THE EFFECTS OF NICOTINE ON BRAIN NEUROTRANSMITTER SYSTEMS

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1. INTRODUCTION

In spite of the fact that the effects of nicotine in the central nervous system have been the subject of many experimental studies, the precise mechanisms involved in the behavioral and centrally-mediated physiological responses to the drug are by no means fully understood. Clearly the interaction of nicotine with post-synaptic nicotinic receptors must play an important part in the production of its effects. However, it is increasingly obvious that many of its central effects are mediated through or are dependent upon changes in the secretion of a number of different neurotransmitters. The purpose of the present review is to summarize the available data on the effects of nicotine on brain neurotransmitter release and turnover and to attempt to examine the extent to which the changes observed can be related to the pharmacological properties of the drug. The vast majority of the work on this topic has been concerned with the effects of the drug on acetylcholine, the catecholamines and 5-hydroxytryptamine and this is reflected by the emphasis put on these transmitter systems in this review.

2. ACETYLCHOLINE

2.1. EFFECTS OF NICOTINE ON ACETYLCHOLINE RELEASE

There is clear evidence to show that the intravenous administration of nicotine to anesthetized cats alters the rate of acetylcholine (ACh) release from the parietal cortex. Using the cortical cup technique, first described by Mitchell (1963), Armitage and his co-workers (Armitage et al., 1968) showed that the injection of small multiple doses of nicotine (2 µg/kg every 30 sec for 20 min) invariably increased ACh release. In three out of six animals given a higher dose less frequently (4 µg/kg every min for 20 min) ACh release was also increased although, with this higher dose, a decreased release was observed in two other animals.

The mechanisms by which nicotine alters ACh release have not been fully explored although there is some evidence to suggest that nicotine-like compounds can release ACh from the storage vesicles of the nerve terminal (Chiou et al., 1970).

2.2. ACETYLCHOLINE RELEASE AND THE PHYSIOLOGICAL AND BEHAVIORAL RESPONSES TO NICOTINE

The nicotine-induced increase in ACh release from the parietal cortex appears to be associated with desynchronization of the cortical electroencephalogram whereas the reduced ACh release, observed in some of the cats given the higher dose of nicotine, was associated with a decrease in cortical activity (Armitage et al., 1968). A similarly complex