

MORPHOLOGY AND MORPHOMETRY OF POSTNATAL SUPRARENAL GLANDS IN SOUTH INDIAN HUMAN CADAVERS

Maruti ram Annamraju¹, Subhadra Devi Velichety², Srihari Rao Bathalapalli³

1. Assistant Professor of Anatomy, S.V. Medical College, Tirupati.
2. Professor of Anatomy, Sri Venkateswara Institute of Medical Sciences, Tirupati.
3. Professor of Surgery, S.V. Medical College, Tirupati.

Corresponding author: Dr.V.Subhadra Devi, Professor of Anatomy, Sri Padmavathi Medical College for women - Sri Venkateswara Institute of Medical Sciences, Tirupati -517507, Andhra Pradesh, India. Phone No: +919440225860. E-Mail: sdvelichety@hotmail.com

ABSTRACT

Study of morphology and morphometry of suprarenal gland facilitates diagnostic and treatment methods for various associated clinical conditions. In the present study 120 suprarenal glands obtained from 60 cadavers were observed for their morphological and morphometric parameters along with weight of the kidneys. Statistical analysis was done by one-way analysis of variance test and Duncan's multiple range test. Age-wise significance in weight of suprarenals and sex-wise significance in weight of kidneys, thickness of left suprarenal and thickness of left cortex and side-wise significance in length, width and thickness of suprarenal, thickness of cortex and weight of kidney were observed in the present study. The results of the present study form a data base for suprarenal morphometry in the south Indian population of a wide age range of 2 years to 64 years of life.

Keywords: Morphology, morphometry, postnatal, suprarenal gland (SG).

INTRODUCTION

Knowledge of normal morphometry of the adrenal gland facilitates surgeons, endocrinologists, pathologists and radiologists to adopt appropriate diagnostic and treatment methods for various adrenal gland associated clinical conditions. Weight of adrenal gland may be affected by patient's gender, age, laterality of gland and presence of systemic disease [Lam et al., 2001 and Grant, 2008].

A review of literature indicated that there are lacunae in the literature on postnatal adrenal

glands of different ages in different population in general and Indian population in particular with no literature in South Indian population. The present study on human cadaveric adrenal glands of a wide age range extending from 2 years to 64 years post-natal period and both sexes was carried out to observe the pattern of growth in the local population and compare with those reported in the literature on other population.

MATERIALS AND METHODS

After approval by the institutional ethical committee, a total of 120 supra renal glands obtained from 60 cadavers of 2 to 64 years and both sexes were included in this study. A total of 98 human adrenal glands from 49 Non- MLC

autopsied bodies in department of Forensic medicine. S.V. Medical college, Tirupati and 22 adrenal glands from 11 unclaimed cadavers used for student demonstration in the department of Anatomy, S.V. Medical College, Tirupati were

Submitted 7th August 2015, corrected 9th November 2015. Published online 1st August 2016. To cite: Maruti RA, Subhadra DV, Srihari RB. K. Morphology and morphometry of postnatal suprarenal glands in south Indian human cadavers. *Anatomy Journal of Africa*. 5: 747 – 754.

utilized. The consent from the close kith and kin were obtained for autopsied bodies. During post mortem examination / dissection, the adrenal glands were collected after recording its location, relation with the kidney, blood supply and weight of kidney (Fig.1).

Collected adrenal glands were preserved in 10% Formalin and subsequently subjected to morphological and morphometric examination. All the samples collected were with normal external features.



Fig.1 Specimen of adult adrenal gland with kidneys

RESULTS

The post-natal cadavers were divided sex-wise and age-wise as shown in table 1.

Table 1: Age-wise and sex-wise distribution of postnatal cadavers

Age in years	MALES (number of cadavers)	FEMALES (number of cadavers)	TOTAL (number of cadavers)
0-25	4	7	11
26-50	28	8	36
>50	9	4	13
Grand Total	41	19	60

Morphological parameters

Location and colour of the adrenal glands was normal but shape varied on each side. Right suprarenal gland was pyramidal or triangular or

'V' shaped. Left suprarenal glands shape varied from semi-lunar, leaf-like, sickle shape, crescentic or ovoid. In three cadavers both glands were of same shape (5%). In a 35 year male and a 42 year female both right and left suprarenal glands were semi-lunar and in a 45 years male both were pyramidal. Surfaces of

both right and left suprarenal glands appeared irregular and covered by adipose tissue in all study samples.

