

Study of computer tomography measurements in normal adrenal glands in Indian population

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Abstract

Background: The adrenal gland (AG) is so called because of its location adjacent to the kidney (adrenal). Adrenals are often difficult to visualize on ultrasound. CT scan is a better mode of visualization of adrenal glands. Knowledge of the range of imaging appearances of the adrenal glands in primary may allow definitive diagnosis in most cases. Present study was aimed to study computed tomography measurements of normal adrenal glands in a urban population.

Material and Methods: Present study was prospective, observational study, conducted in normal, healthy adults of either gender, age > 25 years where computed tomography measurements of normal adrenal glands.

Results: 58 participants were studied, mean age was 46.5 ± 15.2 years, 62.07% were male, mean weight was 71.46 ± 11.39 kgs, mean height was 160.14 ± 12.11 cm, body mass index was 24.16 ± 3.86 kg/m² & waist circumference was 67.33 ± 18.41 mm². Adrenal gland volume in right adrenal gland was 3.47 ± 1.33 mm³, in left adrenal gland was 4.77 ± 1.69 mm³ & Total adrenal gland was 8.25 ± 2.74 mm³. Gender-wise comparison of length, width & thickness in right & left side adrenal gland was comparable among male & female groups & difference was not significant statistically. In present study, majority of patients had Y shape adrenal gland (87.93% in right versus 84.48% left), followed by linear type (6.9% in right versus 8.62% left).

Conclusion: Mean adrenal gland volume in right adrenal gland was 3.47 ± 1.33 mm³, in left adrenal gland was 4.77 ± 1.69 mm³ & Total adrenal gland was 8.25 ± 2.74 mm³.

Keywords: CT scan, adrenal gland volume, adrenal mass, adrenal gland measurements

Introduction

The adrenal gland (AG) is so called because of its location adjacent to the kidney (adrenal). The adrenal glands are situated in the retroperitoneal space, close to the upper pole of the kidney ^[1]. Incidental adrenal masses are common, occurring in about 3–7% of adults, with the majority of them being benign non-functioning adenomas. Characterization of an adrenal mass as benign or malignant is critical and imaging plays a key role in influencing the clinical management of patients ^[2, 3].

The methods commonly used in the AG evaluation and size measurements are ultrasonography, magnetic resonance imaging, and multidetector computed tomography (MDCT). Due to its fast, widely accessible, and high spatial resolution, MDCT is the primary method of choice for the assessment of the Ags^[4, 5].

Adrenals are often difficult to visualize on ultrasound. CT scan is a better mode of visualization of adrenal glands. Knowledge of the range of imaging appearances of the adrenal glands in primary may allow definitive diagnosis in most cases^[6]. Due to its fast, widely accessible, and high spatial resolution, MDCT is the primary method of choice for the assessment of the Ags^[7]. Present study was aimed to study computed tomography measurements of normal adrenal glands in a urban population.

Material and Methods

Present study was prospective, observational study, conducted in department of anatomy with help of department of radiodiagnosis, at BKL Walawakar Rural Medical College & Hospital, Savarde, Chiplun, India. Study duration was of 1 year (January 2021 to December 2021). Study was approved by institutional ethical committee.

Inclusion criteria

- Normal, healthy adults of either gender, age > 25 years.

Exclusion criteria

- Patients with acute or chronic illness affecting adrenal glands.
- Patients with any known adrenal pathology.
- Patients with previous history of contrast allergy.
- Pregnant females.

Study was explained & a written informed consent was taken from participants. General information such as age, gender, height, weight, BMI were noted in case record proforma.

CECT was performed in the Department of Radiodiagnosis. The subjects of the study were given 1.0 to 1.5 litres of plain water for drinking about 45 to 60 minutes before performing the scan. Both unenhanced and enhanced CT acquisitions were performed in the region between diaphragm and pubic symphysis in these patients. Thirty ml of non-ionic contrast medium (Omnipaque/iohexol-350, GE Healthcare, 350 mg of Iodine/ml) was administered intravenously at the rate of 1 ml/s through an 18G cannula placed in the antecubital fossa, another 20 ml of contrast was given at 3 ml/s. After 25 seconds pause another 50 ml of contrast medium was given at rate of 5ml/s, then 30 ml saline chase was given at the rate of 3.5 ml/s using automatic injector (STELLANT-MEDRAD version IPX-1).

