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The Value of Routine Non-Selective Peripheral Vascular Screening and Its Potential Impact on Coronary Bypass Surgery Patients

Eslam Elhelw*, Mohamed Elshalkamy, Sara Elbaz, Omar Hussam, Usama Ali Hamza, Rami Ahmed Sabri
Department of Cardiothoracic Surgery, Faculty of Medicine, Mansoura University, Egypt
***Corresponding author:** Eslam Elhelw, **Mobile:** (+20) 01287813507, **E-mail:** drislamelhelw@gmail.com

ABSTRACT

Background: Coronary artery disease and other peripheral vascular diseases often coexist. Therefore, we sought to determine how frequently routine peripheral vascular screening can influence the surgical decision-making in the patients undergoing coronary artery bypass graft surgery. Additionally, whether the prospective alteration would be valuable or necessary.

Objectives: To assess the role of non-selective peripheral vascular screening and its potential impact on coronary bypass surgery patients.

Patients and Methods: A retrospective analysis for the patients, who underwent coronary bypass grafting surgery with no prior diagnosis of other vessel diseases, between the years 2021 and 2023. The patients were examined using a routine sonographic vascular screening strategy that included Doppler sonography on both carotids. Additionally, Doppler scans of the lower and upper extremities for both the arterial and venous system were done. **Results:** 216 patients were conducted for the screening program. 44 patients (20.4%) had their surgical choice changed. The vein harvesting was compromised in 35 patients (16.2%). Carotid intervention was planned for 6 individuals (2.8%) in total. 3 patients (1.4%) had their surgical choice impacted in terms of both the saphenous vein and the carotids. Additionally, 34 patients (15.7%) required additional, specialized investigations.

Conclusions: Non-selective regular peripheral vascular screening can have a substantial impact on the surgical decisions and maximize the utility of the patients' hospital stay through noninvasive radiological studies.

Keywords: Coronary artery disease, Peripheral artery disease, Carotid, Endarterectomy, Coronary bypass grafting surgery.

INTRODUCTION

The presence of atherosclerosis in one vascular territory frequently raises the possibility of severe vascular diseases in other vascular territories, which might affect the prognosis of patients[(1)]. The term "peripheral artery disease" (PAD) is now used to describe any partial or total obstruction of one or more peripheral arteries [(2)]. Patients with concurrent peripheral artery disease and coronary artery disease had higher mortality rates than people without PAD [(3)], which emphasizes the importance of a precise diagnosis of PAD. Moreover, the existence of coronary artery disease (CAD) also raises the possibility of other important vascular disorders that may be impacted by systemic atherosclerosis: compared to the general population, CAD patients have a higher prevalence of renal artery or carotid artery stenoses [(1)].

After CABG, patients with peripheral artery diseases had a 2.4 times higher risk of dying in a hospital than those without PAD (defined as prior cerebrovascular accidents, history of transient ischemic episodes, carotid stenosis, claudication, or prior vascular surgery)[(4)]. Those with PAD had advanced cardiac disease, were older, and had more comorbid diseases than people without PAD. The prevalence of PAD continued to be a substantial independent risk factor for CABG-related death even after controlling for these comorbidities [(5)].

The aim of the current work was to assess the role of non-selective peripheral vascular screening and its potential impact on coronary bypass surgery patients.

PATIENTS AND METHODS

Design: This is a retrospective observational study, including analysis of the results of routine peripheral vascular screening for all patients underwent coronary artery bypass grafting, who have never developed any signs or symptoms for peripheral artery diseases.

Study population: coronary artery disease patients underwent coronary artery bypass grafting at Cardiothoracic and Vascular Surgery Center (CVSC) at Mansoura University. Patients were collected from the hospital database from 2021 to 2023.

Inclusion criteria: Age less than 70 years old, patients presented with ischemic heart disease who underwent coronary artery bypass grafting surgery (CABG).

Exclusion Criteria: History of previous CABG or vascular surgery such as greater saphenous vein stripping, vascular angioplasty, amputations etc. History of DVT. Patients known to have peripheral vascular diseases as stroke, transient ischemic attacks, peripheral claudication.

Preparation:

Detailed history: A thorough and detailed history was taken, as regards the age, sex, chronic diseases, etc.

Detailed physical examination: including general condition, vital signs, and complete cardiovascular examination, etc.

Routine investigations. In addition to the coronary angiography that identified the coronary artery disease, the patients were conducted to a variety of tests. The

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electrocardiogram, echocardiography, carotid Doppler and Doppler of the lower and upper extremities; both arterial and venous system. The same radiologist conducted the Doppler ultrasound on each patient. A linear transducer probe was used with an ultrasound frequency 7.5 MHZ. Both arterial and venous preset were used [6]. Further specific investigation was done in selected patients as CT angiography for the lower limbs or the carotids.

