Original Article

DOI: 10.7860/IJARS/2023/53616.2884

Radiology Section

Accuracy of Ultrasound Imaging Findings in Diagnosis of Adnexal Masses: A Cross-sectional Study

HARISH GAMBHIR[1], KEWAL ADITYA[2], RAVINDER PAL SINGH[3], SUBHASH SINGLA[4], ROMA ISSACS[5], SUNITA GOYAL[6]

ABSTRACT

Introduction: Adnexal mass lesions are common among women of all age groups. Precise preoperative estimation of the benign or malignant nature of an adnexal mass is important to avoid additional surgical treatment. Sonography is the initial imaging study of choice in the evaluation of women with suspected adnexal masses. Assiut scoring model is a simpler model for differentiation of adnexal masses into benign and malignant using various ultrasonographic parameters.

Aim: To assess the accuracy of ultrasound in differentiating benign from malignant adnexal masses using Assiut Scoring Model.

Materials and Methods: This cross-sectional study was conducted in Department of Radiodiagnosis at Christian Medical College and Hospital (tertiary care hospital), Ludhiana, Punjab, India, from November 2018 to January 2021. The study included 80 cases of adnexal masses. An Ultrasound (USG) diagnosis was made based on tumour volume, type of mass, papillary projections, septae and vessel location and Assiut score was obtained. Histopathological examination was carried out following surgery or biopsy. The diagnostic accuracy of USG (with histopathology as gold standard) was determined. Sensitivity, specificity, Positive Predictive Value (PPV) and Negative Predictive Value (NPV) of USG was assessed for predicting malignancy taking histopathology as gold standard. The p-value <0.05 was considered statistically significant.

Results: Most numbers of patients 33 (41.2%) belonged to age group 21-30 years. Mean age of study subjects was 35.35±12.8 years. Majority 60 (75%) of patients were benign and 20 (25%) were malignant. The USG findings showed good agreement with histopathology (kappa=0.76, p-value <0.0001). Sensitivity, specificity, PPV and NPV for correctly predicting malignant lesions being 90%, 90%, 75% and 96.43% respectively. Median Assiut score in malignant was significantly higher as compared to benign (9.95 vs 3.47, p-value <0.0001). Characteristics such as central or septal vascularisation, presence of thick septa, papillary projections, multilocularity and high tumour volume (especially above 500 mL) showed a significant association with malignancy (p-value <0.0001).

Conclusion: The USG based Assuit scoring model is a good tool in differentiating benign from malignant adnexal masses with high sensitivity and specificity.

Keywords: Adnexal masses, Assiut score, Diagnostic accuracy, Ultrasonography

INTRODUCTION

Adnexal mass lesions are fairly common among women (the prevalence of 0.17-5.9% among asymptomatic women and 7.1-12% among symptomatic women) of all age group but very common among reproductive age [1]. The reported prevalence varies widely depending upon the type of study population as well as the inclusion criteria. A recent study conducted in India reported the prevalence of adnexal lesion to be 16% [2]. The most commonly encountered symptoms found in patients with adnexal mass include abdominal fullness/bloating, pelvic pain, difficulty in bowel movements, increased frequency of urination, abnormal vaginal bleeding or pelvic pressure [3].

The presence of adnexal mass is one of the leading indications for gynecological surgery. Adnexal masses can be benign or malignant. The number of suspected benign masses is far greater than the number of malignant masses [4].

Sonography is the initial imaging study of choice in the evaluation of women with suspected adenaxal masses. Assiut Scoring Model is the simpler model for differentiation of adenaxal masses into benign and malignant using various ultrasonographic parameters [5]. The advantage of this scoring model is the objectivity with which data has to be collected and processed to give us a score. The score is then used to categorise masses into benign or malignant.

There are no studies in India that assess the accuracy of ultrasound as imaging modality in differentiating benign from malignant lesions using Assiut scoring model. Hence, the present study was conducted with the aim to assess the accuracy of ultrasound as imaging modality in differentiating benign from malignant lesions using Assiut scoring model and concordance with histopathology.

MATERIALS AND METHODS

This cross-sectional study was conducted in Gynaecology ultrasound wing of the Department of Radiodiagnosis at Christian Medical College and Hospital (tertiary care hospital), Ludhiana, Punjab, India, from November 2018 to January 2021. Institutional Ethics Committee approval was taken (Ref: 201812624/IECCMCL/PG Thesis- radio diagnosis). Informed consent was taken from all the patients.

