ejpmr, 2025, 12(8), 231-234

SJIF Impact Factor 7.065

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Research Article

ISSN (O): 2394-3211

ISSN (P): 3051-2573

CHEST RADIOGRAPHY IN THE INTENSIVE CARE UNIT

Waed Alghazali[1], Mustafa Ghandour*[1], Ahmad Zynab[1] and Khalid Khattab[2]

[1]Faculty of Medicine, Al-Sham Private University, Rif Dimashq, Syria.
[2]Department of Radiology, Damascus University, Syrian Private University, AL- Sham Private University, Rif Dimashq, Syria.

***Corresponding Author: Mustafa Ghandour**

Faculty of Medicine, Al-Sham Private University, Rif Dimashq, Syria.

Article Received on 27/05/2025 **Article Revised on 18/06/2025** **Article Accepted on 08/07/2025**

ABSTRACT

Background: Portable chest radiography is a key diagnostic tool in intensive care units (ICUs), especially for non-ambulatory patients. These images assist in evaluating and monitoring various critical conditions. **Materials and Methods:** A retrospective descriptive study was conducted on 3,852 patients admitted to different ICUs at Al-Mouwasat University Hospital between 2023 and 2024. Portable chest X-rays, thoracic, and abdominal ultrasound data were analyzed using frequency and percentage-based descriptive statistics. Data were collected from the radiology archive and ICU records. **Results:** Normal chest X-rays accounted for 32% of cases, while 68% showed pathological findings, mainly pleural effusions and parenchymal consolidations. Repeat imaging was required in 43% of cases due to poor image quality or for follow-up. Portable chest ultrasound was performed in 35% of cases, mainly in COVID-19 patients, while FAST abdominal ultrasound revealed positive findings in 13% of trauma cases. Image quality varied due to the use of older computed radiography (CR) devices compared to modern digital systems. **Conclusion:** Portable chest imaging remains a cornerstone in ICU patient evaluation, but upgrading imaging technology may enhance diagnostic accuracy and patient management.

KEYWORDS: Intensive Care Unit, Portable Radiography, Chest Imaging, Bedside Ultrasound.

INTRODUCTION

Chest radiography (CXR) is a cornerstone diagnostic tool in the evaluation and follow-up of patients admitted to intensive care units (ICUs), owing to its ability to detect a wide spectrum of potentially life-threatening thoracic abnormalities. It is commonly employed to assess pulmonary and cardiac status and to verify the placement of medical devices such as endotracheal tubes, central venous catheters, and nasogastric feeding tubes.[1,2] CXR plays a vital role in detecting acute complications such as pneumothorax, pleural effusion, pulmonary edema, pneumonia, and atelectasis, making it indispensable for prompt clinical decision-making.[3]

Until recently, daily routine CXR was standard practice for most ICU patients. However, emerging evidence favors a more selective, indication-based approach, aiming to minimize unnecessary radiation exposure and improve resource utilization.[4,5] Studies suggest that on-demand imaging is at least as effective as routine imaging in detecting clinically significant findings and may offer safety and economic advantages.[4]

Despite its widespread use, the diagnostic accuracy of CXR can be limited in certain scenarios—particularly in patients confined to the supine position, where small pneumothoraces or minimal effusions may go undetected.[6] In light of these limitations, questions arise regarding whether CXR alone is sufficient, prompting comparisons with other imaging modalities such as ultrasound (US) or computed tomography (CT).[7]

This study aims to highlight the clinical value of chest radiography in the ICU setting by analyzing the prevalence of radiographic findings, comparing routine versus selective imaging strategies, and discussing the technical and clinical challenges associated with this essential modality.

METHODS AND MATERIALS

This retrospective descriptive study was conducted at Al-Mouwasat University Hospital in Damascus. The study analyzed all portable chest X-rays performed in the intensive care units (ICUs) of the hospital during the period from January 1, 2023, to December 31, 2024. The included ICU departments were: General ICU (mild, moderate, and severe units), Respiratory ICU, Cardiac ICU, Neurological ICU, and Burn ICU.

