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Original Research Article **Radiology**

Characterization of Normal Adrenal Gland in Sudanese Population Using Computed Tomography

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Abstract

The adrenal gland is, despite her small size, among the most important and vital organs in the human body. The purpose of this study was to evaluate the normal adrenal gland's location, shape, texture and size and correlate that with gender and age in Sudanese population by using computed tomography. The study was performed during the period from June 2025 to September 2025 in CT departments of Military hospital Omdurman. The data were collected from randomly selected sample of 50 patients (21 males and 29 females) who underwent CT abdomen for other indications without evidence of adrenal diseases. The main findings of correlations included that most common shape of the adrenal gland was linear, and when correlating the normal texture and size of the adrenal gland with the age and gender, it was found that texture and size of the adrenal gland decreased with age, and the size of the adrenal gland in females was smaller as compared to males.

Keywords: CT, Adrenal gland, Location, Texture, HU, Size, Shape.

INTRODUCTION

The suprarenal glands are two yellowish retroperitoneal organs that lie on the upper poles of the kidneys against the crura of the diaphragm. The left is related anteriorly to the stomach across the lesser sac, the right lies behind the right lobe of the liver and tucks medially behind the inferior vena cava. They are surrounded by renal fascia. Each gland has a yellow cortex and a dark brown medulla. (Richard s. Snell 2012)

The adrenal medulla secretes epinephrine and norepinephrine, which collectively are called catecholamines and are sympathomimetic, and the adrenal cortex secretes three types of steroid hormones: mineralocorticoids, glucocorticoids, and sex hormones. The sex hormones are estrogens “female” and androgens “male”. (Valerie C. Scanlon and Tina Sanders, 2007).

Diseases of the adrenal cortex can be conveniently divided into those associated with cortical hyperfunction and those characterized by cortical hypofunction. The most important diseases of the adrenal medulla are neoplasms, which include both neuronal neoplasms (including neuroblastomas and more mature ganglion cell tumors) and neoplasms composed of chromaffin cells (pheochromocytomas). (Kumar, V., & Robbins, S. L., 2007)

The adrenal gland is a common site of disease, and radiology is playing a critical role in not only the detection of adrenal abnormalities but in characterizing them as benign or malignant. The adrenal gland is routinely identified at abdominal CT and MR imaging examinations. CT has become the study of choice to differentiate a benign adenoma from a metastasis in the oncology patient. There are numerous imaging modalities including CT, MR imaging, ultrasonography (US), and nuclear medicine imaging that can be used to evaluate the adrenal but the CT is the primary modality for both detection and characterization of adrenal masses. If an adrenal mass is suspected, CT technique should be tailored to optimize visualization of the adrenal gland. (William W. Mayo-Smith, 2000)

METHODS

This a descriptive study comprised of randomly selected sample of 50 patients (21 males and 29 females), and their ages ranged between 30 and 69 (Mean 47 years) underwent CT abdomen for other indications without evidence of adrenal diseases. The study was carried out in Military hospital Omdurman during the period from June 2025 to September 2025. The CT machines used in this study were Toshiba Aquilion 64 slices in Military hospital (slice thickness: 5mm).

The data obtained from serial axial and reformatted coronal and sagittal sections of CT abdomen images of patients.

The adrenal gland's location, shape, texture, length, width and size were determined on the sections where the gland was best seen. (**Figure 1**)

