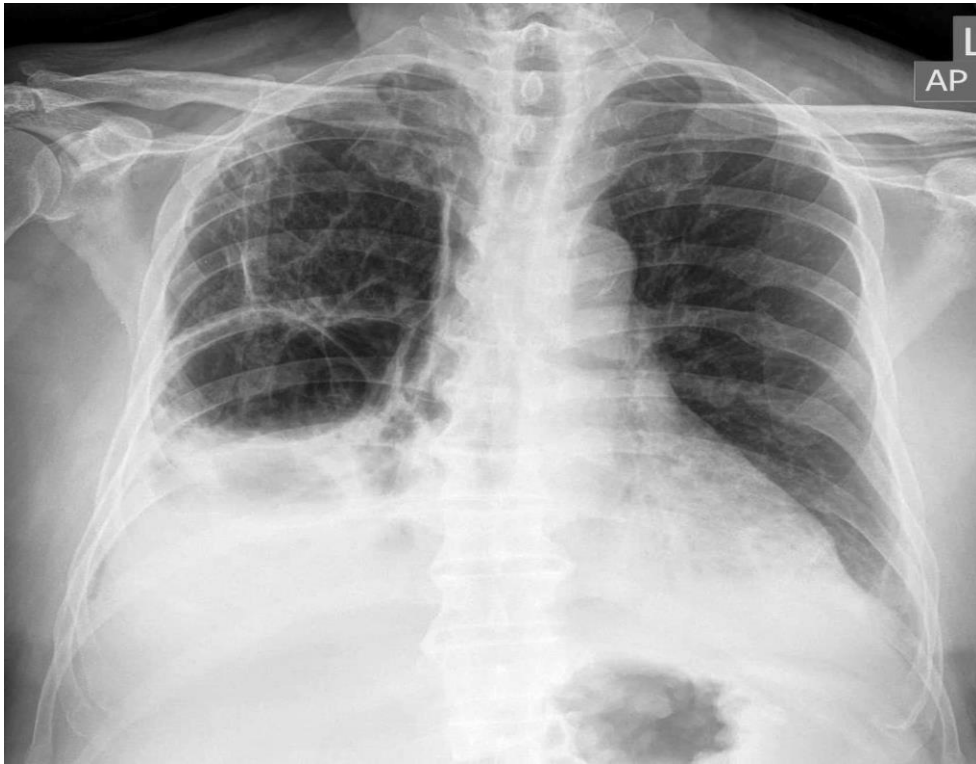


Image quality criteria for cardiac surgery patients in mobile chest radiography



<https://medschool.co/tests/chest-xray/loss-of-lung-markings>

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Mobile X-RAY history

X-ray examination with a mobile X-ray machine was already used in the last century, when there was a need to examine patients in difficult places.

The development and necessary for mobile X-ray equipment is not losing it's essence even now and is becoming more and more current.

Mobile X-ray machines are currently being used to access medically heavy patients whose medical condition is not stable for the doctors to transport them to stationary X-ray equipment.



<https://www.alamy.com/stock-photo/historical-x-ray-machine.html>



<https://www.siemens-healthineers.com/at/radiography/mobile-x-ray/mobilette-elara-max>

Importance of examination

Evaluation of the lungs and the entire chest is of crucial importance before and after cardiac surgery, particularly in terms of pulmonary diseases; relationships of the heart, aorta, and great vessels with other organs; and the extent and degree of calcifications.

The aim of the work

Is to find out the criteria for X-ray quality in the thoracic examination of patients after heart surgery, performing an X-ray with a mobile device.

Working with a mobile X-ray machine in the cardiopulmonary department, each performer have it's own subjective view on the choice of parameters and the performance of the projection in chest radiography.

As the technical possibilities of mobile X-ray equipment are limited both in the choice of technical parameters and in the quality of projection performance, the image quality may differ for each performer.

About this study

In this study was used qualitative quantitative research method.

Analysis of literature sources were used to find information

- about X-ray machines working principle;
- about anatomy of chest and how the images should look in perfect mobile X-ray;
- about what are the accurate X-ray positioning criteria.

