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Histopathological Spectrum of Ovarian Tumors in a Tertiary Care Center of North West Rajasthan

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Abstract

Background: Ovarian tumors represent a highly complex group of neoplasms with broad variations in presentation, histogenesis, and clinical behavior. Histopathological characterization remains the definitive standard for directing specific clinical pathways. **Objectives**: To systematically evaluate the clinical profile, biological spectrum, age-wise incidence, and histopathological classification of ovarian tumors at a major healthcare facility in North West Rajasthan. **Materials and Methods**: This cross-sectional observational study was carried out in the Department of Pathology, Sardar Patel Medical College, Bikaner, spanning a two-year consecutive timeframe. A total of 150 ovarian tissue biopsies were evaluated using routine gross and microscopic structural mapping (H&E staining), supplemented by special histological stains when indicated. Statistical correlations were analyzed via Chi-square methodology.

Results: Among the 150 analyzed cases, the mean patient age was 42.73 years, with peak presentation within the 31–40 age bracket (22.0%). Biologically, 70.0% (n=105) of lesions were benign, 2.0% (n=3) borderline, and 28.0% (n=42) malignant. Surface epithelial tumors predominated, accounting for 68.67% of cases, followed by germ cell tumors (22.0%), sex cord–stromal tumors (7.33%), secondary metastatic lines (1.33%), and mesenchymal variants (0.67%). Serous cystadenoma was the single most common benign lesion (31.43% of benign tumors), whereas high-grade serous

carcinoma led the malignant cohort (50.0% of malignant tumors). A highly significant association was confirmed between biological behavior and advancing patient age ($p = 0.0078$) and clinical presentation ($p = 0.0018$), while maximum tumor diameter showed no significant link ($p = 0.131$).

Conclusion: This regional spectrum highlights a dominant surface epithelial profile. Precise histomorphological evaluation remains indispensable to safely differentiate benign masses from advanced serous carcinomas, particularly as risks scale sharply in peri- and postmenopausal age brackets.

Keywords: Ovarian neoplasms, Surface epithelial tumors, High-grade serous carcinoma, Histopathology, Rajasthan.

Introduction

Ovarian pathomorphology represents one of the most intricate segments of modern gynecological oncology due to the dynamic physiology and diverse cell lineages within the ovary. Neoplastic events can emerge from any of its three fundamental components: the multipotent coelomic surface epithelium, the totipotent germ cells, and specialized sex cord–stromal cells. Among these variations, surface epithelial tumors are encountered most frequently and form the overwhelming majority of neoplasms. Malignant transformations affecting the surface epithelium account for nearly 90% of primary ovarian carcinomas. Conversely, germ cell and sex cord–stromal lines are less frequently observed, collectively contributing to approximately 20-30% of all ovarian entities and under 10% of overall malignancies.

Globally, ovarian carcinoma remains a leading cause of cancer-related mortality among female reproductive system malignancies. This poor prognosis is directly linked to the fact that early stages are typically asymptomatic, combined with a lack of specific screening methods. Definitive staging, diagnosis, and treatment planning depend entirely on formal histopathological evaluation rather than clinical imagery or tumor markers. The standard World Health Organization (WHO) classification provides a critical baseline that correlates distinctive morphological patterns with targeted clinical management. This hospital-based study defines the regional distribution patterns, baseline prevalence metrics, and clinicopathological features of ovarian tumors within the unique population demographic of North West Rajasthan.

Materials and Methods

This hospital-based cross-sectional observational study was conducted in the Department of Pathology at Sardar Patel Medical College and Associated Group of Hospitals, Bikaner, Rajasthan. The investigation covered a consecutive two-year window from January 1, 2024, to December 31, 2025. Based on regional baseline prevalence indices, a minimum sample size of 96 cases was determined using the standard Daniel equation. A total of 150 consecutive ovarian biopsy and surgical specimens matching the inclusion parameters were enrolled over the study timeframe.

