Original Article

Evaluation of Uterine Morphology, Its Body Axis and Utero Cervical Angle with their Clinical Significance using Ultrasound in North Indian Adult Female Population

Dr. Yagika Pareek, Dr. Anshu Gupta, *Dr. Pradeep Singh, Dr. Vibhu Deep, Dr. Kamal Bhardwaj, Dr. Ruchika Garg

1. Dr. Yagika Pareek, Junior Resident (Jr-2), Department of Anatomy, Sarojini Naidu Medical College, Agra, India.
2. Dr. Anshu Gupta, Associate Professor & Head, Department of Anatomy, Sarojini Naidu Medical College, Agra, India.
3. *Dr. Pradeep Singh, Associate Professor, Department of Anatomy, Sarojini Naidu Medical College, Agra, India.
4. Dr. Vibhu Deep, Associate Professor, Department of Anatomy, Sarojini Naidu Medical College, Agra, India.
5. Dr. Kamal Bhardwaj, Professor, Department of Anatomy, Sarojini Naidu Medical College, Agra, India.
6. Dr. Ruchika Garg. Professor, Department of Obstetrics & Gynaecology, Sarojini Naidu Medical College, Agra, India.

***Corresponding author's E-mail:** Psingh2336@gmail.com

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ABSTRACT

Introduction: Women's reproductive tract congenital abnormalities may affect the "uterus, cervix, fallopian tubes, or vagina." The most prevalent of the mullerian variants are uterine abnormalities. Identification of these variations and their clinical consequences is crucial in developing management strategies for preventing gynaecological and obstetrical complications.

Methods: This was an observational and ambispective study conducted on 100 non pregnant nulligravid females with 50 cases (history of PID or dysmenorrhoea) and 50 controls. Evaluation of utero cervical angle (UCA), uterine morphology, and uterine axis was done using trans abdominal ultrasonography (TAS). Retrospective data regarding history of PID, dysmenorrhea etc. were recorded through direct interview with study participants and from their past medical records. Patients were also followed for 6 months for detection of any clinical events.

Statistical Analysis: The data obtained from cases and controls were presented in tabular form. Comparisons of continuous data such as age, BMI, and uterine measurements were performed using unpaired t-tests. Uterine Orientation and baseline parameters were expressed as percentages and ratios and compared using fisher's exact test. A P-value less than 0.05 was taken as a measure of significance.

Results: Anterior utero-cervical angle was significantly higher in cases (127.86 ± 15.54) as compared to controls (108.97 ± 11.42). Uterine body longitudinal and transverse axis were significantly lower as in cases as compared to control whereas uterine cervix longitudinal axis was significantly higher in cases.

Conclusion: Women with short uterus with high UCA and cervical longitudinal axis had higher likelihood of developing pelvic inflammatory disease or dysmenorrhoea.

Keywords: Uterine Morphology, Utero-Cervical Angle, Trans-Abdominal Ultrasonography.

INTRODUCTION

The uterus is a smooth, hollow, contractile muscle organ, intended to house the conceptus throughout its development and to release it at term. This function elucidates the significant transformations experienced by the uterus throughout reproductive life. The cyclical alterations in its lining result in menstruation during the last phase missing implantation.[1, 2]

Women's reproductive tract congenital abnormalities may affect the "uterus, cervix, fallopian tubes, or vagina." The most prevalent of the mullerian variants are uterine abnormalities. The real incidence is unknown due to the fact that the majority of women remain asymptomatic while sensitive imaging techniques have only lately become available. Identification of these variations and their clinical consequences is crucial in developing management strategies for preventing gynaecological and obstetrical complications.[3]

Müllerian duct abnormalities are the most prevalent cause of primary amenorrhea. The septate uterus is the abnormality most commonly linked to reproductive failure.[4, 5]

In certain women, menstrual cycles may be came before and/or associated with the pain characteristic of dysmenorrhea. In 50% of instances, the etiology of dysmenorrhea in young women remains unidentified.[6]

