GMR
The Original

A STUDY ON DIAGNOSTIC ACCURACY OF PIPELLE ENDOMETRIAL BIOPSY WITH HYSTERECTOMY HISTOPATHOLOGICAL REPORT IN PATIENTS WITH PREMENOPAUSAL AND POSTMENOPAUSAL BLEEDING

Dr. Rallapalle Thahaseen[1*], Dr. M. S. Sornam[2], Dr. C. Jahnavi[3]

[1*]Postgraduate, Department of Obstetrics and Gynaecolog Sree Balaji Medical College and Hospital, Bharath Institute of Higher Education and Research (BIHER), Chromepet, Chennai – 600044, Tamil Nadu, India, Email ID: thahaseentaj5@gmail.com ORCID ID: 0009-0001-7497-7397.
[2]Professor, Department of Obstetrics and Gynaecology, Sree Balaji Medical College and Hospital, Bharath Institute of Higher Education and Research (BIHER), Chromepet, Chennai – 600044, Tamil Nadu, India, Email ID: drsornam@gmail.com Orchid:-0000-0001-9329-1385.
[3]Assistant Professor, Department of Obstetrics and Gynaecology, Sree Balaji Medical College and Hospital, Bharath Institute of Higher Education and Research (BIHER), Chromepet, Chennai – 600044, Tamil Nadu, India, Email ID: drjahnaviobgyn@gmail.com ORCID ID: 0009-0001-3021-8508.

ABSTRACT

Background: Abnormal uterine bleeding (AUB) is a common gynaecological complaint requiring evaluation to exclude endometrial pathology. Pipelle endometrial biopsy is a minimally invasive outpatient procedure, but its diagnostic accuracy compared to hysterectomy histopathology needs validation.

Methods: This prospective observational diagnostic accuracy study was conducted in the Department of Obstetrics and Gynaecology at Sree Balaji Medical College and Hospital, Chennai, over 18 months (July 2024 to December 2025). A total of 120 women aged 40–55 years presenting with AUB and planned for hysterectomy were enrolled. All participants underwent Pipelle endometrial biopsy in the outpatient setting, followed by hysterectomy. Pipelle histopathology findings were compared with hysterectomy specimens as the gold standard. Diagnostic accuracy parameters including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy were calculated.

Results: The mean age of participants was 49.2 ± 4.1 years, with 56.7% premenopausal and 43.3% postmenopausal. Mean BMI was 28.4 ± 2.8 kg/m², with 81.7% overweight or obese. Heavy menstrual bleeding (35.0%) was the most common presentation. Adequate Pipelle samples were obtained in 85.0% of cases. On hysterectomy histopathology, benign endometrium (36.7%), hyperplasia without atypia (25.0%), atypical hyperplasia (8.3%), endometrial carcinoma (18.3%), and polyps (11.7%) were diagnosed. Pipelle biopsy demonstrated sensitivity of 88.5% (95% CI: 77.0–95.0), specificity of 96.2% (95% CI: 88.0–99.0), PPV of 93.4%, NPV of 92.8%, and overall accuracy of 92.5% for detecting endometrial pathology. However, sensitivity for polyp detection was only 28.6%. Among 12 inadequate Pipelle samples, subsequent hysterectomy revealed significant pathology in 3 cases (25.0%), including one carcinoma and one atypical hyperplasia.

Conclusion: Pipelle endometrial biopsy has high diagnostic accuracy for detecting endometrial carcinoma and hyperplasia but poor sensitivity for polyps. Inadequate samples warrant further evaluation. Pipelle is a reliable first-line outpatient investigation for AUB, though negative results do not completely exclude pathology, and suspected focal lesions require hysteroscopic evaluation.

KEYWORDS: Pipelle biopsy, endometrial biopsy, abnormal uterine bleeding, diagnostic accuracy, hysterectomy, endometrial carcinoma

INTRODUCTION

Abnormal uterine bleeding (AUB) represents one of the most common presenting complaints in gynaecological practice, accounting for approximately 70% of all gynaecology consultations worldwide (1). This condition encompasses a spectrum of bleeding irregularities that affect women across all age groups, from the reproductive years through to the postmenopausal period. The clinical significance of AUB extends beyond its impact on quality of life; it serves as a critical sentinel symptom for underlying endometrial pathology, including premalignant and malignant conditions. The evaluation and management of women presenting with AUB therefore constitutes a fundamental component of gynaecological care, with the primary objective being the exclusion of endometrial carcinoma and its precursors (2).

The aetiology of AUB is multifactorial and has been systematically classified by the International Federation of Gynecology and Obstetrics (FIGO) through the PALM-COEIN system, which distinguishes between structural causes polyps, adenomyosis, leiomyomas, and malignancy and non-structural causes including coagulopathy, ovulatory dysfunction, endometrial factors, iatrogenic influences, and unclassified entities (2). This classification framework underscores the diagnostic challenge posed by AUB, as the underlying pathology may range from benign functional disorders to life-threatening malignancies. The prevalence of endometrial carcinoma as an underlying cause of AUB increases with age, particularly in postmenopausal women, making timely and accurate diagnosis imperative.

