Peptides represent a valuable class of compounds targeting protein-protein interactions (PPIs). Modulating these PPIs by peptide-based ligands can modify specific signaling pathways providing useful molecular imaging agents, and also safe and efficient drugs. However, peptides have often low stability *in vivo* and reduced brain permeation. The membrane-associated guanylate kinases (MAGUK) family of proteins are found enriched at the postsynaptic density (PSD) in the brain, and their function is related to learning, memory and also to the pathology of ischemic stroke. Recently, the peptide UCCB01-144 was developed as a high-affinity inhibitor of postsynaptic density/disks large/zonula-occludens (PDZ) domains of MAGUK members. In this thesis, we developed a radioligand for molecular imaging of the MAGUKs, based on UCCB01-144. First, we explored lipid modifications of UCCB01-144 to increase its stability and permeability through the blood-brain barrier. We found that even though lipidation can increase peptide stability *in vivo*, it can also induce hemolytic effects when conjugated to cationic cell-penetrating peptides. Next, we labeled UCCB01-144 with fluorine-18, and *in vitro* autoradiography images of this radioligand demonstrated specific binding in brain regions known to express MAGUK members. However, *in vivo* positron emission tomography (PET) imaging displayed low brain uptake and fast elimination. Finally, we returned to lipid conjugation as an attempt to increase radioligand uptake in the brain. Even though this new lipidated radiotracer showed a six times higher brain uptake than our first fluorine-18 UCCB01-144 derivative, we could not demonstrate specific binding *in vivo*. Our study has provided a new *in vitro* molecular imaging radioligand, and we expect that further improvements in peptide stability and membrane permeability would allow PET imaging of intracellular PPIs using peptide ligands