Sample size calculation: The sample size was calculated using formula:

$$N=DEFF\times N_{p(1-P)}/\{d^2/z^2\ (N-1)+p_{(1-p)}$$

where, DEFF=Design effect, Z value=1.96 for p=0.05 or 95% confidence intervals, P=Estimated prevalence, d=Desired precision (for example, 0.05 for ±5%)

Using OpenEpi online calculator (https://www.openepi.com/Samplesize/SSPropor.htm). The population size was 360 (number of adnexal mass patient diagnosed on sonography in a year) and anti fre is 12% at 90% confidence interval.

Inclusion criteria: Clinically suspected cases of adnexal masses confirmed by ultrasonography and operated at Christian Medical College and Hospital, Ludhiana, India, without any age range were included in the study.

Exclusion criteria: All midline uterine masses and pelvic masses unlikely to be adnexal were excluded from the study.

Study Procedure

Ultrasonography (USG): Ultrasound examination was done on all the patients included in the study on HDX-11E (Phillips Medical Systems) with a 3.5 MHz convex transducer. The patient was examined with full bladder. The coupling agent was applied liberally on patient's skin to act as an acoustic window removing the air between the transducer and patient's skin surface and swift movement of the transducer was allowed. To evaluate the adnexal mass, an ultrasound examination consisting of either transabdominal or transvaginal sonography with colour doppler for suspicious cases of malignancy was done. Sonographic findings regarding tumour volume, type of mass, papillary projections, septae and vessel location were assessed. The findings of sonography were recorded and provisional diagnosis was made.

Assiut scoring model: The Assiut score for assessing the malignant nature of the adnexal lesions. It is based on various malignant features where the characteristics are rated on a score of 0-3 and the total score of ≥6 indicates malignancy [Table/Fig-1] [5].

Score	0	1	2	3
2D ultrasound features				
Tumour volume	0-50 mL	≥50-500 mL	>500 mL	
Type of mass	Unilocular	Multilocular	Unilocular-Solid Multilocular-Solid	
Papillary projections	No	Length <3 mm	-	>3 mm
Septae	No	Thin <3 mm	-	Thick ≥3 mm
Doppler features				
Vessel location	Peri-tumour	Peripheral	Central or septal	
Colour score	1	2	3	4

[Table/Fig-1]: Assiut Scoring Model for differentiation of adnexal masses into benign and malignant.
2D: Two dimentional

Histopathology: The histopathological reports of the patients undergoing surgery were obtained from the Department of Pathology, Christian Medical College and Hospital, Ludhiana, India. The results were classified into malignant or benign mass.

Outcome measures:

- The primary outcome measure was diagnostic accuracy of USG against histopathology as gold standard.
- The secondary outcome measures were association of USG characteristics such as tumour volume, type of mass, papillary projections, septae, colour score with histopathology finding.

STATISTICAL ANALYSIS

The data analysis was done using the Statistical Package for Social Sciences (SPSS) software version 21.0. The demonstration of the categorical variables was in the form of number and percentage while the presentation of the continuous variables was done as mean±Standard Deviation (Mean±SD) and median values. Kolmogorov-Smirnov test was used to check normality. Mann-Whitney test (for not normally distributed data) and Independent t-test (for normally distributed data) and Fisher's exact test was used. Inter-rater kappa agreement was used to find out the strength of agreement between USG and histopathology. Sensitivity, specificity, PPV and NPV of USG was assessed for predicting malignancy taking histopathology as gold standard. For statistical significance, p-value <0.05 was considered as significant.

RESULTS

In present study, most numbers of patients 33 (41.2%) belonged to age group 21-30 years. Mean age of study subjects was 35.35±12.8 years with median (25^{th}-75^{th} percentile) of 32 (26.5-41.5) [Table/Fig-2]. In majority (43.75%) of patients, type of mass was unilocular [Table/Fig-3]. In majority of patients, 50 (62.5%) tumour volume was 0-50 mL [Table/Fig-4].

Age (Years)	Number	Percentage (%)
≤20	3	3.75
21-30	33	41.25
31-40	22	27.50
41-50	11	13.75
51-60	6	7.5
>60	5	6.25
Total	80	100

[Table/Fig-2]: Distribution of age of study subjects.

