Medicine by John Grauerholz, M.D.

Shock wave of the future in medicine?

Further research developments indicate the tremendous savings in cost possible in high-technology medicine.

Shock waves have been a source of interest and debate since the 19th-century physicist Bernhard Riemann predicted their existence in an 1859 paper and was roundly attacked by the leading British physicists of his day who proved on the basis of classical Newtonian-Maxwellian physics that such waves could not exist. Reality, as it has a habit of doing, intervened into the debate, on Riemann's side, and shock waves became an acknowledged fact.

Subsequent research in aerodynamics, explosives, and especially in inertial confinement fusion has laid heavy emphasis on the focusing of shock waves to obtain high compression of matter without the heating which accompanies other methods of compression. Two recent developments in the field of medicine are indicative that a revolution in medical and surgical treatment would result from a major research effort in this area.

The first development, of relatively lesser importance, is the approval by the Food and Drug Administration of a device called a lithotripter, which focuses shock waves on kidney stones and crumbles them into sand-like particles that can be passed in the urine. The patient reclines in a tub of water and the shock waves, generated by a spark between two electrode tips situated in a concave metal reflector, are focused on the stone by two X-ray machines. Since water and body tissues have the same acoustical properties, they are unaffected by the shock waves, whereas the more brittle stone crumbles.

The machine, developed by Dornier System of West Germany, could save approximately $2,000 per case as compared to surgery. It is estimated that it would be effective in 80-90% of the 100,000 kidney stone operations that are done each year in the United States. It is estimated that 100 such machines, properly located, costing a total of $170 million, could save $2,000 per case on 80,000 cases in one year and thus essentially pay for themselves in their first year of operation.

A much more significant development is unfolding in the area of laser surgery of coronary artery disease, one of the leading causes of death and disability in the United States. A new laser, known as an excimer or excited-dimer laser, eliminates the problems which make current medical lasers unsuitable for treatment of coronary artery disease.

Most medical lasers generate heat in the tissues on which they are used and this heat is used to destroy the tissue, in the case of tumors, or to coagulate or weld the tissue, as in the treatment of retinal detachment in the eye. One condition in particular, diabetic retinopathy, was untreatable 10 years ago; now lasers seal the hemorrhaging blood vessels that once lead inevitably to blindness.

The problem with this heating effect in blood vessels is that it increases the tendency for blood to clot at the treated site, which is precisely what must be avoided in coronary arteries. The other problem is perforation of the delicate arteries by the laser energy.

The excimer laser produces short, intense bursts of ultraviolet light which shatter the molecules of the atherosclerotic plaque without heating the surrounding tissue. The bursts of light create shock waves which break the chemical bonds of the plaque molecules, vaporizing the plaque into carbon dioxide, hydrogen, and other fragments. Each burst cuts away microns (one-thousandth of a milimeter) of tissue with great precision, thus reducing the possibility of perforation. The pulses are extremely short, lasting from 10-billionths of a second to 100-billionths of a second.

The laser is incorporated into a 1.5-millimeter-diameter catheter containing three bendable glass fibers, known as fiberoptic elements. One fiberoptic element carries the laser energy, another shines a light on the catheter tip, and the third provides a view of the area in front of the catheter.

Estimated cost of the perfected laser-fiberoptic device is $100,000, and a patient could have his coronary arteries cleaned out in a few minutes and might not even have to stay overnight in the hospital. When one considers that 170,000 patients underwent coronary-artery bypass surgery in 1982, at an average cost of $20,000 a person, the potential savings are enormous. More importantly, a great many patients who could not tolerate surgery because of the severity of their disease could be treated by this method. Thus a great many "cardiac cripples" could be offered something other than the tender mercies of opiate overdose in a hospice or the starvation recently proposed by Colorado Gov. Richard Lamm and the New Jersey Supreme Court.