Consequently, the etiopathogenic causes of this termed as essential and primary dysmenorrhea" are based on familial history, genetic predispositions, early onset of puberty, and potential uterine malposition.[7]

Pelvic inflammatory disease (PID) is a syndrome resulting from the ascending migration of bacteria that have settled in the vagina or endocervix into the endometrium, uterine tubes, ovaries, and surrounding structures. It is shown that 4.4 percent of women possess a history of pelvic inflammatory disease (PID).[8, 9] Untreated pelvic inflammatory disease (PID) may result in "a tubo-ovarian abscess (TOA), pelvic peritonitis, peri-hepatitis, and eventual infertility."

The uterocervical angle (UCA), defined as the angle between "the cervical canal and the anterior uterine wall," is a recently studied ultrasonographic measure. Cervical length refers to the measurement between "the internal and external ostia of the cervix." Certain investigations on dysmenorrhea and idiopathic infertility have indicated that a reduction in the anterior UCA influences these disorders.[10-12] The cervix serves as a conduit for bacteria that may induce infection by climbing to the pelvis.

In light of this condition, we posited that anatomical variations may also contribute to the risk factors associated with dysmenorrhea and the development of PID. Therefore, this study was conducted to determine the prevalence uterine variants with respect to uterine morphology, utero-cervical angle, and uterine axis and to correlate with clinical outcomes.

MATERIALS AND METHODS

This was an observational and ambispective study conducted on 100 non-pregnant nulli-gravid females in Department of Anatomy in collaboration with Department of Radiodiagnosis from January 2024 to June 2024. Informed consent was taken from women as per "guidelines of GCP and declaration of Helsinki."

Sampling technique: Consecutive sampling was done to enrol 100 non-pregnant nulli-gravid females.

Inclusion Criteria: Non-pregnant nulli gravid females between age group 16-30 years

Exclusion Criteria: any uterine pathology, pregnancy and history of hysterectomy, a history of abdominal surgery except for caesarean section, cervical surgery for any reason, a history of pelvic organ prolapse and/or surgery for this reason, patients with a retroverted uterus, tubo-ovarian abscess, uterine or cervical pathology, or history of pelvic chemo-radiotherapy.

Methodology:

Subjects were divided into 50 cases (history of PID or dysmenorrhoea) and 50 controls. Evaluation of utero cervical angle, uterine morphology, and uterine axis was done using trans-abdominal ultrasonography (USG). Retrospective data regarding history of PID, dysmenorrhea etc. were recorded through direct interview with study participants and from their past medical records. Patients were also followed for 6 months for detection of any clinical events.

"Ultrasound data were represented by shapes, orientations, biometric values, and uterine structures. Uterine body longitudinal axis, uterine body transverse axis, uterine cervix longitudinal axis and anterior cervical axis angle values were also recorded during the ultrasound examination."

Statistical Analysis:

The data obtained from cases and controls were presented in tabular form and calculations of percentages, means, and standard deviations (SD) of the parameters were performed. Comparisons of continuous data such as age, BMI, and uterine measurements were performed using unpaired t-tests. Uterine Orientation and baseline parameters such as marital status were expressed as percentages and ratios and compared using fisher's exact test. A P-value less than 0.05 was taken as a measure of significance.

