Comparative Analysis of Serum β-hCG Levels in Complete and Partial Hydatidiform Moles

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Abstract

Introduction: Hydatidiform mole (HM) is a gestational trophoblastic disorder caused by abnormal fertilization, resulting in a non-viable pregnancy with trophoblastic hyperplasia. Differentiation between complete hydatidiform mole (CHM) and partial hydatidiform mole (PHM) is clinically important because CHM carries a higher risk of persistent trophoblastic disease. Serum β-hCG is often markedly elevated in molar pregnancy and may assist in distinguishing CHM from PHM. This study aimed to evaluate pretreatment β-hCG levels among different types of hydatidiform mole and assess their diagnostic association.

Methods: This cross-sectional study included 57 histopathologically diagnosed cases of HM collected from the BMU and private laboratories in Dhaka. Pretreatment serum β-hCG levels were obtained for all patients. Based on histopathological criteria, cases were grouped into CHM, PHM, and indeterminate categories. Statistical analysis using Mann-Whitney and Kruskal-Wallis tests was performed to compare β-hCG levels between groups.

Results: Of the 57 cases, 36 were CHM, 13 were PHM, and 8 were categorized as indeterminate. Serum β-hCG levels showed statistically significant variation among the three groups, with CHM showing markedly higher levels than PHM. Elevated β-hCG demonstrated a strong association with the histopathological diagnosis of HM.

Conclusion: Pretreatment serum β-hCG level is a valuable adjunct in differentiating complete from partial hydatidiform mole. When used alongside histopathological assessment, β-hCG can enhance diagnostic confidence and guide appropriate clinical management.

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Introduction

Gestational trophoblastic diseases (GTD) comprise a spectrum of pregnancy-related disorders arising from abnormal trophoblastic proliferation. Hydatidiform moles (HMs) classified as complete (CHM) or partial (PHM) are the most common entities within this spectrum and are characterized by hydropic villi and varying degrees of trophoblastic hyperplasia.[1] Accurate subclassification of HM is clinically crucial, as CHM carries a markedly higher risk of developing persistent trophoblastic disease and, in rare cases, choriocarcinoma, whereas PHM carries a considerably lower malignant potential.[2,3]

The incidence of molar pregnancy varies widely across regions, with the highest rates reported in several Asian countries, ranging from 3 to 10 per 1000 pregnancies, and lower rates in Europe and North America.[4] South Asian studies published in the past decade continue to report relatively elevated incidence, influenced by nutritional, genetic, and reproductive factors.[5] In Bangladesh, recent institutional reports estimate molar pregnancy rates around 4–6 per 1000 deliveries, reflecting a sustained regional burden.[6]

Serum β–human chorionic gonadotropin (β-hCG), produced by syncytiotrophoblasts, is a fundamental biomarker in the evaluation of early pregnancy and gestational trophoblastic disease. Its β-subunit provides biochemical specificity, distinguishing hCG from other glycoprotein hormones.[7] In molar pregnancy, particularly CHM-marked trophoblastic proliferation leads to excessive secretion of β-hCG. Several recent studies have demonstrated significantly higher β-hCG levels in CHM compared to PHM, making the marker a valuable adjunct for initial diagnostic evaluation when histopathology is equivocal.[8,9] Moreover, pretreatment β-hCG levels have prognostic relevance, correlating with the likelihood of persistent trophoblastic disease and guiding follow-up schedules after uterine evacuation.[10]

Given the overlapping histological features between CHM and PHM and the frequent diagnostic challenges encountered by pathologists, measurement of serum β-hCG offers an objective and readily accessible tool to support diagnostic accuracy. This study evaluates pretreatment β-hCG levels across complete, partial, and indeterminate hydatidiform moles and assesses their association with histopathological classification.

Methods

This cross-sectional observational study was carried out in the Department of Pathology, Bangladesh Medical University (BMU), Dhaka, Bangladesh, supplemented by cases obtained from private laboratories across the city. The study population comprised reproductive-age women who had documented pretreatment serum β-hCG levels and were histologically diagnosed as complete hydatidiform mole, partial hydatidiform mole, or categorized as indeterminate. A purposive sampling technique was applied to recruit cases between September 2019 and August 2021. Only cases with adequate tissue sections, complete clinical details, and available pretreatment β-hCG reports were included. Cases with insufficient or autolysed tissue were excluded from the study, as well as patients unwilling to participate. β-hCG values were recorded from laboratory reports and analyzed in relation to the histopathological categories.

Sample Size Calculation

Previous studies have reported that pretreatment serum β-hCG levels >100,000 IU/L are observed in approximately 60–75%

of complete hydatidiform mole (CHM) cases, while such markedly elevated levels are uncommon in partial hydatidiform mole (PHM).[1] For sample size estimation, a conservative prevalence of 65% was used. Calculated sample size was 87.36. Minimum required sample size ≈ 88 cases.

