UCLA Radiological Sciences Quality Assurance Series

Pediatric Chest Imaging

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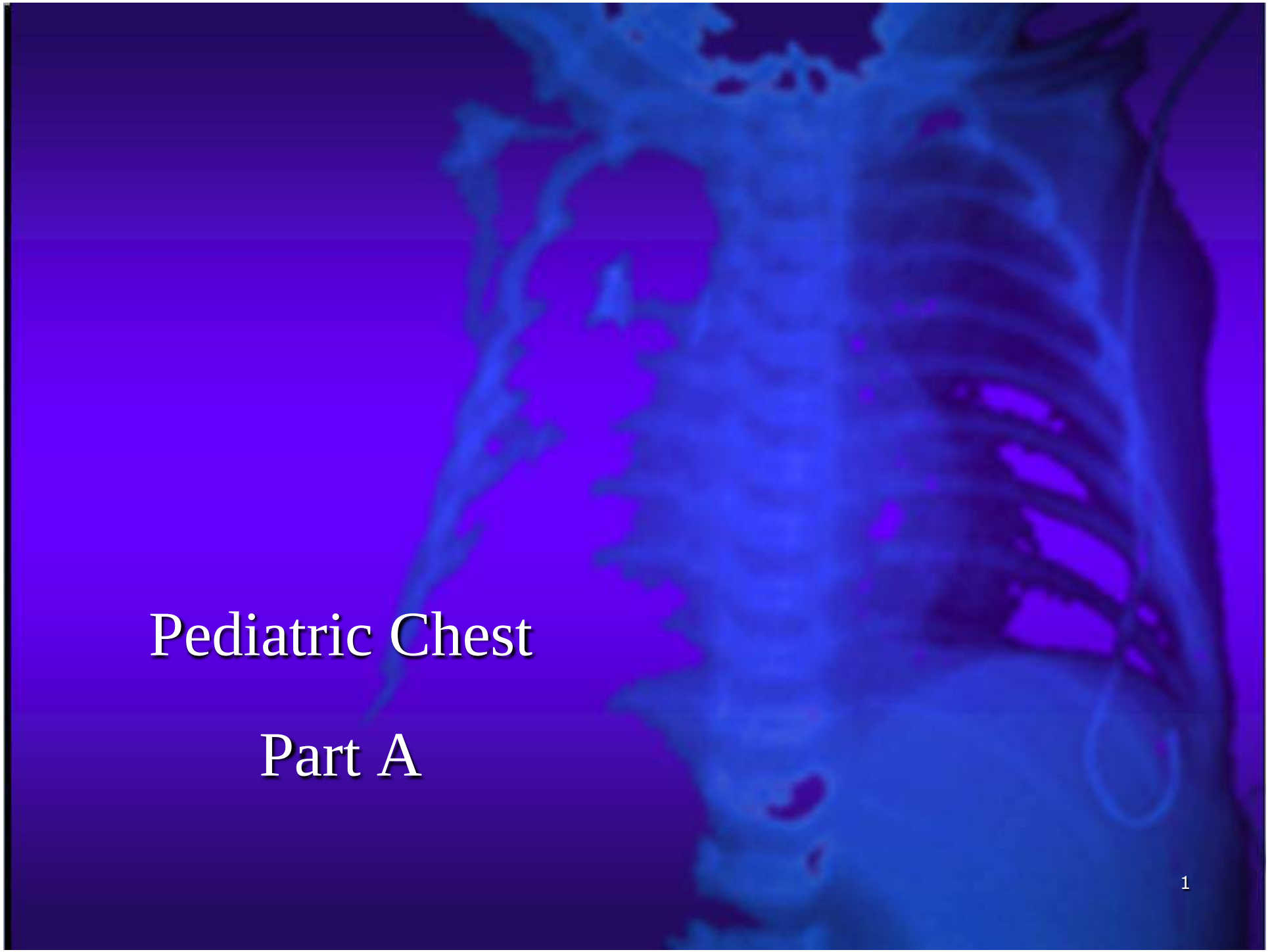

Pediatric Chest

Part A

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Introduction

Successful imaging of the Pediatric Patient requires patience, practice and specialized skills that are gained both through practical knowledge as well as hands on experience. The following training module was designed to highlight the most common imaging mistakes that give rise to poor quality pediatric chest radiographs.

Introduction

The typical pediatric population normally comprises the age group from birth to 18 years. In our experience, the majority of pediatric image quality problems occur with patients under 7 years of age. For this reason the following presentation will primarily focus on the younger pediatric patient and the specific problems encountered when imaging smaller anatomy.

In most cases, two images will be presented on the same patient side by side. One will show a poor quality image noting the imaging error and the other will demonstrate the same patient properly imaged with high quality results. By displaying these images side by side, the technologist will be better able to see some of the more subtle imaging errors and the degradation of quality that can lead to difficultly in diagnosis.

The Pediatric Chest

Imaging the pediatric chest can be a challenging and delicate exam to perform, in particular for the technologist who only occasionally encounters these studies. Since the pediatric chest can be extremely small (as is the case with the neonatal chest), minor flaws in positioning and technique can translate into large image quality problems.

The following Pediatric chest exams demonstrate some of the most troubling image quality errors that lead to interpretation difficulties for the Radiologist, Pediatrician and Neonatologist. Tips and techniques for improving exam quality are presented after each image quality problem.

Positioning

Poor positioning is the number one image quality problem reported by Radiologists. Even a small amount of rotation or incorrect tube angulation can equate to difficulty for the Radiologist to interpret small structures within the thoracic cavity. Anatomical structures, most importantly the heart, become distorted making comparisons to prior exams difficult and often impossible.