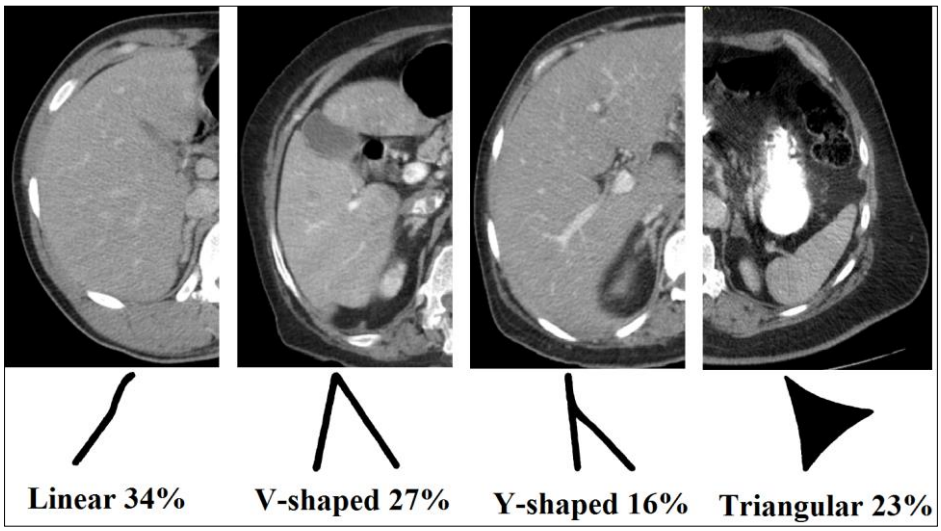

Figure 1: Shows the shapes of the gland configurations on each cross section

RESULTS

The following tables and figures represent data obtained from randomly selected sample of 50 patients (21 males and 29 females) who underwent CT abdomen for other indications without evidence of adrenal diseases.

Table 1: Study group gender distribution

Gender	Frequency	Percentage %
Male	21	42%
Female	29	58%
Total	**50**	**100%**

Table 2: Study group Age distribution

Age classes	Male		Female	
	Frequency	Percentage %	Frequency	Percentage %
30-40	4	19%	11	38%
41-50	9	43%	8	28%
51-60	4	19%	8	28%
61-70	4	19%	2	6%
Total	21	100%	29	100%

Table 3: Mean of study group Age

Gender	Mean
Male	49.67
Female	45.62

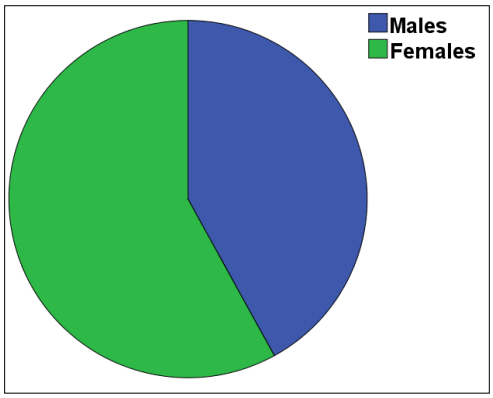

Figure 2: Study group Age distribution

Table 4: Study group Shape distribution

Shape	Frequency	Percentage %
Linear	34	34%
V-shaped	27	27%
Y-shaped	16	16%
Triangular	23	23%
Other	0	0%
Total	**100**	**100%**

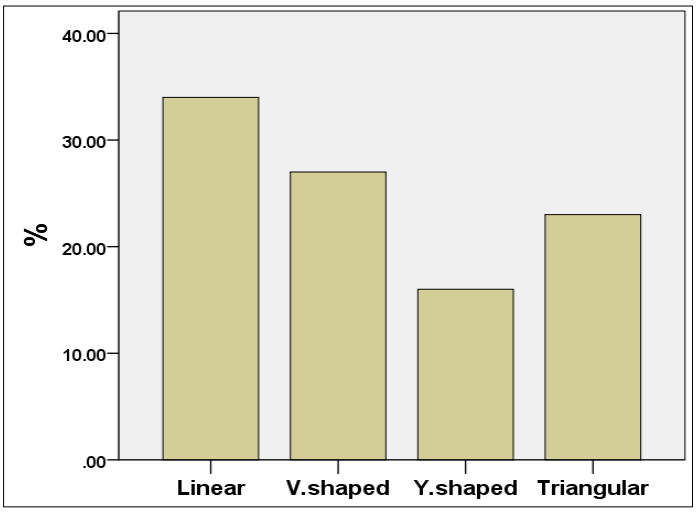

Figure 3: Study group Shape distribution

Table 5: Length of right and left adrenal glands

Number of sections	Right adrenal gland		Left adrenal gland	
	Frequency	%	Frequency	%
8-10	16	32%	7	14%
11-13	14	28%	8	16%
14-16	17	34%	20	40%
17-19	4	8%	12	24%
20	1	2%	1	2%

Slice thickness 2.5 mm.