Ethical approval:

Mansoura Medical Ethics Committee of the Mansoura Faculty of Medicine gave its approval to this study. All participants gave written consent to use their data for research. The Helsinki Declaration was followed throughout the study's conduct.

***Statistical analysis*:** Data analysis was performed by SPSS software, version 25 (SPSS Inc., PASW statistics for windows version 25. Chicago: SPSS Inc.). Qualitative data were described using numbers and percentages and were compared by Chi-Square test. Quantitative data were described using mean± standard deviation (SD) and were compared by the independent Student T test. The significance of the obtained results was judged at the (≤0.05) level.

RESULTS

The baseline sociodemographic characteristics, associated comorbidities, and history of all the studied cases are shown in table 1. Males 42 (23%) had a higher percentage of the affected surgical decision than females 2 (6%) did (p 0.026).

Table (1): Sociodemographic characteristics, associated comorbidities, and history distribution among studied cases

	n=216	%
Age/ years (Mean±SD)	58.24±7.15	
body weight / kg Mean±SD	82.57±7.26	
Sex		
Male	183	84.7
Female	33	15.3
Smoking		
Non	50	23.1
Ex-smoker	52	24.1
Smoker	114	52.8
Comorbidities	183	84.7
Hypertension	169	78.2
DM	114	52.8
Other Medical Conditions		
No	192	88.8
MI	21	9.7
COPD	1	0.5
Focal segmental GN	1	0.5
CKD	1	0.5

The findings of the peripheral vascular screening, which included the upper and lower extremities, as well as the carotid arteries, showed no significance for the screening in the upper limb vessels and lower limb venous system. While the lower arterial system and carotid screening was significant (Table 2).

Table (2): The findings of the peripheral vascular screening, which included the upper and lower extremities, as well as the carotid arteries.

	N=216	%
Lower limb arteries		
Normal	174	80.6
Diseased	42	19.4
Site of ischemia	n=42	
Unilateral	24	57.1
Bilateral	18	42.9
Level of arterial ischemia in the right	n =58	
limb	9	23.7
Femoral	16	42.1
Popliteal	33	86.8
ATA PTA		
The degree of ischemia	n=58	
Monophasic	18	47.4
Biphasic	40	52.6
Level of arterial ischemia in the left	n 30	
limb.	4	18.2
Femoral	11	50.0
Popliteal	15	68.2
ATA PTA		
The degree of ischemia	n=30	
Monophasic	12	54.5
Biphasic	18	45.5
Lower limb venous Doppler		
Normal	214	99.1
CFV hematoma	1	0.5
Bilateral Becker cyst	1	0.5
Upper limb venous Doppler		
Patent	214	99.1
Disease	2	0.9
Carotid Doppler findings		
Normal	155	71.8
Diseased	61	28.2
Site of the lesion	n=61	
Unilateral	34	55.7
Bilateral	27	44.3
Degree of the lesion in the right side	n=39	
Non- significant	28	71.8
50-70	8	20.5
70-90	2	5.1
>90	1	2.6
Degree of the lesion in the left side	n=49	
Non-significant	34	69.4
50-70	11	22.4
70-90	4	8.2
>90	0	0

Further specific investigations were needed in 15.7% for the study group. Additionally, the impact on the surgical decision was 20.4% (Table 3).

Table (3): Further specific investigations and the impact on the surgical decision.

		n	%
Needed further investigations (n=34)	CT angiography lower limb	18	52.9
	CT angiography carotid	16	47.1
Affected surgical decision.	No	172	79.6
	Carotid intervention	6	2.8
	Vein graft harvesting	35	16.2
	Carotid intervention, Vein graft harvesting	3	1.4

Regarding the surgically impacted group, it was found that 32 smokers (28.1%) had a higher level of affection than 8 ex-smokers (15.4%) and 4 non-smokers (8.0%). Between the impacted and non-affected groups, there was no significant difference in HTN or DM (Table 4).

Table (4): The relation between sociodemographic characteristics of the studied cases and affected surgical decision.

