CORRESPONDENCE

Transmyocardial Revascularization: Could Mechanical Puncture Be More Effective than Puncture by Laser?

To the Editor:

A recent history of the Vineberg operation[1] made the point that Vineberg implants into the myocardium often worked, but that the procedure was soon eclipsed by the advent of coronary artery bypass grafting (CABG). I would like to make a similar point about transmyocardial puncture revascularization, which is not at all a new procedure but was introduced in 1965, by P.K. Sen in India.[2] In a series of canine experiments, Dr. Sen punctured the ventricular myocardium—not with a laser, of course, but with a 1.5- to 2-mm knobbed sharpened cannula.

From 1962 to 1968, my late colleague Manuel White and I carried out a number of experimental and trial procedures (among them the Vineberg operation), in an effort to revascularize the heart by some means other than CABG. (We never attempted direct operation on the coronary arteries because of the mistaken belief that elective cardioplegia for coronary disease was not a safe option.)

In our judgment, our most notable success was with the Sen transmyocardial puncture technique. On 24 October 1967, we were still testing this procedure on mongrel dogs when we felt compelled to apply our laboratory experience to a patient whose condition we considered hopeless without radical, immediate revascularization. Our case was reported in detail at the time,[3,4] but I would like to take this opportunity to summarize it and to present some new information from a 14-year follow-up.

Summation of the Case. Our patient was a 61-year-old man who had suffered massive myocardial infarction 4 years before and again 6 months before his October 1967 admission. He had transient congestive heart failure, cardiomegaly, triple-vessel disease, and an elevated left ventricular end-diastolic pressure. Our plan was to do a modified Vineberg procedure (bilateral arterial implants and twin detached omental grafts), and to reserve the Sen procedure as a backup. The experimental nature of puncture channels was explained in detail to our exceptionally inquisitive, alert patient, who accepted the risk.

During the lysing of pericardial adhesions, intractable ventricular fibrillation developed and lasted for 10 minutes or longer, without response to restoration efforts. In our effort to defibrillate the patient, we performed 4 series of transmyocardial punctures (25 punctures per series) with a sharpened 2.5 mm Titus cannula: 85 of these punctures were into all accessible surfaces of the left ventricle and 15 penetrated the anterior wall of the right ventricle. The Vineberg procedure was then completed as planned. The postoperative course was stormy, but the patient made a good gradual recovery and was discharged ambulatory on the 29th postoperative day.

Follow-up. Postoperative angiography performed by Melvin Judkins at the University of Oregon Medical School on 11 September 1968 showed no evidence of direct collateralization with the distal coronary vessels, i.e., the Vineberg implants appeared to be ineffective. The patient, however, was doing remarkably well: in August of 1968, a Master's exercise stress test showed no electrocardiographic change from the resting condition, in contrast with the patient's preoperative ECG, which had indicated marked ischemic changes during and after exercise. Moreover, 13 months after surgery, this man shot a 175-lb. buck, dragged it 100 yards, and lifted it onto his pickup truck. By exclusion of any beneficial result from the Vineberg implants, one might tentatively conclude that the patient's improvement was due to revascularization by transmyocardial puncture.

The subsequent 14 years, indeed, have lent weight to that conclusion. This patient recovered his stamina and moved from Idaho to western Colorado, where for some years he farmed 40 acres of green peas. During his last months, while living in San Diego, he developed severe claudication (at 100 feet), exertional angina, and pedal edema—despite which he continued to smoke. This man's doctor was hopeful that he might recover to the point of having a "fairly normal life," but the patient did not wish to be maintained on life support if he could not thereafter resume a "full and vigorous life," so support was withdrawn and he died on 10 September 1981, at age 75. Regrettably, his body was cremated and there was no opportunity for postmortem study.

Conclusions. In common with the Vineberg operation, transmyocardial revascularization research was overwhelmed by the success of CABG, and for many years it was put on a back shelf. Miroseini,[5] Cooley,[6] and others have since confirmed that laser punctures are indeed useful, particularly in the 15% of patients whose coronary artery disease is too diffuse for bypass or whose bypass anastomoses have failed. Mechanical punctures would appear to have several advantages over laser punctures: the procedure is simple, inexpensive, and does not cause thermal damage, yet it stimulates the development of arterioles and vascular channels, as we confirmed in our canine experiments.

The supreme test of mechanical or laser punctures is experimental excision of the full length of either the left anterior descending or the circumflex coronary artery, to determine if the myocardium can function with either of these vessels removed. Any comparison of mechanical with laser punctures needs to adopt this test as a standard. Dr. White and I repeatedly confirmed the usefulness of mechanical punctures by obtaining long-term healthy survivors after excision of the LAD or the circumflex, in separate experimental animals.[4] To the best of our knowledge, this test has not been applied to animal models subjected to laser revascularization.

Should any of your readers be interested, I have a movie (converted to videotape) that demonstrates the technique of mechanical transmyocardial revascularization, together with experimental excision of the LAD artery.

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The Significance of a Patent Foramen Ovale

To the Editor:

I read with interest the case report by Maraj et al[1] of hypoxia due to patent foramen ovale (PFO) in the absence of pulmonary hypertension. I wish to make a few comments.

First, PFO is indeed a frequent anatomic finding in normal people, more than the figure of 20% as reported by the authors. It was present in 27.3% of normal subjects in a large autopsy series published in 1984.[2]

Second, in addition to the 2 postulated mechanisms for right-to-left shunting via a PFO in the absence of pulmonary hypertension as discussed by the authors, I would like to mention a 3rd possibility—a persistent Eustachian valve. This was present in the case we reported in 1983.[3]

Third, platypnea-orthodeoxia is a relatively uncommon but serious syndrome of arterial hypoxia and breathlessness in the upright position caused by interatrial or intrapulmonary shunting. The most common cause is an interatrial right-to-left shunt through either a PFO or an atrial septal defect.[4] Platypnea-orthodeoxia can be explained on the basis of positional modification of abnormal shunting. Standing upright can stretch the interatrial communication, be it a PFO or an atrial septal defect, thus allowing more streaming of venous blood from the inferior vena cava through the defect, whether or not a persistent Eustachian valve coexists.

Fourth, besides platypnea-orthodeoxia, PFO may also be responsible for paradoxical embolism in the presence of either established or induced pulmonary hypertension.[5] The diagnosis of paradoxical embolism can now be made antemortem.[5-7]

Fifth, when treatment is indicated for PFO, nowadays it can be done nonsurgically by transcatheter closure.[8,9] This approach avoids the morbidity, mortality, and increased expenses associated with open heart surgery.[10,11] As we enter the new millennium, most patients with PFO can be treated in the cardiac catheterization laboratory instead of in the operating room.[12]

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