

Original Article

Endometrial Sampling Techniques: Manual Vacuum Aspiration vs. Pipelle – A Quasi-Experimental Study

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Abstract

Objective: To compare Manual Vacuum Aspiration and Pipelle for endometrial sampling based on procedural time, post-procedure pain, infection rate, bleeding, sample adequacy, and cost-effectiveness.

Methodology: A quasi-experimental study was conducted at the Department of Obstetrics and Gynaecology, Akhter Saeed Medical College/ Farooq Hospital, Rawalpindi. After obtaining informed consent, 290 patients were included in the study. They were divided into two groups with 145 patients in each group. Endometrial sampling was performed using a manual vacuum aspirator in one group, while a Pipelle sampler was used in the other group. Data on procedural time, pain scores, sample weight, infection, bleeding, sample adequacy, and total procedural cost were recorded. Statistical analysis was performed using independent sample t-tests and chi-square tests.

Results: Manual vacuum aspiration was significantly more efficient in terms of procedural time (5.71 ± 0.49 min vs. 8.67 ± 0.68 min; $p < 0.001$) and higher diagnostic tissue yield (100.09 ± 3.52 mg vs. 71.87 ± 2.67 mg; $p < 0.001$). However, the Pipelle group reported significantly lower pain scores (4.05 ± 0.27 vs. 6.23 ± 0.47 ; $p < 0.001$). Economically, MVA was more cost-effective per procedure (500 vs. 1000 Rs.; $p < 0.001$).

Conclusion: Manual Vacuum Aspiration is better than Pipelle in terms of tissue yield, procedural speed, and cost-effectiveness, whereas Pipelle is better tolerated in terms of pain scores. MVA remains a highly effective and economical diagnostic tool for endometrial assessment, making it ideal for routine outpatient evaluations.

Keywords: Abnormal Uterine Bleeding, Endometrial Sampling, Manual Vacuum Aspiration, Pipelle Biopsy.

Introduction

Endometrial pathology, including hyperplasia and carcinoma, is a leading cause of abnormal uterine bleeding (AUB) in premenopausal and postmenopausal women. AUB is a frequent gynaecological concern, affecting an estimated 3–30% of women in Pakistan and contributing to significant morbidity.¹ AUB is an umbrella term that includes heavy menstrual bleeding, inter-menstrual bleeding, and ovulatory disorders, replacing previously used inconsistent and confusing terminology.² The PALM-COIN classification system for AUB, approved by the FIGO, is a universally accepted nomenclature and classification system. This is a practical and pragmatic system that can be used worldwide by researchers and clinicians. The system comprises nine main categories arranged according to the acronym PALM-COIN: "polyp, adenomyosis, leiomyoma and malignancy, and hyperplasia – coagulopathy, ovulatory dysfunction, endometrial, iatrogenic, and not yet classified."³ Early and accurate diagnosis of endometrial conditions is essential for the effective management and prevention of malignancies. Histopathological examination of the endometrium is critical for detecting conditions ranging from benign hyperplasia to carcinoma.⁴

Endometrial sampling is a cornerstone of the diagnostic process. In spite of the fact that hysteroscopy-directed endometrial biopsy is considered the gold standard for endometrial sampling,^{5,6} it carries the risk of perforation, infection, and general anaesthesia.

Recently, minor operation theatre procedures that are fast, secure, and inexpensive, such as the Pipelle biopsy device, Vabra, and Z sampler, have superseded Dilatation&

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Institutional Review Board Approval

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Curettage with good patient adequacy.⁷ WHO's "Safe abortion 2nd edition" recommends the use of Manual vacuum aspiration (MVA) as a safe surgical procedure for early pregnancy abortion in terms of reducing complications and protecting the endometrium.

Sampling techniques have evolved over the years to enhance patient comfort, procedural efficiency, and diagnostic accuracy. MVA involves a suction mechanism to aspirate the endometrial tissue, often requiring cervical dilation.⁹ It is often used in resource-constrained settings and involves the application of negative pressure to aspirate endometrial tissue. Over the last 40 years, clinical studies have demonstrated that MVA is 99% effective for early abortion.⁸ Conversely, Pipelle sampling employs a minimally invasive method that uses a thin, flexible cannula to obtain tissue samples. Pipelle sampling is less invasive and does not require anaesthesia in most cases, making it a preferred option in outpatient settings. Previous studies have highlighted the distinct advantages of each technique.¹⁰ The Pipelle is lauded for its simplicity, minimal invasiveness, and cost-effectiveness, and is often performed in outpatient settings without anaesthesia.¹¹ Despite their clinical relevance, comparative studies on MVA and Pipelle remain limited, particularly regarding patient experience, procedural efficacy, and cost implications.

