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The Original Calibre of the Lower Limbs Arteries as a Possible Risk Factor for Complications of Atherosclerosis: a Statistical Investigation in 90 Subjects by Echocolordoppler

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Key words: lower limbs arterial calibre, atherosclerosis, echocolordoppler.

SUMMARY

Ninety subjects with emodynamically significant atherosclerotic disease of the lower limbs were examined. They had no history of diabetes mellitus or hypertension. Each subject underwent a color Doppler ultrasonographic study of the common iliac, superficial femoral, and popliteal arteries. In each arterial segment, diameter and blood flow velocity were measured. In evaluating the hemodynamic significance of the stenoses, we used the Windsor method. In a comparison of the calibers of the arteries significant relationship emerged in each given subject in two sexes.

Males: a statistically significant difference was found only in the iliac artery, in which the calibre and Windsor indices were greater in the right as compared to the left; right: 1) There was a statistically significant relationship between mean caliber and Windsor indices, ($p < 0.01$); 2) there was a statistically significant correlation between mean calibre and age ($p < 0.05$); Left: 1) There was a statistically significant correlation between mean calibre and Windsor indices calculated at the levels of both the posterior tibialis ($p < 0.05$) and dorsalis pedis arteries ($p < 0.01$); 2) there was a statistically significant correlation between mean calibre and age ($p < 0.05$).

Females: Student's t test for paired samples of the three arteries did not reveal a statistically significant predominance of one side over the other. With respect to the coefficients of correlation between mean calibre and Windsor indices, the results were as follows. Right: 1) There was a statistically significant correlation between mean calibre and Windsor indices calculated at the levels of both the posterior tibialis and dorsalis pedis arteries ($p < 0.01$); 2) there was a statistically significant correlation between age and mean calibre ($p < 0.05$); Left: 1) There was a statistically significant correlation between mean calibre and Windsor indices calculated at the levels of both the posterior tibialis ($p < 0.05$) and dorsalis pedis arteries ($p < 0.01$); 2) there was a statistically significant correlation between mean calibre and age ($p < 0.05$).

INTRODUCTION

In assessing stenotic arterial lesions, the qualitative data that derive from the various methods are more or less precise in delineating the pathological reality and, moreover, are influenced by the sensitivity of the instruments used (Macchi, 1985; Pizzetti *et al.*, 1992). On the other hand, quantitative assesments (Kassam *et al.*, 1985) are limited to either approximate (slightly, moderately, significantly, or completely occluded) or precise (in terms of percentages) descriptions of the stenoses (Franceschi, 1980; von Reutern *et al.*, 1992). In the supraaortic trunk, a rigorous quantitation ot the hemodynamic significance of a stenosis, which is instead assessed by the area of the residual lumen and doppler velocimetric findings (Berguer, 1974; Brown, 1982; Macchi *et al.*, 1993), is not possible. In the lower limbs, in contrast, the hemodynamic significance of a stenosis can be assessed unambiguously and reproduciblely by pressure measurements. Clinically, the irregularity, friability, and degree of ulceration of the atherosclerotic lesion undoubtedly have a determinant role in the evolution of ischemic events (Moore *et al.*, 1968; Edwards *et al.*, 1979; Bartynski *et al.*, 1981; Ammar *et al.*, 1984; Macchi *et al.*, 1991). However, the hemodynamic significance of the stenosis is indisputable, inasmuch as it is associated not only with a reduction of distal perfusion, but with greater injury to the stenotic lesion secondary to the increased velocity and turbulence (Langlois *et al.*, 1983; Ku *et al.*, 1985). The aim of our study is to compare the original arterial calibre with the clinical complications of atherosclerosis by a hemodynamic assessment of the pathology of arteries of the lower limbs. In other words, we propose to establish whether, for the lower limbs as for the supraaortic trunks, the original arterial calibre can be considered a risk factor for the complications of atherosclerosis (Macchi *et al.*, 1993).

PATIENTS AND METHODS

Ninety subjects (45 men, age range: 65 to 90; 45 women, age range: 64 to 90) were examined. They had hemodynamically significant atherosclerotic disease of the lower limbs at rest. The subjects were selected from among patients who had presented with intermittent claudication. They had no history of diabetes mellitus or hypertension. The age, weight, and height of each patient were recorded. Each subject underwent a color Doppler ultrasonographic study of the common iliac, superficial femoral, and popliteal arteries. In each arterial segment, the following parameters were measured: diameter (2 direct measurements and an indirect measurement extrapolated from the circumference of each artery, to tenths of millimeters) and blood flow velocity (pulsed doppler module with spectral analysis). In evaluating the hemodynamic significance of the stenoses, we measured the arterial pressure using the Windsor method in the posterior tibialis and dorsalis pedis arteries. The Doppler probe was placed over a reference point of the artery, in the case of the posterior tibialis artery just above the ankle, and its maximal pressure was measured proximally using a sphigmomanometer. This value was then divided by the brachial pressure, which was measured using the same method. Normally, the index is = 1 or > 1. We used and Acuson 128 XP color doppler ultrasonography apparatus. All values and patients are expressed in *Tab. 1.*