Author developed tables of image quality criteria and projection criteria when performing examinations with a mobile X-ray machine in the cardiopulmonary department of patients after cardiac surgery.

Criteria

Projection criteria consists of seven parameters and image quality criteria consists of ten parameters.

Total of 35 X-rays were taken with a mobile X-ray machine in the cardioreanimation department, in the straight/AP projection.

Projection criteria

- Examination is performed during a deep breath
- Patient lies on his back, in a semi-sitting position or lying on side
- Detector is placed under the back and chest is in the middle of the detector.
- Coronal plane is parallel to the detector, the central beam is perpendicular to the coronal plane
- Patient's shoulders are lowered as far as possible so that the shoulder blades would not cover the fields of the lungs, the hands are placed along to the side
- Central beam is centered at the Th7 level, diaphragmation
- Patients protection safety is observed

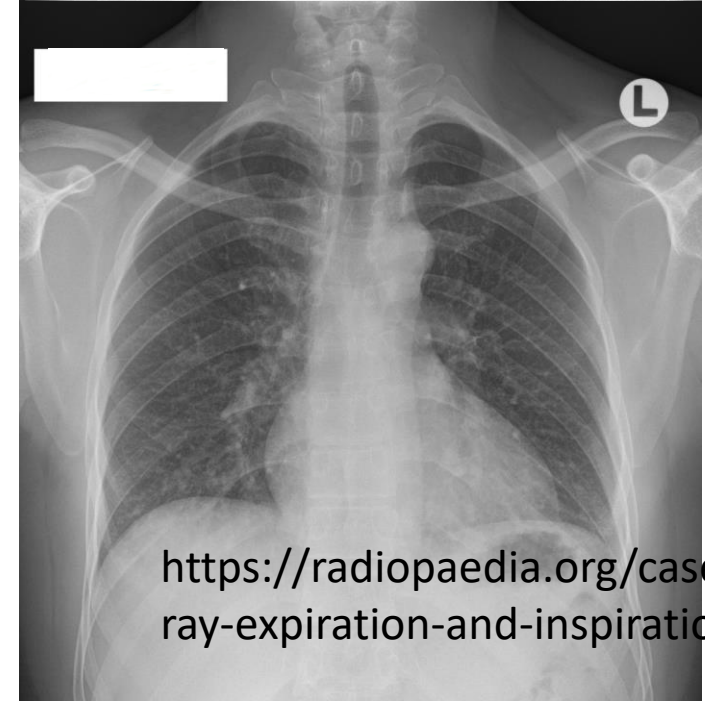
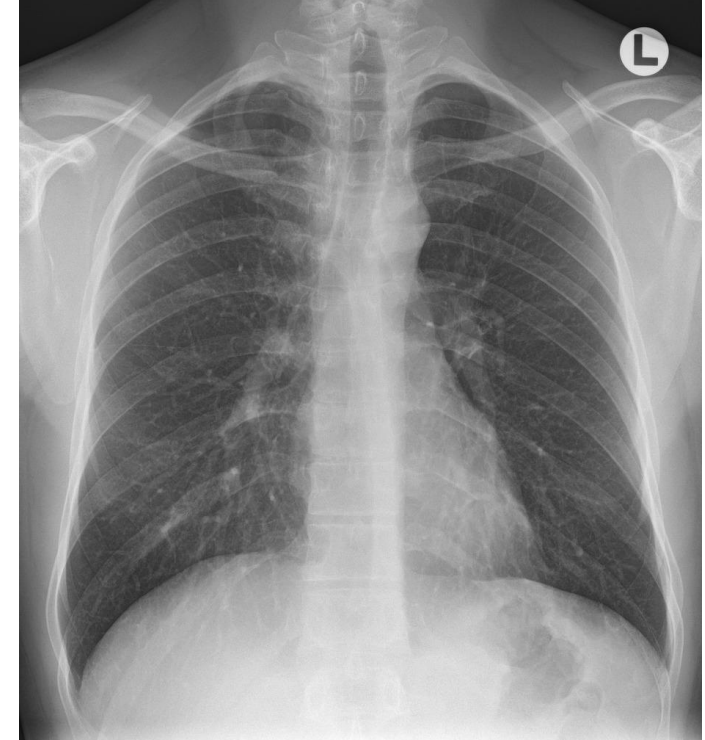
Image quality criteria

