THE TREATMENT OF CORONARY ARTERY DISEASE

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The five chief manifestations of coronary artery disease are: (1) angina pectoris, (2) coronary thrombosis with infarction of the myocardium, (3) cardiac asthma (paroxysmal cardiac dyspnea), (4) Adams-Stokes syndrome, and (5) congestive myocardial failure. Each of these conditions gives rise to a well-differentiated clinical picture, and the management of each differs in important respects from that of the others. The diagnostic features and treatment of the various syndromes will be discussed in the present communication.

ANGINA PECTORIS

Angina pectoris is a descriptive term applied to paroxysmal attacks of substernal pain which characteristically are precipitated by exertion or excitement and are relieved promptly by rest. The patient often experiences difficulty in describing the pain and frequently refers to it as a sensation of fullness, pressure, tightness or heaviness in the anterior chest. The distress is of such a nature as to enforce cessation of all activity and at times is accompanied by a sense of impending death. There may or may not be radiation of the discomfort to the neck, jaws or inner aspect of the arms. Glyceryl trinitrate and similar preparations give prompt relief from the symptoms. Death may occur instantaneously during an attack.

The most important measure in the treatment of angina pectoris consists of impressing upon the patient the imperative need for limitation of his activity in order to avoid, so far as possible, the induction of attacks. Hurry and unusual exertion of all kinds must be prohibited. Certain conditions exert an important effect upon the ease with which the pain is precipitated, and the patient must be instructed fully concerning these. The attacks come on with greater readiness during cold weather than during the warmer months. The patient therefore must be advised to reduce his gait during the fall and winter months and must be informed specifically of the greatly added load which walking against a wind or through snow places upon the heart. Residence in a warmer climate should be urged in all cases in which such a change is financially possible. Less exertion usually is required to induce the pain soon after eating than at other times, and occasionally an attack may result from the taking of a large meal without additional activity. Because of this it is important that overeating be avoided and that the patient rest for at least 30 minutes after each meal. Occasionally it is advisable to allow four or five small meals daily rather than three larger ones. The overweight individual should be placed upon a reducing diet, for the loss of excess weight will result in a proportionate diminution in the

demands on the heart during physical activity. Coffee and tea should be allowed only in moderation, and the consumption of tobacco should be reduced to the lowest level the patient will accept. Because straining at stool may initiate an attack in certain persons, suitable measures must be taken to avoid constipation.

Many preparations have been recommended for use in patients with angina pectoris with the aim of increasing blood flow through the diseased coronary arteries, but the clinical effectiveness of most of these drugs remains doubtful. Although the administration of aminophylline and similar preparations in sufficient amounts results in a certain degree of increase in the ability of the patient to do measured work without pain, the magnitude of this increase is seldom such as to be of appreciable help in the regular daily activities of the individual. Most patients appear to do quite as well without drugs of this nature as they do with them, but because an occasional individual is benefited, a short therapeutic trial with one of the preparations is in order in all patients.

The two drugs of thoroughly established value in the management of angina pectoris are glyceryl trinitrate and amyl nitrite. Of the two, the former is to be preferred; it is just as effective as the latter, has a somewhat longer period of action, is less unpleasant to use and less expensive. Only fresh tablets should be employed, and these should be dissolved under the tongue or should be chewed thoroughly before swallowing. For many individuals a 1/200 grain tablet is as effective as a larger amount. The drug is employed not only for the relief of anginal pain but also as a means of preventing the development of attacks. Many patients are forced by the nature of their occupation to perform tasks which regularly precipitate anginal pain, and in these persons the attacks often can be prevented from developing by the use of glyceryl trinitrate shortly before undertaking the unavoidable exertion. In unusual circumstances from 12 to 20 tablets may be used in this manner each day. When attacks are liable to follow a meal, the drug may be given for its prophylactic effect either immediately before or soon after eating. The frequent use of nitroglycerine in this manner does no harm and often enables the patient to get along comfortably for a long time. It does not excuse him, however, from avoiding unnecessary types of activity that may bring on an attack.

In persons who are inclined to worry or in whom anginal pain is induced by emotional upsets, sedatives are indicated and may have a very beneficial effect. Occasionally an appreciable increase in exercise tolerance follows the use of whiskey or brandy in doses of one-half ounce or one ounce with each meal. Digitalis is employed only in the presence of such evidence of myocardial insufficiency as dyspnea on limited activity, passive congestion of the lungs, and edema of the lower extremities.

Of the various surgical measures that have been employed in the treatment of angina pectoris, alcohol injection of the upper four thoracic sympathetic ganglia on one or both sides appears to be the safest procedure and to be equal to any other in effectiveness. This method of treatment does not change the condition of the coronary vessels but it does afford the patient partial or complete relief from his attacks and may therefore enable him to remain self-supporting for a considerable length of time. Neuritis of the infiltrated intercostal nerves is a rather common complication following injections but is seldom a source of great complaint in those who have had severe anginal attacks. This method of treatment is worthy of wider application than at present but its use should be restricted to those cases in which the attacks can be controlled in no other way.