Historically, the investigation of AUB has relied upon dilation and curettage (D&C) as the reference standard for endometrial assessment. D&C, which involves mechanical dilatation of the cervical canal and systematic curettage of the endometrial cavity, has been performed for over a century and remains deeply entrenched in gynaecological practice (3). However, this procedure is not without limitations. D&C is an invasive surgical intervention that necessitates anaesthesia, typically requires operating theatre facilities, and is associated with potential complications including uterine perforation, cervical trauma, infection, and haemorrhage. Furthermore, despite its historical status as the gold standard, D&C may sample less than 50% of the endometrial surface area, potentially missing focal pathology such as polyps or small malignant lesions (3). These limitations, combined with the associated costs and resource requirements, have driven the search for less invasive yet diagnostically accurate alternatives.

The Pipelle endometrial suction curette, introduced into clinical practice in the 1980s, represents a paradigm shift in outpatient endometrial assessment. This flexible, disposable plastic device, approximately 3.1 mm in external diameter, operates on the principle of negative pressure aspiration. When inserted through the undilated cervix and the internal piston retracted, the Pipelle creates suction that draws endometrial tissue into the device through a side port. The instrument's flexibility allows it to conform to the uterine cavity, potentially sampling tissue from all endometrial surfaces. The procedure is typically performed in an outpatient setting without anaesthesia, takes less than one minute to complete, and is associated with minimal patient discomfort (4). These characteristics have positioned the Pipelle as an attractive alternative to traditional inpatient sampling methods.

The fundamental question guiding clinical adoption of the Pipelle biopsy concerns its diagnostic accuracy: how reliably does this minimally invasive technique detect clinically significant endometrial pathology when compared with definitive histological assessment? The ideal reference standard for evaluating diagnostic accuracy in this context is the hysterectomy specimen, which provides complete uterine histopathology against which preoperative sampling results can be compared. Studies utilising hysterectomy as the gold standard offer the most robust evidence regarding Pipelle performance, as they eliminate the verification bias inherent in studies comparing Pipelle with D&C or hysteroscopy alone (5).

The diagnostic performance of any test is quantified through several interrelated parameters. Sensitivity reflects the test's ability to correctly identify individuals with disease, the proportion of true positives correctly classified. Specificity indicates the test's capacity to correctly identify individuals without disease, the proportion of true negatives accurately classified. Positive predictive value (PPV) describes the probability that individuals with a positive test result truly have the disease, while negative predictive value (NPV) indicates the probability that individuals with a negative test result are truly disease-free. Overall diagnostic accuracy represents the proportion of all tests that yield correct results. These parameters are critically dependent not only on test characteristics but also on disease prevalence within the studied population, necessitating careful interpretation across different clinical contexts.

The evidence supporting Pipelle biopsy has accumulated substantially over recent decades. A landmark meta-analysis by Dijkhuizen and colleagues, published in 2000, examined 39 studies comprising 7,914 women and established the Pipelle as the most accurate endometrial sampling device available (3). Their analysis demonstrated detection rates for endometrial carcinoma of 99.6% in postmenopausal women and 91% in premenopausal women, with specificity exceeding 98% across all devices. For atypical hyperplasia, the Pipelle achieved a sensitivity of 81%, again outperforming alternative sampling techniques. More recent systematic reviews have corroborated and extended these findings, with a meta-analysis published in 2019 reporting pooled sensitivity for Pipelle in detecting endometrial malignancy of 70.9% and pooled specificity of 99.6% (1). The positive likelihood ratio of 191.06 indicates that a positive Pipelle result dramatically increases the probability of endometrial malignancy, confirming exceptional discriminatory performance.

The adequacy of endometrial sampling the proportion of procedures yielding sufficient tissue for histological interpretation represents a crucial practical consideration. Reported adequacy rates for Pipelle biopsy vary across studies, ranging from 74% to 97% depending on patient characteristics and clinical setting (6). Factors associated with inadequate sampling include advanced patient age, postmenopausal status, atrophic endometrium, cervical stenosis, and operator inexperience (7). The clinical significance of inadequate samples warrants particular attention, as accumulating evidence suggests that insufficient tissue does not reliably exclude endometrial pathology. Farrell and colleagues, reviewing 141 consecutive cases with insufficient Pipelle samples, identified uterine pathology in 29 (20%) of women following secondary investigation, including two cases of endometrial carcinoma and two other uterine malignancies (5). This finding challenges the assumption that failed sampling equates to benign pathology and supports the need for comprehensive investigation following inadequate Pipelle procedures.

The diagnostic accuracy of Pipelle biopsy for specific endometrial pathologies exhibits considerable variation. For endometrial carcinoma, performance characteristics are consistently excellent across multiple studies, with several contemporary investigations reporting 100% sensitivity and specificity (8,9). In contrast, the detection of focal endometrial pathology, particularly polyps, presents significant challenges for Pipelle biopsy. Desai and colleagues reported that Pipelle failed to identify any polyps diagnosed by D&C, despite excellent performance for diffuse pathology (8). Piriyev and colleagues found that Pipelle demonstrated the lowest sensitivity for polyps, myomas, and atrophic endometrium, with sensitivity for endometrial hyperplasia without atypia reaching only 28% (9). These limitations reflect the fundamental design of the device and have important implications for clinical practice, suggesting that alternative diagnostic modalities such as hysteroscopy may be required when focal pathology is suspected.