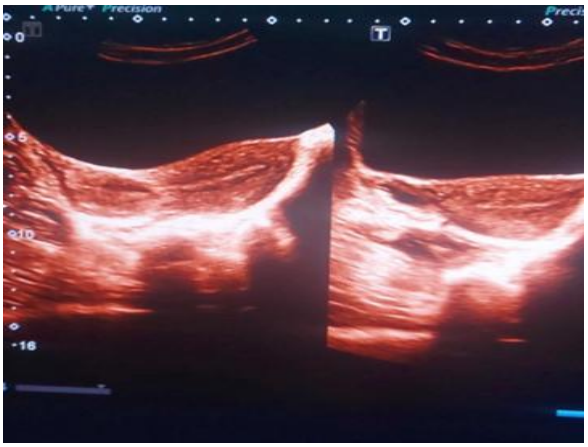

Figure 1: Uterine longitudinal & transverse axis

RESULTS

Table 1: Comparison of Baseline Demographic and Clinical Characteristics between Cases (with PID or Dysmenorrhoea) and Controls (without PID or Dysmenorrhoea)

Parameters	Cases (n=50)	Controls (n=50)	P-Value
Age in Years (mean ± SD)	25.86 ± 4.63	24.27 ± 5.18	0.11*
BMI in kg/m^2	24.98 ± 2.39	24.67 ± 2.47	0.53*
Marital Status, n (%)			>0.99**
Married	28	29	
Unmarried	22	21	
Contraception, n (%)			>0.99**
Yes	23	24	
No	27	26	

*Unpaired t test **Fisher's Exact Test. Controls were matched with cases with respect to age, BMI, marital status and contraception with no statistically significant difference (p>0.05).

Table 2: Comparison of USG Measurements between Cases (with PID or Dysmenorrhoea) and Controls (without PID or Dysmenorrhoea)

Parameters	Parameters in mean ± SD		P-Value (Unpaired t-test)
	Cases (n=50)	Controls (n=50)	
Uterine body longitudinal axis in mm	47.98 ± 4.74	53.69 ± 6.72	**<0.0001**
Uterine body transverse axis in mm	38.89 ± 3.28	42.09 ± 5.39	**0.0005**
Uterine cervix longitudinal axis in mm	32.82 ± 3.97	29.05 ± 4.16	**<0.0001**
Anterior utero-cervical angle (UCA) in mm	127.86 ± 15.54	108.97 ± 11.42	**<0.0001**

Anterior utero-cervical angle was significantly higher in cases (127.86 ±15.54) as compared to controls (108.97 ±11.42). Uterine body longitudinal or transverse axis was significantly lower as in cases as compared to control whereas uterine cervix longitudinal axis was significantly higher in cases.

Table 3: Comparison of Uterine Orientation between Cases (with PID or Dysmenorrhoea) and Controls (without PID or Dysmenorrhoea)

Parameters	Number of Patients (%)		P-Value (Fisher's Exact Test)
	Cases (n=50)	Controls (n=50)	
Version			0.12
Anteversion	46 (92.00)	50 (100.00)	
Retroversion	4 (8.00)	0 (0.00)	
Flexion			**0.006**
Anteflexion	42 (84.00)	50 (100.00)	
Retroflexion	8 (16.00)	0 (0.00)	

There were more cases of retroversion and retroflexion in patients with PID or dysmenorrhoea as compared to controls.

