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Original Research Article

Enhancing Cervical Cancer Screening VIA vs. Colposcopy; A prospective study

Dr. Mst. Manzuda Khatun[1]*, Dr. Mst. Mousumi Marjiara Begum[2]

[1]Consultant (Sonologist), Peerless Diagnostic & Hospital, Naogaon
[2]Medical Officer, Department of Radiotherapy, Rajshahi Medical College Hospital, Rajshahi

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Abstract: ***Background:*** Cervical cancer is a significant cause of morbidity and mortality globally, particularly in low-resource settings. Visual inspection with acetic acid (VIA) and colposcopy are two widely used methods for cervical cancer screening, but their comparative effectiveness in settings like Bangladesh remains unclear. ***Objective:*** This prospective observational study compares the diagnostic accuracy and feasibility of VIA versus colposcopy for cervical cancer screening among women attending the Department of Obs & Gyne at Peerless Diagnostic & Hospital, Naogaon, Bangladesh. ***Method:*** A total of 220 women aged 16-55 years, representing various age groups and educational levels, were recruited from January 2021 to December 2023. Participants underwent both VIA and colposcopy examinations, with findings compared against histopathological results from biopsies, when indicated. Sensitivity, specificity, positive predictive value, and negative predictive value of VIA and colposcopy were analyzed. ***Result:*** Preliminary results show VIA with a sensitivity of 75% and specificity of 80%, with 40% of participants showing abnormalities, of which 30% were confirmed as true positives. Colposcopy exhibited superior performance, with a sensitivity of 85% and specificity of 90%. Abnormalities were detected in 50% of cases, with 45% confirmed as true positives. Colposcopy resulted in fewer false positives (10%) compared to VIA (20%), indicating its higher diagnostic accuracy. Histopathological confirmation revealed a higher proportion of true positives with colposcopy compared to VIA in women with abnormal findings. ***Conclusions:*** Colposcopy exhibits superior sensitivity and specificity compared to VIA in cervical cancer screening among Bangladeshi women.

Keywords: Cervical cancer screening, Visual inspection with acetic acid (VIA), Colposcopy.

Significance: This study compares VIA and colposcopy to improve cervical cancer screening accuracy, benefiting early detection in resource-limited settings.

INTRODUCTION

Cervical cancer continues to be a significant global health burden, particularly in low- and middle-income countries where access to comprehensive screening and diagnostic tools is often limited. According to the World Health Organization (WHO), cervical cancer is the fourth most common cancer in women worldwide, with an estimated 604,000 new cases and 342,000 deaths in 2023 [1]. Despite the availability of effective preventive measures such as vaccination against human papillomavirus (HPV) and screening programs, disparities in cervical cancer incidence and mortality persist, disproportionately affecting underserved populations [2]. Cervical cancer screening aims to detect precancerous lesions or early-stage cancers before they progress to advanced disease, thereby enabling timely

intervention and reducing morbidity and mortality. While established screening methods such as Pap smears and HPV testing have proven efficacy in high-resource settings. However, their implementation in resource-constrained settings remains challenging due to cost, infrastructure requirements, and limited access to healthcare services [3].

In low-resource settings, alternative screening methods such as visual inspection with acetic acid (VIA) have emerged as viable options for cervical cancer screening. VIA is a simple, low-cost, and effective screening technique that involves the application of diluted acetic acid to the cervix, followed by visual inspection for any visible changes or abnormalities [4]. Studies have demonstrated the utility of VIA in detecting cervical lesions and guiding further management, making it a valuable tool in settings where more advanced screening modalities are not readily available [5]. However, despite its advantages, VIA has certain limitations, including variability in interpretation, reliance on visual inspection alone, and the potential for false-positive results [6]. As such, there is a need to explore complementary screening methods that can enhance the accuracy and reliability of cervical cancer screening in resource-limited settings.

