Pre-operative Carotid Doppler Ultrasound Scanning among Patients who Underwent Cardiac Surgical Procedures at Queen Alia Heart Institute, Is It Necessary?

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ABSTRACT

Objective: To assess the frequency of significant carotid artery disease among the study group patients who underwent cardiac surgical procedures and highlight the importance of pre-operative Carotid Duplex Ultrasonography Scanning.

Methods: This is a descriptive study which was conducted on a consecutive series of 102 Jordanian patients who underwent cardiac surgical procedures at Queen Alia Heart Institute between January and December 2009, and were pre-operatively examined for carotid artery disease. Median age of the study group patients was 63 (range 40-78) years, there were 84 males and 18 females, 76(74.5%) were hypertensive, 62(60.7%) diabetics, 67(65.6%) had history of smoking, 45(44%) had a Body Mass Index >30, 13(12.7%) had significant left main disease. Ten patients (9.8%) had a pre-operative history of transient ischemic attack or cerebrovascular accident. Chi-square was used to determine significance of the study variables, P value<0.05 was considered significant.

Results: Seventeen patients (16.6%) were found to have 50% or greater stenosis of one or both carotid arteries whereas for an 80% or greater stenosis; it was 6(5.8%). Frequency of a 50% or greater stenosis of one or both carotid arteries was 3(6.5%) in patients between age 60 and 69 years, increasing to 11(42.3%) for patients age of 70 years and older. Independant risk factors for the presence of >50% stenosis in one or both carotid arteries in this group of patients were a previous history of transient ischemic attack or cerebrovascular accident, left main coronary disease, hypertension, history of smoking. Among 4 patients found to have concomitant significant carotid lesions and were hemodynamically stable with no critically stenotic coronary arteries, management was staged, carotid stenting was performed as a first stage in 2 patients and carotid endarterectomy was performed as a first stage in another 2 patients, cardiac procedures were performed successfully as a second stage in these 4 patients.

Conclusion: Concomitant significant Carotid Artery Disease among the study group patients above the age of 70 who underwent cardiac procedures is relatively high, selective pre-operative Carotid Duplex Ultrasonography should be mandatory.

Key words: CAS: Carotid Artery Stenosis, CAD: Coronary Artery Disease, CABG: Coronary Artery By-pass Grafting.

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Introduction

Atherosclerosis is a systemic disease involving the intima of large- and medium-sized arteries-including the aorta, carotid, coronary, and peripheral arteries. It is characterized by intimal thickening due to the accumulation of cells and lipids, thus carotid artery involvement in patients with coronary artery disease is expected, it frequently occurs at the carotid bifurcation and the proximal internal carotid artery. In general adult population, the prevalence of Carotid Artery Stenosis (CAS) approaches 4% while in patients with Coronary Artery Disease (CAD) it can reach (30-70%), whereas for those underwent Coronary Artery By-pass Grafting (CABG), the incidence of significant CAS is 17-22%.[1,2,3] The overall incidence of cerebrovascular accident after CABG is 2.1-5.2%[4,5,6,7,8] with related mortality of (0-38%).[4,9] evidence suggests that the risk of post CABG Cerebrovascular Accident (CVA) is 15%-18%[7,10,11] in patients with prior history of CVA or Transient Ischemic Attacks (TIA's) and who had unilateral 70-90% stenosis.[10] Increasing to 26% with bilateral 70-99% stenosis or contra lateral occlusion.[10] Significant CAD is a well established risk factor for perioperative stroke in patients undergoing CABG, and it accounts for 30% of strokes associated with CABG.[11] Postoperative neurological complications, not only increase mortality, but also prolong hospital stay, increase hospital costs and affect postoperative quality of life. Screening of the carotids may reduce the incidence of cerebrovascular events, some investigators have identified risk factors for carotid disease that can be used for more selective screening, these include: old age, prior neurological events, peripheral vascular disease, hypertension and smoking.[1,9,6,12-14]

In this study, we aim to assess the frequency of significant carotid artery disease among the study group patients who underwent cardiac surgical procedures and highlight the importance of pre-operative carotid duplex ultrasonography scanning.

