Assessing preoperative biopsy accuracy in endometrial carcinoma: A preliminary low- and middle-income country-based report

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Abstract. Preoperative histopathology is key for guiding the extent of surgical management in endometrial carcinoma (EC). However, the concordance between preoperative endometrial curettage and final histopathology is unclear in low- and middle-income countries. The present pilot study aimed to evaluate the accuracy of preoperative curettage in a Bangladeshi referral center and compare the results with data from middle- and high-income settings. The present cross-sectional study was performed at a single tertiary center (Department of Gynecological Oncology, National Institute of Cancer Research and Hospital; Dhaka, Bangladesh) to assess agreement between preoperative endometrial curettage and final surgical histopathology for histological subtype and International Federation of Gynecology and Obstetrics (FIGO) grade. Diagnostic performance metrics (sensitivity, specificity, positive and negative predictive values) and Cohen's κ were calculated. A total of 48 patients with EC were included. The mean age was 53.77±13.03 years. For endometrioid vs. non-endometrioid classification, sensitivity was 93.9 (31/33; 95% CI 79.8-99.3) and specificity 20.0% (3/15; 95% CI 4.3-48.1). Accuracy for tumor grading was 77.1% for FIGO grade 1 (95% CI 62.7-88.0), 79.2% for grade 2 (95% CI 65.0-89.5) and 93.8% for grade 3 (95% CI 82.8-98.7), yielding an overall κ-value of 0.45 (95% CI 0.21-0.70); 66.7% of presumed grade 1 tumors were ultimately upgraded, underscoring the risk of undertreatment if relying exclusively on preoperative biopsy. Preoperative curettage demonstrated moderate accuracy in predicting final pathology. Given the very small non-endometrioid numbers and only moderate overall agreement, preoperative curettage findings should be interpreted alongside clinical judgment; adjunct modalities (imaging, immunohistochemical markers) may be helpful where available but were not evaluated in the present study. These preliminary single-center estimates from a low-middle income country should be interpreted with caution given the small sample and limited generalizability; larger multicenter studies are warranted.

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Introduction

Endometrial carcinoma (EC) ranks as the sixth most commonly occurring cancer in female patients, with 417,367 new cases globally in 2020 (1). Most EC cases are diagnosed at an early stage, offering a favorable prognosis; however, ~20% of patients present with high-grade EC, characterized by extended disease and poor outcomes (2). Surgical staging, recommended by the International Federation of Gynecology and Obstetrics (FIGO), is typically the primary treatment approach for EC (3). This process involves abdominal exploration, pelvic washings, hysterectomy, bilateral salpingo-oophorectomy, omentectomy and systematic pelvic and para-aortic lymphadenectomy.

The role of lymphadenectomy in the surgical management of EC remains a topic of debate, particularly as many patients are diagnosed at an early stage (4). Routine lymphadenectomy in all patients may lead to unnecessary procedures, resulting in prolonged operative time, extended hospital stay and risks such as vascular injuries, hematomas, lymphocyst formation and ureteric and nerve injury (5). However, although the therapeutic benefits of lymphadenectomy are contested, it is key for complete staging. Nodal stage of EC is a critical prognostic factor and aids in tailoring adjuvant therapy (6).

Predicting lymph node invasion preoperatively and intraoperatively could help avoid unnecessary lymphadenectomy (7). In fact, Mariani *et al* (7) proposed a selective lymph node dissection criterion, suggesting lymphadenectomy

can be omitted in patients with preoperative endometrioid histology, grade 1 or 2 lesions, myometrial invasion ≤50% and a primary tumor diameter ≤2 cm. Conversely, patients with stage I and occult stage II disease not meeting these criteria require comprehensive surgical staging, including lymphadenectomy (7). Therefore, tumor subtype and grade are key for risk stratification before surgery. However, discordances in grading and histological subtype between preoperative and final diagnoses may result in either undertreatment, by underestimating the risk of lymph node metastasis, or overtreatment, with unnecessary surgical procedures and associated complications. Studies comparing endometrial biopsy samples with surgical specimens have reported varying agreement rates for FIGO grade and tumor subtype, generally ranging from 60 to 80% (8-11). However, most of these studies are from Western countries, with a lack of data from developing countries. Therefore, the present study was designed to assess the concordance between preoperative and postoperative pathology in a Bangladeshi referral center to determine if preoperative endometrial curettage can reliably guide the extent of surgery in EC in this patient population.