Morphometric parameters

Various external morphometric parameters of length, width, thickness and weight of suprarenal and renal of both sides and internal supra renal parameters of cortex and medulla thickness were measured and statistically analyzed by applying one way ANOVA and Duncan's multiple range test (DMRT) for the three age-wise groups.

Table.2: Independent sample t-test by gender for external and internal parameters of suprarenal gland and external parameters of kidneys

	Gender	N	Mean	Std. Deviation	t-value	p-value
SG Length Right	Male	41	2.963	.6272	0.141	0.889
	Female	19	2.989	.7483		
SG Length Left	Male	41	4.444	.6580	0.963	0.339
	Female	19	4.258	.7727		
SG Width Right	Male	41	3.341	.7089	1.299	0.199
	Female	19	3.111	.4545		
SG Width Left	Male	41	2.256	.5710	0.398	0.692
	Female	19	2.316	.4646		
SG Thickness Right	Male	41	.606	.2015	1.310	0.195
	Female	19	.537	.1606		
SG Thickness Left	Male	41	.752	.1787	2.681*	0.010
	Female	19	.621	.1686		
Weight(gms)of Kidney Right	Male	41	111.50	15.43	3.266**	0.002
	Female	19	93.42	27.45		
Weight (gms) of Kidney Left	Male	41	121.8	19.07	2.865**	0.006
	Female	19	103.0	31.62		
Weight of adrenal Right	Male	41	3.898	1.2048	1.021	0.312
	Female	19	3.572	1.0141		
Weight of adrenal Left	Male	41	3.765	.92681	1.625	0.110
	Female	19	3.330	1.04534		
Cortex Right(mm)	Male	41	1.336	.2732	0.852	0.397
	Female	19	1.271	.2820		
Cortex (mm) Left	Male	41	1.0685	.48161	2.253*	0.028
	Female	19	.7737	.44854		
Medulla (mm) Right	Male	41	1.022	1.3506	0.328	0.744
	Female	19	.917	.4831		
Medulla (mm)Left	Male	41	.780	1.3309	1.141	0.259
	Female	19	.429	.1336		
Ratio (C/M)Right	Male	41	2.046	1.032	0.917	0.363
	Female	19	1.7907	.9357		
Ratio(C/M) Left	Male	41	1.956	1.1315	0.500	0.619
	Female	19	1.807	.9264		

* :- significant at 0.05 level , ** :- significant at 0.01 level

There is gradual increase in length, width and thickness with age on right side. A decrease in length and thickness in > 50 yrs group and a decrease in width in 26-50 yrs group followed by an increase in > 50yrs age group was observed on left side. A higher mean for length and thickness on left side and higher mean for width on right side were noted in the present study. Significant difference at 5% level in only weight of both kidneys were observed. Weight of both right and left Kidneys of < 25 years age and > 50 years age groups are significantly less than that of 26 to 50 years group. Right dominance in cortex and medulla thickness was observed but not statistically significant. There is a significant difference in suprarenal gland thickness and cortex thickness on left side at 0.05 level and weight of both right and left kidneys at 0.01 levels (Table 2).

When all the age groups were combined, SG length, SG width, SG thickness and cortex showed significant difference at 0.01 level on right side. Whereas weight of kidney showed

significant difference at 0.05 level on right side (Table 3).

Karl Pearson's coefficient of correlation is computed between weight of kidney (right and left) and weight of adrenal gland (right and left). Weight of left kidney and weight of left adrenal gland correlated significantly at 0.01 level in positive direction. Karl Pearson's coefficient of correlation is computed between suprarenal gland (SG) thickness (right and left) and cortex, medulla of corresponding side and also between cortex and medulla of each side. Table 4 shows that right SG thickness and corresponding cortex, medulla are correlated significantly at 0.01 level in positive direction, whereas left SG thickness is correlated with left cortex at 0.05 level and with medulla at 0.01 level in positive direction. The correlation between Right cortex and right medulla is insignificant in negative direction; similarly the left cortex and left medulla are correlated insignificantly in positive direction.

Table.3: Independent sample t-test by side for external and internal parameters of suprarenal gland and weight of kidneys in overall post natal category.

