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Endothelial Dysfunction Status and Vascular Age among Medical Personnel of MGM Medical College, Aurangabad

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Abstract

Introduction: Endothelial dysfunction is the first step in the atherothrombotic process and is a prognostic index for further development of vascular diseases. The present study is proposed to undertake non-invasive assessment of endothelial dysfunction, as a possible inexpensive endpoint that could reflect cumulative burden of vascular diseases.

Aim: To study endothelial dysfunction and vascular age status of medical personnel at MGM Medical College, Aurangabad.

Method: 205 medical personnel in the age group > 15 years were recruited for the study. Endothelial dysfunction was recognised as a change in flow-mediated dilation of artery using an instrument, angiodefender. Vascular age calculated using vascular age calculator consisting of various parameters, viz., diabetes mellitus II, hypertension, smoking, dyslipidaemia, obesity.

Results: The findings revealed that there was statistically significant direct association between endothelial dysfunction and age groups, risk factors, and vascular age.

Conclusion: Flow-mediated dilation, as a non-invasive test, provides information regarding severity of endothelial dysfunction, provides prognostic index for vascular diseases, and warrants a need to recognise and treat all modifiable risk factors for reducing atherogenic medical problems. High vascular age values, when noticed in the young, give alarming signals for timely intervention to prevent vascular complications.

Key words: Endothelial dysfunction, vascular age, flow mediated dilation.

Introduction

Endothelial dysfunction often precedes the development of clinical atherosclerosis. A non-invasive assessment of endothelial function in a peripheral conduit vessel – brachial artery is currently practised. The alterations of endothelial cells and vasculature play a central role in the pathogenesis of varied diseases, viz., stroke, CAD, diabetes mellitus, CKD, tumour growth, venous thrombosis, and several viral diseases[1].

Non-invasive assessment of endothelial function has been proposed as a possible inexpensive endpoint that could reflect cumulative cardiovascular burden and/or responsiveness to therapies in individual patients[2,3]. The small vesse flow-mediated dilation (FMD) response is a hall mark of systemic lack of Nitric Oxide bioavailability, and an associated lack of vasoprotection in clinically relevant areas of the vasculature (coronaries, carotids). The lack of vasoprotection is thought to result in the development of vascular disease[4].

Early recognition of endothelial dysfunction using non-invasive means like "Angiodefender" for assessing FMD of brachial artery is desirable. The study may prove useful – especially in the younger age group – for recognising and treating modifiable risk factors of endothelial dysfunction (atherogenesis), who have a high vascular age, as compared to their chronological age.

Aim

To record endothelial dysfunction status and vascular age in medical personnel of MGM medical college, Aurangabad, Western India, using angiodefender.

Objective

To record and analyse various modifiable and non-modifiable risk factors observed in the younger age group with higher vascular age, versus biological age.

Research study design

1. Study area: Department of Medicine, MGM Medical College, Aurangabad, Maharashtra, Western India.
2. Study period: 8 months.
3. Study design: Observational study.
4. Sample size: 205 participants.
5. Institutional Ethics Committee approval: Obtained.

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6. Study instrument: 'Angiodefender' for measuring change in FMD and vascular age.

Material and methods

All medical personel of either gender, working in MGM hospital, Aurangabad, who were ready to participate were included in this observational study. A detailed clinical history and examination was undertaken. History with special reference to drugs, addiction, diabetes mellitus, hypertension, dyslipidaemia, smoking/tobacco addiction, and alcoholism were recorded.

Endothelium-dependent brachial artery flow-mediated dilation measurements were undertaken using angiodefender. This device uses hyperaemia-induced flow-mediated vasodilatation mechanism for calculating FMD. Measurements of the dilation of brachial artery were recorded at rest and after cuff deflation completing suprasystolic compression (30 mmHg above systolic BP for 5 minutes) of either right or left upper arm. Maximum flow velocity was measured in all subjects at rest and later within 15 seconds of the cuff deflation. Vasodilation was assessed and calculated as the percentage change in the arterial diameter compared to the baseline value. Impaired FMD was defined as a value less than 10%. Severe dysfunction was considered when value was < 6% and moderate, when values were between 6 to 10%.

For the purpose of this study, hypertension was defined as systolic blood pressure > 140 mmHg and diastolic blood pressure > 90 mmHg or persons on antihypertensive medication. ADA criteria were considered for defining Type 2 Diabetes Mellitus (treated with oral hypoglycaemic agent or insulin, or having fasting blood glucose levels > 126 mg/dl or HbA1c > 6.4%).