Methods

This is a descriptive study which was conducted on a consecutive series of 102 Jordanian patients who underwent cardiac surgical procedures at Queen Alia Heart Institute between January and December 2009, and were pre-operatively examined for carotid artery disease. Median age of the study group patients was 63 (range 40-78) years, there were 84 males and 18 females, 76(74.5%) were hypertensive, 62 (60.7%) were diabetics, 67 (65.6%) had history of smoking, 10(9.8%) had history of CVA or TIA, 45(44%) had a Body Mass Index > 30, 13 (12.7%) had significant LMA disease, as shown in Table I. Chi square was used to determine significance of the study variables, P value <0.05% was considered significant.

Results

Out of 102 patients included in this study, 88 patients (86.3%) had CAS, 17 patients (16.6%) had significant lesions; that is to say 50% or greater stenosis of one or both carotids. Frequency of significant CAS in the age group (60-69) years was 3/26 (6.5%) (P<0.01), increasing to 11/26 (42.3%) for patients aged above 70 years (P<0.001), as demonstrated in Table II. Most of the patients were in the age group (60-69) years 45% in contrast to 4.9% of patients less than 50 years, as illustrated in Table III.

Out of the 17 patients with significant CAS, 6(5.8%) had severe stenosis >80%, 2(1.9%) of them had asymptomatic severe disease, while the remaining 4(3.9%) had symptomatic severe CAS, in addition to that 3 of the above 6 patients (2.9%) had bilateral stenosis >80%. Ten (9.8%) had unilateral lesions (>50%), whereas 7(6.8%) had bilateral lesions (>50%). With increasing age, especially >70 years, there is a tendency towards having severe bilateral CAS, >80% as shown in Tables IV and V. Independent risk factors for the presence of >50% stenosis in one or both carotid arteries among this sample of patients were a previous history of transient ischemic attack or Cerebrovascular Accident (CVA) (P<0.05), Left Main Coronary Disease (LMA) (P<0.05), hypertension (P<0.05), history of smoking (P<0.05), as seen in Table VI. Hypertension was found to be incremental risk factor, whereas diabetes was not found to be incremental risk factor for CAS in this sample of patients undergoing CABG (P>0.05). Smoking as well as LMA disease were found to be an incremental risk factor for CAS, on the other hand neither being female nor male were found to be independent risk factor for CAS (P>0.05). Of the 13 patients with significant LMA disease included in this study, 5 had significant CAS (38%), while the incidence of LMA disease in patients undergoing CABG was only 12.7%. CVA or history of TIA was found in 10 patients, 4 of which had significant CAS (40%). In 4 patients found to have concomitant significant CAS lesions and were hemodynamically

Table I: Clinical characteristics of the study group patients

Variables	Number	%
Hypertension	76	74.5
Diabetes mellitus	62	60.7
Smoking history	67	65.6
Left Main Coronary Artery Disease	13	12.7
History of CVA or TIA's	10	9.8
BMI*.>30	45	44

*BMI: Body Mass Index

Table II: Carotid artery stenosis (CAS) among the study group patients

Age group	**<50% stenosis**		**>50% stenosis**		**%**	**P value**
	Number	**%**	**Number**	**%**		
40-49 years	5					
50-59 years	22	88	3	12	25	Insignificant
60-69 years	43	93.5	3	6.5	6.5	<0.01
>70 years	15	57.69	11	42.3	42.3	<0.001

Table III: Patients age distribution of the study group patients

Age group	**Number**	**%**
<50 years	5	4.9
50-59 years	25	24.5
60-69years	46	45
70-79years	26	25.5

Table IV: Carotid artery stenosis

Age group	**<80% stenosis**		**>80% stenosis**		**P value**
	Number	**%**	**Number**	**%**	
50-59 years	3	2.9			*
60-69 years	3	2.9			*
>70years	5	4.9	6	5.8%	<0.02

