Background Breast cancer is a complex disease which is defined by an intrinsic heterogeneity at the histopathological and molecular levels, as well as in response to therapy. It remains the second leading cause of cancer death among women worldwide despite advances in screening, detection and new therapeutic options. Therefore, it is important to establish relevant preclinical mouse models to study new therapeutics and tumor biology. Genetically engineered mouse models (GEMMs) have been developed in order to understand the molecular, biochemical and cellular functions of oncogenes or tumor suppressor genes. However, the application of GEMMs is constrained due to the spontaneous nature of tumor onset and progression and high cost of breeding. Homograft tumor models, which are derived from and retain the histopathological and molecular features of GEMMs, can be used as faithful surrogates of human tumors.

Methods We generated a series of homograft tumor models from GEMMs overexpressing human epidermal growth factor receptor 2 (HER2, also known as ERBB2) or polyomavirus middle T antigen (PyMT) driven by the mouse mammary tumor virus (MMTV) promoter, or Simian Virus 40 T-antigen (SV40 Tag) under the promotion of the rat prostate steroid binding protein (C3(1)), which are commonly used GEMMs in preclinical breast cancer research.1 2 Models were generated by transplanting the mammary tumors into donor animals. Furthermore, we characterized the homograft tumors through histopathological analysis, immunohistochemical analysis, and immune profiling, as well as immunotherapeutic, cytotoxic and targeted therapy.

Results Nine breast cancer homograft models were developed from MMTV-ERBB2, MMTV-PyMT and C3(1)-Tag GEMMs, including six hormone receptor negative and HER2 positive models (mBR9013, mBR9026, mBR9027, mBR9028, mBR9029, mBR9030), one hormone receptor positive and HER2 negative model (mBR6174) and two triple negative models (mBR6004, mBR9014). Immune profiling of six models showed enriched macrophage infiltration in the tumor microenvironment. Immunotherapy treatment with anti-mPD-1 and anti-mCTLA-4 produced tumor growth inhibition (TGI) of 98% and 110%, respectively, in the triple negative model mBR9014, accompanied by tumor regression. HER2 targeted treatment with lapatinib produced robust response with TGI ranging from 48% to 97% in one HER2 negative and two HER2 positive models. Varying response to the cytotoxic treatments was observed among different models, with cisplatin producing robust response of TGI over 80% in all five of the tested models.

Conclusions We have generated and characterized a series of mouse breast cancer homograft models from GEMMs to facilitate both mechanistic investigation and preclinical testing of novel therapeutics.

Ethics Approval Animal experiments were conducted in accordance with animal welfare law, approved by local authorities, and in accordance with the ethical guidelines of Crown-Bio (Taicang).

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