TABLE 1 - *Legend: P. = patients; II A. = common iliac arteries; Fem A. = superficial femoral arteries; Pop A. = politeal arteries; WI M = malleolar Windsor index; WI D = Dorsal Pedis Windsor index; A = age; W = weight; H = height; R = riht; L = left. All values are mm.*

	MALES													FEMALES												
P.	II A.		Fem A.		Pop A.		WI M		WI D		A	W	H	II A.		Fem A.		Pop A.		WI M		WI D		A	W	H
	R	L	R	L	R	L	R	L	R	L				R	L	R	L	R	L	R	L	R	L			
1	7,5	7,6	4,6	4,7	4,5	4,6	48	52	45	40	66	65	164	7,3	7,5	4,5	4,6	4,3	4,3	38	42	35	40	88	70	171
2	7,5	7,6	4,3	4,4	4,2	4,4	55	38	50	33	73	78	177	7,3	7,5	4,2	4,5	4,2	4,2	35	38	30	33	89	50	153
3	7,6	7,8	4,9	5,1	4,5	4,7	27	27	27	27	66	84	175	7,4	7,8	4,9	5,1	4,5	4,7	27	37	27	37	79	58	160
4	7,6	7,5	4,7	4,5	4,3	4,1	38	38	38	38	68	60	158	7,5	7,5	4,8	4,5	4,5	4,3	38	38	38	38	78	71	163
5	7,7	7,3	3,9	3,7	3,9	3,6	64	66	58	60	88	90	180	7,5	7,7	4,5	3,9	4,3	4	65	46	58	40	84	65	158
6	7,8	7,5	4,9	4,5	4,6	4,2	33	37	28	30	67	62	155	7,6	7,5	4,6	4,8	4,3	4,3	43	27	38	27	84	82	171
7	7,9	7,5	5	4,7	4,2	4,3	45	48	42	44	80	71	170	7,6	7,4	4,8	4,6	4,4	4,5	48	45	44	40	81	68	166
8	7,9	7,8	5,4	4,9	5	4,6	25	45	25	45	76	74	176	7,6	7,3	4,9	5	4,8	4,9	45	25	40	25	73	66	170
9	7,9	7,9	5,6	5,1	5,4	5,3	44	27	44	27	79	69	174	7,7	7,7	5,6	5,6	5,4	5,3	44	27	44	27	75	70	164
10	8	8,1	5,7	5,9	5,5	5,7	20	33	20	30	76	58	160	7,7	7,2	5,7	6	5,4	5,7	24	36	20	32	73	63	155
11	8	8	5,6	5,6	5,2	5,1	28	33	28	33	65	59	155	7,7	7,5	5,6	5,8	5,2	5,3	39	43	35	43	88	60	162
12	8,1	7,9	5,6	5,7	5,6	5,6	30	30	28	30	70	66	169	7,8	8	5,4	5,7	5,4	5,6	24	53	24	48	78	78	172
13	8,1	8,4	5,5	5,7	5,6	5,5	33	36	30	32	65	75	172	7,8	8,1	5,3	5,8	5,3	5,5	38	46	32	42	64	53	159
14	8,1	8,3	5,6	5,6	4,9	5	35	37	33	35	65	80	177	7,8	7,8	5,3	5,2	4,7	4,5	37	27	33	25	85	67	165
15	8,2	8	5,6	5,3	5	5	38	40	35	38	72	84	175	7,9	7,6	5,1	5	4,9	4,9	48	43	45	43	83	70	154
16	8,2	8	5,1	4,9	5	4,9	40	44	38	40	67	73	170	7,9	7,5	4,9	5	4,9	4,9	43	33	38	30	77	64	156
17	8,2	7,9	5,2	5,2	5,4	5,1	44	48	44	44	66	79	168	7,9	7,5	4,8	4,6	4,6	4,5	38	38	38	38	89	70	167
18	8,3	8	5,7	5,5	5,4	5,2	46	49	45	45	67	83	171	8	8	4,9	4,8	4,8	4,8	33	47	33	45	86	58	161
19	8,3	8,4	5,3	5,3	5,2	5,3	48	55	47	47	74	92	178	8	7,8	4,8	4,7	4,6	4,7	54	37	47	37	83	61	157
20	8,3	8,5	5,4	5,6	5,3	5,4	50	48	50	50	67	70	166	8	8,2	4,9	5	4,7	5	45	54	45	50	72	65	166
