# Developing a Novel Approach for Analysis of Root Aorta in Ultra Sound Images

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***Abstract*:- The Author report his entire experience with minimal access aortic root, valve, and complex ascending aortic surgery. A total of 290 consecutive patients underwent aortic root, valve, and ascending aortic surgery between July 1996 and February 2000. Four groups were identified: isolated aortic valve replacement (AV group, n = 227), aortic root replacement (AR group, n = 44), aortic valve replacement with concomitant replacement of the supracoronary ascending aorta (V/A group, n = 9), and isolated ascending aortic replacement (AA group, n = 10). The procedures were performed through a partial upper hemisternotomy (87%) or a right parasternal approach (13%). Overall mortality was 3.1% (n = 7) for the AV group, 2.3% (n = 1) for the AR group, 0% for the V/A group, and 10.0% (n = 1) for the AA group. Complications included reoperation for bleeding in 10 (4.5%), two (4.7%), one (11.1%), and one (11.1%) for the four groups respectively; and sternal wound infection in eight (3.6%) patients of the AV group and one (2.3%) patient of the AR group. Five (2.3%) patients of the AV group suffered stroke. Isolated or more complicated aortic valve, root and ascending aortic surgery is feasible and safe through a minimally invasive approach with acceptable incidence of complications and mortality, without compromising the efficacy of the procedure.**

***Keywords:- Aortic Valve,Aortic Root,Aortic Valve Replacement Circulatory Arrest, Right Atrial,blood vessel ,branch ,endoscopic ultrasound.***

## 1. INTRODUCTION

Minimally invasive approaches in aortic valve surgery have become very popular. Since the beginning of the era of minimally invasive cardiac surgery in 1996, a variety of different incisions have been proposed, and trends became apparent as more experience accumulated and specific complications for some of these approaches were documented . Potential advantages to a minimally invasive approach, compared with the conventional full sternotomy, include early extubation, and reduced blood loss, operative time, and costs [14•,15–17]. There are only occasional reports of minimally-invasive approaches applied in more extensive aortic valve procedures, such as aortic root or ascending aortic replacement. We are aware only of the publication of our group, dealing extensively with a series of minimally invasive aortic root replacement [18•]. In this report, we review our 44-month experience with aortic root, valve, and ascending aortic replacement through a minimally invasive approach.

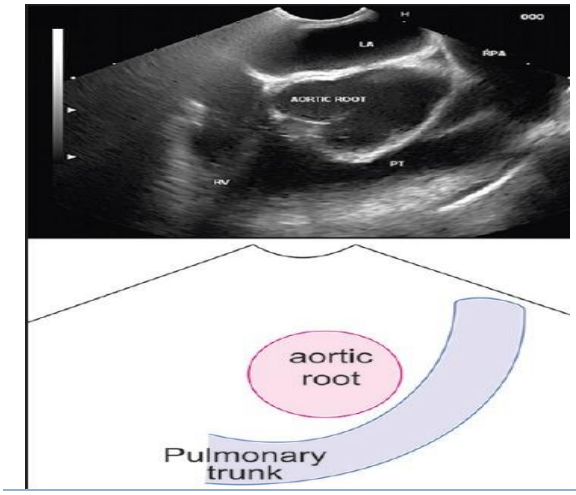
OBJECTIVES

- Preparing ultrasound root Aorta images.
- Removing noise and enhancing the quality of input image dataset.
- Locating root Aorta in ultrasound images.
- Developing algorithm to segment required region of interest(ROI) from image dataset.
- Through machine learning algorithm analysis of the root Aorta.

### 2.1 IMAGING OF AORTIC ROOT AND LOWER PART OF ASCENDING AORTA IMAGING OF AORTIC ROOT AND LOWER PART OF ASCENDING AORTA