The work of Beck and his associates[1] in establishing a new blood supply to the heart by grafting a part of the pectoral muscle upon the myocardium constitutes a direct attack on the underlying coronary artery disease. The clinical results have been distinctly encouraging and the further progress of the work will be watched with great interest.

Coronary Thrombosis

The clinical picture of acute coronary thrombosis is too well known to warrant detailed description at this time. The pain is similar to that in angina pectoris but is more severe and of longer duration. Symptoms of shock of mild or severe degree usually appear soon after the onset, and fever and leukocytosis generally develop within the first 24 hours. The erythrocyte sedimentation rate becomes elevated. A pericardial friction rub may appear at any time during the first few days after the attack and may last for only a few hours or for several days. The electrocardiogram will show characteristic changes in practically all cases of coronary thrombosis if records are made at daily intervals and if both standard and precordial leads are used.

The first aim in the treatment of acute coronary thrombosis is to relieve the pain. For this purpose morphine sulfate should be administered by hypodermic injection as promptly as possible. The initial dose is usually one-fourth grain but whenever the pain is exceptionally severe one should not hesitate to administer one-half grain. Subsequent doses of one-fourth grain should be given at intervals of one-half hour or so if the distress continues unabated. At times, it may be necessary to administer as much as one grain within the first hour or two. The patient should be placed in bed as soon as possible after the onset of symptoms and should not be disturbed by frequent examinations. Because of the shock and profuse perspiration which often are present, the body should be kept warm and, as soon as the patient is more comfortable and is free from nausea and vomiting, fluids should be offered in frequent small amounts. Stimulants, such as caffein sodium benzoate, are

administered only if the systolic blood pressure falls below 80 mm. of mercury.

In the more severe attacks of coronary thrombosis which are accompanied by cyanosis and intense dyspnea, the administration of oxygen should be instituted as promptly as possible, preferably by means of an oxygen tent. Not only does this measure reduce the cyanosis and dyspnea but it may also lessen the intensity and shorten the duration of the pain.

After the pain and initial shock have been controlled, the majority of patients require little medication. It appears advisable, however, to administer quinidine sulfate in doses of 0.2 gm. (3 grains) two or three times a day as a possible prophylactic against the development of ventricular paroxysmal tachycardia and ventricular fibrillation. Aminophylline in doses of 0.1 gm. (1½ grains) may be given three or four times a day but its value is hard to estimate. Sedatives in small divided doses may be necessary during the day or at bedtime to control restlessness. Digitalis is employed only in the event of congestive myocardial failure or when there is auricular fibrillation with a rapid ventricular rate. The diet should be simple and should be limited to a value of 800 or 1000 calories. If the bowels do not move spontaneously, enemas should not be administered until after the second or third day.

The emphasis in treatment should be placed on the necessity for absolute rest. The patient should be fed and should not be allowed to help in changing his position for at least two weeks, and the total period of rest in bed should be from six to eight weeks. The erythrocyte sedimentation rate is a helpful guide in this respect; rest is enforced until the rate has become stationary at a normal or nearly normal level. After the period in bed, the patient is permitted to be up for short and gradually increasing lengths of time daily but is not allowed to return to his business activities for 3 to 12 months, depending upon the severity of the attack.

The most important complications of coronary thrombosis are: (1) sudden death due to rupture of the ventricle or to ventricular fibrillation, (2) ventricular paroxysmal tachycardia, (3) congestive heart failure, and (4) embolic accidents. Sudden death and ventricular paroxysmal tachycardia occur most commonly during the first two weeks after the occlusion. Ventricular tachycardia may be a forerunner of ventricular fibrillation or it may be directly responsible for the development of congestive heart failure. Its onset calls for the administration of increased amounts of quinidine sulfate. Congestive myocardial failure is treated by the usual measures, including the use of digitalis. After acute coronary thrombosis, a mural thrombus commonly forms on the endocardial surface of the infarcted myocardium. Embolic accidents, the result of dislodgment of portions of the thrombus, may occur at any time during

the first six weeks after the attack but are most common during the earlier part of this period. The emboli may lodge in any part of the pulmonary or systemic circulation and their treatment usually is limited to symptomatic measures.

Cardiac Asthma

Coronary artery disease is a common cause of that form of paroxysmal dyspnea to which the term cardiac asthma is applied. The attacks of dyspnea are due to failure of a damaged left ventricle and usually occur at night although occasionally they are induced by exertion. Because of relative weakness of the left ventricle, an increased amount of blood accumulates gradually in the pulmonary vessels during sleep in the recumbent position. The vital capacity, which is already diminished, is still further reduced as the degree of pulmonary congestion increases, and all that is now necessary to initiate the attack of cardiac asthma is some factor which acts as the trigger mechanism. Cough, Cheyne-Stokes respiration, noise, disturbing dreams and the urinary reflex most commonly supply this factor. The patient wakens with respiratory distress and is forced to sit up or stand in order to breathe. Asthmatic breathing develops, with both inspiratory and expiratory difficulty, and as the attack progresses acute pulmonary edema may supervene.