Table 6: Width of right and left adrenal glands

Centimeter	Right adrenal gland		Left adrenal gland	
	Frequency	%	Frequency	%
1 – 1.9	1	2%	1	2%
2 – 2.9	23	46%	35	70%
3 – 3.9	23	46%	13	26%
4 – 5	3	6%	1	2%

Table 7: Thickness of right and left adrenal glands

Centimeter	Right adrenal gland		Left adrenal gland	
	Frequency	%	Frequency	%
0.5	32	64%	34	68%
0.6	14	28%	10	20%
0.7	4	8%	6	12%

Table 8: Right and left adrenal glands measurements Mean

Adrenal glands measurements Mean	Right adrenal gland				Left adrenal gland			
	Length	Width	Thickness	Size	Length	Width	Thickness	Size
Male	3.14	3.04	0.5	5.24	3.58	2.93	0.5	5.97
Female	3.03	3.04	0.5	5.11	3.74	2.61	0.5	5.35

Table 9: Mean of right and left adrenal glands texture

Adrenal glands texture Mean	Right adrenal gland	Left adrenal gland
Male	24.19	25.00
Female	24.21	24.03

Table 10: Correlations between the age and the normal right adrenal gland size

		Age	Right Adrenal Gland Size
Age	Pearson Correlation	1	-.594-**
	Sig. (2-tailed)		.000
	N	50	50
Right Adrenal Gland Size	Pearson Correlation	-.594-**	1
	Sig. (2-tailed)	.000	
	N	50	50
**. Correlation is significant at the 0.01 level (2-tailed).			

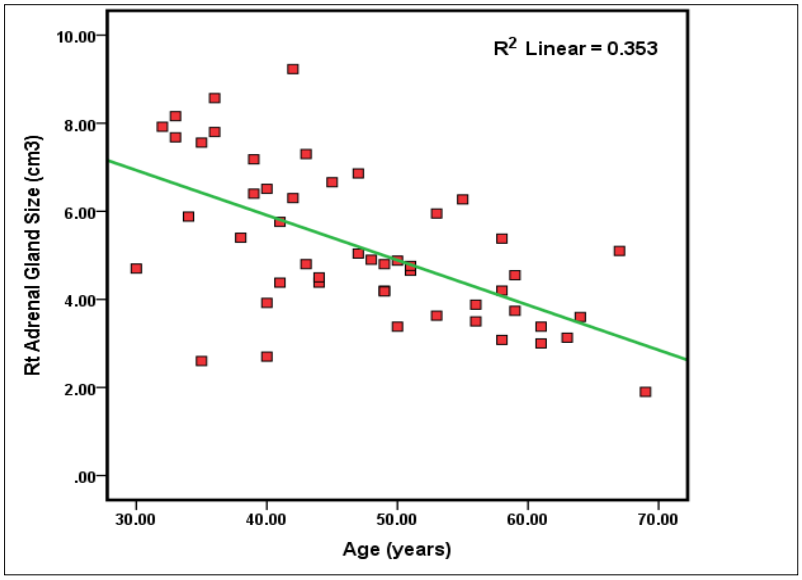

Figure 4: Scatter plot diagram shows the correlation between the age and the normal right adrenal gland size

Table 11: Correlations between the age and the normal left adrenal gland size

		Age	Left Adrenal Gland Size
Age	Pearson Correlation	1	-.472-**
	Sig. (2-tailed)		.001
	N	50	50
Left Adrenal Gland Size	Pearson Correlation	-.472-**	1
	Sig. (2-tailed)	.001	
	N	50	50
**. Correlation is significant at the 0.01 level (2-tailed).			