Materials and methods

Study design and participant selection. The present single-center, cross-sectional diagnostic-accuracy study was performed in a tertiary-care hospital in a low-middle income country. All consecutive, eligible patients who underwent hysterectomy for EC during the study period were included. The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of the National Institute of Cancer Research and Hospital (NICRH; Dhaka, Bangladesh, approval no. NICRH/Ethics/2020/96). This cross-sectional study assessed the agreement between histopathological findings of preoperative endometrial curettage and the final surgical specimen in EC. From July 2020 to June 2021, 48 outpatients (age: 29.5-79.2 years) with EC attending the Department of Gynecological Oncology (NICRH) were included. Written informed consent was obtained from all subjects. For illiterate participants, written informed consent was obtained through a thumbprint in the presence of an impartial witness, who confirmed that the information was accurately conveyed and voluntarily agreed to. The witness signed the consent form, in accordance with international ethical guidelines for research involving human subjects. Eligible participants were diagnosed by endometrial curettage (dilatation and curettage) and underwent primary surgical treatment. The index test consisted of the histological subtype and FIGO grade as determined from the preoperative endometrial curettage, which had been performed either at NICRH or at an external facility. The reference standard was the final surgical histopathology following hysterectomy. Inclusion criteria were as follows: i) Preoperative endometrial curettage consistent with EC and ii) subsequent hysterectomy with available final surgical histopathology. Exclusion criteria were as follows: Neoadjuvant therapy prior to surgery, non-EC histology on final pathology or missing/indeterminate histological grade.

Study procedure. Patients with a preoperative diagnosis of EC by endometrial curettage were enrolled. Preoperative endometrial sampling (curettage) had been performed either at NICRH or at external hospitals/clinics prior to referral. For patients sampled outside NICRH, the original pathology report was obtained from the referral records; centralized rereview of external slides/blocks was not feasible because materials were not consistently available. Final surgical histopathology following hysterectomy was performed at NICRH. All consecutive eligible cases were included irrespective of sampling location to reflect real-world practice. Preoperative and postoperative histopathology reports and sociodemographic data were collected from patients who underwent primary surgery outside NICRH. Patients without prior treatment underwent surgery, including laparotomy, peritoneal washing and total abdominal hysterectomy with bilateral salpingo-oophorectomy. Pelvic and para-aortic lymphadenectomy was performed according to the risk stratification protocol (7). The specimens were sent to NICRH Department of Pathology for examination. Data were collected in detail and analyzed to assess the agreement between preoperative and postoperative histopathological findings.

Histopathology. Curettage and hysterectomy specimens were fixed in 10% neutral buffered formalin for ≥24 h at room temperature. Paraffin embedding was performed, and blocks were sectioned at 4-5 μm. After deparaffinization and rehydration through graded alcohols, sections were stained with Harris hematoxylin and eosin following a standard protocol (3-5 min in hematoxylin and 1-2 min in eosin) at room temperature, dehydrated and mounted with DPX. Slides were examined by light microscopy. EC was classified as endometrioid vs. non-endometrioid (including serous, clear cell, undifferentiated carcinoma and carcinosarcoma). Tumor grade followed standard FIGO architectural criteria (12): Grade 1 (≤5% solid non-squamous, non-morular areas), grade 2 (6-50%) and grade 3 (>50%). Routine digital slide imaging or image analysis was not performed.

Statistical analysis. Categorical data are presented as numbers and percentages, while continuous data are presented as mean, standard deviation and ranges. For binary classification of histological subtype (endometrioid vs. non-endometrioid), diagnostic performance was derived from the 2x2 contingency table. Sensitivity was calculated as true positive (TP)/[TP + false negative (FN)]; specificity as true negatives (TN)/[TN + false positives (FP)]; positive predictive value as TP/(TP + FP); negative predictive value as TN/(TN + FN); and diagnostic accuracy as (TP + TN)/n. Two-sided 95% confidence intervals for these proportions were computed by the exact (Clopper-Pearson) binomial method. For FIGO grade, one vs. rest 2x2 tables were generated for each grade (grade 1 vs. all other grades; grade 2 vs. all other grades; grade 3 vs. all other grades) to calculate the same metrics and confidence intervals. Agreement between preoperative curettage and final histopathology for subtype and grade was assessed using Cohen's κ with 95% confidence intervals. Data were analyzed using SPSS for Windows (version 25.0; IBM Corp.). $P<0.05$ was considered to indicate a statistically significant difference.