Type of mass	Frequency	Percentage (%)
Unilocular	35	43.75%
Multilocular	25	31.25%
Multilocular solid	20	25%
Total	80	100%

[Table/Fig-3]: Distribution of type of mass of study subjects.

Tumour volume	Benign n (%)	Malignant n (%)	Total n (%)	p-value (Fisher's exact test)
0-50 mL	46 (92%)	4 (8%)	50 (100%)	<0.0001
51-500 mL	8 (57.14%)	6 (42.86%)	14 (100%)	
>500 mL	6 (37.50%)	10 (62.50%)	16 (100%)	
Total	60 (75%)	20 (25%)	80 (100%)	

[Table/Fig-4]: Association of tumour volume with histopathology finding.

Characteristics such as central or septal vascularisation, presence of thick septa, papillary projections, multiocularity and high tumour volume (especially above 500 mL) showed a significant association with malignancy (p-value <0.0001) [Table/Fig-4-8]. The [Table/Fig-9] shows association of total score with histopathology findings.

Type of mass	Benign n (%)	Malignant n (%)	Total n (%)	p-value (Fisher's exact test)
Unilocular	35 (100%)	0 (0%)	35 (100%)	<0.0001
Multilocular	19 (76%)	6 (24%)	25 (100%)	
Multilocular-solid	6 (30%)	14 (70%)	20 (100%)	
Total	60 (75%)	20 (25%)	80 (100%)	

[Table/Fig-5]: Association of type of mass with histopathology finding.

Papillary projections	Benign n (%)	Malignant n (%)	Total n (%)	p-value (Fisher's exact test)
No	51 (96.23%)	2 (3.77%)	53 (100%)	<0.0001
Length <3 mm	8 (47.06%)	9 (52.94%)	17 (100%)	
Length ≥3 mm	1 (10%)	9 (90%)	10 (100%)	
Total	60 (75%)	20 (25%)	80 (100%)	

[Table/Fig-6]: Association of papillary projections with histopathology finding.

Septae	Benign n (%)	Malignant n (%)	Total n (%)	p-value (Fisher's exact test)
No	41 (95.35%)	2 (4.65%)	43 (100%)	<0.0001
Thin <3 mm	16 (84.21%)	3 (15.79%)	19 (100%)	
Thick ≥3 mm	3 (16.67%)	15 (83.33%)	18 (100%)	
Total	60 (75%)	20 (25%)	80 (100%)	

[Table/Fig-7]: Association of septae with histopathology finding.

Proportion of histopathology finding (benign) was significantly higher in benign by USG as compared to malignant by USG (96.43% vs 3.57% respectively) and histopathology finding (malignant) was significantly higher in malignant by USG as compared to benign by USG (25% vs 75% respectively) (p-value <0.0001) [Table/Fig-10].

Colour score	Benign n (%)	Malignant n (%)	Total n (%)	p-value (Fisher's exact test)
Peritumour	17 (100%)	0 (0%)	17 (100%)	0.001
Peripheral	24 (82.76%)	5 (17.24%)	29 (100%)	
Central or septal	19 (55.88%)	15 (44.12%)	34 (100%)	
Total	60 (75%)	20 (25%)	80 (100%)	

[Table/Fig-8]: Association of location of vessels and accordingly colour score assessment at colour doppler with histopathology finding.

Total score	Benign n (%)	Malignant n (%)	Total n (%)	p-value (Mann Whitney test)
Mean±SD	3.47±1.78	9.95±2.82	5.09±3.5	<0.0001
Median (25th-75th percentile)	3 (2-4)	10.5 (8.5-12.25)	4 (3-7)	
Range	1-9	3-13	1-13	

[Table/Fig-9]: Association of total score with histopathology finding.

USG	Histopathology		Total n (%)	p-value (Fisher's exact test)
	Benign n (%)	Malignant n (%)		
Benign	54 (96.43%)	2 (3.57%)	56 (100%)	<0.0001
Malignant	6 (25%)	18 (75%)	24 (100%)	
Total	60 (75%)	20 (25%)	80 (100%)	

[Table/Fig-10]: Association of benign or malignant by USG with histopathology finding.

Good agreement exist between histopathology and USG with kappa 0.750 and p-value <0.0001. Among 60 patients diagnosed as benign by histopathology, 54 patients had similar findings in USG. Among 20 patients diagnosed as malignant by histopathology, 18 patients had similar findings in USG [Table/Fig-11].

