



Restrictive Approach to Chest Radiography in the Covid Era and Efficacy in Clinical Decision Making in Critical Care: Observations from a Clinical Audit

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Abstract

Chest X-Rays are routinely performed in Critical Care to aid clinical decision making. Many patients in Critical Care lack capacity for consenting radiological examinations, e.g., invasively ventilated or sedated patients and doctors take decisions to perform these investigations in their patient's 'best interests [1]. We conducted a study in our Critical Care, to assess how many of the chest X-Rays performed effectively produced a change in patient management. Although a restrictive approach was used [2,3], only 32% of the examinations produced a change in clinical management. In COVID patients, the cumulative effect of radiation doses significantly increases the lifetime risk of development of carcinoma. This is the first study in our knowledge that studies the effect of radiation exposure in critically ill COVID patients and also compares the effects of radiation exposure on patients admitted with conditions other than COVID. The radiation risk for each patient was calculated according to the linear no threshold theory, which showed the cumulative effects significantly increased the risk of carcinoma from 1 in 100,000 to 1 in 350 in young patients, due to radiation exposure alone. This holds significance as the newer variants of COVID affect younger patients more [4], and repeated radiation exposure and its aftereffects may produce a plethora of new difficulties to deal with in the post COVID era, in addition to the direct impact of the pandemic. We also found that, the number of Chest X-Rays ordered had a direct positive correlation between length of stay and invasive mode of ventilation separately. No clinical incidents pertaining to delayed/ missed diagnoses were reported during the 4-month period, which further reinforces the justification of a restrictive approach. These observations were concluded as a part of an audit we held at our hospital. For further betterment of clinical practice, the recommendations mentioned below can be followed, one of which is education of healthcare professionals, which is the aim of this article.



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Introduction

Chest radiographs are routinely used in Critical Care Units for diagnosing, assessing disease progression, post procedural follow-up and for early detection of complications associated with indwelling devices, among other indications. In many Critical Care Units around the world, performing daily Chest X-Rays was the norm earlier. However, a more restrictive approach to chest radiography was adopted across most critical care units, as this had several benefits, such as prevention of unnecessary radiation exposure and otherwise unwarranted treatment of minor or false findings and also helped reducing financial burden on healthcare systems. Performing chest radiographs in critically ill COVID patients come with additional risks such as exposure to the pathogen and difficulties in patient positioning for obtaining optimum quality exposure. Many patients admitted to Critical Care are often unable to give consent for radiological examinations due to various factors contributing to their lack of capacity eg, sedated and ventilated patients, ICU delirium etc. This often puts the intensivist/ referrer at a position to make a clinical decision in the “best interests” of the patient. This study aims at finding out if such clinical decisions make an impact on patient care, while considering the risks associated. Our Critical Care Unit located at an NHS healthcare trust in the UK uses a restrictive approach for performing chest radiography.

Materials and methods

Chest Radiographs ordered in the 18 bedded Critical Care were retrospectively reviewed using Carestream PACS (Picture Archiving and Communication System). Indications of each and change in clinical management since imaging was reviewed from patient daily review notes and assessed if the chest radiography impacted decision making in the next 24 hours, for example: Change in ventilation, need for ETT repositioning, drain placements, antibiotic change etc. Data was assessed separately for patients diagnosed with COVID pneumonitis, as the nature of the disease often warrants a prolonged critical care stay requiring respiratory support. Total radiation exposure to each patient was calculated. Also, the lifetime risk of developing cancer (baseline and additional risk) due to exposure was calculated for each patient. The standard that we used to audit unnecessary radiation exposure was the ‘Ionising Radiation Regulations (2017)’ by Health and Safety Executive, England. We aimed to study the number of Chest Radiographs that made a difference in patient management, as a direct outcome of the imaging. We used the radiation risk calculator developed by Dr. Mike Hanley [4], constructed under the theory that the increased risk holds true at lower doses, which is called the linear no threshold model, and is the currently adopted model for calculating radiation risk. This is the most widely accepted model to ensure that the highest standards of patient safety are provided.

Data selection

All patients admitted to Critical Care over four-month time with length of stay >48 hours were analysed. Data was separately collected for COVID patients and non-COVID patients.

Data Analysis

Primary outcome that we investigated for data collection was a change in management plan in the next 24 hours, as a direct impact of the radiological imaging. These ranged from changing mode/type of ventilation, chest drain placements, re-citing of indwelling device or changes in antimicrobials. Other

data collected were Length of ITU stay and mode of ventilation to assess their effect on the total radiation exposure in Critical Care. Data analysis was carried out using simple spreadsheets and charts.

