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Aging and the average diameter of the renal artery using computed tomography angiography (CTA)

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Abstract

Background: A study of the effect of aging on the average diameter of the renal artery in using computed tomography angiography (CTA) images was carried out.

Objective: To determine the variation in the transverse diameter of the renal artery with age and gender in subjects with no renovascular disease using multi-detector computerized angiography tomography images.

Methods: CTA images of 90 subjects (45 females and 45 males) were reviewed. Measurements of the transverse diameter of the renal arteries were taken at the root, middle and tail ends using images of the arterial phases of contrast enhancement and the averages calculated. Images were divided into groups based on the patients' age and gender. Age and gender related differences in the diameter were tested using analysis of variance (ANOVA).

Result: The average transverse diameter of the renal artery was 7.5mm in males and 7.3mm in females. The upper and lower limits of the transverse renal artery diameters for the population studied were 7.0mm and 7.5mm respectively. Peak value of renal artery diameter was 7.8mm at ages 51-60. A 0.4mm increase in renal artery diameter was observed after 20 years while a 4.7mm decrease after the 8th decade of life. Variation of the renal artery with age was found to be statistically significant. Variation with gender was not statistically significant.

Conclusion: The transverse diameter of the renal artery may therefore be dependent on subject's age but not gender.

Keywords

computed tomography, gender, Nigeria

Introduction

The arteries play an important role in the circulatory system as they carry a large portion of blood to the kidneys. The arteries normally arise off the sides of the abdominal aorta^[1]. Narrowing of the renal arteries (stenosis) may result in hypertension. The arteries may also be affected by diseases such as aneurysm and atherosclerosis which usually cause alteration in their luminal diameter^[2]. A 3-dimension (3D) volume rendering computed tomography angiography (CTA) provides a fast non-invasive modality for the evaluation of the renal vascular pedicles. CTA can reliably and accurately depict the renal arteries and it approaches conventional angiography in the assessment of most vascular abnormalities^[3]. The number, size, course and relationship of the renal vasculatures are easily appreciated with real time interactive editing. This provides CTA images of normal anatomy and common variants of the renal arteries^[3]. CTA volume rendering is commonly performed with

a window level function that results in high density materials, such as enhanced vessels or vascular calcification, which are bright and opaque while less dense structures appear dim and translucent^[4]. Overlying structures are easily removed in an interactive clip-plane and the vessels of interest (renal arteries) are then easily rotated into the best orientation for depiction of the region of interest^[4]. The renal artery has a radius of approximately 0.25cm^[5]. The measured mean diameter can differ depending on the imaging modality used. For example, the average diameter was found to be 5.04 ± 0.7mm using ultrasound but 5.68 ± 1.2mm using angiography^[6]. However, these measurements are made for populations outside Nigeria. There is no data regarding the average diameter of the renal arteries for Nigerians.

This retrospective study sought to determine gender differences and the effect of aging and gender on the average diameter of the renal artery using a representative sample of CTA images. The rationale being that some baseline

data for evaluation of renal artery size in Nigeria would be obtained.

Method

A study of renal artery sizes was carried out using CTA images of subjects who did not have renovascular diseases. A total of 90 abdominal CTA images of the arterial phase of contrast enhancement were reviewed and the transverse diameter of the renal arteries (RAD) measured at the root, middle and tail ends (Figure 1) with the computer monitor's measuring devices. A studied diameter and range were recorded against the ages and gender of the subjects. Images were grouped based on age in years as (GP1 (11-20), GP2 (21-30), GP3 (31-40), GP4 (41-50), GP5 (51-60), GP6 (61-70), GP7 (71-80), GP8 (80 and above)). Data were analyzed using analysis of variance (ANOVA) to assess variation in measurements with the age and gender of the subjects.

Results

The peak renal artery diameter of 7.8mm was observed between ages 51-60 years

in the study population. Between the ages of 21-40 years, the renal artery diameter was approximately stable at 7.5mm. A 0.3mm increase in diameter was observed at 51-60 years (Figure 2). Renal artery diameter decreased by 0.2mm between ages 61-70years. A more rapid decrease was observed after the 8th decade (RAD of 4.7mm). The average renal artery diameter for males was 7.5mm and 7.3mm for female (Figure 3).