- Chest symmetrical (not inverted or bent)
- Shoulder blades retracted, not visible in lung area
- Symmetrical lung pneumatization
- Tracheal bifurcations and main bronchi are clearly visualized
- Costodiaphragmatic sinuses are included and clearly visualized diaphragm
- The examination includes apex of the lungs and 2 cm of soft tissue above the top of the lungs
- The ribs do not overlap each other
- Includes C7 + L1 vertebra
- No artifacts (movements, foreign objects)
- Diaphragm and identification of sides

Analysis of the picture criteria

During the X-ray, the patient will not be able to take a deep breath, as the patient may be unconscious and it is contraindicated to hold the breath in the early postoperative period in patients undergoing cardioreanimation.

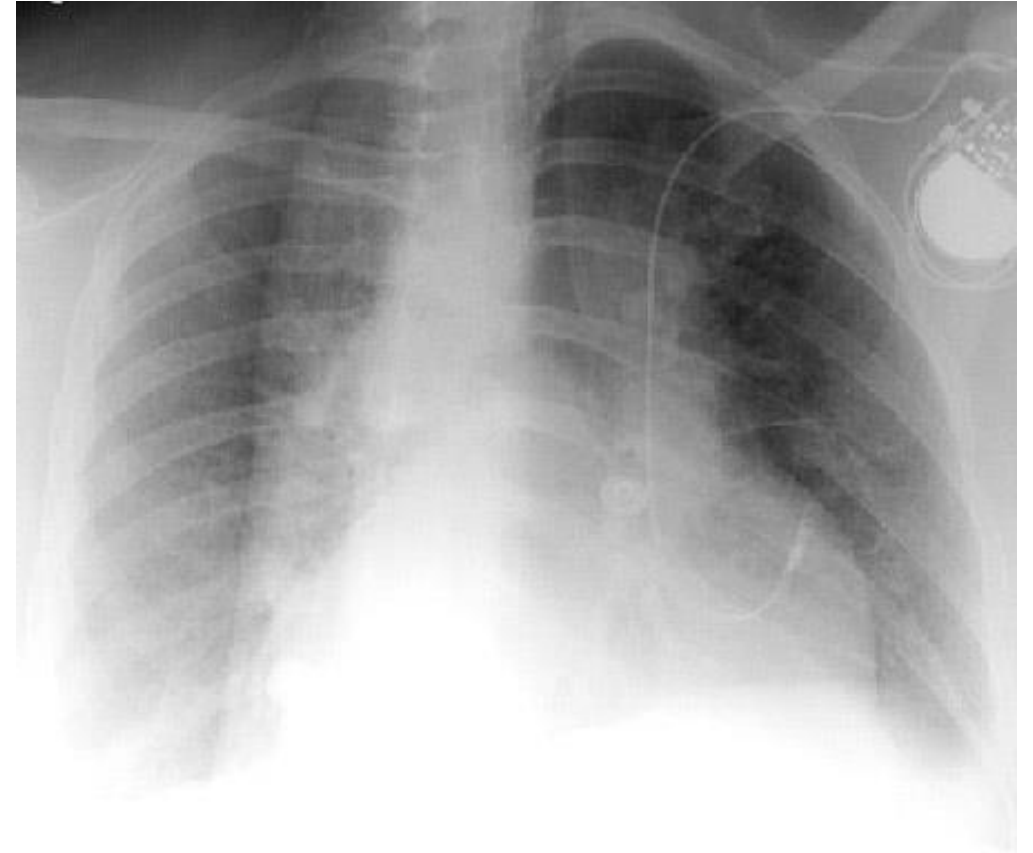
The study concluded that this criteria is met by 0%, as both the study and literature sources summarize deep breathing is prohibited after surgery



Analysis of the picture criteria

Criteria for the patient's position during the examination is lying down (supine).