However, due to the limited number of eligible cases available during the study period, primarily influenced by reduced case flow during the COVID-19 pandemic, the modified Cochran formula for small populations was applied. Using this correction, the adjusted sample size was calculated as 54.82, which was rounded to a minimum required sample size of 55 cases for the study. Fifty seven cases were included finally for the study.

Samples, as Well as Demographic Data Collection

After getting permission from the Institutional Review Board (IRB) of BMU, known cases of hydatidiform mole received at the Pathology department, BMU, and private laboratories were collected. The β-hCG report of all cases was collected from the laboratory reports of patients' file. During the collection of specimens, patients' information and demographic data were recorded systematically in a prepared proforma. Informed written consent was obtained from the patient's attendant in each case. All the cases were numbered chronologically, and the same number was given to histological slides.

Case Selection and Re-Evaluation of Defined Histopathological Parameters

Cases diagnosed either as complete and partial hydatidiform mole or hydatidiform mole in the Department of Pathology, BMU, and other private laboratories in Dhaka city were selected for the study by inclusion and exclusion criteria. Paraffin blocks were collected. Sectioning of the paraffin blocks and H&E staining were done according to the standard protocol followed at the Department of Pathology, BMU.

Cases were evaluated elaborately, including defined morphological features like trophoblastic hyperplasia, intensity and location, cytologic atypia of trophoblastic cells, pseudoinclusions of trophoblast, cistern formation, scalloping, and fetal vessels in villous stroma. Cases were divided into three groups- complete hydatidiform mole, partial hydatidiform mole, and the indeterminate group according to the working definition described earlier.

Statistical Analysis

The statistical analysis was carried out using the Statistical Package for Social Sciences version 22.0 for Windows (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics (frequencies and percentages) were used to summarize the patients' demographic characteristics and presented in Tables, Figures, and Charts. The frequencies of different entities were expressed as percentages. The Fisher-Exact test was used to analyze the relationship between different categorical variables. Kruskal-Wallis test and Mann-Whitney test both are non-parametric methods. These were done to compare two or more independent datasets. The Mann-Whitney test was done to compare two groups of data, and Kruskal-wallis test was done to compare more than two groups of data. P value <0.05 was considered significant.

Ethical Aspect

Ethical clearance for the study was obtained from the Institutional Review Board and the concerned authority, BMU. Every ethical issue was discussed with the patients regarding the study, and informed written consent was taken from each of them. All data were secured with confidentiality of the study population. There was no disclosure of the

information that may be harmful to the patient. This study was conducted only for the benefit of patient management.

Results

This study involved **57 cases of molar gestation** diagnosed by routine histopathology and grouped into complete, partial, and indeterminate types. Among them, **48 samples** were received from BMU, while the remaining **nine cases** were obtained from private laboratories. Of the 57 cases, **54 fulfilled the predefined inclusion criteria**, and three were additionally incorporated to maintain adequate representation of partial mole cases. For each case, demographic parameters and relevant clinical information were reviewed, and **pretreatment serum β-hCG levels** were recorded. β-hCG values were compared across the three histopathological categories to determine their diagnostic utility and to evaluate whether serum levels differed significantly between complete and partial moles.

In the present study, 7 (12.3%) patients were in the 20 or less than 20 age group. 26 (45.6%) patients were in the 21-30 years age group, which represented the highest proportion. Nineteen (33.3%) patients were in the 31-40 years age group, and the lowest age group was >40 years. Only 5 (8.8%) patients were in this group. The mean age of the total 57 study participants was 29.0 years (SD:7.7). Figure 4 shows the age distribution of study cases.

