Skin for the wounds of burns

A polymer engineer and a surgeon decided a decade ago that there must be a method of treating skin loss due to burns that is better than the conventional use of grafts from pigs, cadavers and the patient's own body. So the two scientists, I. V. Yannas of the Massachusetts Institute of Technology and John F. Burke of Massachusetts General Hospital, joined forces to investigate a synthetic alternative — artificial skin. Now the Boston pair report the successful use of an artificial skin, still in its experimental stage, to cover portions of the wounds of seven patients, 5 to 60 years old, who suffered burns over 60 to 90 percent of their bodies.

While it easily accepts a surgeon's needle, this artificial skin also can withstand suture stress without tearing. Surgical convenience is just one of several properties a material must possess before it becomes the preferred graft choice in treating skin loss due to burns.

Calvin Campbell/MIT

Such wounds must be closed while they are healing; otherwise, the patients face serious and possibly fatal problems of fluid loss and bacterial infection. The classical and still preferred method of burn wound closure involves autografting — transplanting the patient's own skin to cover wounds. However, autograft "harvesting"—repeated removal of grafts from a specific donor site that regenerates suitable graft skin about every 20 days—is a serious operation. Moreover, autografts are not abundant when the patient suffers skin loss of 50 percent or more. In such cases, doctors turn to the skins of pigs and cadavers.

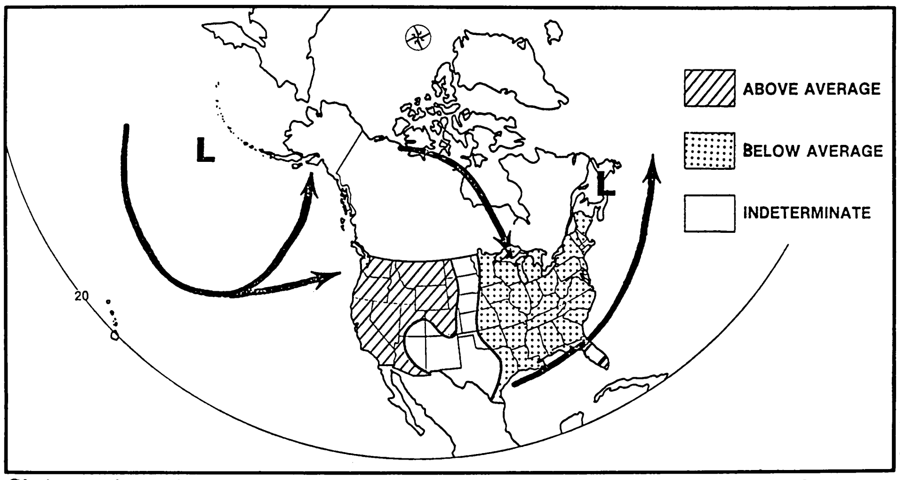
But the pig and cadaver methods also have limitations. Pig skin can close burn wounds for only three to nine days, cadaver skin for 15 to 25 days, before the body begins to reject the graft. In addition, while cadaver skin is preferable to pig skin, it is not always available.

The artificial skin developed by Yannas and Burke not only solves the problems of availability, but also has the potential for extending the period of graft usage before it must be replaced. The artificial skin is a bilayer membrane composed of a transparent, silicone rubber-like top layer bonded to a porous bottom layer that consists of the fiber collagen and the polysaccharide (carbohydrate polymer) glycosaminoglycan (GAC). This synthetic skin sandwich meets several crucial graft criteria. First, it is a flexible "drape" that maintains adequate contact between the graft and wound surfaces. Second, it spreads efficiently over the wound bed to displace the air pockets that encourage bacterial infections. In addition, it allows a moisture flux rate, or loss of moisture, that is close to the human physiological level of about a half a milligram per square centimeter per hour.

In experiments with guinea pigs, Yannas and Burke found that the chemistry of their synthetic sandwich interacted well with the biology of a healing wound. During healing, the epidermal (outer skin layer) cells from the edge of the wound move toward each other between the two layers of the artificial membrane. When these cells meet in the middle to close the burn wound, the top silicone layer of the membrane loses its bond with the bottom collagen-GAC layer and is rejected spontaneously. Meanwhile, fibroblast and endothelial cells from the surrounding dermis (inner skin layer) invade the collagen-GAC layer of the artificial membrane. Here the endothelial cells mediate capillary formation and the fibroblasts use components of the collagen-GAC layer to synthesize new connective tissue. The dermal "invaders" simultaneously biodegrade the nonusable portion of the bottom layer of artificial skin and dispose of the nontoxic waste products.

While the artificial skin system is quite successful in wounds only a few centimeters long, it must be periodically removed and replaced when treating larger wounds. In addition, at its present level of development, called "Stage 1," the membrane leaves behind scars. Says Yannas, "The next stage of the design of artificial skin, Stage 2, addresses these problems." □

Winter forecast: Warm west, cold east



NOAA/NWS

Christmas brought the best present possible to long-range weather forecasters: Confirmation in spades of their prediction for the 1980-81 winter. Earlier this winter, both the Long Range Prediction Group of the National Weather Service and the Climate Research Group at Scripps Institution of Oceanography forecast that the winter will be generally dry but colder than usual in the eastern half of the country and warmer than usual in the western half. Looking at the December statistics, Scripps meteorologist Richard Somerville says, "So far, so good." National Weather Service map shows the distribution of temperatures expected to be above and below the long-term average for 1941 to 1970. Each category has a 65 percent chance of occurring where forecast.