Selection Criteria

Inclusion Criteria: All primary or secondary ovarian mass biopsies, cystectomies, and multi-organ resections submitted for pathological assessment during the study window.

Exclusion Criteria: Severely autolyzed or decomposed tissue masses, non-neoplastic functional cysts (except where required for clinical exclusion), and biopsies displaying inadequate diagnostic material.

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Tissue Processing and Microscopic Analysis

All surgical specimens were fixed in 10% neutral buffered formalin for 4 to 24 hours. Detailed macroscopic features, including aggregate size, outer surface profiles, locularity, and solid-to-cystic ratios, were systematically documented. Representative tissue blocks were taken and processed using standard automated tissue techniques. Paraffin-embedded sections were cut at a thickness of 2–4 microns on standard microtomes and stained with routine Hematoxylin and Eosin (H&E).

Special stains, including Periodic Acid-Schiff (PAS), PAS with diastase digestion, and Southgate Mucicarmine, were applied to clarify specific morphological features such as glycogen content, intracellular mucin distribution, or specialized stroma. Classification adhered to the modern WHO guidelines. Statistical calculations were performed via Microsoft Excel, evaluating data using Chi-square (χ^2) tests with a significance threshold defined at $p < 0.05$.

Results

A complete analysis of the 150 ovarian tumor cases revealed specific correlations across demographic parameters, clinical features, and biological behavior.

Demographic and Biological Correlations

The overall mean age of the cohort was 42.73 years. The highest frequency of cases occurred within the 31–40 years age bracket (22.0%, n=33), followed equally by the 21–30 years and 41–50 years age brackets (20.0% each, n=30). Categorized by biological behavior, benign tumors comprised 70.0% (n=105) of the study group, borderline tumors accounted for 2.0% (n=3), and overtly malignant tumors made up 28.0% (n=42).

Cross-tabulation demonstrated a highly significant association between age distribution and biological behavior ($\chi^2 = 23.93$, df = 10, $p = 0.0078$). Benign processes predominated in younger patients (e.g., 90.0% of the 21–30 years cohort), whereas malignancy rates rose progressively in older groups, reaching 50.0% in the 41–50 years bracket. The mean age for benign tumors was 40.88 years, compared to 48.28 years for malignant lesions.

Tumor Dimensions

Tumors were classified into four categories based on maximum diameter (Table 1). The 5.1–10 cm cohort was the most common, accounting for 42.0% (n=63) of all cases. Chi-square testing showed that the association between tumor size and biological behavior was not statistically significant ($\chi^2 = 9.86$, df = 6, $p = 0.131$). This confirms that tumor size alone is not a reliable predictor of malignancy.

Table 1: Distribution of Ovarian Tumors by Maximum Diameter and Biological Behavior (p = 0.131)

Maximum Diameter	Benign (n)	Borderline (n)	Malignant (n)	Total (n)	Percentage (%)
≤ 5 cm	7	0	2	9	6.0%
5.1 - 10 cm	51	1	11	63	42.0%
10.1 - 15 cm	23	1	19	43	28.7%

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> 15 cm	24	1	10	35	23.3%

Clinical Presentation

Non-specific abdominal pain was the most common presenting symptom, reported by 57.3% (n=86) of patients, followed by a palpable abdominal mass at 24.0% (n=36), abnormal uterine bleeding (AUB) at 15.3% (n=23), and ascites at 3.3% (n=5). Clinical presentation and biological behavior showed a statistically significant correlation ($\chi^2 = 21.03$, df = 6, p = 0.0018). Abdominal pain was associated primarily with benign lesions (80.2%), whereas ascites (80.0%) and AUB (56.5%) showed strong correlations with underlying malignancy.

Histopathological Distribution

Surface epithelial tumors formed the largest primary histogenetic category (68.67%, n=103), followed by germ cell tumors (22.0%, n=33), sex cord–stromal tumors (7.33%, n=11), metastatic lesions (1.33%, n=2), and mesenchymal tumors (0.67%, n=1). This distribution profile and its biological breakdown (Table 2) were statistically significant ($\chi^2 = 20.85$, df = 8, p = 0.0076).

