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calf muscle receptors, and there's preliminary evidence of an equivalent region on human receptor too. "These similarities imply that this region is highly conserved between species," observes Lindstrom. "It might be functionally very important and it might also be a prime target in the autoimmune response of myasthenia gravis."

In addition to using monoclonal antibodies to probe the structure of the acetylcholine receptor, the Salk group is planning to determine their pathogenicity, as are other groups. "For instance," Lindstrom suggests, "if we can isolate antibodies than can fix complement and those that can't, and ones that can cause antigenic modulation and those that can't, then we might be able to determine which of these two processes are most important in destruction of receptors in the disease." A systematic approach of this sort might eventually build up a picture of pathologically vulnerable regions of the receptor molecule, and might even expose an immunological Achilles' heel.

So far less than half a dozen papers on monoclonal antibodies relating to myasthenia gravis have appeared in the scientific literature, but a flood of them is on its way.—ROGER LEWIN

Consensus on Bypass Surgery

In most cases, the operation has not been shown to save lives, but patients do say they feel better after surgery

Since its inception, coronary artery bypass surgery has been controversial. A few years ago, a number of physicians at major surgical centers claimed that it saved lives, although good data from clinical trials were not available (*Science*, 17 December 1976). Now the emphasis has shifted to its role in improving the quality of life. Although quality of life can be hard to measure, patients say they feel better after the operation and the surgery is popular—110,000 operations were performed in the United States last year at an average cost of $15,000 per patient.

On 3 to 5 December 1980, a consensus conference, sponsored by the National Heart, Lung, and Blood Institute and the National Center for Health Care Technology, considered the scientific and clinical aspects of bypass surgery. The consensus panel, whose chairman was Robert Frye of the Mayo Clinic, said at the outset that it would not make recommendations. Instead, it would determine what is now known about the procedure, which meant considering data on the diagnosis of coronary artery disease, the survival rates of surgical patients, and the quality of life following surgery.

The consensus, reached after 2 days of animated discussions among the meeting participants, was conservative. Although the panel declared bypass surgery a "major advance," it did not claim miracles for the treatment and took an extremely cautious view of the epidemiological data presented. It concluded that the operation can improve blood flow to the heart, can improve the quality of life, and can, in some patients, prolong life. But it stopped short of concluding that the great number of bypass operations performed each year is fully justified.

By grafting sections of vein or internal mammary artery to blocked coronary arteries, a surgeon can bypass occlusions that slow blood flow to the heart. The operation can be somewhat risky, however. In the best of circumstances and among patients with the best prognoses, the consensus panel concluded, 1 to 4 percent of patients die as a result of the procedure and there is a small chance—about 1 percent—that a patient who survives will have neurological damage. In the worst cases—patients with congestive heart failure whose hearts cannot pump blood efficiently—the lowest operative mortality rates attainable are between 10 and 15 percent, the panel said. But the operation today is far safer than it was even a few years ago. According to James Ware, a meeting participant and biostatistician at the Harvard School of Public Health, the mortality rates in the best cases 5 years ago ranged from 6 to 10 percent. "I think there's a lot to be impressed about here," he says.

Most patients who undergo bypass surgery have angina pectoris, which is a tightening or heaviness in the chest that occurs during exertion or, in some people, even at rest, because portions of the heart do not receive enough blood. It can be a debilitating and frightening symptom of heart disease.

The consensus panel concluded that in one, or possibly two, subgroups of patients, the surgery does seem to prolong life. The best evidence is in patients with blocked left main coronary arteries. (Three arterial vessels directly feed the heart; two are forks of the left main coronary artery.) A randomized, controlled trial conducted by the Veterans Administration in which nearly 700 men were studied for 6 years showed that the expected mortality rate of 10 percent per year in this subgroup of patients was cut in half by the surgery. These results were confirmed by the European Collaborative Study, a randomized, controlled trial in which nearly 900 patients were followed for 6 years.

The VA and European trials also provided evidence that patients with three-vessel disease, in which the three arterial vessels that reach the heart are obstructed but the left main artery is not, may also live longer as a result of bypass surgery. However, the data here are less conclusive and the consensus panel expressed some hesitation about accepting the results on three-vessel disease without further confirmation.

Only a minority of patients with angina have three-vessel disease or blocked left main coronary arteries, however. For example, Michael Mock of the Heart, Lung, and Blood Institute says that 9 percent of the 18,143 men in a registry for the Institute's Coronary Artery Surgery Study had left main disease and 34 percent had three-vessel disease. But a major rationale for doing bypass surgery is to relieve angina—not necesssarily to prolong life. There was some feeling at the consensus meeting that a significant number of patients are deciding too quickly that surgery is the only acceptable way to improve the quality of their lives. T. Joseph Reeves, director of the Cardiovascular Laboratory at St. Eliza-

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beth's Hospital in Beaumont, Alabama, for example, said that angina can be controlled in most patients if they take medications and change their life-styles—stop smoking, get their blood pressure under control, and, possibly, limit their activities. However, Gottlieb Friesinger, director of the Division of Cardiology at Vanderbilt University Medical Center, points out that many of these patients control their angina by avoiding activities that they expect to cause it and by taking nitroglycerin prophylactically.