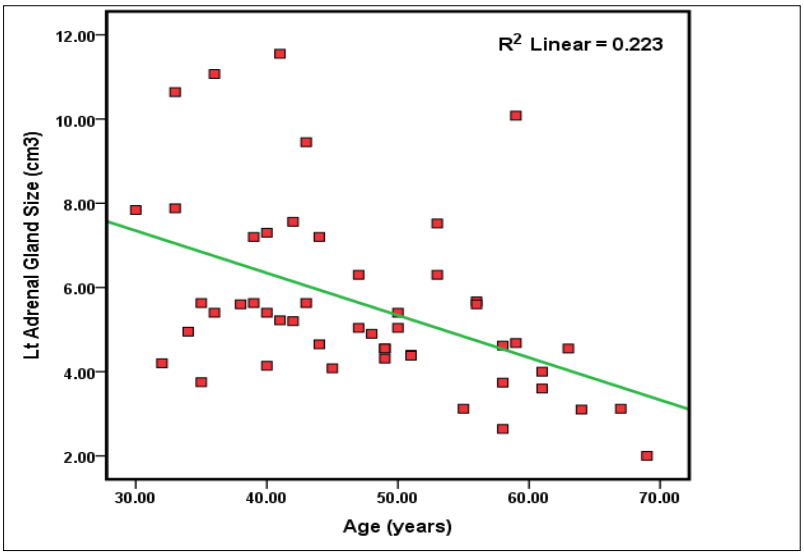

Figure 5: Scatter plot diagram shows the correlation between the age and the normal left adrenal gland size

Table 12: Correlations between the age and the normal right adrenal gland texture

		Age	Right Adrenal Gland Texture
Age	Pearson Correlation	1	-.678-**
	Sig. (2-tailed)		.000
	N	50	50
Right Adrenal Gland Texture	Pearson Correlation	-.678-**	1
	Sig. (2-tailed)	.000	
	N	50	50
**. Correlation is significant at the 0.01 level (2-tailed).			

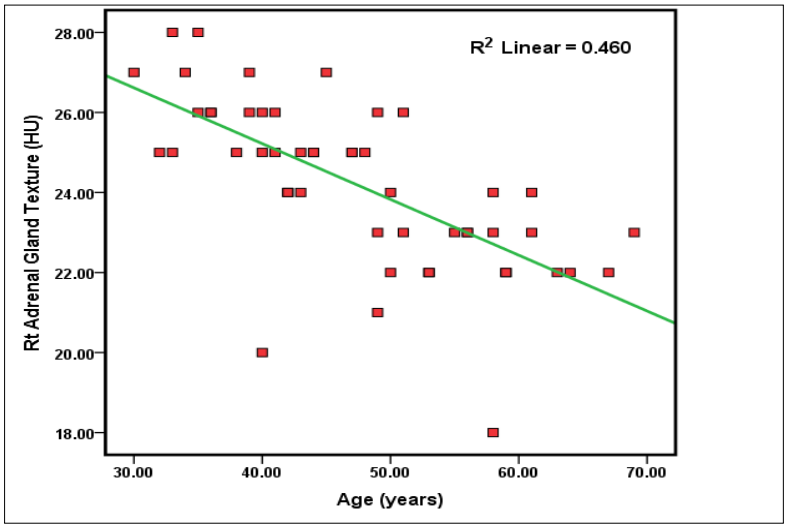

Figure 6: Scatter plot diagram shows the correlation between the age and the normal right adrenal gland texture

Table 13: Correlations between the age and the normal left adrenal gland texture

		Age	Left Adrenal Gland Texture
Age	Pearson Correlation	1	-.322-*
	Sig. (2-tailed)		.023
	N	50	50
Left Adrenal Gland Texture	Pearson Correlation	-.322-*	1
	Sig. (2-tailed)	.023	
	N	50	50
*. Correlation is significant at the 0.05 level (2-tailed).			