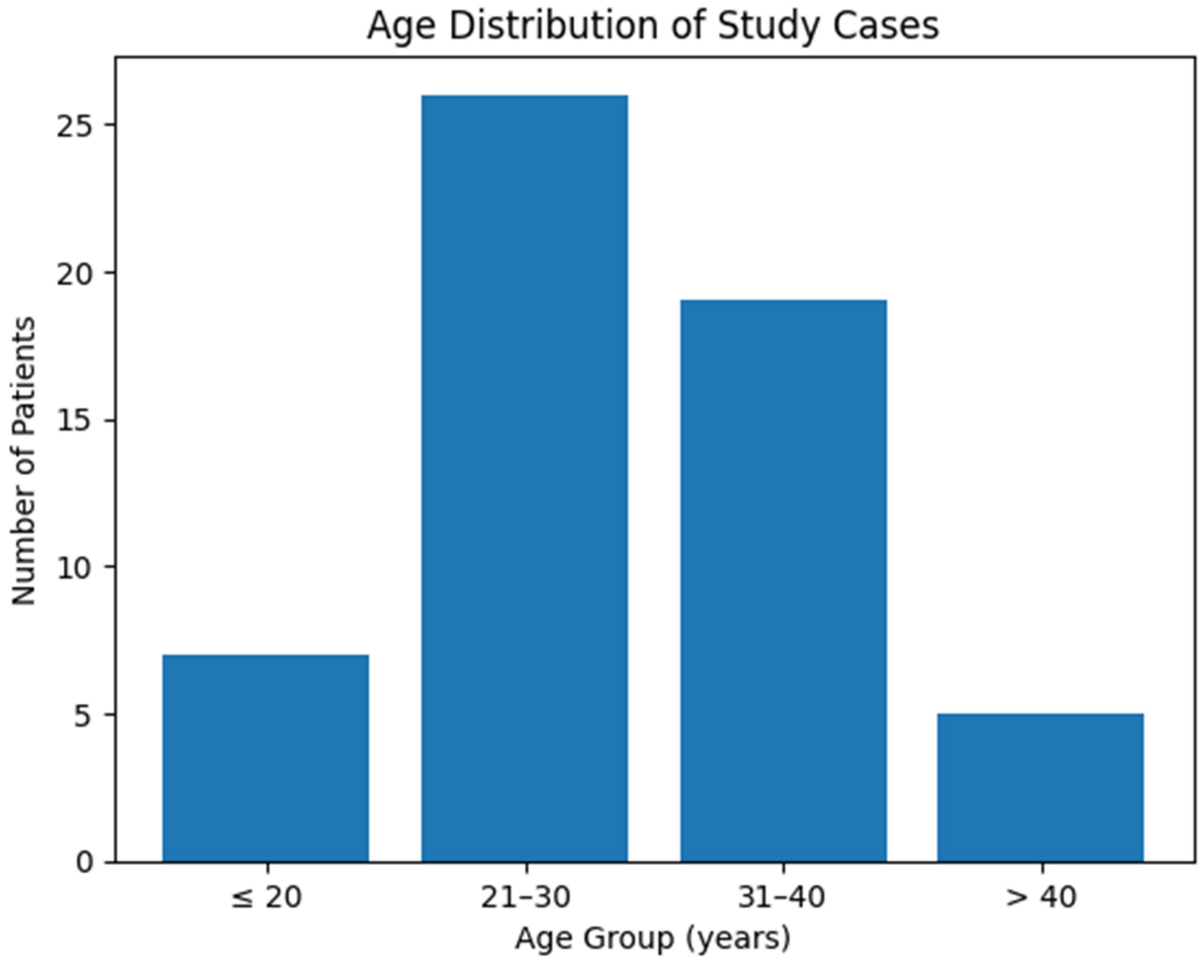

Figure 1. Age distribution of study cases

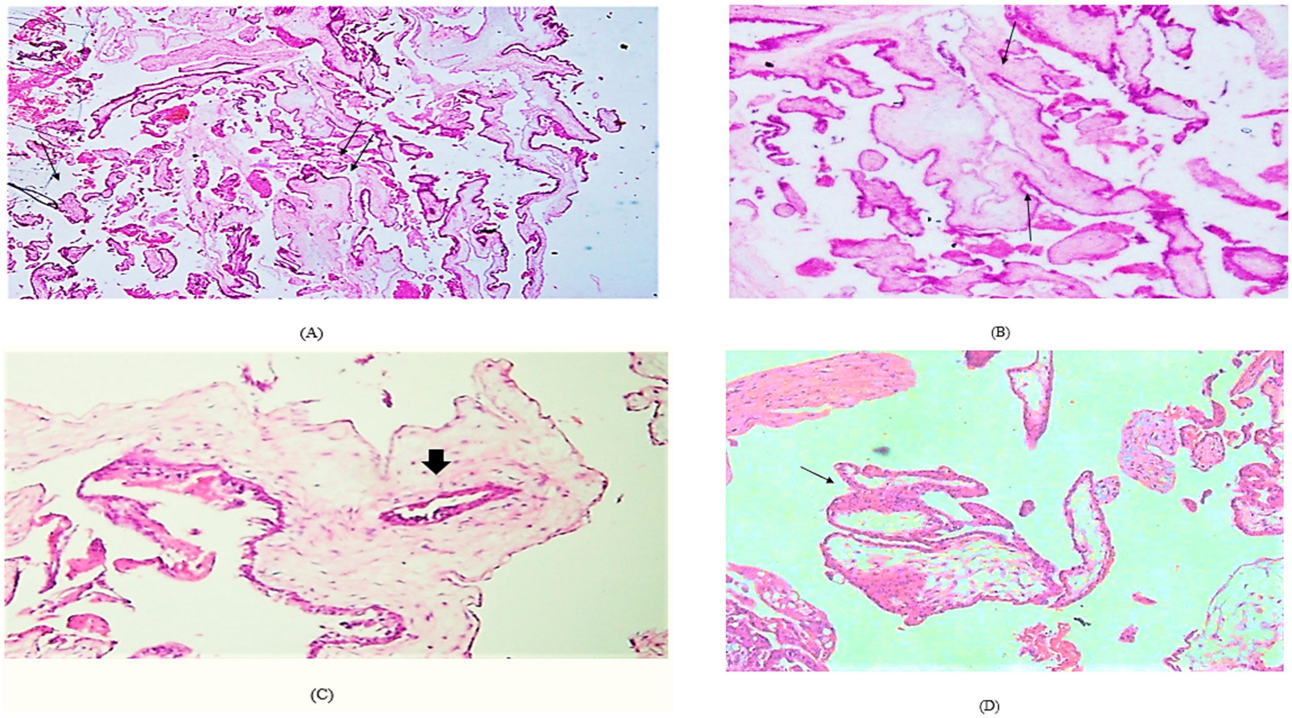

Figure 2. (A) Photomicrograph showing partial hydatidiform mole. Two populations of villi-sclerotic (single arrow) and hydropic (double arrow), both are seen. (Case no. 50, H&E, 100x). (B) Photomicrograph showing scalloping of villi in partial hydatidiform mole (Case no. 50, H&E, 200x). (C) Photomicrograph showing pseudoinclusion of villi in partial hydatidiform mole (Case no. 3, H&E, 200x). (D) Photomicrograph showing mild polar trophoblastic hyperplasia in partial hydatidiform mole (Case no. 7, H&E, 200x).

