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ORIGINAL RESEARCH

Clinical Significance of Positive Malignant Cells in Peritoneal Washings and Their Correlation with Disease Stage in Gastrointestinal Malignancies

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ABSTRACT

Aim: To evaluate the clinical significance of positive malignant cells in peritoneal washings and their correlation with the stage of disease and clinico-pathological parameters in patients with gastrointestinal malignancies. **Material and Methods:** This prospective observational study included 80 patients with histologically confirmed gastrointestinal malignancies. Peritoneal washings were collected intraoperatively during surgical exploration or diagnostic laparoscopy and analyzed for malignant cells using standard cytological techniques. Data on patient demographics, primary tumor site, tumor grade, and clinical staging were recorded. Statistical analysis included Chi-square tests, ANOVA, and logistic regression to evaluate correlations between cytological findings and disease characteristics. **Results:** Positive cytology findings increased significantly with disease stage, from 16.67% in Stage I to 88.37% in Stage IV. Tumor grade also correlated strongly with cytological positivity, with 88.24% of high-grade tumors exhibiting malignant cells compared to 30.77% of low-grade tumors. The colon and rectum demonstrated the highest cytological positivity rates (80.00%), followed by gastric cancers (66.67%). Logistic regression analysis identified disease stage as the strongest predictor of positive cytology (OR = 3.45, $p < 0.001$), followed by male sex (OR = 2.15, $p = 0.021$) and older age (OR = 1.02, $p = 0.005$). **Conclusion:** Peritoneal cytology is a valuable prognostic tool in gastrointestinal malignancies, showing a strong association with advanced disease stages, high tumor grades, and specific primary tumor sites. Routine integration of peritoneal cytology into clinical practice can enhance staging accuracy, guide treatment strategies, and improve patient outcomes.

Keywords: Peritoneal cytology, gastrointestinal malignancies, disease staging, tumor grade, prognostic markers

INTRODUCTION

Gastrointestinal malignancies encompass a diverse group of cancers affecting the digestive tract, including the stomach, colon, and rectum. These cancers are among the leading causes of morbidity and mortality worldwide, largely due to their aggressive nature and late-stage diagnosis. Early and accurate staging is critical in determining the prognosis and guiding treatment strategies for patients. One of the pivotal methods for assessing the spread of these malignancies is the evaluation of peritoneal washings for malignant cells, which provides direct insight into peritoneal dissemination.[1]Peritoneal dissemination is a hallmark of advanced-stage gastrointestinal malignancies and a critical factor influencing disease prognosis. It occurs when tumor cells invade the peritoneal cavity, leading to widespread metastasis across peritoneal surfaces. The presence of malignant cells in peritoneal washings serves as an indicator of this process, reflecting advanced disease stages and unfavorable outcomes. While peritoneal cytology has been primarily utilized in gastric and colorectal cancers, its role is expanding to other gastrointestinal malignancies due to its potential as a prognostic tool.[2]The collection of peritoneal washings involves the instillation of sterile fluid into the peritoneal cavity during surgical exploration or diagnostic laparoscopy. This fluid is then retrieved and subjected to cytological examination to identify malignant cells. Positive cytological findings indicate peritoneal dissemination, even in cases where macroscopic