The aortic root has a diameter of 2.4-4.7 cm (its diameter is more in males than females) and lies at the base of the left ventricle posterior to the right ventricular outflow tract. The aortic annulus, which lies at the base of the aortic root, provides attachment to three semilunar cusps (one anterior and two posterior). Distal to the attachment of the cusps the aorta is wide and presents three dilatations which are called the aortic sinuses of Valsalva, (right coronary — anterior, left coronary — left posterior and non coronary — right posterior) [Figure 1]. From the aortic root, the ascending aorta passes upwards, forwards and to the right to continue as the arch at the level of upper border of the right second costal cartilage (sternal angle, lower border of the T4 vertebra). It ascends anterior to the left atrium, right pulmonary artery and right principal bronchus, and posterior to the right ventricular outflow tract and beginning of the pulmonary trunk. The aortic root has a diameter of 2.4-4.7 cm (its diameter is more in males than females) and lies at the base of the left ventricle posterior to the right ventricular outflow tract. The aortic annulus, which lies at the base of the aortic root, provides attachment to three semilunar cusps (one anterior and two posterior). Distal to the attachment of the cusps the aorta is wide and presents three dilatations which are called the aortic sinuses of Valsalva, (right coronary — anterior, left coronary — left posterior and non coronary — right posterior) [Figure 1]. From the aortic root, the ascending aorta passes upwards, forwards and to the right to continue as the arch at the level of upper border of the right second costal cartilage (sternal angle, lower border of the T4 vertebra). It ascends anterior to the left atrium, right

pulmonary artery and right principal bronchus, and posterior to the right ventricular outflow tract and beginning of the pulmonary. The path physiology of these cardiac complications of acromegaly is incompletely understood. On pathological examination, the myocardium is affected by interstitial fibrosis and the leaflets have the appearance of myxoid degeneration. It has been hypothesized that abnormal extra cellular matrix regulation by over production of GH and/or insulin-like growth factor-I (IGF-I) in patients with acromegaly may contribute to both systolic and diastolic LV dysfunction. Abnormalities in matrix regulation are associated with cardiac chamber dilation and reduced myocardial tensile strength trunk.

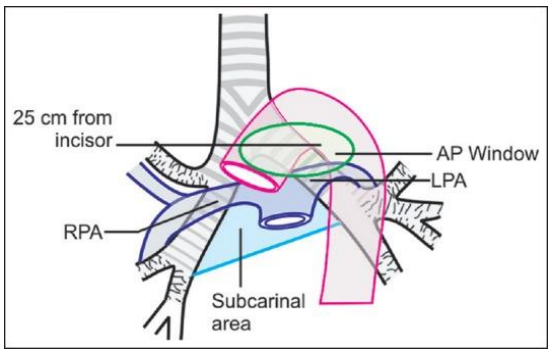



*2.2 Technique of imaging*

a. Identify the left atrium and right pulmonary artery.
b. The left atrium is identified as the largest pulsatile chamber at about 30 cm in the anterior wall of the esophagus.
c. The right pulmonary artery is seen above the left atrium.
d. Identify the root of the aorta.
e. The root of aorta is identified interiorly to the upper part of the left atrium or right pulmonary artery .
f. Rotation of the scope is able to identify the individual leaflets of the aortic valve. The origin of both coronary arteries can be visualized in this position.
g. Trace the ascending aorta from the aortic valve.
h. The ascending aorta is identified as a long tubular structure going up for a distance of about 5 cm from the aortic valve.

*1.3 THE ARCH OF AORTA*

The aortic arch begins as a continuation of the ascending aorta at the level of the upper border of the right stern costal joint. Its diameter ranges from 0.9 to 2.5 cm. It ascends slightly to the left across the anterior surface of the trachea, arches over the root of the left lung and then descends on the left side of the trachea and T4 vertebra to continue as the descending thoracic aorta [Figure 3]. The lower border of the arch forms an important boundary of the aorta pulmonary (AP) window.




## 2. LITERATURE REVIEW

SC Mitchell[1] ,he referenced in 1971 within the prospective study of 56,109 total births,457 young stars have been found to have congenital heart disease. The overall incident is 8.14/1000 total births,8.0/1000 for the negro and 8.3/1000 for the white. A spvvecific lesion has been identified for each patient. At birth, systemic arterial pressure and aortic flow increase as a result of the decrease in pulmonary vascular resistance, the closure of shunts, and the disappearance of the placental vascular bed. In the week surrounding birth, very rapid accumulation of elastic and collagen in the aorta has been noted, more pronounced in the thoracic than in the abdominal aorta. At the same time the pressure in the pulmonary artery drops, and after closure of the ductus arteriosus, it receives all of the right ventricular output in a high flow/low pressure circulation. As a result, the wall thickness, the elastin and collagen content become significantly higher in the proximal ascending aorta than in the pulmonary artery a few weeks after birth, while the percentage of VSMCs in both trunks is comparable.