Although bypass surgery has become safer and, many doctors believe, more effective in the past decade, medical treatments for angina have also improved. Generally, patients treated medically are given drugs such as propranolol, which reduces the amount of work the heart does, and nitrates, which dilate the coronary arteries, allowing more blood to reach the heart. The drugs have side effects, as might be expected. Propranolol can cause fatigue and depression and nitrates can cause headaches. Physicians, the consensus panel cautioned, must carefully adjust the dosages of these potent drugs according to the needs of each patient.

Physicians' attitudes may contribute to the large amount of bypass surgery being done, according to a number of participants at the conference. Vallee Willman, a cardiac surgeon at St. Louis University School of Medicine, said, "It is difficult for physicians to spend time to medically manage patients and encourage changes in life-style. It is easier to encourage surgery." Shahberdin Rahimtoola, chief of cardiology at the University of Southern California, said, "Maybe we [physicians] haven't done our best to encourage patients to try medical treatment."

It was also pointed out at the conference that many patients demand surgery rather than medical treatment. Reeves explained that patients often "want to be seen as men, as husbands, as providers, and they are willing to risk their lives at the time of the operation so as not to change their life-styles." Willman mentioned still another reason why patients demand surgery. Their angina, he said, is a constant reminder that they are vulnerable to a heart attack or sudden death. "The patients want the consolation of having done everything possible. Surgery is at least a tangible assault on the process," he said.

The panel agreed that medical management can be time-consuming and difficult, saying in its consensus statement: "It is critically important to recognize that appropriate, comprehensive medical care of the patient with coronary heart disease requires an intensive effort on the part of the physician, involving consideration of almost every aspect of the patient's life. . . . It must also be recognized that in many cases, dissatisfaction with the altered life-style imposed by the illness is a result of inadequate attention to the details of management." Yet the panel noted that, even in the best of circumstances, some patients may find medical treatment inadequate to control their symptoms and allow them to live their lives as they wish. In those cases, the panel said, "surgical therapy may be advised."

By some indices, patients are better following surgery. Between 75 and 90 percent say their angina is relieved. They take fewer medications than those not operated on, and most have an improved blood flow to their hearts. But since the surgery does not cure the underlying atherosclerosis, new blockages may occur. Even if they do not, the bypass grafts may close. According to Martial Bourassa of the University of Montreal Medical School, angina recurs or worsens in about 5 percent of bypass patients per year.

Friesinger believes that, for many patients, quality of life is improved after surgery because they feel relieved of the threat of sudden death. "The reason for improved symptoms is not so simple as increased blood flow to the heart. There is a significant minority of patients—perhaps 10 to 15 percent—where there is every reason to believe they are not a stitch better after surgery. Yet they say they feel better," he says.

It is hard to assess how bypass surgery affects the quality of patients' lives. One puzzling finding is that the surgical patients are no more likely to return to work than those treated medically—only about two-thirds of both groups of patients work. Acknowledging that it would be reasonable to expect more patients to work after surgery than after medical treatment, the panel concluded, "The consensus is that this expectation has not been accomplished." Many angina patients are, of course, at or near the age of retirement, so many would be unlikely to work, regardless of their therapy. But even among younger patients, no more returned to work after surgery than after medical treatment.

The conference participants emphasized that patients may stop working for many reasons other than severe angina or fatigue. Their doctors may sign disability papers, for example, or employers may not want to take them back. And some patients believe that their heart disease was due to the stress of work and so are reluctant to return.

Yet Paul Meir, a statistician and panel member from the University of Chicago, questions whether the surgical patients really feel as good as they claim. After all, he says, angina is a very subjective symptom. "What we offer patients is not a longer life but a different perception of themselves—a return to normal. Medical patients have no reason to deny their symptoms. But we must weigh reports of a patient's symptoms after surgery with the patient's belief that he has now done the maximum possible for his disease. Is a surgical patient, then, as likely to confess his symptoms?" One way to interpret the finding that a large number of surgical patients do not return to work, Meier says, "is as a devastating comment on the claim of improvement in lifestyle."

Despite the paucity of good data, the consensus panel concluded that the operation does improve the quality of life.

Despite the paucity of good data, the consensus panel concluded that the operation does improve the quality of life. Elliot Rapaport, a panel member from the University of California at San Francisco, says that what the consensus panel hopes to convey is that "Surgery should be reserved primarily for those patients in whom good medical management fails to control symptoms and for whom the quality of life has deteriorated to where both the patient and physician feel surgery is indicated." A second conference, to be held in April, will emphasize the economic, social, and ethical issues arising from bypass surgery and will address the question left unanswered by Rapaport's statement: How much of an improvement in quality of life, and at what costs?—GINA BARI KOLATA