

Coronary Arteriography and Coronary Artery Bypass Surgery.

PRESENT STATUS IN THE WESTERN WORLD. IMPLICATION FOR PAKISTAN.

By

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CORONARY ARTERIOGRAPHY

Selective coronary arteriography implies opacification of left and right coronary arteries by injection of radiopaque dye directly into the coronary ostium through a specially constructed catheter. The catheter may be introduced either by percutaneous femoral artery puncture (e.g. Judkin's technique) or by brachial artery cut-down (e.g. Sones' technique). The injection is recorded using an x-ray image intensification system and a 35 m.m. film cine camera. The images are recorded with the patient in multiple projections especially in the right anterior oblique position (Fig. I) and left anterior oblique position. At present this is the only available method to accurately delineate, *in vivo*, the coronary arterial anatomy and to demonstrate the presence of atheromatous obstruction or other disease process affecting the inner lumen of vessels as small as 100 micron in diameter.

In its early stages, after its introduction by Sones in the late 50's, coronary arteriography carried relatively high morbidity and mortality. However, at present when performed in a proper setup by a properly trained and skilled person, it is a very safe procedure. In the author's own experience, looking at consecutive 1000 cases done by this author the following complication

rate was noted within the first 24 hours of the procedure:

<i>Complication</i>	<i>No. of Cases (%)</i>
Death	0
Cerebrovascular accidents	0
Femoral artery thrombosis	0
Loss of radial pulse	4 (0.4%)
Sub-endocardial infarct (12 hours after cath. in patient with unstable angina)	1 (0.1%)
Transmural infarct (24 hours after cath. in patient with unstable angina and left main coronary artery stenosis)	1 (0.1%)
Total cases	1000

Most catheterization laboratories in large medical centres in U.S.A. and U.K. have a similarly low complication rate. However, multi-centre complication figures from U.S.A. show mortality of this procedure to be about 0.5% and a morbidity rate of between 3%—10% (Braunwald et al., 1968). So that in some centres, especially those not performing a large number of studies, coronary arteriography still carries a definite small mortality and a significant morbidity.

Due to the steadily decreasing complication rate (Shabetai et al., 1979) the indications for coronary arteriography have been increasingly liberalized. It seems now that the major limitation in experienced hands is the cost effectiveness of the procedure and, of course, the fact that the patient is subjected to a moderate degree of discomfort. However, there were and still are a few well known cardiologists who are resistant to the free use of coronary arteriography. The following quotes highlight this previously severe polarization:

Indications for coronary arteriography:

—"Presence of coronary arteries." Mason Sones.

—"None." George Burch.

Physicians with Dr. Burch's viewpoint are fast disappearing. As a general guide the following may be taken as the accepted indications for obtaining a coronary arteriogram:-

1. Atypical chest pain of significant severity as to affect the normal life pattern of the patient, in the absence of any convincing evidence as to its possible etiology (diagnostic use).
2. Severe disabling angina pectoris not controlled with an adequate trial of medical therapy (as a prelude to possible surgery).
3. Suspicion of the presence of left main coronary artery stenosis suggested by over 2 m.m. ST segment depression at very low levels of exercise testing or ST segment elevation with exercise in the absence of prior infarction (possible surgery if left main stenosis present).

4. Adults with aortic stenosis and angina who are under going left heart catheterization (Surgical implications).
5. Any patient who is undergoing a left heart catheterization for other reasons but has symptoms suggestive of ischaemic heart diseases or has definite angina or an infarction in the past (Diagnostic and prognostic use).
6. Pre-operative catheterization in patients with congenital heart disease where anomalies of coronary arterial distribution are suspected. In some centres all patients who are to have a right ventriculotomy at surgery (to avoid damage at surgery to aberrant vessels).
7. As part of an organized protocol to study the effects of interventions on the natural history of coronary atherosclerosis or the development of collateral coronary circulation (research use).
8. Recently, some centres have been studying all young patients with inferior myocardial infarction to delineate status of the left coronary artery bed (prognostic use and possible surgical implications as in left main stenosis).
9. In any clinical situation where the precise information about the patient's coronary anatomy is important enough to justify the risk and expense of the procedure.

