Local and regional anesthetic techniques for the patient with ischemic heart disease

Robert G. Merin, M.D.

Rochester, New York

Care of the patient with ischemic heart disease still revolves around balancing oxygen supply and demand. Oxygen supply is dependent on the coronary blood flow and the oxygen content of the coronary arterial blood, and the distribution of that coronary blood flow. Coronary blood flow in turn is governed by the diastolic arterial blood pressure and coronary vascular resistance. The oxygen demand of the heart is related to the rate at which the heart beats, the tension that heart muscle develops in its wall, and the contractile performance of the heart. In the clinical evaluation of myocardial oxygen supply and demand, we really have little more than an estimation of the oxygen-carrying capacity of blood and the diastolic arterial blood pressure. Fortunately, it has been demonstrated that myocardial oxygen demand is quite accurately correlated with the product of heart rate and systolic blood pressure. Perhaps it is more correct to consider these two determinants separately.

In patients with ischemic heart disease, the oxygen supply is much more dependent on the perfusion pressure of the coronary arteries inasmuch as there are fixed obstructions to flow, and coronary vascular resistance cannot be varied appreciably in these areas. In addition, there is evidence that flow through stenotic areas is better preserved with lower

viscosity blood. To keep oxygen supply at reasonable levels in the patient with ischemic heart disease, diastolic arterial pressure should be kept within 10 torr of angina-free level and the hemoglobin level should be ± 12 g/dl.

Since oxygen demand appears to be a function of heart rate and arterial blood pressure, it seems prudent in patients with ischemic heart disease to keep both of these indices within 20% of normal angina-free limits.

It is difficult to determine whether or not there is good balance between oxygen supply and oxygen demand. In the clinical situation we have only two guides at the present time. One is symptoms of angina pectoris. If the patient is unable to tell us about his symptoms, the only clinical measure of myocardial supply-demand imbalance (ischemia) is monitoring of the electrocardiographic ST segments. This presents a multitude of problems, but still is valuable. The usefulness of regional anesthesia ultimately depends on how it affects the oxygen supply-demand ratio, although as will be pointed out, there may be another aspect of the use of regional anesthesia in patients with ischemic heart disease.

Nerve blocks that have minimal influence on the systemic cardiorespiratory apparatus include blocks of the upper and lower extremities, blocks of the cervical plexus, and cranial nerve blocks. In addition, epidural and spinal anesthesia with the level below T8-10 can also be achieved with minimal effects on circulation and respiration. Consequently, one is unlikely to see specific effects from the local anesthetic procedure on oxygen supply-demand ratios unless there is intravenous absorption of local anesthetic. The problem with these blocks is quite simply the emotional status of the patient. If the patient is unable to accept the performance of a nerve block or the experience of being relatively aware of the operating room during the operation, it is likely that he will respond to the whole experience with hypertension and tachycardia, both of which lead to increased oxygen demand in excess of the increase in oxygen supply and can be dangerous for the patient with ischemic heart disease. However, there are two major advantages of peripheral or cranial nerve blocks. First, as has been mentioned, the cardiovascular and respiratory systems will be disturbed minimally and the patient's supply-demand ratio should not be affected. Second, and perhaps more important, the best sign of developing imbalance in myocardial supply and demand is preserved. Unless there is heavy use of adjuvant drugs, the patient will be able to tell the anesthetist when he is having symptoms of ischemia, namely, angina pectoris. This is a valuable aspect of this type of anesthesia.

With thoracoabdominal, spinal, and epidural anesthesia one cannot guarantee that thoracoabdominal sympathetic blockade will not result in decrease in arterial blood pressure, perhaps to levels that interfere with coronary perfusion and oxygen delivery in these patients and even resultant tachycardia if the block does not extend high enough to block cardiac sympathetic nerves. Many patients become acutely anxious in this circumstance, particularly if the sensory and motor supply of the chest wall is blocked, giving them the sensation of dyspnea. However, there is evidence that the decrease in arterial pressure produced by high spinal anesthesia is accompanied by no evidence of myocardial hypoxia in a group of patients randomly selected from the medical ward.[1] There has been recent evidence that cardiac sympathetic stimulation can re-

sult in coronary vasospasm and the signs and symptoms of ischemic heart disease in patients and in animals.[2] Therefore, sympathetic blockade by spinal or epidural anesthesia may be beneficial. Two recent investigations in dogs with ligated coronary arteries have shown beneficial effects of thoracic epidural anesthetic blockage on ST segments,[3] and transmural coronary blood flow.[4] There is increasing evidence that thoracic epidural blockade interrupts surgically induced "stress" hormone secretion as only deep general anesthesia can do.[5-9] Therefore, sympathetic blockade during spinal and epidural anesthesia should be sought rather than feared.

There are little data available comparing results of anesthesia and surgery with regional versus general anesthesia in patients with ischemic heart disease. The epidemiologic studies of Topkins and Artusio[10] and Tarhan et al[11] did not include enough regional anesthetics to be meaningful. Arkins et al[12] and Steen et al[13] found no significant difference in mortality[12] and morbidity[13] when general and regional anesthesia were compared in patients with documented ischemic heart disease. In an uncontrolled series, Backer et al[14] reported an extremely low incidence of postoperative myocardial infarction in a group of patients with ischemic heart disease undergoing eye surgery under regional block anesthesia. However, no comparable series under general anesthesia was compared.

Summary

There are theoretical and experimental reasons why regional anesthesia should be desirable in properly selected patients with ischemic heart disease. A properly controlled study comparing similar patient populations and operations with regional and general anesthesia is needed.

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