Section: Radiodiagnosis

Original Research Article

THE ROLE OF COLOR DOPPLER IN CHARACTERIZING ENDOMETRIAL PATHOLOGIES: DIFFERENTIATING BENIGN AND MALIGNANT LESIONS WITH HISTOPATHOLOGICAL CORRELATION AND COMPARISON TO PAST OBSERVATIONS

Vikas Rai[1], Amit Kumar Chaubey[2], Ritu Roy[3]

[1]Senior Resident, Department of Radiodiagnosis, Icare Medical College, Haldia. Kolkata West Bengal, India.
[2]Assistant Professor. Department of Radiodiagnosis, Vivekananda Institute of Medical Science, Kolkata, West Bengal, India.
[3] Consultant, Department of Pathology, Icare Medical College, Haldia. Kolkata West Bengal, India.

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Corresponding Author:
Dr. Vikas Rai,
Email: superdoc_cal@yahoo.com.

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Abstract

Background: This study aims to establish the adjunctive role of color Doppler in characterizing endometrial pathologies and its ability to differentiate between benign and malignant lesions. The research also includes histopathological correlation to validate the Doppler findings and compares the results with past observations and relevant studies. Additionally, the study explores the potential of Doppler as a screening tool for endometrial pathologies and its utility in pre-surgical mapping to minimize unnecessary invasive procedures. **Materials and Methods:** A prospective observational study was conducted in the department of Icare Medical College, Haldia, from from Jan 2022 to Dec 2022. The present study consists of 63 patients between the age group of 18 & 75 years, with youngest patient of 18 years and eldest at 75 years. The most common presenting symptoms in all age groups were bleeding per vagina with altered menstrual history. Only those patients who came back for follow up and underwent treatment in our hospital either through OPD / Indoor department were included. These patients underwent tissue diagnosis either Dilation/ Suction curettage /Post-operative histopathologic examination. During Transvaginal examination, gray scale & colour Doppler interrogation was done in all the cases and following points were noted, Uterine size and echotexture, endometrial thickness, Vascular morphology was noted, Readable spectral indices (angle independent) were also noted. **Results:** Single most common benign endometrial pathology came out to be the cases of endometrial polyp (19%) of total cases of abnormal endometrium having its highest incidence around 3rd – 5th decade (peri& post-menopausal age group). Endometrial pathologies were most common in multiparous women (84%). Endometrial carcinoma was noted to be quite common in 6th decade onward. Quite a significant association of endometrial carcinoma was noted multiparousity in the given study. The most common clinical presentation Bleeding per vagina. The most common clinical finding came out to be Bulky uterus. The commonest identified imaging parameter on grey scale (TAS+TVS) came out to be Bulky uterus. **Conclusion:** In this study, individual pathologies such as Polyp, Ectopic pregnancy, Retained products, and Endometrial atrophy were evaluated using both morphological endometrial criteria and specific spectral signatures and indices. These combined criteria proved to be valuable in reaching accurate diagnoses. A higher endometrial thickness cut-off (>15 mm) and the identification of vascularity, especially with a high diastolic flow pattern in postmenopausal women, were found to be sensitive indicators of malignant pathology. Such cases should undergo immediate invasive and histopathological evaluation, allowing for pre-surgical mapping and planning. Although newer techniques like perfusion Doppler and ultrasound contrast agents show promise in studying vascular structures around tumors, the gold standard for diagnosing

endometrial pathologies remains histopathological evaluation. Ongoing research using volumetric studies is expected to provide further insights into normal and abnormal vascular structures in and around tumors in the future.

