THE ROLE OF VASCULAR DUPLEX ULTRASOUND IN EVALUATION OF PATIENTS UNDERGOING CABG OPERATION

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in cardiovascular medicine

BY

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To the loving memory…………

Of my late

Father…………

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Mohammed Elsayed Mustafa

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Abbreviations:

CABG: Coronary arteries bypass grafting
PTCA: percutaneous transluminal coronary angioplasty
QOL : Quality of life
LMCA : left main coronary artery
LAD: left anterior descending coronary artery
LCx or Cx : circumflex coronary artery
PCI : percutaneous coronary intervention
CCA: common carotid artery
ICA : Internal carotid artery
ECA : external carotid artery
CEA : carotid endarterectomy
CAD : coronary artery disease
MI : myocardial infarction
UA : unstable angina
STEMI: S-T segment elevation myocardial infarction
IMT : intima- media thickness
U/S : ultrasound
RI : renal impairment
RA: radial artery
GSV: great saphenous vein
V.V. : varicose veins
DVT : deep venous thrombosis
TIAs : transient ischemic attacks
HTN : hypertension

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Abstract

Patients and methods: This study recruited 1576 patients scheduled for CABG, divided into two main groups. The group A includes 500 patients. Mean age was 60.78 ± 6.09 ranging between 45 and 77 years, 415 were males (83%) and 85 were females (17%). This group had data about age, sex, risk factors for atherosclerosis (smoking, HTN, DM, dyslipidemia and +ve family history of CAD) and associated diseases mainly (TIAs, CVS, PVD and renal dysfunction). The data includes also mode of presentation, echocardiographic assessment of L.V. systolic function, the detailed coronary angiographic data as well as the duplex parameters of the carotid &radial arteries as well as GSV. The group B includes 1076 patients, 964 males (89.6%) and 112 females (10.4%). Mean age was 57.05 ± 9.2 ranging between 24 and 83 years. This group had data about only age, sex and duplex parameters of the carotid& radial arteries as well as the GSV.

All patients were classified into three subgroups according to carotid duplex data: subgroup 1: those have carotid stenosis ≥ 70% in either side, subgroup 2: those have carotid artery stenosis insignificant (< 70%) and subgroup 3: those with normal carotid artery i.e. no plaques and IMT is ≤ 1mm in both sides).

Results: Severe carotid artery stenosis (≥ 70%) was detected in 37 patients (2.3%) of the whole patients and in the group A they were 13 patients (2.6%). Predictors of severe carotid artery stenosis were significant LM lesion, TIAs, smoking, HTN and male gender respectively.

There were 388 patients (24.6%) with radial artery not suitable as a bypass graft; 277 of them (17.6%) has small diameter <2mm and 111 patients (7%) had radial dependent blood supply of their hands.

There were 2463 examined lower limb having diameter between 2-5 mm in the mid-thigh (78%) and 2254 limbs having the same diameter range in mid-leg (71.5%). Pathological abnormalities in GSV were varicose veins (0.4%), post phlibitic limb (1.2%) and acute DVT (0.2%).

Conclusion: Severe carotid artery stenosis was detected in 2.3% of patients with multi-vessel CAD. Radial artery wasn't suitable as a bypass graft in (24.6%).pre operative GSV duplex was of great value in identifying the exact anatomic & pathological data about the vein.

Key words: Coronary artery disease, carotid artery disease and coronary artery bypass grafts.

Coronary Artery Bypass Graft Surgery (CABG)

In 1962, a cardiac surgeon by the name of Sabiston conducted the first unsuccessful saphenous vein graft from the ascending aorta to the distal right coronary artery and the patient died 3 days later. The technique was then pioneered by Argentinean René Favaloro and others at the Cleveland Clinic in the late 1960s. The next major development was in 1970, when the internal mammary artery was used as a bypass conduit to the coronary arteries. By the mid 1970s, many centers in the United States, Australia, and Europe were performing CABG with low peri procedural mortality, and a high rate of pain relief. (1) In 1989, the number of procedures performed per 100.000 people was: 26.6 in the United Kingdom, 62.9 in Australia and 141.8 in the United States. (2) The CABG operation has become the most completely studied operation in the history of surgery. It has been shown to be highly effective for the relief of severe angina, and to have prolonged life in subsets of patients.

