Normal Adrenal Gland Thickness on Computed Tomography in Nepalese Adults Presenting to Tertiary Referral Hospital

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Abstract

Introduction: Various benign and malignant conditions may alter the morphology and dimensions of adrenal gland. There is limited data on normal dimensions of adrenal gland in Nepalese population. Our study aimed to find out the normal adrenal gland thickness measurement.

Methods: It is a descriptive cross-sectional study conducted in a tertiary referral hospital over a period of one year. Ethical approval was taken from the institutional review committee. All the patients referred to Radiology Department for abdominal Computed Tomography evaluation unrelated to adrenal pathology were included. We measured maximum thickness of adrenal limb and body along with diaphragmatic crus on either side.

Results: Mean adrenal gland thickness of right medial limb, right lateral limb and body was 3.57 ± 0.87 mm, 3.33 ± 0.79 mm, 5.69 ± 1.19 mm respectively. Similarly, mean adrenal gland thickness of left medial limb, left lateral limb and body was 4.16 ± 0.9 mm, 3.84 ± 0.85 mm, 6.07 ± 1.35 mm respectively. On comparison of medial and lateral limbs to ipsilateral diaphragmatic crus thickness, 298 (99.3%) and 296 (98.6 %) cases had ratio less than one on right side and 280 (93.3%) and 268 (89.3 %) cases had ratio less than one on left side.

Conclusions: Our study has established the reference measurement of normal adrenal gland thickness in Nepalese adult population. Similarly, the ratio of adrenal limb thickness to ipsilateral diaphragmatic crus thickness can also be a helpful parameter for predicting the normality.

INTRODUCTION

The adrenal glands are paired abdominal endocrine organs located directly above the kidneys whose secretions are required for the maintenance of life.[1] The normal adrenal gland has a linear, inverted V or Y or triangular shape.[2] With increase in availability, Computed Tomography (CT) has been widely used imaging modality in patient care leading to subsequent increased detection of incidental adrenal masses.[3] The size and morphology of the adrenal glands are affected by several physiological and pathological conditions.[4]

There is limited data on the normal size of the adrenal glands and no study has been done in our setup and population. This study aims to determine the normal measurement of adrenal gland thickness and its variation among age, sex and laterality; and also, to assess the ratio of adrenal gland limbs' thickness with ipsilateral diaphragmatic crus thickness.

METHODS

This is a hospital based descriptive cross-sectional study done in B.P. Koirala Institute of Health Sciences, Dharan, Nepal from 20 February 2020 to 19 January 2021 after receiving the ethical approval from institutional review committee BPKIHS (IRC/1726/019). Written consent from the patient was taken. Patients who have undergone CT abdomen for various clinical indications but unrelated to adrenal pathology were included in the study. Proven or suspected participants with adrenal pathology, incidentally detected lesion on CT abnormal biochemistry reports and patients on steroid therapy were excluded from the study. Convenient sampling technique was used.

Images obtained for analysis were from portal venous phase in soft tissue window (Neuviz 16 slice CT). The maximum thickness of limbs and body of adrenal glands were measured in the direction perpendicular to the long axis of the limbs or body. Similarly, the maximum thickness of diaphragmatic crura was also measured on either side using the same criteria (Fig. 1). Mean and standard deviation were derived from continuous variables. T-test was applied to assess differences of mean between genders and between the two sides. Pearson's correlation was used to detect correlation of age with several parameters as applicable. Data entry and analysis was done using IBM Statistical Package for Social Sciences (SPSS) version 11.5.

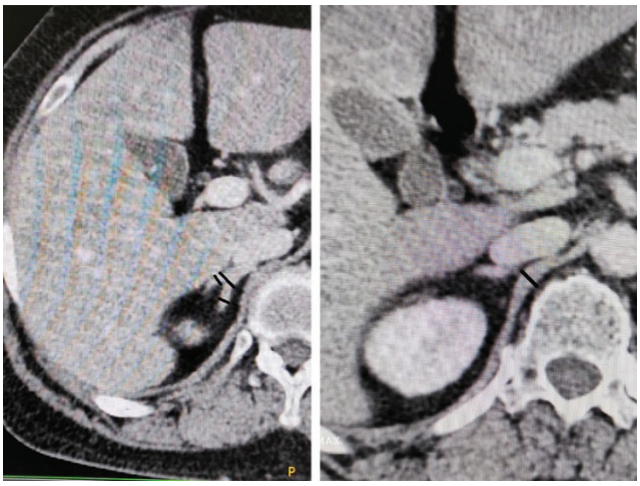

Figure 1. Measurement of adrenal gland limbs, body and diaphragmatic crus thickness.

