Coma as a legitimate brain activity

A person hit hard on the head, typically in an automobile accident or a fall, often loses consciousness. When the victim is completely unresponsive for an extended period — with eyes closed and no recognizable speech — physicians describe the condition as coma. Most speculations about this unconscious state consider brain activity to be depressed, especially in the brainstem, the site of awareness functions. But now scientists have evidence that coma results from activation of a specific brain system that suppresses normal behavior.

Hayes

During a coma, specific sites (arrows) increase their metabolic activity, while most brain metabolism is depressed. In this slice of cat brainstem, dark areas represent high metabolic activity.

Existence of a coma-producing brain center suggests that unconsciousness may be something other than a destructive process to be avoided at all costs. Ronald L. Hayes of the Virginia Commonwealth University in Richmond speculates that such a system might afford survival value of two types. First, if a head injury disrupts the brain's control of behavior, an injured animal would best avoid predators and further injury by remaining immobile, playing dead. Second, because brain injuries frequently depress respiration, unconsciousness prevents active muscles from competing with the brain for the limited oxygen available.

Hayes, Donald P. Becker and colleagues examined head injury experimentally produced in anesthetized cats by pressure against the membrane surrounding the brain. This experimental concussion temporarily made the cats "totally unarousable," Hayes says. Measurement of glucose metabolism in the brain (SN: 1/31/81, p. 76) revealed depressed brain activity in most regions. However, the scientists were surprised to find increased activity at one pair of brainstem sites, called the pontine ventral tegmental nuclei. These sites are near areas implicated in the inhibition of muscle activity during sleep.

A second line of evidence also suggests that coma results from specific brain activity. The areas showing increased metabolism during unconsciousness contain cells using the chemical acetylcholine to transmit a signal to other cells. At the meeting in Minneapolis of the Society for Neuroscience, Hayes and co-workers report they injected into these brain sites small amounts of a chemical that mimics acetylcholine. They found that in less than four minutes the cats appeared comatose, and they recovered in less than 20 minutes. The unconscious animals could not be aroused even by normally painful stimuli. But after an injection of atropine, a chemical that blocks acetylcholine, they became conscious again.

Scattered reports from other laboratories also implicate acetylcholine-containing nerve cells in unconsciousness after experimental head injury in animals, Hayes says. There is even a 1950 report that high doses of atropine abolish coma following human brain injury, but it is not clear the treatment benefited the patients in the long run.

Hayes says, "Improved understanding of the mechanisms underlying traumatic unconsciousness could provide insights into the treatment of concussive brain injury. In addition, these studies can provide important information on brain mechanisms regulating normally occurring changes in states of consciousness." —*J.A. Miller*

EPA in Superfund squabbles

The Environmental Protection Agency continues to generate controversy over its handling of the billion-dollar "Superfund," created two years ago by Congress for the cleanup of chemical dumpsites around the country. While the agency's critics charge that implementation of Superfund programs has been sluggish and that many important hazardous waste regulations have been dangerously loosened, the EPA contends that it is merely streamlining procedures for greater efficiency. Both sides of this dispute are reflected sharply in several events of recent weeks: one an apparent enforcement victory for the EPA, and three others that have led to harsh criticism of the agency's actions.

- The EPA announced that 24 companies have agreed to provide $7.7 million for the cleanup of a dumpsite in Seymour, Ind., one of the largest hazardous waste facilities in the country. EPA Administrator Anne M. Gorsuch hailed the out-of-court settlement with her agency as "an important indication of the success of EPA's [enforcement] policy," which has stressed such "voluntary" cleanups over stricter measures such as lawsuits.
- The Environmental Defense Fund released EPA documents revealing that the agency recently refused to provide Superfund money for an emergency cleanup of PCBs in Fort Smith, Ark. Oil contaminated with large amounts of the toxic chemical had been spread to control road dust in a residential area, but EPA official Rita Lavelle argued that the situation did not warrant emergency action by her agency because lethal exposure was unlikely. "In order for a child to consume an acute lethal dose of PCBs," Lavelle wrote, "the child would have to eat about 150 grams of oil-laden dirt, the equivalent of about three candy bars."

Ellen Silbergeld, the Defense Fund's chief toxicologist, called Lavelle's statements "callous and irresponsible," pointing out that by the EPA's own estimates of PCB toxicity, many area residents could absorb doses high enough to cause such injuries as liver dysfunction and skin lesions.

- The Environmental Defense Fund obtained and made public an EPA briefing paper that indicates a possible relaxation of EPA's standards on dioxin, an extremely toxic chemical described by the EPA itself as one of the most potent carcinogens known. The paper detailed options being considered by the EPA in its Superfund cleanup of contaminated sites in southeastern Missouri. One of the options is to allow dioxin concentrations of up to 100 parts per billion to remain in the soil after cleanup — roughly 10,000 times the levels allowed by the EPA at the Hyde Park and Love Canal waste sites in New York State. Silbergeld calls the possible change "beyond the range of what anyone could sensibly think of. The EPA documents show that the reason this option is being looked at is cost alone — it's not based on any new scientific evidence."

These disclosures have prompted Rep. John Dingell (D-Mich.) to call for hearings before the House energy committee's subcommittee on oversight and investigations, which he heads. The Arkansas and Missouri incidents, he says, "demonstrate serious problems with the EPA's commitment to protect the public health and safety."

- Dingell is also continuing to press a separate investigation by his subcommittee into the EPA's overall management of Superfund programs, spurred in part by the agency's declining record of prosecutions in waste violation cases. Dingell has ordered Gorsuch to turn over EPA documents dealing with Superfund operations at several major dumpsites in California, Michigan and Oklahoma. But Gorsuch so far has refused, arguing that the documents disclose EPA legal strategies that could compromise the agency's enforcement efforts if made public. Dingell disagrees about the sensitivity of the documents, and says that the EPA is "throwing roadblocks at an important congressional investigation." —*R. Pollie*