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SOURCES OF ERROR IN EMERGENCY ULTRASONOGRAPHY

Running head: ULTRASONOGRAPHY

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Abstract:

Medication errors are the most common errors in healthcare systems across the world wherein administration errors, dispensing errors, and prescribing errors. Among these, the patients are mostly affected by diagnosing errors, which are mostly identified in radiology. According to the Institute of Medicine, an error is defined as the failure of any planned action for completing as intended initially, or utilizing any wrong plan for achieving an aim. The identified errors in medical imaging have been observed as early as 1959 wherein the surprising degrees of errors 50 years ago have since remained unchanged and persistent. Currently, ultrasonography has become a significant diagnostic tool for an enhanced number as well as a range of clinical conditions where the detection of abdominal masses or evaluation of traumatic abdominal conditions has become commonplace (Pinto et al. 2016). Emergency ultrasonography has unfortunately become quite susceptible to errors where misinterpretation of sonographic images is considered a severe risk in clinical diagnosis.

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INTRODUCTION:

Medication errors are the most common errors in healthcare systems across the world wherein administration errors, dispensing errors, and prescribing errors. Among these, the patients are mostly affected by diagnosing errors, which are mostly identified in radiology. According to the Institute of Medicine, an error is defined as the failure of any planned action for completing as intended initially, or utilizing any wrong plan for achieving an aim. The identified errors in medical imaging have been observed as early as 1959 wherein the surprising degrees of errors 50 years ago have since remained unchanged and persistent. Currently, ultrasonography has become a significant diagnostic tool for an enhanced number as well as a range of clinical conditions where the detection of abdominal masses or evaluation of traumatic abdominal conditions has become commonplace (Pinto et al. 2016). Emergency ultrasonography has unfortunately become quite susceptible to errors where misinterpretation of sonographic images is considered a severe risk in clinical diagnosis. The errors in emergency ultrasound have been currently representing an increasing issue in recent years owing to numerous unique features which are related to both the inherent characteristics associated with the discipline and the latest developments. Thus, this paper will focus on the sources of such errors in emergency ultrasound imaging.

DISCUSSION:

Recent researchers have focused on identifying the various sources of such errors in emergency radiography, especially ultrasonography. Multifactorial causes have been identified to date which include lack of communication with the mostly uncooperative patients, lack of attention to the clinical examination and history, lack of knowledge regarding technical equipment, lack of proper knowledge about the various possibilities regarding differential diagnosis, failure of suggesting further ultrasound examinations, overestimating personal skills, utilizing inappropriate probes and failing to suggest other imaging techniques such as MRI or CT (Rebours et al., 2022).

The technical errors in ultrasonography as a source of error in ultrasonography include the impact of incorrect choices regarding the transducer, amount of sonographic gel, and setting of the technical equipment. The correct functioning of the ultrasound transducer is key to reliable diagnosis through ultrasonography, especially in emergency ultrasonography. In this aspect, another evidential source of misinterpretation of image artifacts is frequently encountered in clinical ultrasonography, which might arise due to physical limitations of the modality or improper scanning techniques (Pinto et al. 2016). Technical limitations as a source of error in such processes also extend to the technical skill of the operator to correctly conduct the ultrasonography based on their training, expertise, and operator skill. Despite current ultrasonography being adept at identifying and producing images that permit the diagnosis of anomalies, diagnoses as critical as this can only be conducted if the operator is skilled enough (Di Serafino et al. 2022). Thus, operator skills paired with technological advancements are necessary for the identification of the sources of error within emergency ultrasound.

The specific errors in the ultrasonography of emergency rooms present scenarios with maximum errors and severe consequences. The major reason for such diagnostic errors through emergency ultrasonography is that physicians or diagnosticians are often required to make quick diagnoses and decisions with minimum information about the patient. In most cases they are under the influence of certain substances, alcohol, or uncooperative due to unconsciousness, hence presenting an environment with significant risk. The frequency of these missed diagnoses is mostly dependent on the frequency of the errors which were assessed based on the registries of trauma incidents and reports, missed or delayed diagnoses are mostly reported hence (de Casasola et al. 2022). These however might lead to higher rates of morbidity and mortality owing to a missed diagnosis. Most of these diagnostic errors are retrospective of delayed diagnoses or missed diagnoses (Sabour 2020).

Errors or mistakes during ultrasonography in the emergency departments have been categorized into three groups technical errors, patient influences, and environmental factors. The environmental factors which mostly affect and classify as the source of error include a large number of investigations of various appropriateness, and overcrowding in the emergency rooms, which affect the diagnosis and management of all the factors which contribute to the high-risk setting (Pinto et al. 2013). The patients who are admitted to the emergency room are mostly required to be prepared for the unanticipated examinations which include bladder distention, fasting status, etc. The patients mostly are unwilling to cooperate, and experience discomfort, pain, or uneasiness from the pressure of the probe (Di Serafino et al., 2022). The

misinterpretation of the obtained images is thus identified in most of these cases wherein the diagnostic imaging modalities are subject to risks of misdiagnosis.

