

Revascularization of the Septal Artery

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ABSTRACT The septal artery has been infrequently considered for bypass grafting due to its apparent inaccessibility. Twelve patients have recently been found to have a large single obstructed septal artery that supplied an area of left ventricle great enough to justify revascularization. A review of 100 normal arteriograms showed that 30% (30/100) of the patients had a septal artery of sufficient size to sustain a graft. Early restudy of 8 of the 12 patients who received septal bypasses showed all grafts to be patent and functioning well.

During the past seven years, revascularization procedures utilizing bypass grafts for coronary artery disease have gradually progressed from simple single and double bypasses [3] to more complex techniques and combinations of grafts. Frequently 3 and 4 or more grafts are used to bypass not only the three major divisions of the coronary circulation but also the minor divisions [6]. The diagonal branch of the anterior descending, the obtuse marginal branch of the circumflex, and the acute marginal and posterior descending branches of the right coronary artery have all been found at times to be of sufficient size to accept an appropriate vein or internal mammary artery graft.

The septal branch of the anterior descending coronary artery is frequently noted to be a major vessel in terms of size and distribution. Stenosis of the origin of a septal artery attracts attention to the possibility of including its distal distribution in the vessels to be bypassed during a revascularization procedure. The apparent inaccessibility of this artery has not been found to be a major problem. During the past eighteen months 12 of our patients have received a graft to a septal artery; they were selected from 700 who

underwent various coronary artery bypass procedures during that same period. These 12 patients are described and the anatomy of the septal distribution of the anterior descending coronary artery is reviewed.

Material and Methods

The 12 patients who received a graft to a septal artery included 11 men and 1 woman. Their average age was 55 years. All procedures were done with cardiopulmonary bypass utilizing moderate hypothermia and intermittent aortic cross-clamping for the distal anastomosis. The graft was directly anastomosed to the exposed proximal 1.5 cm of the septal artery in 8 patients (Fig 1A). The right or left internal mammary artery was used as the graft in 6 of these patients, the radial artery in 1, and the saphenous vein in 1. An indirect revascularization procedure was accomplished in the other 4 patients by anastomosing a saphenous vein or radial artery graft to an isolated segment of anterior descending coronary artery that included an unobstructed septal artery as the principal runoff for that segment (Fig 1B). The total number of grafts per patient ranged from 2 to 5 with an average of 3.8. The average cardiopulmonary bypass time was 2 hours 46 minutes.

To evaluate the size and distribution of the septal arteries, 100 coronary arteriograms were reviewed. The arteriograms were obtained during the same period and all had been reported normal. A tracing was made of each anterior descending coronary artery with the septal branches viewed in the right anterior oblique projection. These tracings were then evaluated to establish the number, size, and distribution of the septal branches originating from the anterior descending coronary artery.

Anatomy of the Septal Arteries

The first large septal artery originates from the proximal third of the anterior descending coronary artery. It descends inferiorly and medially

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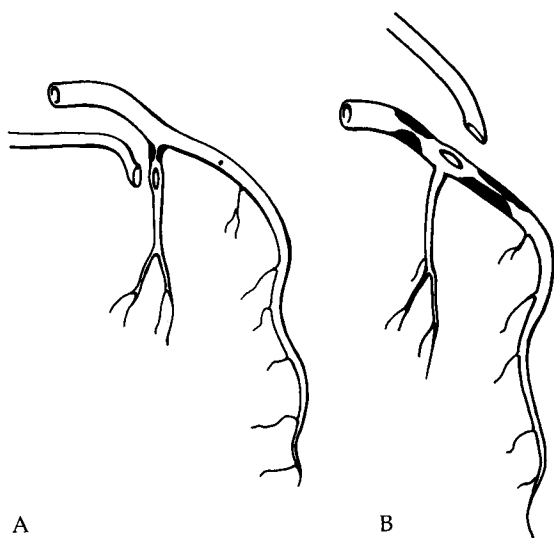


Fig 1. (A) Direct anastomosis of the bypass graft to the proximal septal artery. (B) Indirect anastomosis of the bypass graft to the anterior descending coronary artery.

for a short distance in the interventricular sulcus and gradually curves medially and posteriorly down the ventricular septum in a diagonal direction. As it enters the septal muscle it remains near the endocardial surface of the right ventricle [1].

This submyocardial portion of the septal artery then divides into two or more relatively straight branches that continue down the septum in a direction paralleling the course of the parent septal branch. Right-angle branches are uncommon. The characteristic long parallel branches are easily recognized on coronary arteriogram and distinguish the septal artery from other branches of the coronary circulation.

The 100 normal coronary arteriograms reviewed in this study show that considerable variation exists in the distribution of the septal arteries. The larger septal arteries originate from the proximal one-third of the anterior descending coronary artery. The septal branches of the middle and distal thirds are usually short, with infrequent arborization.