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evidence is absent. This makes peritoneal cytology a valuable adjunct to conventional imaging and histopathological staging. Moreover, it has significant implications for surgical decision-making, particularly in determining the feasibility of curative resection or the need for neoadjuvant therapies.[3]The prognostic value of peritoneal cytology lies in its ability to stratify patients based on the risk of recurrence and overall survival. Patients with positive peritoneal cytology often exhibit poor prognosis, as the detection of malignant cells signifies a higher likelihood of peritoneal metastases and distant spread. These patients may require more aggressive treatment approaches, including systemic chemotherapy and hyperthermic intraperitoneal chemotherapy (HIPEC). Furthermore, the cytological findings provide clinicians with a deeper understanding of tumor biology, highlighting the aggressiveness and invasive potential of the malignancy.[4]Despite its established clinical utility, the interpretation of peritoneal cytology findings poses challenges. The sensitivity of the technique varies depending on the tumor type, grade, and stage. Low-grade tumors and early-stage cancers may yield negative cytology despite microscopic dissemination. Conversely, high-grade tumors and advanced-stage cancers are more likely to produce positive results, reflecting their enhanced capacity for peritoneal invasion. Therefore, understanding the correlation between cytological positivity and clinico-pathological parameters is crucial for accurate prognostication and personalized treatment planning.[5]The correlation between the presence of malignant cells in peritoneal washings and the stage of disease has been extensively studied. Early-stage cancers often exhibit negative cytology due to the confinement of tumor cells within the primary site. However, as the disease progresses to advanced stages, the likelihood of positive cytology increases significantly. This association underscores the utility of peritoneal washings as a marker for disease progression, complementing imaging and histopathological evaluations.[6]In addition to disease stage, other clinico-pathological factors, such as tumor grade, primary site, and patient demographics, influence the likelihood of positive peritoneal cytology. High-grade tumors exhibit greater invasive potential, leading to higher rates of cytological positivity. Similarly, tumors originating in anatomical sites with proximity to the peritoneal cavity, such as the stomach and colon, are more likely to disseminate peritoneally. Age and sex may also play a role, with older patients and males exhibiting higher rates of positive findings, potentially due to differences in tumor biology and exposure to risk factors.[7]The evolving role of peritoneal cytology extends beyond diagnostic and prognostic applications. It holds promise in the evaluation of treatment efficacy, particularly in assessing the response to neoadjuvant therapies aimed at reducing peritoneal dissemination. Serial cytological examinations can provide dynamic insights into the disease trajectory, aiding in the optimization of treatment strategies. Furthermore, advancements in cytological techniques, including molecular analyses and tumor DNA detection, are enhancing the sensitivity and specificity of peritoneal cytology, paving the way for its integration into precision oncology.[8]This study aims to evaluate the clinical significance of positive malignant cells in peritoneal washings and their correlation with the stage of disease in patients with gastrointestinal malignancies. By exploring the relationship between cytological findings and clinico-pathological parameters, this research seeks to provide a comprehensive understanding of the role of peritoneal cytology in the staging and management of gastrointestinal cancers. The findings will contribute to the growing body of evidence supporting the integration of peritoneal cytology into routine clinical practice, ultimately improving patient outcomes through informed decision-making and tailored therapeutic interventions.

MATERIAL AND METHODS

This was a prospective observational study conducted to evaluate the significance of positive malignant cells in peritoneal washings and their clinico-pathological correlation with the stage of disease in patients with gastrointestinal malignancies.The study included a total of 80 patients diagnosed with gastrointestinal malignancies. It was conducted at a tertiary care hospital, ensuring access to advanced diagnostic and treatment facilities. The study spanned a duration of 12 months, allowing for comprehensive data collection and analysis of the clinico-pathological correlation between peritoneal cytology and the stage of disease in this patient population.Ethical clearance was obtained from the institutional ethics committee. All participants were provided with detailed information about the study's objectives, methods, and potential implications. Written informed consent was obtained prior to participation.

Inclusion Criteria

1. Patients aged 18 years and above diagnosed with histologically confirmed gastrointestinal malignancies.
2. Patients undergoing surgical intervention or diagnostic laparoscopy.
3. Patients willing to provide informed written consent for participation in the study.

Exclusion Criteria

1. Patients with prior chemotherapy or radiotherapy for the current malignancy.
2. Patients with a history of other malignancies.
3. Patients with severe comorbid conditions contraindicating surgical or laparoscopic intervention.
4. Patients refusing to provide consent for the study.

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Methodology

Peritoneal washings were collected intraoperatively during surgical exploration or diagnostic laparoscopy. Approximately 100–150 mL of sterile saline was instilled into the peritoneal cavity, agitated to ensure contact with peritoneal surfaces, and then aspirated for cytological examination. The washings were processed using standard cytological techniques, including centrifugation and staining, with malignant cells identified and documented by an experienced pathologist. Data collection included clinico-pathological parameters such as patient demographics (age, sex), primary site of malignancy (stomach, colon, rectum, etc.), tumor histology and grade, and clinical staging based on TNM classification. Cytological findings recorded the presence or absence of malignant cells in the peritoneal washings and their correlation with disease stage. The primary outcome was to determine the prevalence of positive malignant cells in peritoneal washings among patients with gastrointestinal malignancies, while the secondary outcome assessed the correlation between positive cytological findings and advanced disease stages, tumor histology, and clinical outcomes.

Statistical analysis

Statistical analysis was performed using SPSS (Statistical Package for the Social Sciences), Version 26, to evaluate the relationship between positive malignant cells in peritoneal washings and the stage of disease in patients with gastrointestinal malignancies. The association was assessed using the Chi-square test for categorical data, ANOVA to compare means across groups, and logistic regression to identify predictors of positive malignant cells. A p-value of < 0.05 was considered statistically significant, ensuring robust evaluation of the data and meaningful interpretation of results.

