Protein found to stimulate bone growth

A group of California scientists reports it has isolated a potent chemical, a protein found in human bone, that stimulates bone growth and might be responsible for regulating the body's normal bone destruction and rebuilding process.

The protein, called skeletal growth factor (SGF), was isolated and tested by John R. Farley, David J. Baylink and colleagues at Loma Linda University in California.

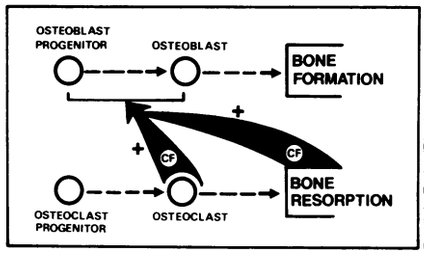
Baylink explains that in normal adults, bone is constantly being destroyed and renewed at equal rates. Many scientists believe a "coupling factor" exists that regulates this process so that the right amount of bone volume is maintained. Baylink and Farley believe that SGF is such a factor. They propose that destroyed bone releases SGF, which stimulates growth of osteoblast cells, which in turn lay down new bone. The researchers report in the July 16 BIOCHEMISTRY that SGF increased the growth rate of bone cells taken from human hip bone by 1,000 percent but had no effect on human skin cell growth. The group previously reported that embryonic chicken bone exposed to SGF showed an increased growth rate of almost 200 percent over that of controls.

If SGF is a coupling factor it might have important implications in the detection and treatment of certain bone diseases. "Most of the bone diseases we see are abnormalities of too much bone or too little bone, so the mechanism that would regulate bone volume could be very important," Baylink says.

According to Guy Howard, who studies the protein at the University of Washington in Seattle, SGF might ultimately help physicians diagnose and treat osteoporosis, a common debilitating bone disease characterized by lower than normal bone formation. Howard says researchers believe osteoporosis patients have lowered amounts of the coupling factor. If that were true, he says, doctors could measure the amount of coupling factor in a suspected osteoporosis patient and take steps to treat the disorder early. Right now, most osteoporosis patients are diagnosed after the disease has progressed enough to show porous or broken bone on X-ray film, according to Howard.

Baylink says that preliminary results measuring SGF in bone disease patients look promising. In early experiments with patients having Paget's disease (a disorder characterized by higher-than-normal bone destruction), the group has found abnormally high levels of SGF. Baylink says this is what one would expect if SGF is a coupling factor; bone destruction would release increased amounts of the coupling factor, which in turn leads to increased bone formation. In fact, Baylink says, these patients have deformed bones that are sometimes twice the normal size.

Baylink admits there is much skepticism in the scientific community about whether SGF is indeed a coupling factor. He says, "We have reservations about what its function might be. At the very least it has some function in fracture repair." Though the evidence that SGF acts as a coupling factor is compelling, he concedes that it is still mostly circumstantial. Marshall Urist, a bone researcher at the University of California at Los Angeles medical school, says he is not convinced that the protein Baylink's group has isolated is a coupling factor. "There is no proof that it [SGF] is actually connected to bone resorption," he says. To date, researchers haven't been able to prove that bone destroyed or resorbed *in the body* releases SGF or that SGF stimulates bone cell growth in the body. Howard says all research has been done on bone cells in the laboratory and that no one knows how SGF functions *in vivo*. He says research proving SGF's function *in vivo* would be technically difficult and that the best evidence that SGF is a coupling factor may be circumstantial. —*K.A. Fackelmann*



Baylink, Farley/Biochemistry

A model of Baylink and Farley's coupling mechanism in bone. They suggest that SGF, a large molecular-weight protein molecule, regulates bone formation/resorption by stimulating bone cells called osteoblast progenitors, which produce osteoblast cells. Baylink's group believes SGF is probably released during bone resorption by the bone itself, but may be released by bone-destroying osteoclast cells.

Attractions of a polyhelical magnet

To study the magnetic properties of matter, any and all kinds of matter, it is necessary to provide the magnetic fields that make those properties do whatever it is they do. There is a continuing need for stronger and stronger fields. At last week's 3rd Joint Intermag-Magnetism and Magnetic Materials Conference in Montreal, H.D. Schneider-Muntau of the Max Planck Institute in Grenoble, France (a laboratory supported jointly by the French National Council for Scientific Research and the German Max Planck Society) reported a new record for an electrically resistive magnet, 25 tesla, with a new kind of magnet design, the so-called polyhelix. (One tesla equals 10,000 gauss or about 20,000 times the average strength of the earth's magnetic field.)

Steady, reusable magnets come in two kinds, resistive and superconducting. Superconducting magnets have the advantage of producing relatively strong fields with very little power expenditure, because of the resistanceless quality of the coils that generate the field. But superconducting magnets carry their own doom inside themselves. Superconductivity and magnetism are generally incompatible. One tends to drive the other out. When the field of a superconducting magnet reaches a certain critical strength (depending on the metal or compound in the coils), it destroys the superconductivity, and the magnet goes kaput. Superconducting magnets are effective up to between 11 and 13 tesla, Schneider-Muntau says.

Resistive magnets can do better, provided there is a design that will stand the heat and the electrical and mechanical stresses, and provided the requisite power can be supplied. It took 10 megawatts of power (or 10,000 kilowatts for those who like to figure the electric bill) to get 25 tesla out of the new Grenoble magnet. Only two magnet laboratories in the world can supply that much power to a magnet, says Schneider-Muntau, Grenoble and the Francis Bitter National Magnet Laboratory in Cambridge, Mass.

The usual design for high-field resistive magnets has been the Bitter magnet, named after its inventor, the late Francis Bitter. This is basically a stack of circular copper plates interleaved with insulation. The plates look something like phonograph disks, having a large hole in their centers, the bore, in which experimental material is placed. The plates are connected to each other in such a way that the current flows around the top plate, descends to the next, flows around it, descends again and so on in a helical path until it comes to the other end.

The strength of field that can come out for a given power input without having the magnet tear itself apart depends on a complicated balance of electrical, mechanical and thermal properties. The Grenoble people found that they could improve on the Bitter design by slicing the disks into concentric rings and connecting the rings vertically; instead of the single, wide-ribbon helix of the Bitter design, they get an arrangement of concentric narrow-ribbon helices electrically insulated from one another. (Cambridge did manage to reach 25 tesla with a Bitter design, says Schneider-Muntau, but it took 16 megawatts of power and the power density led to electrical burnout.) Other places in the world doing better than 20 tesla are Moscow; Wroclaw, Poland; and Nijmegen, the Netherlands.

The next step is hybrid magnets, a superconducting coil on the outside, a re-