

Original research article

Aortic Knuckle and its Contribution to Left Cardiac Outline: A Radiographic Study

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Abstract

Background: Chest radiography is an important method of imaging, providing an cheap, accessible and effective diagnostic tool. Aortic knuckle is an important finding in chest radiography. Aortic knuckle enlargement suggests underlying cardiovascular comorbidity including diabetes mellitus and hypertension.

Aims and objectives: To analyze the contribution of aortic knuckle to left cardiac outline in normal population and compare with the patients suffering from cardiovascular comorbidity in Postero-anterior (PA) chest radiography.

Materials and methods: Postero-anterior (PA) chest radiography of 648 individuals between the ages of 18 to 75 years were evaluated. Curved length of aortic knuckle (AKC) and total length of left cardiac outline (LCOT) were studied and contribution of aortic knuckle to left cardiac outline in normal population versus the patients suffering from cardiovascular comorbidity was analyzed. Statistical analysis was carried out with the help of IBM-SPSS (IBM Corporation) and Microsoft Excel.

Results and Conclusion: Curved length of aortic knuckle (AKC) and total length of left cardiac outline (LCOT) were analyzed to compare normal population with those with cardiovascular co-morbidity. The contribution of aortic knuckle to left cardiac outline was 18.4% in normal population and 25.5% in co-morbid patients. Thus, simple measurement of aortic knob in PA chest x-ray may help in predicting cardiovascular comorbidity.

Keywords: aortic knuckle, comorbidity, hypertension

Introduction

Background

Chest radiography is the most important modality of imaging, providing an cheap, easily accessible and effective diagnostic tool for various pathology involving the visceral and skeletal system involving the cardio-thoracic region.^[1] Aortic knuckle is an important finding in posteroanterior chest radiography, its enlargement suggests underlying cardiovascular comorbidity such as diabetes mellitus and hypertension. The aortic knuckle refers to the chest x-ray appearance of the distal aortic arch as it curves posterolaterally to continue as the descending thoracic aorta. It appears as a laterally projecting bulge in the left cardiac outline on posteroanterior chest x-ray, as the medial aspect of the aorta cannot be seen separate from the mediastinum. It forms the superior border of the left cardiomedial contour.^[2,3] The aortic knuckle is enlarged due to increased pressure flow in aorta or changes in the elasticity of its wall and resulting in the thickening of the elastic fibre and smooth muscles in the tunica media of arterial wall.^[4] Prominence of aortic knob is seen in systemic hypertension, aortic

stenosis (post-stenotic dilatation), cystic medial necrosis of aorta, coarctation of aorta, aortic dissection and aortic aneurysm. Systemic hypertension and diabetes mellitus are common cardiovascular comorbidity resulting in enlarged aortic knuckle.^[4,5]

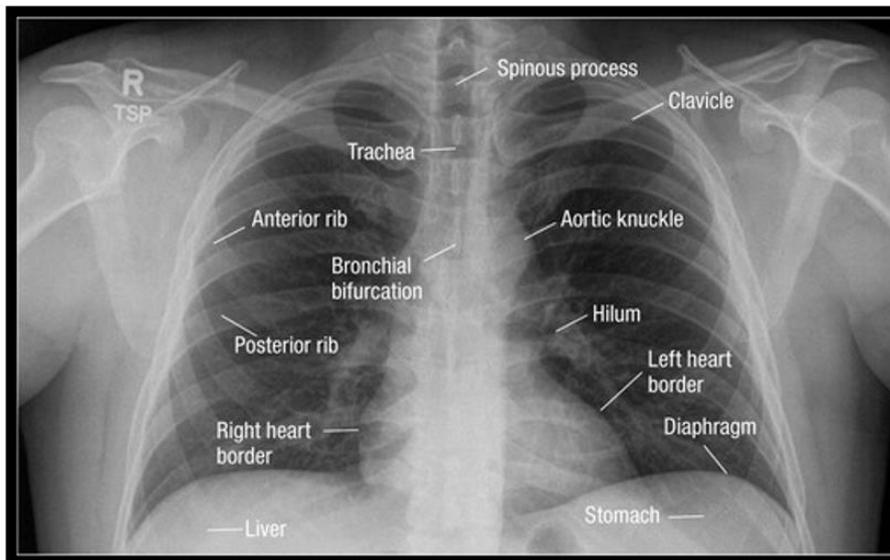


Figure 1: Demonstration of aortic knuckle in chest X-ray PA view^[6]