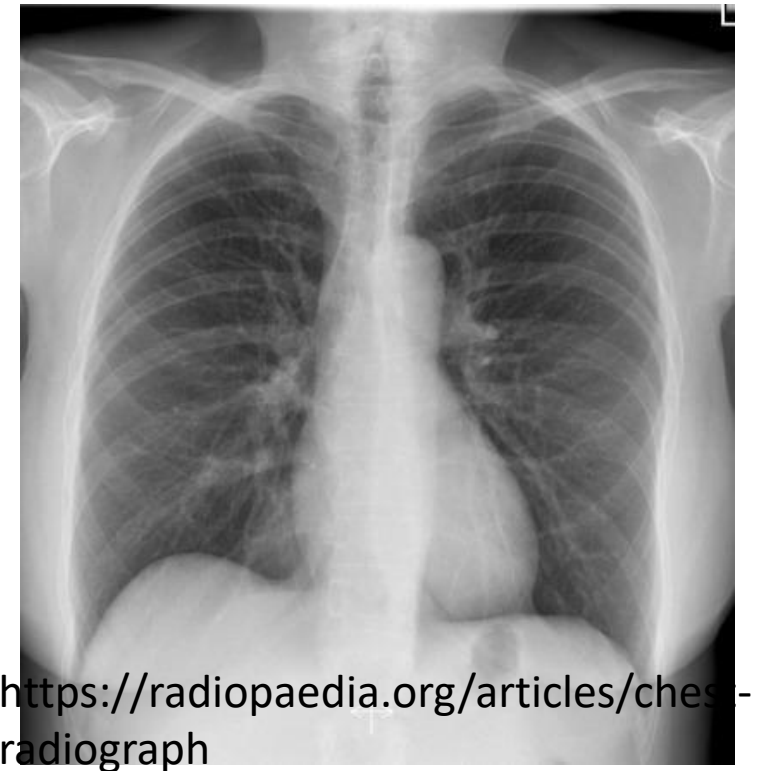
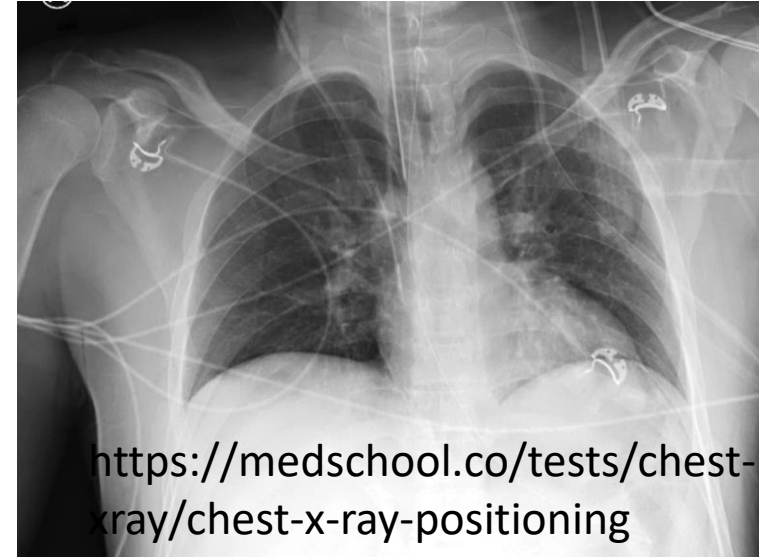
In 85% of cases, patients meet this criterion because the patient is in the back position, however, in 15% of cases the patient may be bent to one side or the other and may not be fully positioned in the back position for various reasons.



Analysis of the picture criteria

The chest should be visualized in middle of the image.

The analysis of the study concluded that this criteria was met in 98%, but not in 2% of cases, as patients are diverse and often fail to position the detector accurately.



Analysis of the picture criteria

The central beam must be incident perpendicular to 90° of the test site.

In the analysis of the study, this criterion was met in 98% of cases, but not in 2%, because the mobile X-ray machine also has technical problems when the X-ray lamp cannot hold 90° and "slips" a few degrees forward.



<https://www.siemens-healthineers.com/gr/radiography/mobile-x-ray/polymobil>



<https://www.siemens-healthineers.com/radiography/mobile-x-ray/polymobil>

Analysis of the picture criteria

Projection criteria for sleeping patients is that the hands be slightly away from the body so that the scapula do not cover the lung areas.