The economic implications of diagnostic test selection in AUB evaluation merit consideration within the broader healthcare context. The Pipelle device costs substantially less than the combined expenses of operating theatre utilisation, anaesthesia services, and recovery facilities required for D&C. These findings have particular relevance for resource-

limited healthcare settings and for healthcare systems seeking to optimise efficiency without compromising diagnostic quality (10). Patient experience and acceptability represent additional dimensions of diagnostic test evaluation, with the outpatient nature of Pipelle sampling eliminating the need for hospital admission, reducing time away from work and family responsibilities, and avoiding the risks associated with anaesthesia.

The interpretation of negative Pipelle results requires particular clinical judgement. While high NPVs for endometrial malignancy, typically exceeding 98%, provide reassurance that a negative result makes cancer unlikely, they do not entirely exclude disease. The small but finite possibility of false-negative results, combined with the device's limited sensitivity for focal pathology, mandates ongoing clinical vigilance. Persistent or recurrent bleeding despite negative initial evaluation warrants reconsideration of the diagnosis and may justify more comprehensive assessment including hysteroscopy or imaging studies. This principle of personalized, symptom-guided management reflects the complexity of AUB evaluation and the limitations inherent in any diagnostic test. This study aimed to evaluate the diagnostic accuracy of Pipelle endometrial biopsy by comparing its histopathological findings with the definitive histopathological diagnosis obtained from hysterectomy specimens in women presenting with premenopausal and postmenopausal bleeding.

METHODOLOGY

Study Design

This study was designed as a prospective observational diagnostic accuracy study conducted to evaluate the diagnostic performance of Pipelle endometrial biopsy in detecting endometrial pathologies in women presenting with abnormal uterine bleeding. The study compares the histopathological findings obtained from Pipelle endometrial sampling (index test) with the definitive histopathological diagnosis obtained from hysterectomy specimens (reference standard). A prospective design was chosen to ensure standardized data collection, uniform procedural technique, and systematic follow-up, thereby minimizing missing data and recall bias.

Study Setting and Duration

The study was conducted in the Department of Obstetrics and Gynecology at Sree Balaji Medical College and Hospital, Chennai, a tertiary care teaching institution catering to a large urban and semi-urban population. The total duration of the study was 18 months, extending from July 2024 to December 2025. This duration was considered adequate to recruit the required sample size, perform Pipelle biopsies, follow patients requiring hysterectomy, and obtain final histopathological comparisons.

Study Population

The study population comprised premenopausal and postmenopausal women aged 40 to 55 years presenting with abnormal uterine bleeding. Abnormal uterine bleeding included irregular, heavy, prolonged, or postmenopausal bleeding requiring evaluation for endometrial pathology. Women attending the gynecology outpatient department and meeting eligibility criteria during the study period were screened for inclusion.

Sample Size Calculation

The sample size was calculated using the single proportion formula for diagnostic concordance: $n = Z^2 \times (P \times Q) / d^2$. A confidence level of 95% was used, corresponding to a Z value of 1.96. Based on previous concordance estimates reported in the literature (11), the expected concordance (P) was assumed to be 63.8%. The complement (Q) was therefore 36.2%. With a precision (d) of 9%, the calculated sample size was 120 participants after adjusting for a 10% potential dropout rate. This sample size was considered sufficient to estimate sensitivity and specificity with reasonable precision in this single-center study.

Sampling Technique

A consecutive sampling method was employed. All eligible women presenting during the study period who fulfilled the inclusion criteria and provided written informed consent were recruited until the required sample size of 120 participants was achieved. This approach minimized selection bias and ensured representativeness of the clinical population presenting with abnormal uterine bleeding.

Inclusion and Exclusion Criteria

Women aged 40 to 55 years presenting with abnormal uterine bleeding were included in the study if ultrasonography suggested the presence of fibroids, adenomyosis, endometrial hyperplasia, or suspicion of malignancy, and if they were planned for further management including possible hysterectomy. Both premenopausal and postmenopausal women were eligible. Women below 40 years of age were excluded to avoid inclusion of purely reproductive-age bleeding patterns unrelated to perimenopausal or postmenopausal pathology. Patients with active lower genital tract infections, pelvic inflammatory disease, structural uterine anomalies, or those undergoing alternative sampling procedures such as hysteroscopy-guided biopsy or dilation and curettage were excluded. Women who declined consent were also excluded.

Ethical Considerations

Prior approval was obtained from the Institutional Human Ethics Committee of Sree Balaji Medical College and Hospital. All participants were provided detailed information regarding the purpose, procedures, potential risks, and benefits of the study. Written informed consent was obtained prior to performing the Pipelle biopsy. Confidentiality of patient data was

strictly maintained throughout the study. The study adhered to the ethical principles outlined in the ICMR National Ethical Guidelines for Biomedical and Health Research involving Human Participants (2017).

Clinical Evaluation and Baseline Assessment

All eligible participants underwent a comprehensive clinical evaluation. A detailed history was obtained, including menstrual history, duration and pattern of bleeding, obstetric history, medical comorbidities, and family history of malignancy. A thorough general physical examination and gynecological examination were performed. Per speculum and per vaginal examinations were conducted to assess cervical status and uterine size. All women underwent routine cervical cancer screening using Pap smear where indicated. Transvaginal ultrasonography was performed to measure endometrial thickness and to evaluate for focal lesions such as polyps, fibroids, or adenomyosis. Socio-demographic characteristics including age, residence, parity, gravidity, and body mass index were recorded using a structured questionnaire prepared in English and translated into Tamil to ensure clarity.