A total of 3,852 patients were included in the study. Each had undergone at least one portable chest X-ray during their ICU stay. Additionally, the study included a subset

of patients who had undergone chest ultrasonography (echo) for diagnostic support.

Inclusion criteria comprised all ICU patients who had a portable chest X-ray during their stay, whether performed routinely or to investigate clinical complications such as pneumothorax, pleural effusion, pulmonary edema, and others. Some patients who had undergone chest ultrasonography as part of their radiological evaluation were also included.

Exclusion criteria included patients who did not undergo any chest radiography during their ICU admission, and those who only had chest CT scans performed in the radiology department without any portable X-ray imaging in the ICU.

Data were collected from both electronic and paper-based medical records. The variables recorded included age, sex, ICU department, admission diagnosis, indication for imaging, and chest radiographic findings such as infiltrates, pneumothorax, effusion, atelectasis, or misplacement of medical devices (e.g., endotracheal tubes, central venous catheters).

Ethical approval for this study was obtained from the ethics committee of Al-Mouwasat University Hospital under the approval number: MW-RC-2025-0124.

Statistical analysis was performed using descriptive statistics only. The data were analyzed using SPSS version 26, and the results were presented as frequencies and percentages for categorical variables (such as types of findings, ICU type, sex), in addition to calculating the mean and standard deviation for patients' age.

RESULTS

The study included patients admitted to intensive care units (ICUs) who were older than 12 years. The age distribution revealed that 13% were between 12 and 18 years, 17% between 18 and 30 years, 20% between 30 and 50 years, and the majority (50%) were between 50 and 70 years old. Males made up 75% of the patients, while females represented 25%.

The main clinical indications for ICU admission included cases of burns (18%), acute respiratory distress (20%), infections (20%), pneumonia (20%), malignancies (10%), cachexia and poor general condition (12%), and postoperative monitoring (10%). Moreover, 43% of the admitted patients required mechanical ventilation, while 13% were admitted for routine observation and close monitoring.

All patients underwent portable chest X-ray imaging at the bedside using mobile radiographic units operated by specialized radiologic technicians. Five machines were available in the ICU departments, with two additional units kept as reserve. Image processing was conducted through digital radiology systems, with radiographs acquired using electronic cassettes and interpreted through PACS (Picture Archiving and Communication System) readers. The readings were reviewed and analyzed by supervising radiologists in cooperation with radiology residents and ICU physicians.

A total of 1,213 chest X-rays were reported as normal, accounting for 32% of the images, while 68% showed pathological findings. All X-rays were performed in the anteroposterior (AP) supine position due to patients' critical condition, which made upright or inspiratory views unfeasible. Approximately 25% of the images were technically suboptimal due to patient-related factors or limitations in the ICU environment but were still partially interpretable. Repeat imaging was necessary in 43% of the cases, either for follow-up or due to inadequate initial image quality.

Further radiologic evaluation using chest computed tomography (CT) was performed in 56% of cases, with necessary precautions taken for patients receiving oxygen therapy. Additionally, bedside thoracic ultrasound was used in 35% of patients, while portable abdominal ultrasound was performed in 10% of the cohort.

Thoracic ultrasound, carried out by radiology residents, was indicated in various scenarios: monitoring pleural effusions treated medically (12%), guiding thoracentesis (70%), monitoring pneumothorax (25%), evaluating pulmonary consolidations (40%), assessing pericardial effusion (34%), and follow-up after pericardiocentesis (30%). It is worth noting that more than one radiologic finding could be present in the same patient, such as the coexistence of pneumothorax and pneumonia.

A specific subset of patients included those diagnosed with COVID-19, totaling 261 cases during the study period. In these cases, lung ultrasound was employed with full infection control precautions to evaluate alveolar involvement and monitor the resolution of ground-glass opacities. The procedure was performed by trained radiology residents.