JP Bound[2], he referenced in 1957 to 1971,there were 57,979 births in a circumscribed population in north-west England. The requirement for a valid survey of incident of congenital heart disease where largely met. The aortic and pulmonary trunks originate from the remodeling of the pharyngeal arch arteries during the early embryonic development. The original six symmetrical arteries, attached to the dorsal aorta, give rise to the ascending aorta (partly derived from the left fourth artery), and pulmonary trunk (derived from the left sixth artery), with two branch pulmonary arteries attached. Aortic stiffness was significantly higher in the group with dilated aorta ,independent of aortic volume load. Histological analysis of a respected neo-aortic root, in a patient with a root aneurysm 10 years after Fontan, demonstrated no evidence of inflammation but rather fragmentation of elastic fibers, deposition of myxoid material, and loss of medial VSMC.

C Ferencz[3], he referenced in 1985 ,infant study is a regional epidemiologic study of congenital heart disease. among infants born in the study area in 1981 and 1982, 664 had d diagnosis of congenital heart disease

confirmed in the first year of life by echocardiography. Recent evidence has indicated that dilatation of the ascending aorta occurs as a consequence of aortic medial degeneration, similar to the one seen in connective tissue disorders resulting from apoptosis of neural crest derivatives. To obtain a complete view of the aorta and its branches using a multi-plane modality, a magnetic resonance imaging study (MRI) is preferable to a CT scan, because of the absence of ionizing radiation, and because patients with dilated aortas will need multiple studies during their lifetime. MRI may be the preferred investigation when TTE is suboptimal, to exactly measure regurgitant valve fraction, and appreciate left ventricular function.Diameter measurements on CT and MRI are 1-2 mm larger than obtained on TTE, as the aortic wall segments are included.

Benacerraf BR[4], he referenced some investigators support the notion there the four-chamber view of the fetal heart is sufficient for the sonographic identification of most serious heart defects. He also found that the evalution of great vessels(aorta and pulmonary artery) is crucial for the detection of some of the most common heart defects such as tetralogy of fallot and transposition of the great arteries. In the absence of guidelines for the other pathologies previously discussed, a pragmatic attitude is probably appropriate: As no case reports have appeared about ruptured aortas <55 mm in adult sized patients, this diameter should be used as a cut-off. A diameter of>60 mm is considered the hinge point for the ascending aorta, above which the chance for rupture increases exponentially.[99] In small children, rapid progression in size may urge faster intervention.

D.J.Sahn[5], he suggested that new high-resolution real-time ultra sound cross sectional imaging systems have enabled us to demonstrate detailed fetal cardiac anatomy in the second half of pregnancy.he studied normal fetal cardiac development quantitevly by echocardiography in the second half of pregnancy in 69 normal pregnancies of healthy mothers. Dilatation of the aortic root and the ascending aorta is frequently encountered in patients with congenital heart disease (CHD) at initial presentation and during follow-up. Dilatation of the aortic root and the ascending aorta is frequently encountered in patients with CHD at initial presentation and during follow-up. As large cohorts of surgically treated patients survive into adulthood, more retrospective studies emerge discussing progressive aortopathy in patients with CHD. Specific guidelines about indication for medical and surgical treatment are largely lacking. Future recommendations should include indexed size measurements, adapted to growing children.

Comstock CH[6], he determined that in an attempt to establish the normal ratio of pulmonary artery to aorta diameters at varying gestational ages ,the pulmonary artery and aorta diameters of 316 normally grown fetuses between 14 and 39 weeks gestational age where measured. he conclude that the diameters of the pulmonary artery and aorta are closely related to fetal age but that the ratio is independent of age. The dilatation of the aorta or the neo-aortic root cannot be considered as a stand-alone characteristic, but needs to be regarded as part of the aorta-ventricular complex, comprising the systemic ventricle, the aortic valve, the aortic root, and the aortic vascular wall.

Elefteriades JA[7],he obtain a complete view of the aorta and its branches using a multi-plane modality, a magnetic resonance imaging study (MRI) is preferable to a CT scan, because of the absence of ionizing radiation, and because patients with dilated aortas will need multiple studies during their lifetime. MRI may be the preferred investigation when TTE is suboptimal, to exactly measure regurgitant valve fraction, and appreciate left ventricular function. Diameter measurements on CT and MRI are 1-2 mm larger than obtained on TTE, as the aortic wall segments are included.