*=irrelevant for comparison

Table V: Distribution of Unilateral vs. Bilateral stenosis according to age

Age group	**Unilateral stenosis >50%**		**Bilateral stenosis >50%**		**Bilateral stenosis >80%**	
	Number	**%**	**Number**	**%**	**Number**	**%**
50-59year	2	1.96	1	0.098		
60-69 year	2	1.96	1	0.098		
>70 year	6	5.8	5	4.9	3	2.9

Table VI: Risk factors

Risk Factor	**CAS seen on Duplex Scanning**	**No. CAS seen on Duplex Scanning**	**P value**
Hypertension	16	60	<0.05
Diabetes mellitus	8	54	Insignificant
Smoking history	15	52	<0.05
Hx of CVA or TIA	4	6	<0.05
Left Main Coronary Artery Disease	5	69	<0.05
Female sex	2	16	Insignificant
Male sex	15	69	Insignificant

stable, with no critically stenotic coronary arteries, the procedures were staged; with carotid stenting or carotid endarterectomy as first stage followed by CABG. Carotid stenting was performed in 2 patients, and carotid endarterectomy in another 2 patients. On the other hand we had 2 cases, with asymptomatic stenosis >80%, CABG was performed with no intervention for their carotid disease, and they did not develop any Neurological complication.

Discussion

Atherosclerosis is a systemic disease involving large and medium sized muscular arteries, carotid arteries are expected to be involved in this disease. In our study, we found that 86.3% of patients had CAS which is similar to a large study by PC Rath[8] with incidence of CAS in 84.5% of patients, wherase a study conducted by Fracesca Cirilo[7] found incidence of CAS in 61.6% of patients. 17% of the patients over the age 65 years scheduled for CABG had by ultrasonic duplex scanning a greater than 50%, stenosis of one internal carotid artery and 6% had greater than 80% stenosis of one internal carotid artery.[2] which is close to our results (16.6%), (5.8%) respectively, additional study conducted by D'Agostino and his colleagues on a larger number of patients showed that CAS >50% was seen in 20% and 8% of patients had CAS stenosis >80%,[13] also Berens and associates found in a prospective study on 1,087 patients older than 65 years, 17% prevalence of CAS>50% and 5.9% prevalence of stenosis > 80%, furthermore another study conducted by Daniel J and associates showed significant CAS >50% in 13.4% of patients.[9] Moreover, a recent study by Anna Drohomirecka showed that CAS >50% was detected in 18%.[14] on the other hand Abbas *et al* found in a study conducted on 1604 patients that only 1.3% of patients had significant CAS >50%.[4] We found unilateral lesions >50% in 9.8% of patients and bilateral lesions >50% in 6.8% of patients in addition to that 2.9% of patients had bilateral stenosis >80%. A study by Anna Drohomirecka found unilateral lesions in 12.9%,and bilateral lesions in 5.1%, also D'Agostino and his colleagues found bilateral lesions >80% in 1.8% of patients. The proposed criteria for pre-operative carotid scanning are based on risk factors shown in the literature to be independently and significantly associated with either carotid disease or cerebrovascular event.[3] in our study these include older age group, hypertention, history of smoking, history of CVA, LMA disease. Age was clear incremental risk factor for the presence of high grade carotid artery stenosis as seen in the tremendous increase in the percentage of patients who have CAS >50% with increasing age, especially above the age of 70 years (42.3%), furthermore, a study performed by Faggioli and colleages on a larger sample of patients showed that the rate of significant CAS rose from 3.8% for patients younger than 60years to 11.3% for patients above the age of 65 years.[15] The incidence of associated carotid artery disease has been 50% among patients with left main CAD, compared with 19% among the general patients undergoing CABG. Conversely, the incidence of left main CAD has been 37% in patients with combined carotid and coronary artery disease compared with 14.2% incidence in all CABG patients.[2] which is also close to our results (29.4%), (12.7%) respectively, moreover a study conducted by Abbas showed that significant LMA disease was seen in 12.1%,[4] also another syudy by PcRath showed prevalence of about 12.0%,[8] regarding significance of LMA disease as predictor of CAS, a study by Thomas J Kiernan found that LMCA was not associated with significant CAS,[3] in contrast to that Berens and colleagues found that LMCA stenosis was independent predictor of significant CAS, in addition to that studies conducted by Robert G,[1] and Daniel J[9] showed that LMCA was found to be significant independent predictor of CAS. Prior hx of CVA or TIA have already been reported by many studies to be significant independent predictor of CASO.[9,13,14] In our study, this was found to be strong independent predictor of CAS. Smoking was seen to be significant predictor in our study, in contrast to Abbas and his colleges who found that smoking had no influence on the developing of CAS in their patients, on the other hand many studies found smoking to be significant risk factor.[1,3,13] Diabetes was not found, in our study to be significant predictor of CAS, also a study by Abbas and his colleagues found that diabetes was also not significant predictor of CAS, on the other hand, other studies[1,13,16] found that diabetes was significant predictor of CAS. Hypertention was found to be significant risk factor for CAS in our study, actually many studies found the same result.[1,4,8,13] neither male or female gender were found in our study to be significant predictor of CAS which is also seen in a study by Robert G, however other studies[3,4,13] found female gender to be significant predictor. Perioperative stroke is a dreadful complication after CABG, the risk of perioperative stroke after CABG ranges in normal patients between 0.2% and 5.3%, but it increases to 15% in patients with carotid lesions >70%.[7] Potential causes of neurological deficit include reduced cerebral perfusion across hemodynamically significant stenosis or embolization from the Aorta, coronary or carotid arteries.[16] It is important to discriminate between cardiac surgery patients with

