

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

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ABSTRACT: CONTEXT BACKGROUND: Aortic knob or aortic knuckle is an important finding in chest radiograph. It may give the first clue of cardiovascular disease. Though many sophisticated investigations are there to diagnose cardiovascular diseases, but these investigating tools are only available in urban developed areas. They are hardly available in rural developing areas of West Bengal, where low cost X-ray machine is available. So, still today chest X-ray is the first investigation in suspected cardiac disease especially in rural areas. There should be a normal reference value of aortic knob diameter (AD) with variation of age and sex. The value may vary with Heart diameter (HD) and Transverse thoracic diameter (TD). In our study we tried to find out all these parameters. **SETTING:** Sub-divisional hospitals in Bishnupur and Chhatna blocks, Bankura, West Bengal. **DESIGN:** Simple random sampling method **DURATION OF STUDY:** Two years. **METHOD:** 650 people attending the out-patient department, meeting the deserved criteria are selected. Their chest X-ray were taken, aortic diameter, heart diameter and transverse thoracic diameter were measured. **STATISTICAL ANALYSIS:** From these data, we calculate the mean and standard deviation and lastly correlation coefficient. **RESULT:** We find the mean average diameter of aortic knob is 3.10cm±3.34 in male and 3.076cm±3.9 in female. We also note that aortic diameter in both male and female increases in increasing age. We also note that there lies positive correlation of aortic diameter with heart diameter and transverse diameter of thorax. **CONCLUSION:** Aortic knob diameter is slightly more in male than in female. It increases as age increases. It has got positive correlation with heart diameter and transverse thoracic diameter.

KEYWORDS: Postero-Anterior Chest X-ray, Aortic knob, Aortic knuckle, Heart diameter, Transverse thoracic diameter.

INTRODUCTION: Numerous studies have been done on the heart size in chest X-ray which plays a crucial role in the prediction of healthy or diseased heart. On the other hand there is paucity of data regarding the size of the aortic knob (AK) in Indian population which can be easily visualized in the Postero-Anterior Chest X-ray which is the commonest imaging modality in both rural and urban areas of India and economically feasible as it is cheaper than any other imaging modalities like CT scan or MRI, though the latter techniques are better indicators in assessing cardiac conditions than the chest X-ray.

Aortic knob is the radiographic not an anatomic entity. It is best visualized in front chest radiograph.¹ It represents the distal-most portion of the aortic arch where it turns slightly backward than downward and is continuous with the descending thoracic aorta.

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So in radiological view it appears foreshortened. The foreshortened distal most portion of the aortic arch where it joins the descending aorta represents the aortic knob or aortic knuckle and it constitutes the superior most part of the left border of the cardiac silhouette.

The aortic knob can be enlarged due to increased pressure flow in aorta or changes in the elasticity of its wall e.g. systemic hypertension, cystic medial necrosis of aorta or aortic dissection. Prominence of aortic knob is also seen in certain cases of aortic stenosis (post-stenotic dilatation), coarctation of aorta and aortic aneurysm. Aortic knob is also helpful in the measurement of 'pulmonary bay'. So in the locality or area of poor economic condition, the enlargement of aortic knob though not specific but still a firsthand investigating tool to predict the cardiac malfunction in the outdoor practice and to take appropriate further investigations and treatment.

As already mentioned there is relatively lack of data of the size of the aortic knob in Indian population, so in this study we design to find out the normal diameter of the aortic knob in a mixed population of Bankura district of West Bengal.

REVIEW OF LITERATURES: Although the Postero-anterior chest X-ray is one of the most commonly done investigations in outdoor practice, there is paucity of data regarding the width of aortic knuckle (AK). The width of aortic knob has been measured by different workers in different methods which also give variable results.¹

Rose et al² and Anyanwu et al³ measured the aortic knob width as the sum of the maximum extension of the aortic shadow to the right and left of the midline and found the mean of aortic knob diameter varies between 4.7 ± 0.5 cm

In a study of a great number of normal Chest X-ray and using the methodology as we have done in our study, Felson⁴ measured AK width and found to be less than 3cm in a large majority of subjects. The same result was obtained by Yun et al.⁵ On the other hand, Umerab⁶ found to be higher values in aortic knob diameter in his study.

Stuart et al⁷ found to be higher values around $4.1 \text{cm} \pm 0.5$ in Sudanese population

Sex differences in AK diameter have been reported by many investigators. Higher values being found in male than in female of the same age group.^{1,8}

MATERIALS AND METHODS: This study was carried out in the sub divisional hospitals in Bishnupur and Chhatna blocks of Bankura district, West Bengal, in the time span between January 2012 to January 2014. Postero-anterior chest radiographs were collected. These samples include both sexes and their age ranges from 20-60 years. Proper history was taken and they were physically examined to note any cardio-vascular disease or thoracic skeletal abnormalities. The P.A. chest radiographs of all the candidates were taken in erect posture, breath held at the end of normal quite inspiration and film focus distance of 1.8 meter.

Total 650 persons (male=350, female=300) were selected with the following inclusion criteria's:

1. Age between 20-60 years.
2. No thoracic skeletal deformity.
3. No past or present cardio-vascular disease.
4. Blood pressure between 110-140 mm Hg systolic and 60-84 mm Hg diastolic.

Exclusion Criteria's:

1. Age below 20 years and above 60 years.
2. Having thoracic skeletal deformity.
3. Having present or past cardio-vascular disease.
4. Systolic blood pressure less than 110 or more than 140 mm Hg and diastolic blood pressure less than 60 or more than 84 mmHg.