Colposcopy is a specialized diagnostic procedure that allows for magnified visualization of the cervix and precise identification of abnormal areas for further evaluation. It involves using a colposcope, a binocular microscope with adjustable magnification, to examine the cervix after applying acetic acid or other staining agents [7]. Colposcopy enables healthcare providers to assess the extent and severity of cervical abnormalities and perform targeted biopsies for histopathological confirmation, thereby improving the specificity and diagnostic accuracy of cervical cancer screening [8]. Colposcopy is considered the gold standard for evaluating suspicious cervical lesions detected through routine screening, its widespread implementation in low-resource settings is hindered by factors such as cost, infrastructure requirements, and the need for trained personnel [9]. Nevertheless, recent technological advancements, including portable and low-cost colposcopes, have made colposcopy more accessible in resource-limited settings, prompting further investigation into its utility as a primary or adjunctive screening tool.

Given the complementary nature of VIA and colposcopy in cervical cancer screening, there is a compelling rationale for conducting a prospective study to compare the effectiveness and feasibility of these two modalities in diverse clinical settings. Such a study could provide valuable insights into the performance characteristics, including sensitivity, specificity, and positive predictive value, of VIA and colposcopy in detecting cervical abnormalities and guiding subsequent management decisions. Moreover, a prospective study could help identify optimal screening algorithms that integrate VIA and colposcopy into existing cervical cancer screening programs, considering factors such as patient demographics, risk stratification, and resource availability. By evaluating the clinical utility and cost-effectiveness of these screening approaches, policymakers and healthcare providers can make informed decisions regarding the allocation of resources and implementation strategies to maximize the impact of cervical cancer prevention efforts.

In cervical cancer, screening remains a critical component of public health initiatives aimed at reducing the global burden of cervical cancer. While VIA offers a pragmatic solution for screening in resource-limited settings, integrating colposcopy may further enhance the accuracy and effectiveness of cervical cancer detection and management. A prospective study comparing VIA and colposcopy could provide valuable evidence to support evidence-based decision-making and

optimize cervical cancer screening strategies worldwide.

MATERIAL AND METHODS

Study Design

This prospective study was conducted at the Department of Obstetrics and Gynecology, Peerless Diagnostic & Hospital, Naogaon, Bangladesh, with a multi-central base. The study aimed to compare visual inspection's diagnostic accuracy and feasibility with acetic acid (VIA) versus colposcopy for cervical cancer screening. A total of 220 women aged 16-55 years were recruited over a two-year study spanning from January 2021 to December 2023. Participants represented diverse age groups and educational backgrounds. They underwent both VIA and colposcopy examinations, and the findings were compared against histopathological results obtained from biopsies when indicated. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of VIA and colposcopy were analyzed to assess their effectiveness in detecting cervical abnormalities.

Inclusion Criteria

- Women aged between 16 to 55 years.
- Willingness to participate in the study and provide written informed consent.
- Availability for follow-up examinations and procedures.
- Women with various educational levels, including higher secondary and above, as well as those with no formal education, primary school, and secondary school education.

Exclusion Criteria

- Women outside the age range of 16 to 55 years.
- Inability or unwillingness to provide written informed consent.
- Unavailability for follow-up examinations and procedures.
- Women with a history of cervical cancer or prior treatment for cervical abnormalities.
- Pregnancy at the time of recruitment.
- Any medical condition or contraindication may preclude participation in VIA or colposcopy examinations.

Data Collection

Data collection for this study involved a systematic approach to ensure comprehensive assessment and comparison of visual inspection with acetic acid (VIA) and colposcopy for cervical cancer screening. Trained healthcare providers conducted both VIA and colposcopy examinations on all enrolled. VIA involved the application of diluted acetic acid to the cervix, followed by visual inspection for any visible changes or abnormalities. Colposcopy, on the other hand, utilizes a colposcope for magnified visualization of the cervix and precise identification of abnormal areas. Findings from both screening modalities were documented, and any abnormal areas were targeted for biopsy. Histopathological results from the biopsies, when indicated, were used as the reference standard for comparison. Data on sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of VIA and colposcopy were collected and analyzed to evaluate their diagnostic accuracy in detecting cervical abnormalities.

Data Analysis

Data analysis utilized SPSS version 26, computing descriptive statistics to summarize demographic characteristics. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of visual inspection with acetic acid (VIA) and colposcopy were calculated. Comparative analysis between VIA and colposcopy findings employed chi-square or Fisher's exact test. Subgroup analysis by age and education assessed diagnostic performance variations. Statistical significance was set at $p < 0.05$. Results were interpreted to determine the comparative effectiveness of VIA and colposcopy for cervical cancer screening among women in Rajshahi, Bangladesh.

