The Dopamine Dilemma

Trying to tease out what each of these chemical messengers does from this tangled web of wide ranging neurotransmitter interrelationships is impossible, as illustrated by the very versatile dopamine. So much has been written about the role of dopamine in sex, love, compulsive gambling, smoking, drinking, and other addictions that provide pleasure, that a movie was devoted to it. The prize winning Dopamine, which premiered at the 2003 Sundance Film Festival explores whether all of the above are merely different manifestations of dopamine activities and if romantic love is also just a chemical response.

Dopamine can have varied and even contradictory effects, including: promoting feelings of rage or falling in love, making people more talkative and irritable, depressed, schizophrenic, decreasing blood flow to the gut and coordinating muscle movements. These and other responses depend on where dopamine is located and which nervous system pathways are either stimulated or suppressed.

A 2000 Nobel Prize was awarded to three scientists who showed that dopamine improved learning and memory and that Parkinson's disease was due to a deficiency of dopamine in a certain portion of the brain. This led to the discovery of L-dopa, which is converted to dopamine in the brain as a treatment for Parkinson's. In one animal model of severe Parkinson's, rabbits that had been in a sustained stupor awakened rapidly following injections of L-dopa.

This was the basis for Awakenings, a 1990 movie based on a book by Oliver Sachs. A disorder similar to Parkinson's disease was seen following the Spanish flu pandemic after World War I that killed up to 40 million people and caused encephalitis that left many others in a permanent coma. In the movie, Robin Williams, a neurologist assigned to a ward of such patients, decided to try L-dopa on Robert Di Niro who had been sleeping for 30 years. The movie describes how he suddenly awakes to find that he is no longer a teen-ager and how he and other treated patients try to cope with this strange new world.

Dopamine deficiency in other parts of the brain can cause depression, which is also common in Parkinson's. While most attention has focused on correcting low serotonin levels drugs that boost dopamine and noradrenaline are also effective. Since these three monoamines are converted to one another in the brain it is difficult to determine which is being affected. Drugs like Effexor target both serotonin and noradrenaline and Wellbutrin raises levels of all three but particularly dopamine.

In addition to its antidepressant effects, Wellbutrin has also been found effective in treating addictions. Zyban, a sustained release version is used to aid smoking cessation. Dopamine is strongly associated with reward and learning mechanisms because you don't learn as well if you're not rewarded. Zyban works best in patients who are not motivated as opposed to primarily being anxious. Cocaine and other addictive drugs increase dopamine by binding to sites that remove it but as these effects wear off, more is craved. Anti-Parkinson drugs that work in a similar fashion are also associated with an increased incidence of compulsive gambling, shopping, eating and sex that disappear when dosages are lowered. Some believe that the high rate of drug use and smoking in people with eating disorders could be partly explained by their increased need for dopamine. In one study, obese individuals had less dopamine receptors than controls of normal weight and the heavier the individual, the fewer the receptors.

Schizophrenics have increased amounts of dopamine in the frontal lobes and a shortage here is associated with poor memory. Too much dopamine in the limbic system and not enough in the cerebral cortex can produce an overly suspicious personality given to bouts of paranoia or may inhibit social interaction. Most antipsychotic drugs are dopamine antagonists that can have strange side effects. Risperdal, one of the most popular, was recently found to induce lactating breasts in young males, in addition to the more common complaints of drowsiness, dizziness, nausea, weight gain, constipation, nervousness, fatigue and difficulty in concentrating and sleeping.