RESULTS

Out of 300 patients in this study, 147 (49%) were males and 153 (51%) females. The mean age in our study was found to be 49.85 ± 16.63 years. The mean age of male population was 48.83 ± 16.82 years and the mean age of female population was 50.83 ± 16.44 years with maximum number noted in 30 to 60 years of age (Figure 2).

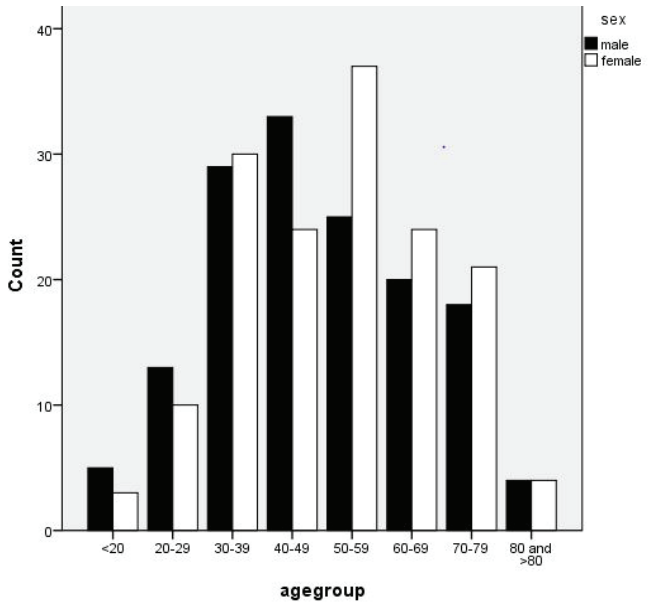

Figure 2. Distribution of age groups among male and female population

Mean adrenal gland thickness of medial limb, lateral limb and body on either side along with mean thickness of diaphragmatic crus were calculated (Table 1).

Table 1. Mean thickness (in mm) of adrenal limbs, body and diaphragmatic crus

	Total mean	Male	Female	p-value
Right medial limb	0.87 ± 3.57	0.87 ± 3.63	0.87 ± 3.50	0.209
Right lateral limb	0.79 ± 3.33	0.74 ± 3.35	0.85 ± 3.32	0.799
Right body	1.19 ± 5.69	1.20 ± 5.89	1.15 ± 5.48	0.003
Left medial limb	0.9 ± 4.16	0.85 ± 4.18	0.95 ± 4.14	0.754
Left lateral limb	0.85 ± 3.84	0.89 ± 3.87	0.81 ± 3.81	0.593
Left body	1.35 ± 6.07	1.48 ± 6.13	1.22 ± 6.02	0.491
Right diaphragmatic crus	1.4 ± 6.48	1.45 ± 6.83	1.27 ± 6.14	0.00
Left diaphragmatic crus	1.19 ± 5.69	1.29 ± 5.87	1.07 ± 5.52	0.12

Significant difference was observed between the right medial and left medial limb thickness, right lateral and left lateral limb thickness, right body and left body measurement with left side parameters being larger than right (p = 0.00). Significant difference was also observed between right diaphragmatic crus and left diaphragmatic crus thickness, right crus being thicker than the left (p = 0.00). There was no significant difference between the values of adrenal limb thickness when compared with sex. The adrenal body on the right side and diaphragmatic crus

thickness on the right side showed significant difference between sexes with values slightly higher in males than females.

The ratio of the adrenal limbs to the diaphragmatic crus thickness was also compared. On the right side, 298 (99.3%) and 296 (98.6%) cases showed ratio less than one on comparison of the right lateral limb thickness and the right medial limb thickness respectively to ipsilateral diaphragmatic crus thickness. However, on the left side, 280 (93.3%) and 268 (89.3%) cases showed ratio less than one on comparison of left lateral and medial limb thickness respectively to ipsilateral diaphragmatic crus thickness. Adrenal limbs and body on both sides did not show any significant correlation with age. Only the right diaphragmatic crus thickness showed significant but weak positive correlation (r = 0.149, p = 0.01) with age (Table 2).