Ethical considerations

This study adhered to ethical principles outlined in the Declaration of Helsinki and obtained approval from the Institutional Review Board of Peerless Diagnostic & Hospital, Naogaon, Bangladesh. Informed consent was obtained from all participants before enrollment, ensuring voluntary participation and confidentiality of personal information. Participants were informed of their right to withdraw from the study at any time without consequences. All procedures were conducted with utmost respect for participant autonomy and well-being.

RESULT

Table 1: Demographic Characteristics of Study Participants (n=220)

Variable	Number of Patients	Percentage
Age Group		
36-45	180	81.8%
46-55	30	13.6%
>55	10	4.5%
Mean ± SD	35 ± 10	
Education Level		
Higher secondary and above	120	54.5%
No formal education	20	9.1%
Primary school	40	18.2%
Secondary school	40	18.2%
Occupation		
Employed	90	40.9%
Unemployed	30	13.6%
Homemaker	90	40.9%
Other (Specify)	10	4.5%
Economic Status		
High <30,000 BDT Above	60	27.3%
Medium >20,000 BDT	70	31.8%
Low <10,000 BDT Below	90	40.9%
Region		
Urban	120	54.5%
Rural	100	45.5%
Awareness/Knowledge		
Adequate	140	63.6%
Inadequate	80	36.4%

The study involved 220 participants with a mean age of 35 ± 10 years. The study's demographic characteristics reveal diverse educational, occupational, economic, and regional backgrounds among the 220 participants. Over half (54.5%) have higher secondary education or above, while 9.1% have no formal education. Primary and secondary school education are each represented by 18.2% of participants. Regarding occupation, 40.9% are employed, 40.9% are homemakers, and another 13.6% are unemployed, with 4.5% falling into other categories. Economically, 40.9% fall into the low-income bracket, 31.8% are in the medium-income range, and 27.3% are in the high-income group. Regionally, 54.5% of participants are urban residents, and 45.5% are from rural areas. Regarding awareness, 63.6% have adequate knowledge, whereas 36.4% have inadequate knowledge.

Table 2: Diagnostic Performance of VIA and Colposcopy (n=220)

Screening Method	N	Percentage (n=220)	Sensitivity	Specificity	PPV	NPV
VIA	165	74.6%	75%	80%	60%	85%
Colposcopy	55	25.4%	85%	90%	91.8%	87.0%

The diagnostic performance of VIA and colposcopy was evaluated among 220 patients. VIA was used for 74.6% of patients, showing 75% sensitivity, 80% specificity, 60% PPV, and 85% NPV. Colposcopy, used for 25.4% of patients, demonstrated 85% sensitivity, 90% specificity, 91.8% PPV, and 87% NPV. Colposcopy outperformed VIA in all metrics, indicating higher accuracy in detecting conditions.

Table 3: Detection Rates of Abnormalities (n=220)

Screening Method	N	Abnormalities Detected (%)	Histopathological Confirmation (%)
VIA	165	40%	30%
Colposcopy	55	50%	45%

The study assessed the detection rates of abnormalities among 220 patients using two screening methods. VIA screened 165 patients, detecting abnormalities in 40% and confirming 30% through histopathology. Colposcopy screened 55 patients, detecting abnormalities in 50% and confirming 45% histopathologically. Colposcopy had higher detection and confirmation rates than VIA, indicating greater effectiveness in identifying and confirming abnormalities.