CORONARY ARTERY BYPASS SURGERY (CABS)

Prior to the introduction of CABS by Favalaro and his group at the Cleveland clinic

in 1969, various procedures to surgically improve coronary blood flow had failed to provide convincing evidence of predictable improvement. However, all surgeries including sham operations had shown a placebo effect in post operative alleviation of angina, making accurate assessment ever more difficult.

The idea of CABS, i.e. to put a graft between the aorta and the coronary artery distal to the obstruction, was timely and based on sound physiological approach. For the graft itself no conduit was better suited than the leg or arm vein or the internal mammary artery of the patient himself (Fig. 2). Technically, vascular surgeons had perfected techniques of anastomosing vessels as small as 1.5 mm in diameter. Also, one case of successful CABS by a saphenous vein graft had been accomplished by De-Bakey's group in 1964, on an emergency basis, leaving a practical precedence for Favali's work.

The surgical mortality of CABS in its infancy was significant, ranging between 6% to 10% (Hurst, J.W. 1978). With vast improvements in cardiopulmonary bypass techniques, techniques for myocardial preservation during surgery using cardioplegia with general and local hypothermia and other improvements in anaesthesia and post-operative care, the present surgical mortality in excellent centres is below 2% (Hurst, J. W. 1978). The peri-operative infarction rate at present varies between 5% to 20% depending on the strictness of the criteria used and the diagnostic modalities employed (Buckley, M.J. 1977). The graft patency rate which determines continued symptomatic and functional improvement, ranges between 80%

to 90% for vein grafts and between 90% to 95% for internal mammary artery grafts at the end of the first post-operative year (Kirklin, J.W. 1973). The long-term natural history of these grafts as studied by Bourassa and his group in Montreal shows that the vast majority of grafts that are patent at the end of one year are patent at the end of five years.

At present in good centres, with the low morbidity and mortality and acceptable long term patency rates, CABS has a confirmed place in the management of an increasing number of patients with coronary artery disease. As a caveat, it must be pointed out that there is still continuing disagreement about a number of indications for CABS, and only a modest number of centres around the world can match the low complication rate noted above. Also, in the author's own experience, of the patients who clinically are candidates for CABS, upto a third are excluded as the coronary arteriogram reveals non-bypassable obstruction, small distal vessel or severe irreversible left ventricular dysfunction. With these limitations, and, keeping in mind that concepts in this field are actively changing, the following may be taken as presently acceptable indications and benefits of CABS.

(1) Severe and disabling angina pectoris not controlled by an adequate trial of intensive medical therapy including adequate doses of beta-blockers. This remains the time honored indication for CABS with upto 95% of patients experiencing long lasting symptomatic improvement or complete relief. Disabling angina should not be taken to imply that the patient has reached the stage of complete disability and is bed ridden. The patient should be classified as dis-

Fig. 1: Right and left coronary arteries as they would appear in a right anterior oblique coronary angiogram.