Determining exact locations of lines and tubes can also become difficult when the patient is not consistently positioned in a true AP position with correct tube alignment.

Rotation

Technologists will almost always encounter the small patient in various positions of recumbent and nearly all patients will need some adjustment to get the upper body flat.

Most neonatal and ICU patients are intubated causing the upper torso to rotate towards the intubation tubing. In addition, newborns typically exhibit larger head to body ratios than do other pediatric patients, further causing the upper torso to rotate toward the side of the body the head is facing.

Due to the extreme delicate nature of pediatric ICU patients, technologists are hesitant to request any movement of the patient to attempt to straighten out the chest for proper visualization of thoracic structures. However, in most situation's if asked, the child's nurse will be willing to make adjustments for you.

Rotation cont.

The following slides will demonstrate the effect of even the slightest body rotation and the resulting degradation in image quality.

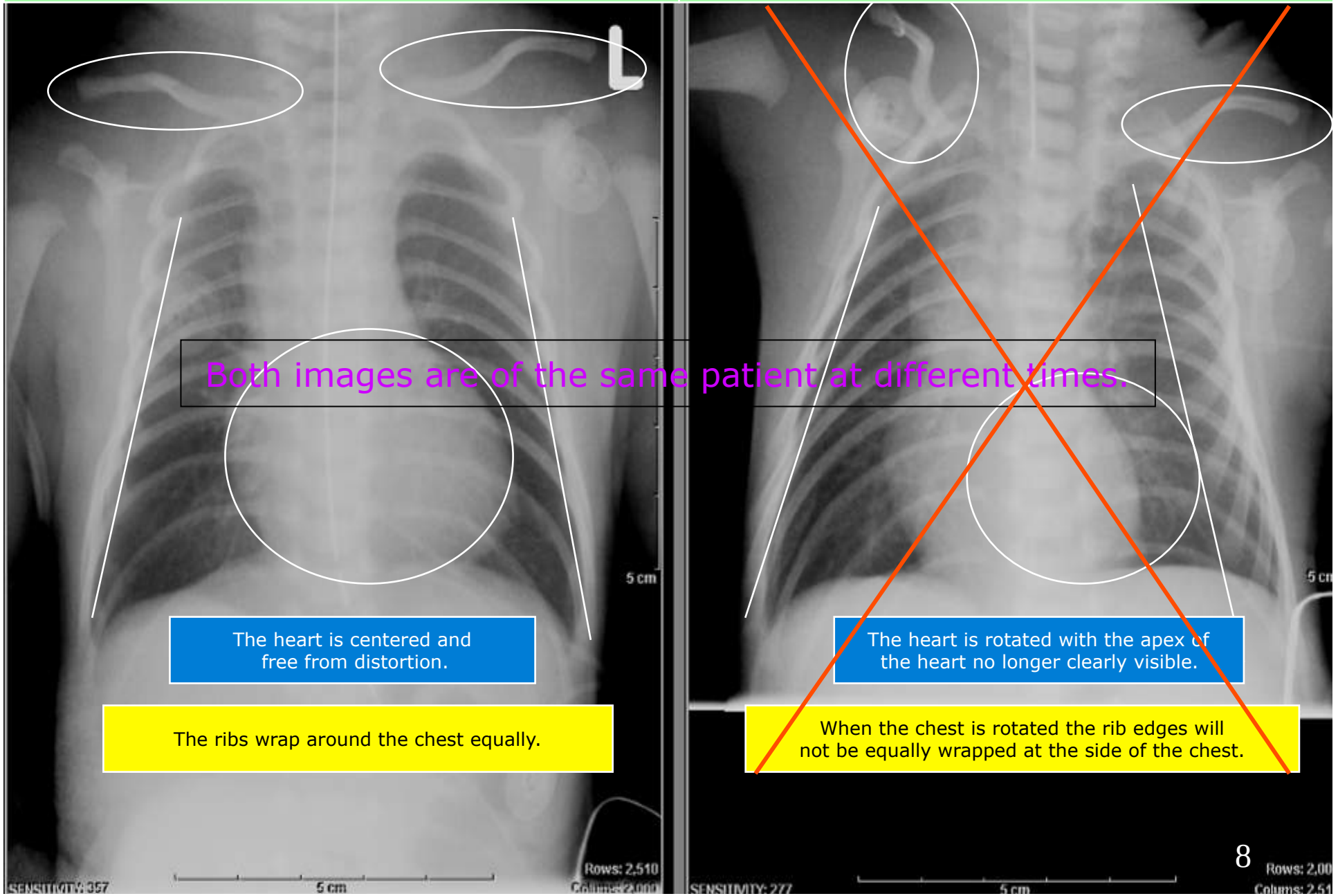
All examples demonstrate one good chest projection and one with various degrees of rotation. Note the two major signs of body rotation:

