Oxidized phospholipids (OxPLs) are known to be present in living organisms due to oxidative stress. However, the physiological function of OxPLs is still not fully understood. They have been shown to be present in many inflammatory diseases such as atherosclerosis and neurodegenerative diseases like Parkinson’s and Alzheimer’s disease. In this work we present the influence of two truncated OxPLs on the lateral heterogeneity of a model lipid membrane. Specifically, we studied the effect of 1-palmitoyl-2-(5'-oxo-valeroyl)-sn-glycero-3-phosphocholine (POVPC) and 1-palmitoyl-2-glutaryl-sn-glycero-3-phosphocholine (PGPC) on the formation of nanodomains present in giant unilamellar vesicles containing 1,2-dioleoyl-sn-glycero-3-phosphocholine (DOPC), cholesterol and sphingomyelin. Only few techniques are capable of detecting nanometer-sized domains in the membrane with high resolution. Time resolved Förster resonance energy transfer (TR-FRET) combined with Monte Carlo (MC) simulations provide a strong tool not only to detect lateral heterogeneities but also characterize them with the resolution of 2 nm. Profound effects on the nanodomain size were observed in the presence of both studied OxPLs and differences were detected, as PGPC with a carboxylic group drives formation of larger nanodomains than POVPC containing an aldehyde group. Furthermore, MC simulations were used to study symmetry of lipid bilayers.