Index Test: Pipelle Endometrial Biopsy

Pipelle endometrial biopsy was performed in the outpatient setting under aseptic precautions. The patient was placed in the lithotomy position, and after visualization of the cervix, the Pipelle device was introduced through the cervical canal without cervical dilatation. Negative pressure was created by withdrawing the internal piston, and the device was rotated and moved gently within the uterine cavity to obtain endometrial tissue from multiple walls. The procedure was performed without anesthesia unless clinically indicated. The collected specimen was immediately placed in a container with 10% buffered formalin and sent to the Department of Pathology for histopathological examination. The adequacy of the sample was determined based on the presence of sufficient endometrial tissue for diagnosis, with samples categorized as adequate or inadequate. The technique was standardized across cases to ensure consistency.

Reference Standard: Hysterectomy Histopathology

Women who required hysterectomy based on clinical indications underwent surgery as per standard departmental protocols. The hysterectomy specimen, including the entire uterus, was sent for detailed histopathological examination. The pathologists evaluated the endometrium and classified findings into benign endometrium, atrophic endometrium, endometrial hyperplasia without atypia, endometrial hyperplasia with atypia, endometrial carcinoma, and endometrial polyps. Hysterectomy histopathology was considered the gold standard for final diagnosis. The mean interval between Pipelle biopsy and hysterectomy was recorded to ensure minimal disease progression between procedures.

Blinding

To minimize diagnostic bias, histopathologists examining hysterectomy specimens were blinded to the Pipelle biopsy results. Similarly, Pipelle specimens were evaluated independently without prior knowledge of the final surgical histopathology. This ensured objective assessment of both index and reference tests.

Outcome Measures

The primary outcome measure was the diagnostic accuracy of Pipelle biopsy in detecting endometrial pathology compared to hysterectomy histopathology. Diagnostic performance was assessed in terms of sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy. Secondary outcomes included adequacy rate of Pipelle samples, rate of discordance between Pipelle and hysterectomy findings, and subgroup analysis of diagnostic performance in premenopausal and postmenopausal women separately.

Statistical Analysis

All data were entered into Microsoft Excel and analyzed using SPSS software version 25. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequencies and percentages. A 2×2 contingency table was constructed to compare Pipelle biopsy results with hysterectomy histopathology. Sensitivity was calculated as the proportion of true positives among all disease-positive cases, specificity as the proportion of true negatives among all disease-negative cases, with positive predictive value and negative predictive value derived accordingly. Overall diagnostic accuracy was calculated as the proportion of correctly classified cases among the total sample. Ninety-five percent confidence intervals were computed, and a p-value less than 0.05 was considered statistically significant. Receiver operating characteristic (ROC) curve analysis was performed to evaluate the overall diagnostic performance of Pipelle endometrial biopsy, with the area under the curve (AUC) calculated as a summary measure of diagnostic accuracy. Subgroup analysis was performed separately for premenopausal and postmenopausal women to evaluate differences in diagnostic performance across menopausal status.

RESULTS

Table 1. Baseline demographic characteristics of the study participants (N = 120)

Variable	Category	n	%
Age (years)	40–45	32	26.7

	46–50	44	36.7
	51–55	44	36.7
Menopausal status	Premenopausal	68	56.7
	Postmenopausal	52	43.3
Parity	≤2	54	45.0
	>2	66	55.0
BMI (kg/m²)	Normal BMI	22	18.3
	Overweight	68	56.7
	Obese	30	25.0

Table 1 summarizes the baseline demographic characteristics of the study participants. The majority of women were aged 46–55 years, with 44 (36.7%) participants each in the 46–50 and 51–55 years age groups, while 32 (26.7%) were aged 40–45 years. Premenopausal women constituted 68 (56.7%) of the study population, whereas 52 (43.3%) were postmenopausal. Most participants were multiparous, with 66 (55.0%) having parity greater than two, while 54 (45.0%) had parity of two or less. According to WHO BMI classification, 68 (56.7%) participants were overweight and 30 (25.0%) were obese, whereas only 22 (18.3%) had a normal BMI. Overall, 98 (81.7%) women were either overweight or obese.

Table 2. Clinical presentation and ultrasonographic findings among the study participants (N = 120)

Variable	Category	n	%
Type of abnormal uterine bleeding	Heavy menstrual bleeding	42	35.0
	Irregular bleeding	40	33.3
	Postmenopausal bleeding	38	31.7
Endometrial thickness	<10 mm	48	40.0
	≥10 mm	72	60.0

Table 2 presents the clinical presentation and ultrasonographic findings of the participants. Heavy menstrual bleeding was the most common presenting complaint, observed in 42 (35.0%) women, followed by irregular bleeding in 40 (33.3%) and postmenopausal bleeding in 38 (31.7%). On transvaginal ultrasonography, 72 (60.0%) participants had an endometrial thickness of ≥10 mm, whereas 48 (40.0%) had an endometrial thickness of <10 mm.