In 95% of cases, this criterion was not met because of limited mobility. 5% of all patients were able to move their arms slightly away from the body.

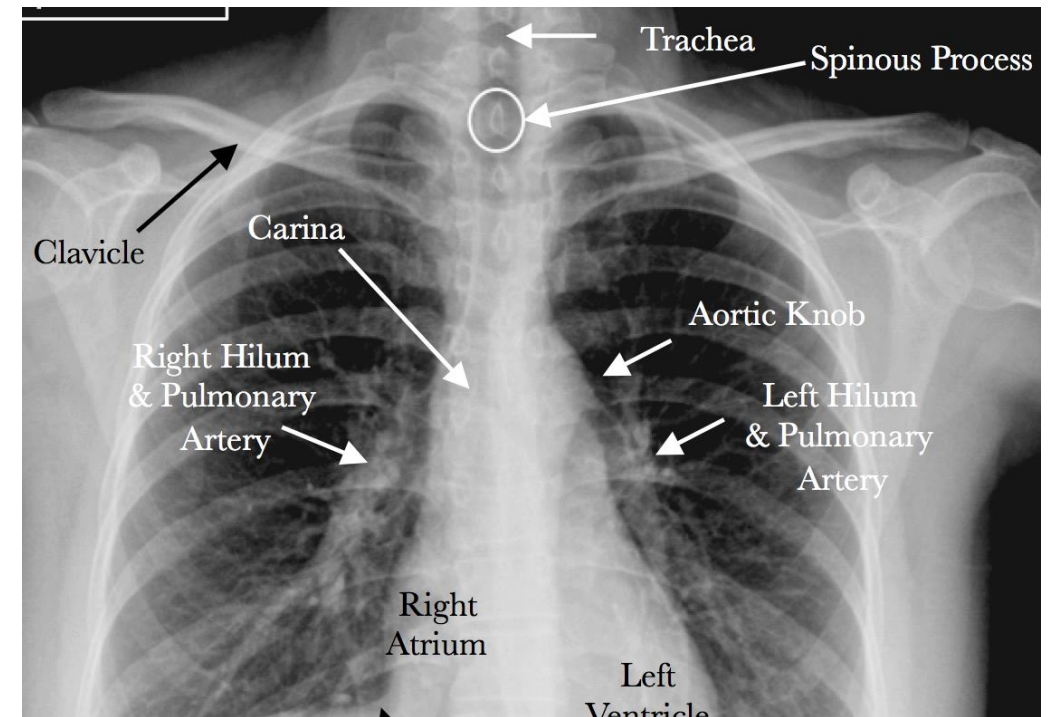


https://www.researchgate.net/figure/Normal-chest-X-ray-on-the-1-st-postoperative-day-in-Intensive-Care-Unit_fig1_317545948

Analysis of the picture criteria

Lung visualization- the roots of the lungs should be structured, which indicates that the ventilation of the lungs are not disturbed, the trachea and major bronchi also need to be visualized.

When studying the obtained data, this criterion corresponds to 100% of cases.