Figure 2: Uterocervical Angle

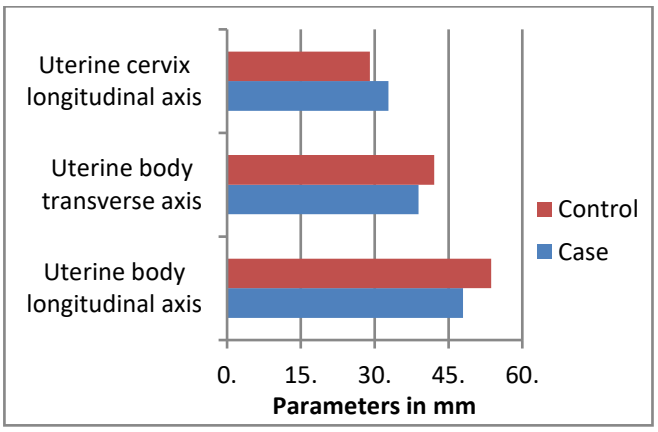

Figure 3: Comparison of Uterine Measurements

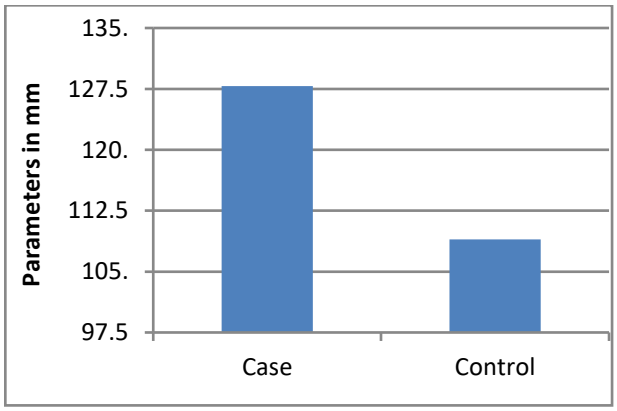

Figure 4: Comparison of UCA

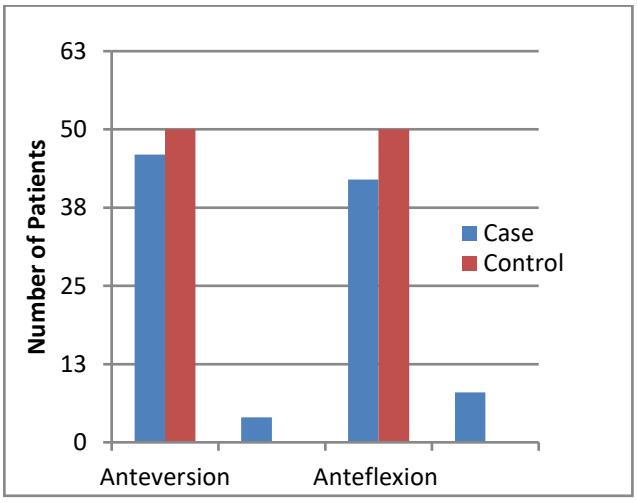

Figure 5: Comparison of Uterine Orientation

Table 4: Comparison of Mullerian Abnormalities between Cases (with PID or Dysmenorrhoea) and Controls (without PID or Dysmenorrhoea)

Parameters	Number of Patients (%)		P-Value (Fisher's Exact Test)
	Cases (n=50)	Controls (n=50)	
Bicornuate Uterus	3	1	0.62
Hypoplasia	1	0	>0.99

The presence of an arcuate uterus was noted in 6% of cases and 2% of controls, with a p-value of 0.62, indicating no statistically significant difference. Similarly, hypoplasia was observed in 2% of cases and 0% of controls, with a p-value of >0.99, suggesting no significant association between Mullerian abnormalities and the conditions of PID or dysmenorrhea in this sample size.

