

SURGICAL TREATMENT OF ANGINA PECTORIS*

EXPERIENCES WITH LIGATION OF THE GREAT CARDIAC VEIN AND
PERICORONARY NEURECTOMY

MERCIER FAUTEUX, M.D.

MONTREAL, CANADA

IT IS WELL KNOWN that in coronary disease sensory disturbances, vasomotor reactions, and mechanical interferences with the coronary blood flow are always intimately interwoven. It probably never occurs that a single group of these pathologic phenomena acts alone. It is, therefore, fundamentally important to elaborate surgical procedures which would simultaneously block all the nervous deleterious influences and improve the mechanical conditions of the coronary circulation. This basic principle was never lost sight of in the experimental studies that we have carried on since 1935.

To improve the mechanical conditions of the coronary circulation, the value of coronary venous ligation was reinvestigated. To block the action of reflexes, all the important pathways to and from the coronary arteries were resected at the root of the aorta and the origin of the coronary arteries. This last procedure which is obviously more than a sympathectomy, as vagal, sympathetic and sensory branches are resected, is referred to as pericoronary neurectomy.

In 20 dogs, used as a control series, the circumflex artery was ligated at its origin; namely, two to four millimeters from the origin of the left coronary artery. Twenty per cent of the animals survived. In a second group of ten dogs, prepared in advance by coronary venous ligation, the circumflex artery was ligated as in Group I, about one month after. Forty per cent of the dogs survived. It is interesting to note that all the animals which died, except one, succumbed rapidly after the arterial occlusion. In a third group of ten dogs, prepared in advance by pericoronary neurectomy alone, ligation of the circumflex artery was done as in the previous groups at various intervals after operation. Sixty per cent of the animals lived. The interesting point to mention about this series is that not a single animal which died succumbed immediately after the arterial occlusion. In a fourth group of 15 dogs, prepared in advance by pericoronary neurectomy and coronary venous ligation, the circumflex artery was tied again as in the other groups. The survival rate rose to 86.7 per cent. These last results seem to indicate very clearly that coronary venous ligation combined with pericoronary neurectomy decrease substantially the mortality rate after a very high coronary occlusion.

* Read before the American Surgical Association, April 2-4, 1946, Hot Springs, Virginia.

Other experiments were carried out with Swenson to evaluate pericoronary neurectomy in abolishing anginal pains. The method originally described by Sutton and Lueth (1930) was used. The results obtained showed that pericoronary neurectomy abolished pain. In our control series of ten dogs, seven gave responses of a high degree which were graded (++); two gave fairly good positive responses (+); one did not respond (-). In the latter, the negative result was undoubtedly due to the animal's poor condition at the time of the test. Ten dogs operated upon in advance by pericoronary neurectomy gave the following results: Six gave no responses at all (---); one was irresponsive in five tractions on the coronary artery and in one traction the result was questionable because the animal seemed restless (--); two gave doubtful reactions, for they were very active during the rest periods and it is difficult to conclude whether the activity they presented during the tests was due to pain or just to a normal behavior. One only had a positive reaction which was graded (+). It was concluded that pericoronary neurectomy, when technically well done, can abolish coronary pain.

Finally, other experiments were done to see if pericoronary neurectomy could prevent ventricular fibrillation appearing after sudden coronary occlusion. For this purpose, the adrenalin test was used. In a control series, two cubic centimeters of a solution of adrenalin 1:1000 was injected into the left auricular appendage of the intact dog's heart. A sharp elevation in the blood pressure immediately followed, accompanied by ventricular tachycardia and arrhythmia. No ventricular fibrillation occurred. Gradually, the blood pressure and cardiac rate returned to normal. In another series, either the ramus descendens or the circumflex branch of the left coronary artery was ligated at a level that was known by many previous experiments as not high enough to determine ventricular fibrillation within at least one hour after occlusion. One or two minutes after ligation, the same dose of adrenalin as used in the previous group was administered into the left auricular appendage. In all cases, ventricular fibrillation developed within one or two minutes. In a final series, prepared in advance by pericoronary neurectomy, the same procedure as in the latter group was carried out. It was immediately followed by a sharp elevation in the blood pressure, ventricular tachycardia and arrhythmia. In no instance did ventricular fibrillation develop. It seems, therefore, that pericoronary neurectomy helps substantially to prevent fibrillation following coronary occlusion.

The physiologic basis of coronary venous ligation and pericoronary neurectomy as well as the reasons for their association have been discussed at length in other papers. Needless to say, the experiments reported briefly today illustrate clearly that it is fundamental to act simultaneously against both mechanical and vasomotor disorders in coronary disease to achieve better results through operation. Finally, they suggest that coronary venous ligation combined with pericoronary neurectomy should be tried and carefully studied in correctly selected cases of coronary disease.

Sixteen cases have been operated upon during the past six years. They are divided in three groups: In the first, only coronary venous ligation was done. At that period, the experimental work on the coronary nerves was not advanced enough to allow denervation in patients. This group has, however, the advantage of showing the value and limitations of the procedure when used alone. The second group consists of cases of coronary venous ligation combined with pericoronary neurectomy. In the third group—only one case—pericoronary neurectomy alone was performed.