The two most important measures in the treatment of attacks of cardiac asthma are morphine and the upright position. Morphine exerts its beneficial effect by depressing the respiratory and vasomotor centers in the medulla and by reducing the patient's apprehension and anxiety. The drug should be administered hypodermically as early in the attack as possible, usually in doses of one-fourth grain, and should be repeated if the patient does not appear to be improved within fifteen or twenty minutes. The relief which the patient experiences in the upright position probably is due principally to the increase in the vital capacity which accompanies the change from the recumbent to the erect posture. There is evidence also that the minute volume output of the heart is decreased in the upright position, and, of course, any reduction in cardiac work would lead to an improved state of the pulmonary circulation.

Morphine and the upright position at times may fail to relieve the patient sufficiently and other measures must be employed. Aminophylline may be given by intravenous injection in doses of 0.48 gm. diluted with physiologic solution of sodium chloride or 50 per cent dextrose solution and may result in prompt improvement. The beneficial effect of the preparation is attributed principally to its action on the coronary circulation[2] but the drug also causes a diminution in the degree of bronchial spasm[3]. In the absence of anemia, venesection should be carried out with the removal of 250 cc. to 500 cc. of blood. This may result in prompt and lasting relief, particularly in patients who present engorge-

ment of the peripheral veins. Venesection reduces the circulating blood volume, and as a result, the work of the heart is diminished and pulmonary congestion is lessened. An effect similar to that of venesection may be obtained by applying blood pressure cuffs to the four extremities and inflating them to a pressure just above diastolic blood pressure. The administration of oxygen by means of a tent or by nasal catheter is also a measure of great value and should be instituted as promptly as possible.

In patients in whom cardiac asthma progresses to acute pulmonary edema in spite of the above measures, either strophanthin or digitalis should be given intravenously. It is, of course, essential to ascertain that these patients have not received digitalis earlier.

A patient who has experienced an attack of cardiac asthma due to failure of the left ventricle should be treated as any other individual who presents evidence of impaired myocardial reserve. Complete digitalization and the subsequent administration of daily maintenance amounts of the drug are indicated, and in subjects who have had but mild attacks, this measure alone may suffice to prevent the recurrence of paroxysms. In those who have suffered more severe attacks, a period of absolute rest is advisable and should be followed by strict limitation of activity. Restriction of fluids and the administration of diuretic drugs also are valuable measures. At times, the intravenous injection of hypertonic glucose solution (50 to 100 cc. of a 25 or 50 per cent solution daily for several days) may be helpful in diminishing the frequency of attacks. Because cardiac asthma due to left ventricular failure usually occurs at night and the onset of the seizure is favored by the recumbent position, the patient should be instructed to sleep well propped up in bed. Sedatives also should be given to insure sound sleep since the attacks generally are precipitated by some factor which tends to waken the patient.

Heart Block

Coronary artery disease is the most common cause of auriculoventricular block. Simple prolongation of auriculoventricular conduction time is observed at times in individuals who have no symptoms referable to the cardiovascular system. More commonly, however, just as in the higher grades of heart block, the patient presents evidence of reduced myocardial reserve, and in such cases the cautious administration of digitalis is indicated. The treatment should be carried out with electrocardiographic control, and if the degree of block increases, the drug should be discontinued. In favorable cases, suitable amounts of digitalis not only relieve the symptoms of myocardial insufficiency but may also reduce the degree of block or abolish it entirely.

The higher grades of heart block, and particularly complete auric-

uloventricular dissociation, may be complicated by Adams-Stokes attacks due to temporary standstill of the ventricles. The seizures are characterized by dizziness, syncope or convulsions, depending upon the duration of the ventricular asystole. Adams-Stokes attacks are not common, but individuals in whom they occur are liable to have repeated seizures. The actual attacks seldom call for treatment, and therapy is directed toward preventing their recurrence. Occasionally, however, the standstill may be of such duration as to necessitate the intracardiac injection of epinephrine and this procedure may be directly responsible for the saving of life. The most effective drugs for preventing recurrent attacks are epinephrine (0.5 cc. to 1.0 cc. of the 1:1000 solution) by intramuscular injection every 3 or 4 hours and ephedrine sulfate (gr. $\frac{3}{8}$ or gr. $\frac{1}{2}$) by mouth 3 or 4 times in 24 hours.

Congestive Heart Failure

Coronary artery disease often results in the gradual development of symptoms and signs of congestive heart failure instead of the more dramatic episodes of angina pectoris, coronary thrombosis, cardiac asthma or Adams-Stokes seizures. Treatment does not differ from that of myocardial failure due to other types of heart disease and consists principally of absolute rest in bed, the proper administration of digitalis, sedatives, and diuretic drugs, restriction of the fluid intake, and, less often, venesection and the mechanical removal of fluid from the thorax or abdomen.

Summary

The most common manifestations of coronary artery disease are angina pectoris, coronary thrombosis, cardiac asthma, the Adams-Stokes syndrome, and congestive heart failure. The treatment of each of these conditions has been summarized.

References

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