddlers. These tools must be used correctly, ensuring that the patient doesn't move throughout the examination, remains still and that the right projection is made.⁵

Holding children still – A five-point model⁶

Even though it is well recognized that all healthcare workers who interact with children need to be educated and trained in kid immobility and distraction, there aren't many studies that show various ways of holding and soothing children. To do this, Stephens et al.⁸ created a five-point model of child comfort and immobilization for nursing operations that may be customized to satisfy the requirements of other health professions.

- Explain the process to the youngster and their guardian and get them ready for it.
- Invite the guardian to attend.
- Use a particular room for uncomfortable operations.
- Place the youngster in a cozy position.
- Retain a serene and upbeat atmosphere

Prepare child and guardian

Most children consider going to a medical exam in a hospital setting to be a significant event, Therefore, radiologists should approach the kid in a serious but pleasant manner while keeping in mind that their role is to give comfort, create confidence, and present essential information rather than make the youngster happy. Both the kid and the guardian must understand why the radiographic examination is required, how it will be carried out, and what is there before the operation starts. Because children frequently regress to an earlier developmental stage in stressful circumstances, it can be challenging for radio technologists with little experience working with children to explain things at a level that is acceptable for the kid. Therefore, it is not suitable to use chronological age alone as a reference to the degree of explanation; instead, it is necessary to evaluate the child's apparent developmental age. If maximum cooperation is to be attained and the usage of physical constraints is to be avoided, it is imperative to take the

time to thoroughly explain the technique. The explanation should, if at all possible, be presented in a neutral environment, like the waiting room, and it should be written in a way that both adults and children, including those as young as 12 months old, can understand it. This is because the age at which cognition begins is uncertain. An effective explanation, however time-consuming, will result in a more efficient examination since improved kid and guardian collaboration will reduce the time spent doing the examination and, if the explanation can be carried out outside of the imaging room, will reduce patient wait times. a method for an effective explanation.

Invite guardian to be present

A children's health is impacted by a variety of cultural, social, and environmental elements in addition to their physical and mental health. Patients in the past, even children, were regarded as clinical cases rather than as unique people, and their medical conditions received practically all of the attention. Children are now addressed not only as individuals but also as members of their families, communities, and cultures, changing the focus of health treatment. This change did not occur overnight; rather, it took place as a result of several family-centered care initiatives that included guardians and family in the care of hospitalized children and assisted the family in maintaining normal functioning.⁷ The kid feels more secure in the testing room when a parent or caregiver is around.⁹ Additionally, caregivers may comfortably reassure the kid and regularly use the appropriate diversionary strategies out of instinct, which can improve the child's compliance, reduce the need for restraints, and lower the child's dread and anxiety.

II. CONCLUSION

The article concludes that there is a need for proper education and training of technologists in pediatric radiography to avoid and overcome the challenges. The technologist should have a positive attitude and good communication skills

Positioning Child/toddler/infant in a comfortable manner

Radiographers should be more innovative in imaging tactics when evaluating youngsters and work with what is offered rather than 'forcing' the kid to assume a position frequently utilized in the imaging of adults. Children as young as 7 or 8 years old will decide to sit across a guardian's lap or near a guardian during an imaging exam to feel more at ease in their company. Even older children and adults request "cuddles" and comfort during imaging procedures.

Tools for Distraction

The use of play and distraction strategies in healthcare is becoming more and more common, and play specialists are experts in these fields. Play specialists often work in children's wards and outpatient clinics rather than imaging departments, where they are less common. A should be called to provide advice on the requirements of kids in radiology departments. However, most play experts would welcome the chance to talk with other health care professionals on kid-friendly settings and distraction strategies.

Reporting suspected child abuse

The majority of institutions and hospitals have a formal process in place for reporting suspected child abuse or non-accidental trauma (NAT); in the past, this was referred to as battered child syndrome (BCS). In most cases, the radiographer's job is to describe the facts as they are observed or suspected, not to judge whether or not child abuse has happened. According to departmental practice, the technician should consult the appointed higher authority or another supervisor if non-accidental trauma (NAT) is thought to have occurred.¹²

besides clinical skills to increase the chance of a successful examination. Periodic training and workshops are also important to update technologists with the latest trends in pediatrics radiography. The overall factors that affect the examination are poor clinical knowledge, bad attitude, impatience, poor knowledge of immobilization devices, and uncooperative

patient or attendant (Caretaker) besides that there are also some other factors like room design, lighting, distraction tools that can affect the overall quality of the examination.

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