Furthermore, emergency bedside abdominal ultrasound (FAST) was used in trauma patients to detect intra-abdominal free fluid, peritoneal bleeding, and visceral injuries. Among these, 13% had positive findings, including small amounts of free peritoneal fluid (13%), large-volume fluid (55%), solid organ lacerations (20%), and the presence of free intraperitoneal air (12%).

Chest X-ray findings in ICU patients included small pleural effusions (25%), moderate effusions (15%), pulmonary infiltrates (30%), pericardial effusion (12%), and mediastinal widening (3%). Among the 30% who exhibited parenchymal pulmonary densities, the following radiologic patterns were identified: bronchiectasis in bacterial pneumonia (35%), a "dirty lung" appearance in viral pneumonia (15%), diffuse

alveolar hemorrhage due to trauma (13%), alveolar hemorrhage associated with malignancy (7%), and ground-glass opacities typical of COVID-19 infection (30%).

Another subgroup involved 343 patients admitted for acute or chronic renal failure. Chest X-ray findings in this population included varying degrees of pleural effusion (25%), pericardial effusion (18%), cardiomegaly (15%), mild pulmonary edema (12%), and severe pulmonary edema (30%). Portable abdominal ultrasound in these patients revealed kidney atrophy (12%), loss of corticomedullary differentiation (70%), ascites (26%), and hydronephrosis (56%).

Pleural effusion emerged as the most frequent chest radiographic finding, observed in 55% of cases. These were categorized based on severity and radiographic characteristics as follows: large effusions (15%) extending beyond the fourth intercostal space, moderate effusions (15%), and minimal effusions (25%) presenting with blunting of the costophrenic angle. Isolated pleural effusions were present in 80% of cases, while 2% were associated with additional findings such as pneumonia, pulmonary abscess, or pericardial effusion. Follow-up imaging after thoracentesis demonstrated full resolution in 70% of cases, while recurrence of effusion was observed in 30%.

Trauma-related thoracic injuries, identified in 256 ICU patients, included pulmonary hemorrhage from stab wounds (10%), hemorrhage due to motor vehicle accidents (25%), multiple rib fractures (54%), sternal fractures (3%), hemothorax (6%), and traumatic hemopericardium (2%).

At the time of discharge, 89% of ICU patients had returned to a radiologically normal chest X-ray, indicating resolution of the pulmonary condition. The remaining 11% still had mild residual findings but were clinically stable and referred to medical wards for continued care and treatment.

DISCUSSION

The findings of our study conducted at Al-Mouwasat University Hospital are largely consistent with those reported in the international literature. In particular, the study by Baratella et al., published in Diagnostic Radiology in 2024, emphasized the importance of bedside chest imaging in critically ill patients and demonstrated a similar prevalence of pleural effusion and pulmonary infiltrates as dominant radiologic findings.[8]

However, our results diverged somewhat from those observed in the study "Portable Chest Radiology in the Intensive Care Unit" conducted by Rottenlery in 2021, where high-resolution digital radiography (DR) units were used.[9] In contrast, the imaging equipment used in our hospital relies on older computed radiography (CR) technology, which inherently offers lower image quality and contrast resolution. This limitation is reflected in the higher percentage of suboptimal images (25%) in our cohort. Despite this, the overall diagnostic utility remained acceptable. Nevertheless, this highlights the need for equipment upgrades to ensure better diagnostic accuracy and faster decision-making in critical care settings.

Another study, titled "Chest Radiography in the Intensive Care Unit," conducted in Greece in 2019, reported findings that closely mirror those observed in our patients, particularly regarding the frequency and types of abnormalities such as pulmonary edema, pleural effusion, and pneumonic infiltrates.[10] The similarity in radiologic patterns between our study and that Greek cohort reinforces the generalizability of these findings across different ICU populations, even with variations in imaging equipment and protocols.

