

Radiographic characteristics of asthma

Yu-Jang Su^{1,2}

¹Department of Emergency Medicine, Mackay Memorial Hospital, ²Department of Oral Hygiene, College of Oral Medicine, Taipei Medical University, Taipei, Taiwan

ABSTRACT

Objectives: A novel and interesting observation is that ribs go less sloped in asthma patients' radiograph than non-asthmatics people. The aim of this study was to investigate whether a smaller horizontal curve of the ribs is a special trait on chest radiograph of asthma patients. **Materials and Methods:** A retrospective review of the chest radiographs of 57 cases of asthma who were admitted between January 2011 and February 2011, and 57 non-asthma patients was performed. Chest radiographs were examined and lines drawn horizontally through the middle point of the sixth rib, and to where the sixth rib reaches the thoracic cage. The angle between these two lines was defined as the angle of rib curve (ARC). The ARCs were then compared between groups using the Student's *t*-test. **Results:** The mean ARC was smaller in asthma patients than in non-asthma patients ($10.7 \pm 4.7^\circ$ vs. $14.3 \pm 4.7^\circ$, $P < 0.0001$). In the asthma group, the mean male ARC was smaller than the mean female ARC ($8.4 \pm 4.1^\circ$ vs. $11.5 \pm 4.7^\circ$, $P = 0.026$); however, there was no statistical difference in gender in the non-asthma group ($P = 0.405$). **Conclusions:** This is the first study to report that the ribs of asthma patients are less sloped than in patients without asthma. This photographic trait may be helpful in daily practice for suspecting a diagnosis of bronchial asthma.

KEY WORDS: Asthma, gender, ribs, thoracic cage

Address for correspondence: Dr. Yu-Jang Su, 92, Section 2, Chungshan North Road, Taipei City 10449, Taiwan.
E-mail: yjsu@ms1.mmh.org.tw

INTRODUCTION

Asthma is a common emergency department problem. The clinical aspects of asthma are paroxysmal respiratory distress, recurrent cough, wheezing, and chest tightness. However, the radiographic traits of asthma have seldom been reported and found. Park reported that acute asthma reversibly increases lung compliance and total lung capacity (TLC).^[1] The authors confirm anecdotal evidence of a smaller horizontal curve of the ribs as a characteristic finding on chest radiographs of asthma patients. We compared the radiographic features of asthma and non-asthma patients.

STUDY DESIGN: DEFINITION OF ANGLE OF RIB CURVE (ARC)

Since the first rib is relatively short and the 12th rib is easily bothered by shadow of the diaphragm and abdominal soft-tissue; the author chose the sixth rib for calculation of ARC.

Because the number of ribs is 12 in each one side of chest, we choose the six ribs and using a chest radiograph of an asthma patient [Figure 1], we drew a line (AB) horizontally through the middle point of the six ribs, and point C was defined as the crossing point where the six ribs reaches the thoracic cage. The angle between the lines AB and AC was defined as the ARC. This was repeated for a non-asthma patient [Figure 2], and we found the ARC to be larger than that of the asthma patient. We then collected the same number of cases of asthma and non-asthma patients from a medical center in Northern Taiwan, and measured the ARC for statistical analysis.

MATERIALS AND METHODS

We performed a retrospective review of 57 cases of asthma who were admitted between January 2011 and

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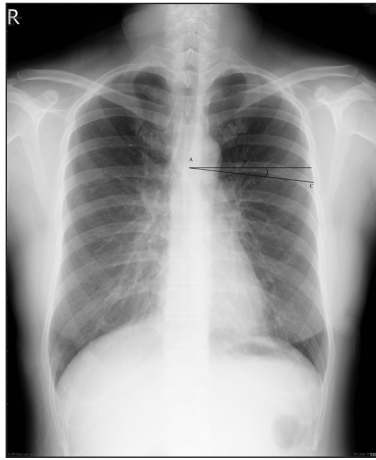


Figure 1: A radiograph of an asthma patient. AB was drawn horizontally through the middle point of the sixth rib; point C is where the sixth rib reaches the thoracic cage. The angle between the lines AB and AC was defined as the angle of rib curve

February 2011, and 57 non-asthma patients who visited our Emergency Department without chest complaints for analyses.