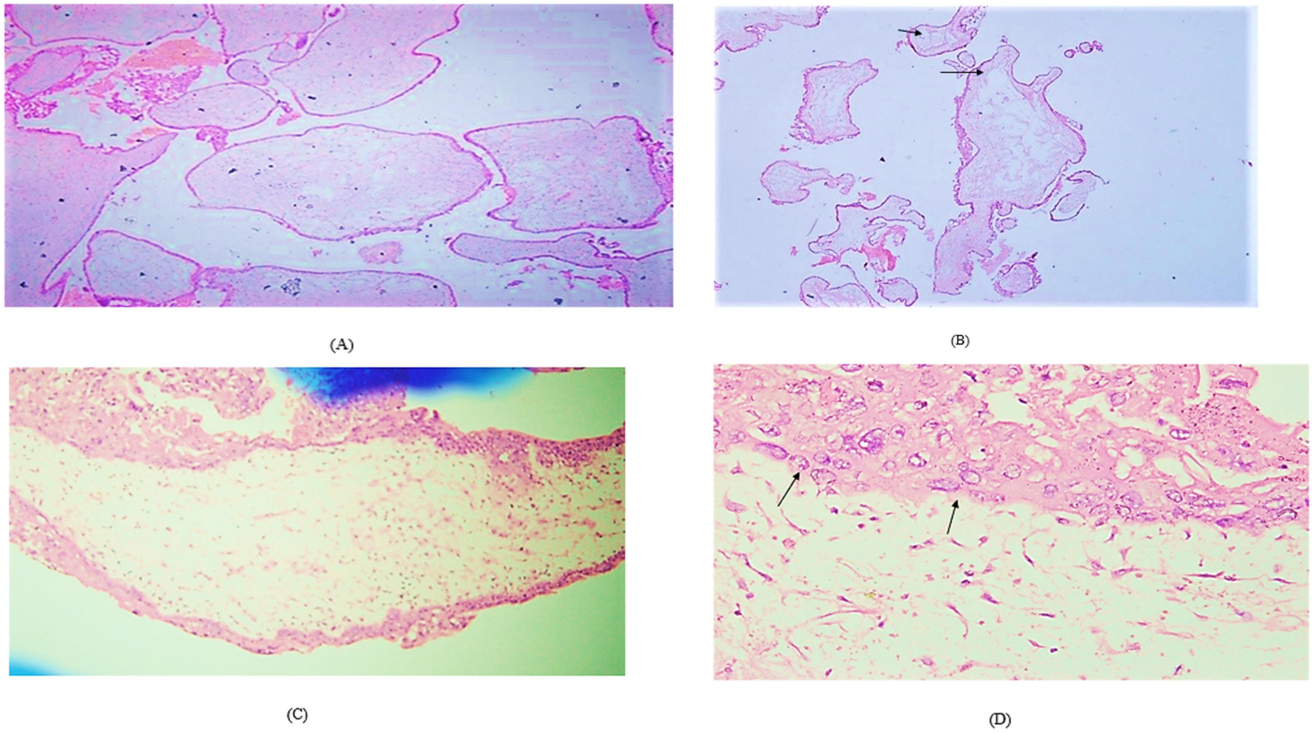

Figure 3. (A) Photomicrograph showing diffuse hydropic degeneration of villi in complete hydatidiform mole (Case no. 14, H&E, 100x). (B) Photomicrograph showing diffuse hydropic degeneration of villi with cistern formation (arrow) in complete hydatidiform mole (Case no. 10, H&E, 100x). (C) Photomicrograph showing marked, circumferential trophoblastic hyperplasia in complete hydatidiform mole (Case no. 44, H&E, 200x). (D) Photomicrograph showing marked cytologic atypia of trophoblastic cells in complete hydatidiform mole (Case no. 44, H&E, 400x).