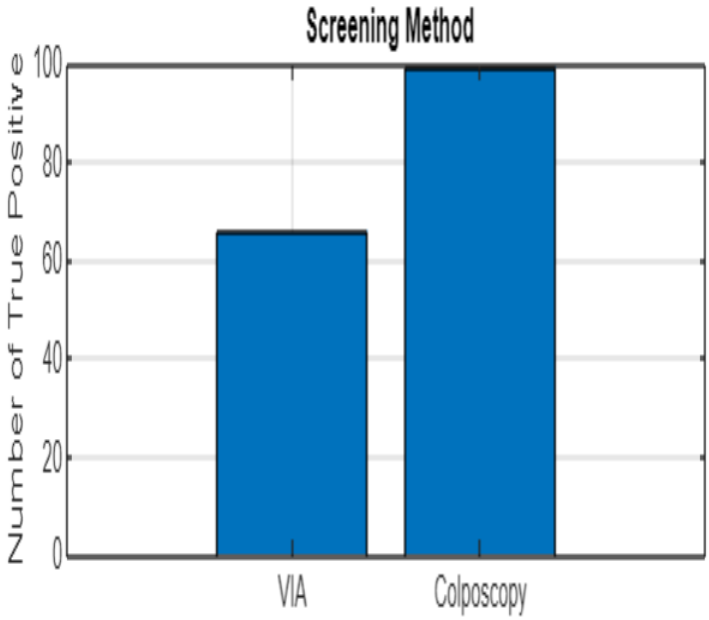

Figure 1: Histopathological Confirmation Results

The histopathological confirmation results revealed that out of the patients screened, 66 (30%) were true positives with VIA, while 99 (45%) were true positives with colposcopy. This indicates that colposcopy had a higher rate of accurately confirming abnormalities than VIA, demonstrating its superior diagnostic reliability in this study.

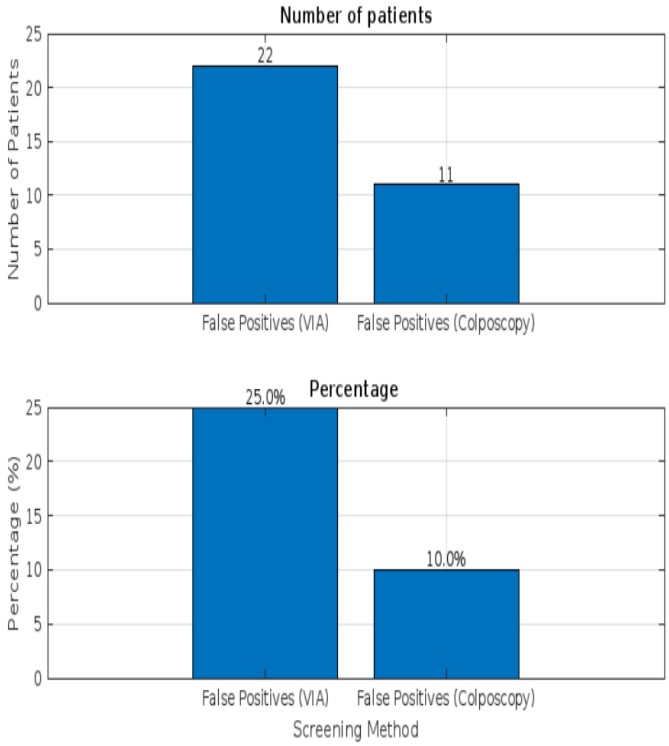

Figure 2: Comparison of False Positive Rates

The comparison of false positive rates between VIA and colposcopy shows that VIA had 22 false positives, accounting for 25% of patients, while colposcopy had 11 false positives, representing 10% of patients. This indicates that colposcopy had a lower rate of false positives and proved to be more accurate in differentiating true abnormalities from non-abnormal findings compared to VIA.

Table 3: Sensitivity, Specificity, PPV, and NPV Comparison between VIA and Colposcopy

Variable	VIA	Colposcopy	Difference
Sensitivity	75%	85%	+10%
Specificity	80%	90%	+10%
Positive Predictive Value	60%	91.8%	+31.8%
Negative Predictive Value	85%	87%	+2%