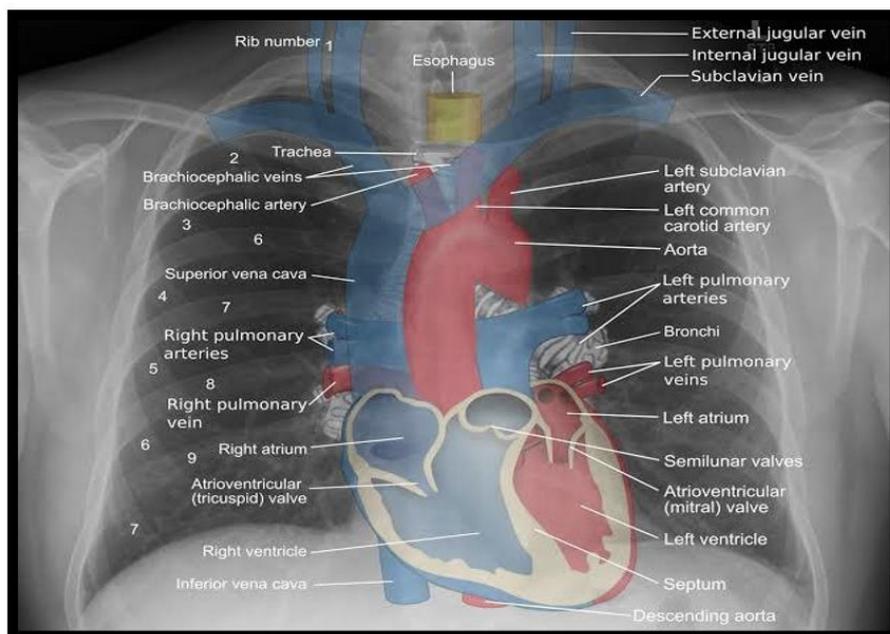


Figure 2: Formation of aortic knuckle by arch of aorta^[7]

The appearance of the aortic knuckle is purely a feature of posteroanterior chest radiography and not an anatomic entity.^[8] The enlarged aortic knuckle does not suggest definitive diagnosis of cardiovascular comorbidity, but such an incidental finding in chest radiography provides an initial preliminary investigating tool to predict cardiovascular comorbidity.^[9] Not much studies are done to estimate the contribution of aortic knuckle to left cardiac outline, that indirectly provides the knowledge of the enlargement of aortic knuckle.^[10,11]

Aims and objectives

To analyze the contribution of aortic knuckle to left cardiac outline in normal population and compare with the patients suffering from cardiovascular comorbidity in Posteroanterior (PA) chest radiography.

Materials and methods

A descriptive cross-sectional study was conducted in the department of anatomy, Bangalore Medical College and Research Institute, Bangalore, India for a period of 1 year. A total of 648 posteroanterior (PA) chest radiographs from 324 normal individuals and 324 individuals with cardiovascular comorbidity were randomly selected and evaluated. Radiography of both males and females in the age group 18-75 years were included. The radiographs of individuals with musculoskeletal deformity and trauma involving thoracic region are excluded. The accurate measurements were performed using the digital software available on the computed visual radiographic system. The parameters measured in the present study are curved length of aortic knuckle (AKC) and total length of left cardiac outline (LCOT). The curved length of aortic knuckle is the measurements of aortic knuckle contributing to left cardiac outline. Other structures contributing to left cardiac outline are left brachiocephalic vein, left pulmonary artery, auricle of left atrium and left ventricle.