Table I. Demographic variables.

Characteristic	Value
Mean age, years	53.8±13.0
Level of education, %	
Illiterate	13 (27.1)
Primary	23 (47.9)
Secondary	5 (10.4)
Higher and above	7 (14.6)
Menopausal status	
Pre-menopausal	13 (27.1)
Post-menopausal	35 (72.9)
Marital status	
Single	1 (2.1)
Married	35 (72.9)
Divorced	1 (2.1)
Widowed	11 (22.9)

Results

A total of 48 patients with EC were included. Table I presents the socio-demographic characteristics of the study participants. The mean age was 53.8±13.0 years. The majority of patients had attained primary education (23; 47.9%), and a notable proportion (13, 27.1%) were illiterate. A total of 35 patients (73%) were postmenopausal at presentation, and the remaining 13 subjects (27%) were premenopausal. Most participants (35, 72.9%) were married, 11 (22.9%) were widowed, one (2.1%) was divorced and one (2.1%) was never married.

The histological subtype diagnostic characteristics from the preoperative biopsy are detailed in Table II. Of the 43 patients preoperatively diagnosed with endometrioid adenocarcinoma, 31 (72.1%) were confirmed. For endometrioid vs. non-endometrioid classification, sensitivity was 93.9% (31/33; 95% CI: 79.8-99.3) and specificity (Sp) was 20.0% (3/15; 95% CI: 4.3-48.1%). Of five non-endometrioid lesions identified in preoperative curettage, two (40.0%) were reclassified as endometrioid in the final pathology. Of five non-endometrioid lesions identified in preoperative curettage, two (40.0%) were reclassified as endometrioid in the final pathology. Therefore, subtype agreement was slight (κ=0.17), consistent with sparse non-endometrioid counts (Table III).

Table IV outlines the diagnostic properties of preoperative endometrial curettage for FIGO tumor grading. The biopsy showed 57.1% Sn, 80.5% Sp, 33.3% positive predictive value (PPV), 91.7% negative predictive value (NPV) and 77.1% diagnostic accuracy (DA) for diagnosing FIGO grade 1. As shown in Table IV, diagnostic performance varied by FIGO grade. Accuracy was highest for grade 3 (93.8%), followed by grade 2 (79.2%) and grade 1 (77.1%; Table IV). Sensitivity was lowest for grade 1 and highest for grade 2, whereas specificity exceeded 95% for grade 3.

The overall agreement between preoperative and postoperative tumor grading was moderate, as indicated by κ statistic of 0.45 (Table V). Given the limited sample, the present study did not perform stratified accuracy analyses by sampling location (NICRH vs. external).

Discussion

The present study examined the reliability of preoperative endometrial curettage for predicting final histopathology in a low-resource setting. Compared with cohorts (8-11) from higher-income countries, where patients tend to be older and have higher levels of educational attainment, our population reflects a younger and more socio-economically disadvantaged group. Such contextual differences may influence patterns of presentation, access to imaging, and the feasibility of comprehensive staging. Previous studies from well-resourced settings have reported variable but generally moderate agreement between preoperative and final histopathology, particularly for high-grade or non-endometrioid tumors (8-11). Our findings align with this in showing better concordance for endometrioid cancers and more limited accuracy for non-endometrioid subtypes and low-grade lesions. These observations highlight the challenges of relying solely on curettage-based assessment in environments where advanced diagnostic techniques or centralized pathology review may not be available. Moreover, the slight concordance in subtype (κ=0.17) mirrors findings from high-income settings 8-11), where non-endometrioid tumors likewise demonstrate low biopsy-to-hysterectomy agreement, reflecting the heterogeneity and sampling limitations inherent to these histologies.

The present findings align with multiple investigations in higher-income contexts (8-11), which consistently document imperfect agreement between preoperative biopsy and final surgical pathology (Table VI). For example, Batista *et al* (13) found a fair overall concordance for grading (κ=0.22) and noted that 15% of initially designated grade 1 tumors were upgraded. Similarly, in a large Turkish cohort, Göksedef *et al* (14) observed that nearly one-third of tumors diagnosed as grade 1 were upgraded postoperatively, illustrating how baseline curettage can underestimate tumor aggressiveness.