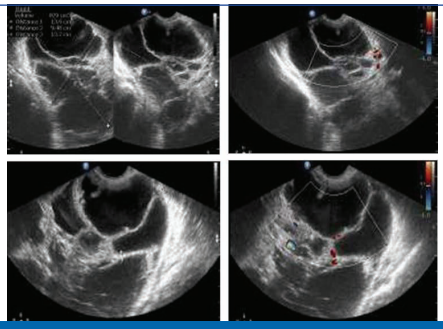
Sensitivity, specificity, PPV and NPV of USG for correctly predicting malignant lesions being 90%, 90%, 75% and 96.43% respectively [Table/Fig-12]. Ultrasonographic findings are seen in [Table/Fig-13-18].

USG	Histopathology		Total n (%)	p-value and Kappa
	Benign n (%)	Malignant n (%)		
Benign	54 (67.50%)	2 (2.50%)	56 (70%)	**<0.0001,** 0.750
Malignant	6 (7.50%)	18 (22.50%)	24 (30%)	
Total	60 (75.00%)	20 (25.00%)	80 (100%)	

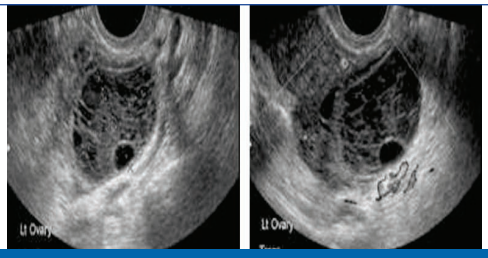
[Table/Fig-11]: Inter-rater kappa agreement between USG and histopathology.

For predicting malignancy	USG
Sensitivity (95% CI)	90% (68.30% to 98.77%)
Specificity (95% CI)	90% (79.49% to 96.24%)
AUC (95% CI)	0.90 (0.81 to 0.96)
Positive predictive value (95% CI)	75% (53.29% to 90.23%)
Negative predictive value (95% CI)	96.43% (87.69% to 9.56%)
Diagnostic accuracy	90%

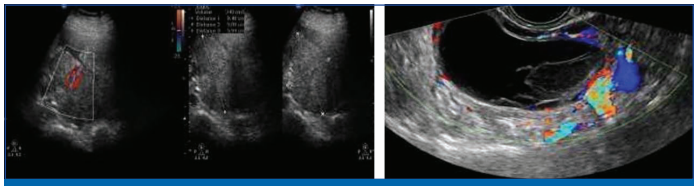
[Table/Fig-12]: Sensitivity, specificity, PPV and NPV of USG taking histopathology as gold standard.



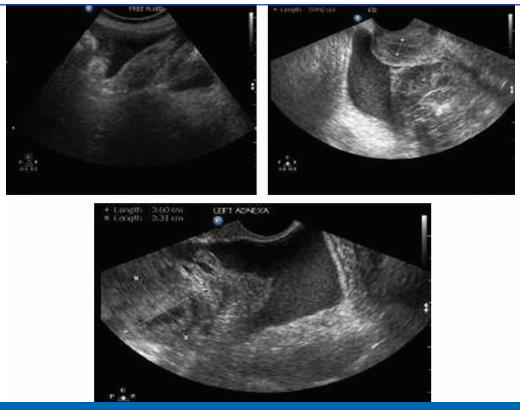
[Table/Fig-13]: Transvaginal ultrasonographic images of a patient showing a large multilobulated cystic mass with solid components, thick septations and internal vascularity. Histopathology result was low grade serous carcinoma.



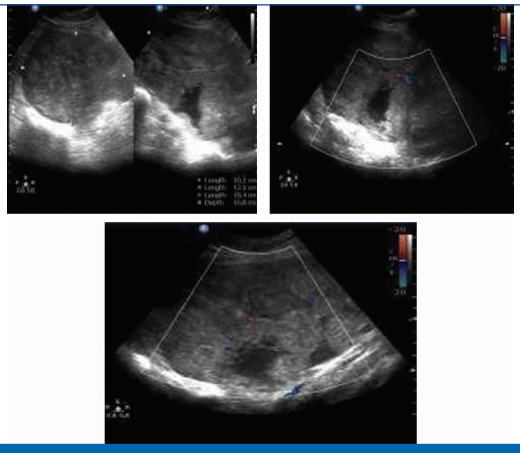
[Table/Fig-14]: Transvaginal ultrasound image showing a complex cystic mass in proximity to left ovary measuring 3.4×4.0 cm with no vascularity. Histopathology confirmed it as haemorrhagic cyst.