Table 2. Showing correlation of thickness of adrenal and diaphragm parameters with age

Adrenal gland part	r- value	p-value
Right medial limb	-.02	0.969
Right lateral limb	.022	0.699
Right body	.096	.096
Right diaphragmatic crus	0.149	0.01
Left medial limb	.011	0.844
Left lateral limb	.047	0.418
Left body	.024	0.682
Left diaphragmatic crus	.002	0.97

DISCUSSION

The adrenal gland produces steroid hormones i.e., mineralocorticoids, glucocorticoids, adrenal androgens from the cortex and catecholamines, epinephrine and nor-epinephrine from the medulla.[5] The variability of these hormones has been associated with the change in size of the gland. The atrophied adrenal glands may be seen in patients with Addison's disease or with chronic steroid abuse.[4] The glands may be enlarged due to neoplastic, infective and endocrinal conditions (e.g., Cushing's syndrome) or hemorrhage.[6] CT measurement of adrenal limbs is believed to represent the adrenal cortical tissue as shown by Dobbie JW et al.[7]

The lack of specific criteria to differentiate enlarged from normal adrenal gland creates dilemma time and again in interpretation of the radiology reports. On one hand the increasing use of imaging modalities has also increased the incidental detection of adrenal pathologies, while on the other hand clinicians are frequently referring for imaging evaluation of suspected adrenal pathologies. With increasing discovery of more abnormalities of adrenal glands, clinicians expect more precise report on adrenal gland. Though ultrasound is widely available and easy to perform, its sensitivity in detection of adrenal pathologies is low and can only detect large masses. MRI can detect adrenal pathologies with higher sensitivity than other modalities but the availability and the cost are the major disadvantages for its frequent use. CT is the commonly used imaging modality for assessment of adrenal pathologies due to its availability, patient compliance and relatively easy operability though its major drawback being the radiation hazard.

Adrenal gland consists of two limbs and a body giving V, Y or triangular shape.[2] Though there is concordance between linear measurements and volume of the adrenal gland, adrenal gland volume is better preferred over linear measurements because of its better reproducibility.[8] Despite the preferability, it is often troublesome to measure volume in every case where massive number of cases has to be reported every day. So, we preferred to evaluate limbs and body in our set up rather than the volume.

Our study showed slightly increased mean value of adrenal limb thickness of both right and left sides as compared with Vincent JM et al.[9] They performed the study in small sample before the advent of Multidetector Computed Tomography (MDCT). The availability of MDCT in present days has made the measurement easier and more accurate than conventional way of image interpretation. On the other hand, our study showed mean adrenal limb thickness slightly less than that of John R et al but almost similar finding was seen in Thai population.[4,10] The difference may reflect the constitution of different samples in different areas. The mean adrenal gland thickness of limbs and body on left side was found to be more than right in our study. Similar finding was also noted by John R et al.[4] Hamdi et al[11] also found similar findings for limbs but not for adrenal gland bodies. The thinness of right side than the left side may be attributed to the restricted expansion of the gland by the neighboring solid organs.[12] In agreement with the previous studies our study also showed thickness of body less than 10 mm except in one case on the right and three cases on left side.[11,13]

Our study showed no significant difference between adrenal gland measurement between males and females. Akin D et al also found no significant difference between lateral limbs and body whereas medial limb thickness was observed significantly different in both sexes.[12] However, John R et al[4] found significant difference in all the measurements of adrenal gland size between males and females, with greater value in males. The adrenal limbs and body didn't show correlation with age in our

study. This is contrast to the study by John R et al[4] who showed medium positive correlation between the patient age and all the adrenal gland measurements with the exception of left medial limb thickness, which showed a weak positive correlation. But Wang X et al[14] also showed adrenal volume did not change significantly with age.

Similar to the study by Dovgan DJ et al,[15] our study also showed the right crus thicker than the left but with lower frequency i.e. 70% compared to 91% in their study. The range of crural thickness also showed variation which was about 3-11.3 mm in overall in our study in contrast to the previous study by Dovgan DJ et al[15] showing range of 1.8-21.1 mm. Usually, the thickness of the gland's limbs should not exceed the thickness of the ipsilateral diaphragmatic crus at the same level as stated in Goldmann et al.[16] Due to the scanty research to support this statement, we also compared the ratio of adrenal limb thickness with ipsilateral diaphragmatic crus thickness. We found that large number of cases showed concordance with this statement though the maximum adrenal limb thickness was more consistently shown to be smaller than the maximum diaphragmatic crus thickness on right side compared to the left.

Our study was done in the hospital patients after excluding all possible clinical, biochemical and imaging findings with limited sample size. Though it can be a reference for future study, a study in a larger area with larger sample is recommended to derive the reference measurement of our Nepalese population.