The technical skills of the operator which are related to the training, skills, and experience, include the utilization of the diagnostic capability of the department and possessing the knowledge to identify what is amiss (de Serafino et al. 2022). The competence in interpreting the images and findings based on their physiology knowledge and pathological changes of the examined tissues or organs is also identified as a major source of influence in the errors within such departments. The number of operators and devices devoted to radiology departments across healthcare organizations determines the influence such systems and operations have on emergency ultrasound diagnoses and reports (Dhamankar et al. 2020). Owing to the widespread diffusion of the ultrasonography methodology, it is often mistakenly believed to be a fairly simple procedure to be performed. The errors which occur from the technical operators are mostly due to interpretational doubts, which in turn influence the need for further diagnostic imaging procedures, consequently causing medico-legal disputes, diagnostic delays, and healthcare costs. The errors related to the identified issues are also related to the inadequate knowledge of sonographers which is an effect of inadequate training or insufficient skill development. The errors of implementation also occur during the application of any such knowledge which hence needs to be addressed effectively for proper diagnostic performance and making the concrete diagnosis of illnesses (Oglat et al. 2020).

Among the various sources of errors that are mostly identified in emergency ultrasounds, errors of interpretation are the most common. The errors of interpretation are subject to the chest artifacts with little or no clinical contexts, ultrasonography setting errors, bad artifacts, and anatomy or anatomical variants (di Serafino et al. 2022).

Image artifacts which are generally found with the ultrasonography technique can be confusing to those who are in the process of interpreting and diagnosing the patient's condition. Improper scanning techniques often lead to image artifacts, contributing to errors in the interpretation of the obtained or developed images. These are mostly witnessed due to the physical limitations of the various modes, which include mirror imaging effects, speed displacement effects, side lobe artifacts, image adaptation artifacts, anisotropy, and reverberation and refraction artifacts (Mayo et al. 2022). The side lobe artifacts, for instance, are caused by the powerful reflecting surface which is settled out of the primary ultrasound beam-generated echoes. In the gallbladder or bladder ultrasonography is observed at the bottom of the ladder, in the presented pseudo-mud property, which might be corrected through proper setting of the US image, usage of multiple scans, and focusing (Pinto et al. 2016).

In specific instances where errors in interpretation occur, such as chest ultrasonography, the patient-related artifacts are mostly affected by the image interpretations. The implemented ultrasonography techniques which are focused on chest ultrasonography are utilized for the identification of various chest conditions (Newitt 2020). The patient-related artifacts for instance subcutaneous emphysema, pathologies that decrease or increase the air content of sub-pleural space, in conditions such as atelectasis or emphysema, and existing fibrotic interstitial lung disease, are usually identified as confounding factors for the interpretation of lung conditions through ultrasonography (Pinto et al. 2016). These misinterpretations are mostly affected in the acute settings of emergency departments and are mostly influenced by the age of patients. There exist certain intrinsic limits to the lung ultrasonography techniques and these techniques are also dependent upon the B-line or A-lines, which are always to be considered while recognizing them and should be contextualized to the clinical data which are to be presented for the dichotomous interpretation (Bialek and Jakubowski 2017).

The next category of errors that mostly arise in the context of ultrasonography is setting errors. To prevent any errors from occurring, a thorough understanding of the underlying mechanics and functionality of the ultrasonography equipment is necessary. It is recommended that the highest possible image quality is necessary to be identified in any ultrasonography diagnostic procedure, and hence a checklist procedure is to be configured for the correct system settings to be presented along with the proper Doppler parameters, which must be critical for interpreting the clinical ultrasonography findings (Kim et al. 2021).

The anatomical variants and anatomical structures which might yield certain cases of difficult-to-interpret pictures are also sources of error in emergency ultrasonography techniques. Among these the most insidious, especially in emergencies are the pseudo collections of the peritoneal, pleural, pericardial, and retroperitoneal fluids (Rachuri et al. 2017). These abnormalities or anatomical variants are related to the