Overall sample	Side	N	Mean	Std. Deviation	t-value	p-value
SG Length(cms)	Right	60	2.972	0.6616	11.408**	0.000
	Left	60	4.385	0.6952		
SG Width(cms)	Right	60	3.268	0.6445	9.176**	0.000
	Left	60	2.275	0.5363		
SG Thickness(cms)	Right	60	0.584	0.1909	3.685**	0.000
	Left	60	0.710	0.1846		
Weight(gms)of Kidney	Right	60	105.78	21.5250	2.374*	0.019
	Left	60	115.910	25.0980		
Weight of adrenal(gms)	Right	60	3.795	1.1494	0.857	0.393
	Left	60	3.628	0.9785		
Cortex (mm)	Right	60	1.316	0.2753	4.710**	0.000
	Left	60	0.975	0.4876		

Medulla (mm)	Right	60	0.989	1.1447	1.554	0.123
	Left	60	0.669	1.1106		
Ratio (C/M)	Right	60	1.9650	1.0020	0.301	0.764
	Left	60	1.9080	1.06520		

* :- significant at 0.05 level , ** :- significant at 0.01 level

In the present study the thickness of cortex and medulla are more on right side than left side. The thickness of cortex increased with age on right side. Whereas on left side it increased up to 50 yers and later decreased. Mean Cortico-medullary ratio was same on both sides. The cortico-medullary ratio in 26-50 years group is less than that of < 25years and it showed an increase in > than 50years group. Gender-wise Independent sample t- test for cortex thickness, medulla thickness and cortico-medullary ratio of both sides revealed significant difference in suprarenal gland thickness and cortex thickness on left side (p<0.05).

Gender-wise Independent sample t- test for weight of kidney and supra renal, cortex thickness, medulla thickness and cortico-medullary ratio of both sides revealed significant difference in suprarenal gland thickness and cortex thickness on left side (p<0.05) and weight of both right and left kidneys(p<0.01) though

they presented variation in sexes. This indicates gender-wise statistical significance of these parameters and non-significance of other parameters.

Mean of Cortico-medullary thickness ratio on the right side is 2.80:1 and on the left side it is 2.77:1. Mean Renal-Suprarenal weight ratio on right side is 30.54:1 and on left side it is 33.44:1.

When the three groups are analyzed independently the results obtained were at variance. There is significant side-wise difference (p<0.05) in case of medulla thickness and highly significant values (p<0.01) for gland length and width in less than 25 years group. In case of 26-50 years age group gland length, width, thickness, weight of kidney and cortex showed significant side-wise difference (p=<0.01).

Table 4. Correlation matrices for thickness and cortex, medulla of suprarenal gland

		Cortex Right(mm)	Cortex (mm) Left	Medulla (mm) Right	Medulla (mm)Left
SG Thickness Right (cms)	Pearson Correlation	0.356(**)		0.419(**)	
	Sig. (2-tailed)	0.005		0.001	
	N	60		60	
SG Thickness Left(cms)	Pearson Correlation		0.300(*)		0.336(**)
	Sig. (2-tailed)		0.020		0.009
	N		60		60
Cortex Right(mm)	Pearson Correlation			-0.011	

	Sig. (2-tailed)			0.931	
	N			60	
Cortex (mm) Left	Pearson Correlation				0.082
	Sig. (2-tailed)				0.533
	N				60

* :- significant at 0.05 level , ** :- significant at 0.01 level

Gland length, width, thickness, cortex and medulla thickness showed significant difference ($p < 0.05$) in more than 50 years age group. When all the age groups were compared, gland length, width, thickness and cortex thickness showed highly significant difference ($p < 0.01$) whereas weight of kidney showed significant

difference ($p < 0.05$).

Karl Pearson’s coefficient of correlation shows significant correlation between weight of left kidney and weight of left adrenal gland ($p < 0.01$).

DISCUSSION

In the present study the supra renal glands are located antero-superior to the superior pole of kidney and it corresponds to that reported by Jit and Banga (1987). The predominant shape of right gland is pyramidal (86.66%) as stated by Jit and Bangla, 1987. This is followed by triangular (10%) and semilunar (3.33%) shapes. The predominant shape of left gland was semilunar (78.33%) as stated by Anand, 1999. The other shapes of left glands are leaf-like (10%), sickle shape (1.66%), crescentic to ovoid (8.33%) and pyramidal (1.66%). This type of percentage distribution of various shapes was not reported in literature.