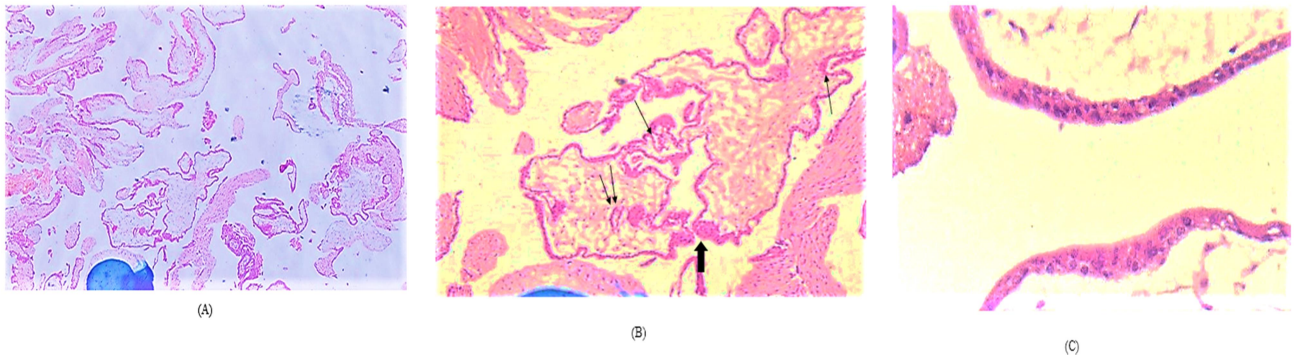

Figure 4. (A) Photomicrograph showing indeterminate hydatidiform mole (Case no. 52, H&E, 100x). (B) Photomicrograph showing marked hydropic degeneration of villi with pseudoinclusion (double arrow), scalloping (single arrow), and marked polar trophoblastic hyperplasia (block arrow) in an indeterminate hydatidiform mole (Case no. 52, H&E, 200x). (C) Photomicrograph showing mild cytologic atypia in an indeterminate group of hydatidiform mole (Case no. 31, H&E, 400x).

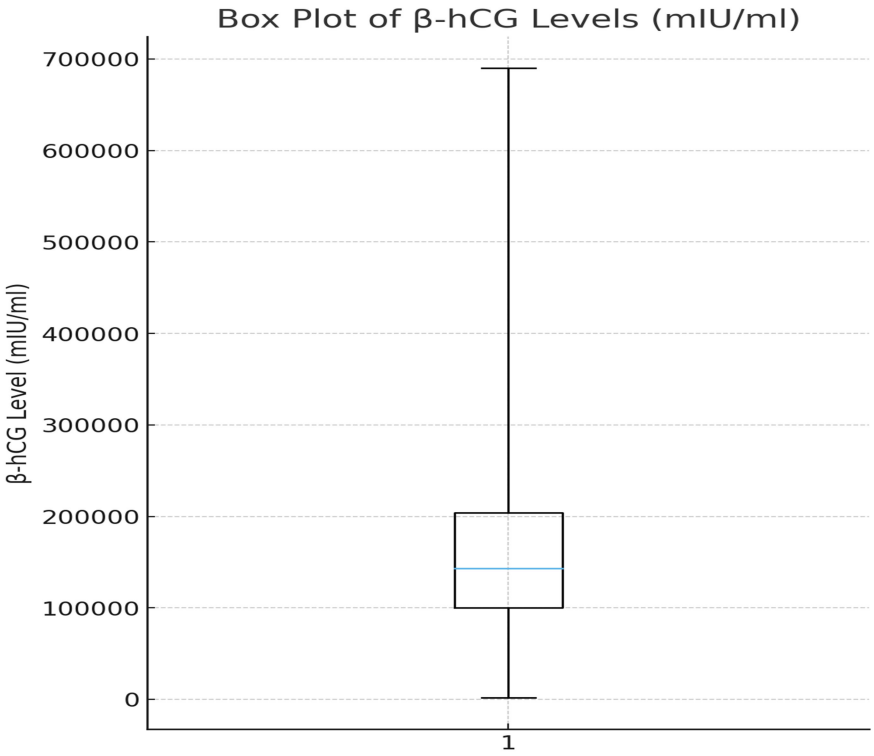

Figure 5. Distribution of study cases by β-hCG level (mIU/ml)