The width of the aortic knob is measured as the maximum transverse diameter from the lateral border of the air in the trachea to the lateral border of the aortic knob.⁴

Transverse Thoracic Diameter (TD) is measured at the level of the left dome of the diaphragm.^{9, 10}

Transverse diameter of heart (HD) is measured as the sum of the maximum projection to the right and left heart borders from midline.^{9, 10}

RESULTS: One of the most common investigations in our day to day practice is the chest X-ray PA view. One of the land marks of the X-ray plate of chest X-ray is the aortic knob or aortic knuckle to note if there any deformity or enlargement of the said knob is present or not.

In our study we selected 650 candidates, out of which 350 were male and 300 were female with the age range between 20-60 years. In male group we found mean average diameter of aortic knob is 3.10cm±3.34, transverse diameter of chest is 15.73 cm±11.65 and transverse diameter of heart is 7.17cm±14.02 (table I).

In female group the mean aortic diameter is 3.076cm±3.9, mean transverse diameter of the thorax is 15.473cm±12, 66 and mean transverse diameter of heart is 7.132±15.61 (table II). In total sample population including both males and females the mean AD is 3.04cm±4.1, mean TD is 15.528cm±12.80 and mean HD is 7.072cm±16.06 (table III). So there is increased value of all parameters like AD, TD and HD noted in males than in females.^{8, 1}

In our study we also noted an increase in AD in both males and females with increase in age (table IV).

On plotting the data on linear correlation coefficient, it has been found that there occurs positive correlation of AD with age, HD and TD in both males and females¹¹ (table V).

DISCUSSION: Chest X-ray PA view is one of the important investigations everywhere in the field of medical practice. It is easily available and cheap with profound diagnostic value especially in rural communities of India. Enlargement of aortic knob though not perfectly case-sensitive but still it gives first hand indication of certain diseases like long standing cases of systemic hypertension, atherosclerosis, cystic medial necrosis of aorta, aortic dissection etc. but there is little study of normal aortic knob width in chest X-ray PA view in India.

So we tried to find out the mean values of AD (aortic knob diameter) in a sample of population. So any greater values of the data may indicate the enlargement of arch of aorta and help us to smell the first indication of the above mentioned diseases in Indian population as Western and African studies recorded a bit higher values.⁸

We also found that there is positive correlation between AD and with age, HD and TD.¹¹ All these data will help us to suspect any abnormality present in the aortic knob in chest X-ray.

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Parameters	n	Minimum	Maximum	Mean	S.D.
Age	350	20	60	33.46	9.16
Aortic diameter (cm)	350	2.8	4.1	3.10	3.34
Transverse diameter of chest (cm)	350	14.1	16.9	15.734	11.65
Transverse diameter of heart (cm)	350	6.6	8.1	7.174	14.02

TABLE I: Mean and standard deviation of different measured parameters in male

Parameters	n	Minimum	Maximum	Mean	S.D.
Age	300	20	60	34.46	9.16
Aortic diameter (cm)	300	2.6	4.0	3.076	3.9
Transverse diameter of chest cm)	300	13.9	15.4	15.473	12.60
Transverse diameter of heart cm)	300	6.2	7.8	7.132	14.612

TABLE II: Mean and standard deviation of different measured parameters in female

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Parameters	n	Minimum	Maximum	Mean	S.D.
Age	650	20	60	33.8	10.06
Aortic diameter (cm)	650	2.6	4.1	3.04	4.1
Transverse diameter of chest (cm)	650	13.9	15.734	15.528	12.80
Transverse diameter of heart (cm)	650	6.2	7.174	7.072	16.06

TABLE III: Mean and standard deviation of different measured parameters in total no. of population (male+female)

Age (years)		20-30	31-40	41-50	51-60
Aortic diameter (cm)	Male	2.96	3.03	3.06	3.08
	Female	2.94	3.01	3.04	3.06

TABLE IV: Age wise distribution of aortic diameter (mean value)

Sex	Parameter	Age	HD	TD
Male	AD	0.4167	0.0729	0.1277
Female	AD	0.4034	0.1163	0.3022

TABLE V: Summary of correlation coefficient value

AD= Aortic Diameter, HD=Heart Diameter, TD=Transverse Thoracic Diameter

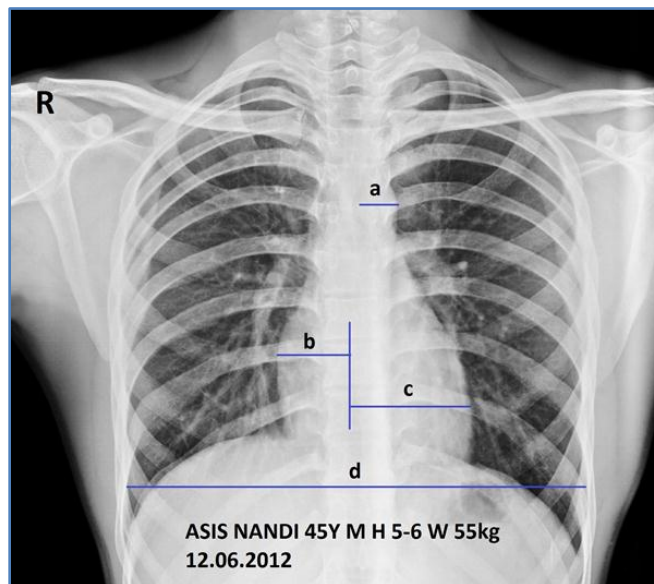


Fig. - measurement of different parameters in chest x-ray as described in the text

a= aortic diameter (AD), b+c=heart diameter (HD), d=transverse thoracic diameter (TD)

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