In the present study, the mean length, width and thickness were 3.7 x 2.8 x 0.6 cms which are in agreement with those reported in the literature. These parameters presented sex-wise differences with higher values for males than for females. When Gender-wise Independent sample t- test for length, width, thickness, were applied they are not statistically significant. No literature on these lines was available for comparison.

Lam et.al. 2001 probably based on their studies on longest dimensions of supra renal glands in 333 autopsied Chinese bodies (208 men, 125 women) reported a greater longitudinal length of left (5.2cms) adrenal than the right (4.8 cm). The average weight of adrenal in the present study is 3.8gms which is less than that reported in the literature by Lam et.al., 2001, Jit and Banga, 1987, Singh et.al., 2004 and Folligan et.al., 2005 and is close to the value reported by Kumar et.al., 2004 and Guyton and Hall, 2006. Studzinski et.al., 1963 stated that 99% of apparently normal adrenal glands weigh less than 6 g each and those exceeding this weight should be considered as abnormal. In the present study except for right gland of a 55yrs male which weighed 6.53 gms, all the other were less than 6 gms.

In the present study the mean length is greater on left (4.38cms) than on right (2.97cms) side and is in agreement with the observation of Lam et.al., 2001 in Chinese population. But the values obtained in the present study are less than the values reported by Lam et.al., 2001 probably due

to the population difference. Width in the present study is greater on right side and thickness is almost similar on both sides. There are no reported studies in literature for comparing these parameters.

In the present study there is gradual increase in weight of right adrenal with age but a decrease in weight of left adrenal but they are not significant statistically. This is in agreement with the report of Lam et.al.,2001 and Dilruba et.al., 2010. The weight of kidney showed significant difference in > 50 yrs group ($p < 0.05$) in the present study and not significant when side and age-group are combined as reported by Dilruba et.al., 2010.

Mean weight of right adrenal is more than that of left and is in agreement with the statement of Lam et.al.,2001 but not in agreement with that of Singh et.al., 2004 who observed in a large sample. The variation in the studies on Indian population reported by Singh et.al.,2004 and the present study could be due to the method of collection of sample. Singh et.al.,2004 observed on adult autopsies whereas the present study is on a wide range of cadavers of 2 to 64 yrs age.

The weight of gland in males is heavier than that of females but they are not statistically significant. This is in agreement to that reported in literature [Lam et.al., 2001; Jit and Banga,1987]. Narongchai duo,2008 reported that the glands are heavier in females.

Karl Pearson's coefficient of correlation revealed significant correlation ($p < 0.01$) between weight of left kidney and adrenal; right gland thickness and corresponding cortex and medulla; left gland thickness with left medulla. Left gland thickness is correlated with left cortex ($p < 0.05$). According to Aliab'ev and Paderov, 2004 age-dependent increase of adrenal mass is accompanied by the changes in cortex-to-medulla mass ratio. According to them the

increase of adrenal mass was predominantly caused by the growth of the cortex in the left adrenal and by the growth of medulla in both adrenal glands. Domination of the mass of left adrenal and of its cortex over the similar parameters of the right adrenal gland is found in all the age groups in their study. The results of the present study are not in agreement with those reported by Aliab'ev and Paderov,2004.

Conclusion: The results of the present study form a data base for suprarenal morphometry in the south Indian population of a wide age range of 2 years to 64 years of life. Some important observations which were not available in the literature and not in agreement with the literature were found. The percentage distribution of various shapes of both the suprarenal glands were reported. The length, width and thickness of the suprarenal glands had higher values in males than for females. The gender wise sample t-test for length, width and thickness were statistically insignificant. The mean length of the left suprarenal gland was greater than that of the right suprarenal gland, width was greater on the right side and the thickness was almost same on both sides. Mean weight of the right suprarenal gland was more than that of the left one. The male suprarenal glands were heavier than the female suprarenal glands. Age-wise significance in weight of suprarenal and sex-wise significance in weight of kidneys, thickness of left suprarenal and thickness of left cortex were observed. Side-wise significance was observed in length, width and thickness of suprarenal, thickness of cortex and weight of kidney. A significant correlation was observed between weight of left kidney and left adrenal and also in thickness of supra renal with thickness of cortex and medulla of same side. This knowledge of normal morphology and morphometry helps in detecting the pathological condition of the suprarenal gland at an early stage.

