PD-L1 and FOXP3 Expression in De Novo Invasive Breast Carcinoma: Association with Molecular Subtypes and Clinicopathological Parameters

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Abstract

Background: The tumour immune microenvironment plays an important role in breast carcinoma progression and immune evasion. Programmed cell death-ligand 1 (PD-L1) and Forkhead box protein 3 (FOXP3)-positive regulatory T cells are key components of tumour-associated immune suppression. Their combined evaluation may provide insight into the immunological heterogeneity of invasive breast carcinoma.

Aim: To evaluate PD-L1 and FOXP3 expression by immunohistochemistry in de novo invasive breast carcinoma and assess their association with molecular subtypes and clinicopathological parameters.

Methods: This cross-sectional study included 97 women with de novo invasive breast carcinoma. PD-L1 expression was assessed using combined positive score (CPS), tumour proportion score (TPS), and immune-cell score, while FOXP3 expression was evaluated in tumour-infiltrating lymphocytes. Associations were analysed using appropriate statistical tests, with Spearman's rank correlation for PD-L1 and FOXP3 scores.

Results: PD-L1 CPS ≥1 was observed in 65.98% of cases versus TPS ≥1 in 35.05%. CPS positivity was significantly associated with higher histological grade ($p<0.0001$), estrogen receptor negativity ($p=0.0028$), progesterone receptor negativity ($p=0.0005$), and triple-negative breast cancer ($p=0.0414$); Luminal A tumours showed significantly lower CPS expression ($p=0.0025$). High FOXP3 expression was observed in 16.49% and was associated with histological grade ($p=0.0289$) and nodal status ($p=0.0017$). Notably, all high-FOXP3 tumours were CPS-positive ($p=0.0043$). FOXP3 correlated with CPS ($\rho=0.43$) and more strongly with PD-L1 immune-cell score ($\rho=0.49$), both $p<0.0001$.

Conclusion: PD-L1 and FOXP3 are closely associated within the breast tumour immune microenvironment, particularly within the immune-cell compartment, suggesting a coordinated immunosuppressive profile. PD-L1 was preferentially associated with higher-grade, hormone-receptor-poor tumours, particularly triple-negative breast cancer. Combined assessment of these markers may provide more comprehensive immune profiling of invasive breast carcinoma.

Keywords

PD-L1, foxp3, cps, invasive breast carcinoma, tumour immune microenvironment, immunohistochemistry.