INTRODUCTION

In gynecological disorders related to menstrual bleeding, endometrial pathologies play a significant role, with variations depending on age and reproductive phase. There is a need for a non-invasive imaging modality to differentiate between benign and malignant pathologies in perimenopausal and postmenopausal women. Color Doppler, as an adjunct to routine ultrasound, offers advantages in characterizing individual pathologies based on vascularity, spectral signature, and flow patterns.[1,2]
Previous studies have shown certain conclusions regarding the use of Doppler in identifying specific pathologies. Doppler can enhance confidence in diagnosing endometrial polyps, decidual tissue, arteriovenous malformations, endometrial atrophy, endometrial carcinoma, and characterizing adnexal masses. However, its role in distinguishing benign and malignant endometrial pathologies is still debatable, with varying results in different studies.[3,4]
Recent trends in studies involve volumetric 3D & 4D USG and color mapping patterns along with tissue harmonic and ultrasound contrast agents for better resolution. Color Doppler fits well into this approach as it is affordable, easily accessible, portable, non-invasive, and useful for guided procedures like FNAC/biopsy. Nevertheless, it also has drawbacks, including operator dependence, technical parameter reliance, and poor reproducibility.[5]
The present study investigates the role of color Doppler as an adjunct to gray-scale transvaginal ultrasound in differentiating endometrial pathologies. The aim is to determine if Doppler can serve as a screening tool and enhance diagnostic confidence in imaging differentials, guiding clinicians in choosing appropriate management approaches. However, the role of Doppler ultrasound in endometrial evaluation is still in its early stages, and its usefulness as an adjunctive modality remains a topic of debate.

MATERIALS AND METHODS

A prospective observational study was conducted in the department of Icare Medical College, Haldia, from from Jan 2022 to Dec 2022. The present study consists of 63 patients between the age group of 18 & 75 years, with youngest patient of 18 year and eldest at 75 years. The most common presenting symptoms in all age groups were bleeding per vagina with altered menstrual history. Only those patients who came back for follow up and underwent treatment in our hospital either through OPD / Indoor department were included. These patients underwent tissue diagnosis either Dilation/ Suction curettage /Post-operative histopathologic examination. During Transvaginal examination, gray scale &colour Doppler interrogation was done in all the cases and following points were noted, Uterine size and echotexture, endometrial thickness, Vascular morphology was noted, Readable spectral indices (angle independent) were also noted.

Selection Criteria

Patients were taken from routine patients who were referred to our department from OPD or Indoor department/ Day care USG (Obs. & Gyn.) with relevant history/ clinical finding/ imaging findings. Only those patients who came for follow up in our OPD & subsequently got admitted in the indoor were taken. As in these cases histopathological diagnosis was established & correlation was possible.

Exclusion Criteria

Patients who were lost in follow up despite the initial ultrasound had relevant findings. Patient in whom other parameters like biochemical/clinical findings didn't correlate with imaging findings.
Patient who underwent conservative treatment (hormonal treatment) and as such tissue diagnosis couldn't be established. Thus study initially excluded 100 patients out of which 63 patients were finally available for correlation.
Following Detailed Clinical History & Examination all Patients are put to Per Abdomen Ultrasound, Followed by Transvaginal Ultrasound
Detailed Proforma& technique given separately. During Transvaginal examination, gray scale &colour Doppler interrogation was done in all the cases and following points were noted:
Uterine size and echotexture, endometrial thickness
Vascular morphology was noted
Readable spectral indices (angle independent) were noted down

a. RI
b. PI

In cases where intrauterine vascularity was demonstrated, power/ perfusion Doppler was put on. All the grey scale colour& spectral Doppler patterns were compared with the available literature and a provisional imaging differential was reached at, Statistical analysis is carried out with correlation comparison of clinical findings & imaging parameters and final histopathological diagnosis.
Colour Doppler/power Doppler effort was made to visualise intra-uterine flow on colour Doppler and in cases where smaller vessels were visualised, power Doppler was turned on to visualize the vascular architecture and vascular morphologic typing was done based on J L Alcazar et al (2003) into type A, type B & type C. thus when colour Doppler didn't show intrauterine vascularity power Doppler interrogation was intentionally omitted for the

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simplicity of the study & to avoid multiple variable parameters which would have made the study results ambiguous. An arbitrary scale was prepared combining the clinical & imaging parameters (grey scale & Doppler) to differentiate & define the malignant pathology.

RESULTS

Table 1: Age Distribution

Age Group	No of Patients	Percentage
10 – 19	01	1.98
20 – 30	20	31.74
31 – 39	13	20.63
40 – 49	13	20.63
50 – 59	06	9.5
60 – 70	10	15.8
Total	63	100

The table presents the distribution of cases in different age groups, totaling 63 cases. Among these age groups, 1 case (1.98%) falls in the 10 to 19 years category, 20 cases (31.74%) are in the 20 to 30 years category, 13 cases (20.63%) belong to the 31 to 39 years category, another 13 cases (20.63%) are in the 40 to 49 years category, 6 cases (9.5%) are found in the 50 to 59 years category, and finally, 10 cases (15.8%) fall within the 60 to 70 years category.