Table I: Distribution of the study cases by gestational age (n=57)

Gestational Age (weeks)	Number of Cases (n)	Percentage (%)
< 12	12	21.05
12–16	33	57.89
17–20	12	21.05
Total	57	100.00

Table II: Association between histopathological diagnosis and β-hCG Level (mIU/ml) **(n=54)**

β-hCG Level	CHM (n=36)	PHM (n=11)	Indeterminate (n=7)	*p* value
Mean±SD	1,87,726.02±1,18,462.42	69,547.64±63,939.66	1,21,558.00±29,642.41	
Median	1,76,000	66,567.50	1,19,000	0.001[s]
IQR	1,35,000-2,22,500	8,391-1,17,250	1,00,000-1,36,000	

s= significant
p-value reached from Kruskal-wallis test
β-hCG - β-Human Chorionic Gonadotropin
IQR - Interquartile range

Table III: Association between histopathological diagnosis and villous morphology

Histopathological finding	Diagnosis	CHM (n=36) n (%)	PHM (n=13) n (%)	Indeterminate (n=8) n (%)	p value
Hydropic degeneration of villi	Focal	0 (0.0)	12 (92.3)	2 (25.0)	0.001*
	Diffuse	36 (100.0)	1 (7.7)	6 (75.0)	
Cistern formation	Present	34 (94.4)	1 (7.7)	4 (50.0)	0.001*
	Absent	2 (5.6)	12 (92.3)	4 (50.0)	
Scalloping	Present	1 (2.8)	13 (100.0)	7 (87.5)	0.001*
	Absent	35 (97.2)	0 (0.0)	1 (12.5)	

Table IV: Association between trophoblastic hyperplasia and histopathological diagnosis

Trophoblastic hyperplasia (intensity & location)	CHM (n=36) n (%)	PHM (n=13) n (%)	Indeterminate (n=8) n (%)	p value
Marked, circumferential	26 (72.2)	0 (0.0)	0 (0.0)	0.001*
Marked, polar	10 (27.8)	0 (0.0)	2 (25.0)	
Mild, circumferential	0 (0.0)	3 (23.1)	4 (50.0)	
Mild, polar	0 (0.0)	10 (76.9)	2 (25.0)	

Table V: Association between cytologic features and histopathological diagnosis

Histopathological feature	Diagnosis	CHM (n=36) n (%)	PHM (n=13) n (%)	Indeterminate (n=8) n (%)	p value
Cytologic atypia of trophoblast	Mild	5 (13.9)	13 (100.0)	7 (87.5)	0.001*
	Marked	31 (86.1)	0 (0.0)	1 (12.5)	
Pseudoinclusions of trophoblast	Present	0 (0.0)	5 (38.5)	3 (37.5)	0.001*
	Absent	36 (100.0)	8 (61.5)	5 (62.5)	
Fetal vessels in villous stroma	Present	0 (0.0)	4 (30.8)	0 (0.0)	0.001*
	Absent	36 (100.0)	9 (69.2)	8 (100.0)	

Data analyzed using Fisher's Exact test; $p < 0.05$ considered statistically significant. CHM = Complete Hydatidiform Mole; PHM = Partial Hydatidiform Mole; Cir = Circumferential

Table VI: Association Between Histopathological Features and Pretreatment β-hCG Levels (n=54)

Histopathological Feature	Category	n	Mean β-hCG (mIU/ml)	p value
Hydropic degeneration	Diffuse	43	1,87,726	0.001*
	Focal	14	69,548	
Cistern formation	Present	39	1,80,000	0.001*
	Absent	15	80,000	
Scalloping of villi	Present	20	70,000	0.001*
	Absent	34	1,85,000	
Trophoblastic hyperplasia	Marked, circumferential	26	1,87,000	0.001*
	Marked, polar	12	1,80,000	
	Mild, circumferential	7	1,21,500	
	Mild, polar	9	69,548	
Cytologic atypia	Marked	32	1,87,000	0.001*
	Mild	22	70,000	
Pseudoinclusions	Present	8	68,000	0.001*
	Absent	46	1,80,000	
Fetal vessels in villous stroma	Present	4	69,548	0.001*
	Absent	50	1,80,000	

*Statistically significant, $p < 0.05$

Distribution of study cases by gestational age showed that the proportion of study cases was highest among the gestational age of 12 to 16 weeks, which was 57.89% (33 cases). The other two groups were <12 weeks and 17-20 weeks, and the proportion of study cases were same for both groups, which was 21.05% (12 cases in each group). The mean gestational age was 13.96±3.43 weeks. Figure 4.2 shows the distribution of study cases by gestational age. (Table I)

The box plot of pretreatment β-hCG levels (n=54) demonstrates a distinctly right-skewed distribution. The median β-hCG concentration was 143,000 mIU/ml, with an interquartile range extending from 100,000 to 204,000 mIU/ml, indicating substantial variability among the central portion of the study population. The minimum value observed was 1,705 mIU/ml, whereas the maximum reached 690,000 mIU/ml, resulting in a markedly elongated upper whisker. This pattern reflects the presence of patients with very high β-hCG levels, a characteristic frequently associated with molar gestations. Overall, the box plot indicates that the majority of cases presented with elevated pretreatment β-hCG values, consistent with the expected biochemical profile of hydatidiform mole (Figure 5).