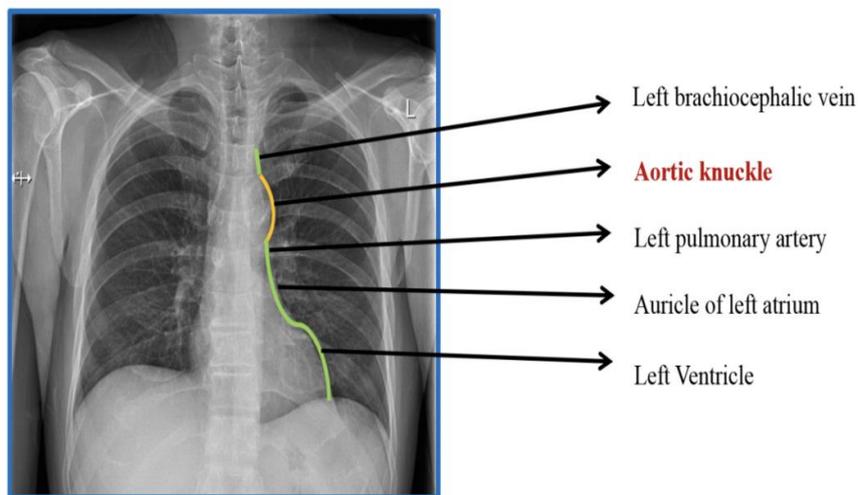


Figure 3: Structures contributing to left cardiac outline

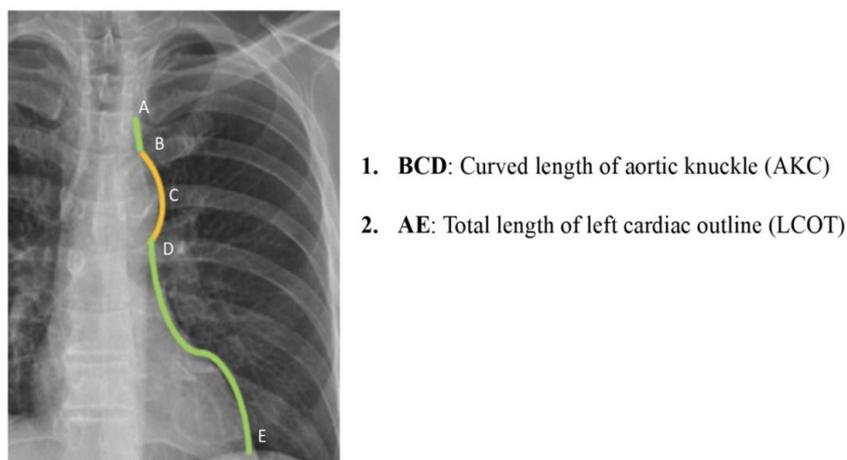


Figure 4: Measurements of Aortic Knuckle

Statistical analysis was carried out using IBM-SPSS software and Microsoft excel. The percentage contribution of aortic knuckle to left cardiac outline in normal and comorbid individuals was evaluated and demonstrated using simple bar diagram.

Results

The curved length of aortic knuckle (AKC) and total length of left cardiac outline (LCOT) was measured in 324 normal and 324 comorbid individuals and proportionately compared.

Normal population: The mean value of curved length of aortic knuckle (AKC) in PA view of chest radiography was 2.34 cm and the total length of left cardiac outline (LCOT) was 12.72 cm. The Mean contribution of aortic knuckle to left cardiac outline in PA view of chest X-ray in normal individuals was 18.4 %.

Comorbid population: The mean value of curved length of aortic knuckle (AKC) in PA view of chest radiography was 3.29 cm and the total length of left cardiac outline (LCOT) was 12.91 cm. The Mean contribution of aortic knuckle to left cardiac outline in PA view of chest X-ray in normal individuals was 25.5 %.

Table 1: Measurements of curved length of aortic knuckle (AKC) and total length of left cardiac outline (LCOT)