Asthma in the study subjects was defined as “discharged with a diagnosis of asthma from chest ward” and labeled by a pulmonologist. Non-asthmatic patients were randomized selected from Emergency Department in Northern Taiwan medical center without chest complaints and shortness of breath. Exclusion criteria in non-asthmatic patients included presentation as dyspnea or any other chest complaint in the emergency department.

The diagnosis of the 57 non-asthma patients admitted to the Emergency department in Northern Taiwan Medical Center from March 1, 2011 to March 10, 2011 included gastroenteritis ($n=11$), trauma ($n=9$), urinary tract infection ($n=4$), depression ($n=4$), drug overdose ($n=3$), rhinitis/pharyngitis/tonsillitis ($n=3$), intracranial hemorrhage ($n=3$), headache/dizziness ($n=3$), abdominal pain ($n=2$), myalgia/neuralgia ($n=2$), upper gastrointestinal bleeding ($n=2$) and infectious diarrhea, pneumonia, constipation, pelvic inflammatory disease, stroke, appendicitis, hyponatremia, convulsions, pancreatitis, hypertension and urolithiasis in one case each.

We measured the ARC of each case and analyzed the data using the SPSS statistical software (SPSS for Windows, Version 11.0, SPSS Inc., and Chicago, IL). The document number for pulling and reading medical records of the asthma patients is 2511243. The Student’s *t*-test was used for statistical analyses, and significance was set at a *P* value of less than 0.05.

RESULTS

The asthma group consisted of 15 males and 42 females with a mean age of 48.1 years (SD ± 11.8, range: 31-64 years). The

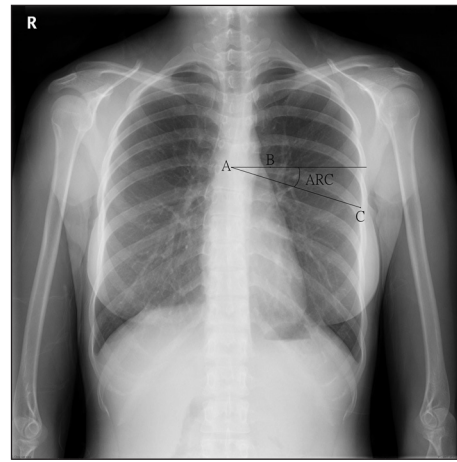


Figure 2: A chest radiograph of a non-asthma patient. The angle of rib curve was larger than in the asthma patient

Table 1: Basic data and comparisons of age and angle of rib curves of the asthma and non-asthma groups () = n, = significant statistical difference

	Asthma (57)	Non-asthma (57)	<i>P</i> value (2-tailed)
ARC	10.7±4.7	14.3±4.7	0.000*
Age	48.1±11.8	35.2±12.2	
	Asthma, male (15)	Asthma, female (42)	
ARC	8.4±4.1	11.5±4.7	0.026*
Age	49.5±11.1	47.6±12.1	
	Non-asthma, male (30)	Non-asthma, female (27)	
ARC	13.9±5.3	14.8±4	0.405
Age	36.9±11	33.4±13.4	

*Significant statistical difference

non-asthma group consisted of 30 males and 27 females with a mean age of 35.2 years (SD ± 12.2, range: 20-61 years). The ARC was smaller in asthma patients than in non-asthma patients (10.7 ± 4.7° vs. 14.3 ± 4.7°, *P* < 0.0001). In the asthma group, the mean male ARC was smaller than the mean female ARC (8.4 ± 4.1° vs. 11.5 ± 4.7°, *P* = 0.026); however, there was no statistical difference in gender in the non-asthma group (*P* = 0.405) [Table 1] [Figure 3]. In asthma and non-asthmatics patients, age is not significantly related to ARC (*P* = 0.714, and *P* = 0.107) [Figure 4].