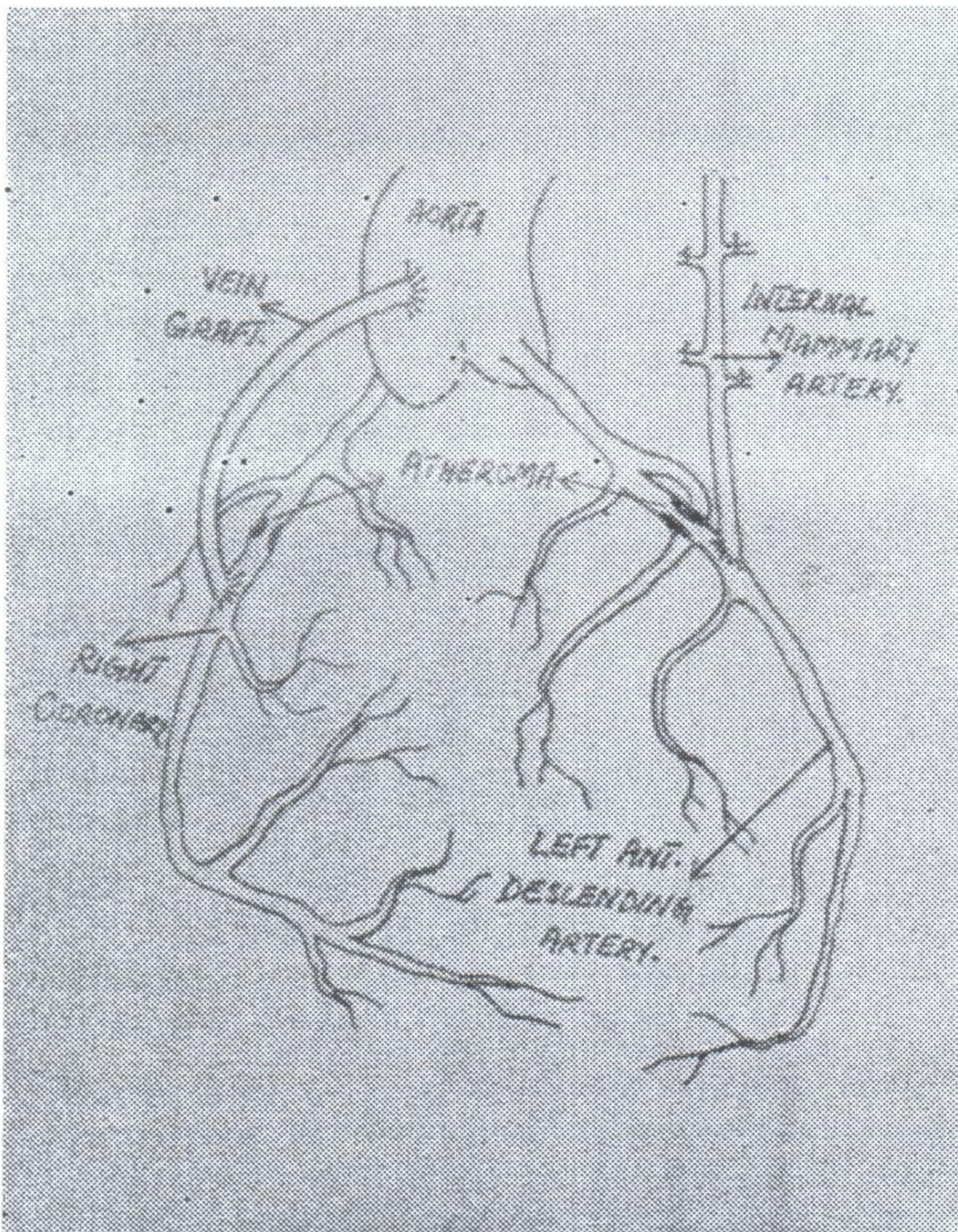
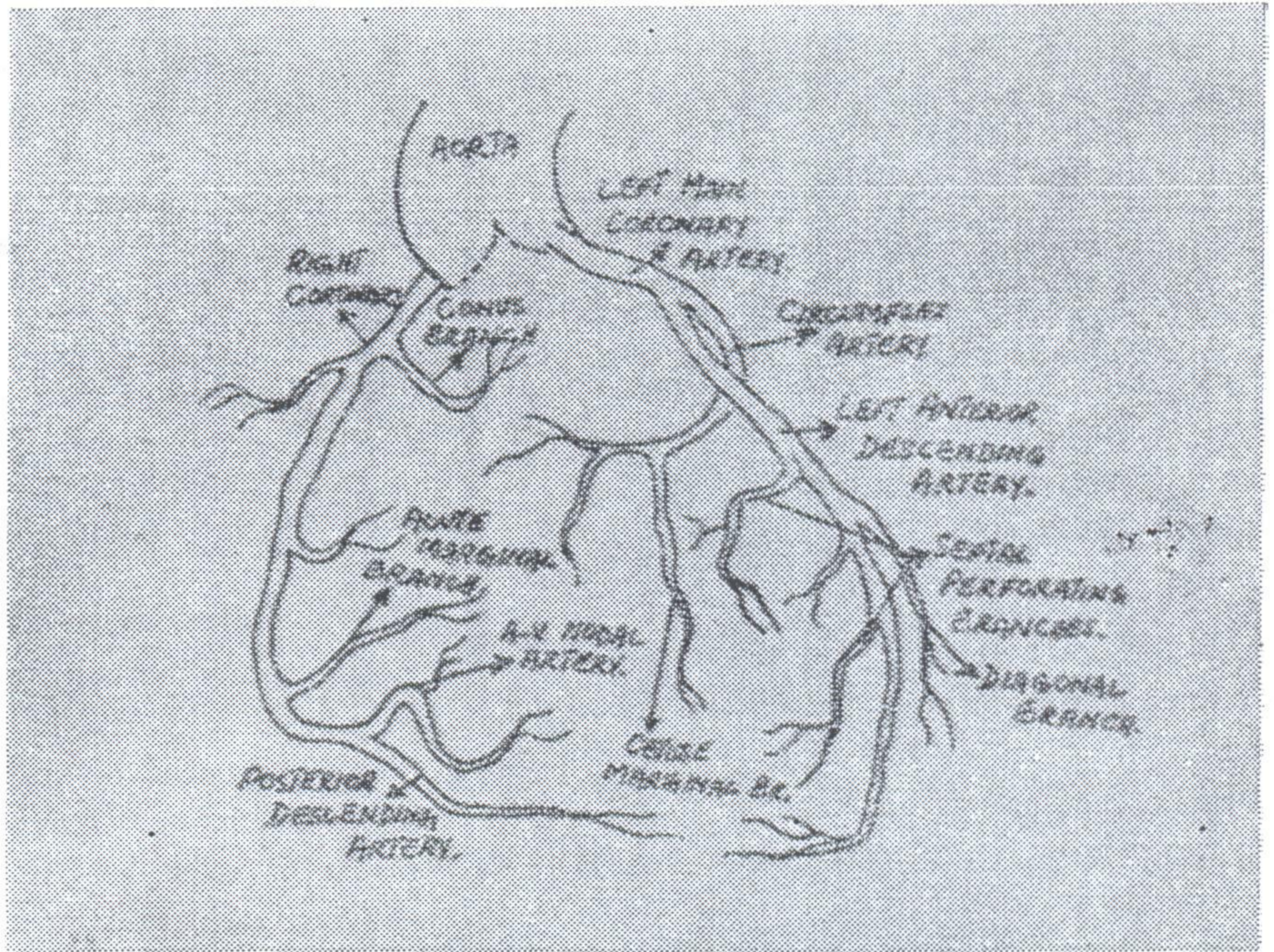


