FACT SHEET: TOBACCO AND NERVOUS SYSTEM

Tobacco and Stroke

- Cigarette smoking is a preventable risk factor for ischemic stroke. Nicotine has been shown to alter the function of the blood–brain barrier (BBB) and stimulate DNA synthesis, which leads to endothelial cell proliferation.[1]
- Cigarette smoking, diabetes mellitus, ischemic heart disease, and valvular heart disease are causal risk factors for ischemic stroke and the association is strong, consistent, biologically plausible, and independent of other factors that were measured and analyzed.[2]
- Approximately one in three cases of sub-arachnoid hemorrhage (SAH) could be attributed to current smoking with a clear dose-dependent effect, but risks decline quickly after smoking cessation.[3]
- Past smokers had no increase in risk of total hemorrhagic stroke, intra-cranial hemorrhage, or SAH compared with never smokers.[4,5]
- Nicotine disrupts the tight junctions of the BBB and has numerous detrimental effects on endothelial components in the brain including mediators of thrombosis and leukocyte migration.[1]

Neuro-pharmacology of Nicotine

- The tobacco in manufactured cigarettes contains between 6 and 12 mg of nicotine. On average, a cigarette smoker absorbs into the body about 1 mg of nicotine per cigarette smoked.[6]
- Nicotine is shaped like the neurotransmitter acetylcholine so, it can fit in the nicotinic receptors and act just like acetylcholine.[7]
- Activation of nicotinic receptors could modulate the immune response either by activation of the hypothalamus–pituitary–adrenal axis or activation of the autonomic nervous system through sympathetic and parasympathetic innervations.[8]
- Nicotine attaches to the core neurons of the brain's reward system situated in the ventral tegmental area (VTA), where beneficial behaviors are rewarded and reinforced.[9]
- Nicotine activates dopamine systems within the brain by stimulating nicotinic receptors and triggering the production of dopamine in the nucleus accumbens (NAc).[9]

Tobacco and Neurodegenerative Diseases

- The risk of Alzheimer's disease decreased as the number of cigarettes smoked daily increased.[10]
- The protective association between smoking and Alzheimer's disease was restricted to patients with a family history of dementia and was independent of

cardiovascular history and potential confounding variables such as age, sex, and alcohol consumption.[10]

- Smoking was found to increase in the risk of multiple sclerosis (MS)[11,12] and clinical MS progression and the incidence increased with cumulative exposure to smoking.[12]
- Parental smoking at home was associated with a significant increase in the risk of first episode of MS in children.[12]
- A variety of mechanisms have been suggested to explain the association between smoking and multiple sclerosis, including immune stimulation or suppression, direct effect of cigarette smoke components on the blood–brain barrier, nicotine effect on microvascular blood flow in the brain, direct toxic effects on the central nervous system through cigarette smoke components like cyanide and NO, etc.[11,12]

References:

1. Hawkins BT, Brown RC, Davis TP. Smoking and ischemic stroke: a role for nicotine? Trends Pharmacol Sci. 2002; 23:78–82.
2. Hankey GJ. Potential new risk factors for ischemic stroke: what is their potential? Stroke. 2006; 37:2181–8.
3. Anderson CS, Feigin V, Bennett D, Lin RB, Hankey G, Jamrozik K. Active and passive smoking and the risk of subarachnoid hemorrhage: an international population-based case-control study. Stroke. 2004; 35:633–7.
4. Kurth T, Kase CS, Berger K, Schaeffner ES, Buring JE, Gaziano JM. Smoking and the risk of hemorrhagic stroke in men. Stroke. 2003; 34:1151–5.
5. Kurth T, Kase CS, Berger K, Gaziano JM, Cook NR, Buring JE. Smoking and risk of hemorrhagic stroke in women. Stroke. 2003; 34:2792–5.
6. Benowitz NL. Cotinine as a Biomarker of Environmental Tobacco Smoke Exposure. Epidemiol Rev. 1996; 18:188–204.
7. National Institute on Drug Abuse. Brain Power! Challenge: Grades 6-9; Module 2: Legal Doesn't Mean Harmless. Available at: http://www.drugabuse.gov/JSP4/MOD2/page3.html
8. Sopori M. Figure 3. A simplified schematic of possible communication between the CNS and the immune system through nicotinic acetylcholine receptors. In: Effects of cigarette smoke on the immune system. Nat Rev Immunol. 2002; 2:372–7. Available at: http://www.nature.com/nri/journal/v2/n5/fig_tab/nri803_F3.html
9. School of Chemistry, Bristol University, UK. The Metabolism of Nicotine. Available at: http://www.chm.bris.ac.uk/motm/nicotine/E-metabolisme.html
10. van Duijn CM, Hofman A. Relation between nicotine intake and Alzheimer's disease. BMJ. 1991; 302:1491–4.
11. Hawkes CH. Smoking is a risk factor for multiple sclerosis: a metanalysis. Mult Scler. 2007; 13:610–15.

12. Mikaeloff Y, Caridade G, Tardieu M, Suissa S on behalf of the KIDSEP study group. Parental smoking at home and the risk of childhood-onset multiple sclerosis in children. Brain. 2007; 130:2589–95:1–7.