



## ASSESSMENT OF PRE AND POST CHEST X-RAY OF INTUBATED PATIENT IN INTENSIVE CARE UNIT

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### Abstract

*Background:* Endotracheal intubation is a commonly performed lifesaving procedure in critically ill Intensive Care Unit (ICU) patients. Incorrect endotracheal tube placement may result in serious complications, including bronchial intubation, pneumothorax, atelectasis, and hypoxia. Chest X-ray (CXR) is considered the gold standard for confirming endotracheal tube position and detecting post-intubation pulmonary complications. *Objectives:* To assess and compare pre- and post-intubation chest X-ray findings, and to determine the frequency of correct and incorrect endotracheal tube (ETT) placement among intubated patients. *Methodology:* A descriptive cross-sectional study was conducted among 129 intubated ICU patients at Lady Reading Hospital and Hayatabad Medical Complex from December 2025 to April 2026. Patients with available pre- and post-intubation chest X-rays were included. Data on demographic characteristics, endotracheal tube placement, and radiographic findings were collected using a structured Questionnaire. Data were analyzed using IBM SPSS version 25.0, and a *p*-value of <0.05 was considered statistically significant. *Results:* A total of 129 intubated ICU patients were included in the study. Most patients were adults (89.9%), and males represented 53.5% of the sample. Consolidation was the most common pre-intubation chest X-ray finding (66.7%). Post-intubation chest X-rays demonstrated a significant increase in consolidation compared with pre-intubation findings (*p* < 0.001). Among patients with initially clear lungs, 48.8% developed new consolidation after intubation. New pneumothorax occurred in 2.4% of patients, while new atelectasis and pulmonary edema were observed in 5.6% and 5.6%, respectively. No significant changes were noted for pleural effusion, cardiomegaly, or ARDS severity. *Conclusion:* Post-intubation chest X-ray plays an essential role in confirming correct endotracheal tube placement and detecting pulmonary complications in ICU patients. The study demonstrated a significant increase in pulmonary consolidation after intubation, while pneumothorax, atelectasis, and pulmonary edema were observed in a smaller proportion of patients. These findings highlight the importance of routine post-intubation chest radiography for early identification of complications and improved patient management, particularly in resource-limited settings.

## Introduction

Intensive Care Units (ICUs) manage critically ill patients requiring continuous monitoring and advanced life-support interventions, including endotracheal intubation and mechanical ventilation. Endotracheal intubation is a lifesaving procedure commonly performed in patients with respiratory failure, decreased level of consciousness, airway compromise, and hemodynamic instability (1,2). Despite its clinical importance, improper placement of the endotracheal tube (ETT) may lead to serious complications such as right main bronchus intubation, accidental extubation, pneumothorax, aspiration, atelectasis, and hypoxia (3). Although bedside clinical assessment and capnography are routinely used to confirm ETT placement, these methods may not always accurately determine tube position or detect associated pulmonary complications (4,5). Therefore, chest X-ray (CXR) remains the gold standard for confirming correct ETT placement and identifying post-intubation complications (6). Current recommendations suggest positioning the ETT tip 3–7 cm above the carina to minimize complications related to malposition (7). Post-intubation chest radiography also helps identify complications such as pneumothorax, pulmonary edema, pleural effusion, atelectasis, and consolidation, which may influence ventilatory management and patient outcomes (8). In resource-limited settings, chest radiography remains the most accessible and cost-effective imaging modality for evaluating intubated ICU patients (9). Despite the importance of chest radiography after intubation, limited local evidence is available regarding pre- and post-intubation chest X-ray findings in ICU patients. Therefore, this study was conducted to assess and compare pre- and post-intubation chest X-ray findings in ICU patients.