DISCUSSION

Asthma is commonly seen in daily clinical practice. It is a systemic disease that involves inflammation of the pulmonary airways and bronchial hyperresponsiveness leading to the usually reversible clinical symptom of a lower airway obstruction. In acute episodes of asthma, hyperacute asthma was so-called acute respiratory failure within 3 h after acute exacerbation of asthma. Physiologically, bronchial hyperresponsiveness is documented by decreased bronchial airflow after bronchoprovocation with allergens such as cold air, respiratory tract infection, and cigarette smoke. The gross pathology of asthmatic airways displays lung hyperinflation, smooth muscle hypertrophy, mucosal edema, and mucus gland hypersecretion.^[2] Acute

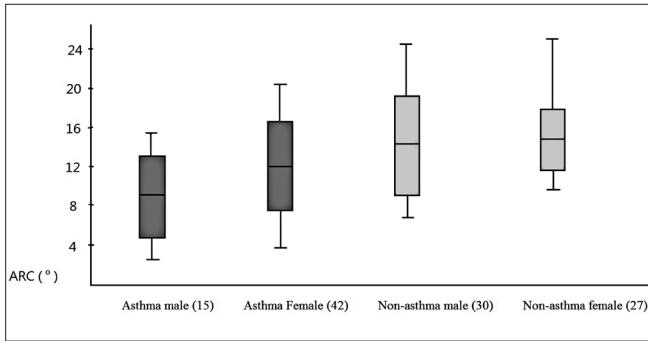


Figure 3: Comparisons of angle of rib curves (ARCs) in different groups by asthma, non-asthma, and gender. Asthma male have the smallest ARC than other group (n)

reversible increases in TLC do occur during exacerbations of asthma was described in the year of 1990.^[3] There was a significantly smaller ARC in the asthma group than the non-asthma group, and a smaller ARC in the males in the asthma group compared to females. The lesser curving of the ribs in asthma may results from the hyperinflation in asthma patients.

In asthmatic patients, inspiratory with continuous outward motion of the upper anterior rib cage produced a horizontal aligned ribs in chest radiography.^[4]

In non-asthmatics expiration, the respiratory muscles are completely relaxed, but this is not the case in patients with asthma. Therefore, a smaller ARC may be the anatomic consequence of asthma rather than the cause. This characteristic finding has never been previously described.

In gender, female asthmatic patients have significantly lower strength of inspiratory and expiratory muscle than male, this related to this study's finding of smaller ARC in male asthmatic patients than female's.^[5] Lesser the hyperinflation associated with bronchoconstriction, lesser is the end-expiratory volume in the rib cage leading to larger ARC.^[6]

We all know that diagnoses of asthma including evaluation for reversibility of airflow obstruction and bronchial hyperresponsiveness, not depending on radiographic trait of chest radiographs. However, this study applied an interesting method and glance in raising suspicion of asthma patients.

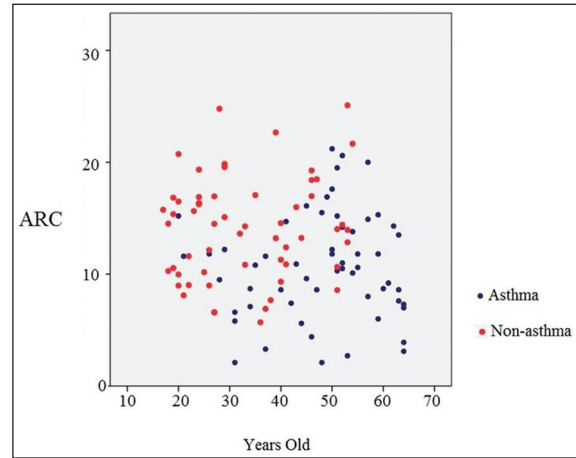


Figure 4: In asthma (blue spots) and non-asthmatics patients (red spots), age is not significantly related to angle of rib curve ($P=0.714$, and $P=0.107$)

CONCLUSION

This is the first study to report that the ribs of asthma patients are less sloped than in patients without asthma. In the opinion of the author, this trait of the chest radiograph can help a physician arouse a suspicion of bronchial asthma in day to day clinical practice.

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