The WHO criteria for Asian population were considered for defining body mass index (Normal 18.5 to 23 kg/m^2, overweight 23 to 27.5 kg/m^2 and obese > 27.5 kg/m^2). Dyslipidaemia was considered when total cholesterol value was > 200 mg/dl and HDL < 40 mg/dl. Smoking (having smoked at least five cigarettes per day in the last month) was enquired in each subject.

Vascular age was determined by using angiodefender device (Everist) which is CE certified and has been proven to be equivalent to the gold standard – BAUS imaging. Everist Health Vascular age calculator comprising of inputs as FMD, smoking habit, hypertension, HbA1C, total cholesterol and serum HDL level were used for calculating vascular age.

Data on categorical variables was presented as percentage. P values < 0.05 were considered to be statistically significant. Entire data was analysed using the statistical package for social sciences version 20.0 for MS windows.

Results

Table I: Endothelial dysfunction in different age groups.

Age group (years)	Normal (> 10%)		Modrate (6 - 10%)		Severe (< 6%)		Total (n)
	n	%	n	%	n	%	
16 - 25	3	7.5	26	65	11	27.5	40
26 - 35	5	3.6	117	84.8	16	11.6	138
36 - 45	3	20	10	66.7	2	13.3	15
> 45	0	0	8	66.7	4	33.3	12
Total (n)	11	5.4	161	78.5	33	16.1	205

Chi-square = 17.1, P-value = 0.009 significant, n = Number of subjects.

Table I shows a comparison of endothelial dysfunction with change in arterial diameter with respect to flow-mediated vasodilation in different age groups. The observations were statistically significant.

Table II: Endothelial dysfunction and risk factors.

Endothelial	Risk factors				Total (n)
dysfunction	≤ 2		> 2		
(FMD%)	n	%	n	%	
Normal (> 10%)	11	100	0	0	11
Moderate (6 - 10%)	89	55.3	72	44.7	161
Severe (< 6%)	11	33.3	22	66.7	33
TotaL (n)	111	54.1	94	45.9	205

Chi-square = 15.2, P - value = 0.001 significant, n = Number of subjects.

Table II shows that as number of risk factors increase, the severity of endothelial dysfunction increases, and the observation was statistically significant.

Table III: Endothelial dysfunction and gender.

Endothelial	Gender				Total (n)
dysfunction	Male		Female		
(FMD%)	n	%	n	%	
Normal (> 10%)	7	63.6	4	36.4	11
Moderate (6 - 10%)	86	53.4	75	46.6	161
Severe (< 6%)	17	51.5	16	48.5	33
Total (n)	110	53.6	95	46.4	205

Chi-square = 0.505, P-value = 0.777 non-significant, n = Number of subjects.

Table III shows that there was no statistically significant association between endothelial dysfunction and gender.

Table IV: Endothelial dysfunction and vascular age.

Endothelial	Vascular age						Total (n)
dysfunction	<1		±1		>1		
(FMD %)	n	%	n	%	n	%	
Normal (> 10%)	10	90.9	1	10.1	0	0	11
Moderate (6 - 10%)	8	4.9	22	13.7	131	81.4	161
Severe (< 6%)	0	0	13	39.4	20	60.6	33
Total (n)	18	8.8	36	17.6	151	73.6	205

Chi-square = 111.2, P-value = < 0.0001 significant, n = Number of subjects.

Table IV shows statistical significant association between endothelial dysfunction and vascular age. Subjects with moderate to severe dysfunction had higher vascular age as compared to their chronological age.

Table V: Risk factors and gender.

Risk factors	Gender				Total (n)
	Male		Female		
	n	%	n	%	
≤ 2	66	59.5	45	40.5	111
>2	44	46.8	50	53.2	94
Total (n)	110	53.6	95	46.4	205

Chi-square = 3.28, P-value = 0.07 non-significant, n = Number of subjects.

Table V shows no statistical association between gender and risk factors.

Table VI: Age and risk factors.

Age (years)	Risk factors				Total (n)
	≤ 2		> 2		
	n	%	n	%	
16 - 25	24	60	16	40	40
26 - 35	76	55	62	45	138
36 - 45	7	46.7	8	53.3	15
> 45	4	33.3	8	66.7	12
Total (n)	111	54.1	94	45.9	205

Chi-square = 3.03, P-value = 0.387 non-significant, n = Number of subjects.

Table VI shows no association between the age and the risk factors.

Table VII shows statistically significant association between chronological age and vascular age.

Table VII: Age and vascular age.