## Methodology

A descriptive cross-sectional study was conducted in the medical, surgical, neurological, and pediatric intensive care units (ICUs) of Lady Reading Hospital and Hayatabad Medical Complex over a period of six months from December 2025 to April 2026. A total of 129 intubated ICU patients were included in the study. Patients intubated for more than 48 hours up to 10 days and having both pre-

and post-intubation chest X-rays (CXRs) available were enrolled. Patients with Do-Not-Resuscitate (DNR) orders, brain death, thoracic surgery, or poor-quality chest radiographs were excluded. Data were collected using a structured questionnaire. Demographic and clinical information including age, gender, ICU type, diagnosis, endotracheal tube (ETT) size, and tube depth were recorded. Pre- and post-intubation chest X-rays were assessed for ETT position and pulmonary complications including pneumothorax, atelectasis, consolidation, pleural effusion, pulmonary edema, and acute respiratory distress syndrome (ARDS). Data were analyzed using IBM SPSS version 25.0. Categorical variables were presented as frequencies and percentages. McNemar and McNemar–Bowker tests were applied to compare paired pre- and post-intubation findings. A p-value of <0.05 was considered statistically significant. Ethical approval was obtained from the Institutional Review Board of Khyber Medical University and the respective hospital research committees. Patient confidentiality and anonymity were maintained throughout the study.

## Results:

A total of 129 intubated ICU patients were included in the study. Most patients were aged 14–90 years (89.9%), while males constituted 53.5% of the sample. The majority of patients were admitted to Lady Reading Hospital (71.3%), and the medical ICU accounted for the highest proportion of admissions (59.7%). The most commonly used endotracheal tube (ETT) size was 7.5 mm (51.2%), with a mean ETT depth of  $20.1 \pm 3.35$  cm. Respiratory disorders were the most frequent primary diagnosis (24.8%), followed by cardiac and renal diseases (20.9%) and neurological disorders (18.6%). Pre-intubation chest X-rays commonly demonstrated consolidation/infiltrates in 66.7% of patients, while pleural effusion, atelectasis, pulmonary edema, and pneumothorax were less frequent. Mild-to-moderate ARDS was observed in 7.0% of patients.

**Table 1: Pre-Intubation CXR findings**

Finding	Present (n)	Present (%)	Absent (n)	Absent (%)
Consolidation/Infiltrates	86	66.7	43	33.3
Pleural Effusion	7	5.4	122	94.6
Pneumothorax	2	1.6	127	98.4
Cardiomegaly (n=128)	6	4.7	122	95.3
Hydropneumothorax (n=128)	1	0.8	127	99.2
ARDS (Mild-Moderate)	9	7.0	120	93.0
Pulmonary Edema (n=128)	4	3.1	124	96.9
Atelectasis	5	3.9	124	96.1

Comparison of pre- and post-intubation chest X-rays revealed a significant increase in consolidation/infiltrates following intubation ( $p < 0.001$ ). Among patients with initially clear lungs, 48.8% developed new consolidation after intubation. In patients with pre-existing consolidation, 46.5% showed worsening findings.

New pneumothorax developed in 2.4% of patients, while new atelectasis and pulmonary edema were observed in 5.6% each after intubation. No statistically significant changes were observed in pleural effusion, atelectasis, cardiomegaly, pulmonary edema, or ARDS severity.

**Table 1: Comparison of Pre and Post CXR findings**

Finding	Pre-Intubation Status	Post-Intubation Status (n, %)	Statistical Significance
<b>Consolidation</b>	Absent (n=43)	Absent: 22 (51.2%); New & Improved: 9 (20.9%); Worsened: 12 (27.9%)	McNemar-Bowker $p < 0.001^*$
	Present (n=86)	Improved: 7 (8.1%); Worsened: 40 (46.5%); Unchanged: 39 (45.3%)	
<b>Pleural Effusion</b>	Absent (n=122)	Absent: 112 (91.8%); New & Improved: 5 (4.1%); Worsened: 4 (3.3%)	McNemar-Bowker $p = 0.280$
	Present (n=7)	Improved: 6 (85.7%); Worsened: 1 (14.3%)	
<b>Pneumothorax</b>	Absent (n=127)	Absent: 124 (97.6%); New & Improved: 3 (2.4%); Worsened: 0 (0%)	(Small cell counts)
	Present (n=2)	Improved: 1 (50%); Worsened: 1 (50%)	
<b>Atelectasis</b>	Absent (n=124)	Absent: 117 (94.4%); New & Improved: 5 (4.0%); Worsened: 2 (1.6%)	McNemar-Bowker $p = 0.121$