- Straightening of the ribs cage on one side
- Clavicles not symmetrical

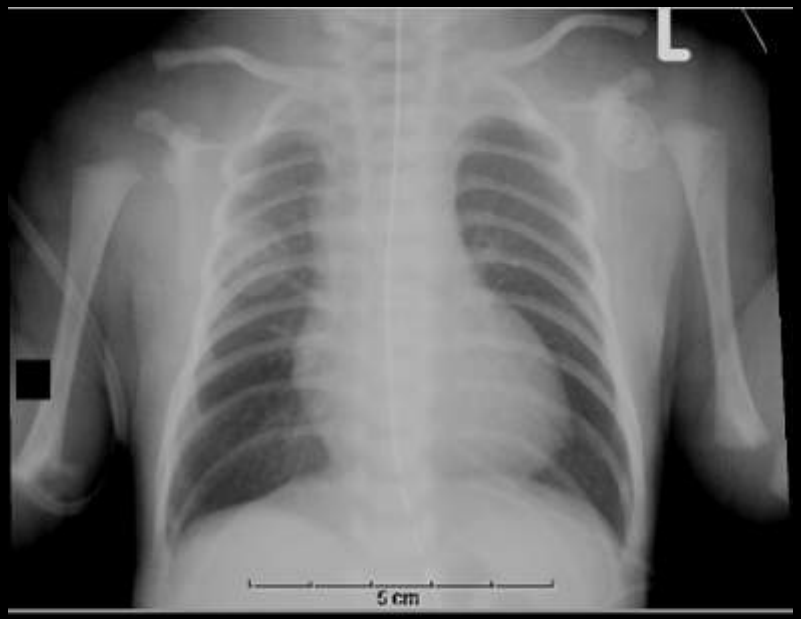
While some examples clearly show significant rotation, other examples demonstrate much more subtle rotation. However in most cases any amount of body rotation could result in organ distortion and diagnostic difficulty.

This image demonstrates a chest free from body rotation. Note the straight equal clavicles.

This image demonstrates a chest with the body rotated towards the right. Note position of the clavicles.

