

Carotid plaque progression and regression in cardiological patients: an observational long-term study on atherosclerosis management

Abstract

Background

If traditional cardiovascular risk factors commonly measured in clinical practice are under control, cardiovascular risk is reduced and atherosclerotic burden is passivated. In this study we hypothesize, that patients with plaque progression as compared to patients with plaque stabilization or regression have a better control of cardiovascular risk factors such as blood pressure, lipids, diabetes, smoking, and obesity.

Methods

We selected referred cardiology patients with cardiovascular symptoms or known cardiovascular diseases and assessed these patients for major independent cardiovascular risk factors, namely, diabetes mellitus, lipids, office blood pressure, smoking, body-mass-index in the Kardiolab cardiological practice in the year 2023. Patients with higher or equal amounts of carotid total plaque area (cTPA) in previous visits were regressors and patients with the highest cTPA in 2023 were progressors. Difference between groups were statistically verified with Chi-squared or Mann-Whitney test for independent samples and with Cox proportional-hazards regression for atherosclerotic events (ASCVD) or regression of cTPA categories (progression=1, stable to regression 0 to $-39 \text{ mm}^2=2$, -40 mm^2 or more =3). Event free survival was tested with Kaplan-Meier analysis.

Results (Table)

We assessed 226 patients (42% women), of which 15% had ASCVD history and 13% have diabetes mellitus and the median age was 58 years. Both in progressors and regressors, risk factors were lowered in the final visit compared to the baseline visit and well controlled regarding systolic blood pressure, lipids ($p=NS$) and the number of smokers could be reduced from 19% to 13% ($p=0.078$).

Patients with cTPA progression were younger ($p<0.001$) at the baseline test and had a higher cTPA ($p=0.011$) than patients without progression except for a higher rate of smokers in progressors at baseline ($p=0.011$). Other traditional risk factors were not significantly different between groups both at baseline and at the final visit. ASCVD risk was low both in progressors and regressors, by Chi-squared analysis however, significantly more ASCVD events occurred in progressors (4 versus 3, extrapolated 10-year risk was 6% in progressors, and was 2% in regressors, $p=0.048$), which however became insignificant using Kaplan-Meier survival analysis. The only identifier of plaque progression was Diabetes mellitus in Cox proportional-hazards regression with plaque categories as the outcome measure over time ($p=0.0008$).

VARIABLES		Baseline	Baseline			Follow Up		
		ALL	Progressors	Regressors	P	Progressors	Regressors	P
Number	Kardiolab 2023	226	53	163		53	163	
AGE YEARS	Median (95% CI)	58 (55-59)	54 (52-58)	59 (57-61)	0.001	65 (59-72)	66 (59-75)	0.416
BP SYSTOLIC	Median (95% CI)	129 (127-131)	124 (120-125)	127 (125-131)	0.070	132 (127-136)	132 (130-134)	0.693
BODY MASS INDEX (BMI)	Median (95% CI)	26.8 (26.1-27.4)	26.8 (25.7-27.8)	26.8 (25.7-27.5)	0.293	26.4 (25.7-27.8)	26.8 (26.2-27.7)	0.686
Cholesterol	Median (95% CI)	5.4 (5.2-5.6)	5.4 (4.6-6.0)	5.4 (5.2-5.7)	0.754	4.0 (3.7-4.6)	4.1 (3.8-4.3)	0.612
HDL	Median (95% CI)	1.4 (1.3-1.5)	1.4 (1.2-1.5)	1.4 (1.3-1.5)	0.636	1.4 (1.3-1.6)	1.4 (1.3-1.5)	0.603
LDL	Median (95% CI)	3.2 (3.1-3.4)	3.2 (2.9-3.7)	3.2 (3.1-3.4)	0.481	2.0 (1.7-2.5)	2.0 (1.9-2.2)	0.468
TOTAL PLAQUE AREA	Median (95% CI)	63 (53-75)	48 (35-65)	71 (55-81)	0.011	72 (50-114)	40 (32-50)	0.000
SEX FEMALE	N (%)	94 (42)	20 (38)	74 (45)	0.329	20 (38)	74 (45)	0.329
DIABETES MELLITUS	N (%)	30 (13)	10 (19)	20 (12)	0.229	10 (19)	20 (12)	0.229
CURRENT SMOKER	N (%)	44 (19)	16 (30)	28 (17)	0.042	9 (17)	22 (13)	0.531
BMI>30	N (%)	61 (27)	16 (30)	45 (28)	0.718	15 (28)	44 (27)	0.853
ATHEROSCLEROTIC CARDIOVASCULAR DISEASE	N (%)	35 (15)	13 (25)	22 (13)	0.059	13 (25)	22 (13)	0.059
EVENT (ASCVD)	N (%)	7 (3)				4 (7.5)	3 (1.8)	0.042
EVENT 10 YEARS (ASCVD)	EXTRAPOLATION					3.1 (5.8)	3.3 (2.0)	
TIME TO EVENT (ASCVD)	YEARS (AVERAGE)					13	9	
KAPLAN-MEIER (ASCVD)	EVENT SURVIVAL							0.860

Discussion

As shown by Spence in 2002 (DOI: 10.1161/01.STR.0000042207.16156.B9), patients with carotid plaque stabilization or regression have about a 50% ASCVD event reduction. In our study, traditional risk factors with the exception of diabetes mellitus were not predictive of cTPA progression or regression and usually under good medical control. Therefore, other factors contributing to atherosclerotic progression, such as chronic inflammatory diseases, elevated LP(a) levels, social factors or elevated homocysteine may be responsible for increases in cTPA and this may explain residual risk.

Conclusion

ASCVD risk is low in cardiological patients with good control of cardiovascular risk factors over about 10 years. However, reliance on traditional risk factors during follow-up visits may be insufficient to detect about 25% of patients with atherosclerosis, who have observable progression of cTPA and therefore, we must reject our study hypothesis. Since atherosclerosis progression is related to ASCVD events, cTPA offers the possibility to detect more vulnerable patients earlier and in these, other cardiovascular risk factors not commonly measured, such as LP(a) or homocysteine could be assessed or intensified cardiovascular risk management could be performed to attempt a reduction of residual ASCVD risk. Atherosclerosis Imaging appears to have a major role for personalized atherosclerosis management both in men and women in cardiology.