In the present study, subtype concordance between preoperative curettage and final histopathology was slight (κ=0.17), reflecting sparse non-endometrioid counts (five preoperative; three confirmed). For endometrioid vs. non-endometrioid classification, Sn was 93.9% (31/33) and Sp 20.0% (3/15), with a PPV of 72.1% and NPV of 60.0%. Grading concordance was higher than subtype concordance, although still limited, particularly for low-grade tumors (κ=0.45): Grade-specific diagnostic accuracy was 77.1 for grade 1, 79.2 for grade 2 and 93.8% for grade 3. These data suggest that relying solely on preoperative curettage to determine the extent of surgery risks under-treatment for certain patients and over-treatment for others, particularly because access to intraoperative frozen section and advanced imaging markedly improve the accuracy of preoperative assessment of tumor grade and myometrial invasion, as demonstrated in prior studies (15-25). Beyond curettage, more targeted sampling is performed. Su *et al* (26), for example, compared dilation and curettage (D&C) with transcervical resectoscopy (TCR) and reported an upgrade rate of 2.6% in the TCR group, compared with 12.6% with D&C, suggesting that direct visualization boosts diagnostic accuracy.

Table II. Diagnostic characteristics of preoperative endometrial curettage for diagnosing histological subtypes.

Preoperative histological subtype	Postoperative histological type		Diagnostic characteristic				
	Endometrioid	Non- Endometrioid	Sn	Sp	PPV	NPV	DA
Endometrioid	31	12	93.9 (95%CI: 79.8-99.3)	20.0 (95%CI: 4.3-48.1)	72.1 (95%CI: 56.3-84.7)	60.0 (95%CI: 14.7-94.7)	70.8 (95%CI: 55.9-83.0)
Non- Endometrioid	2	3					

Sn, sensitivity; Sp, specificity; PPV, positive predictive value; NPV, negative predictive value; DA, diagnostic accuracy,

Table III. Agreement between the histological subtype of preoperative endometrial curettage report and final histopathology report.

Tumor cell type on preoperative biopsy report	Tumor cell type on final histopathological report		κ coefficient	P-value
	Endometrioid (%)	Non- endometrioid (%)		
Endometrioid	31 (93.9)	12 (80.0)	0.170 (95% CI: 0.09-0.43)	0.143
Non-endometrioid	2 (6.1)	3 (20.0)		

Table IV. Diagnostic characteristics of preoperative endometrial curettage for diagnosing tumor grade.

Preoperative grade	Postoperative grade v		Diagnostic characteristics				
	1	Other	Sn	Sp	PPV	NPV	DA
1	4	8	57.1 (95%CI: 18.4-90.1)	80.5 (95%CI: 65.1-91.2)	33.3 (95%CI: 9.9-65.1)	91.7 (95%CI: 77.5-98.2)	77.1 (95%CI: 62.7-88.0)
Other grades	3	33					
	2	Other					
Grade 2	29	3	80.6 (95%CI: 64.0-91.8)	75.0 (95%CI: 42.8-94.5)	90.6 (95%CI: 75.0-98.0)	56.3 (95%CI: 29.9-80.2)	79.2 (95%CI: 65.0-89.5)
Other grades	7	9					
	3	Other					
3	3	1	60.0 (95%CI: 14.7-94.7)	97.7 (95%CI: 87.7-99.9)	75.0 (95%CI: 19.4-99.4)	95.5 (95%CI: 84.5-99.4)	93.8 (95%CI: 82.8-98.7)
Other	2	42					

Sn, sensitivity; Sp, specificity; PPV, positive predictive value; NPV, negative predictive value; DA, diagnostic accuracy.

Table V. Agreement between grading of preoperative endometrial curettage report and final histopathology report.

Grading on preoperative biopsy report	Grading on final histopathological report			κ coefficient	P-value
	Grade I (%)	Grade II (%)	Grade III (%)		
Grade I	4 (57.1)	7 (19.4)	1 (20.0)	0.450 (95% CI: 0.21-0.70)	<0.001
Grade II	2 (28.6)	29 (80.6)	1 (20.0)		
Grade III	1 (14.3)	0 (0.0)	3 (60.0)		

Table VI. Comparison of preoperative biopsy vs. final pathology in EC.

