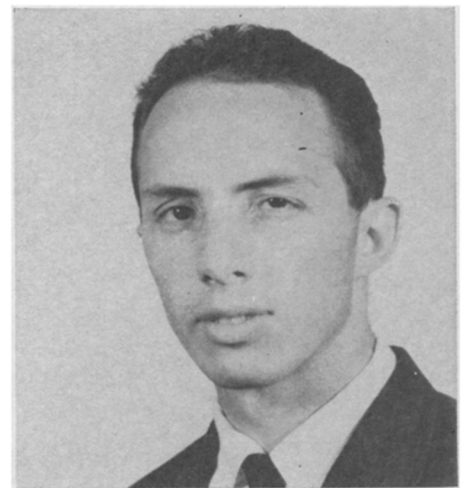


# The liver: outer limit of the state of the art

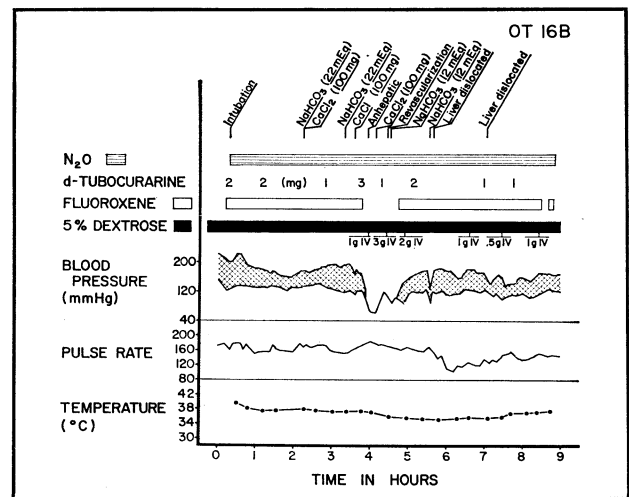
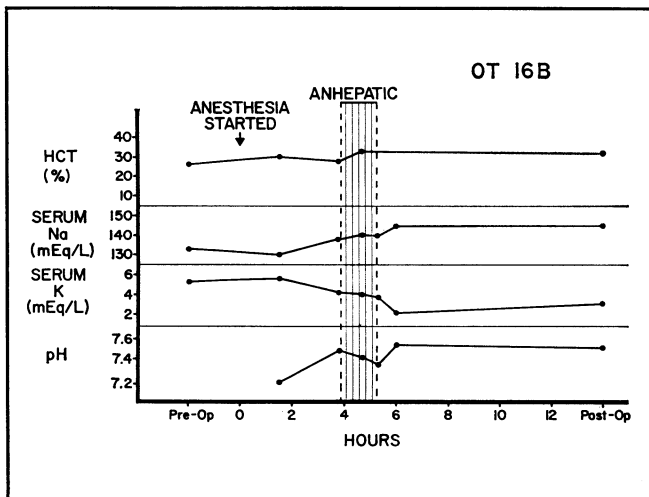
Just getting a liver transplant patient to survive the operation is a challenge, but with proper medical techniques it can be done

by Jeanne Bockel



Aldrete

Dr. Aldrete: Too many deaths.



VA Hospital, Denver

*Circulatory and metabolic control during the anhepatic state are prime factors in patient survival.*

No human organ transplant so far can be said to be much more than an experimental success, with the exception of kidney transplants, where the problem is eased because there are two kidneys.

For a variety of reasons, generally linked to the problem of rejection, transplant recipients' borrowed time is limited by the state of knowledge.

To the surgeons who are concerned with the transplantation of livers, however, even arriving at the point of worrying about a recipient's survival of the operation has represented an elusive goal.

Because of the kind of organ the liver is, a patient's chances of surviving the surgery itself are so slim that most surgeons who have approached the idea have abandoned it as beyond the state of their art.

Not only is the liver the body's biggest and bloodiest organ, but it acts as the main barrier between life and the environment. Its primary functions are fourfold. Briefly, the liver metabolizes

a number of toxic agents, making them nontoxic. Further, the liver circulates one-third of the body's supply of blood, stores the body's sugar and produces bile for neutralizing the acid in the intestines. Thus when the liver is removed from the body, many metabolic and circulatory problems result.

And when substances as toxic as many anesthetics are involved, the liver's function is even more essential. As a result, the six hours or so a transplant patient is expected to survive on an operating table, without his or anybody else's liver working for him, can result in what Dr. George J. Cosmides of the National Institutes of Health calls "severe derangements not encountered in any other clinical condition."

With heart and lung transplants, the patient is placed on mechanical aids during the time the organs are out of the body. With the kidney, there is no major problem since the body can function without the organ for several days. But neither mechanical aids nor

extended time are available to the liver transplants.

