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Ovarian tumors' morphological and immunohistochemical features in connection to their clinical outcome

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Abstract
Background and Objectives: Ovarian tumors include a wide array of neoplasms characterized by varied morphological attributes and clinical manifestations. Accurate histopathological classification, together with immunohistochemistry (IHC) profiling, is essential for prognostic prediction and treatment decision-making. The objective of this study was to assess the morphological and immunohistochemical features of ovarian cancers and to connect these findings with clinical outcomes.
Material and Methods: This prospective study, conducted over three years, involved 50 patients with histologically confirmed ovarian cancers. We used hematoxylin and eosin staining to look at the morphological properties of tissue sections that had been fixed in formalin and embedded in paraffin. We used IHC markers including CK7, WT1, CA-125, ER, PR, and Ki-67 to get more information about the cells. Clinical data, encompassing age, parity, tumor stage, and follow-up outcomes, were documented and analyzed in relation to pathological results. Statistical analysis was used to evaluate the correlation between morphological/IHC patterns and clinical outcomes.
Results: The majority of the ovarian tumors (36 out of 50) were epithelial, whereas a small number were germ cell and sex cord-stromal. Serous carcinoma accounted for 55.5% of all epithelial tumors. The clinical result was poor and the stage was progressed when the Ki-67 labeling index was high ($p < 0.05$). In serous carcinoma, WT1 and CK7 were very positive, whereas AFP and PLAP were expressed in germ cell malignancies. In epithelial malignancies, a better prognosis was substantially linked to positive ER and PR expression ($p<0.05$). While benign and borderline tumors had excellent prognoses, patients with high-grade serous carcinoma had the worst survival results.
Conclusion: Ovarian cancers can be better predicted using morphological categorization in conjunction with immunohistochemistry profiling. When it comes to subtyping and clinical outcome prediction, IHC markers like Ki-67, ER, PR, and WT1 are invaluable. The diagnostic accuracy and patient care techniques can be improved by integrating histology and IHC findings.

Keywords: Ovarian tumors, morphology, immunohistochemistry, clinical outcome, prognosis

Introduction
One of the top causes of gynecological cancer-related deaths globally is ovarian tumors, which include a broad spectrum of neoplasms, from harmless cysts to extremely aggressive carcinomas. Because they don't usually cause any symptoms when they're first starting out, malignant instances often have a late clinical presentation and a bad prognosis. Analyzing the morphological patterns and molecular profiles of ovarian cancers in great detail is necessary for an accurate diagnosis and prognosis [1-3].
Classification of ovarian cancers relies heavily on histopathological investigation, which provides vital information about tumor kind, grade, and stage. But in instances of poorly differentiated or borderline lesions, morphology alone might not be enough to differentiate between categories. When this occurs, immunohistochemistry (IHC) is a vital supplementary tool for accurate tumor characterisation by detecting the expression of targeted biomarkers [4-6].
Cytokeratin 7 (CK7), Wilms' tumor protein (WT1), cancer antigen-125 (CA-125), estrogen receptor (ER), progesterone receptor (PR), and proliferation marker Ki-67 are some of the most frequently utilized immunohistochemistry (IHC) markers for ovarian tumor evaluation. In addition to aiding in the differentiation of histological subtypes, these markers also offer prognostic insights. Serious carcinoma is significantly connected with WT1 positive, and

aggressive biological behavior is indicated by a high Ki-67 index, for instance. Similarly, better clinical outcomes have been associated with epithelial ovarian cancers that are ER and PR positive [7-9].

Ovarian cancer, especially high-grade serous carcinoma, still has a terrible overall survival rate and a significant recurrence rate, even though surgical and chemotherapy treatment options have improved. Thus, it is possible to enhance diagnostic accuracy, help with risk classification, and direct individualized treatment plans by combining morphological evaluation with immunohistochemical profiling. The purpose of this study was to examine the relationship between the immunohistochemical and morphological features of ovarian tumors in 50 individuals and their clinical outcomes [10, 11].

Material and Methods

This study was conducted at Department Obstretics and Gynacology, Madha Medical College, Kundrathur Main Road, Kovur, Chennai, Tamil Nadu, India. Study period was February 2020 to January 2021.

Relevant clinical information, such as age, parity, clinical presentation, operation results, and follow-up data, was extracted from hospital records. A panel of antibodies, including CK7, WT1, CA-125, ER, PR, and Ki-67, was used to do immunohistochemistry on representative slices. We used heat-induced antigen retrieval and a DAB detection device to see the results.

Inclusion criteria

- Patients with histopathologically confirmed ovarian tumors (benign, borderline, or malignant).
- Adequate formalin-fixed, paraffin-embedded tumor tissue available for morphological and IHC evaluation.
- Availability of complete clinical details and follow-up data.

Exclusion criteria

- Patients with metastatic tumors involving the ovary from non-ovarian primary sites.
- Inadequate or poorly preserved tissue samples unsuitable for IHC analysis.
- Cases lacking sufficient clinical and follow-up information.

Results

We looked at 50 examples of ovarian tumors, which might be either benign or malignant. The results of the morphological and immunohistochemical analysis are detailed below.

Table 1: Distribution of Ovarian Tumors According to Histological Type (n = 50)

Tumor Type	No. of Cases (%)
Epithelial tumors	36 (72%)
Germ cell tumors	8 (16%)
Sex cord-stromal tumors	6 (12%)

The most common type of tumor was an epithelial tumor, which accounted for 72% of cases. Germ cell tumors accounted for 16% of cases, and sex cord-stromal cancers for 12%. Serious carcinoma was the most common subtype of epithelial cancers.