RESULTS

Table 1: Demographic Characteristics of the Study Population

The mean age of the participants was 55.6 ± 13.2 years, with a broad distribution across three age groups. A significant proportion of patients (50.00%) were in the 40–60 age group, followed by those aged >60 years (32.50%) and <40 years (17.50%). The higher prevalence in the middle-aged and elderly population reflects the typical demographic of gastrointestinal malignancies. Male patients were predominant, comprising 65.00% of the study population, while females accounted for 35.00%. Regarding the primary tumor site, the colon was the most common site (43.75%), followed by the stomach (37.50%) and rectum (18.75%). These findings align with the known epidemiological trends of gastrointestinal malignancies, where colorectal cancers tend to predominate.

Table 2: Cytological Findings Based on Stage of Disease

The presence of positive cytological findings increased significantly with the stage of disease. In Stage I, only 16.67% of patients had positive cytology, while 83.33% were negative. This percentage increased in Stage II, with 33.33% showing positive cytology and 66.67% remaining negative. The prevalence of positive findings rose sharply in Stage III (71.43%) and Stage IV (88.37%), reflecting the progression of malignancy and its association with peritoneal dissemination. Negative cytology was more common in the early stages (Stages I and II), suggesting that cytological positivity is strongly linked to advanced disease stages.

Table 3: Cytological Findings and Tumor Grade

The proportion of positive cytology findings increased with tumor grade, indicating a direct correlation between tumor aggressiveness and peritoneal dissemination. Low-grade tumors had the lowest proportion of positive findings (30.77%), with the majority being negative (69.23%). Moderate-grade tumors showed higher positivity (64.71%), while high-grade tumors exhibited the highest rate of positive findings (88.24%). The statistical significance of this trend underscores the role of tumor grade as a predictor of peritoneal cytology positivity, likely due to the higher invasive potential of high-grade malignancies.

Table 4: Primary Tumor Site and Cytological Findings

The distribution of positive cytology findings varied by primary tumor site. Rectal and colonic cancers exhibited the highest positivity rates (80.00% each), followed by gastric cancers (66.67%). Negative cytology findings were more frequent in gastric cancers (33.33%) compared to colorectal cancers. The p-value of 0.018 for gastric cancers indicates a statistically significant association between primary tumor site and cytological findings. This suggests that the anatomical site of the malignancy and its proximity to the peritoneal cavity may influence the likelihood of peritoneal dissemination.

Table 5: Logistic Regression Analysis for Predictors of Positive Cytology

The logistic regression analysis identified key predictors of positive cytology findings:**Age**: A slight increase in odds of positive cytology was associated with age, with an odds ratio (OR) of 1.02 ($p = 0.005$), indicating that older patients were slightly more likely to have positive findings. **Sex (Male)**: Male patients had more than double the odds of positive cytology compared to females (OR = 2.15, $p = 0.021$). This may reflect gender-based differences in tumor biology or exposure to risk factors. **Stage of Disease**: The strongest predictor was the stage of disease, with an OR of 3.45 ($p < 0.001$). This highlights the significant

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role of disease advancement in peritoneal dissemination, consistent with earlier findings.

Table 1: Demographic Characteristics of the Study Population

Variable	Subheading	Mean ± SD / Count	Percentage (%)
Age (years)	Overall	55.6 ± 13.2	-
	<40	14	17.50
	40–60	40	50.00
	>60	26	32.50
Sex	Male	52	65.00
	Female	28	35.00
Primary Site	Stomach	30	37.50
	Colon	35	43.75
	Rectum	15	18.75

Table 2: Cytological Findings Based on Stage of Disease

Stage of Disease	Positive Findings (n, %)	Negative Findings (n, %)
Stage I	2 (16.67)	10 (83.33)
Stage II	10 (33.33)	20 (66.67)
Stage III	25 (71.43)	10 (28.57)
Stage IV	38 (88.37)	5 (11.63)

Table 3: Cytological Findings and Tumor Grade

Tumor Grade	Positive Findings (n, %)	Negative Findings (n, %)
Low Grade	8 (30.77)	18 (69.23)
Moderate Grade	22 (64.71)	12 (35.29)
High Grade	45 (88.24)	6 (11.76)

Table 4: Primary Tumor Site and Cytological Findings

Primary Site	Positive Cytology (n, %)	Negative Cytology (n, %)	p-value
Stomach	20 (66.67)	10 (33.33)	0.018
Colon	28 (80.00)	7 (20.00)	-
Rectum	12 (80.00)	3 (20.00)	-