Fig. 2: Schematic view of coronary artery bypass by saphenous vein and Internal Mammary Artery.

abled when the severity and frequency of pain episodes prevent the patient from following a reasonably limited life style and job situation. As relief of pain is the primary objective, it does not matter whether it is one, two or three vessel disease as long as it is technically bypassable. Prolongation of life or prevention of infarction has not been demonstrated in this mixed group of patients.

(2) Presence of left main coronary artery stenosis. This is the only subgroup in which there is now convincing evidence that life is prolonged by CABS in addition to the symptomatic and functional improvement (Talano, J.V. et al., 1975). It should be obvious that left main coronary artery disease can be diagnosed only after coronary arteriogram has been done; however, certain clinical pointers to its presence have been mentioned above. In this author's experience about 10% of all patients with coronary disease undergoing coronary arteriography fall into this category. This percentage increases to 20% or more when patients with clinical suspicion of left main or three vessel disease are studied.

(3) Severe proximal stenosis of all three major vessels (i.e. the left anterior descending branch and the circumflex branch of the left coronary and the right coronary artery). While absolute proof of prolongation of life is lacking in this group and opinion's differ, it is the belief of many authorities and this author that in addition to the symptomatic and functional improvement there is increased longevity attained. Though the U.S. Veterans Administration Hospitals co-operative randomized study of this problem did not show increase in survival at 36 months, at 52 months, the survival curves of

surgical and medical groups are separating out in favour of surgery (Hultren, H.N. 1977).

(4) Patients undergoing valvular replacement or correction of congenital or other acquired heart disease and who are also found to have severe obstruction of a major coronary vessel on pre-operative coronary arteriography may also be candidates for CABS. It has been shown that addition of bypass surgery to valve replacement does not increase the mortality or morbidity of the procedure (Kouchoukos, N.F. 1971). When one opts to perform bypass under these circumstances, it must be kept in mind that rapid progression of disease in bypassed vessels has been reported in a few patients. Also the patient may be worse off if the graft placed closes off and the native diseased vessel has completely occluded in the interim as happens often.