[Table/Fig-15]: Transabdominal ultrasound image showing a solid adnexal mass having a volume of 240 cc with internal vascularity. Histopathology showed it was metastatic adenocarcinoma.
[Table/Fig-16]: Transvaginal ultrasound image of a cystic adnexal mass with solid components and thin septations and peripheral vascularity. Histopathological diagnosis was haemorrhagic cyst. (Images from left to right)



[Table/Fig-17]: Transvaginal ultrasound image of a left adnexal solid cystic mass measuring 3.6×3.3 cm with significant pelvic free fluid having internal echoes. Histopathologic diagnosis was ruptured ectopic pregnancy.



[Table/Fig-18]: Transabdominal ultrasound images showing a large solid adnexal mass with small cystic component and internal vascularity. Histopathological diagnosis was serous papillary carcinoma.

DISCUSSION

The present study was a cross-sectional study on 80 women with adnexal masses who were investigated with an aim to determine the utility of USG in differentiating benign from malignant masses using Assuit Scoring Model. There is currently no study done in India which uses this scoring method. The results of this study can be used to compare the utility of this scoring model as compared to other methods in Indian context.

Sharma A et al., found that USG diagnosis of adnexal masses revealed a sensitivity of 94.4% specificity of 83.3%, PPV of 70.8%, and NPV

of 97.2% [6]. In a study by Prasad BS and Shetty M, USG showed the sensitivity of 92%, specificity of 89% in differentiating benign from malignant lesions [7]. Priya FM and Kirubamani VN, showed USG sensitivity of 88% and specificity of 80.68% in prediction of ovarian cancer [8]. Radhamani S and Akhila MV, revealed that USG had sensitivity of 87.5% and specificity of 95.65% with an accuracy of 95% for predicting ovarian cancer [9]. In a study by Rathore OP et al., USG showed sensitivity of 100%, specificity of 88.4% and accuracy of 90.3% in diagnosing malignancy in adnexal masses [10].

Sarbhai V et al., reported that sensitivity of USG in diagnosing simple ovarian cyst was 20% with NPV of 80% [11]. USG has low sensitivity in diagnosing endometrioma of 50% and high specificity of 94.1% with PPV of 75% and NPV of 84.2%. A comparative analysis of diagnostic accuracy for USG in our study and other studies has been shown in the [Table/Fig-19] [6-10,12].

Study	Total patients (%)	Benign (%)	Malig-nant (%)	Sensitivity of USG (%)	Specificity of USG (%)	PPV (%)	NPV (%)
Prasad BS and Shetty M, [7] (2016)	50	37.5	48	92	89	92	89
Rathore OP et al., [10] (2017)	50	86	14	100	88.4	-	-
Dalia Y et al., [12] (2017)	50	90	10	71	73.33	71	73
Radhamani S and Akhila MV, [9] (2017)	100	90.5	9.5	87.5	95.65	-	-
Priya FM and Kirubamani VN, [8] (2017)	113	78	21	88	80.68	56.41	95.95
Sharma A et al., [6]	60	66	34	94.4	83.3	70.8	97.2
Present study	80	75	25	90	90	75	96.43

[Table/Fig-19]: Comparison of sensitivity, specificity, PPV and NPV of ultrasound with previous studies [6-10,12].

The present study results found that USG findings showed good agreement with histopathology (kappa=0.750, p-value <0.0001). Overall, USG showed a good diagnostic accuracy in predicting the malignant nature of the adnexal lesion before surgery, thus guiding us to an appropriate management.

The strength of the study was that, many of present results corroborated with other studies done at different times and in different places both in India as well as outside India. This study, thus, adds to the already existing literature about the concordance of diagnosis made from USG and histopathology with one another and analysed the reliability of USG in reaching a correct diagnosis in Indian women with adnexal masses. Thus, the current study can act as a stepping stone for further larger studies to find out accuracy of USG using Assiut Scoring Model in Indian women with adnexal masses.

Limitation(s)

Although, the sample size of the study was good, but being a single centre hospital based study, the results of the concordance of USG and histopathology in reaching a correct diagnosis in women with adnexal masses may need further validation. Another limitation was that USG was not compared with other diagnostic modalities such as Magnetic Resonance Imaging (MRI), which would have been valuable in understanding advantages of USG above other diagnostic modalities. Being a cross-sectional study, the treatment and outcomes of the women were not analysed.