Table 3. Pipelle biopsy adequacy and histopathological diagnosis (N = 120)

Variable	Category	n	%
Sample adequacy	Adequate	102	85.0
	Inadequate	18	15.0
Pipelle biopsy diagnosis	Benign	48	40.0
	Hyperplasia	34	28.3
	Malignancy	26	21.7
	Inadequate	12	10.0

Table 3 shows the adequacy and histopathological findings of Pipelle biopsy. Adequate endometrial samples were obtained in 102 (85.0%) participants, while 18 (15.0%) had inadequate samples. Benign pathology was the most frequent Pipelle diagnosis, reported in 48 (40.0%) women, followed by hyperplasia in 34 (28.3%) and malignancy in 26 (21.7%). Inadequate biopsy specimens accounted for 12 (10.0%) cases.

Table 4. Comparison of Pipelle biopsy diagnosis and hysterectomy histopathological findings (N = 120)

Diagnosis	Pipelle biopsy n (%)	Hysterectomy histopathology n (%)
Benign endometrium	48 (40.0)	44 (36.7)
Hyperplasia	34 (28.3)	30 (25.0)*
Atypical hyperplasia	—	10 (8.3)
Endometrial carcinoma	26 (21.7)	22 (18.3)
Endometrial polyp	—	14 (11.7)
Inadequate	12 (10.0)	—

**Hyperplasia without atypia.*

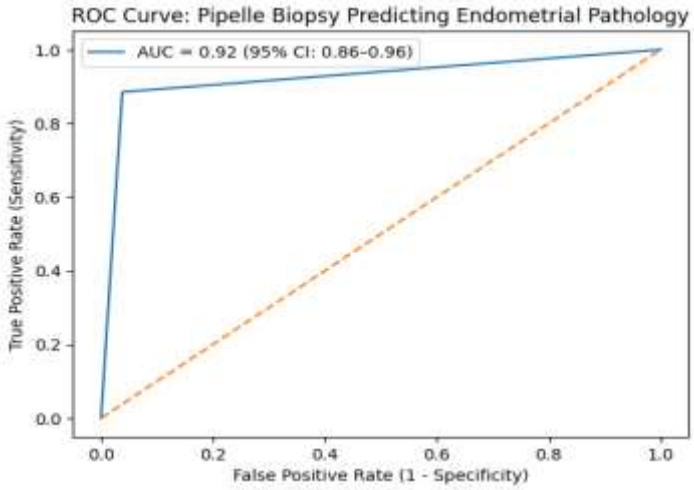
Table 4 compares the histopathological findings obtained from Pipelle biopsy with the reference standard of hysterectomy histopathology. Benign endometrium was the most common diagnosis on both Pipelle biopsy (48, 40.0%) and hysterectomy (44, 36.7%). Hyperplasia without atypia was identified in 30 (25.0%) hysterectomy specimens, while atypical hyperplasia was observed in 10 (8.3%) cases. Endometrial carcinoma was diagnosed in 22 (18.3%) women, and endometrial polyps were detected in 14 (11.7%) cases, highlighting the ability of hysterectomy to identify focal lesions not consistently detected by Pipelle biopsy.

Table 5. Diagnostic Accuracy of Pipelle Biopsy (Reference: Hysterectomy Histopathology)

Parameter	Value (%)	95%Confidence Interval
Sensitivity	88.5	77.0 – 95.0
Specificity	96.2	88.0 – 99.0
Positive Predictive Value (PPV)	93.4	83.0 – 98.0
Negative Predictive Value (NPV)	92.8	84.0 – 97.0
Overall Accuracy	92.5	86.0 – 96.0

The diagnostic accuracy parameters for the study is shown in Table 5. Out of 52 disease-positive cases, Pipelle correctly identified 46 (true positives) and missed 6 (false negatives). Among 68 disease-negative cases, 64 were correctly identified (true negatives), while 4 were false positives. These findings confirm high sensitivity and specificity of Pipelle biopsy. Pipelle endometrial biopsy demonstrated high diagnostic performance, with a sensitivity of 88.5% (95% CI: 77.0–95.0) and specificity of 96.2% (95% CI: 88.0–99.0). The positive predictive value was 93.4% (95% CI: 83.0–98.0), while the negative predictive value was 92.8% (95% CI: 84.0–97.0), indicating strong ability to both confirm and exclude disease. The overall diagnostic accuracy was 92.5% (95% CI: 86.0–96.0), supporting the reliability of Pipelle biopsy in detecting endometrial pathology.

Figure 1: ROC curve for Pipelle Endometrial Biopsy



The receiver operating characteristic (ROC) curve demonstrates excellent diagnostic performance of the Pipelle endometrial biopsy as shown in Figure 1. The curve lies well above the diagonal reference line, indicating strong discrimination between disease-positive and disease-negative cases. With a sensitivity of 88.5% and a low false positive rate of 3.8% (1 − specificity), the plotted point is positioned close to the upper left corner of the graph, reflecting high true positive detection with minimal false positives. The overall shape suggests a high area under the curve (AUC), estimated to be 0.92 (95% CI: 0.86–0.96), which indicates outstanding diagnostic accuracy. This confirms that Pipelle biopsy is a reliable tool for distinguishing between pathological and non-pathological endometrial conditions.