An average of 8 septal branches was found for each anterior descending coronary artery, with variation from 4 to 13. A septal artery was considered large enough to sustain a graft if the proximal portion appeared to be 1.5 mm in diameter, if the artery appeared to traverse at least

70% of the upper ventricular septum, and if the distal portion arborized into at least four branches. Such a single large septal artery was found in 30% of the arteriograms reviewed (Fig 2A). The remaining patients had a small septal artery (28%; Fig 2B), multiple small arteries (18%; Fig 3A), or 2 or 3 septal arteries of equal size (24%; Fig 3B).

Two other interesting variations of the septal blood supply were noted. The first has been previously described by James [4]. A small septal artery may originate from the right coronary sinus or from the very first part of the right coronary artery, traverse the crista supraventricularis, and then descend in the superior ventricular septum (Fig 4A). This variation has been noted 2 or 3 times per 1,000 patients.* In each case the septal artery originating from the right coronary artery was small. The second variation is not so rare. Occasionally an unusually large single septal artery was seen that appeared to be parallel to but deeper than the anterior descending coronary artery and gave rise to all the septal arteries of the proximal two-thirds of the septum. Two such arteries were noted in the 100 arteriograms reviewed (Fig 4B).

Surgical Technique and Results

The septal artery is not visible on the epicardial surface of the heart. It can frequently be located by its relationship to the most proximal diagonal branch of the anterior descending coronary artery. The septal artery usually originates on the inferior surface of the anterior descending artery opposite the origin of the diagonal branch on the anterior surface. Dissection should begin by exposing several centimeters of the anterior descending coronary artery at the level of the pulmonary valve. The medial and inferior surface of this vessel is exposed by dissection of the surrounding epicardial fat. The septal artery is identified on the underside of the anterior descending artery as it courses diagonally down the interventricular sulcus for a short distance. Frequently a few muscle fibers must be divided to obtain access to the first 1.5 cm of the septal artery. Circumferential traction sutures are

*Engle HJ, Torres C, Page HL: Personal communication, 1974.

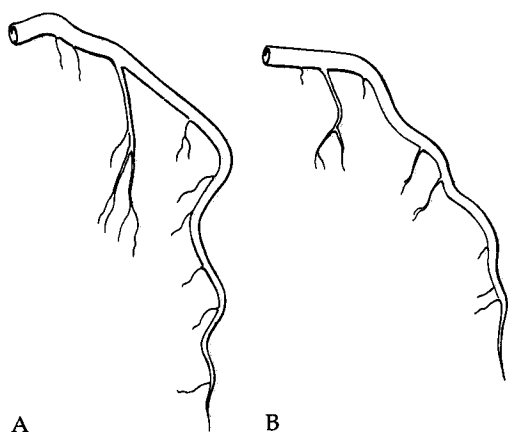


Fig 2. (A) Single large septal artery (30 of 100 patients). (B) Single small septal artery (28 of 100 patients).

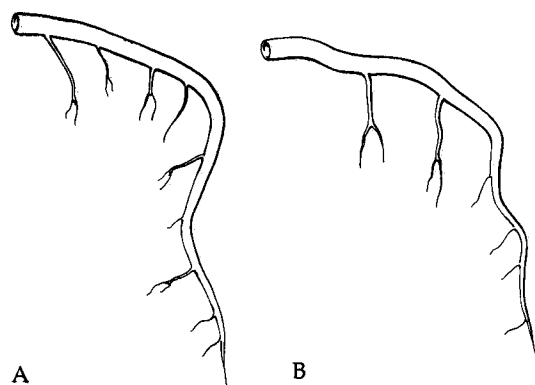


Fig 3. (A) Multiple small septal arteries (18 of 100 patients). (B) Two or 3 major septal arteries (24 of 100 patients).

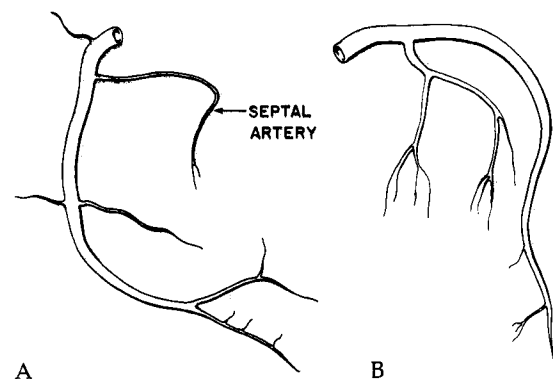


Fig 4. (A) Septal artery originating from the right coronary artery. (B) Dominant first septal artery.

placed about the anterior descending artery above and below the septal artery to improve exposure. The medial epicardial fat is retracted by a large, padded stay-suture (Fig 5A). Only a short length of artery should be exposed, as extending the incision distally will eventually open the right ventricle (Fig 5B). By means of aortic cross-clamping, an internal mammary artery or vein can be anastomosed to the opened septal artery using techniques appropriate for other small coronary arteries (Fig 5C).