Finding	Pre-Intubation Status	Post-Intubation Status (n, %)	Statistical Significance
		Worsened: 2 (1.6%)	
	Present (n=5)	Improved: 4 (80.0%); Worsened: 1 (20.0%)	
Cardiomegaly (n=128)	Absent (n=6)	Absent: 4 (66.7%); New Present: 2 (33.3%)	McNemar p = 0.375
	Present (n=122)	Persistent: 121 (99.2%); Resolved: 1 (0.8%)	
ARDS (0-3 scale)	No significant change overall	–	McNemar-Bowker p = 0.736
Pulmonary Edema (n=128)	Absent (n=124)	Absent: 117 (94.4%); New Present: 7 (5.6%)	McNemar p = 1.000
	Present (n=4)	Persistent: 4 (100%)	
Hydropneumothorax (n=128)	Absent (n=127)	Absent: 125 (98.4%); New Present: 2 (1.6%)	(Small cell counts)
	Present (n=1)	Improved: 1 (100%)	

Overall, post-intubation chest X-rays provided important additional diagnostic information regarding endotracheal tube placement and post-intubation pulmonary complications.

**Discussion:**

The study assessed pre- and post-intubation chest X-ray findings among ICU patients and evaluated the frequency of pulmonary complications following intubation. The findings demonstrated that post-intubation chest radiography provides important diagnostic information regarding endotracheal tube placement and newly developed pulmonary abnormalities.

In the study, consolidation were the most common pre-intubation radiographic finding, observed in 66.7% of patients. Following intubation, a significant increase in pulmonary consolidation was observed (p < 0.001), with nearly half of the patients who initially had clear lungs developing new consolidation. These findings are consistent with previous studies reporting that critically ill and mechanically ventilated patients are at increased risk of developing pulmonary infiltrates, aspiration pneumonia, and ventilator-associated complications (10). Similar findings were reported

by Goyal et al., who emphasized the importance of portable chest radiography in monitoring disease progression in critically ill patients (11).

The study also identified new post-intubation complications including pneumothorax (2.4%), atelectasis (5.6%), and pulmonary edema (5.6%). Although the incidence was relatively low, these complications are clinically important because delayed recognition may lead to severe morbidity and mortality. Previous studies have similarly reported that mechanical ventilation and airway manipulation increase the risk of barotrauma and pneumothorax in ICU patients (12). Atelectasis following intubation may result from mucus plugging, poor ventilation, and prolonged immobilization, particularly in critically ill patients (13).

The findings support previous evidence that bedside clinical assessment alone may not reliably detect endotracheal tube malposition or post-intubation complications. Studies by Lotano et al. and McGillicuddy et al. demonstrated that clinically unsuspected tube malposition was frequently identified on post-intubation chest X-rays (1,2). Therefore, chest radiography remains an

essential tool for confirming tube position and identifying procedure-related complications, especially in resource-limited settings where advanced imaging modalities are not readily available.

No statistically significant changes were observed for pleural effusion, cardiomegaly, pulmonary edema, or ARDS severity following intubation. These findings suggest that such abnormalities were more closely related to the patients' underlying critical illnesses rather than intubation itself. Similar observations have been reported in previous ICU-based studies evaluating radiographic abnormalities in mechanically ventilated patients (14).

The current study also highlights the ongoing importance of chest radiography in low- and middle-income countries. While recent literature supports an on-demand rather than routine daily chest X-ray approach in ICUs (15), post-intubation chest radiography remains widely recommended because of its ability to identify clinically significant complications that may not be detected clinically.

Overall, the findings of the study demonstrate that post-intubation chest X-rays provide valuable additional diagnostic information in ICU patients and play a critical role in the early detection of pulmonary complications and confirmation of safe endotracheal tube placement.

