



ARAŞTIRMA / RESEARCH

Anatomical assessment of chest radiographs

Göğüs radyografilerinin anatomik olarak değerlendirilmesi

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Abstract

Purpose: The aim of this study was to determine the frequency of anatomical parameters and their measurement as seen on normal posteroanterior (PA) chest radiographs in a Turkish population.

Materials and Methods: We evaluated fifty normal PA chest radiographs of Turkish population adults. The frequency of anatomical parameters and their measurement with respect to the diaphragm was evaluated.

Results: The frequency of anatomical parameters and their measurement with respect to the diaphragm is as follows: level (right side higher in 98%, left and right sides same level 2%), lobulation (88% absent, 12% present), eventration (98% absent, 2% present) and contour (90% smooth, 10% not smooth); level of hilum (right and left sides same level 52%, left side higher 36%, right side higher 12%); number of pairs of ribs (twelve 96%, unable to determine 4%); number of ribs superposing the lung parenchyma (seven 2%, eight 4%, nine 24%, ten 70%); distance from the lateral margin of the vertebral body to the aorta (16.44 ± 4.35 mm); angle between the vertebral body and the aortocapulmonary line (16.04 ± 3.110); the carina angle (58.46 ± 11.130) and the cardiothoracic ratio (38.75 ± 4.27).

Conclusion: The data presented in this study may be useful in understanding normal thoracic structures. A knowledge of the normal anatomy as well as variations are significant for physicians in the assessment of chest radiographs.

Key words: Chest radiograph, carina angle, cardiothoracic ratio.

Öz

Amaç: Bu çalışmanın amacı bir Türk popülasyonunda normal posteroanterior (PA) göğüs radyografisinde normal anatomik bulguların frekansı ve ölçülerinin tespit edilmesidir.

Gereç ve Yöntem: Elli sağlıklı Türk erişkinin normal PA radyografileri değerlendirilmiştir. Anatomik parametrelerin sıklıkları ve diyaframa göre ölçümleri de değerlendirilmiştir.

Bulgular: Anatomik parametrelerin ve ölçümlerinin diyaframa göre frekansları şöyledi: Seviye (sağ taraf daha yüksek %98, eşit %2), lobulasyon (%88 yok, %12 var), evantrasyon (%98 yok, %2 var), kontür (%90 düzenli, %10 düzensiz), hilum seviyesi (eşit %52, sol yüksek %36, sağ yüksek %12), Kosta çifti sayıları (12; %96, tespit edilemeyen %4), akciğer parankimine süperpoze olan Kosta sayısı (yedi %2, sekiz %4, dokuz %24, on %70), vertebral cismin lateral kenarının aortaya olan uzaklığı ($16,44 \pm 4.35$ mm) vertebra cismi ve ve aortikopulmoner hat arası açısı (16.04 ± 3.110), karina açısı (58.46 ± 11.130) ve kardiyotorasik oran (38.75 ± 4.27).

Sonuç: Bu çalışmada sunulan veriler normal torasik yapıların anlaşılmasında katkı sağlayacaktır. Normal anatominin yanı sıra varyasyonlarının da bilinmesi hekimlerin göğüs radyografilerini değerlendirmeleri açısından önemlidir.

Anahtar kelimeler: Göğüs radyografisi, karina açısı, kardiyotorasik oran

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INTRODUCTION

Initial radiologic examination for many patients is the Thorax x-ray film¹. Thorax x-ray film is the most commonly ordered radiologic routine which is inexpensive and can be performed in most health care settings. It is useful in medical decisions for countless medical conditions. It helps to discover abnormalities and diseases of the airways, blood vessels, bones, heart and lungs. Therefore it is fundamental that physicians have an accurate knowledge in interpreting chest x ray films to detect the variations manifested in these films^{1,2,3}. A systematic assessment and experience is of top priority to extinguish reviewer induced mistakes for Thorax graphy. An accurate assessment of chest x-ray films nessecitates experience with normal anatomy and variations of the region².