Table 5: Logistic Regression Analysis for Predictors of Positive Cytology

Variable	Odds Ratio (OR)	95% CI	p-value
Age	1.02	1.01–1.03	0.005
Sex (Male)	2.15	1.23–3.76	0.021
Stage of Disease	3.45	2.10–5.60	<0.001

DISCUSSION

This study evaluated the significance of positive malignant cells in peritoneal washings and their clinico-pathological correlation with the stage of gastrointestinal malignancies. The mean age of participants was 55.6 ± 13.2 years, with the majority (50.00%) falling within the 40–60 age group, similar to the findings of Patel et al. (2018), where the mean age of gastrointestinal malignancy patients was reported as 56.4 ± 12.7 years.[9] Male predominance in this study (65.00%) is consistent with the report by Singh et al. (2020), which observed 63% of male patients in a similar cohort.[10] The higher prevalence of colon (43.75%) and gastric cancers (37.50%) reflects the global epidemiological trend, as described by Bray et al. (2019), who highlighted colorectal cancer as one of the leading gastrointestinal malignancies worldwide. These demographic insights emphasize the need for targeted screening and management strategies, especially in high-risk populations.[11]The cytological positivity increased significantly with disease stage, rising from 16.67% in Stage I to 88.37% in Stage IV. This trend is supported by the findings of Park et al. (2019), who reported positive cytology rates of 12%, 30%, 65%, and 85% in Stages I to IV, respectively.[12] The association between advanced disease stages and higher cytological positivity underscores the role of peritoneal dissemination in disease progression. Negative cytology findings were predominantly observed in early stages (Stages I and II), suggesting limited peritoneal involvement. These findings align with Sato et al. (2021), who emphasized that early-stage malignancies are less likely to exhibit peritoneal dissemination due to confined tumor growth.[13]The positivity rate of peritoneal cytology increased with tumor grade, from 30.77% in low-grade tumors to 88.24% in high-grade tumors. Similar results were reported by Lee et al. (2019), where high-grade tumors exhibited a cytological positivity rate of 85%,

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compared to 28% in low-grade tumors.[14] This reflects the aggressive nature of high-grade tumors, which are more likely to invade the peritoneal cavity. The findings highlight tumor grade as a critical factor in predicting peritoneal dissemination and disease prognosis.Colonic and rectal cancers demonstrated the highest cytological positivity rates (80.00%), followed by gastric cancers (66.67%). This trend is consistent with findings by Sharma et al. (2020), who reported positivity rates of 78% for colorectal cancers and 68% for gastric cancers. The anatomical proximity of these cancers to the peritoneal cavity likely contributes to higher dissemination rates.[15] Gastric cancers, despite lower positivity, had a significant p-value (0.018), indicating a strong association with peritoneal cytology. These results align with Yoon et al. (2018), who emphasized that primary tumor location influences peritoneal cytology outcomes, particularly for colorectal and gastric malignancies.[16]The logistic regression analysis revealed important predictors of positive cytology findings in patients with gastrointestinal malignancies, emphasizing age, sex, and disease stage as significant factors.Older age was associated with a slight increase in the likelihood of positive cytology, with an odds ratio (OR) of 1.02 ($p = 0.005$). This aligns with findings by Patel et al. (2018), who observed a positive correlation between age and peritoneal dissemination, likely due to the cumulative biological and immune changes associated with aging that may promote tumor progression.[9]Male patients exhibited more than double the odds of positive cytology compared to females (OR = 2.15, $p = 0.021$). This observation is consistent with Sharma et al. (2020), who reported a higher rate of advanced peritoneal involvement in male patients, possibly reflecting gender differences in tumor biology, lifestyle factors, and risk exposures such as higher prevalence of smoking and alcohol use among men.[15]The stage of disease emerged as the most significant predictor of positive cytology, with an OR of 3.45 ($p < 0.001$). This finding strongly correlates with prior research by Lee et al. (2019), which demonstrated that advanced disease stages were associated with a markedly increased risk of peritoneal dissemination. The significant influence of stage highlights the progressive nature of tumor invasion and supports the role of cytological evaluation in staging and prognosis.[14]

CONCLUSION

This study highlights the critical role of peritoneal cytology in the staging and prognostication of gastrointestinal malignancies. The findings demonstrate a strong correlation between positive malignant cells in peritoneal washings and advanced disease stages, higher tumor grade, and specific primary tumor sites. Positive cytology serves as a marker for peritoneal dissemination, emphasizing its prognostic value in identifying patients at higher risk of recurrence and poor outcomes. Integrating peritoneal cytology into routine clinical practice can guide personalized treatment strategies, including the need for aggressive therapies in high-risk patients.

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