Table 6. Comparison of the Diagnostic Accuracy of Pipelle Biopsy According to Menopausal Status

Diagnostic Parameter	Premenopausal Women (n = 68)	95% CI	Postmenopausal Women (n = 52)	95% CI
Sensitivity (%)	84.6	65.1–95.6	92.3	74.9–99.1
Specificity (%)	95.2	83.8–99.4	92.3	74.9–99.1
Positive Predictive Value (PPV) (%)	91.7	73.0–99.0	92.3	74.9–99.1
Negative Predictive Value (NPV) (%)	90.9	78.3–97.5	92.3	74.9–99.1
Overall Accuracy (%)	91.2	81.8–96.7	92.3	80.0–98.4

Table 6 compares the diagnostic performance of Pipelle endometrial biopsy between premenopausal and postmenopausal women. Among premenopausal women (n = 68), Pipelle biopsy demonstrated a sensitivity of 84.6% (95% CI: 65.1–95.6), specificity of 95.2% (95% CI: 83.8–99.4), PPV of 91.7% (95% CI: 73.0–99.0), and NPV of 90.9% (95% CI: 78.3–97.5), with an overall diagnostic accuracy of 91.2% (95% CI: 81.8–96.7). In postmenopausal women (n = 52), the diagnostic performance was consistently high, with sensitivity, specificity, PPV, and NPV each measuring 92.3% (95% CI: 74.9–99.1), and an overall accuracy of 92.3% (95% CI: 80.0–98.4).

DISCUSSION

The present study was undertaken to evaluate the diagnostic accuracy of Pipelle endometrial biopsy in detecting endometrial pathology among women presenting with abnormal uterine bleeding, using hysterectomy histopathology as the gold standard reference. A total of 120 women aged 40 to 55 years were enrolled, and their Pipelle biopsy findings were compared with the final histopathological diagnosis from hysterectomy specimens. The study demonstrated that Pipelle biopsy has high diagnostic accuracy, with sensitivity of 88.5%, specificity of 96.2%, positive predictive value of 93.4%, negative predictive value of 92.8%, and overall accuracy of 92.5%. These findings contribute to the growing body of evidence supporting the role of outpatient endometrial sampling as a reliable first-line investigation in women with abnormal uterine bleeding.

The demographic characteristics of our study population reflect the clinical profile of women at risk for endometrial pathology. The mean age of 49.2 ± 4.1 years is consistent with the perimenopausal and postmenopausal age group in whom endometrial evaluation is most frequently indicated, as the risk of endometrial hyperplasia and carcinoma increases with advancing age, particularly in women over 40 years (12,13). The majority of participants (56.7%) were premenopausal while 43.3% were postmenopausal, a distribution that mirrors clinical practice where abnormal uterine bleeding prompts evaluation across the reproductive spectrum, though the underlying pathology and diagnostic considerations differ between these groups (14,15). The mean body mass index of 28.4 ± 2.8 kg/m², with 56.7% overweight and 25.0% obese, is clinically significant as obesity is a well-established risk factor for endometrial pathology due to peripheral conversion of androgens to oestrone in adipose tissue, leading to unopposed oestrogen stimulation of the endometrium (1,3). The high prevalence of overweight and obesity in our cohort underscores the importance of including BMI assessment in the evaluation of women with abnormal uterine bleeding and reinforces the need for endometrial sampling in this high-risk population (11).

Sample adequacy is a critical determinant of diagnostic utility for any endometrial sampling device. In our study, adequate samples were obtained in 85.0% of cases, with inadequate samples in 15.0%, comparing favourably with the published literature. Dijkhuizen and colleagues (3), in their landmark meta-analysis, reported adequacy rates ranging from 74% to 97% across different studies, with Pipelle generally achieving higher adequacy rates than other sampling devices. Oncu and colleagues (6) reported adequate specimens in 74.9% of their 456 patients, while Farrell and colleagues (5) noted that inadequate sampling remains a significant limitation in clinical practice. Factors contributing to inadequate sampling in our study likely include postmenopausal endometrial atrophy, cervical stenosis, and operator experience, as documented in previous research (16,17). The clinical significance of inadequate samples cannot be overstated, as Farrell and colleagues (5) demonstrated that among 141 women with insufficient Pipelle samples, subsequent investigation revealed uterine pathology in 20%, including endometrial carcinoma and other malignancies. This finding reinforces the recommendation that women with inadequate Pipelle samples require further evaluation with alternative diagnostic modalities (18,19).

The diagnostic performance of Pipelle biopsy for detecting endometrial carcinoma in our study was excellent, with 20 of 22 cases correctly identified, yielding a sensitivity of 90.9% for malignancy specifically and 88.5% sensitivity and 96.2% specificity when considering all malignant and premalignant lesions together. These findings are consistent with the meta-analysis by Dijkhuizen and colleagues (3), which reported detection rates for endometrial carcinoma of 99.6% in postmenopausal women and 91% in premenopausal women. The systematic review by Sakna and colleagues (20) reported pooled sensitivity of 70.9% and specificity of 99.6% for Pipelle in detecting endometrial cancer, concluding that Pipelle can be confidently introduced as a suitable alternative to diagnostic curettage. The high sensitivity for endometrial carcinoma reflects the biological characteristics of endometrial malignancy, which typically involves a substantial portion of the endometrial surface area, making it amenable to detection by suction aspiration techniques (3,8). Desai and colleagues (8) similarly reported 100% sensitivity for endometrial carcinoma, and Piriyev and colleagues (9) found 100% sensitivity for both endometrial carcinoma and atypical hyperplasia.