Diaphragma is an anatomic structure made of muscle and aponeurosis which seperates abdomen and thorax from each other. On a normal Thorax X-ray, right diaphragm is higher than the left diaphragma. Evantration is defined as the abnormal elevation and contour of the dome of diaphragma to due absence and deficiency of muscle of diaphragma or incomplete anterior muscularisation^{4,5,6}. Depending on ones strength diaphragmatic deep breathing level (inspiration) changes.

This study aims to determine the presence and size of anatomical parameters as found on normal posteroanterior chest x-rays in an adult population. This will supply basic approach understandings for systematic review of chest x-ray

films and the frequency of common thoracic x-ray images on random graphies.

MATERIALS AND METHODS

We evaluated fifty normal PA adult chest radiographs. The cases were between 20-63 years of age (mean 42 years) with 21 men and 29 women. The height and weight of the cases are unknown. The frequency of anatomical parameters and their measurement with respect to the diaphragm was evaluated.

The level (left or right side higher, left and right sides same level), lobulation (absent or present) (Fig. 1A), eventration (absent or present) (Fig. 1B) and contour (smooth or not smooth) (Fig.1C) of diaphragm; level of hilum (right and left sides same level, left side higher or right side higher); number of pairs of ribs; number of ribs superposing the lung parenchyma were assessed. The distance from the lateral margin of the vertebral body to the aorta; the angle between the vertebral body and the aorticopulmonary line; the cardiothoracic ratio (maximum transverse diameter of the heart shadow/maximum transverse diameter of the thorax X 100) (Fig 1D) and the carina bifurcation angle were measured (Fig.1E).

Statistical analysis

Statistical analysis was performed using SPSS software (Version 17.0, SPSS Inc., Chicago, IL, USA). Descriptive analysis (mean, standard deviation, frequencies) are evaluated and reported.

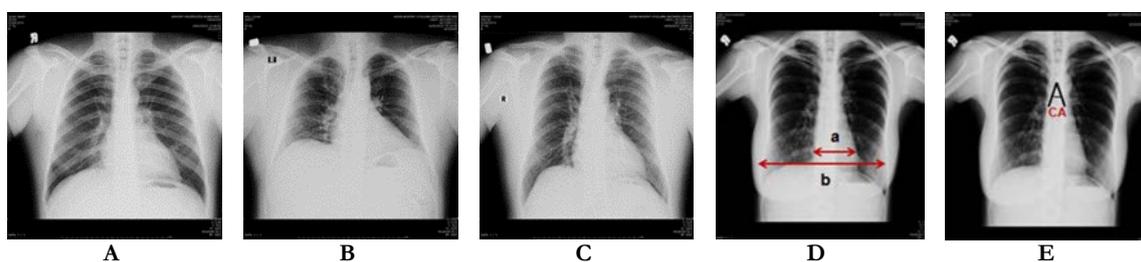


Figure 1. The lobulation (A), eventration (B) and contour (not smooth) (C) of diaphragm were shown with arrows. The cardiothoracic ratio was estimated with following formula: $a/b \times 100$ (a: maximum transverse diameter of the heart shadow, b: maximum transverse diameter of the thorax) (D). The carina bifurcation angle (CA) were measured (E).

RESULTS

The frequency of anatomical parameters and their measurement with respect to the diaphragm is as follows: level (right side higher in 98%, left and right sides same level 2%), lobulation (88% absent, 12% present), eventration (98% absent, 2% present) and contour (90% smooth, 10% not smooth); level of hilum (right and left sides same level 52%, left side higher 36%,

right side higher 12%) (Table 1); number of pairs of ribs (twelve 96%, unable to determine 4%); number of ribs superposing the lung parenchyma (seven 2%, eight 4%, nine 24%, ten 70%) (Table 2); distance from the lateral margin of the vertebral body to the aorta (16.44 ± 4.35 mm); angle between the vertebral body and the aorticopulmonary line (16.04 ± 3.110); the carina bifurcation angle (58.46 ± 11.130) and the cardiothoracic ratio (38.75 ± 4.27) (Table 3).

Table 1. The frequency of anatomical parameters of diaphragm.

