Dextran Helps Save Lives

ROBERT J. DIMLER

He might have died—not from the injury itself, but because he went into a state of shock.

Yet he lives—because of dextran, a product of research after World War II. The life saved by dextran has been on the battlefield, in the emergency room of a hospital, and on the operating table where the operation itself causes shock.

Dextran is a welcome partner to the blood bank. Blood still must be ready for use, but clinical dextran can take over as a first emergency treatment to serve as a blood-volume expander.

Behind the story of clinical dextran is the hand of a soft-spoken woman from Texas, Allene Jeanes, whose scientific abilities in carbohydrate chemistry were combined with a concern about the needs of America. To her research we add teamwork and inputs from other workers, including early leads from Sweden and England.

Shock. My first aid handbook reads: "Any severe injury can cause shock . . . the skin is quite pale and feels clammy (cool and somewhat moist)."

That pale skin tells the story. His blood is not circulating. Maybe the victim lost a lot of blood through the injury. There is not enough left for the heart to pump out to other parts of his body. But a state of shock is not necessarily caused by bleeding. Instead, the bloodstream loses fluid into the rest of the body. Again, there is not enough volume of blood to go around in the blood vessels.

So the doctor must put fluid (liquid) back in to restore the volume.

Simple, you say? Give a blood transfusion. But many times it is not so simple. What is the patient's blood type? Is there time enough to find out? Is his blood type on hand? Battlefields lack the refrigerated storage needed for a blood bank. There may not be enough blood on hand for an unexpectedly large number of casualties. Furthermore, blood has a short storage life, and the supply must be replaced at least every 3 to 4 weeks.

Even blood plasma, the fluid part of the blood, has limitations. While it does not require blood typing and its storage life is somewhat longer, still it cannot be kept for long periods unless freeze-dried. Then it still presents problems. Sterile water must be added, a time-consuming act at best and quite difficult under many emergency conditions, such as on the battlefield.

What about water, alone? No, but why not? Something has to be added to help hold the water in the veins and capillaries. And that is where dextran comes into the picture.

Dr. Jeanes, U.S. Department of Agriculture chemist at Peoria, Ill., started working with dextran at the Northern Regional Research Laboratory in 1942—but not for treatment of shock. Her project was cornstarch, its chemistry and molecular structure. In particular, she was trying to find out more

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about the branch-point linkage in the starch molecule.

What a job that was! Only 5 percent of the linkages in starch was this special kind. Where might she find an abundance of this linkage? Dextran was the answer—a polysaccharide made by a harmless bacterium when it grew on sucrose (cane sugar or beet sugar). Dextran and starch are polysaccharides in which the building blocks are dextrose units. Both give dextrose (corn sugar) when broken down completely by hydrolysis. Dr. Jeanes knew from the work of others that almost all of the linkages in the molecular structure of dextran were like the few special ones in starch.

Soon after Dr. Jeanes turned her attention to dextran, fate played into her hands, although the full import was not to be seen until much later.

A bottle of root beer went bad; it became thick and sirupy (sometimes called ropey). The merchant brought it to the northern laboratory to see if anyone could tell him what had happened. The bacteriologists quickly saw that an abundant growth of the organism *Leuconostoc mesenteroides* was changing the sugar to dextran to give the viscous character to the root beer. This particular strain of *L. mesenteroides* was entered into the ARS Culture Collection at the Peoria laboratory with the number NRRL B–512.

Dr. Jeanes was eager to work with the new dextran. The organism grew exceptionally well and produced a dextran in good quantities. This dextran was easier to separate than any she had worked with before.

Meanwhile the atom bomb had been dropped; atomic warfare was a reality. Preparedness and the threat of an atomic bomb attack on the United States became an increasing concern.

Then a number of pieces fell into place. Dr. Jeanes, with her feeling for human lives, turned her thoughts to a question several high-level people had asked. How could the United States prepare for treatment of masses of people injured in an atomic attack, people who would suffer from a state of shock, people who would need a blood transfusion or require blood plasma? Stockpiling of blood or plasma for such an emergency was impossible.

She saw a ray of hope in reports she had read from Sweden and England where solutions of dextran had been injected for emergency treatment of shock. Although the results were not perfect, lives were being saved.

Most important, she and her fellow workers had been studying dextran. They had found that there was an array of different dextrans, each produced by a different strain of the same micro-organism. Dr. Jeanes had confidence that one dextran could be found that would be better than the material used in Sweden and England.

How right she was! And how fortunate that in 1950 she took the lead in urging that the U.S. Department of Agriculture turn its attention to the problem of a blood plasma volume expander that could be stockpiled for emergency use.