Table 2: Histogenetic Distribution vs. Biological Behavior (p = 0.0076)

Histogenetic Lineage	Benign	Borderline	Malignant	Total Cases
Surface Epithelial	66	3	34	103
Germ Cell	32	0	1	33
Sex Cord–Stromal	6	0	5	11
Mesenchymal	1	0	0	1
Metastatic	0	0	2	2

Age grouped against histogenetic lineage showed that germ cell lesions had a distinct predilection for patients under 40 years of age, accounting for 32.43% of cases in that age group, while surface epithelial tumors grew increasingly dominant in older cohorts (p = 0.039).

Diagnostic Spectrum

Serous cystadenoma was the most common benign diagnosis, accounting for 31.43% of the benign cohort (n=33/105), closely followed by mature cystic teratoma at 30.48% (n=32/105). Within the malignant cohort (n=42), high-grade serous carcinoma was the leading diagnosis, representing 50.0% (n=21) of all malignancies, followed by mucinous carcinoma at 19.05% (n=8) and adult granulosa cell tumors at 11.90% (n=5).

Discussion

Ovarian neoplasms remain a major diagnostic challenge due to their diverse cell origins and overlapping clinical profiles. The demographic patterns identified in this study closely match historical baseline data from multi-center studies in India. The finding that the highest concentration of tumors occurs in the fourth decade of life (31–40 years) aligns with findings by Pranshu

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Sharma et al. and Sampurna K et al., reflecting cellular changes linked to regular ovulatory wear and repair.

This study demonstrated a clear relationship between advancing patient age and an increased proportion of malignant tumors ($p = 0.0078$). Younger women presented predominantly with benign diagnoses, while women in perimenopausal and postmenopausal phases showed a higher rate of epithelial malignancies. The primary clinical presentation identified was non-specific abdominal pain (57.3%), consistent with findings by Marachapu et al. and Ritu Singh et al. This emphasizes that tumors often remain silent until mechanical distortion or secondary pressure effects occur. However, the presence of ascites or abnormal uterine bleeding showed a strong statistical correlation with malignant behavior ($p = 0.0018$).

Maximum tumor diameter did not serve as a definitive predictor of biological behavior ($p = 0.131$). This lack of significance is due to a structural overlap between benign and malignant lesions: certain benign processes, particularly mucinous cystadenomas, can reach substantial sizes without invading tissue, while malignant developments like clear cell or low-grade serous carcinomas can present as smaller, complex structural nodes. This pattern matches observations reported by Patel et al., suggesting that structural complexity and internal solid/cystic components are more accurate indicators of malignancy than tumor size alone.

Surface epithelial tumors were the most frequent lineage (68.67%), matching baseline distributions reported by Snehal Tale et al. and Shringi et al. Serous cystadenoma remained the single most common benign diagnosis. Within the malignant category, high-grade serous carcinoma was the dominant diagnosis (50.0%). Germ cell lesions, primarily mature cystic teratomas, formed the second largest group (22.0%) and showed a distinct predilection for patients under 40 years of age. Sex cord–stromal tumors, led by adult granulosa cell tumors, were less common but remain clinically notable due to their potential to secrete estrogen, which can cause secondary endometrial structural revisions and require long-term clinical monitoring.

Conclusion

This study outlines the morphological trends of ovarian neoplasia in North West Rajasthan, demonstrating a clear predominance of surface epithelial tumors. While benign diagnoses like serous cystadenomas and dermoid cysts occur more frequently in reproductive-aged women, the risk of developing aggressive malignancies, such as high-grade serous carcinoma, scales significantly with advancing age. Tumor size alone was not a reliable indicator of malignancy, emphasizing the vital role of thorough gross and microscopic examination. Comprehensive histopathological classification remains essential for accurate diagnosis, staging, and selecting targeted therapies.

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