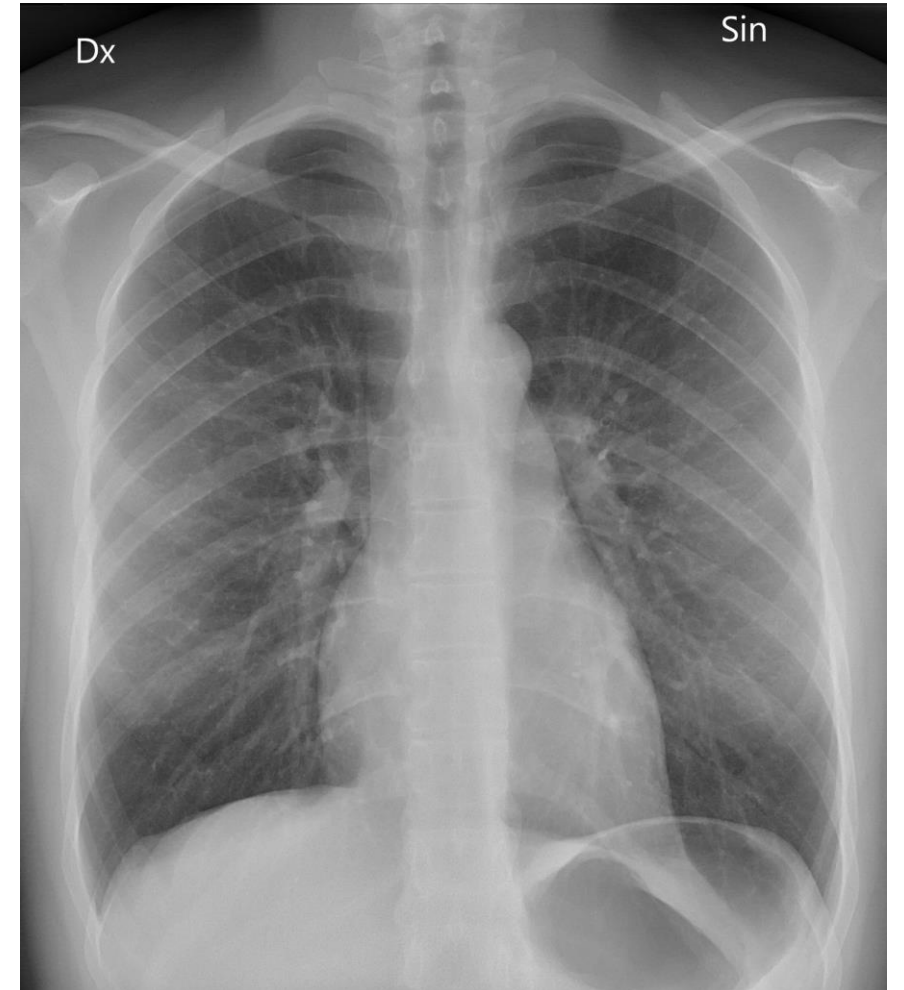


<https://www.pinterest.com/pin/411797959657604751/>

Analysis of the picture criteria

The seventh cervical vertebrae should be included, it is an important reference point for the radiologist to navigate the image.

In 98% of cases this seventh cervical vertebra is included, however, in 2% of cases this criterion was not fulfilled.



Analysis of the picture criteria

In the examinations of the chest it is possible to see pleural cavities, in the straight projection only the anterior ones are visualized. Infiltrative changes have often been observed in these areas of the lungs.

When evaluating the results of the study in the examinations in 100% of cases this criterion was met. Ribs may overlap over important anatomical structures when performing chest X- ray. It is seen when the bed is not positioned exactly horizontally and the head is slightly raised. When evaluating the results of the study in 100% of cases this criterion was observed and the ribs did not cover important anatomical structures.

Conclusion

Examination with a mobile X-ray machine is much more limited because the patient can be examined in a straight projection (AP), but standard examinations such as a straight projection (PA) and a lateral projection (LL) cannot be performed.

Image quality is mostly affected by the inability of the radiologist to interact with the patient, as the patient may be unconscious and unable to participate in proper projection.

The technical capabilities of mobile X-ray equipment are also slightly more limited than those of stationary X-ray equipment. The distance of the focus detector of the mobile X-ray machine is 1.30m, but in order to examine the chest with the correct technical parameters, the required distance of the focus detector is 1.50m - 1.80m.

Conclusion

Protection of the patient, the radiologist's assistant and the surrounding patients is a key factor.

The radiologist's assistant must understand and be able to explain the safety rules to others, as well as provide personal protective equipment against ionizing radiation. In hospital when performing X-ray in departments the protection does not perform that well.



<http://comfortmedical.sg/>



<https://www.snexplores.org/article/experts-rethink-need-for-x-ray-shielding-of-patients>

Conclusion

When performing a chest X-ray of patients after cardiac surgery in cardiology departments, the radiologist's assistant is often unable to meet the criterion of correct projection because the patient is connected to life-support devices that may make it difficult to access the mobile X-ray machine.

Thank You
for Your attention!