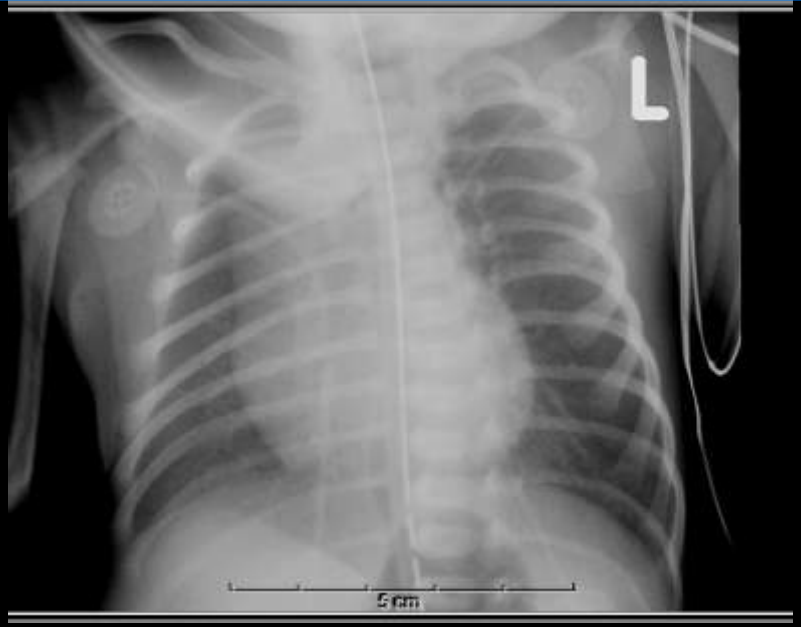


Good
AP position

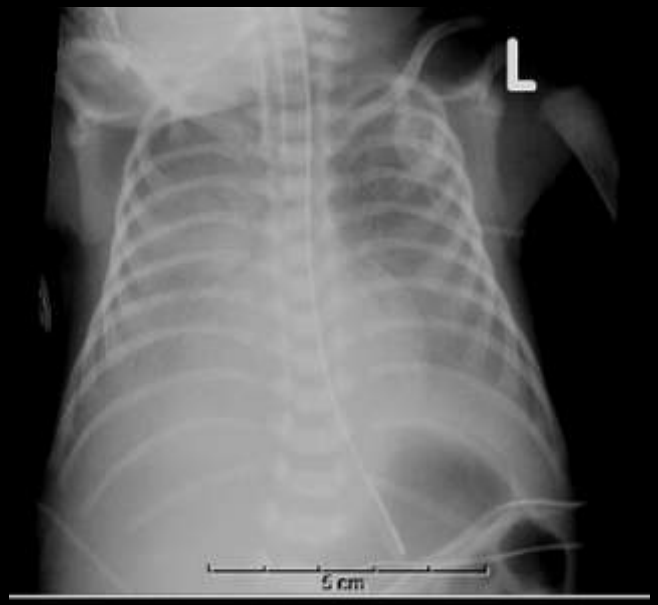


Same patient

Body rotated
Towards Right



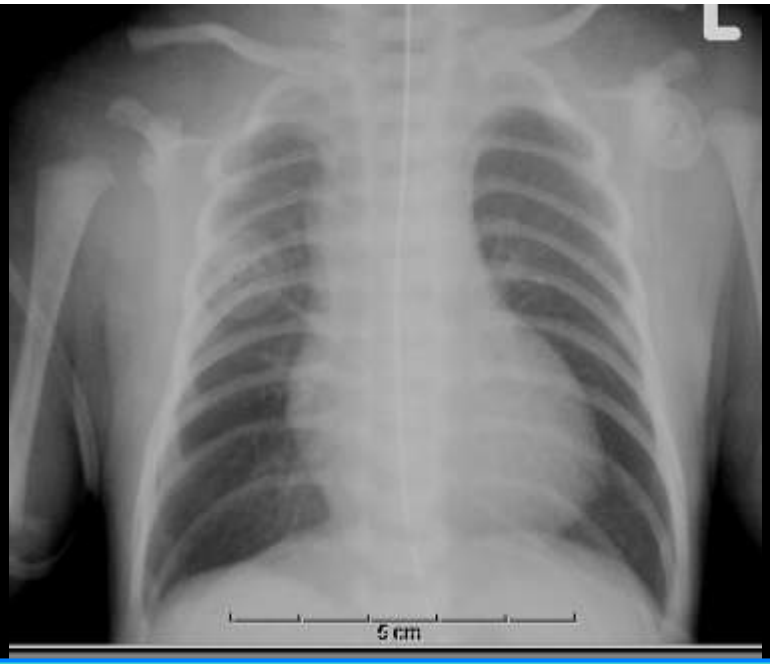
Good
AP position



Same patient

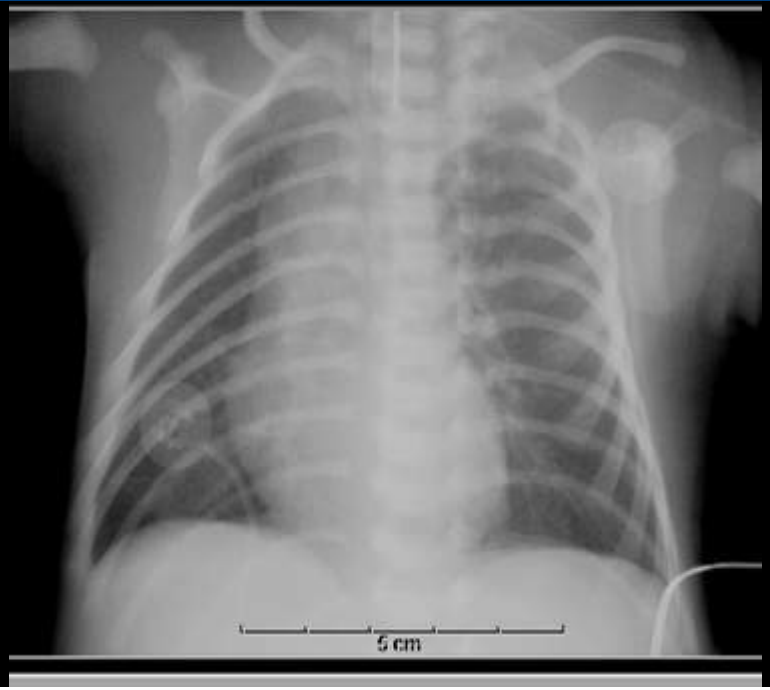
Body rotated
Towards Left

Good
AP position

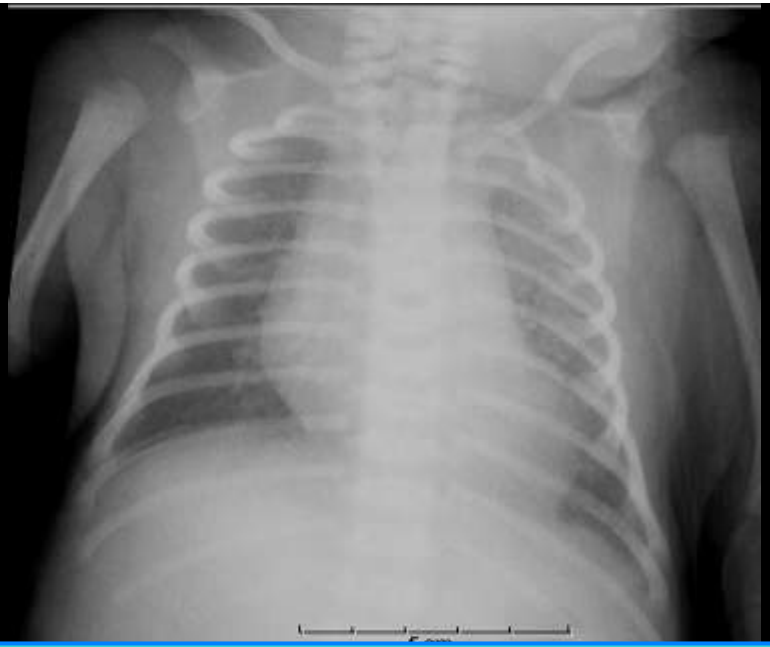


Same patient

Body rotated
Towards Right

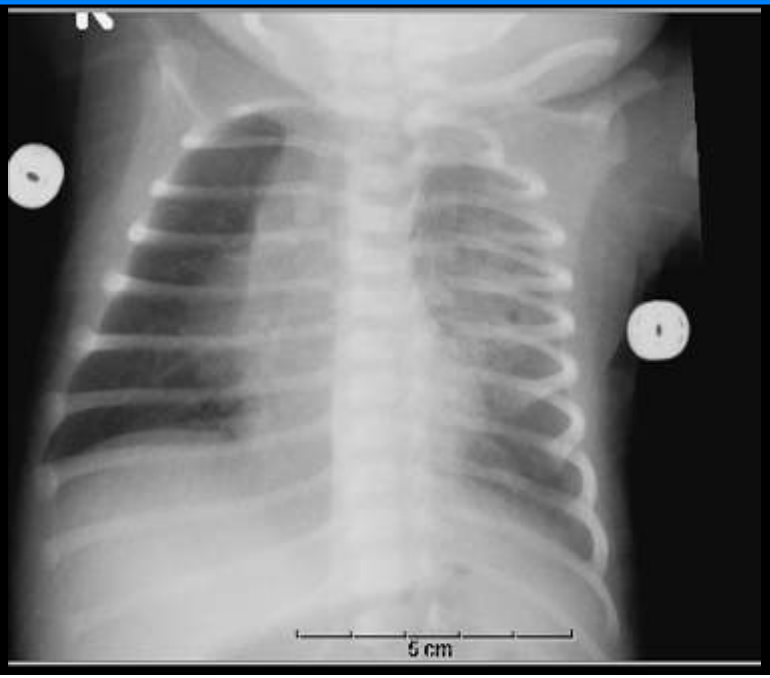


Good
AP position



Same patient

Body rotated
Towards Right



This chest is rotated towards the left.
Note the right shoulder is elevated.

