повышать или стабилизировать экспрессию лиганда программированной клеточной смерти 1 (PD-L1) опухолевыми клетками, тем самым косвенно снижая эффективность противоопухолевых иммунных реакций (Morein et al., 2020). Установлено, что активация CXCR4 связана с усилением иммуносупрессии при тройном негативном РМЖ (Lu et al., 2021). Авторы показали, что комбинация анти-PD-L1 с антагонистом CXCR4 с липосомным составом (liposomal-AMD3100) продемонстрировала повышенный противоопухолевый эффект и пролонгированное время выживания по сравнению с монотерапией анти-PD-L1 на мышиной модели тройного негативного РМЖ (Lu et al., 2021). Аналогичные результаты получены и другими авторами как на моделях РМЖ, так и рака яичников и поджелудочной железы (Feig et al., 2013; Chen et al., 2019; D'Alterio et al., 2019; Zeng et al., 2019).

ЗАКЛЮЧЕНИЕ

Таким образом, данные литературы свидетельствуют о том, что хемокин CXCL12 и его рецепторы CXCR4/CXCR7 играют важную роль в процессах роста опухоли, инвазии, метастазирования, опухолевого ангиогенеза, индукции ЭМП, модуляции противоопухолевого иммунитета, а также развитии лекарственной устойчивости. Эта ось является многообещающей мишенью для терапевтического вмешательства. Однако следует учитывать тот факт, что CXCL12 и его рецепторы играют важную роль не только в опухолевой прогрессии, но и в гомеостазе и воспалении, что предполагает значительную токсичность фармакологических препаратов, нацеленных на эту ось**.** Помимо этого, недостаточно изучена роль и функции CXCR7 в прогрессировании рака. Выяснение этих функций и их механизмов, несомненно, внесет вклад в разработку более совершенных противоопухолевых средств, нацеленных на ось CXCL12. В перспективе необходимо исследовать возможность адресной доставки для антагонистов CXCR4, что повысит их эффективность и уменьшит их побочные эффекты (Shi et al., 2020). Другим перспективным направлением является разработка радиофармпрепаратов, нацеленных на CXCR4, которые можно использовать как с диагностической целью (для визуализации опухоли и метастазов), так и с терапевтической (Yu et al., 2023).

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В работе не участвовали животные или люди в качестве объектов исследования.

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CHEMOKININ CXCL12 AND ITS RECEPTORS CXCR4 AND CXCR7 IN THE PROGRESSION OF BREAST CANCER

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Breast cancer ranks first in terms of cancer incidence and mortality among the female population. The main cause of death from breast cancer, as with other malignant neoplasms, is tumor dissemination and the development of resistance to treatment. Chemokines have been found to play an important role in the progression of malignant neoplasms. In this short review, we describe the current understanding of the role of the most studied chemokine, CXCL12 and its receptors, CXCR4 and CXCR7 in the progression of breast cancer.

Keywords: breast cancer, progression, chemokines, CXCL12, CXCR4, CXCR7