This study aimed to provide a comparative analysis of five clinically meaningful parameters: procedural time, patient-reported comfort, complication rates, histopathological sample adequacy, and cost-effectiveness. This review will guide clinicians in selecting the most suitable approach and provide insights into optimising endometrial sampling approaches.

Methodology

A quasi-experimental study was conducted at the Department of Obstetrics and Gynaecology, Akhter Saeed Medical College/Farooq Hospital, Rawalpindi, from November 2023 to June 2024. Institutional Review Board (IRB) approval was obtained before commencing the research. Informed consent was obtained from all the participants involved in the study. The research was conducted with respect to participant privacy, confidentiality, and autonomy.

A total of 290 women were enrolled using non-probability convenience sampling. The sample size of 290 participants was established using the 84.5% sensitivity reported by Sirimai et al,¹² as the primary parameter. This exceeds the minimum requirement of 201 subjects at a 95% confidence level and 5% margin of error), providing increased statistical power and a margin for potential specimen inadequacy, and ensuring more robust diagnostic validation.

The inclusion criteria comprised women aged 18–65 years with indications for endometrial sampling, including abnormal uterine bleeding (AUB), endometrial hyperplasia, endometrial polyps, postmenopausal bleeding, and suspected malignancies.

The exclusion criteria were pregnancy, uterine anomalies, coagulopathies, and active pelvic infections.

Patients were allocated to either the MVA or Pipelle group based on clinician judgment and instrument availability at the time of the scheduled procedure. This non-randomised, clinician-directed allocation introduces a risk of selection bias, as the two groups may differ in clinical severity, indication profile, and baseline characteristics. This limitation is discussed further in the Limitations section of this paper.

The following parameters were assessed and documented for each participant.

The procedural time was recorded in minutes from instrument insertion to completion of sampling. Pain was assessed post-procedure immediately using a 10-point visual analogue scale (VAS), where 0 indicated no pain, and 10 indicated the worst imaginable pain. Complications, including post-procedure infection and significant bleeding, were monitored and recorded. Sample adequacy was evaluated based on the quantity of tissue obtained and the subsequent histopathology reports, which were assessed for diagnostic adequacy by a consultant histopathologist. Cost analysis was performed for each procedure, incorporating equipment costs, anaesthesia charges where applicable, and overall procedural costs, to enable a direct economic comparison between the two techniques.

Data were analysed using SPSS version 27. The assumption of normality for continuous variables was tested using the Shapiro-Wilk test. Independent Samples T-tests were applied for normally distributed continuous data, and the Mann-Whitney U test was utilised for severely skewed variables. For all primary outcomes (procedural time, tissue yield, and VAS pain score), the absolute mean difference between the MVA and Pipelle groups is reported, together with its 95% Confidence Interval (CI). Categorical variables were compared using the chi-square test. Statistical significance was set at $p < 0.05$.

Results

A total of 290 patients were enrolled and allocated to either the MVA (n=145) or Pipelle (n=145) group, with no subsequent exclusions or loss to follow-up. The baseline demographic characteristics were comparable between the two groups. The mean age was 52.7 (5.3) years in the MVA group and 52.1 (2.5) years in the Pipelle group. The

mean BMI was 27.7 (2.1) and 28.3 (1.8), respectively. The primary indications for biopsy were AUB, which affected 111 (76.6%) patients in the MVA group and 103 (71.0%) patients in the Pipelle group.

Patients allocated to the MVA group demonstrated a shorter mean procedural time than those in the Pipelle group (5.71 (0.49) vs. 8.67 (0.68) minutes; Mean Difference [95% CI], -2.96 [-3.15 to -2.77]; $P < .001$). MVA retrieved a significantly higher tissue quantity (100.09 (3.52) mg vs. 71.87 (2.67) mg; MD [95% CI], 28.22 [26.5 to 29.9]; $P < .001$). Patients in the Pipelle group reported lower pain scores (4.05 (0.27) vs 6.23 (0.47); MD [95% CI], -2.18 [-2.3 to -2.0]; $P < .001$).

Evaluating the economic impact in Pakistani Rupees (PKR), the average cost per procedure for MVA was Rs. 500, whereas Pipelle averaged Rs. 1000. Both procedures maintained excellent safety profiles, with zero infections reported in either group.