Same baby as in the prior slide with the body in correct position. The right shoulder is now flat.

Straightening the pelvis will naturally rotate the upper body for good position.

The pelvis is now straight, helping to ensure a flat upper body.

Diapers make good positioning rolls.

Most babies, even when intubated, will squirm for a few moments after any adjustment to their position. Wait for the baby to calm down before attempting to take the exposure, or your result will be similar to this picture.

Patients on respiratory oscillators are extremely sensitive to position change. Locate the patients nurse before attempting any movement of these delicate patients.


Please return any changes made at the patient bedside to the way you found them.

Tips to achieve a true AP projection

- Straighten out the pelvis and the chest will follow.
- Use “rolls” (diapers, sheets or other radiolucent material) to prop up body side being sure to keep the “prop” away from the chest field.
- If needed, ask the nurse to rotate the head to a more midline position (not always possible).
- After placement of the cassette or movement of the baby into position, let the baby calm down and relax before making the exposure.
- Take a few extra moments to look at your setup before making the exposure, never rush the exam.

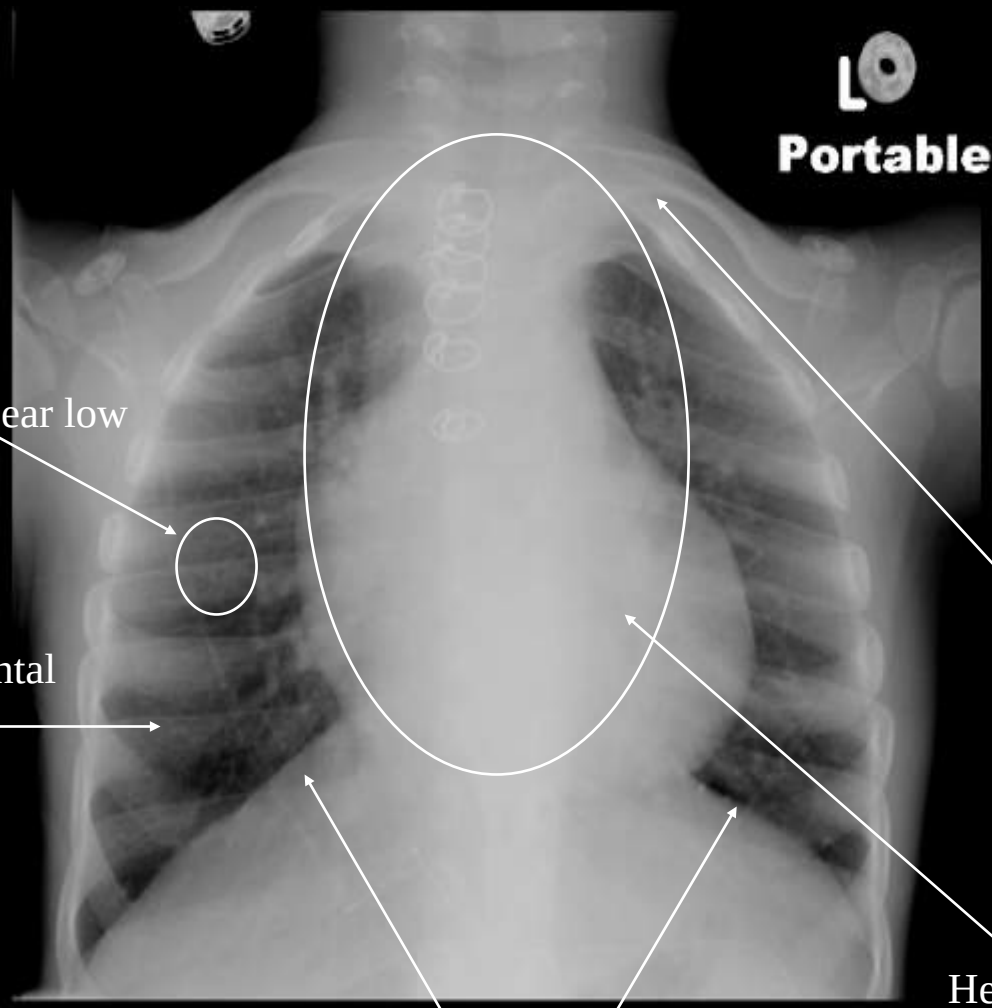
Incorrect Tube Angulations

In the pediatric and very small neonatal chest the margin for error is very small. Even the slightest tube angle miscalculation can result in either foreshortening or elongation, distorting organ prospective.

Premature newborns are typically cared for within incubators. These warming beds do not allow for even the minimum 40” source to plate distance. Therefore a maximum of 30” is typically what the technologist can achieve, requiring even greater accuracy in tube alignment. The following examples show the result of poor tube to plate alignment causing distortion of structures within the thoracic cavity.