Results

A total of 260 radiographs were reviewed from 79 patients who were admitted to our Critical Care unit during this time period and satisfied the above criteria, i.e., LOS >48 hours and requiring a chest radiograph imaging at some point during their stay.

For COVID patients, the average LOS in Critical Care was found to be 14 days. Despite the high amounts of radiation exposure, only 32% of X-Rays produced a change in management of these patients. The average radiation exposure as a result of Chest X-rays alone for a patient admitted with a diagnosis of COVID was negligible but however, when coupled with other radiological examinations such as CTPA, increases the risk of developing carcinoma significantly, more so in younger patients. As we calculated [4], it was found that in a patient in mid 20s with an average LOS of 14 days, at the current rate of radiation exposure, considering all the radiological exposure the patient receives, the risk significantly increased from 1 in 100,000 to 1 in 350. However, as the age of the patient progresses, the same amount of radiation did not significantly increase the risk of developing a carcinoma [5]. Additionally, exposing younger patients to ionising radiations come with the risk of gonadal exposure and development of deleterious heritable effects on the progeny [6,7] later. This becomes important in the current situation, where there is a shift in demographics, with the current variants of the pathogen affecting younger individuals [4]. There were no circumstances in which imaging studies revealed a new pathology which was not suspected clinically. A few radiographs aided in diagnosing pneumothoraxes that significantly helped in early diagnosis, which is a complication that arises in many invasively ventilated COVID patients. The most common indication for Portable chest X-rays in COVID patients was disease progression followed by Nasogastric tube insertion.

For patients admitted with conditions other than COVID, the average radiation exposure due to Chest Xray alone and their risk was negligible. The most common indication was progression. However, only 28% of the imaging resulted in a change in management of the patient.

The most common indication for X-rays in critical care was disease Progression followed by confirmation of device placements and acute deterioration in clinical status. Overall, only 32% of patients had a change in clinical management plans as a result of the outcome of chest imaging. No incident reports of delayed diagnoses, device misplacements or missed diagnoses were registered during this time, which further reinforces that the current restrictive practice of imaging has not resulted in any clinical mishaps. This also further form firm grounds for justifying reduction in ordering chest radiographs compared to current practice.

Discussion

In critically ill COVID patients (particularly younger patients) exposed to significant increases the risk of carcinoma significantly. For those effected with COVID, this would have further implications in the post-pandemic era, requiring screening for oncological pathologies based on the presence of additional risk factors such as genetics.

In certain countries such as the USA, The American College of Radiology (ACR) and the International Atomic Energy Agency (IAEA) recommend hospitals monitor radiation exposure due to the potential hazards of exposure to radiation for diagnostic and therapeutic purposes.

Only 32 % of imaging studies resulted in a change of management in both these group of patients

According to the study, LOS and IPPV are factors that have a positive impact on the decision for requesting imaging.

Cost on healthcare: National average cost of performing a privately funded chest Xray in the UK is 101 GBP. The number of unnecessary chest X-rays ordered during the pandemic era has also significantly impacted the financial aspects of healthcare.

53 Chest X-rays were performed despite having a chest X-ray performed earlier on the same day, which constitutes 20% of the total number of X-Rays studied. Judicious decision making while anticipating clinical events can be key to preventing unnecessary radiation exposure.

Recommendations

Education of healthcare professionals regarding Ionising Radiation exposure and associated risks.

Anticipating and planning the placement of devices such as Endotracheal tubes, intravenous lines, NG tubes etc. to ensure all necessary interventions are completed before imaging and hence preventing unnecessary imaging.

Limitations

This was a single centre study on radiation exposure in critical care. Subjects were selected at a period of time when 77% of the population in the United Kingdom were vaccinated (two doses) against COVID. This was also the period when there was a significant shift in COVID demographics affecting younger patients, which is significant from the perspective of the results of the study.

The study uses the Linear no Threshold model to calculate radiation doses and patient risk, since it is based on the highest standards of patient safety. The LNT is a risk model used internationally by most health agencies and nuclear regulators, including International Commission on Radiation Protection. However, there has been controversies regarding the theory, as it is often hard to attribute the risks to low levels of radiation exposure. Finally, it was agreed upon by the ICRP to retain the LNT theory³ unless or until this position becomes scientifically untenable.

Conclusion

Radiological examinations should be ordered judiciously in all patients, considering the immediate challenges as well as the aftereffects of radiation exposure. As seen from our study, a significant proportion of chest radiographs (68%), even while using a restrictive approach, did not produce a change in management plan. COVID patients, overall are exposed to higher radiation doses. For younger patients alone, this carries a significant increase in the lifetime risk of developing cancer. Early interventions and education of healthcare professionals are key to risk reduction.

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