Cohen MS[8], he study with a median follow-up of 9 years after Fontan completion, neo-aortic root progressively dilated out of proportion to body size over time, with 98% of patients having a root z-value of >2 at most recent follow-up. The authors concluded that early volume unloading had no beneficial impact on the size of the neo-aortic root. Only a few case reports of quickly progressive neo-aortic root dilatation necessitating surgical intervention, have been published.In the majority of cases, a valve-sparing operation was attempted, with variable results.

## 4. METHODOLOGY

Step1: Database is an organized collection of data that models a part of the reality (a domain). A database refers both to the data and to the organization of that data.
Step2: For the selected image suitable algorithm is applied to detect the disease.
Step3: Noise removal is the process of removing noise from a signal.
Step4: The goal of segmentation is to simplify and /or change the representation of an image into something that is more meaningful and easier to analyze.
Step5: Obtaining ROI means the region of interest in root aorta.
Step6: Error correction is the process of detecting errors in transmitted message and reconstructing the original error-free data.
Step7: Feature extraction involves reducing the amount of resources required to describe a large set of data.
Step8: Result is outcome, consequence or conclusion of a problem, probe or experiment after a period of time.

4.1 FIGURE

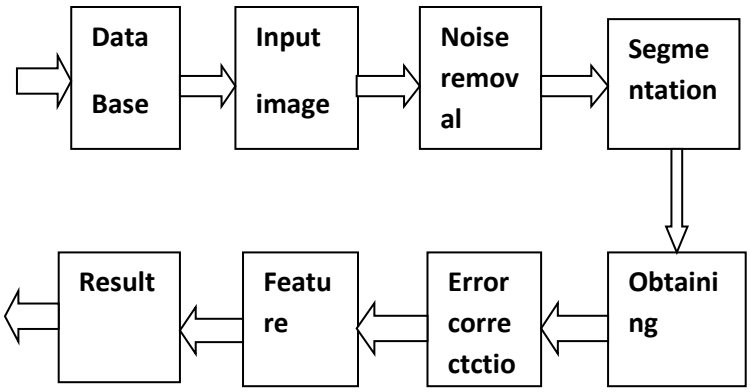



Fig .Architecture Design

5.RESULT

This review describes the aortic root as a composite structure of several elements, not only the valvar leaflets. The valvar leaflets have a unique shape with deep closure lines buttressed by the nodule of Arantius. The coronary orifices are located closed to the level of sinutubular junction. Patients and controls were matched for age, gender, BSA, valvular regurgitation, and LV dimensions and function. During follow-up of all patients with acromegaly, the diameter of the aortic root at the annulus and at the sinotubular junction increased However, the diameters at the level of the sinus and the ascending aorta did not differ between baseline and follow-up.

**Factors influencing aortic root diameters in patients with acromegaly**

Disease activity at baseline, Baseline and follow-up diameters of the aortic root were not different between patients with active and inactive acromegaly. When patients with active and inactive disease were analyzed separately, only the diameter of the sinotubular junction increased in patients with inactive acromegaly. We found an increase in the diameter of the aortic root at the sinotubular junction in patients with inactive acromegaly that is somewhat unexpected. The diameter of the aortic root also increased in patients with active acromegaly, although this did not reach statistical significance, and when all patients are analyzed together. In conclusion, aortic root diameters were increased in patients with acromegaly compared with healthy controls. These abnormalities were not associated with disease duration, current disease activity, or blood pressure. In addition, during follow-up, aortic root diameters at the level of the aortic annulus and the sinotubular junction increased. These findings indicate that in patients with acromegaly an extension of the cardiac evaluation to the aortic root offers a more indebt assessment of the state of the individual acromegalic cardiomyopathy.

6. ACKNOWLEDGMENT

The research presented in this thesis has been supported by the SDM Institution of technology, ujire. This work would not have been possible without the support and assistance of many others. First and foremost, we would like to thank our advisor Dr. K. Suresh for providing us an opportunity to work in his research group. We are very grateful for his expert advice and insightful suggestions throughout our research. We would also express his gratitude to supervisor Prof. Naveen Pagad s who guided our research and supported to writing this. Our thanks also go to our guide Dr. Dharmanna L for reviewing this Unfortunately, actual research in the held of computer vision is not yet able to provide a fully automated system for general purposes. Nevertheless, initial steps in diffrent medical applications have already been taken in the last thirty years.

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