Five signs of incorrect tube angulations

1. Ribs are horizontal
2. Diaphragm is elevated or appears flat
3. Clavicles are projected above lung apices
4. Lungs and structures within thoracic cavity appear foreshortened
5. Lung volumes “appear” to be in expiration due to foreshortening



Lung volumes appear low

Ribs are horizontal

Clavicles are projected above apices

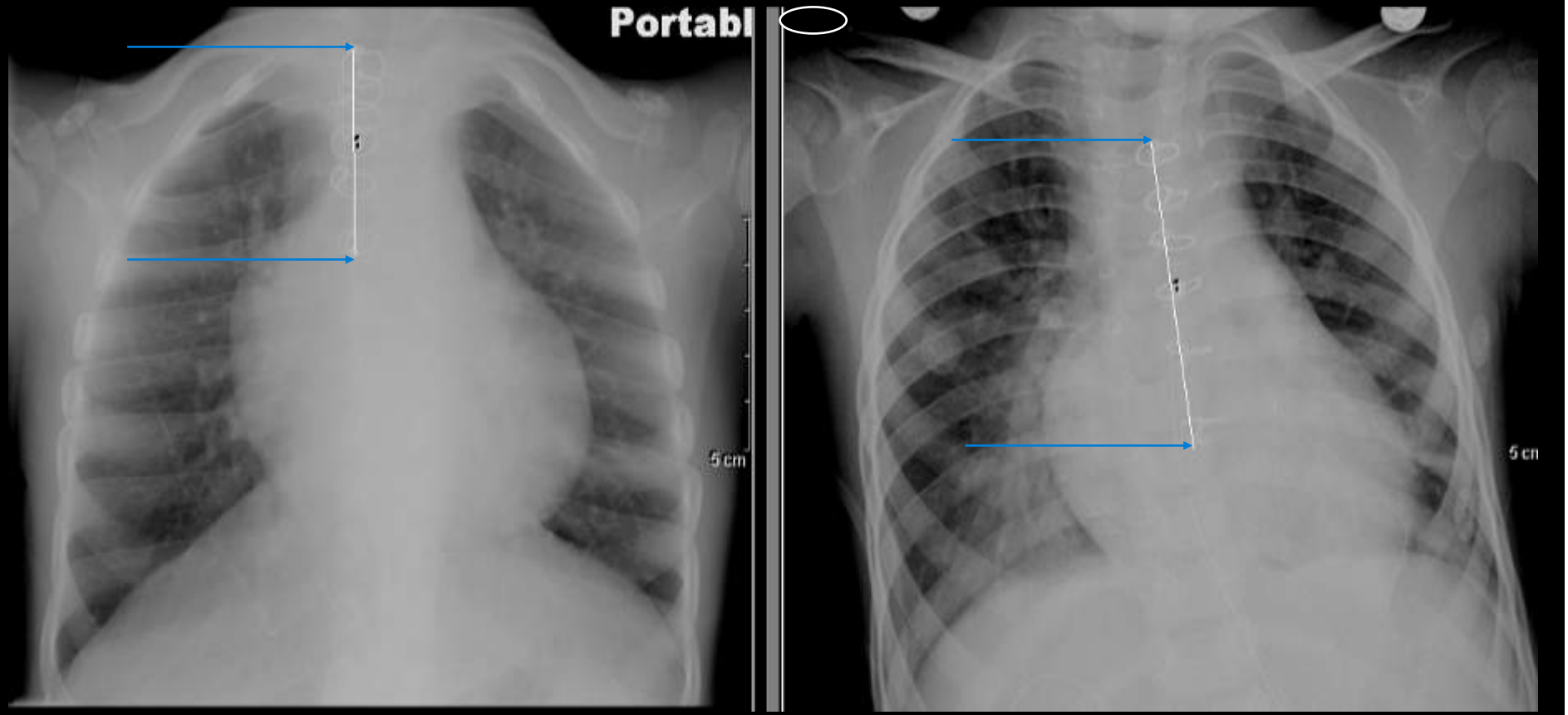
Heart is foreshortened

Diaphragm elevated

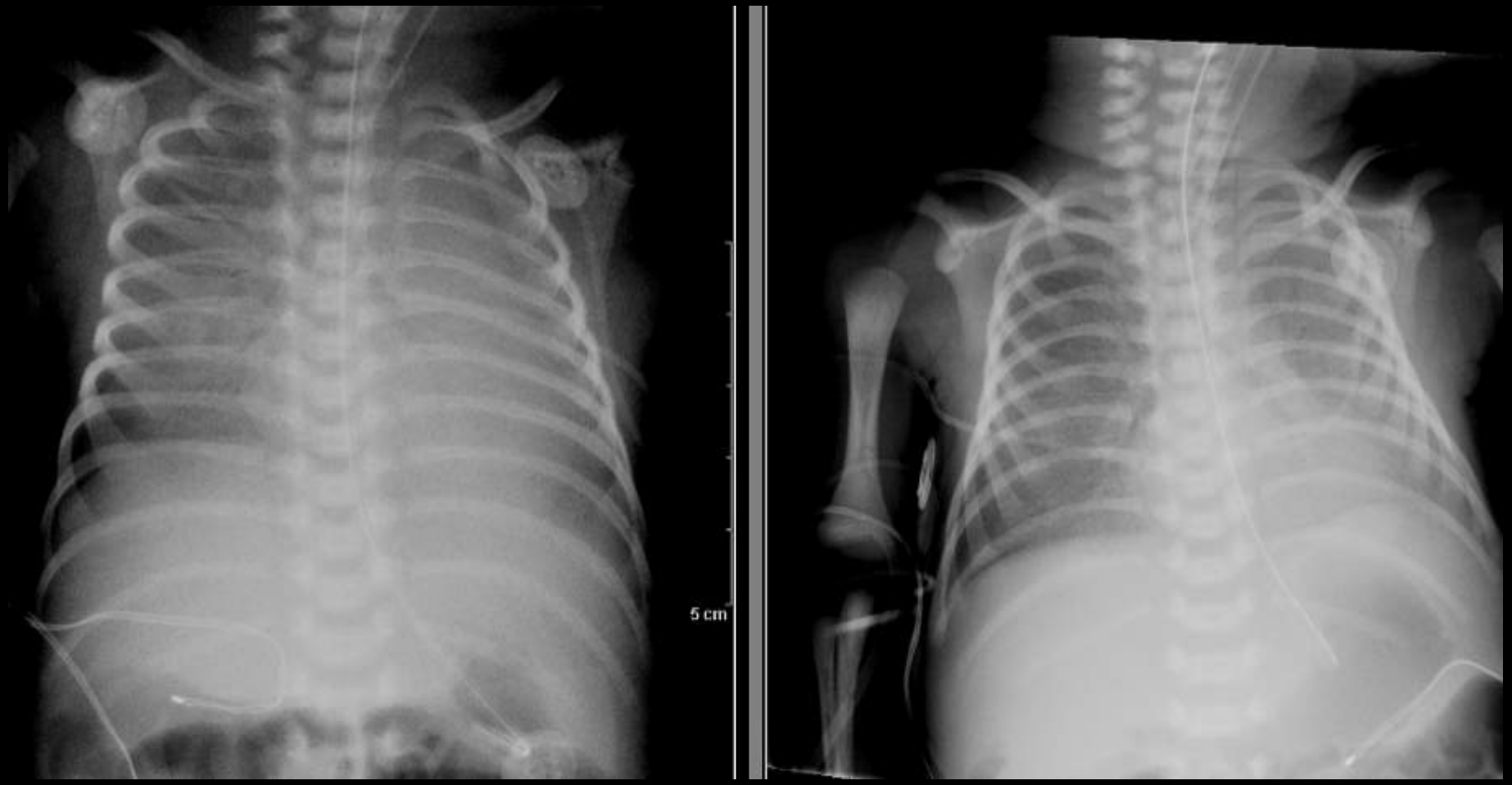
Tube angled towards the head

Poor tube angulation
Lordotic projection

The image on the left demonstrates an exaggerated tube angulation towards the head, while the image on