'Brain food' boosts neurotransmitters

As brain research advances, it becomes increasingly apparent that neurotransmitters play key roles in both the emotional and physical behavior of human beings. These chemical signal carriers of the brain have already been implicated in emotional disturbances and mental health problems. Translating relatively new-found knowledge into practical applications, however, is almost always a lengthy process. Historically, the transformation of basic science into clinical treatment frequently has taken a generation or more.

But that is not always the case. In less than three years, one laboratory breakthrough in knowledge about a neurotransmitter has carried Massachusetts Institute of Technology scientists to the threshold of widespread treatment of certain mental hospital patients. "It's surprising that we've been able to manipulate something as important as a chemical transmitter by administering a nutrient," Richard J. Wurtman, director of MIT's Laboratory of Neuroendocrine Regulation, said in an interview.

The transmitter in this case is acetylcholine; the nutrient is its chemical precursor, choline, which is found in eggs, meat and fish. The major source of choline is lecithin, present within those foods. It is also added, for its emulsifying properties, to most chemically prepared foods.

Abnormally low levels of acetylcholine in the brain are believed to be primarily responsible for tardive dyskinesia (TD), a condition marked by involuntary twitching of the face, tongue, arms and legs. TD is fairly common among chronic mental patients who have taken antipsychotic drugs for a substantial period of time. Scientists also believe that inadequate acetylcholine production may be linked to other ailments such as mania and memory loss.

After discovering in 1975 that feeding choline to rats increased formation of acetylcholine in the brain, Wurtman, John Growdon and several other MIT researchers tested the nutrient (against a placebo) on 20 TD patients at Medfield State Hospital in Massachusetts. The results of the two-week test, published in the Sept. 8, 1977 NEW ENGLAND JOURNAL OF MEDICINE (pp. 524-527), showed that nine of the patients exhibited major improvements, 10 were unchanged and one had a worsening of symptoms.

In that study, each patient received 10 to 12 miligrams a day of choline in capsule form. However, in a yet-to-be-published study, Growdon is finding that lecithin — mixed in with puddings and other foods — "seems to be even more efficient" than pure choline in increasing the brain's production of the neurotransmitter and suppressing TD symptoms.

Growdon told SCIENCE NEWS that lecithin is more effective because, unlike pure choline, much of it is not broken down by bacteria in the intestine. This could maintain the choline's potency in boosting the blood and brain choline levels, and is found to eliminate the "rotten fish" side effect — an unsavory smell produced by the gut bacterial breakdown.

TD has been known to subside naturally in some cases, but in many instances of chronic antipsychotic drug use the development of the ailment has been virtually untreatable. Anti-Parkinson disease drugs have worked with only a few TD victims, and one drug, physostigmine, lasts for only a short time and carries side effects such as abdominal pain and nausea. However, physostigmine's effect of blocking the enzyme that kills off choline in the brain was among the key discoveries concerning acetylcholine's critical role in the onset of TD.

"We're not talking cure here, we're talking suppression — an average decrease in symptoms of 50 to 75 percent," Growdon says. Nevertheless, he and Wurtman are excited about the work, for both its clinical and purely chemical significance. The direct effect of a nutrient/precursor administered through the digestive system upon the production of a brain transmitter was unexpected, Wurtman says. "We know of no hormone that acts that way."

Other preliminary experimental results also indicate that enhanced acetylcholine production might also help in restoring memory deficit in the senile, as well as in controlling manic episodes, Wurtman says.

And, in the course of their studies, the MIT researchers have also "stumbled" on another possible benefit of lecithin: It appears to lower cholesterol levels. The scientists subsequently found that German researchers observed the same reactions and are already studying that aspect of lecithin therapy. "It's not our main interest, but it might be an unexpected bonus," Growdon says.

The MIT group is currently "tooling up" to examine all the possible effects of acetylcholine enhancement over a long-term treatment period (the longest so far has been several months). "This is a new treatment with unknown long-term effects," Growdon says. "We're casting our net as widely as possible." □

Sickled cells: More than one culprit

Most scientific evidence to date suggests that sickle cell anemia is due to a single genetic mutation in hemoglobin present in red blood cells. It seems that the amino acid valine substitutes for glutamic acid in the sixth position of the beta chain of hemoglobin proteins. These abnormal hemoglobin proteins then purportedly distort red blood cells into sickle (crescent) shapes during sickling crises. The sickled cells clog blood vessels, causing excruciating pain and tissue damage.

But sickle cell anemia can produce a wide variety of symptoms in persons who have inherited the genetic trait for abnormal hemoglobin from both parents. For instance, one 14-year-old girl experienced many severe sickling crises in her short life span and needed blood transfusions. In contrast, a 23-year-old man with the disease had never once experienced a sickling crisis. Then a 25-year-old woman had undergone some crises, but only during the past few years, constituting an intermediate rather than an unstable or stable sickler. So how can a sole genetic defect produce such a gamut of disease expression?

The answer may have been found by Carl A. Luer and Kin-Ping Wong of the University of Kansas Medical Center in Kansas City. Their research is scheduled to appear in BIOCHEMICAL MEDICINE. Sickle cell anemia is not caused exclusively by a genetic defect in the hemoglobin beta chain, their findings suggest, but is also due to altered proteins in the membranes surrounding red blood cells.

Luer and Wong obtained red blood cell membranes from one healthy subject; two carriers of sickle cell anemia, one of whom displayed symptoms of the disease with occasional joint pains; one carrier of Beta-thalassemia, another kind of hemoglobin disease; and from three other patients with sickle cell disease, who showed mild to severe disease symptoms.

The researchers attempted to see whether there were differences in the various membranes' proteins. They found that there were. The membrane protein profile for the healthy subject, the Beta-thalassemia carrier, the healthy sickle cell carrier and a sickle cell patient with mild symptoms were similar. In contrast, the red cell membrane proteins for the sickle cell carrier with occasional problems and for the sickle cell patients with moderate or severe symptoms were strikingly different, not only from normal membrane proteins but also from each other. What's more, the proteins differed in both quantity and quality. Thus, alterations in red cell membrane proteins appear to be directly related to the severity of sickle cell disease or its carrier state, ruling out the conventional notion that the disease is due exclusively to a genetic defect in hemoglobin proteins.

Further studies of red cell membrane proteins in sickle cell patients with varying degrees of disease now need to be conducted to better understand the molecular basis of the disease, and also to explore the possibility of treating the disease via the red cell membrane proteins. □