Discussion

Sectional imaging computed tomography has helped in the clarification and better elucidation of anatomical structures. This enables the study of organ size, dimensions and morphology to aid clinical decision making. Multi-detector computerized angiography is one of the advances in CT that has enabled physiological and pathological changes in blood vessels to be studied. Different methods have been used to assess and follow up structural changes of the renal arteries. Management decisions are often based on a comparison of the observed renal artery diameter with normal variations. There is paucity of data regarding renal artery diameters to help characterize the physiological ranges of renal artery diameter^[7]. Therefore, for the definition and classification of structural abnormalities, such as aneurysms, stenosis, etc, knowledge of normal renal artery diameter is quite essential.

This study determined the average transverse diameter of the renal artery in Nigerian subjects. The variation in size of diameter relative to age and gender was assessed for the study population. Age appears to have a strong influence on the renal artery diameter. This study shows a 0.4mm increase in diameter after 20 years of age; an approximately constant diameter of 7.5mm at ages 31-50 years; a 0.4mm decrease between 60-70 years of age. A 4.7mm decrease after the 8th decade of life was also observed (Figure 2). Analysis of variance (ANOVA) showed a statistically significant difference with age ($p < 0.05$). Turba *et al.*^[8] reported a 1mm increase per decade while Lorenz *et al.*^[9] found an association between older ages with renal artery narrowing. The increase in the transverse diameter of the renal artery in early adulthood could be attributed to workload due to increased physical activity and associated increased cardiac

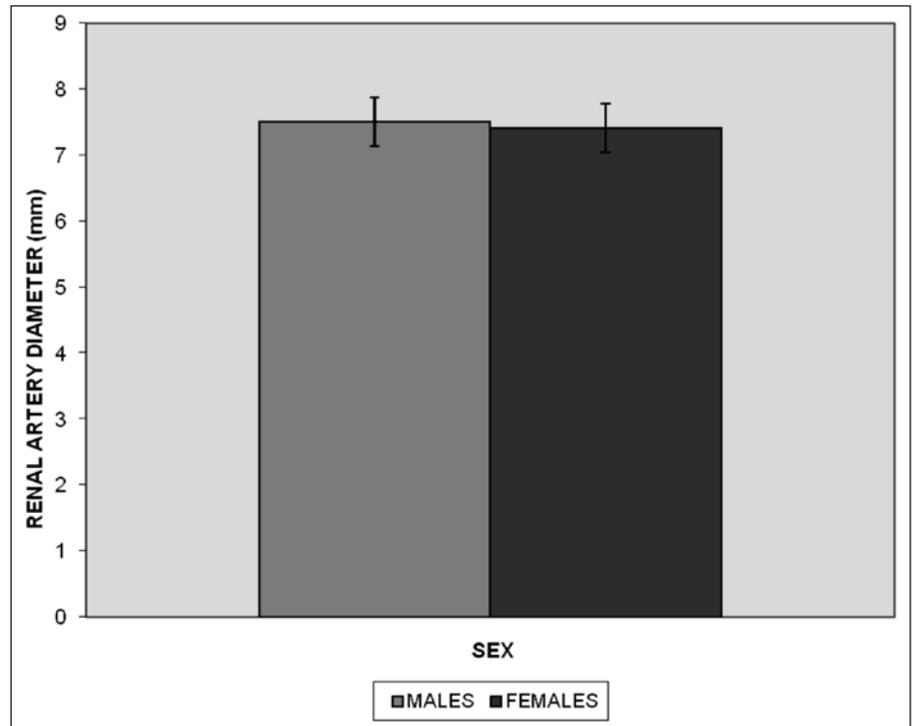


Figure 1: CT image showing position of measurement.

