PROTECTION OF THE MYOCARDIUM DURING ISCHEMIC ARREST

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There are 2 distinct surgical reasons for interrupting the coronary blood supply: The first one is necessity for working in the area of the coronary ostia, e.g. aortic valve surgery. The second is the need for a dry quiet field, e.g. coronary bypass surgery.

When working in the area of the ostia it is possible to cannulate the coronary arteries and allow the heart to beat normally. This technique, however, has many technical limitations and hazards and usually does not provide uniform perfusions of the entire myocardium unless great care is taken. Because of these limitations some surgeons prefer to not perfuse the heart at all or to perfuse intermittently, either with or without topical or whole body hypothermia of varying degrees.

In the case of coronary bypass surgery, an arrested heart is usually necessary and some form of persistent cardioplegia is necessary, e.g. electric current, cold, ischemia. The most common technique is intermittent total ischemia with or without topical saline slush cooling. Moderate total body hypothermia is also frequently used. Experience also shows that the myocardium (unperfused) will cool itself to at least 3 or 4 degrees below body temperature.

When one considers the different modes of induction of cardioplegia, different rhythmic states during cardioplegia, different forms of perfusion, and different uses of hypothermia, the combinations seem endless. Add to this the fact that the ventricle is frequently markedly abnormal, and the magnitude of studying this problem becomes apparent.

There is controversy and conflicting evidence in most of the aforementioned factors. Nevertheless, a preponderance of evidence in literature would seem to indicate the following:

1. Different hearts vary markedly in their tolerance to ischemia.
2. Hypothermia increases tolerance to ischemia.
3. Any ischemic time extracts a toll in ventricular performance.
4. Even very small amounts of embolic matter to the coronaries, whether it be gaseous, liquid, or solid can be very detrimental and should be avoided if at all possible.
5. PO_2 of the perfusion blood over 120 mm. Hg. would seem be of no benefit and possible harm.
6. Perfusion pressures should never exceed normal diastolic pressure in the coronary arteries.
7. Ostial cannulation should be done with only the utmost care, especially in diseased arteries.
8. The endocardium is particularly susceptible to ischemic damage.
9. Hypertrophied hearts and recently infarcted hearts seem to tolerate ischemia least.

Our technique of coronary bypass is to utilize moderate body hypothermia (34 degrees C.). In addition, we attempt to hold the PO_2 below 120 and routinely use a screen type filter on the arterial line and a Dacron type filter on the suction return line. We utilize short (15 to 30 minutes) periods of ischemia with 5 minute periods of perfusion between ischemic periods. With this technique 96 to 98% of our patients leave the operating room despite a high percentage of severely diseased ventricles. For aortic valves the procedure is similar except that the coronaries are perfused with metal hand-held cannulae five minutes out of twenty with pressures not exceeding 60 mm. of mercury in the artery.

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