#### Conclusion:

Post-intubation chest X-ray is an important diagnostic tool in ICU patients for confirming endotracheal tube placement and detecting pulmonary complications following intubation. The study demonstrated a significant increase in post-intubation pulmonary consolidation, while smaller proportions of patients developed pneumothorax, atelectasis, and pulmonary edema after intubation. The findings suggest that bedside clinical assessment alone may be insufficient for identifying tube malposition and procedure-related complications. Therefore, routine post-intubation chest radiography remains essential, particularly in resource-limited healthcare settings where advanced imaging modalities may not be readily available. This study also provides important local evidence regarding pre- and post-intubation chest X-ray findings among ICU patients and highlights

the need for standardized imaging protocols, proper airway management training, and early radiographic evaluation to improve patient safety and clinical outcomes.

#### Limitations:

This study has several limitations. First, the study was conducted in only two tertiary care hospitals, Lady Reading Hospital and Hayatabad Medical Complex, which may limit the generalizability of the findings to other healthcare settings. Second, the cross-sectional design assessed patients at a single point in time and did not allow long-term follow-up of radiological changes or patient outcomes. In addition, chest X-ray interpretation was primarily performed by a respiratory therapist, and inter-observer variability with radiologists was not assessed. Some chest radiographs were excluded because of poor image quality, which may have affected the overall findings. Advanced imaging modalities such as CT scan or bedside lung ultrasound were not routinely used for comparison, which may have limited the detection of subtle pulmonary abnormalities.

#### References:

1. McGillicuddy DC, Babineau MR, Fisher J, Ban K, Sanchez LD. Is a postintubation chest radiograph necessary in the emergency department? *Int J Emerg Med.* 2009;2(4):247-9.
2. Lotano R, Gerber D, Aseron C, Santarelli R, Pratter M. Utility of postintubation chest radiographs in the intensive care unit. *Crit Care.* 2000;4(1):50-3.
3. Godoy MC, Leitman BS, de Groot PM, Vlahos I, Naidich DP. Chest radiography in the ICU: Part 1, evaluation of airway, enteric, and pleural tubes. *AJR Am J Roentgenol.* 2012;198(3):563-71.
4. Walls RM, Murphy MF, Lutten RC. Manual of emergency airway management. 5th ed. Philadelphia: Wolters Kluwer; 2018. p. 36-51.
5. Baratella E, Marrocchio C, Bozzato AM, Roman-Pognuz E, Cova MA. Chest X-ray in intensive care unit patients: what there is to know about thoracic devices. *Diagn Interv Radiol.* 2021;27(5):633-8.
6. Gambato M, Scotti N, Borsari G, Zambon Bertoja J, Gabrieli JD, De Cassai A, et al. Chest X-ray interpretation: detecting devices

- and device-related complications. *Diagnostics*. 2023;13(4):599.
7. Brunel W, Coleman DL, Schwartz DE, Peper E, Cohen NH. Assessment of routine chest roentgenograms and the physical examination to confirm endotracheal tube position. *Chest*. 1989;96(5):1043-5.
  8. Silverstein DS, Livingston DH, Elcavage J, Kovar L, Kelly KM. The utility of routine daily chest radiography in the surgical intensive care unit. *J Trauma*. 1993;35(4):643-6.
  9. Ganapathy A, Adhikari NK, Spiegelman J, Scales DC. Routine chest x-rays in intensive care units: a systematic review and meta-analysis. *Crit Care*. 2012;16(2):R68.
  10. 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.
  11. Goodman DK, Putman JC, Conrardy JF. Determining ideal endotracheal tube position by reference to the carina on the chest radiograph. *AJR Am J Roentgenol*. 1976;127(3):433-4.
  12. Frondelius P, Lai LC, Adimoolam RR, Oermann EK, Letham BK. Image augmentation and automated measurement of endotracheal-tube-to-carina distance on chest radiographs in the ICU using a deep learning model with external validation. *Healthcare*. 2022;10(12):2422.
  13. 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.
  14. Clec'h C, Simon P, Hamdi A, Hamza L, Karoubi P, Fosse JP, et al. Are daily routine chest radiographs useful in critically ill, mechanically ventilated patients? A randomized study. *Intensive Care Med*. 2008;34(2):264-70.
  15. Al Shahrani A, Al-Surimi K. Daily routine versus on-demand chest radiograph policy and practice in adult ICU patients – clinicians' perspective. *BMC Med Imaging*. 2018;18(1):4.