The mean β-hCG level was 1,87,726.02±1,18,462.42mIU/ml in CHM, 69,547.64±63,939.66mIU/ml in PHM, and 1,21,558.00±29,642.41mIU/ml in the indeterminate group. The median β-hCG level was 1,76,000mIU/ml in CHM, 66,567.50mIU/ml in PHM, and 1,19,000mIU/ml in the indeterminate group. β-hCG level IQR was 1,35,000 to 2,22,500 in CHM, 8,391 to 1,17,250 in PHM and 1,00,000 to 1,36,000 in indeterminate group. The difference was statistically significant ($p<0.05$) among the three groups. These features are shown in table (Table II).

Table. IIIA demonstrates the association between histopathological diagnosis and villous morphological features. Diffuse hydropic degeneration of villi was observed in all cases of complete hydatidiform mole (100%), whereas focal hydropic change predominated in partial hydatidiform mole (92.3%). In the indeterminate group, diffuse hydropic degeneration was seen in 75% of cases.

Cistern formation was a prominent feature in CHM, present in 94.4% cases, while it was uncommon in PHM (7.7%) and moderately present in the indeterminate group (50%). Scalloping of villi was characteristically seen in all PHM cases (100%) and the majority of indeterminate cases (87.5%), but was rarely observed in CHM (2.8%). These differences in villous morphology were statistically significant ($p < 0.05$).

Table IIIB shows the distribution of trophoblastic hyperplasia according to intensity and location among the three diagnostic groups. All CHM cases exhibited marked trophoblastic hyperplasia, with the majority showing marked circumferential hyperplasia (72.2%), while the remaining cases demonstrated marked polar hyperplasia (27.8%).

In contrast, PHM cases predominantly showed mild trophoblastic hyperplasia, most commonly mild polar hyperplasia (76.9%), followed by mild circumferential hyperplasia (23.1%). The indeterminate group displayed mixed features, with mild circumferential hyperplasia being the most frequent pattern (50%). The differences in trophoblastic hyperplasia patterns among the groups were statistically significant ($p < 0.05$).

Table IIIC illustrates the association between histopathological diagnosis and cytologic as well as fetal features. Marked cytologic atypia of trophoblastic cells was observed predominantly in CHM (86.1%), whereas only mild atypia was seen in all PHM cases (100%) and in most indeterminate cases (87.5%).

Pseudoinclusions of trophoblast were absent in CHM but were identified in 38.5% of PHM and 37.5% of indeterminate cases. Fetal vessels within the villous stroma were detected exclusively in PHM (30.8%) and were not observed in either CHM or indeterminate cases. These cytologic and fetal features showed statistically significant differences among the three groups ($p < 0.05$). Table 4 shows the association between histopathological features and pretreatment serum β-hCG levels among 54 cases of molar gestation. The mean β-hCG levels were markedly higher in features typical of complete hydatidiform mole, including diffuse hydropic degeneration, presence of cisterns, absence of scalloping, marked circumferential trophoblastic hyperplasia, and marked cytologic atypia. Conversely, features commonly seen in partial hydatidiform mole, such as focal hydropic degeneration, scalloping of villi, mild trophoblastic hyperplasia, mild cytologic atypia, pseudoinclusions, and presence of fetal vessels, were associated with lower mean β-hCG levels. All associations were statistically significant ($p < 0.05$), indicating that pretreatment β-hCG levels correlate closely with specific histopathological features, which can aid in differentiating complete from partial or indeterminate moles.