In this group of patients the graft to the septal artery was the last of several bypasses to be completed. Prior to anastomosis the internal diameter of the septal artery was calibrated in 8 patients and was found to be 1.5 to 2.5 mm.

Eleven of the 12 patients survived and were discharged from the hospital. One patient sustained dissection of the aorta originating at the site of aortic cannulation and died in the operating room. A second patient suffered an acute anterior infarction during the procedure and required two hours of intraaortic balloon assist at the completion of the operation. Subsequent restudy of this patient showed all grafts to be patent with no loss of ventricular contractility. New Q waves were noted in a third patient, who did not undergo restudy. Other postoperative problems included transient atrial fibrillation, thromboembolism, and bleeding. There have been no late deaths, although the longest follow-up has been only eighteen months. All patients were symptomatic prior to the operative procedure, and 3 had preinfarction angina. Ten of the 11 survivors are asymptomatic. One patient still has occasional episodes of angina on exertion.

During the same hospitalization a postoperative arteriogram was obtained in 7 of the 8 patients who received a direct graft to the septal artery. All 7 grafts were patent and functioning well. Of the indirect grafts, 1 restudy was obtained that also showed good function.

Comment

The blood supply of the ventricular septum has been described by James [4, 5] and by Farrer-Brown and Rowles [2]. They have confirmed that two-thirds of the septal blood supply is derived from the septal branches of the anterior descend-