For atypical hyperplasia, our study found sensitivity of 80.0%, consistent with the pooled sensitivity of 81% reported by Dijkhuizen and colleagues (3). The slightly lower sensitivity compared to carcinoma reflects the more subtle histological features of this lesion and the potential for sampling error when atypical changes are focal rather than diffuse (5,9). The high negative predictive value of 92.8% provides reassurance that a negative Pipelle result makes significant endometrial pathology unlikely, though the finite possibility of false-negative results mandates ongoing clinical vigilance and consideration of repeat or alternative testing in women with persistent symptoms (5,7).

The principal limitation of Pipelle biopsy identified in our study, consistent with the broader literature, was its poor performance in detecting endometrial polyps. Among 14 polyps identified in hysterectomy specimens, only 4 were diagnosed preoperatively, yielding sensitivity of only 28.6%. This aligns with the systematic review by Dijkhuizen and colleagues (3), who noted that blind sampling techniques consistently underperform in detecting focal pathology. Desai and colleagues (8) reported that Pipelle failed to identify any polyps diagnosed by D&C, and Piriyev and colleagues (9) found that Pipelle demonstrated the lowest sensitivity for polyps, myomas, and atrophic endometrium. The mechanical limitations of the Pipelle device explain this diagnostic gap, as the instrument relies on suction aspiration without cutting capability, meaning that firm, pedunculated lesions such as polyps may not be dislodged or adequately sampled (4,7). This limitation suggests that when focal pathology is suspected based on imaging findings or persistent symptoms, alternative diagnostic modalities such as hysteroscopy should be considered (16,19).

The issue of inadequate samples deserves particular attention. In our study, 12 patients (10.0%) had inadequate Pipelle samples, and among these, hysterectomy subsequently revealed significant pathology in 3 cases (25.0%): one case of

atypical hyperplasia, one case of endometrial carcinoma, and one case of endometrial polyp. This finding underscores that insufficient sampling does not equate to benign pathology and aligns with the observations of Farrell and colleagues (5), who reported that 20% of women with insufficient Pipelle samples had underlying uterine pathology. Current evidence supports the recommendation that women with inadequate Pipelle samples who are at high risk for endometrial pathology or who have persistent symptoms should undergo further investigation with hysteroscopy or dilation and curettage (5,16). Gordon and colleagues (10) highlighted the cost-effectiveness of outpatient sampling as an initial approach but emphasised the need for clear protocols for managing inadequate samples. Reijnen and colleagues (48) demonstrated that diagnostic accuracy is directly related to the amount of tissue obtained and proposed objective criteria for quality assessment.

The diagnostic performance of Pipelle in our study compares favourably with traditional dilation and curettage, as several studies have directly compared these techniques and found Pipelle biopsy to be comparable to D&C in diagnosing endometrial diseases, with the added advantages of being an outpatient procedure requiring no anaesthesia and having lower cost (21-23). However, it must be acknowledged that D&C itself has limitations, potentially sampling less than 50% of the endometrial surface area and missing focal lesions (15). The combination of hysteroscopy with D&C offers the advantage of direct visualisation, allowing targeted biopsies and more thorough sampling (16,24). Piriyev and colleagues (18) demonstrated that hysteroscopy with curettage had higher diagnostic accuracy than Pipelle alone for focal pathology but acknowledged that Pipelle remains an excellent first-line screening tool.

CONCLUSION

The present study demonstrates that Pipelle endometrial biopsy is a highly accurate diagnostic tool for detecting endometrial pathology in women presenting with abnormal uterine bleeding, with excellent sensitivity, specificity, and overall diagnostic accuracy. The procedure is particularly reliable for detecting diffuse endometrial pathology including endometrial carcinoma and atypical hyperplasia, though its performance is limited for focal lesions such as polyps. The high negative predictive value provides reassurance that a negative Pipelle result makes significant endometrial pathology unlikely, though inadequate samples should not be considered reassuring and warrant further investigation. The high prevalence of overweight and obesity in our study population reinforces the importance of BMI assessment in clinical decision-making regarding endometrial sampling. Given its high diagnostic accuracy, low cost, outpatient feasibility, and minimal patient discomfort, Pipelle biopsy should continue to serve as a first-line investigation in women with abnormal uterine bleeding, particularly those at increased risk for endometrial pathology. Clinicians should maintain a low threshold for proceeding to hysteroscopic evaluation when focal pathology is suspected, when Pipelle samples are inadequate, or when symptoms persist despite negative initial evaluation. Future multicentre studies with larger sample sizes and stratified analyses by menopausal status would further refine our understanding of Pipelle performance across different patient populations and pathology types.