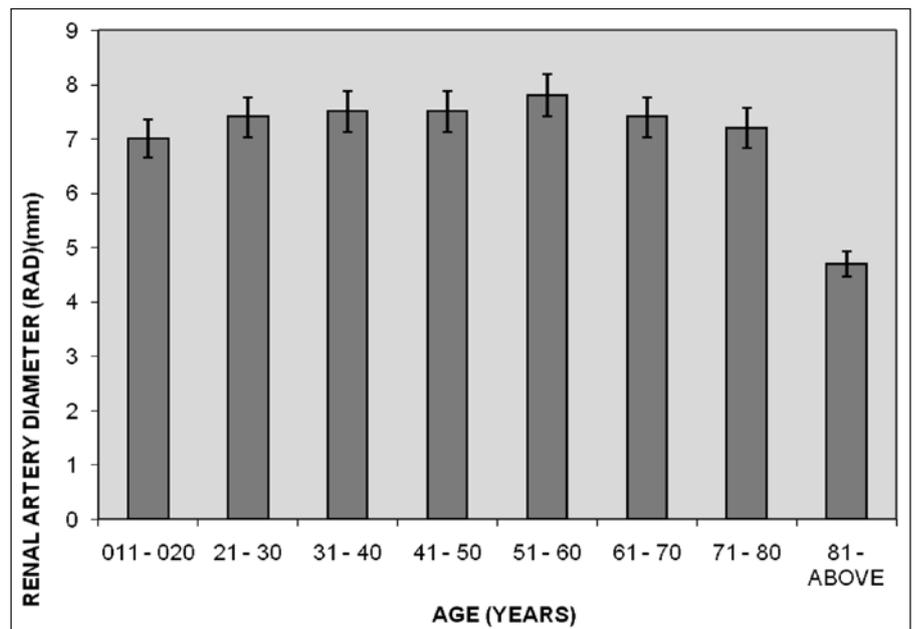


Figure 2: Age variation in renal artery diameter (RAD).

output. Physiological changes occurring in early adulthood may also be implicated. Similarly, decrease in diameter at old age may be a consequence of senescence as old age leads to progressive thickening of the tunica intima layer as well as thinning and separation of individual elastin lamellae and an increase in the collagen matrix^[10, 11].

A difference of 0.2mm was observed between the mean renal artery diameters of males and females (Figure 3). The

influence of gender is therefore negligible as this is statistically insignificant ($P < 0.05$). This is consistent with the findings of Barnes^[12] who maintained that the influence of gender on the renal artery was negligible.

Conclusion

The value CTA in vascular diagnosis and clinical decision making cannot be over-emphasized. It has provided insight into factors both physiological and pathologi-

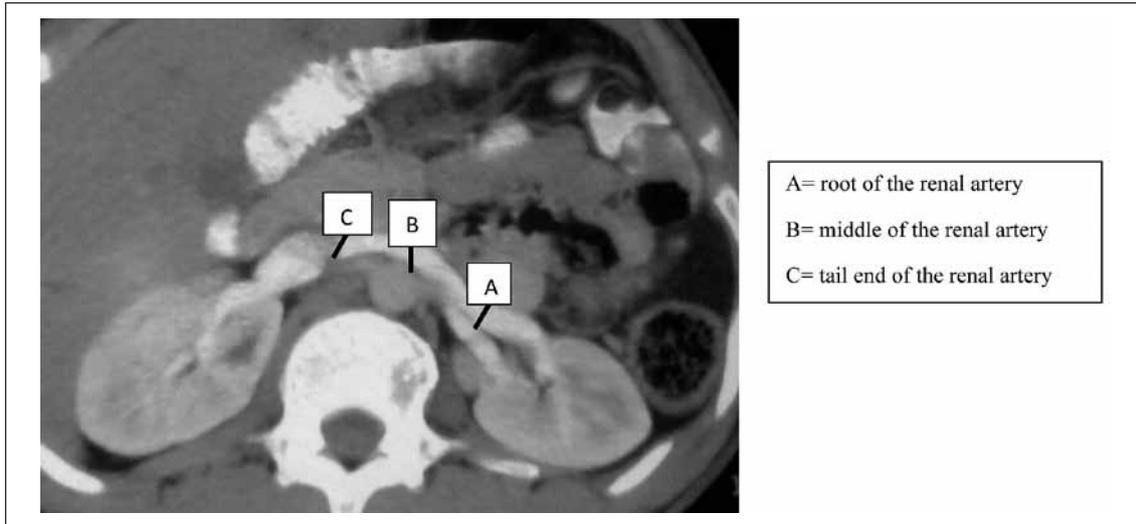


Figure 3: Sex distribution of renal artery diameter (RAD).

cal that influence vascular size and morphology. It is clear from the foregoing that renal artery diameter increases after 20 years of age, appears constant between the ages of 30-50 years and decreases further after the 6th decade of life. The decrease is more drastic after the 8th decade. The effect of gender on average transverse diameter of the renal artery is negligible. Further research should provide clues as to the various aging factors which affect renal artery diameter.

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