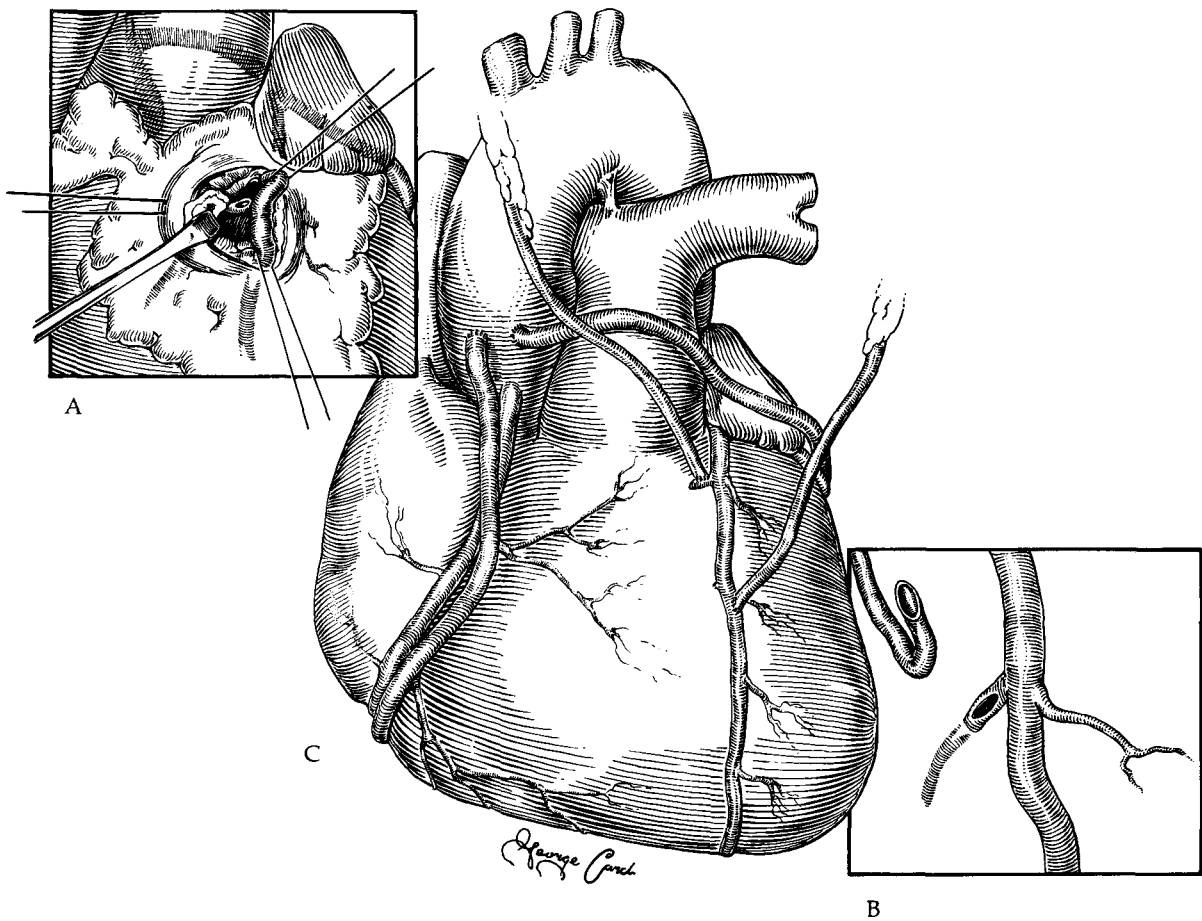


Fig 5. (A) Exposure of the proximal septal artery by retracting the epicardial fat. (B) The arteriotomy is confined to the proximal artery to avoid injury to the right ventricle. (C) Vein grafts to the right and circumflex arteries with mammary grafts to the septal and anterior descending arteries.

ing coronary artery. The septal branches of the posterior descending artery supply the remaining one-third or less. These septal branches act as important sources for collateral circulation between the anterior descending and posterior descending coronary arteries.

The first large septal artery is of sufficient size to justify a separate bypass graft in only 30% of the normal arteriograms reviewed. The total left ventricular myocardium revascularized by such a graft must be rather small. It is estimated that a single large septal artery supplies approximately 10 to 15% of the left ventricular myocardium [5]. However, the vasculature of this part of the septum, because of its importance to the ventricular

conduction tissue, merits special attention. Of secondary importance is the rather constant collateral relationship with the posterior descending artery. For both reasons it appears that the septal artery deserves consideration beyond its size and distribution.

The surgical exposure of this vessel does involve more dissection than is required for epicardial surface arteries. The dissection introduces the possibility of injury to the anterior descending coronary artery or another of its branches. Also, extensive dissection of the septal artery could produce an opening into the right ventricle that would be difficult to control without possible injury to the septal artery. It seems likely that operative problems or post-operative complications could be increased by the exposure and dissection required for a graft to the septal artery. In the small number of patients we treated, the advantage of a patent graft to this area seems to have justified any additional risk and operative time. The long-term

advantages of revascularizing the septal artery will be difficult to determine but should be comparable to the results with other secondary divisions of the coronary arteries.

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Discussion

DR. JAMES E. AUER (Milwaukee, WI): I congratulate the authors on an approach which we believe to have considerable merit. We have always thought that all heavily stenosed coronary artery branches of reasonable size should be bypassed.

The first septal bypass graft in our center was performed by Dr. Dudley Johnson in May of 1972. A total of 29 septal bypasses have been done. Measured flow

has varied from 25 to 110 ml per minute. The location of the occlusive disease in patients with septal artery stenosis is such that the anterior descending and diagonal coronary arteries are usually bypassed in addition to the septal artery.

The anterior descending and diagonal grafts should be performed before the septal graft because the traction required on the anterior descending and diagonal coronary arteries to expose the septal artery may result in temporary occlusion of the descending, diagonal, or both.

We operated on a patient in May, 1972, who had stenosis of a very large septal artery with substantial disease in the diagonal branch in addition to almost total occlusion of the anterior descending coronary artery. A study 18 months after operation demonstrated a patent left mammary artery bypass, side-to-side to the diagonal and end-to-side to the left anterior descending, and a vein graft to the large septal coronary artery.

In another patient we found a very noticeable stenosis of the anterior descending coronary artery before the origin of the septal artery and also disease of the diagonal and anterior descending arteries distal to the septal artery. This artery was isolated from adequate circulation by the disease process. A postoperative study showed vein grafts to the anterior descending, diagonal, and septal artery.

In our 29 septal bypass grafts we have had no major problems entering the right ventricle during dissection of the septal artery. There have been no postoperative septal infarctions. Postoperative echocardiograms have demonstrated increased appropriate action in some of these patients.

Notice from the Southern Thoracic Surgical Association

The Twenty-second Annual Meeting of the Southern Thoracic Surgical Association was held at the Fairmont-Roosevelt Hotel, New Orleans, LA, November 6-8, 1975. The President was Frederick H. Taylor, M.D., Charlotte, NC. Officers elected for the coming year are James W. Brooks, M.D., President; Joseph W. Peabody, Jr., M.D., President-Elect; and Edmund R. Taylor, M.D., Vice-President.

Thirty-three applicants were elected to membership. The President's Award for the best scientific paper given at the 1974 meeting was presented to Dr. Harvey W. Bender, Jr.

The 1976 meeting will be held at the Princess Hotel, Acapulco, Mexico, on November 4-6. Chairman of the Program Committee is Harold C. Urschel, Jr., M.D.; Chairman of the Membership Committee, Orin D. Butterick, M.D.; and Chairman of the Meeting Site Selection Committee, O. Brewster Harrington, M.D. Bertram A. Glass is in charge of Local Arrangements.

J. Kent Trinkle, M.D.
Secretary-Treasurer