REFERENCES

1. Aliab'ev FB Paderov IU M 2004. Age related structural asymmetry of human adrenal glands. *Morfologiia*. 125(2): 61-4.
2. Anand MK Anand C Choudhry R Sabharwal A. Morphology of human suprarenal glands: a parameter for comparison. *Surg Radiol Anat*. 1999;20(5):345-9.
3. Datta AK. *Essentials of Human Anatomy, part I* 8th edition. Current books International, 2008; pp 160-170.
4. Dilruba S Shamim A Nurunnabi ASM Rukshana A Parven HA: A post-mortem study on the weight of the human adrenal glands. *Bangladesh Journal of Medical Sciences*, 2010; 09(4):204-207.
5. Folligan K Bouvier R Targe F Morel Y Trouillas J. Development of the human adrenal glands. *Ann Endocrinol*. 2005; 66(4):325-32.
6. Grant CS. *Surgical anatomy of the Thyroid, Parathyroid and Adrenal glands*. In: Fischer JE, Bland KI, Callery MP, Clagett FP, Jones DB, Logerfo FW, et al, - *Mastery of surgery* , Vol. 1. 5th edition. Philadelphia : Lippincott Williams & Wilkins 2007; pp 394-7.
7. Guyton AC and Hall JE. The adreno cortical hormones In: *Textbook of medical physiology* 11th edition New Delhi: Elsevier, 2006; pp. 869-83.
8. Jit I Banga N. shape, size, weight and relations of the human right supra renal gland. *Journal of Anatomical Society of India*, 1987;36(2):73-81.
9. Kumar V Abbas AK Fausto N. eds. *Robbins and Cotran pathologic basis of disease*. 7th ed. New Delhi: Saunders; 2004: pp.1207-23.
10. Lack EE Kozakewich HPW: Embryology, developmental anatomy and selected aspects of non-neoplastic pathology. In Lack EE, editor: *Pathology of adrenal glands*, New York, Churchill Livingstone. 1990 (Cited by Ernest et.al.1996)
11. Lam KY Chan AC Lo CY. Morphological analysis of adrenal glands: a prospective analysis. *Endocr Pathol*. 2001;12(1):33-8.
12. Lee McGregor.: *Synopsis of surgical Anatomy*. 12th edition. John Wright & Sons Ltd. 1986 ;p.p.307-313.
13. Moore KL Persaud TVN: *The Developing Human- Clinically oriented Embryology*, 8th edition. Elsevier, India. 2008 ; p260.
14. Narongchai P Narongchai S.: Study of the normal internal organ weights in Thai population. *J Med Assoc Thai* 2008; 91(5):747-53.
15. Quinan C Berger AA. Observations on human adrenals with especial reference to the relative weight of the normal medulla. *Ann Intern Med*, 1933; 6:1180.(cited by Ernest et.al.1996)
16. Ranganathan TS. *Textbook of Anatomy*. 5th edition. S.Chand & company Ltd., New Delhi. 2000; pp. 343-346.
17. Sahana SN: *Textbook of human anatomy*. Vol II. 4th edition. 1985; Page No. 439-442
18. Singh D Bansal YS Sreenivas M Pandey AN Tyagi S. Weights of human organs at autopsy in Chandigarh zone of north-west India. *J Indian Aca Forensic Med* 2004; 26(3):97-9.
19. Snell RS.: *Textbook of clinical Anatomy for medical students*. 8th edition. Lippincott, Williams & Wilkins. 2008; pp 269-271
20. Soffer LJ Dorfman RI Gabrilove JL. The human adrenal gland. *Lea and Febiger*. 1961; pp. 11-30.
21. Stoner HB Kozakewich HPW Emery JL. The effect of systemic disease on the adrenal cortex of the child. *J. Pathol Bacteriol* 1953;66:171. (cited by Ernest et.al.1996)
22. Studzinsky GP Hay DCF Symington T: Observations on the weight of the human adrenal gland and the effect of preparations of corticotropin with different purity on the weight and morphology of the human adrenal gland. *Clin Endocrinol Metab* 1963; 23: 248. (cited by Ernest et.al.1996)

