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DISCUSSION

DR. OSCAR CREECH, JR. (New Orleans): Since I have no experience with this or any other method of supporting the failing heart, I must confine my comments to what Dr. Dennis has presented.

Dr. Dennis has emphasized that by this method of left heart bypass one can effectively support the circulation; that this work reduces the myocardial work of the left ventricle as measured by oxygen consumption; and, finally, that it does increase the partial pressure of oxygen in the myocardium.

An ischemic heart, unlike the ischemic limb, must nourish itself. It appears that the general failure of the circulation, including that of the myocardium, is the principal factor leading to death of the heart after infarction rather than the amount of work the heart has to perform. Therefore, it appears that adequate and prolonged support of the circulation would be an essential element in recovery.

If this is done and the myocardium is not irreparably damaged, recovery should follow, and this has been demonstrated by the cardiologists from time to time when they have used vasopressor agents. However, it is often necessary to continue this support for a period of days. Dr. Dennis' method provides for support of the circulation for relatively long periods and, in fact,

he has used it for as long as 24 hours. Thus, it is promising.

The difficulty of cannula placement, however, should be overcome before the method is widely adopted. The patient who has suffered a massive myocardial infarct is in no condition to withstand the consequences of an improperly placed cannula.

Dr. Robert Schramel, one of my associates, has worked with prepulmonary oxygenation as a method of supporting the failing lung. Since an oxygenator is used in this circuit, destruction of platelets and erythrocytes occurs to a tremendous extent over a period of eight hours of perfusion. In his paper Dr. Dennis alluded to the lack of hematologic change following left heart bypass. I wonder if he would comment more specifically to what extent the platelets and erythrocytes are damaged.

Then, I would like to ask him these questions: Does right ventricular work remain unchanged during total left heart bypass?

Second, he refers to the frequency of ventricular fibrillation with this method. In the presence of adequate systemic and myocardial circulation, would not fibrillation further reduce the work of the heart over that associated with a sinus mechanism?

Third, would pulsatile flow offer any advantage over the presumably nonpulsatile flow that he has used?

And, finally, is there any alteration in the myocardial circulation in terms of perfusion of the capillary bed, in the filling, ejecting, and the non-filling of the ventricle?

DR. RALPH A. DETERLING, JR. (Boston): I rise to mention the studies of my associate, Dr. Harry Soroff, with aortic counterpulsation and diastolic augmentation. Having been associated earlier with Drs. Harken and Claus, he has continued to work in this field. Mr. Clifford Birtwell of the Flow Corporation and he have developed a refined accordion type of blind-ended ventricle which produces minimal damage to blood even after prolonged use.

More significant is a new synchronous pump, which represents a distinct improvement over the Davol pump.

In addition to being activated by the R-wave of the patient's electrocardiogram, it can be triggered by the arterial presence of AC interference, low voltage, arrhythmias and other states seriously interfering with the electrocardiographic signal.

Our studies, too, have shown a 30 to 50 per cent reduction in myocardial oxygen consumption and left ventricular work, with a greater simplicity of application of the cannula in the femoral artery. The arterial pressure curves conclusively indicate the ability of the counter-pulsation to reduce the pressure against which the left ventricle works, and to augment the diastolic perfusions pressure.

I would hope that Dr. Dennis can provide us with a critical comparison of the two methods in his future studies, especially with prolonged use.

DR. CLARENCE DENNIS (closing): With regard to the matter of changes in the cellular components of the blood, we had a series of ten dogs which were carried over 24 hours of near total left heart bypass by this technic and lost but one, in which we ran out of our donor supply of blood about midnight and had to wait until 7 a.m. to get more blood. In this group of dogs, the plasma hemoglobin average at the end of 24 hours was about 87 mg./100 ml. It is true that the platelets dropped, and sometimes they dropped to a low of 40 to 50 thousand, but the dog did not seem to have serious difficulties with clotting problems,

and the platelet counts were back to normal in a day or two after termination of the period of bypass.

I am sure I do not know whether fibrillation would decrease the amount of work that the heart has to do. We have been a little exercised about it, but in the clinical cases that we are about to start in Brooklyn, Dr. William Dock has indicated that he would not be concerned if left ventricular fibrillation should occur in our patients, because he feels that we could carry the circulation satisfactorily. We have no clinical experience on this as yet.

I think the question of pulsatile flow is a very real one and we are proposing to set up some studies with this in mind. In order to see how long an animal could go with left heart bypass, we started one dog and kept the bypass going as long as possible. The experiment lasted a little bit over three days, but after approximately a day and a half, edema began to develop, and he gained about 35 per cent of his body weight in the form of edema, mostly from the blood that we gave to maintain satisfactory flow. I do not know whether absence of pulse is the whole explanation for this, but we are suspicious that this may have been the case.

With regard to myocardial perfusion in the filling as compared with the nonfilling ventricle, we do not have much information as yet. Dr. Wesolowski and Dr. Cappelletti have done studies on coronary collateral circulation under the circumstances of left heart bypass and have found that retrograde flow from the distal side of the point of division of a coronary artery is about twice as great while bypass is in effect as it is under control conditions. This, of course, suggests a wider collateral blood flow during left heart bypass.

I am unable at the present time to answer Dr. Deterling's questions with regard to aortic counterpulsation. A critical review of the two methods is, of course, essential, and I do not know which is going to bear more fruit. We had considerable discussion among the group of us in Stockholm about which course to follow before embarking upon left heart bypass, and I think we will follow both courses before any of us is satisfied.