PD-1-decorated nanocages with tumor draining lymph node targeting for anti-cancer immunotherapy

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Targeted delivery of an immunomodulatory molecule to the lymph nodes is an attractive approach to improve anti-cancer immunotherapeutic efficacy. In this study, to improve the therapeutic efficacy of the PD-1 blockade-based therapy, we designed nanocages by surface engineering to decorate a programmed cell death protein 1 (PD-1) that is capable of binding against programmed death-ligand 1 and 2 (PD-Ls). This nanocage-mediated multivalent interaction remarkably raises the binding avidity and improves the antagonistic activity, compared to soluble PD-1. Also, upon the desirable size of the nanocages for an optimal tumor-draining lymph node (TDLN)-targeting, we observed rapid draining and an increased accumulation into the TDLNs. Moreover, the interfering of PD-1/PD-Ls axis with the ultra-high affinity in the tumor microenvironment (effector phase) and the TDLNs (cognitive phase) significantly enhance the dendritic cell-mediated tumor-specific T cell activations. As a result, this successfully inhibits the tumor growth and induces complete tumor eradication in some mice. so, The delivery of immunomodulatory molecules with nanocages can be a efficient strategy to anti-tumor immunity.