		Total number	Affected surgical decision		test of significance	p value
			Not affected (n=172)	Affected(n=44		
Age/ years		216	57.86±7.37	59.73±6.08	1.55	0.123
Body weight / kg		216	82.54±7.26	82.67±7.37	0.100	0.920
Sex	**Male**	183	141(77.0)	42(23.0)	4.92	0.027*
	Female	33	31(93.9)	2(6.1)		
Smoking	**Non**	50	46(92.0)	4(8.0)		
	Ex-smoker	52	44(84.6)	8(15.4)	9.68	0.008*
	Smoker	114	82(71.9)	32(28.1)		
Comorbidities		183	143(78.1)	40(21.9)	1.63	0.201
Hypertension		169	134(79.3)	35(20.7)	0.06	0.814
DM		114	86(75.4)	28(24.6)	2.61	0.106

*: Statistically significant

42 patients with lesions were found by lower limb Doppler screening within the study group; for 38 of these patients, surgical decisions were affected. Nine of the 61 patients with lesions identified by the carotid Doppler screening had severe lesions that required surgery.

Table (5): The relation between Doppler findings of the studied cases and affected surgical decision.

		Total number	Affected the surgical decision		test of significance	p value
	Lower limb arteries findings		Not affected N=178	Affected N=38		
	Normal	174	174(100)	0	191.04	<0.001*
	Diseased	42	4(9.5)	38(90.5)		
Site of ischemia	Unilateral	24	3(12.5)	21(87.5)		
	Bilateral	18	1(5.6)	17(94.4)	0.575	0.623
Level of arterial ischemia in both lower **limbs**	Femoral	13	8(61.5)	5(38.5)	4.15	0.04*
	Popliteal	27	22(81.5)	5(18.5)	0.018	0.892
	ATA - PTA	48	20(41.7)	28(58.3)	70.66	<0.001*
Degree of ischemia	Monophasic	30	0	30(100)	51.32	
	Biphasic	48	40(83.3)	8(16.7)		<0.001*
	Carotid Doppler findings		not affected N=207	affected N=9		
	Normal	155	155(100)	0	23.86	<0.001
	Diseased	61	52(85.3)	9(14.7)		*
Site of lesion	Unilateral	34	32(94.1)	2(5.9)		
	Bilateral	27	20(74.1)	7(25.9)	4.81	0.028*
Degree of the lesion in right side.	Non-significant	28	28(100)	0		
	50-70	8	7(87.5)	1(12.5)		
	70-90	2	0	2(100)	29.49	<0.001*
	>90	1	0	1(100)		
Degree of the lesion in left side.	Non-significant	34	34(100)	0		
	50-70	11	10(90.9)	1(9.1)		
	70-90	4	0	4(100)	31.78	<0.001*
	>90%	0	0	0		

*: Statistically significant

Figure (1) showed that, 44 patients (20.4%) had their surgical decisions affected by the screening, with the site of vein harvesting being either above knee or contralateral limb instead of the typical site, which was the right lower limb below knee. Furthermore, carotid endarterectomy was required, either electively after surgery or during the same CABG procedure. While, 172 patients (70.6%) did not.

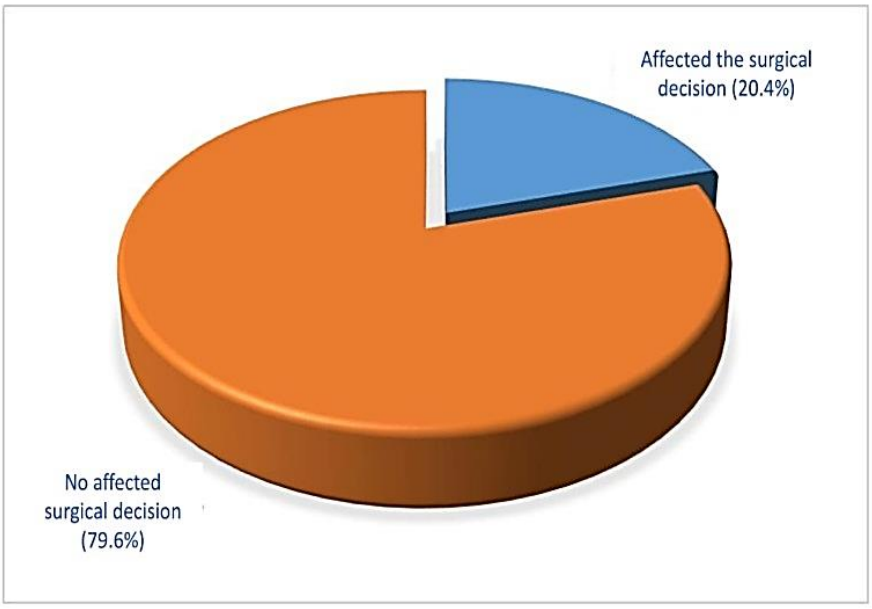

Fig. (1): The affected surgical decision among the studied group.

Figure (2) shows that, 174 patients (80.6%) had an arterial system free of disease, while 42 patients (19.4%) displayed arterial lesions. There were 18 bilateral and 24 unilateral lesions. The distribution of the lesions and the degree of ischemia in both lower limbs.