pseudo-pneumothorax related to the abolished lung sliding owing to the patient's apnoea or lung pulse, which are especially difficult to diagnose in emergencies (Koster and van der Horst 2017). These are also accompanied by the hypertrophy diaphragmatic pillar, Rouleau phenomena, and bladder pseudo-masses, which are highly conditioned, random, and generic. The emergency conditions which are present in clinical contexts are mostly accompanied by the traumatic injuries or accidents that patients undergo, which influence the interpretational doubts or the over-diagnosis with the added necessity of the added diagnostic confirmations (Rebours et al. 2022). These not only add to the added costly and complex examinations but also increase the waiting time for both medico-legal disputes and final diagnosis. The specific instances of such anatomical variants being misinterpreted include splenic hematoma which is misidentified on the CT scan as a gastric fundus distended by fluids. Other instances include the crescent-shaped hypoechoic area which is often misinterpreted as a hematoma between the surface of the spleen and the left hemidiaphragm. This anatomical variant usually appears to be a hypertrophy of the left hepatic lobe with specific splenic kissing (Sabour 2020). The longitudinal ultrasonography of a patient’s inguinal canal for instance, when compared with the color doppler scan revealed differences in interpretation with the former interpretation coming to be inguinal canal blockage and the second appearing as right epididymitis with funiculitis.

Another category of error in emergency ultrasonography is the error of underestimation, which depends on the various aspects of excessive diagnostic confidence generated by the superficiality or lack of experience, lack of correctness in clinical approach, and lack of experience. The inconclusive or inadequate reports in ultrasonography and poor image quality might often relate to certain errors of underestimation. This hence demonstrates the importance of documenting in certain details, the various ultrasound findings which provide for safeguarding the archives in case of potential medico-legal disputes (Azizi et al. 2020). Detailed and accurate reports are essential in emphasizing the various important descriptions of the pathological changes which are detected and should be presented in easy-to-understand as well as timely answers concerning the relevant clinical question (de Casasola et al. 2020).

The obstetric measurements in the ultrasonography of gynecology measurements and obstetrics are mostly subjected to errors of interpretation and misdiagnosis. The performance of obstetric ultrasonography presents serious medico-legal risks, which overlooks the detectable fetal abnormality resulting in the large indemnification of the medical malpractice (Jachetti et al. 2021). The pregnancy ultrasound examinations often include a proper structural survey in avoiding missing fetal anomalies, wherein the sonographic examination is considered suboptimal and might require repetition, whereas the second sonographic examination is mostly repeated in its entirety. General radiologists often miss the subtle fetal abnormalities and often claim malpractice immunity for the reason that they are not sonographic specialists. The fetal anomalies and significant abnormalities if unsure and difficult to be identified by radiologists or sonographers, hence should contact physicians or consult experienced healthcare providers in such cases (Altug et al. 2022).

The new cutting-edge medical and technological advances are essential in the development of various medical improvements. Artificial intelligence has recently been emerging as a new subset of computer science that is involved in the human process of adapting, learning, and also solving complex problems (Chambers et al. 2017). The various branches of artificial intelligence in medical imaging are usually inclusive of deep learning and machine learning methods. These usually consist of algorithms that can make predictions or decision tasks without any prior explicit programmed regulations. The deep learning method is a subgroup of the machine learning technique which is framed as artificial neural networks comprising multi-layered networks which extract features automatically, without performing any high levels tasks or prior labels (Jachetti et al. 2021). The machine learning aspect includes the algorithms which utilize the iterative statistical learning techniques which train the data to progressively improve their model performance with time and thus enable the recognition of patterns in larger databases and classifying instances. These artificial intelligence models can be implemented and developed within the ultrasound sector for better empowerment (Milkau et al. 2018). The empowerment would be mostly in the fields of clinical and radiological workflow, reducing ultrasound errors, which are mostly derived through various image variation factors including scanner, operator and patient-dependent factors. The development of such artificial intelligence ultrasonography should be assisting the lesser experienced users with the performance of correct examinations, hence improving ultimately the clinical decision process in the radiology sector (Seyedhosseini et al. 2017). The current evidence is showing improved image quality by utilising artificial

intelligence algorithms for enhancing the resolution of images. These make the images easier to read and more detailed than they usually present. The artificial intelligence systems are also applied to certain ultrasonography image-based tasks which include abnormality detection, disease classification, prognosis assessment, and image segmentation. These are usually for various organ systems such as abdomen, pelvis, heart, musculoskeletal systems, disease classification, thyroid, obstetrics and gynecology, breast, etc. The outlook of artificial intelligence in ultrasonography hence remains promising and hence would require further research (Duarte et al. 2022).

CONCLUSION:

Considering the numerous possibilities of misinterpretation or technical glitches that might occur while an ultrasonography is being performed in emergency departments. The misinterpretation of the ultrasonography images should thus be considered as an adverse risk in diagnosis affecting patient safety and healthcare to be provided. The etiology of these errors is multifactorial and depends on various factors, such as patient factors, technical factors, environmental factors, errors, in interpretation, influenced by poor clinical correlation, setting errors, anatomical variants, intrinsic ultrasonography artifacts, etc. These should thus be considered while performing emergency ultrasonography. The recent developments of artificial intelligence in the medical technological development can also be modified to reduce the chances of error in the Ultrasonography.

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