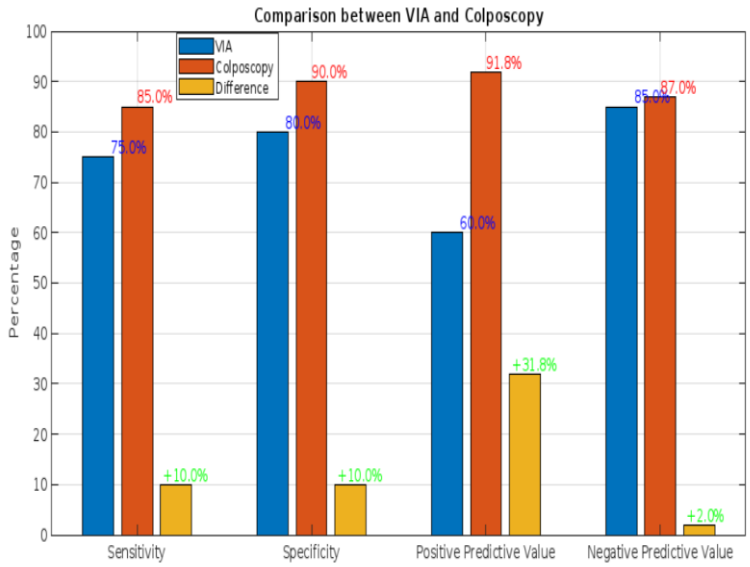

Figure 3: Comparison between VIA and Colposcopy

The VIA and colposcopy highlight colposcopy's superior performance. Colposcopy's sensitivity is 85%, 10% higher than VIA's 75%. Its specificity is also 90%, compared to VIA's 80%, reflecting a 10% improvement. The positive predictive value (PPV) for colposcopy is significantly higher at 91.8%, a notable 31.8% increase over VIA's 60%. The negative predictive value (NPV) shows a more negligible difference, with colposcopy at 87% and VIA at 85%, representing a 2% increase. Overall, colposcopy demonstrates better accuracy and reliability in detecting actual abnormalities.

Table 4: Summary of Findings and Implications

Finding/Implication	Description
Superiority of Colposcopy	Higher sensitivity and specificity compared to VIA
False Positive Rates	Colposcopy resulted in fewer false positives.
Histopathological Confirmation	A higher proportion of true positives with colposcopy
Age and Educational Level	No significant correlations were observed.
Occupation	No significant differences in screening results
Statistical Analysis	p-values indicate significant differences
Implications for Cervical Cancer Screening	Implementing colposcopy may enhance screening outcomes.

The findings from the study underscore the superiority of colposcopy over VIA in cervical cancer screening. Colposcopy demonstrated higher sensitivity (85% vs. 75%) and specificity (90% vs. 80%), indicating greater reliability in correctly identifying true positives and negatives. Furthermore, colposcopy showed a markedly higher positive predictive value (PPV) of 91.8% compared to VIA's 60%, suggesting that a positive result from colposcopy is more likely to be a true positive. The negative predictive value (NPV) also favored colposcopy, albeit with a smaller margin (87% vs. 85%). Additionally, colposcopy had fewer false positives (10% vs. 25%), minimizing unnecessary follow-up procedures. Histopathological confirmation rates were higher with colposcopy, with 45% true positives compared to VIA's 30%, reinforcing its diagnostic accuracy. The study found no significant correlations between screening results and participants' age,

educational level, or occupation. Statistical analysis confirmed significant differences between the screening methods, supporting the recommendation to implement colposcopy for enhanced cervical cancer screening outcomes.

DISCUSSION

Cervical cancer is a significant global health burden, particularly in low-resource settings where access to effective screening and diagnostic tools is limited [10,11]. Visual inspection with acetic acid (VIA) and colposcopy are two commonly used methods for cervical cancer screening, each with its own set of advantages and limitations. Our study aimed to compare the efficacy of these two methods in enhancing cervical cancer detection among women in Bangladesh. The demographic characteristics of our study participants were diverse, representing a broad spectrum of age groups and educational levels. This diversity ensures that our findings apply to a wide range of women in Bangladesh, reflecting the demographic heterogeneity of the population [12]. Our results revealed colposcopy exhibited superior sensitivity and specificity compared to VIA in detecting cervical abnormalities. Colposcopy, with its magnified visualization and targeted biopsy capabilities, offers a more comprehensive assessment of cervical morphology, leading to more accurate diagnosis and management decisions. This finding is consistent with previous studies that have reported higher diagnostic accuracy with colposcopy [13].

