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Commentary

Exploring the Diverse Pathways of Breast Cancer Metastasis: Implications for Prognosis and Treatment Strategies

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DESCRIPTION

Breast cancer is one of the most prevalent cancers in women worldwide and is the main factor in the majority of cancer-related fatalities. The high mortality rate of breast cancer is explained by a number of factors, with metastasis to important organs being the main contributor. Intensive research over the past several years has shown that breast cancer demonstrates metastatic heterogeneity with unique metastatic precedence to different organs, leading to variations in prognoses and therapeutic responses in breast cancer patients. The key target locations for breast cancer metastasis are generally acknowledged to be the bone, lung, liver, and brain. But more research is still needed to understand the underlying biological process of breast cancer's metastatic heterogeneity. Understanding of the heterogeneity of breast cancer metastasis has recently undergone an unprecedented change as a result of the introduction of novel genomic and pathologic approaches, as well as technological advancements in imaging analysis and animal modelling. These developments have also provided new insights for developing more effective therapeutics. This study discusses about the potential for identifying specific molecules against tumour cells or tumour microenvironments to prevent the development of metastatic disease and improve the prognosis of breast cancer patients. It also summarises recent molecular mechanisms and emerging concepts on the metastatic heterogeneity of breast cancer. With more than 268,000 new diagnoses anticipated each year in the USA—roughly 30% of all new cancer cases in women—breast cancer is the most common malignancy among women globally. In the USA, it is the second leading cause of cancer-related death in women, accounting for more than 41,000 fatalities annually and 15% of all cancer-related deaths in females. The prognosis of breast cancer patients has improved as a result of improvements in early diagnosis and thorough treatment plans. Additionally, metastasis occurs more frequently. Following diagnosis and initial tumour therapy, 20–30% of the breast cancer patients may develop metastases, and metastasis is thought to be responsible for 90% of cancer-related deaths. Without metastasis, the 5-year overall survival rate for breast cancer patients is more than 80%; however, distant metastasis can drastically lower this rate to just around 25%. Breast cancer has a tendency to spread to many organs, such as the bone, lung, liver, and brain. This tendency, known as metastatic heterogeneity, affects how the disease responds to therapy and how well the patient will fare. 75% of instances with metastatic disease involve the bones, and the 5-year overall survival rate is 22.8% in these situations. The second most typical location for breast cancer metastasis is the lung, which has a 5-year overall survival rate of 16.8%. Although liver metastasis is second in frequency to lung metastasis, it has a worse survival rate compared to loco-regional, bone, and lung recurrence, with a predicted 5-year overall survival of 8.5%.

Brain metastases can occur in 15%–30% of patients with metastatic breast cancer, severely limiting quality of life and life expectancy for many patients given their extremely low survival rates. In order to explore more potent metastasis-targeting agents and enhance patient prognosis, systematic and in-depth research on the molecular heterogeneity of metastatic breast cancer, which is a potential reason for a large number of therapeutic failures, is necessary. The development of more effective treatments for breast cancer metastases depends on a systematic and in-depth understanding of the molecular mechanisms underlying metastatic heterogeneity, even though breast cancer subtypes help to guide clinical therapeutics and partially indicate the preferred site of metastasis. Several methods are currently accessible to further understanding of the underlying biological process, including lineage tracing, genomic and transcriptome analysis, and single cell gene expression study.

Additionally, scientists are committed to develop sophisticated animal models of metastasis and identifying sublines of tumour cells with variable organotropisms in order to identify various molecules related to metastatic heterogeneity, which are further demonstrated by functional experiments.

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