CONCLUSIONS

Our study has established the reference value of normal adrenal gland thickness in our set up and Nepalese population. And, the ratio of adrenal limb thickness to ipsilateral diaphragmatic crus thickness can also be a helpful parameter for predicting the normality besides reference values.

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REFERENCES

1. Susan Smith M. H. Maurice Goodman: Basic Medical Endocrinology, 4th edn. Endocr. 2009 Apr 1;35(2):131-2. DOI:10.1007/s12020-009-9149-3
2. Wang F, Liu J, Zhang R, Bai Y, Li C, Li B, et al. CT and MRI of adrenal gland pathologies. Quant Imaging Med Surgery. 2018 Sep;8(8):853. DOI:10.21037/qims.2018.09.13
3. Korivi BR, Elsayes KM, de Castro SF, Garg N, Qayyum A. An update of practical CT adrenal imaging: what physicians need to know. Curr Radiol Rep. 2015 Apr 1;3(4):12. DOI:10.1007/s40134-015-0091-2
4. John R, Putta T, Simon B, Eapen A, Jebasingh F, Thomas N, et al. Normal adrenal gland thickness on computerized tomography in an Asian Indian adult population. Indian J Radiol Imaging. 2018 Oct;28(4):465. DOI: 10.4103/ijri.IJRI_129_18
5. Dutt M, Wehrle CJ, Jialal I. Physiology, Adrenal Gland. StatPearls [Internet]. 2022 May 8.
6. Johnson PT, Horton KM, Fishman EK. Adrenal imaging with MDCT: nonneoplastic disease. Am J Roentgenol. 2009 Oct;193(4):1128-35. DOI:10.2214/ajr.09.2551
7. Dobbie JW, Symington T. The human adrenal gland with special reference to the vasculature. J Endocrinol. 1966 Apr 1;34(4):479-NP. DOI: 10.1677/joe.0.0340479
8. Schneller J, Reiser M, Beuschlein F, Osswald A, Pallauf A, Riester A, et al. Linear and volumetric evaluation of the adrenal gland—MDCT-based measurements of the adrenals. Acad Radiol. 2014 Nov 1;21(11):1465-74. DOI: 10.1016/j.acra.2014.06.008
9. Vincent JM, Morrison ID, Armstrong P, Reznek RH. The size of normal adrenal glands on computed tomography. Clin Radiol. 1994 Jul 1;49(7):453-5. DOI:10.1016/S0009-9260(05)81739-8
10. Suvannarerg V, Veerasomboonsin V, Teerasamit W. Normal Adrenal Glands in Multidetector Computed Tomography. Siriraj Med J. 2018 Dec 21;70(6):502-6. DOI: 10.14456/smj.2018.81
11. Hamidi C, Göya C, Hattapoğlu S, Çetinçakmak MG, Teke M, Dusak, A et al. Adrenal bezkalınlığının multi-dedektörlüb ilgisayarlıtomografiiledeğerlendirilmesi. J Clin Exp Invest. 2012 Jul 1;3(3). DOI:10.5799/ahinjs.01.2012.03.0185
12. Akin D, Tugrul YM, Ozbek O, Özbiner H, Emine CA, Büyükmumcu M, et al. Morphometric Analysis of Suprarenal Glands (Adrenal Glands) with Multislice Computerized Tomography. Int J Morphol. 2017 Mar 1;35(1). DOI:10.4067/S0717-95022017000100020
13. Montagne J, Kressel HY, Korobkin M, Moss AA. Computed tomography of the normal adrenal glands. Am J Roentgenol. 1978 May 1;130(5):963-6. DOI: 10.2214/ajr.130.5.963
14. Wang X, Jin ZY, Xue HD, Liu W, Sun H, Chen Y, et al. Evaluation of normal adrenal gland volume by 64-slice CT. Chin Med Sci J. 2012 Dec 1;27(4):220-4. DOI: 10.1016/s1001-9294(13)60005-x
15. Dovgan DJ, Lenchik L, Kaye AD. Computed tomographic evaluation of maximal diaphragmatic crural thickness. Conn Med. 1994 Apr;58(4):203-6. PMID: 8045119
16. Goldman SM, Coelho RD, FreireFilho ED, Abdala N, Szejnfeld D, Faria J, et al. Imaging procedures in adrenal pathology. Arq Bras Endocrinol Metabol. 2004 Oct;48(5):592-611. DOI:10.1590/S0004-27302004000500004