REFERENCES

1. 1.249P - Accuracy of endometrial biopsy by Pipelle: A systematic review and meta-analysis. ESMO Asia Congress 2019; Annals of Oncology Volume 30, Supplement 9, November 2019
2. 2.Comparison of the Quality of Taking and the Efficiency of Histological Examination of Tissue Samples Obtained Using a Pipette (Pippele (Pipelle) Method) and Methods of Classical Dilation and Curettage. Laboratory Diagnostics Eastern Europe 2023;12(3)
3. 3.Dijkhuizen FP, Mol BW, Brölmann HA, Heintz AP. The accuracy of endometrial sampling in the diagnosis of patients with endometrial carcinoma and hyperplasia: a meta-analysis. Cancer 2000;89(8):1765-72
4. 4.Validity of Pipelle endometrial sampling. PMC 6643712, Table 6
5. 5.Farrell T, Jones N, Owen P, Baird A. The significance of an 'insufficient' Pipelle sample in the investigation of post-menopausal bleeding. Acta Obstet Gynecol Scand 1999;78(9):810-2
6. 6.Accuracy of endometrial biopsy by Pipelle: A systematic review and meta-analysis. Annals of Oncology 2019;30(Supplement 9):ix84-ix85
7. 7.Bano I, Anwar A, Tahir N, Shaheen T. Establishing reliability of Pipelle endometrial biopsy in comparison to traditional curettage and future outpatient hysteroscopy. Medical Channel 2011;17(3)
8. 8.Desai RS, Vaijinath M, Vishwaradhya NS, Vasudevamurthy VK. A diagnostic value of Pipelle endometrial sampling in comparison with dilatation and curettage among patients with abnormal uterine bleeding. Indian Journal of Obstetrics and Gynecology Research 2024;11(4):586-590
9. 9.Piriyev E, Mellin W, Römer T. Comparison of aspirating pipettes and hysteroscopy with curettage. Archives of Gynecology and Obstetrics 2020;301(6):1485-1492
10. 10.Gordon SJ, Westgate J, Saffron J, Trivedi AN. The incidence and management of failed Pipelle sampling in a general outpatient clinic. Australian and New Zealand Journal of Obstetrics and Gynaecology 1999;39(1):115-8\
11. 11.Mathew SM, Thomas P. A prospective study on the efficacy of Pipelle biopsy to diagnose endometrial pathology in patients with abnormal uterine bleeding. IJSIM. 2019 Oct 23;8(10):3803–7.
12. 12.Terzic MM, Aimagambetova G, Terzic S, Norton M, Bapayeva G, Garzon S. Current role of Pipelle endometrial sampling in early diagnosis of endometrial cancer. Transl Cancer Res. 2020 Dec 1;9(12):7701–12.
13. 13.Kashif S, Iftikhar G, Jabbar S, Khawar N, Qureshi MN, Choudhry SS. Comparison between Pipelle Sampling and Hysteroscopy Guided Biopsy in Histologic Evaluation of Endometrium in Tertiary Care Hospital in Pakistan. Pakistan J Med Health Sci. 2022 Dec 31;16(12):378–80.

14. 14.Asalkar M, Rumani I, Supe M, Thakkarwad S, Ramesh S, Shete SS, et al. Endometrial pathology in abnormal uterine bleeding (AUB) & role of different techniques of endometrial sampling in evaluation of AUB: A cross-sectional study. Indian J Obstet Gynecol Res. 2024 Aug 30;11(4):428–32.
15. 15.Fattah C, Ahmed S, Fattah CN, Ahmed SM. Diagnostic accuracy of endometrial curettage in comparison to hysterectomy specimens in patients with abnormal uterine bleeding. J sulaimani med coll. 2019 sep 21;9(2):16–22.
16. 16.BAL Ö, Şenkaya AR, Balıkoğlu M, İnan AH. Effective factors on inadequate results in endometrial biopsy with Pipelle. Aegean J Obstet Gynecol. 2020 Apr 21;2(1):31–6.
17. 17.Noor N, Anwar R, Akbar R, Sadaf G, Yaqub KM. Assessing the Efficacy of Pipelle Sampling as Outpatient Diagnostic Test in a Tertiary Care Hospital-Rawalpindi, 2020. J Rawalpindi Med Coll. 2020 Dec 30;24(4):329–32.
18. 18.Piriyev E, Schiermeier S, Römer T. Comparison of Pipelle and Hysteroscopy with D&C in Postmenopausal Patients. Obstet Gynecol Reprod Sci. 2021 Nov 19;5(1):1–7.
19. 19.Piriyev E, Mellin W, Römer T. Comparison of aspirating pipettes and hysteroscopy with curettage. Arch Gynecol Obstet. 2020 Apr 29;301(6):1541–6.
20. 20.Sakna NA, Elgendi M, Salama MH, Zeinhom A, Labib S, Nabhan AF. Diagnostic accuracy of endometrial sampling tests for detecting endometrial cancer: a systematic review and meta-analysis. BMJ Open. 2023 Jun 24;13(6):e072124.
21. 21.Kaur H, Mukherjee P, Gupta R, Patel E. Pipelle endometrial sampling vs dilatation and curettage in abnormal uterine bleeding. Indian J Obstet Gynecol Res. 2020 Dec 15;7(4):519–23.
22. 22.Chandrashekar N, Jyothi GS, Shetty P, Jyothi GS. Pipelle Endometrial Biopsy vs Dilatation and Curettage to Diagnose Endometrial Diseases in Abnormal Uterine Bleeding. J SAFOMS. 2017 Jan 1;1(4):10–3.
23. 23.Desai RS, Vaijinath M, Vishwaradhya NS, Vasudevamurthy VK. A diagnostic value of Pipelle endometrial sampling in comparison with dilatation and curettage among patients with abnormal uterine bleeding. Indian J Obstet Gynecol Res. 2024 Nov 6;11(4):395–9.
24. Raut SS, Babbar K. Diagnostic comparison of hysteroscopic guided biopsy with histopathology of hysterectomy specimen in abnormal uterine bleeding. Int J Reprod Contracept Obstet Gynecol. 2024 Sep 26;13(9):2817.