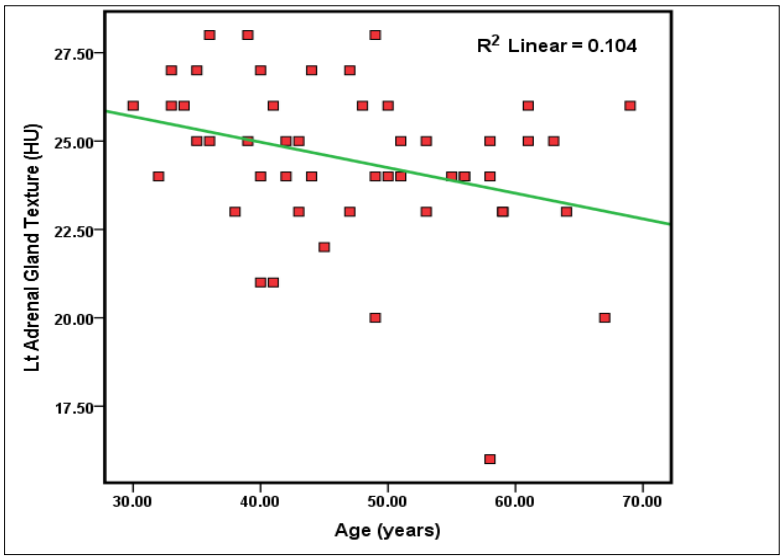

Figure 7: Scatter plot diagram shows the correlation between the age and the normal left adrenal gland texture

DISCUSSION

Prior studies characterized the normal adrenal glands using computed tomography. The presence, location, size, and shape of both adrenal glands were evaluated. Measurements were made on the hard copy recording medium. Most frequent shape of normal adrenal glands was linear (87%) in the right gland and V-shaped (50%) in the left gland. The normal adrenal gland's length, width, thickness were 2-4 cm, 2-2.5 cm, 1 cm respectively. (Jean-Philippe Montagne, Herbert y. Kressel, Melvyn korobkin, and Albert A. Moss, 1978)

In this study sample (50 patients), both adrenal glands were delineated clearly enough to perform the measurements of length, width and thickness and determine the shape of the gland.

Both right and left adrenal glands were in their typical locations, the right lies behind the right lobe of the liver and extends medially behind the inferior vena cava and the left lies behind the pancreas, the lesser sac, and the stomach.

The study showed that the most common shape of the normal gland was linear (34%).

The normal adrenal gland's length, width, thickness and size in male right adrenal gland were 3.14 cm, 3.04 cm, 0.5 cm, 5.24 cm3 respectively, and male left adrenal gland were 3.58 cm, 2.93 cm, 0.5 cm, 5.97 cm3 respectively, and female right adrenal gland were 3.03 cm, 3.04 cm, 0.5 cm, 5.11 cm3 respectively, and female left adrenal gland were 3.74 cm, 2.61 cm, 0.5 cm, 5.35 cm3 respectively, and these measurements showed that the size of the adrenal gland in females is smaller as compared to males.

Study showed that there was significant Correlation between age and adrenal gland's size and texture. The right adrenal gland's size decreased by – 0.594 starting from 5.76 cm3 as the age increased and the left adrenal gland's size decreased by – 0.472 starting from 5.40 cm3 as the age increased.

The right adrenal glands texture decreased by – 0.678 starting from 26 HU as the age increased, and the left adrenal glands texture decreased by – 0.322 starting from 25 HU as the age increased.

CONCLUSION

The researchers concluded that most common shape of the adrenal gland was linear, and the texture and size of the adrenal gland decreased with age, and the size of the adrenal gland in females was smaller compared to males.

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