All images obtained were independently analyzed in random order using a workstation (Extended Brilliance workspace, Philips Medical Systems). Axial, coronal, sagittal, multi-planar reformatted image (MPR), and maximum intensity projections (MIP) were reviewed. Maximum intensity projection (MIPs) was obtained using various thicknesses (5-10 mm).

Adrenal gland dimensions were taken of the included subjects. Length, width, thickness, size of adrenal gland, shape of adrenal glands were recorded.

Statistical analysis was done using descriptive statistics.

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi-square test or

Fisher exact test as applicable. P value less than 0.5 was considered as statistically significant. Pearson's co-efficient correlation test were used to assess the association between adrenal glands dimensions and some anthropometric parameters.

Results

58 participants were studied, mean age was 46.5 ± 15.2 years, 62.07% were male, mean weight was 71.46 ± 11.39 kgs, mean height was 160.14 ± 12.11 cm, body mass index was 24.16 ± 3.86 kg/m² & waist circumference was 67.33 ± 18.41 mm². Adrenal gland volume in right adrenal gland was 3.47 ± 1.33 mm³, in left adrenal gland was 4.77 ± 1.69 mm³ & Total adrenal gland was 8.25 ± 2.74 mm³.

Table 1: Descriptive statistics

Clinical characteristic	Number of cases (%) / Mean \pm SD
Age (years)	46.5 \pm 15.2
Gender	
Male	36 (62.07%)
Female	22 (37.93%)
Weight (kg)	71.46 \pm 11.39
Height (cm)	160.14 \pm 12.11
Body mass index (kg/m ²)	24.16 \pm 3.86
Waist circumference (mm ²)	67.33 \pm 18.41
Adrenal gland volume (mm³)	
Right adrenal gland	3.47 \pm 1.33
Left adrenal gland	4.77 \pm 1.69
Total adrenal gland	8.25 \pm 2.74

Gender-wise comparison of length, width & thickness in right & left side adrenal gland was comparable among male & female groups & difference was not significant statistically.

Table 2: Gender-wise comparison of length, width & thickness

Variable	Male (Mean \pm SD)	Female (Mean \pm SD)	'p'-Value
Length (mm)			
Right	30.12 \pm 5.48	32.55 \pm 4.31	0.092
Left	29.35 \pm 4.96	29.16 \pm 5.07	0.073
Width (mm)			
Right	30.83 \pm 4.26	29.45 \pm 3.74	0.090
Left	29.27 \pm 5.16	27.33 \pm 3.85	0.055
Thickness (mm)			
Right	5.79 \pm 1.07	5.81 \pm 1.30	0.092
Left	5.91 \pm 1.41	5.65 \pm 1.66	0.062

In present study, majority of patients had Y shape adrenal gland (87.93% in right versus 84.48% left), followed by linear type (6.9% in right versus 8.62% left).

Table 3: Shape of the adrenal glands

Shape of Adrenal Gland	Right adrenal gland (%)	Left adrenal gland (%)
Y type	51 (87.93%)	49 (84.48%)
Linear type	4 (6.9%)	5 (8.62%)
V type	1 (1.73%)	2 (3.45%)
Triangular	2 (3.45%)	2 (3.45%)

Discussion

Awareness of the range of normal size and shape is useful for adequate interpretation of computed tomography (CT) scans in patients with suspected adrenal pathology. Most of the previous studies performed for evaluating the size of the adrenal glands were performed on early-generation CT scan systems employing prolonged data acquisition times that yielded low-resolution images [8].

Besides ultrasound and nuclear medicine techniques, computed tomography (CT) and magnetic resonance imaging (MRI) are commonly used to examine adrenal lesions in both symptomatic and asymptomatic patients. Due to the variability of AG morphology, thickness measurements may not be accurate. However, volumetric analysis can provide more standardized evaluations due to advances in MDCT software technology.

Bilateral atrophic AGs are generally seen in patients with Addison's disease or a history of chronic steroid usage [9], while unilateral or bilateral adrenal enlargement may be seen in the presence of an underlying lesion, hypo- or hyperfunction [10, 11]. Thus, the knowledge of normal AGV value is of high significance.