Table 2: Parity Wise Distribution of Endometrial Pathologies

Parity	No of Patients	Percentage
Nulliparous	10	16.0
Multiparous	53	84.0
Total	63	100

Nulliparous were 10 cases, accounting for 16.0% and Multiparous were 53 cases, making up 84.0% of the total cases.

Table 3: Clinical Presentation of Patients

Symptoms	No. of Patients	Percentage
Bleeding P-V	51	81.0
Abdomino Pelvic Pain	14	22.2
Infertility	4	6.4
Leucorrhoea	4	6.4

The clinical presentation of patients included symptoms such as bleeding per vaginum observed in 51 patients, representing 81.0% of the total cases. Abdomino-pelvic pain was reported by 14 patients, accounting for 22.2% of the cases. Additionally, 4 patients (6.4%) presented with infertility, and the same number (4, 6.4%) experienced leucorrhoea.

Table 4: Clinical Findings

Disease	No. of Patients	Percentage
Bulky Uterus	49	77.8
Abdomino Pelvic Lump	2	3.2
Dilated IOS	13	20.6
Forniceal Tenderness	3	4.8

The clinical findings revealed that 49 patients (77.8%) had a bulky uterus, while 2 patients (3.2%) presented with an abdominal pelvic lump. Additionally, 13 patients (20.6%) exhibited a dilated internal os (IOS), and 3 patients (4.8%) showed forniceal tenderness.

Table 5: Disease Spectrum & Incidence

Individual Pathology	No. of Patients	Percentage
Endometrial Polyp	12	19.0
Endometrial Carcinoma	6	9.5
Endometrial Atrophy	5	7.9
Submucosal Fibroid	3	4.8
Endometrial Hyperplasia	4	6.3
Retained Products/Incomplete Abortion	13	20.6

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Adenomyosis	8	12.7
PID	1	1.6
Ectopic Pregnancy	2	3.1
Molar Pregnancy	4	6.3
Fibroid	5	7.9
Total	63	100.0

The disease spectrum and incidence of individual pathologies in the study are as follows: 19.0% of the patients had endometrial polyps, 9.5% had endometrial carcinoma, 7.9% had endometrial atrophy, 4.8% had submucosal fibroids, and 6.3% had endometrial hyperplasia. Additionally, 20.6% of the patients presented with retained products/incomplete abortion, 12.7% with adenomyosis, 1.6% with pelvic inflammatory disease (PID), 3.1% with ectopic pregnancy, and 6.3% with molar pregnancy. Moreover, 7.9% of the patients had fibroids. The total number of patients included in the study was 63, accounting for 100.0% of the cases.

Table 6: Relationship of Spectral Indices & Pathology based on Benign & Malignant Seggregation

Benign Pathology	Malignant
R.I : 0.5 – 0.9	0.37 – 0.58
P.I : 1.6 – 3.5	1.5 – 1.61

The relationship of spectral indices with pathology is based on benign and malignant segregation. For benign pathology, the Resistance Index (RI) ranges from 0.5 to 0.9, and the Pulsatility Index (PI) ranges from 1.6 to 3.5. On the other hand, for malignant pathology, the Resistance Index (RI) ranges from 0.37 to 0.58, and the Pulsatility Index (PI) ranges from 1.5 to 1.61. These spectral index ranges can be useful in differentiating between benign and malignant pathologies based on their characteristic values.

Objective to determine sensitivity, specificity & predictive value w.r.t to malignancy detection

True Positive (TP) – 4 True Negative (TN) – 56

False Negative (FN) – 3 False Positive (FP) – 1

$$\text{Sensitivity} = \frac{TP}{TP + FN} \times 100 \Rightarrow \frac{4}{4 + 3} \times 100 = 56\%$$

$$\text{Sensitivity} = \frac{TN}{TN + FP} \times 100 \Rightarrow \frac{56}{56 + 1} \times 100 = 92\%$$

$$\text{Positive Predictive Value} = \frac{TP}{TP + FP} \times 100 \Rightarrow \frac{4}{4 + 1} \times 100 = 80\%$$

DISCUSSION

Highest number of patients with endometrial pathologies were noted in age group of 18 -30 yrs (33%). Most of these patients had benign pathologies related to pregnancy/Peripartum/Postpartum complication and clinical profile with imaging findings clinched the diagnosis. This age group has highest OPD turnover. Endometrial pathologies were more common in multiparous women. According to "Robbins text book of pathology" endometrial polyp commonly presents at perimenopausal age group and is a leading cause of post/perimenopausal bleeding. Our study shows (19%) patients had endometrial polyp and almost all presented in perimenopausal age group. In our study 3/6 cases (50%) association of endometrial carcinoma was noted nulliparity.