the right shows the same patient with correct tube to plate positioning. Notice the difference between the two images. Using the sternum wires a measurement is made to demonstrate foreshortening. The image on the left measures 44 mm from the upper most wire to the bottom of the wires. The image on right measures 71 mm from top to bottom of wires. A difference of 27mm due to image distortion. A direct comparison to the correctly imaged chest on the right cannot be made.



Same patient



Poor Projection, tube angled towards head

Good AP position
Tube to plate parallel

Same Patient

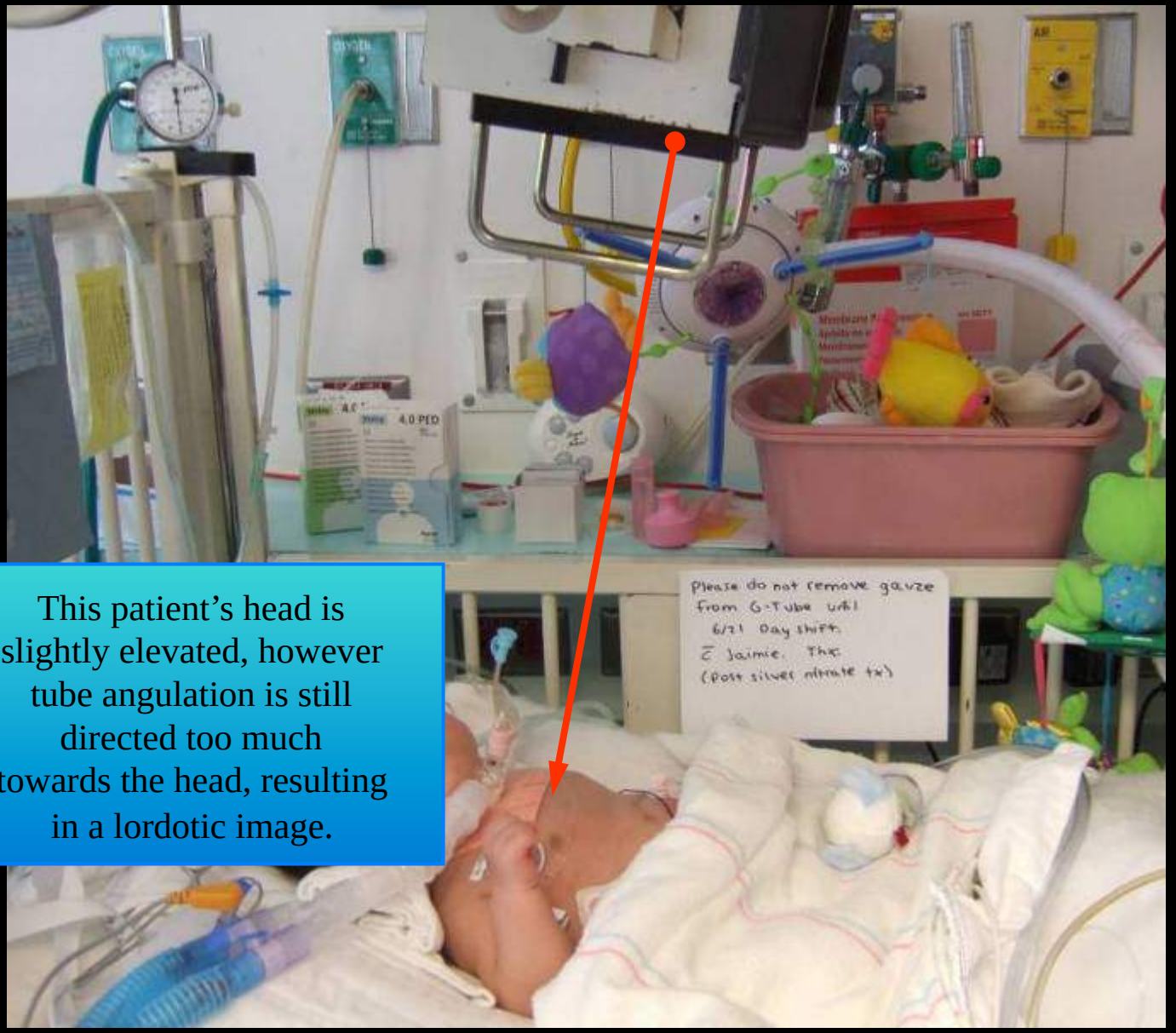
Poor Projection, tube angled towards head