	AKC (cm)	LCOT (cm)
Normal individuals	2.34	12.72
Comorbid individuals	3.29	12.91

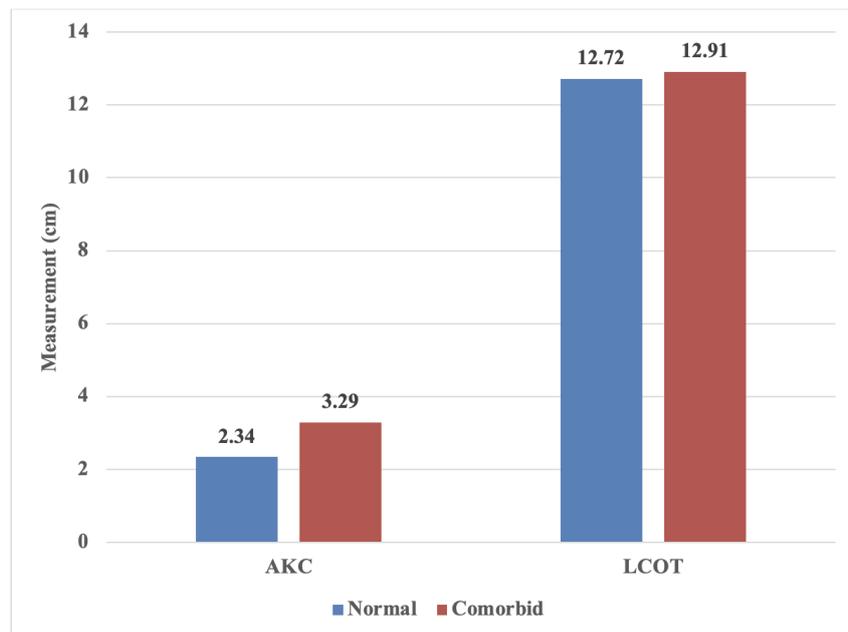


Figure 5: Bar diagram contrasting AKC and LCOT in normal and comorbid population

Discussion

Posteroanterior chest radiography is simple yet easily accessible imaging modality that has not been fully utilized to its potential as a predictor of cardiovascular morbidity. No studies have been done to evaluate the contribution of aortic knuckle to left cardiac outline. Numerous studies are done on various other measurements of the aortic knuckle such as width of aortic

knuckle, straight length of aortic knuckle and aortic knuckle index. Studies done on measurements of aortic knuckle such as straight length of aortic knuckle and width of aortic knuckle showed higher values in patients suffering from cardiovascular comorbidity such as hypertension and diabetes mellitus.^[5,9,12] The present study after the research had evaluated a higher contribution of aortic knuckle to left cardiac outline in patients suffering from comorbidity such as hypertension and diabetes mellitus.

Conclusion

Curved length of aortic knuckle (AKC) and total length of left cardiac outline (LCOT) was measured and proportionate comparison was done between normal and comorbid individuals. The mean contribution of aortic knuckle to left cardiac outline in normal and comorbid individual was 18.4 % and 25.5 % respectively. There was a significant increase in the contribution of aortic knuckle to left cardiac outline in individuals with cardiovascular comorbidity. A simple imaging modality such as PA chest radiography can be used as an preliminary investigation for assessing cardiovascular comorbidity.

References

1. Sutton D, Gregson RHS. *Arteriography and interventional angiography*. In: Sutton D Textbook of Radiology and Imaging. 7th ed. Edinburgh: Churchill livingstone; 2003. 427.
2. Shankar N, Veeramani R, Ravindranath R, Philip B. Anatomical variations of the aortic knob in chest radiographs. *European Journal of Anatomy*. 2010; 14(1): 25-30.
3. Felson B. *A review of over 30,000 normal chest roentgenograms*. In: Chest Roentgenology. Philadelphia: WB Saunders; 1973. 495.
4. Ikeme AC, Ogakwu MA, Nwakonobi FA. The significance of the enlargement of the aortic shadow in adult Nigerians. *African journal of medicine and medical sciences*. 1976; 5(3): 195-9.
5. Anyanwu GE, Anibeze CIP, Akpuaka FC. Transverse aortic arch diameters and relationship with heart size of Nigerians within the south east. *Biomedical Research*. 2007; 18(2): 115-18.
6. Taranpal Bansal, Richard Beese. Interpreting a chest X-ray. *British Journal of Hospital Medicine*. 2019; 80(5): 26.
7. Sally Candy. *Interpreting imaging of the chest and mediastinum*. In: Tapia et al. Augmented Radiology. University of Cape Town, South Africa: Division of diagnostic radiology; 2020. 24-36
8. Brain LR, Hillel G, Lionel HO. Chest radiograph: A useful investigation in the evaluation of hypertensive patients. *American Journal of Hypertension*. 2004; 17(6): 507-10.
9. Obikili EN, Okoye IJ. Aortic arch diameter in frontal chest radiographs of a normal Nigerian population. *Nig J Med*. 2004; 2: 171-74.
10. Ungerleinder HE, Gubner RL. Evaluation of heart size measurements. *Am Heart J*. 1942; 24, 494-510.
11. Kabala JC, vilde P. The measurement of the heart size in the antero-posterior chest radiograph. *Brit J Radiology*. 1987; 60: 981-86.
12. Abhijit Ray, Dhruva Mandal, Panchanan Kundu, Srijita Manna, Saswati Mandal. Aortic knob diameter in chest x-ray and its relation with age, heart diameter and transverse diameter of thorax in a population of Bankura district of West Bengal, India: A cross sectional study. *Journal of Evolution of Medical and Dental Sciences*. 2014; 31(3): 8595-8600.