Discussion

The age distribution of the study participants demonstrated that the majority of molar pregnancies occurred in women aged 21–30 years. This finding aligns with global epidemiological trends indicating that reproductive-age women constitute the highest-risk population for hydatidiform mole (HM).[11] Although extremes of maternal age (<20 years and >40 years) are well-recognized risk factors, the present study observed a smaller proportion in these categories, consistent with more recent population-based data reporting a decline in very young and advanced maternal age pregnancies due to shifting reproductive patterns.[12] The mean age of 29 years is comparable to studies from other South Asian regions, suggesting a similar demographic profile.[13]

Most molar pregnancies in this study presented between 12–16 weeks of gestation, a period when abnormal uterine bleeding, excessive vomiting, or ultrasound abnormalities commonly prompt clinical evaluation. Earlier studies also reported that molar gestations are often diagnosed during the late first or early second trimester due to more frequent use of ultrasonography and early antenatal care.[14] The nearly equal distribution between <12 weeks and 17–20 weeks groups further indicates that a subset of women either seeks care late or presents only after complications develop. Similar diagnostic patterns have been documented in studies involving Asian and Middle Eastern populations.[15]

The β-hCG distribution exhibited a distinctly right-skewed pattern, reflecting markedly elevated values in a subset of cases. Such a distribution is characteristic of molar gestations, particularly complete moles, where diffuse trophoblastic proliferation produces excessive β-hCG secretion.[16] The wide range (1,705–690,000 mIU/ml) emphasizes the variability in trophoblastic activity across HM subtypes. Studies from Japan, Korea, and the UK have similarly shown significant variability but consistently

high median β-hCG levels in molar pregnancies.[17,18] The elevated interquartile range in the current study further supports the biochemical heterogeneity inherent to HM.

A significant association was observed between HM subtype and β-hCG level, with CHM demonstrating the highest mean and median concentrations. This finding aligns with evidence showing that androgenetic CHM produces substantially higher β-hCG levels due to more pronounced trophoblastic proliferation and absent fetal tissue.[19] In contrast, PHM, which contains both maternal and paternal genomic components and often has fetal tissue, yields relatively lower β-hCG concentrations.[20] The statistically significant difference across CHM, PHM, and indeterminate groups also reinforces β-hCG as a supportive diagnostic marker. Recent studies incorporating serum biomarkers have similarly confirmed its usefulness in differentiating between HM subtypes, although with overlap between groups.[21]

The classical histopathological features demonstrated a strong and statistically significant association with HM subtype. Diffuse hydropic swelling, marked circumferential trophoblastic hyperplasia, and pronounced cytologic atypia were predominantly found in CHM, which mirrors characteristic descriptions in contemporary pathology literature.[22,23] In contrast, PHM cases showed focal villous changes, mild trophoblastic hyperplasia, scalloping, and the presence of fetal vessels—diagnostic features well established in updated WHO classifications.[24] The indeterminate group displayed overlapping morphology, underscoring the diagnostic difficulty reported by multiple authors.[25]

The distribution in this study showed CHM as the most common subtype (63.2%), followed by PHM (22.8%) and indeterminate (14%). This pattern is similar to that reported in regional studies from Pakistan, India, and Indonesia, where CHM accounts for 60–75% of molar pregnancies.[26,27] The proportion of indeterminate cases highlights the inherent limitations of histology-based diagnosis, particularly in early gestation specimens or when tissue is fragmented. Recent multicenter evaluations continue to show that up to 15% of molar samples remain ambiguous on morphology alone, further advocating for integration of p57 IHC and, when available, molecular analysis for definitive classification.[28]

The findings of this study demonstrate a clear association between histopathological features and pretreatment β-hCG levels in molar gestation. Features characteristic of complete hydatidiform mole, such as diffuse hydropic degeneration, cistern formation, marked circumferential trophoblastic hyperplasia, and marked cytologic atypia, were associated with significantly higher β-hCG levels. In contrast, histological patterns commonly seen in partial moles, including focal hydropic degeneration, scalloping of villi, mild trophoblastic hyperplasia, mild cytologic atypia, presence of pseudoinclusions, and fetal vessels within villi, corresponded to lower β-hCG levels. These results are consistent with previous studies, which have shown that β-hCG levels tend to be elevated in complete moles due to extensive trophoblastic proliferation and abnormal villous development, whereas partial moles usually exhibit milder trophoblastic hyperplasia and a lower biochemical profile.[29,30] The statistically significant differences observed in this study highlight the diagnostic utility of β-hCG in conjunction with histopathological evaluation, supporting its role not only as a biochemical marker but also as a tool to differentiate between complete, partial, and indeterminate molar gestations.

Conclusion

Pretreatment serum β-human chorionic gonadotropin (β-hCG) level serves as an important adjunctive tool in distinguishing complete hydatidiform mole (CHM) from partial hydatidiform mole (PHM). Although histopathological evaluation remains the gold standard for diagnosis, there are instances where morphological features overlap or where tissue samples are limited, making definitive classification challenging. In such cases, β-hCG levels can provide additional diagnostic clarity. Typically, CHM is associated with markedly elevated β-hCG concentrations, in contrast PHM generally presents with comparatively lower β-hCG levels. By integrating β-hCG measurement with histopathological findings, clinicians can achieve higher diagnostic confidence, reduce misclassification, and initiate appropriate clinical management, including timely uterine evacuation, risk stratification for persistent gestational trophoblastic neoplasia, and tailored follow-up protocols.

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