Gaurav R *et al.*, [12] studied 35 normal healthy adults (11 males and 24 females; mean age 44 years). The mean lengths of right adrenal in males was 28.01 ± 5.48 mm and in females was 32.55 ± 4.31 mm. The mean length of left adrenal gland in males was 27.35 ± 3.96 mm and in females it was 29.16 ± 5.07 mm. The mean widths of right adrenal in males was 29.83 ± 4.26 mm and in females was 29.45 ± 3.74 mm. The mean width of left adrenal gland in males was 26.27 ± 5.16 mm and in females it was 27.33 ± 3.85 mm. The mean thicknesses of right adrenal in males was 5.70 ± 1.07 mm and in females was 5.65 ± 1.30 mm. The mean thickness of left adrenal gland in males was 5.91 ± 1.41 mm and in females it was 5.60 ± 1.66 mm. It was observed that the length and width of right adrenal gland was more as compared to the left side.

John R *et al.*, [13] studied 586 adults who underwent a CT, median age was 51 (range: 18–85) years. The mean maximum thickness of the adrenal body, medial, and lateral limbs were 7.2 ± 1.8 , 4.1 ± 1.1 , and 4.3 ± 1.1 mm on the right side and 8.8 ± 1.9 , 4.7 ± 1.1 , and 4.9 ± 1.3 mm on the left. The cumulative thickness of the body and the limbs were 15.6 ± 3.7 mm and 18.4 ± 3.8 mm on the right and left sides, respectively. There was a statistically significant difference in all the measurements between the right and left adrenal glands (all P values = 0.000) and between men and women, being larger in men (P value <0.05). 27% had at least one adrenal gland body measuring ≥ 10 mm in thickness.

Gurun E *et al.*, [14] studied 115 MDCT scans, mean age of participants was 49.5 ± 17.7 (19–81). The average right AGV (RAGV), left AGV (LAGV), and total AGV were 3.47 ± 1.33 , 4.77 ± 1.33 , and 8.25 ± 2.74 , respectively. The ICC values for all measurements were >0.80–0.90, indicating good and excellent agreement. LAGV was measured as higher than the RAGV. A positive moderate correlation of the AGVs with BMI and WC was observed. The increase in BMI and WC, which are indicators of obesity, correlates with the increase in AGV, we think that the findings will be valuable in evaluating the pathophysiology of the hypothalamic-pituitary-adrenal axis.

In study by Sundaa Raja PR *et al.*, [15] mean thickness was measured by using computed tomography images and the mean values are as follows right medial limb measured 2.90 ± 0.61 mm, right lateral limb 3.10 ± 0.69 mm, right body thickness 5.39 ± 1.28 mm, left medial measured 3.34 ± 0.9 mm, left lateral limb measured 3.15 ± 0.78 mm and left body thickness measured 6.1 ± 1.23 mm.

Aggarwal N *et al.*, [16] studied CT images in 1250 patients & concluded that the average width of the body of the right and left adrenal glands is 6.9 ± 0.31 mm and 5.4 ± 0.24 mm, respectively (though maximum width of the body may reach up to 11 mm) and that normal adrenal limbs should not measure >5 mm. The most common shape of the adrenal glands was

found to be Y shape, followed by the V and triangular shapes.

The measurements of adrenal gland offers a baseline for determining adrenal normality or enlargement on CT examination of the adrenal glands in the clinical or research setting.¹⁷ With the advent of multidetector CT technology, it is now possible to acquire very thin-slice CT images with very good spatial resolution.

Conclusion

CT is an excellent screening and often decisive radiologic test of assessing the adrenal gland. Mean adrenal gland volume in right adrenal gland was $3.47 \pm 1.33 \text{ mm}^3$, in left adrenal gland was $4.77 \pm 1.69 \text{ mm}^3$ & Total adrenal gland was $8.25 \pm 2.74 \text{ mm}^3$. This was normal range of adrenal gland volume in Indian adult population, which may be used as a baseline reference for future research and as a reference for radiological reporting.

Conflict of Interest: None to declare.

Source of funding: Nil.

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