Biomedicine

Diane D. Edwards reports from San Diego at the 29th annual American Cancer Society science writers' seminar

Still looking for cancer immunotherapy

An estimated three out of four families in the United States will be directly affected by cancer, says the American Cancer Society. But, thanks to aggressive cancer research, innovative approaches to cure and treatment of the disease have improved the chances of survival. Last week, scientists presented recent data on potential treatments — particularly those involving the immune system.

In cancer, immune therapy may involve stimulating the patient's own response, or substituting for that response with outside factors like antitumor antibodies. Monoclonal antibodies — made by tumor cells joined to antibody-producing cells — are possible anticancer candidates.

However, those present at the seminar agreed that the use of monoclonal antibodies alone may be neither potent enough nor specific enough in treating cancer. To bolster the antibodies' effect, Jack A. Roth, from M.D. Anderson Hospital and Tumor Institute in Houston, suggests that linking those antibodies to substances that are toxic to cells will form an immunotoxin capable of selectively destroying cancer cells.

In animal experiments, Roth has successfully treated metastases (cancer spread beyond the initial site) using an immunotoxin made from a monoclonal antibody against the tumor, and with a plant product called ricin, which inhibits protein synthesis; one molecule of ricin can kill a cancer cell. The antibody alone does not kill the tumor cells, but the hybrid antibody-ricin reduces the number of tumor cells by 1,000- to 10,000-fold, says Roth. And adding a veterinary antibiotic called monensin to the treatment system increases the immunotoxin's killing ability another 10-fold.

Moving immunology from the laboratory into the operating room, a team at the Huntington Medical Research Institutes in Pasadena, Calif., is treating primary malignant brain tumors with surgery followed by insertion of stimulated immune cells. The invariably fatal brain tumors appear in about 15,000 new cases each year in the United States, with an average life expectancy of one year following initial diagnosis.

According to Huntington's Deane B. Jacques, immune cells taken from the patient's peripheral blood are stimulated with interleukin-2 and then replaced into the brain. Interleukin-2 causes white blood cells to turn into cancer-killing cells. The procedure is similar to an immune-stimulating approach developed at the National Cancer Institute in Bethesda, Md. (SN: 12/7/85, p.359), with differences in the type of interleukin-2 and cell populations used. Another aspect that distinguishes the Pasadena technique is that the stimulated cells are not administered throughout the body, but are placed directly into the hole left by the excised tumor.

For brain tumor patients, life is measured in days rather than months or years. But Jacques's patients survived longer than the three-month life expectancy often seen following failure to respond to conventional treatment. (All the patients studied had previously been treated with conventional therapy, including surgery and radiation.) Of the first 19 patients treated, nine are still alive, with an average survival time of 55 weeks. Those who have died of their disease survived an average of 38 weeks. In some, the tumors continue to shrink months after the special surgery, which appears to have minimal toxic effects on the body, says Jacques.

Jacques admits that the procedure is "highly experimental," with much to be learned about optimizing it. Because two patients had remained free of tumors for about two years following immunotherapy, the physicians had hoped the cancer had been cured. But a patient who apparently had been free of tumors for two years returned last month with new malignant growth, and Jacques says he now questions whether "cure," rather than just prolonging life expectancy, is possible.

Space Sciences

Jonathan Eberhart reports from Houston at the Lunar and Planetary Science Conference

Comets: Life in an imperfect icebox

Comets often are described as examples of the most pristine material in the solar system, preserved in the permanent deep-freeze of space since the system's earliest days. Yet this does not necessarily mean that they are absolutely perfect relics, surviving unaltered since their formation.

Though comets are widely believed to reside largely at the system's outermost fringes in a region known as the Oort cloud — except for those few that are sent in toward the sun by the gravitational influences of passing stars — some researchers have proposed in recent years that there may be factors causing them to change from their original state. High-energy radiation, for example, as well as impacts by solid grains of interstellar material, could be chipping away at cometary surfaces, while penetration by the charged particles of galactic cosmic rays could be having an effect farther in.

Now two additional possibilities have been suggested by Alan Stern of the University of Colorado in Boulder. These factors, he says, could make significant changes in a comet's just-born appearance in as little as a billion years, about one-fifth of the estimated age of the solar system.

One such possibility is the heat of passing stars, which could be evaporating volatile materials such as carbon dioxide and nitrogen with even a tiny increase in warmth. "We think we're talking about a perfect icebox," says Stern, "but someone comes along and leaves the door open from time to time." Though passage through the Oort cloud by numerous stars with luminosity like our sun's would have "processed" only "an insignificant fraction" of the cloud's comets, according to Stern, the far smaller number of stars that are 1,000 to 1,000,000 times brighter could have far-reaching effects. Based on the relative populations of different stellar luminosity classes, Stern finds it "statistically likely that all comets in the Oort cloud have been [heated] to 27 kelvins [−246°C] at least once, and that 20 to 40 percent of all Oort comets have experienced at least one episode of surface heating to 50 K [−223°C]." As few as 50 to 100 stars with 10,000 times the sun's luminosity may ever have been through the cloud, he says. But he notes that such a star can evaporate methane, a presumed cometary constituent, from as far away as 20,000 astronomical units, about 40 percent of what some researchers estimate to be the cloud's diameter. Other possible components, such as nitrogen, carbon monoxide, argon and neon, could be vaporized even more easily. "This finding is important to understanding the behavior of new comets approaching the sun," says Stern, "and is in accordance with the lack of observed methane and nitrogen volatiles in long-period comet spectra."

Another factor that may have been at work changing the faces of comets since the day they were born is collisions, not so much the rare ones between comets but those between comets and the much larger number of small chunks and chips that may reside in the Oort cloud. Calculating the mean time between collisions of different-sized chunks (and assuming a population of 10^{14} and 10^{12} objects, respectively, in the cloud's inner and outer portions), Stern finds in his model that there are no pristine objects at all that are smaller than about 10 meters across. In addition, a "large fraction" of the surface area of the larger, surviving objects has been heavily "gardened," or scarred, by impacts from the littler bits. Even those collisions are relatively rare, he notes. But he adds, although "an impact per thousand years may not sound like much, over the age of the solar system there could have been lots of them."

Stern's next question, which he is investigating together with colleague Michael Shull, is that of how such "evolution" may actually be affecting the comets themselves, as well as the interstellar medium — the not-quite-empty space between them.