All these patients had a history of coronary thrombosis confirmed by electrocardiographic tracings. Some of them gave a history of two or three attacks of coronary thrombosis. All were practically disabled by "angina of effort" and did not respond to rest and medication. Three died either during or rapidly after operation. In the first group, the cause was pneumothorax tension; in the second, intoxication by quinidine; and in the third, rapid cardiac failure, both coronary arteries being totally occluded at the aortic orifice.

Two of these cases have succumbed since operation. One, a 65-year-old patient with angina and cardiac failure, was discharged from the hospital relieved of his pain. He died three months later from progressive cardiac failure. The other lived during 2.5 years after operation. Before coronary venous ligation, he was not able to walk a block without dyspnea. The slightest emotional upset provoked marked pain. Five months after operation, he walked five miles without resting and had no discomfort. He resumed his work as a janitor. Up to the time of his death, he was examined frequently, and the marked improvement in his condition noticed after ligation was maintained. He died suddenly. His heart was examined and histologic sections showed a high degree of vascularity of the cardiac muscle. Vessels of the posterior and anterior papillary muscles were markedly dilated and gave the appearance of being cavernous. Actual pools of blood were also found in the sections.

Eleven patients are still living; one, six years after the operation. At the age of 65 he is working; his only complaint is a slight dyspnea after exertion. He is now obese and hypertensive. Three patients were operated upon approximately five years ago; they all do the same type of work in which they were engaged before coronary disease incapacitated them, and they have no anginal pain. In the recent group of three patients in which coronary venous ligation was combined with pericoronary neurectomy, one patient is working steadily and has been for 1.5 years; he does not complain of angina. The second case is much improved but states that at the end of the day he often feels pain in his chest of less intensity than before the operation. The third case, operated upon last November, is remarkably well. Before November he was unable to work on account of angina. Subternal pains occurred with bowel movements, and after marital relations, or walking on the level. Since the operation, this pain has been absent. In January he walked in a snowstorm, face against the wind, and

reached his home without having pain or the slightest discomfort. On another occasion, he walked two miles without resting, and immediately afterwards ate a hearty meal. This was not accompanied or followed by angina. He admits that he never could have done this a year ago.

In one severe case, it was necessary to perform the operation in two stages. In the first stage, the ribs were partially resected; and in the second stage, denervation was done. Coronary venous ligation was omitted because we did not dare to prolong the operation. The blood pressure was at a low level. It is too early to evaluate the results in this patient. Yet it is encouraging to note that, since the operation, he has improved a great deal. Formerly he took about six nitroglycerin pills, but now he does not need this medication.

DISCUSSION.—DR. ELLIOTT C. CUTLER, Boston, Mass.: In this afternoon of brilliant papers, I hope this contribution by Doctor Fauteux will take its place as a valuable contribution. In this Association, the greater number of Fellows work in excellent hospitals, and have every facility for assisting and stimulating their pupils in investigative work. Doctor Fauteux has conceived and planned all his work himself. He came to us five years ago, and has continuously prosecuted experimental work out of his own experience and imagination. He has been helped by us largely through technical assistance, and what credit is forthcoming belongs to him alone.

To those interested in the application of surgery for relief of angina pectoris it is common knowledge that two major surgical plans have been proposed:

(a) The first plan is that originated by Francois Franck, a French physician in the last century, who proposed that the division of the sympathetic nerves in the neck might diminish the anginal pain. This procedure was largely practiced in Europe and completely elaborated upon by Rene Leriche. It has received further modification in this country at the hands of J. C. White, and others.

(b) The second method is that which seeks to bring a new blood supply to the heart devitalized by coronary disease. This school of thought is best represented by C. S. Beck in the United States and O'Shaughnessy in England.

Doctor Fauteux has, for the first time, tried to bring these two schools of thought into a common method, and the paper presented today has, I believe, made clear that both the neurologic elements, as well as the injured myocardium, must be considered in any thoughtful attack upon this problem. Moreover, he has brought the neurologic attack to the heart itself and, thus, avoided any injury to the accelerator or depressor apparatuses. His addition of vein ligation as a means of improving the local blood supply is a method which, though it has not produced benefits in other fields, has, by his experiences, seemed to produce benefits in relation to the myocardium.

Finally, he seems to have made secure his point that ischemia *per se* is not the cause of fibrillation, which is the vital element in this disorder. If this be so, it certainly strengthens his viewpoint that interference with the neurologic apparatus must also be utilized in attacking this condition.

DR. CLAUDE S. BECK, Cleveland, Ohio: I want to congratulate Doctor Fauteux on this work. I believe it is an important contribution and I should like to give him every encouragement to keep on with it. This work is difficult. It is difficult in the laboratory where the experiments are done, and it is difficult in the Clinic where laboratory ideas are applied to patients afflicted with coronary artery disease.

I cannot discuss reflexes in the heart. In our work we purposefully avoided consideration of reflexes. I believe the key to the coronary artery problem is in arterial blood supply and oxygen. The fundamental concept underlying our work can