ABSTRACT

Fast changes in the extracellular concentration of neurotransmitters can arise from phasic neuronal firing, whereas long-lasting changes are associated with tonic firing. Dopaminergic neurons exhibit both of these firing patterns. Fast-scan cyclic voltammetry has been used to measure rapid changes in dopamine concentration in vivo, but it has not been able to access the absolute concentration of dopamine. We develop a technique; controlled-adsorption voltammetry, to overcome this limitation. The adsorption of dopamine to carbon-fiber microelectrodes is exploited to make measurements of its absolute concentration in vivo (limit-of-detection of 5 nM). Additionally, differences in the adsorption profiles for metabolites and interferences were characterized. The sensitivity for dopamine over DOPAC is approximately 50-fold and the sensitivity for dopamine over ascorbic acid is over 1000-fold, meeting selectivity requirements for in situ analysis. This technique is used to measure slow (tonic) changes in real-time and coupled with traditional fast-scan cyclic voltammetry to measure rapid (phasic) changes in dopamine neurotransmission. The pharmacology measurements validate the method and allow phasic and tonic concentrations to be tracked simultaneously at the same site in vivo.