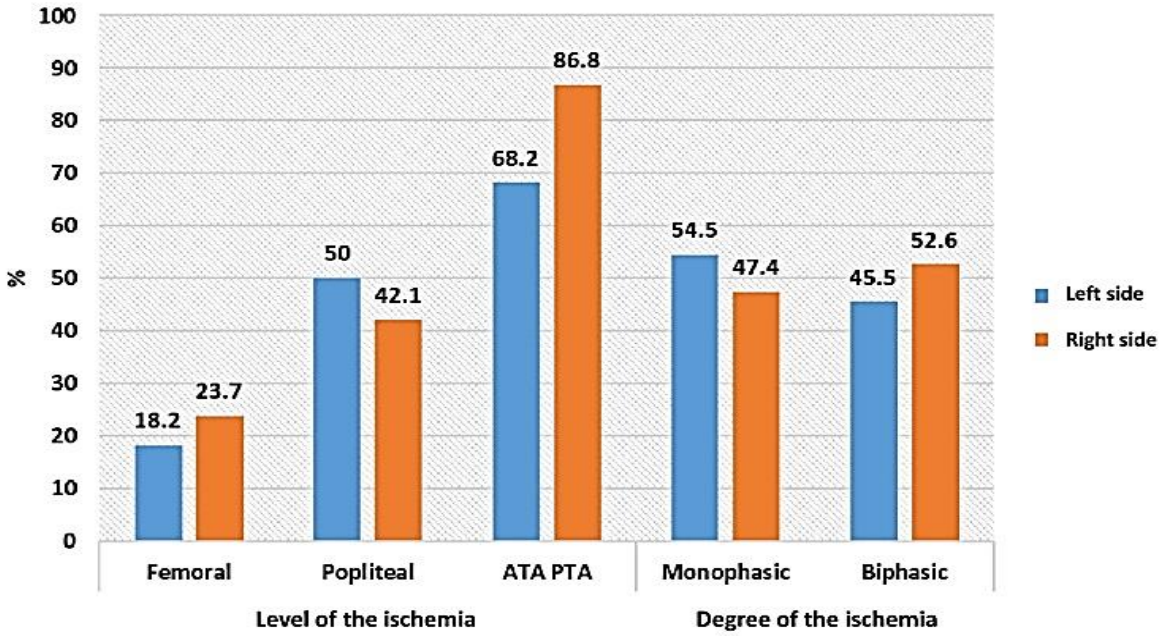

Fig. (2): The distribution and degree of arterial ischemia in both lower limbs.

Figure (3) shows that, 155 patients (71.8%) had healthy carotid vessels, while 61 patients (28.2%) had diseased carotid vessels. The number of lesions was 27 bilaterally (44.3%) and 34 unilaterally (55.7%). The location and severity of the lesions.

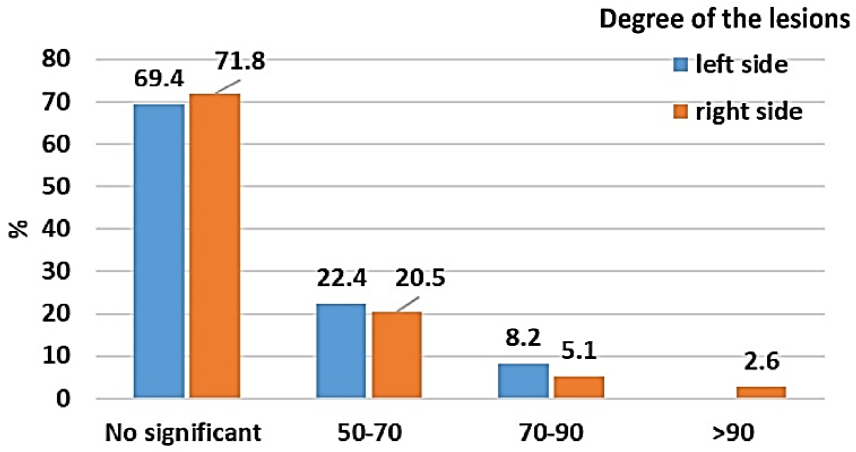

Fig. (3): The distribution and degree of lesion on both carotids.

DISCUSSION

Ten to thirty percent of the patients, undergoing surgical treatment for coronary artery disease, have peripheral artery disease [(7)]. The rate of complications during coronary artery bypass grafting (CABG) is greater in patients with a history of PAD [(8)]. Consequently, the choice of the revascularization approach and the selection of the graft are crucial elements for the success of the treatment in these patients [(9)].