Age (years)	Vascular age						Total (n)
	<1		±1		>1		
	n	%	n	%	n	%	
16 - 25	11	27.5	8	20	21	52.5	40
26 - 35	5	3.6	19	13.8	114	82.6	138
36 - 45	2	13.3	4	26.7	9	60	15
> 45	0	0	5	41.7	7	58.3	12
Total (n)	18	8.8	36	17.5	151	73.7	205

Chi-square = 32.2, P-value = < 0.0001 significant, n = Number of subjects.

< 1 indicates vascular age less than by 1 year to the chronological age.

± 1 indicates vascular age less or more than 1 year to the chronological age.

> 1 indicates vascular age more than 1 year to the chronological age.

Table VIII: Risk factors and vascular age.

Risk factors	Vascular age						Total (n)
	<1		±1		>1		
	n	%	n	%	n	%	
≤ 2	16	14.4	24	21.6	71	64	111
> 2	2	2.1	12	12.8	80	85.1	94
Total (n)	18	8.8	36	17.6	151	73.6	205

Chi-square = 14.1, P-value = 0.001 significant, n = Number of subjects.

Table VIII shows statistically significant association between risk factors and vascular age. As risk factors increase, vascular age also increases.

Table IX: Gender and vascular age.

Gender	Vascular age						Total (n)
	<1		±1		>1		
	n	%	n	%	n	%	
Male	12	10.9	19	17.3	79	71.8	110
Female	6	6.3	17	17.9	72	75.8	95
Total (n)	18	8.8	36	17.6	151	73.6	205

Chi-square = 1.35, P-value = 0.51 non-significant, n = Number of subjects.

Table IX shows no statistical association between gender and vascular age.

Discussion

Vascular endothelial cells line the entire circulatory system from heart to the smallest capillaries. Advancement in medicine has led to better understanding of the complex functions of the endothelium. These cells have a distinct physiological function vital to vascular biology, viz., selective permeability to water and electrolytes, fluid filtration, blood fluidity, haemostasis, neutrophil recruitment, hormone trafficking and cell matrix interactions. Besides, it functions actively to regulate blood flow, coagulant thrombosis, and

thrombolysis[5].The free radicals can disrupt the balance of nitric oxide and damage the endothelium. Percentage of FMD provides valuable and independent prognostic significance[6,7].

The present study was undertaken to assess endothelial dysfunction in medical and paramedical personnel of different age groups. Certain modifiable and non-modifiable risk factors like age, Body Mass Index, Type 2 Diabetes Mellitus, dyslipidaemia, and smoking were assessed using flow-mediated vasodilatation of brachial artery.

Several other studies reported that presence of conventional risk factors cause endothelial dysfunction and decrease in FMD values[2,8]. The study conducted by Sancheti *et al*, in 2018 concluded that there was no statistically significant difference between the number of risk factors and percentage of FMD[9].

The present study shows the observations were statistically significant for age.The data suggest that more the number of risk factors in an individual, higher is the severity of endothelial dysfunction.

Out of 178 cases studied – who were in the age group 16 to 35 years – we observed higher vascular age in 135 cases. Most of these studied personnel had > 2 risk factors with them, and therefore the data was statistically significant.

In the present study, with advancing age the severity of endothelial dysfunction was noted to be high. FMD values < 6% were good predictors of the presence of coronary artery disease reported by Enderle *et al* in 1998. percentage of FMD discriminated between the presence or absence of coronary artery disease[10]. Schroeder *et al* reported that determination of endothelial dysfunction was a sensitive and specific screening test to predict the presence of vascular disease[11]. Abnormalities of vascular disease can be reversed over weeks to months with risk reduction therapy[12].

Maximum number of candidates in our study belonged to the young age group between 16 and 35 years, compared to candidates above 35 years, who were less in number in our study. As the age advanced, the severity of endothelial dysfunction also increased in this age group, between 16 and 35 years.

In an apparently young healthy individual, when abnormal values of endothelial dysfunction (< 10%) suggest subclinical atherosclerosis, measures are needed for timely intervention to prevent overt vascular disease.

FMD studies may serve as an important marker of premature atherosclerosis. Recognition of normal FMD values in elderly age, when noted, may speak of lower vascular age versus their chronological age.

Conclusion

Mean FMD values differ widely in the studied groups, as regards to age and severity of endothelial dysfunction. FMD values of higher age group, when noticed in young persons would be considered abnormal as their values reveal higher vascular age to their chronological age. It is advised to recognise and treat all modifiable risk factors of premature atherosclerosis for reducing atherogenesis related problems. Use of angiodefender for FMD response to recognise endothelial dysfunction and vascular age could prove a useful tool, and screening test for recognising early anticipated problems, especially in the young.

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