In one case tamoxifen induced endometrial carcinoma was noted in a patient of treated Breast Carcinoma.

Colour flow was demonstrable only in 25 cases of endometrial pathologies out of total of 63 cases and it came out to be 39.6%. Out of it 4/6 cases of malignant pathology (66%) and 21/63 in benign pathologies (33%).

These result showed close concordance to result published by Hata et al(1992) w.r.t to malignant lesions.[6]

High diastolic flow with low RI & PI value, in suspected cases of postmenopausal bleeding with thickened endometrium yielded moderate sensitivity of 56% and high specificity of 92%. These was used as criteria for separating benign and malignant

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pathologies based of study published by Juhasz (1990), Kupesic-Urek (1993), Aleem (1995).[7-9]

Almost all cases were correctly diagnosed by imaging in case of endometrial atrophy using the criteria elaborated in the review of literature.

The cut off value of endometrial thickness as mentioned in the review of literature of and also proposed by Nasriet al.[10] (5mm) and wikland et al[11] (>4mm single layer) for post-menopausal bleeding cases were perfectly matched as in none of the cases endometrial carcinoma was proved below the 5mm cut off value.

The Grey Scale morphological criteria of heterogeneous endometrial structure and intrauterine fluid and blurred endometrial interphase was noted in 3/5 (60%) cases of endometrial carcinoma – this was quite similar in respect to criteria mentioned by Kurjaket al.[12]

In case of benign pathologies- the Grey Scale & Doppler features as suggested by Kurjak-Kupesic clinched diagnosis in almost all cases of (i) Retained product/Incomplete abortion & (ii) vascular endocervical polyp with visualised vascular pedicle.[12]

Endometrial hyperplasia

Bulky/normal sized uterus. Diffusely thickened endometrium with/without cystic changes.

Intrauterine flow visualised/may not be visualised. Uterine artery spectrum shows low diastolic flow. Scattered vessel pattern on power Doppler. Type–C according to J L Aleazar (2003). In case of power Doppler showed single vessel pattern- this is in accordance to study of J L Aleazar (2003).

Endometrial atrophy

Leading cause of postmenopausal bleeding in up to 50% as stated by Grademark et al. Uterus normal/small in size. Endometrial thickening < 5mm. No intrauterine flow visualised. Main uterine artery spectrum shows low diastolic flow. Endometrial carcinoma Uterus normal slightly enlarged in size. Diffuse/focal thickening of endometrium (Kurjak-Kupesic). Loss of endomymetrial interphase (Kurjak-Kupesic).[12] Endometrium appears heterogeneous (Kurjak-Kupesic).[13] Intrauterine flow visualised with colour doppler (Illijas et al, 1996).[14]

Main uterine artery spectrum shows high diastolic flow Bourne TH,[15]

Intrauterine collection (Kurjak).[13] Above findings are also supported by Rumack in his text book review in “Diagnostic Ultrasound” 3rd edition, 2005. Multivessel pattern in case of power Doppler (Type-A) Aleem F (1995).[16]

CONCLUSION

In this study, individual pathologies such as Polyp, Ectopic pregnancy, Retained products, and Endometrial atrophy were evaluated using both morphological endometrial criteria and specific spectral signatures and indices. These combined criteria proved to be valuable in reaching accurate diagnoses. A higher endometrial thickness cut-off (>15 mm) and the identification of vascularity, especially with a high diastolic flow pattern in postmenopausal women, were found to be sensitive indicators of malignant pathology. Such cases should undergo immediate invasive and histopathological evaluation, allowing for pre-surgical mapping and planning. Although newer techniques like perfusion Doppler and ultrasound contrast agents show promise in studying vascular structures around tumors, the gold standard for diagnosing endometrial pathologies remains histopathological evaluation. Ongoing research using volumetric studies is expected to provide further insights into normal and abnormal vascular structures in and around tumors in the future.

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