Study (Year)	Country (Income)	No. of Patients	Biopsy Method(s)	Subtype Concordance	Grade Concordance	Upgrade / Downgrade	Key Observations	(Refs.)
Batista *et al*, (2016)	Brazil (UMI)	79	Mix (~40% hysteroscopy, ~38% D&C, ~12% other)	Some mismatch (e.g., adenosquamous reclassified)	Overall: 60.8% (κ=0.22, 'fair') G1: 67%, G2: 44%, G3: 40% Accuracy for final G1: ~67%	15.2% of preop G1 → G2/G3	Authors consider preop biopsy only a 'modest' predictor of final grade, stressing need to include other pre/intraoperative parameters (imaging, tumor markers).	(13)
Goksedef *et al*, (2012)	Turkey (UMI)	335 (endometrioid only)	D&C	Not specifically detailed	Accuracy: G1= 75.5%, G2= 66.2%, G3=88.3	G1→G2: 32.9%, G1→G3: 3.6%, G2→G3: 11.4%	Nearly 1/3 of initially G1 tumors were upgraded, emphasizing underestimation of high-grade disease with preop sampling.	(14)
Su *et al*, (2015)	Taiwan (HI)	203	D&C vs. TCR (transcervical resectoscopy)	Not reported	Not reported	TCR upgraded: 2.6% D&C upgraded: 12.6%	Direct visualization (TCR) greatly reduced underestimation compared to D&C, suggesting more accurate surgical planning.	(26)
Lago *et al*, (2018)	Spain (HI)	332	D&C (13%), Pipelle (31%), Hysteroscopy (56%)	Not the main focus	Accuracy: G1= 74.7%, G2= 73.2%, G3=89.8%	14.2% upgraded, 11.7% downgraded; Hysteroscopy best (κ=0.55)	Large tumors (>3 cm) correlate with higher mismatch. Conclude hysteroscopy yields better sampling vs. 'blind' methods (D&C or Pipelle).	(27)
Garcia *et al*, (2017)	Brazil (UMI)	166	Mixed (D&C, office[a], hysteroscopy)	Endometrioid: 93.2%, Non-endometrioid: 68.9% (κ=0.73)	G1: 61.5%, G2: 56.0%, G3: 78.9% (overall κ=0.46)	1.9% G1→G3, 16% G2→G3	'Suboptimal' accuracy: authors warn against fully trusting biopsy for surgical decision-making.	(28)
Kisielewski *et al*, (2016)	Poland (HI)	204 total (160 EC, 44 atypical hyperplasia)	Fractional curettage (D&C)	~83.75% (overall), ~85.8% (endometrioid specifically)	~69.31%	34% of 'hyperplasia' were invasive	Emphasizes a significant fraction of 'atypical hyperplasia' harbor true carcinoma, underlining importance of definitive surgical pathology.	(29)
Liberis *et al*, (2021)	Greece (HI)	203	D&C	94.1% (κ=0.73)	89.1% (κ=0.76)	~10.9% grade mismatch, ~5.9% subtype mismatch	Despite 'substantial' agreement, caution remains for under-or overtreatment due to remaining discordance.	(30)

Table VI. Continued.

Study (Year]	Country (Income)	No. of Patients	Biopsy Method(s)	Subtype Concordance	Grade Concordance	Upgrade/ Downgrade	Key Observations	(Refs.)
Present Study	Bangladesh (LMI)	48	D&C	Endometrioid: 93.9%, Non-endometrioid: 20% (κ=0.17)	G1: 77.1%, G2: 79.2%, G3: 93.8% (overall κ=0.45)	~41.7% of G1 upgraded	Subtype accuracy especially low for non-endometrioid. Additional diagnostic strategies recommended given limited resources in LMIC setting.	

D&C, dilation and curettage; TCR, transcervical resectoscopy; EC, endometrial cancer; LMI, lower-middle income; UMI, upper-middle income; HI, high income. [a]Outpatient, office-based endometrial sampling procedures.

Lago *et al* (27) similarly demonstrated that hysteroscopic biopsy yielded the highest κ-value (0.55), whereas D&C showed the lowest (0.39) and noted 14.2% of tumors were upgraded and 11.7% downgraded at final pathology.