It has frequently been observed that patients with arterial peripheral disease have impaired leg wound healing. This finding undoubtedly supports the practice of harvesting the saphenous veins from legs that have the least vascular insufficiency[(10)]. The benefits of CABG could occasionally be outweighed by a lower extremity wound complication that renders the patient unable to move [(11)]. According to **Thomas *et al.*** [(12)] a major peripheral vascular procedure was required in 17% of cases. In 7% of instances, at least one major lower extremity amputation was required, and patients who encountered one of these possible fatal lower extremity wound complications required an additional 10 days in the hospital than the unaffected control cohort

Our findings show that 44 patients (20.4%) had their surgical decisions affected by the screening, with the site of vein harvesting being either above knee or contralateral limb instead of the typical site, which was the right lower limb below knee. Furthermore, carotid endarterectomy was required, either electively after surgery or during the same CABG procedure. While, 172 patients (70.6%) did not.

According to **Goto *et al.*** [(13)], men are more likely than women to have risk factors for stroke, such as severe peripheral vascular disease, severe aortic atherosclerosis, and carotid artery stenosis. Preoperative cognitive impairment and antecedent cerebral infarction occurred at comparable rates in both sexes.

According to the findings of the lower limb Doppler examination, 174 patients (80.6%) had an arterial system free of disease, while 42 patients (19.4%) displayed arterial lesions. There were 18 bilateral and 24 unilateral lesions.

Among the 42 affected cases, 18 patients required additional lower limb CT angiography, and 38 patients' surgical decisions were impacted, one of them was referred for post-CABG femoral angioplasty. There were 28 lesions at the level of the ATA and PTA, five at the level of the popliteal artery, and five at the level of the femoral artery, which were the locations of the lesions that had an impact on the surgical choice.

Aboyans *et al.* [(14)] claim that a single independent predictor of severe or complete internal carotid artery blockage is the presence of triple coronary disease. Additionally, carotid artery stenosis is a documented risk factor for perioperative/postoperative stroke in individuals who have undergone CABG surgery, with prevalence rates of 3% for unilateral stenosis, 5% for bilateral stenosis, and 7% overall. In the most current literature, the incidence of combined coronary artery disease and carotid artery disease with higher than 75% stenosis affecting at least one carotid artery has ranged from 1.7 to 12%, according to **Schwartz *et al.*** [(15)]. Additionally, the prevalence of stenosis more than 50% might reach 22%.

In our research, 155 patients (71.8%) had healthy carotid vessels, while 61 patients (28.2%) had diseased carotid vessels. The number of lesions was 27 bilaterally (44.3%) and 34 unilaterally (55.7%). 16 (26.2%) of the 61 patients, who were affected, required further CT carotid angiography, and 9 (14.7%) of them had their surgical decision impacted by whether concomitant carotid endarterectomy or a reversed-stage approach.

Our study found that there was no real benefit to screening for lower leg venous system. Only 2 (0.9%) patients in our study were discovered to have Becker's cysts and common femoral vein hematomas, whereas

all other study participants had normal results. Only 2 (0.9%) of the patients in the upper limb vascular investigation had a damaged arterial system; otherwise, the remaining outcomes were unremarkable.

Based on our results, the identification of peripheral artery disease prior to surgery can influence the surgical decision as it might guide patients towards less invasive procedures, including off pump or endoscopic vein harvesting. Patients who are undergoing surgery and have significant carotid artery disease concurrently may benefit from CEA to reduce their risk of stroke, and cerebral hypoperfusion can be avoided through maintaining a high mean pressure by the perfusionists. In addition to providing potential sites for intra-aortic balloon pump insertion, sites of conduit harvesting can be selected to avoid extremity ischemia and delayed wound healing [(16)].

In summary, non-coronary arterial lesions cover a wide range of disorders with discrete subtle presentations at multiple vascular sites; they might happen simultaneously at several locations. PAD carries a significant predictor of mortality, hospitalizations, and expenses, and is frequently associated with CAD[(16)]. Being aware of the condition and actively using low-tech diagnostic techniques to check for non-coronary atherosclerosis are crucial.

Limitations and future possible prospects:

The modest sample sizes in our study, which involved 216 participants in a single centre, limited our ability to identify more profound correlations. Additional study is necessary, ideally in the form of a multi-center investigation with bigger sample sizes. Moreover, investigation and a longitudinal follow-up is required to determine the progression of the less significant findings.

CONCLUSIONS

Sonographic routine non-selective peripheral vascular screening in patients with coronary artery disease scheduled for CABG is a feasible and effective strategy since it provides us with crucial hints in surgical practice.

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