Indications of CABG:

The CABG procedure is indicated for the relief of symptoms (primarily angina) unresponsive to medical treatment or percutaneous transluminal coronary angioplasty (PTCA), particularly when it is likely that this operation will delay unfavorable events (death, myocardial infarction, angina recurrence) longer than other forms of treatment. For angina relief, surgery has often succeeded where medical or interventional therapy has failed or is not recommended. For survival, the situation is more complex. There is general agreement that CABG improves prognosis in the early post-surgical years in those patients with symptomatic left main coronary artery stenosis or stenosis of the three main coronary vessels, although this advantage is not thought to be significant after 10–12 years (3,4) . However, for the majority of patients with less severe pathology, the prognosis is good without surgery(5,6).

Furthermore, cardiac surgery has advanced to a point where mortality rates have declined dramatically (7). Thus, with such low death rates, selection among alternative courses of cardiac therapy is increasingly being based on measures of quality of life (QOL), including minimization of pain and disability.

The 2004 ACC/AHA guidelines on CABG (8) state that CABG is the preferred treatment for:

- Disease of the left main coronary artery (LMCA).
- Disease of all three coronary vessels (LAD, LCX and RCA).
- Diffuse disease not amendable to treatment with a PCI.

The 2005 ACC/AHA guidelines further state: CABG is likely the preferred treatment with other high-risk patients such as those with severe ventricular dysfunction (i.e. low ejection fraction), or diabetes mellitus.

Complications of surgery and re-hospitalization:

Outcomes of CABG can be grouped into categories that reflect the expected goals of CABG such as: prolongation of life, reduction of symptoms, improvement in physical, psychological and social functioning, and improvement in vocational status. (9,10,11,12,13) some surgical complications and medical problems have resulted in hospitalization following CABG. In an early study, 23% of CABG patients were re-hospitalized in the first 6 months following surgery. Cardiac problems were responsible for 32% of these hospitalizations, complications of surgery (including cardiac complications) for 14%, gastrointestinal difficulties for 9%, and a wide variety of problems in other organ systems for 45% of hospitalizations (14). More recently, 33% of CABG patients were re-hospitalized in the first 2 years after surgery, with the most common reasons for re-admission being acute myocardial infarction, arrhythmia or angina (15). Risk factors for re-hospitalization include: length of stay in intensive care; severe non-cardiac complications; duration and severity of pre-operative cardiac symptoms; intra-aortic balloon insertion; pre-operative resting angina; female gender; age; diabetes; and surgical procedure (patients with left internal mammary artery graft or multiple arterial grafts are less likely to be re-hospitalized(14,16,17,18) . Thus, a significant number of patients are re-hospitalized following CABG, although this high rate of readmission may reflect a greater likelihood that physicians will hospitalize patients if there is a recent history of cardiac surgery. Neurological complications following CABG include: stroke (5%–6% of patients); and ophthalmologic abnormalities such as retinal infarction, retinal embolization and reduction in visual acuity (13%–29% of patients)(19).

Adverse Cerebral Outcomes after Coronary Bypass Surgery:

Adverse cerebral outcomes after coronary bypass surgery are relatively common and serious; they are associated with substantial increases in mortality, length of hospitalization, and use of intermediate- or long-term care facilities. New diagnostic and therapeutic strategies must be developed to lessen such injury.

Stroke, the third leading cause of death in the United States, will continue to be a challenging problem as the population ages. Patients, who undergo myocardial revascularization procedures, now more than 800,000 a year throughout the world, are particularly prone to stroke, encephalopathy, and other neurologic dysfunction, because they are relatively old and have atherosclerotic disease. They are also subject to marked hemodynamic fluctuations; cerebral embolization of atherosclerotic plaque, air, fat, and platelet aggregates; cerebral hyperthermia after the discontinuation of cardiopulmonary bypass; and other inflammatory and neurohumoral derangements associated with surgery (20, 21, 22, 23, 24).