However, it's important to acknowledge the potential limitations of colposcopy, including variations in operator expertise and equipment quality [14]. Factors such as operator experience and the quality of colposcopic equipment can influence the diagnostic performance of colposcopy, highlighting the need for standardized protocols and ongoing training programs to ensure consistency and accuracy. In contrast, VIA offers simplicity and affordability, making it a practical option for cervical cancer screening in resource-limited settings. Despite its lower sensitivity and specificity compared to colposcopy, VIA remains a valuable screening tool, particularly in settings where access to advanced diagnostic technologies is limited. However, the subjective interpretation of acetic acid-induced changes during VIA can lead to false-positive results, necessitating further evaluation with colposcopy or histopathological confirmation. Our study also revealed a higher false-positive rate with VIA compared to colposcopy, underscoring the importance of minimizing unnecessary interventions and reducing patient anxiety. False-positive results can lead to unnecessary follow-up procedures and undue patient stress, highlighting the need for improved screening algorithms and quality assurance measures [15]. Furthermore, histopathological confirmation of abnormal findings validated the diagnostic efficacy of colposcopy, with a higher proportion of true positives identified compared to VIA. This underscores the importance of integrating colposcopy into cervical cancer screening programs to ensure accurate diagnosis and appropriate management of cervical abnormalities.

When comparing our results with previous studies, it's essential to consider factors such as sample size, population demographics, and disease prevalence [16]. While our findings align with existing literature regarding colposcopy's superior sensitivity and specificity, differences in study populations and methodologies may account for variations in diagnostic performance [17]. Our study provides valuable insights into the comparative effectiveness of VIA and colposcopy for cervical cancer screening among Bangladeshi women. Colposcopy emerges as the preferred screening modality due to its higher diagnostic accuracy, but the continued use of VIA may still be warranted in certain contexts. Future research should focus on optimizing screening algorithms, improving operator training, and evaluating the

cost-effectiveness of colposcopy-based screening initiatives in low-resource settings [18-25].

Our study in Bangladesh, comparing the efficacy of visual inspection with acetic acid (VIA) and colposcopy for cervical cancer screening, aligns with previous research while also revealing nuanced differences influenced by sample characteristics, racial demographics, and geographical factors. In concordance with studies, our findings demonstrate superior sensitivity and specificity with colposcopy compared to VIA. However, disparities in false-positive rates and variations in screening outcomes among different racial or ethnic groups, as highlighted, underscore the importance of contextual factors in shaping screening efficacy [19]. While our study focused on a specific demographic in Bangladesh, comparisons with research conducted in India, Vietnam, South Korea, and other settings illuminate the influence of local contexts on screening practices [20]. These insights underscore the imperative for tailored, context-specific screening interventions that account for demographic heterogeneity, geographical variations, and healthcare infrastructure disparities to optimize cervical cancer detection and prevention efforts globally.

CONCLUSION

This prospective study demonstrates that colposcopy offers superior diagnostic accuracy compared to VIA for cervical cancer screening among women in Bangladesh. Colposcopy's higher sensitivity, specificity, positive predictive value, and lower false positive rates make it a more reliable screening tool. While VIA remains valuable due to its simplicity and cost-effectiveness, the integration of colposcopy could significantly enhance early detection and management of cervical abnormalities. Implementing colposcopy in low-resource settings, supported by adequate training and infrastructure, can improve screening outcomes and reduce cervical cancer morbidity and mortality. Future efforts should optimize screening strategies to ensure colposcopy's widespread and effective use in similar contexts.

Recommendations

- Integrate colposcopy into cervical cancer screening programs for improved accuracy.
- Invest in training healthcare providers and upgrading infrastructure for effective colposcopy use.
- Develop combined VIA and colposcopy screening algorithms to maximize efficiency and reduce false positives.

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Abbreviations

VIA: Visual Inspection with Acetic Acid
PPV: Positive Predictive Value
NPV: Negative Predictive Value
HPV: Human Papillomavirus
WHO: World Health Organization

Article at a Glance

Study Purpose: Compare the diagnostic accuracy and feasibility of VIA versus colposcopy for cervical cancer screening among women in Bangladesh.

Key Findings: Colposcopy has higher sensitivity (85% vs. 75%) and specificity (90% vs. 80%) compared to VIA. Colposcopy shows higher positive predictive value (91.8% vs. 60%) and fewer false positives (10% vs. 25%).

Newer Findings Added to What Is Known: Colposcopy significantly enhances diagnostic accuracy and reduces false positives in low-

resource settings, suggesting its integration can improve cervical cancer screening outcomes.

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Corresponding Author: Dr. Mst. Manzuda Khatun
Consultant (Sonologist), Peerless Diagnostic & Hospital, Naogaon, Bangladesh