Table 2: Morphological Subtypes of Ovarian Tumors (n = 50)

Histological Subtype	Benign (%)	Borderline (%)	Malignant (%)	Total (%)
Serous	8 (16%)	2 (4%)	10 (20%)	20 (40%)
Mucinous	4 (8%)	2 (4%)	4 (8%)	10 (20%)
Endometrioid	-	-	4 (8%)	4 (8%)
Germ cell (Dysgerminoma, Teratoma)	-	-	8 (16%)	8 (16%)
Sex cord-stromal (Granulosa, Fibroma)	-	-	6 (12%)	6 (12%)
Total	12 (24%)	4 (8%)	32 (64%)	50 (100%)

Mucinous tumors (20%) were the second most common type of tumor, after serous tumors (40%). Of all the cases, 64% were malignant tumors, 24% were benign, and 8% were borderline tumors.

Table 3: Immunohistochemical Marker Expression in Ovarian Tumors

Marker	Positive Cases (%)	Correlation with Subtype/Outcome
CK7	34 (68%)	Strong in serous & endometrioid carcinomas
WT1	22 (44%)	Predominantly in serous carcinoma
CA-125	28 (56%)	Higher in malignant epithelial tumors
ER	18 (36%)	Associated with better prognosis
PR	14 (28%)	Favorable prognosis when co-expressed with ER
Ki-67 (High index)	20 (40%)	Significantly correlated with advanced stage and poor outcome ($p < 0.05$)

The diagnostic relevance of CK7 and WT1 was confirmed by their significant positivity in serous cancer. There was a strong correlation between the expression of ER and PR and a better prognosis. Poor outcomes and advanced illness stage were associated with a high Ki-67 index, which was detected in 40% of cases.

Table 4: Correlation of Tumor Type with Clinical Outcome

Tumor Type	No. of Cases	Favorable Outcome (%)	Poor Outcome (%)
Benign (n = 12)	12	12 (100%)	0
Borderline (n = 4)	4	4 (100%)	0
Malignant epithelial (n=20)	20	8 (40%)	12 (60%)
Germ cell (n = 8)	8	6 (75%)	2 (25%)
Sex cord-stromal (n = 6)	6	5 (83.3%)	1 (16.7%)

All benign and borderline tumors exhibited positive clinical outcomes. Sixty percent of malignant epithelial tumors had bad outcomes, especially high-grade serous carcinoma. Germ cell and sex cord-stromal cancers often demonstrated a positive prognosis, while adverse outcomes were observed in few advanced-stage instances.

Discussion

The biological behavior, prognosis, and therapeutic response of the many different types of neoplasms that make up ovarian tumors can vary greatly. Consistent with earlier findings that epithelial neoplasms make up the preponderance of ovarian tumor types, this study found that out of 50 tumors, epithelial tumors accounted for 72% of the cases. Among epithelial cancers, serous carcinoma has emerged as the most common, which is in line with its status as the most common subtype globally [11-13].

Cancer accounted for 64% of the tumors, with 24% being benign and 8% being borderline, according to the morphological spectrum. The tertiary care setting of the study may explain why there is a higher frequency of malignant tumors. Patients with more advanced diseases are more likely to be referred to this setting [14, 15].

Additional insights into diagnosis and prognosis were provided by immunohistochemical analysis. The diagnostic value of CK7 and WT1 in separating serous carcinomas from other subtypes was reaffirmed by their significant positivity in serous carcinoma. CA-125 is well-established as a diagnostic and monitoring marker, and its preponderance in malignant epithelial tumors lends credence to this claim. Notably, prior research has shown that hormone receptor positivity is linked with improved survival and may predict response to hormonal treatment; this finding is consistent with the correlation between ER and PR expression and positive prognosis [15, 16].

Advanced tumor stage and worse clinical outcome were linked to the proliferation marker Ki-67, which was found to be highly higher in high-grade tumors, especially serous carcinomas. This finding further supports Ki-67's prognostic importance, since a high index indicates aggressive tumor biology and an increased chance of recurrence [17, 18].

In this investigation, we found that malignant epithelial tumors, particularly high-grade serous carcinoma, had the worst survival outcomes, but benign and borderline tumors all had positive prognoses. Consistent with their known chemo reactivity and somewhat indolent course, sex cord-stromal cancers and germ cell malignancies often had better outcomes [19, 20]. In conclusion, this study's results show how important it is to diagnose and predict the prognosis of ovarian cancers by integrating morphological evaluation with immunohistochemical profiling. Using all of these components together improves the accuracy of diagnoses, enables risk stratification, and yields useful data for developing individualized plans of care for each patient [21].

Conclusion

This study shows that ovarian cancers have a wide range of morphological and immunohistochemical features that have a big effect on clinical outcomes. Epithelial tumors, especially high-grade serous carcinoma, were the most prevalent and linked to a poor prognosis. Immunohistochemical markers such CK7, WT1, and CA-125 were useful for accurately subtyping, and the expression of ER and PR was linked to good outcomes. A high Ki-67 index was associated with aggressive tumor behavior and poor survival. Combining standard histology with immunohistochemical profiling improves the accuracy of diagnoses, gives prognostic information, and helps doctors make personalized treatment plans for ovarian cancers.

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None

Conflict of Interest

None

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