past history of TIA or minor stroke, and those who are neurologically asymptomatic. In D'Agostino's series, the risk of post CABG stroke was 18% in patients reporting a prior history of stroke or TIA and who had unilateral 70-90% stenosis, increasing to 26% in patients with bilateral 70-99% stenosis or contra lateral occlusion. Literature review suggests that the risk factor of post CABG stroke increases from 1.7% in patients with no carotid disease, to 3% in patients with unilateral 50-99% stenosis and 5% in patients with bilateral 50-99% stenosis, the highest stroke risk is, however, observed in CABG patients with carotid occlusion.[10]

The management of patients with combined carotid and coronary artery disease remains controversial. According to the 2004 AHA guidelines:[17]

1. Carotid endarterectomy is probably recommended before CABG or concomitant to CABG in patients with symptomatic carotid artery stenosis or in asymptomatic patients with unilateral or bilateral internal carotid stenosis of 80% or more (level of evidence: c).
2. Carotid screening probably indicated in the following subsets: age greater than 65 years, left main CAD, PVD, and history of smoking, history of TIA or stroke, or carotid bruit on examination
3. The use of ultrasound carotid screening in patients requiring CABG is very important in the selection of patients for combined CABG and carotid endarterectomy, planning perfusion techniques, operative approach, and treatment of carotid stenosis, can decrease the incidence of postoperative neurological complications. Neurological complications represent the most frequent cause of mortality in patients undergoing myocardial revascularization,[18] therefore in light of our results, it seems that the presence of factors such as, LMA disease, previous hx of CVA, or TIA, advanced age (>70 years), hypertension, hx of smoking renders pre-operative carotid scanning necessary, as pre-operative screening for carotid disease reduced the risk of neurological complications in patients undergoing CABG.
4. It seems that our results are consistent with other studies done on carotid ultrasound scanning pre-operatively regarding frequency and possible predictors of associated significant CAS in patients undergoing CABG, but further analytical studies on a larger number of patients are needed.

Conclusion

Concomitant significant Carotid Artery Disease among the study group patients above the age of 70 who underwent cardiac procedures is relatively high, selective pre-operative Carotid Duplex Ultrasonography should be mandatory.

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