The 'Terminal Rat': Where Addiction Occurs

Among the most intriguing and puzzling functions of the brain is its interaction with narcotics and its own apparent production of narcotic-like neurotransmitters. Scientists believe they have pinpointed specific areas within the brain that utilize various opiates — from both externally injected drugs and brain-manufactured peptides. The areas include parts of the thalamus, brain stem, dorsal spinal cord, amygdala, caudate and others.

Although the behavioral functions of such brain circuits remain relatively unexplored, observations of drug effects indicate that various centers mediate euphoria, sedation and pain-killing functions as well as certain reflexes and neuroendocrine roles. Electrical stimulation of a portion of the upper brain stem's gray matter —the "periaqueductal gray"—has already been shown to produce analgesia in humans. And animal experiments with several other opiate-related brain centers suggest that electrical stimulation can trigger behavioral effects similar to those produced by narcotic drugs themselves.

Aware that such findings (particularly the animal results) can conjure up visions of a "terminal man" and other types of futuristic mind control possibilities, scientists tend to stress the "preliminary" nature of such experiments and the "tentativeness" of the results.

It was with such caution that researchers Diane Avallone of Hunter College and Eliot L. Gardner of Albert Einstein College of Medicine in New York reported their work in Washington last week at the annual meeting of the Eastern Psychological Association. Nevertheless, their results appear to link—through brain stimulation — opiate tolerance, dependence and addiction with altered states of function in specific brain areas.

In the first of a planned series of experiments with morphine-addicted male albino rats, Avallone and Gardner report that they significantly decreased opiate withdrawal symptoms by electrical stimulation of one of two brain areas — the mid portion of the dorsal thalamus in the central brain; and the periaqueductal gray. "This might suggest," says Gardner, "that certain aspects of [narcotic] tolerance and dependence might involve modulation of certain brain areas." He emphasizes, however, that the results are "very preliminary."

Two sets of rats underwent surgical implants of electrodes in one of the two specified brain areas. The animals were then progressively injected with increasing morphine doses until they were maintained at 600 milligrams per kilogram per day. Morphine was then withheld, and the rats went into characteristic withdrawal symptoms such as jumping, teeth chattering, "wet dog shaking," eye fluttering, writhing, self-grooming, swallowing and chewing.

In a series of five-minute observation periods, the researchers noted the rats' behavior during alternate periods of electrical stimulation and nonstimulation of the key brain areas. (The majority of rats in this study had implants in the dorsal thalamus, an area previously implicated in experiments with the narcotic antagonist naloxone.) They found that "during the five-minute observation period immediately following brain stimulation a significant [more than 50 percent] decrease in opiate withdrawal symptoms was observed."

Avallone, who conducted the work under Gardner's supervision, concedes that some might argue that the thalamus has little to do specifically with addiction and may simply produce general calmness when stimulated. But, she says, the achievement of the same results with the periaqueductal gray, plus the previous findings of others "tend to militate against this possibility."

Even among their research colleagues, the work raises questions about possible unforeseen effects of brain manipulation. "Could the stimulations be addictive in themselves?" asked one scientist. Avallone said there was no such indication in her experiments. "The more we know about exact areas where addiction is taking place," she told SCIENCE NEWS, "the more our chances are enhanced of producing nonaddictive drugs more effective than present ones." □

'Pot' with paraquat may pose health hazard

Smoking marijuana contaminated with the herbicide paraquat may cause permanent lung damage, according to the National Institute of Drug Abuse. In reversal of an earlier opinion, which was based on preliminary toxicology tests (SN: 12/31/77, p. 425), NIDA now says there may be a significant health hazard to heavy "pot" smokers — those who smoke three to five "joints" (marijuana cigarettes) per day — and will not rule out some risk to less frequent users. That puts a lot of people at risk, since NIDA estimates that more than 16,000 people smoked pot during the last 30 days.

The Mexican government, which considers marijuana its top priority "drug" problem, has been trying to eradicate it by spraying fields with the extremely toxic herbicide. Congressional inquiry last year aroused concern about whether pot entering this country might contain paraquat residues. As a result, NIDA toxicologists tested samples of marijuana confiscated in the Southwest by law-enforcement officials.

Of 63 samples, 21 percent contained paraquat in levels ranging from 3 parts to 2,000 parts per million; the average was 450. Although paraquat breaks down under heat, NIDA now estimates that two percent to three percent survives in the smoke and may be inhaled.

Kenneth Powell of the Center for Disease Control in Atlanta says that this remaining two percent to three percent corresponds to a possible 700 nanograms of paraquat in joints contaminated at the 2,000 ppm level and that a person smoking three to four joints per day could inhale a microgram. Rats given one microgram per day develop pulmonary fibrosis, irreversible scarring of the lungs, Powell told SCIENCE NEWS. If the damage becomes extensive, significant shortness of breath results, he said. But because the body contains "considerable lung reserve," he said, "a fair amount of damage might take place before any symptoms occur."

NIDA says there are no documented cases of human paraquat poisoning from pot. Last week, however, the Washington Post reported that three cases of apparent paraquat poisoning had turned up only days earlier at the Haight-Ashbury Free Medical Clinic. A problem, Powell says, is that although tiny amounts of paraquat can be measured in marijuana smoke, the same amounts are probably too small to be detected once they enter the body, so it may be impossible to tell in any particular case whether poisoning symptoms are due to paraquat.

As a result of this renewed paraquat scare, PharmChem, a Palo Alto, Calif., "street" toxicology laboratory offering anonymous drug analyses, has been flooded with thousands of samples. PharmChem says 17 percent of the tested samples contained paraquat, although it does not know at what levels. Positive samples came from all over the country.

NIDA, which will not analyze individual drug samples, suggests that concerned smokers contact their local drug abuse center for names of nearby street toxicology labs. Although many such labs have come to the agency in the last two weeks requesting information on how to perform paraquat analyses, PharmChem is still the only lab NIDA knows which performs the test now. □