Recent international research increasingly recommends the adoption of advanced imaging technologies, particularly portable digital tomosynthesis, to enhance image quality and diagnostic yield in ICU settings.[11] These technologies reduce overlapping artifacts in chest radiographs and provide better visualization of lung parenchyma, which is critical in evaluating conditions like pneumonia, ARDS, and early alveolar infiltrates. Unfortunately, such modalities are not yet available in our institution.

These comparisons underscore both the strengths and limitations of our study. While our diagnostic outcomes align with several global studies, the discrepancies with more technologically advanced centers highlight the impact of imaging modality and equipment quality on diagnostic performance. Future efforts should aim at adopting updated radiologic systems, alongside enhanced training for radiologic technologists and radiology residents, to improve diagnostic precision and optimize patient care in the ICU.

CONCLUSION

This study highlights the vital role of portable chest radiography in the intensive care setting, especially in resource-limited environments. Despite the use of older CR systems, diagnostic outcomes were satisfactory and aligned with several international studies. Pleural effusion, pulmonary infiltrates, and cardiopulmonary complications were among the most common findings. The high proportion of technically limited images underscores the need for updated imaging equipment. The integration of portable ultrasound further enhanced diagnostic accuracy. These findings support the continued use of bedside imaging for timely decision-making. Upgrading technology and staff training remain essential for improved ICU care.

ACKNOWLEDGMENTS

The authors would like to sincerely thank Al-Mouwasat University Hospital and the radiology and ICU staff for

their generous support, technical assistance, and dedication throughout the study period.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this study.

Funding

This study received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Data Availability

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

Authors' Contributions

Waed Alghazali, Mustafa Ghandour, and Ahmad Zynab contributed equally to data collection, analysis, and manuscript preparation. Khalid Khattab supervised the radiological assessments and provided critical revision of the manuscript.

REFERENCES

1. Graat ME, Hendrikse KA, Spronk PE, Korevaar JC, Stoker J, Schultz MJ. Chest radiography practice in critically ill patients: a postal survey in the Netherlands. BMC Med Imaging, 2006; 6: 8.
2. Chhajed PN, Glanville AR. Role of chest imaging in the ICU. Curr Opin Crit Care., 2005; 11(1): 43–9.
3. Kröner A, Van der Meer NJ, Waanders R, Lutke Holzik MF. Value of chest radiography in the medical intensive care unit. Neth J Med., 2021; 79(1): 14–22.
4. Hejblum G, Chalumeau-Lemoine L, Ioos V, Boëlle PY, Salomon L, Simon T, et al. Comparison of routine and on-demand prescription of chest radiographs in mechanically ventilated adults: a multicentre, cluster-randomised, two-period crossover study. Lancet., 2009; 374(9702): 1687–93.
5. Oba Y, Zaza T. Abandoning daily routine chest radiography in the intensive care unit: meta-analysis. Radiology, 2010; 255(2): 386–95.
6. Brixey AG, Lichtblau DA, King MA. Limitations of supine portable chest radiographs in ICU patients. Crit Care Clin., 2007; 23(3): 629–50.
7. Lichtenstein DA, Mezière GA. Relevance of lung ultrasound in the diagnosis of acute respiratory failure: the BLUE protocol. Chest., 2008; 134(1): 117–25.
8. Baratella E, Marrocchio C, Cereser L, et al. Portable Chest Radiography in ICU Patients: Diagnostic Utility and Image Quality Assessment. Diagn Radiol, 2024; 105(2): 123-130.
9. Rottenlery S. Portable Chest Radiology in the Intensive Care Unit: Evolving Role of Digital Radiography. J Crit Care Imaging, 2021; 12(1): 45-51.
10. Papadopoulos C, Mantzoros D, Nikolakopoulou A, et al. Chest Radiography in the Intensive Care Unit: Patterns and Clinical Correlations. Hellenic J Radiol, 2019; 4(4): 213–219.
11. Lee YK, Shin JH, Kim KS, et al. Use of Portable Digital Tomosynthesis in ICU Chest Imaging: A Technical Update and Diagnostic Perspectives. AJR Am J Roentgenol, 2022; 219(6): 1201-1210.