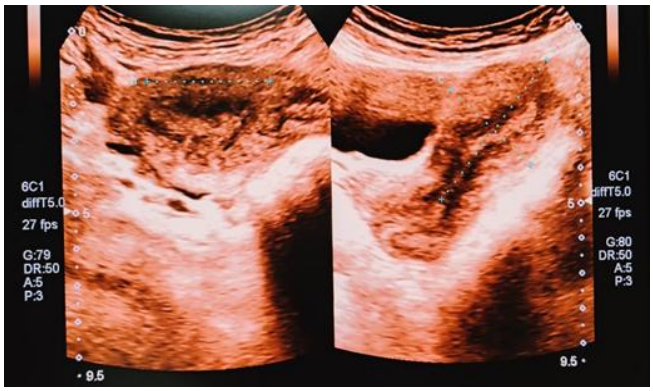

Figure 6: Anteverted uterus

Figure 7: Retroverted uterus

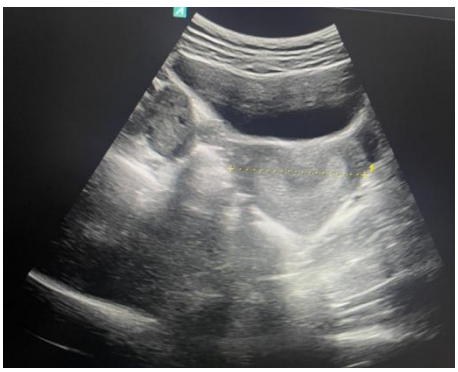

Figure 8: Bicornuate Uterus

DISCUSSION

In individuals with PID, "the longitudinal and transverse axes of the uterine body" were smaller, the longitudinal axis of the cervix of the uterus was longer, and the UCA was broader. "The longitudinal axis of the uterine body, the longitudinal axis of the uterine cervix, and the UCA" were substantially correlated with PID and dysmenorrhoea.

Pelvic inflammatory disease is frequently observed in individuals of reproductive age. Numerous partners, early onset of sexual intercourse, and the use of IUDs have been identified as potential risk factors.[13-16] Barrier strategies have been documented to diminish the chance of developing pelvic inflammatory disease (PID).

Furthermore, a study revealed that fifty percent of patients having PID are smokers.[17] PID development is commonly linked to the colonization of "the vagina and endocervix by microorganisms through the ascending route." The primary etiological agents of PID are the sexually transmissible Chlamydia trachomatis as well as Neisseria gonorrhoeae.[18] Furthermore, additional vaginal bacteria have been demonstrated to induce PID at an incidence of 15%. Sexual activities and backward menstruation are believed to contribute to the development of PID.[9] In bacterial vaginosis, enzymes generated by the responsible microorganisms have been shown to diminish cervical mucus and compromise the cervical barrier, hence allowing sexually transmitted diseases.[19, 20]

"The longitudinal axis of the uterine body, the longitudinal axis of the uterine cervix, and the UCA" were found to be significant predictors of the likelihood of developing PID and dysmenorrhoea. In our study, the longitudinal and also transverse axes of the uterine body were reduced, the longitudinal axis of the uterine cervix was elongated, and the UCA was 78/ enlarged in individuals with PID. This study suggests that an expanded UCA and a shortened uterus may promote ascending bacterial infections and increase the risk factors for PID development.

The uterus is often anteverted and anteflexed as a result of the interplay of uterine static forces.[1] 92 percent of the subjects that took part in this survey experienced this situation. In 8%, we identified instances of uterine malpositions, including retroversion as well as retroflexion, thereby affirming the infrequency of these conditions. The literature indicates a prevalence of 20 to 25% for all types of uterine positioning anomalies, with or without dysmenorrhea, in the female population across all age groups.[1] Sahin et al. discovered a correlation between "the angle of uterine flexion" and the incidence and severity of dysmenorrhea.[11]

Our investigation identified a statistically significant association between uterine flexion abnormalities and dysmenorrhea. In their 2016 investigation, Kim et al. not only identified a relationship among uterine malpositions with dysmenorrhea but also noted a potential association with pelvic abnormalities in these individuals.[21]

The study's limitation is the broad age range. The structure of the uterus may vary due to hormonal fluctuations in individuals aged 18 to 45 years. Consequently, a further investigation should be conducted within a more restricted age range. Furthermore, employing three-dimensional ultrasound or MRI for ultrasonographic assessments of the uterus in this research would be advantageous.

CONCLUSION

Women with short uterus with high UCA and cervical longitudinal axis had higher likelihood of developing pelvic inflammatory disease or dysmenorrhoea and mullerian abnormalities. The statistical examination of uterine echo-anatomy variables indicated that uterine malposition constituted the anatomical characteristics that could elucidate the risk of pelvic inflammatory disease or dysmenorrhea. Given that ultrasound is an operator-dependent assessment, the evaluation of the uterus in our group of subjects should be followed by a more objective imaging modality, such as MRI, in order to definitively attribute dysmenorrhea to positional anomalies in the subjects involved.

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