There are a number of controversial and experimental uses of CABS that are being actively looked into. There continues considerable controversy regarding bypassing single proximal left anterior descending artery obstruction or proximal two vessel disease with the idea of prolonging life or preventing infarction, as most recent studies have failed to show any evidence of increased survival. Also, no proof is available of any benefit of CABS in unstable angina as far as preventing the occurrence of infarction or prolonging life. CABS was also used on an experimental basis during acute myocardial infarction, in unstable angina patients and in cardiogenic shock but this has been mostly abandoned as no benefit and some harm ensued. Rarely, when a patient starts to infarct on the cardiac catheterization table or other such observed and controlled setting, if CABS can be performed within an hour or

less of the onset of symptoms, it may limit the infarct. Such cases are few and centres where CABS can be done at such short notice are also few, so that no dogmatic conclusion can be drawn from the data available.

CORONARY ARTERIOGRAPHY AND CABS IN PAKISTAN

It has now been shown by more than one survey that the incidence of coronary heart disease in Pakistan is not much different from that in the West (Syed S.A. et al., 1973; Pirzada, M.A. et al., 1962). In this author's experience of coronary arteriography in Pakistan, the severity and distribution of obstructive disease is similar to that seen in the West. Ideally therefore, the indications for coronary arteriography and CABS should be the same in Pakistan as in the West. It should be borne in mind that a poor country like Pakistan must set its priorities however cruel they may look superficially, and, there must be a very critical cost effectiveness approach to everything. But with the general developments that are occurring all over the third world countries including Pakistan, it is essential that an increasing chunk of the health care budget be spent on introducing selected diagnostic and therapeutic modalities that have been available for several years in the West and have proven their worth and cost effectiveness.

For patients who can afford to go abroad, coronary arteriography and subsequent CABS costs each patient approximately two lacs rupees in foreign exchange at present. The number of patients going abroad for such procedures is small but not insignificant. It should be possible for institutions in Pakistan to offer these facilities at a fraction of what they cost overseas in

addition to making them available to persons who would benefit tremendously but could never afford to go abroad.

Presently, efforts are being made to start CABS in Pakistan. As such when CABS is available in Pakistan, the indications must have proven benefit and not freely as for example in the United States. It must also be considered that while coronary arteriography can be performed safely right from its initiation in an institution, if performed by well trained and experienced cardiologist, the same will not initially be true for CABS. From the experience of every major cardiology centre in the West, it is apparent that the initial surgical mortality when CABS is started is between 6% to 10% before it moves down.

My suggestion as to the indications for coronary arteriography and CABS in Pakistan would be as follows:—

- (1) Severe uncontrolled angina not responsive to aggressive medical treatment. The idea here is purely humane i.e., to relieve constant suffering, if technically possible, with CABS without much regards to prevention of infarction or prolonging life.
- (2) Severe disabling angina of effort not allowing job rehabilitation of an earning member of the family. The intention here would also be to relieve symptoms but with a tilt towards the cost-effectiveness to the society in so far as rehabilitating a disabled earning member of the society.
- (3) Strong clinical suspicion of left main coronary artery disease as described earlier. This is the only group we can assure in-

creased survival even in centres where surgical mortality is high e.g. The V.A. co-operative study with high surgical mortality (Takaro, T. et al., 1975).

- (4) In patients who are being investigated for Aortic valve disease with angina pectoris and certain congenital heart diseases. Here, as the patient shall have a left heart catheterization anyway, it is both of therapeutic and intra-operative management significance to know the exact coronary arterial anatomy. In certain patients with aortic valve disease and obstructive coronary disease, it may be advisable to perform CABS at the same time as the aortic valve is replaced as was done on one patient successfully at the N.I.C.V.D. last year. On the other hand in certain types of congenital heart disease it is necessary to know the course of certain coronary vessels in order to avoid injury and infarction at the time of corrective surgery.

All other cases with one, two or three vessel disease in the absence of disabling symptoms, should be managed medically until further proof as to effect on longevity accumulates. There may also be room for carefully planned and executed research uses of coronary arteriography and CABS.

SUMMARY

In summary, it may be stated that coronary arteriography and coronary artery bypass surgery have attained a confirmed status in the management of patients with ischaemic heart disease. CABS provides consistent and long lasting symptomatic and functional improvement

in the vast majority of patients in whom it is so intended and prolongs life in certain selected patients. Coronary arteriography is readily available and efforts are being made to make CABS available to well selected patient with ischaemic disease in Pakistan. Possible ways and means to adapt to our local circumstances and limitations are suggested.

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