CONCLUSION(S)

The USG is a novel diagnostic modality in characterising benign and malignant nature of adnexal masses. USG findings showed good agreement with histopathology. Malignant masses had significantly higher Assiut score with each USG characteristics (central or septal vascularisation, presence of thick septa, papillary projections, multilocularity and high tumour volume) showing significant association with malignancy. Thus, USG can be used as the primary imaging modality to identify and characterise adnexal masses, as it is readily available, and non invasive.

REFERENCES

[1] Bhagde AD, Jani SK, Patel MS, Shah SR. An analytical study of 50 women presenting with an adnexal mass. Int J Reprod Contracept Obstet Gynecol. 2017;6:262-5.
[2] Rai R, Bhutia PC, Tshomo U. Clinicopathological profile of adnexal masses presenting to a tertiary-care hospital in Bhutan. South Asian J Cancer. 2019;8(3):168-72.
[3] Givens V, Mitchell G, Harraway-Smith C, Reddy A, Maness DL. Diagnosis and management of adnexal masses. Am Fam Physician. 2009;80(8):815-20.
[4] Jeong YY, Outwater EK, Kang HK. Imaging evaluation of ovarian masses. Radiographics. 2000;20:1445-70.
[5] Abbas AM, Zahran KM, Nasr A, Kamel HS. A new scoring model for characterization of adnexal masses based on two-dimensional gray-scale and colour Doppler sonographic features. Facts Views Vis Obgyn. 2014;6(2):68-74. PMID: 25009729; PMCID: PMC4086018.
[6] Sharma A, Lokwani MS, Lokwani S. Correlation between ultrasound features and histopathological findings in adnexal masses- a study in a tertiary care centre in Central India. Int J Sci Stud. 2019;7(4):05-14.
[7] Prasad BS, Shetty M. Role of ultrasonography and CT in diagnosing different types of adnexal masses and correlation with histopathological report. Int J Recent Trends Sci Technol. 2016;20:201-05.
[8] Priya MHF, Vanusha, Kirubamani NH. Clinical correlation of ovarian mass with ultrasound finding and histopathology report. Int J Rep Contracept Obstet Gynecol. 2017;6:5230-34.
[9] Radhamani S, Akhila MV. Evaluation of adnexal masses- correlation of clinical, sonological and histopathological findings in adnexal masses. Int J Sci Stud. 2017;4:88-92.
[10] Rathore OP, Rana K, Gehlot RN. Radiopathological correlation of adnexal lesions: Our experience. J Med Sci Clin Res. 2017;25:24876-86.
[11] Sarbhai V, Yadav M. Diagnostic accuracy of ultrasonography with laproscopy for assessment of benign adnexal masses. Int J Reprod Contracept Obstet Gynecol. 2020;9:283-87.
[12] Dalia Y, Agrawa M. Sharma A. A case series of bilateral adnexal masses. J Dent Med Sci. 2017;16:48-53.

PARTICULARS OF CONTRIBUTORS:
1. Assistant Professor, Department of Radiodiagnosis, Christian Medical College and Hospital, Ludhiana, Punjab, India.
2. Senior Resident, Department of Radiodiagnosis, Christian Medical College and Hospital, Ludhiana, Punjab, India.
3. Postgraduate Resident, Department of Radiodiagnosis, Christian Medical College and Hospital, Ludhiana, Punjab, India.
4. Professor, Department of Radiodiagnosis, Christian Medical College and Hospital, Ludhiana, Punjab, India.
5. Professor, Department of Pathology, Christian Medical College and Hospital, Ludhiana, Punjab, India.
6. Professor, Department of Obstetrics and Gynaecology, Christian Medical College and Hospital, Ludhiana, Punjab, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Ravinder Pal Singh,
Postgraduate Resident, Department of Radiodiagnosis, Christian Medical College and Hospital, Ludhiana, Punjab, India.
E-mail: docravi81@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Dec 27, 2021
- Manual Googling: Jul 22, 2022
- iThenticate Software: Jul 24, 2022 (12%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Dec 24, 2021**
Date of Peer Review: **Jan 22, 2022**
Date of Acceptance: **Jul 25, 2022**
Date of Publishing: **May 01, 2023**