It was a big job. Many things had to be worked out. Discoveries were made. High standards of quality were met. Processes were devised which could be depended on to give the product needed.

Cooperation was the word—within the USDA laboratory at Peoria; with other Government agencies including the Department of Defense, the National Bureau of Standards, and the National Institutes of Health; with research scientists in universities and medical schools; and with industrial companies that went into production of dextran as a blood plasma volume expander.

The dextran team at the northern laboratory in Peoria numbered some 50 people. It included bacteriologists, biochemists, chemists, and engineers. They were filled with enthusiasm and inspired by the urgency of the problem.

The timetable was breathtaking: Into action in 1950. Experimental commercial samples produced by one company early in 1951. Four companies producing clinical dextran by the end of 1951. Armed services award

Dr. Allene Jeanes, with life-saving dextran produced in the research she supervises.

of contracts for 1 million injection units by the midpoint of 1952. The battlefields of Korea were the proving grounds for dextran. In May 1953, the Army announced that dextran (NRRL B–512) would be used in large measure in place of blood plasma for all needs at home and overseas.

Finally, sales for civilian use became possible in 1954.

What were some of the problems and steppingstones to success? First, which dextran? More than 100 different ones were prepared, but results with the dextran produced by the NRRL B–512 strain (the one found in the sirupy root beer) were so good that an all-out effort was placed on it.

Next, exactly how do you tailor dextran for use as a blood plasma volume expander? The size of the molecules is critical in this area. Neither too large nor too small. The micro-organism makes molecules that are too large. Methods were worked out for breaking the molecules down and separating out just the right fraction. These procedures were the pattern for the first commercial production of clinical dextran in the United States.

Then the discovery of how to use an enzyme preparation (called dextransucrase), instead of the micro-organism itself, gave a more economical method of making clinical dextran with the correct narrow range of molecular size.

Woven through these developments was the perfecting of methods for measuring the size of the molecules. These, and other analytical methods, were used by the Government in its specifications for purchase of clinical dextran.

Careful clinical testing went hand in hand with the work on making dextran. Initially on animals, then on people, the safety and effectiveness of clinical dextran NRRL B–512 were established.

The speed and the smoothness with which all of these things, and many more, were accomplished is a tribute to the teamwork and dedication of research people. As might be expected, special tributes have come to Dr. Jeanes. Among them are the Garvan Medal and the Federal Woman's Award. Her leadership was strong throughout the work. She devoted personal interest and time to all the phases, far beyond what was expected. Her experiments were meticulously planned, precise, and accurate. All these attributes influenced others working on the team and contributed to the speed and success of their research. Such personal leadership often is at the heart of great accomplishments. Yet—as in all such research—the key to success is many people working together.

Of course, the lifesaving story of

dextran is not over. Clinical dextran is stockpiled for use in national emergencies, both civilian and military. It has become a standard item in many civilian hospitals in the United States. The Vietnam conflict again brought quantities of dextran onto the battlefields. During 1967, total civilian and military purchases of clinical dextran (6 percent solution in physiological saline for intravenous injection) were valued at $2 million.

Clinical dextran does not replace the blood bank. Many patients still must have blood transfusions. But dextran can tide them over until the blood can be administered.

So—He might have died
But he lives
Because of dextran.

The Many-Splendored Potato, A Marvel of Convenience

BERNARD FEINBERG *and* MERLE L. WEAVER

There is one field in which the average Russian does better than the average American—eating potatoes. The Russian eats over 400 pounds a year, the American little more than 100. Back in 1910, we were pretty good potato eaters; we ate about 180 pounds per person. However, by 1952, this had dropped to about 100 pounds.

One reason for this drop in potato consumption was the growing concern of the public with calorie intake and the mistaken belief that potatoes are high in calories. It is unfortunate that potatoes acquired this undeserved reputation. It is not the potato, but the added butter, gravy, or the absorbed frying oil which account for most of the calories in our favorite styles of cooked potatoes.

Another reason for the decline in potato consumption was growing competition from other starchy foods like rice and macaroni. Just as important was the fact that American housewives became time-conscious and impatient with the task of food preparation. Peeling, cutting, boiling, and frying potatoes just took too much time. Other processed foods which were already prepared, cooked, and flavored, and therefore provided convenience, pushed potatoes out of the shopping basket of Americans.

The only processed potato product readily available in the supermarket up until about 1950 was potato chips. Potato chips still qualify as the ideal convenience food because they can be eaten directly from the bag. Chips remain one of the most popular processed potato products. Indeed, until 1965 when frozen french fries production topped 1.5 billion pounds, chips were the most important processed potato product.

Beginning around 1950, a variety of new processed potato products began to appear on the market.

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