Parameters		n	%
Level of diaphragm	Right side higher	49	98
	Left side higher	0	0
	Right and left sides same level	1	2
Lobulation of diaphragm	Absent	44	88
	Present	6	12
Eventration of diaphragm	Absent	49	98
	Present	1	2
Contour of diaphragm	Smooth	45	90
	Not smooth	5	10
Level of hilum	Right side higher	6	12
	Left side higher	18	36
	Right and left sides same level	26	52

Table 2. The frequency of anatomical parameters of ribs

Parameters		n	%
Number of pairs of ribs	Twelve	48	96
	Unable to determine	2	4
Number of ribs superposing the lung parenchyma	Seven	1	2
	Eight	2	4
	Nine	12	24
	Ten	35	70

Table 3. The measurements of thorax

Parameters	Range	Mean \pm SD
VB-A (mm)	5-27.71	16.44 \pm 4.35
AVB-APL (°)	9-22	16.04 \pm 3.11
CTR	30.77-49.26	38.75 \pm 4.27
CA (°)	40-80	58.46 \pm 11.13

VB-A: The distance from the lateral margin of the vertebral body to the aorta; AVB-APL: the angle between the vertebral body and the aorticopulmonary line; CTR: the cardiothoracic ratio; CA: the carina bifurcation angle.

DISCUSSION

Most of the studies on this particular topic reflect results from European and American population⁷. There have been so few reports describing the normal radiographic anatomy and variations of the thoracic structures in Turkish population. Therefore

we assessed normal PA chest radiographs and analysed the radiographic anatomy in detail among Turkish population. The results represented here show adult thorax graphies of our cases to be in line with literature displaying expected measurements. On a normal Thorax X-ray, visible structures are; trachea, hila, lungs, diaphragm, heart, aortic knuckle,

ribs, scapulae, breasts and bowel gas. Important obscured and invisible structures are: sternum, esophagus, spine, pleura, fissures and aorta^{1,2}.

Bilateral diaphragmatic eventration usually displays poor prognosis. It may be congenital in nature and with a defect of cervical myotomes migrating with intact nerve supply posteriorly. It maybe primary or a result of phrenic nerve damage. These cases are generally asymptomatic but if serious eventration is present acute lung, heart and gastrointestinal consequences may occur especially in children⁸.

The surface of diaphragm is smooth. However due to diaphragmatic hernias and abnormal enlargement of the liver and some other abdominal content it may be irregular or lobular. Lobulation of the diaphragm may point to a serious problem in the presence of a large hernia². Hila consists of vessels, lymph nodes and bronchi. The left hilum is usually higher than the right. Abnormalities of these structures are presented by a change in position or enlargement of hilar size or elevated density. Asymmetric hilar enlargement may be due to malignancy². The ribs are important points in assessment of thorax X-rays. The anterior edge of 5-7 ribs and posterior edge of 8-10 ribs should be visible to indicate complete breath. Visualization of more than 7 ribs from the anterior suggest lung hyperextension. The image must be demonstrating the sixth rib on the anterior and the ninth rib on the posterior over the diaphragm dome for an accurate Thorax X-rays^{9,10}. Cardiothoracic ratio helps to evaluate the size of the heart. It is the ratio of the image of the cardiac diameter to thoracic diameter. In normal subjects this ratio must be >0.5 . Increased cardiothoracic ratio refers to increased heart size and warrants search for associating pathologies^{11,12,13}. Carina is a part of the trachea found at the base and the carina bifurcation angle is formed when the main bronchi is divided into right and left branches. It usually sits in the T4/5 plane. The absolute mean value of the tracheal bifurcation angle was found to be 79.7 degrees and the range 37-105 degrees^{14,15}. An increased tracheal carinal bifurcation angle is shown to indicate left atrial enlargement. If it is greater than 100 degrees it can be concluded that left atrial enlargement is present^{16,17}.

The assessment of thorax X-ray of our cases displayed the usual primary anatomic structures to be in line with textbook and literature data. The relatively small sample size may weaken the power

of the study but that, these graphics are obtained from healthy subjects will help better evaluate the variables of thoracic x-ray films. The data presented in this study may be useful in understanding normal thoracic structures. A knowledge of the normal anatomy as well as variations are significant for physicians in the assessment of chest radiographs.

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