Garcia *et al* (28) found 16% of grade 2 tumors being upgraded to grade 3 and 1.9% of grade 1 lesions upgraded to grade 3, highlighting how higher grade disease can initially be misclassified. Kisielewski *et al* (29) demonstrated 34% of patients preoperatively labeled with atypical hyperplasia turned out to have invasive carcinoma upon final assessment. Liberis *et al* (30) reported that concordance for subtype and grade both exceeded 80% but observed ~10% discordance, underscoring the persistent risk of under- or overtreatment.

Taken together, the aforementioned studies suggest preoperative sampling methods frequently underestimate tumor grade and aggressiveness, particularly in lesions that appear well-differentiated and direct visualization approaches (hysteroscopy or TCR) generally outperform blind sampling. These patterns point to the potential value of a multimodal approach (imaging, pathology expertise, selected immunohistochemical markers) where resources permit; however, these modalities were not assessed in the present study, and no inferences about their diagnostic performance can be drawn. The limitations in preoperative biopsy are universal, although the gap in specialized resources may be especially impactful in under-resourced settings.

The present study focused on an LMIC referral center, filling a gap in the literature where data are lacking, and provided a direct comparison of preoperative and final histopathology in a patient cohort that mirrors real-world clinical circumstances in under-resourced settings. However, the present study has limitations: The small, single-center sample limits precision and generalizability, blinding of pathologists to preoperative results was not feasible in this real-world setting and some subgroup estimates are underpowered. These constraints, which are common in LMIC tertiary-care settings, underscore the need for larger multicenter validations and standardized preoperative sampling protocols. Second, preoperative biopsies were obtained both at NICRH and external facilities; because centralized rereview of external slides was not systematically feasible, variability in sampling technique and interpretive expertise may have introduced misclassification. While this reflects real-world care pathways in resource-constrained systems, it limits internal validity; future multicenter work with standardized sampling and central pathology review is needed. Moreover, estimates for non-endometrioid disease are based on small numbers (five preoperative; three confirmed), yielding wide confidence intervals and an unstable κ for subtype (0.17), and should not be over-interpreted. Furthermore, because the sample size was limited, the present study did not have sufficient power for subgroup analyses. Lastly, the present study did not assess whether more advanced sampling methods (hysteroscopic or pipelle) would have improved accuracy.

From a clinical standpoint, the present findings suggest the importance of confirming risk stratification beyond preoperative curettage, where feasible, while acknowledging the preliminary, single-center nature of these estimates. Relying exclusively on curettage in suspected low-grade cases risks undertreatment if the tumor is

actually higher grade or non-endometrioid. Conversely, overtreatment may occur if the preoperative biopsy suggests a more aggressive lesion than is confirmed on final histopathology. This is particularly crucial in resource-limited settings, where patient comorbidities may make extensive surgical staging risky and cost-effective decision-making is paramount. Where available, adjunct approaches such as immunohistochemical biomarkers and imaging may refine preoperative risk stratification; however, these modalities were not evaluated in the present study.

Larger multicenter studies are warranted to validate the present results and explore how emerging technologies, such as office-based hysteroscopic biopsy or low-cost molecular markers, may improve diagnostic accuracy. Additionally, research examining how these findings translate into treatment outcomes, including rates of overtreatment or undertreatment, is key. In LMICs, collaborative efforts to standardize pathology review, train specialized gynecological pathologists and optimize imaging resources could help mitigate the diagnostic pitfalls.

In the present preliminary single-center study from a LMIC, preoperative endometrial curettage showed moderate agreement with final histopathology for subtype and grade. These results should be interpreted cautiously given the small sample and single-center design and should inform, rather than determine, preoperative risk stratification and surgical planning. Larger multicenter studies using standardized sampling and pathology protocols are needed to refine estimates and identify context-appropriate pathways.

Despite being conducted in a resource-limited setting, the present findings are in line with those from high-income countries (8-11), indicating similar challenges in the preoperative assessment of EC across healthcare settings.

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Availability of data and materials

The data generated in the present study may be requested from the corresponding author.

Authors' contributions

RK conceived and designed the study, performed the literature review and analyzed data. SP, TN, EG, RA, AAZ and AGM analyzed and interpreted data and revised the manuscript. RA and MKB performed the literature review. All authors have read and approved the final manuscript. RK and SP confirm the authenticity of all the raw data.

Ethics approval and consent to participate

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of the National Institute of Cancer Research and Hospital (Dhaka, Bangladesh, approval no. NICRH/Ethics/2020/96). Written informed consent was obtained from all subjects.

Patient consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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