Overall, the mortality rate of coronary artery surgery is low, at around 2%–3% (25), although this benefit is offset by a complication rate of 20%–30%. Furthermore, post-surgical neurocognitive impairment is of concern (26, 27). PCI has had a dramatic effect on CABG, arresting the rapid growth of surgery in the 1980s and shifting the attention of surgeons to patients with more advanced coronary disease and extensive coexisting conditions. This has motivated surgeons to refine coronary revascularization techniques in order to maximize clinical effectiveness, limit costs, and reduce invasiveness.

Outcomes of CABG have historically been measured in terms of mortality and morbidity; however adjustment to CABG is a multidimensional phenomenon that is not fully explained by medical factors. When investigating postoperative adjustment to CABG, it is important to assess various physical, psychological and social variables as well, which is increasingly being recognized in recent studies.

Anatomy of the carotid artery

In human anatomy, the common carotid artery is an artery that supplies the head and neck with oxygenated blood; it divides in the neck to form the external and internal carotid arteries.(28) The left and right common carotid arteries follow the same course with the exception of their origin. The right common carotid originates in the neck from the brachiocephalic trunk. The left arises from the aortic arch in the thoracic region.The left common carotid artery can be thought of as having two parts: a thoracic (chest) part and a cervical (neck) part. The right common carotid originates in or close to the neck, so it lacks a thoracic portion.

Thoracic part:

Only the left common carotid artery has a substantial presence in the thoracic region. It originates along the aortic arch, and travels upward through the superior mediastinum to the level of the left sternoclavicular joint, where it is continuous with the cervical portion.

Relations:

During the thoracic part of its course, the left common carotid artery is related to the following structures: In front, it is separated from the manubrium of the sternum by the sternohyoid and sternothyroid muscles, the anterior portions of the left pleura and lung, the left brachiocephalic vein, and the remains of the thymus; behind, it lies on the trachea, esophagus, left recurrent laryngeal nerve, and thoracic duct.

To its right side below is the brachiocephalic trunk, and above, the trachea, the inferior thyroid veins, and the remains of the thymus; to its left side are the left vagus and phrenic nerves, left pleura, and lung. The left subclavian artery is posterior and slightly lateral to it.

Cervical part:

The cervical portions of the common carotids resemble each other so closely that one description will apply to both. Each vessel passes obliquely upward, from behind the sternoclavicular joint to the level of the upper border of the thyroid cartilage, where it divides.

At the lower part of the neck the two common carotid arteries are separated from each other by a very narrow interval which contains the trachea; but at the upper part, the thyroid gland, the larynx and pharynx project forward between the two vessels.

The common carotid artery is contained in a sheath known as the carotid sheath, which is derived from the deep cervical fascia and encloses also the internal jugular vein and vagus nerve, the vein lying lateral to the artery, and the nerve between the artery and vein, on a plane posterior to both. On opening the sheath, each of these three structures is seen to have a separate fibrous investment.

At approximately the level of the fourth cervical vertebra, the common carotid artery bifurcates into an internal carotid artery (ICA) and an external carotid artery (ECA). While both branches travel upward, the internal carotid takes a deeper (more internal) path, eventually travelling up into the skull to supply the brain via the carotid canal. The external carotid artery travels more closely to the surface, and sends off numerous branches that supply the neck and face.

Relations:

At the lower part of the neck the common carotid artery is very deeply seated, being covered by the integument, superficial fascia, the platysma muscle, deep cervical fascia, the sternocleidomastoid muscle, the sternohyoid, sternothyroid, and the omohyoid; in the upper part of its course it is more superficial, being covered merely by the integument, the superficial fascia, the platysma, deep cervical fascia, and medial margin of the sternocleidomastoid.

When the sternocleidomastoid muscle is drawn backward, the artery is seen to be contained in a triangular space known as the carotid triangle. This space is bounded behind by the sternocleidomastoid, above by the