Table 1: Baseline Demographics and Clinical Indications

Parameter	MVA (n=145)	Pipelle (n=145)
Age (years), Mean (SD)	52.7 (5.3)	52.1 (2.5)
Parity, Mean (SD)	3.3 (0.9)	2.7 (0.7)
BMI, Mean (SD)	27.7 (2.1)	28.3 (1.8)
Indications, n (%)		
- AUB	111 (76.6%)	103 (71.0%)
- Postmenopausal Bleeding	18 (12.4%)	27 (18.6%)
- Endometrial Polyps	12 (8.3%)	4 (2.8%)
- Thickened Endometrium	4 (2.7%)	11 (7.6%)

Table 2: Comparative Analysis of Clinical Outcomes

Parameter	MVA (n=145)	Pipelle (n=145)	P-value
Procedural Time (min), Mean (SD)	5.71 (0.49)	8.67 (0.68)	< 0.001
Pain Score (VAS), Mean (SD)	6.23 (0.47)	4.05 (0.27)	< 0.001
Sample Adequacy (mg), Mean (SD)	100.09 (3.52)	71.87 (2.67)	< 0.001
Infection, n (%)	0 (0%)	0 (0%)	> 0.99
Significant Bleeding, n (%)	0 (0%)	1 (0.7%)	0.99

Discussion

This study highlights the critical outcome differences between the MVA and Pipelle techniques, providing clinicians with evidence-based insights to guide outpatient practices.

Our study found that MVA retrieved significantly larger tissue samples than Pipelle (100.09 (3.52) vs. 71.87 (2.67) mg, $P < .001$). Larger sample sizes improve diagnostic reliability by reducing false negatives.^{13,14} This observation is consistent with the findings of Sirimai et al,¹² who demonstrated a strong diagnostic correlation between MVA and endometrial cell sampling. Several studies have shown that MVA often yields larger tissue amounts, improving the detection of focal lesions.^{14,15}

Pain perception was higher in the MVA group (VAS 6.23 (0.47)) than in the Pipelle group (VAS 4.05 (0.27), $P < .001$). This aligns with the findings of Wanijasombutti et al.¹¹ who demonstrated higher pain scores with MVA, attributed to cervical manipulation. Rauf et al. found that Pipelle was significantly less painful.¹⁶ The reduced discomfort associated with Pipelle is likely due to the thinner diameter of the cannula and the absence of a strong mechanical vacuum pressure. In terms of safety, our study found no significant difference in infection rates (MVA% vs. Pipelle 0 %, $p=1.000$) or bleeding (0% vs. 1%, $p=0.7$). This finding supports the results of several studies,^{17,18} that also documented minimal complication rates with Pipelle.

In our study, MVA was significantly faster (5.71 (0.49) min) than Pipelle (8.67 (0.68) min, $P < .001$). This finding supports the conclusions of Nama et al.¹⁸ The variation in procedural speed across different studies suggests that operator training and specific patient characteristics strongly influence timing outcomes.¹⁹ From a cost perspective, MVA was significantly more economical in our setting (500 vs. 1000 Rs.). The reusability of MVA kits reduces the per-procedure cost compared to the single-use disposable nature of the Pipelle tool, making MVA the more cost-effective option overall.

The primary limitations of this study include its single-centre design and nonrandomised allocation of patients, which introduces an inherent risk of selection bias. Additionally, the lack of blinding limited the objectivity of the patient-reported VAS pain scores. Future research should involve multicentre randomised controlled trials to incorporate rigorous allocation concealment and detailed long-term follow-up data.

Limitations and Future Direction

The principal limitation of this study is the risk of selection bias inherent in its quasi-experimental design. Because patients were not randomly allocated to the MVA or Pipelle group, systematic differences between the two groups may exist beyond those captured by the recorded variables. Clinicians were more likely to select MVA for patients with clinical features suggesting a higher tissue yield requirement, potentially confounding the comparisons of diagnostic adequacy. Future research should employ randomised allocation to mitigate this bias and strengthen the causal inference.

Conclusions

Manual Vacuum Aspiration (MVA) and Pipelle sampling are both effective interventions for endometrial evaluation. MVA provides faster procedural times, greater sample adequacy, and improved cost-effectiveness, making it a highly reliable choice in resource-limited settings. The Pipelle is a significantly less painful option that optimises patient comfort. Both techniques offer complementary roles in routine outpatient screening for abnormal uterine bleeding (AUB).

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Contributions:

RR SQ - Conception, Design

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