Probably the greatest successes with liver transplant have been achieved at the University of Colorado Medical Center in Denver by Dr. Thomas E. Starzl, who has performed over 35 of the operations—about 85 percent of the total. Of these, about 25 percent have survived more than a year, and one is still living 20 months after the operation.

Dr. Starzl ascribes his success almost strictly to the handling of the anhepatic state, the problem that has turned so many surgeons off. "The procedure is fairly safe now," he says. And he credits procedures developed by Dr. J. Antonio Aldrete, chief anesthesiologist at the Veterans Administration Hospital in Denver and member of the Colorado team.

Dr. Leroy D. Vandam, director of anesthesia at Peter Bent Brigham Hospital in Boston, calls organ transplant the greatest challenge to the anesthetist, drawing on all the knowledge and skills



*Dr. Aldrete and surgical team during liver transplant operation: Anesthesia must be nontoxic, controllable.*

that a specialist should possess. "It is not a mere routine choice of giving anesthesia but a situation that involves more participation and knowledge of medicine."

What creates the problem, says Dr. Aldrete, is that the metabolic and circulatory complications that occur during a liver transplant can weaken the patient for up to a month after the operation. And the key to whether it was medical management or rejection that finally caused the death is how long the patient survives. Although the cause of death beyond a month after surgery is usually rejection, says the anesthesiologist, the causes of an earlier death can be due to metabolic complications, liver failure where there is an inadequate flow of blood to the new organ, hemorrhage, blood clot and infection. And all of these, says Dr. Aldrete, are due in some way to an "unawareness of proper medical management during transplant."

Dr. Aldrete estimates that of transplants done at Denver, 15 or 20 percent have died within a month, compared to 75 percent of similar transplants done elsewhere. Dr. Aldrete insists that the circulatory and metabolic problems are more critical in this than in any other surgical process and contends the percentages could improve everywhere, with better management during and immediately after surgery.

The liver, supplied with blood through the hepatic artery and portal vein, then passes it through the inferior vena cava, the great vein of the lower body. Dissecting these arteries and veins for the transplant makes blood loss an acute problem.

Moreover, the inferior vena cava and portal vein are cross-clamped during the operation to prevent blood clots.

And this means that a third of the body's blood supply must be re-directed, since it cannot go through the liver. With so much blood thus being trapped in the lower part of the body, the heart is unable to pump and severe low blood pressure results and must be compensated for.

Metabolic changes, he says, may include both blood sugar and acid-base imbalance. Sugar and serum electrolytes, carried by the blood to prevent acidity, are depleted, also because of the blood's circumvented flow. And the liver itself serves as a supply of sugar which must be supplemented in the absence of liver function.

**All of these** factors, says Dr. Aldrete, must be continually monitored during the course of transplant.

But since it is the liver that should protect the body from an anesthetic's toxic effects, the anesthetic itself is particularly critical. A suitable anesthetic must be both nontoxic and capable of keeping the patient extremely relaxed and quiet.

Dr. Aldrete uses fluoroxene, a modified ether, added to a mixture of nitrous oxide and oxygen. The combination has low toxicity and its effects can be lightened or deepened.

And, in conjunction with the anesthetic, muscle relaxants are given to relax the body and thus ease the cutting and eventual rejoining of the large vessels. One called Gallamine, which is eliminated through the kidneys rather than the liver, is a good selection here, says Dr. Aldrete.

To restore blood loss, large quantities of fresh, rather than stored, blood are used. Stored blood, says the Denver anesthesiologist, is often preserved with acids which upset further the acid-base imbalance created by the loss of liver

function. The amount of blood used can reach as high as 30 pints and, according to one West Coast anesthesiologist, 8 to 10 pints are often used within two hours.

To prevent the blood sugar from falling, glucose is administered long before the liver is removed. Dosage is increased while the liver is not functioning, and sugar levels are checked about every 15 minutes. Dr. Aldrete warns that, during postsurgery, blood sugar can drop to life-threatening levels if not handled properly during transplantation. In two instances, he says, respiration actually stopped due to severe low sugar, and for this reason he continues glucose administration for many days following surgery.

Lastly, the high acid state of blood is neutralized by alkaline solutions such as plasma, bicarbonate and hemoglobin. Postoperative care remains similar to that given during the actual operation except that human albumin is sometimes given to expand blood vessels.

Although Dr. Vandam claims the anesthetist has improved the success rate and survival times of liver transplants, Dr. Aldrete contends that the state of the art is still inadequate. And even with present techniques there are still too many deaths, he says, resulting from an "unawareness of the importance of medical management during liver transplant."

**It is generally** agreed, however, that skill on the part of the anesthesiologist and teamwork are needed for the medical management needed during transplant. Dr. Mark Wolcott of the Veterans Administration Hospital in Washington, D.C., confirms the importance of this by citing the record of the Colorado team. "Their fine results are an excellent example," he says.