A significant fraction of clusters of galaxies are observed to have substructure, which implies that merging between clusters and subclusters is a rather common physical process of cluster formation. It still remains unclear how cluster merging affects the evolution of cluster member galaxies. We report the results of numerical simulations, which show the dynamical evolution of a gas-rich late-type spiral in a merger between a small group of galaxies and a cluster. The simulations demonstrate that time-dependent tidal gravitational field of the merging excites non-axisymmetric structure of the galaxy, subsequently drives efficient transfer of gas to the central region, and finally triggers a secondary starburst. This result provides not only a new mechanism of starbursts but also a close physical relationship between the emergence of starburst galaxies and the formation of substructure in clusters. We accordingly interpret post-starburst galaxies located near substructure of the Coma cluster as one observational example indicating the global tidal effects of group-cluster merging. Our numerical results furthermore suggest a causal link between the observed excess of blue galaxies in distant clusters and cluster virialization process through hierarchical merging of subclusters.