Good AP position
Tube to plate parallel

The image on the left demonstrates all five signs of poor tube angulation.
The image on the right is the same patient with good tube to plate position.

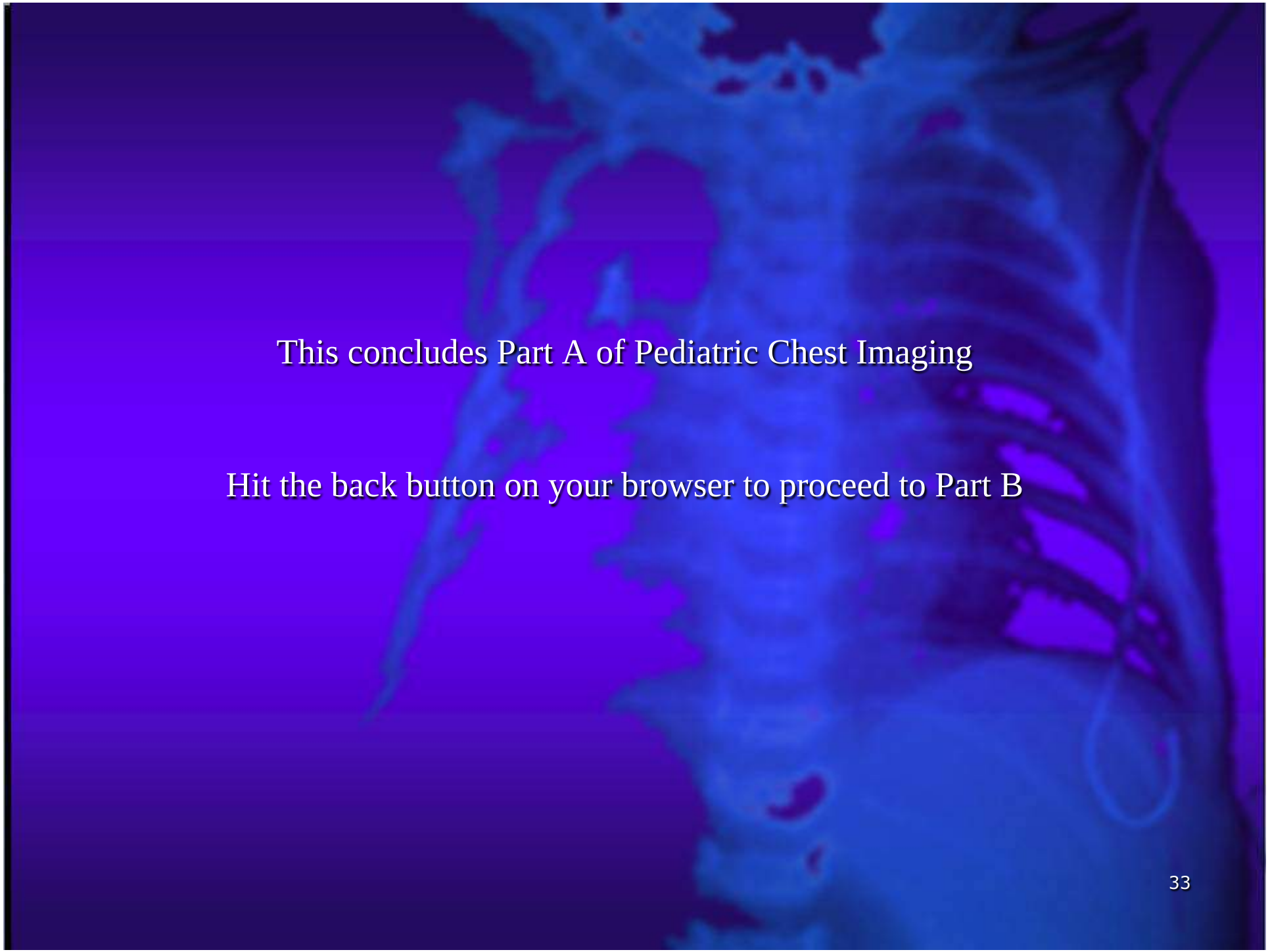
Poor Projection, tube angled towards head

Good AP position
Tube to plate parallel



This patient's head is slightly elevated, however tube angulation is still directed too much towards the head, resulting in a lordotic image.

Same patient with the tube in correct position for a true AP projection.


This concludes Part A of Pediatric Chest Imaging
Hit the back button on your browser to proceed to Part B