21	8,4	8,5	5,5	5,6	5	5	53	78	50	73	71	81	174	8	7,9	4,9	4,7	4,5	4,5	47	65	44	65	66	49	158
22	8,4	8,4	5,6	5,6	5,1	5,2	55	44	52	44	66	78	163	8,1	8	5	5	4,8	4,6	33	48	33	46	83	68	169
23	8,4	8,5	5,6	5,7	5,2	5,3	75	80	70	75	67	98	178	8,1	8,1	4,9	4,8	4,8	4,8	64	75	60	75	69	69	173
24	8,5	8,3	5,6	5,6	5,4	5,3	45	50	42	45	73	63	159	8,1	8,3	5	5,2	5	5,1	35	48	30	45	87	78	177
25	8,5	8,6	5,8	5,6	5,5	5,2	55	55	55	55	70	67	179	8,2	8,3	5,1	5,3	5,1	5,2	63	68	60	68	84	67	163
26	8,6	8,4	5,8	5,7	5,2	5,2	43	35	40	33	68	88	178	8,2	8,2	5,2	5,3	5	5	48	33	40	33	78	73	159
27	8,6	8,6	5,6	5,5	5,2	5,2	34	25	34	25	69	103	182	8,2	8	5,1	5,3	5	4,9	44	30	40	30	87	80	167
28	8,6	8,4	5,8	5,7	5,5	5,2	45	38	45	38	71	52	153	8,2	8,1	5,2	5	5,1	5,1	42	42	42	42	82	62	158
29	8,6	8,5	5,8	5,7	5,5	5,3	69	78	64	78	68	75	168	8,3	8,4	5,3	5,2	5,3	5,2	72	80	68	68	66	73	170
30	8,7	8,5	5,9	5,7	5,7	5,4	84	38	44	35	70	74	165	8,3	8,2	5,5	5,2	5,4	5,2	75	44	70	44	72	58	161
31	8,8	8,5	5,9	5,7	5,6	5,4	65	65	65	65	87	94	179	8,3	8	5,6	5,6	5,6	5,6	63	70	60	65	68	66	164
32	8,9	8,6	5,9	5,7	5,5	5,5	68	68	64	64	67	86	180	8,4	8,2	5,5	5,7	5,3	5,3	71	64	68	64	66	51	155
33	9	9	5,6	5,8	5,5	5,5	70	60	70	60	79	77	170	8,4	8,1	5,3	5,1	5,2	5,1	81	65	75	62	65	74	171
34	9,1	8,9	6	5,9	5,3	5,3	68	75	65	73	69	89	180	8,4	8,1	5,5	5,3	5,2	5,2	58	76	55	70	64	81	159
35	9,2	9,3	5,6	5,4	5,6	5,6	70	70	70	70	78	73	179	8,5	8,6	5,5	5,6	5,5	5,7	65	75	65	75	73	85	165
36	9,3	8,9	5,5	5,7	5,3	5,3	72	75	70	70	73	83	172	8,5	8,7	5,7	5,8	5,4	5,5	73	80	73	76	75	59	163
37	9,4	9,5	5,7	5,8	5,4	5,4	78	84	78	84	88	68	169	8,6	8,5	5,6	5,4	5,3	5,2	79	82	75	80	68	77	172
38	9,4	9,6	5,5	5,7	5,5	5,7	60	87	58	84	87	76	181	8,6	8,4	5,4	5,3	5,3	5,2	73	84	71	80	86	59	166
39	9,5	9,3	5,6	5,5	5,4	5,4	75	60	73	60	70	95	176	8,7	8,4	5,7	5,5	5,3	5,2	60	77	58	77	73	70	173
40	9,6	9,5	5,7	5,5	5,5	5,4	50	50	50	50	86	69	178	8,7	8,7	5,6	5,4	5,6	5,3	52	65	48	65	89	55	158
41	9,7	9,8	5,7	5,9	5,5	5,6	69	74	69	70	89	90	186	8,8	8,9	5,3	5,4	5	5	79	85	73	78	64	66	164
42	9,8	9,8	5,4	5,8	5,3	5,6	67	67	67	67	80	88	183	8,9	9	5,4	5,5	5,3	5,6	76	83	70	78	76	71	154
43	9,9	9,7	5,7	5,6	5,5	5,4	44	38	40	33	87	70	181	9,2	9,6	5,8	5,9	5,4	5,4	54	58	50	55	83	63	160
44	10	9,9	5,9	5,8	5,6	5,4	85	77	80	77	85	82	164	9,5	9,4	5,8	5,5	5,5	5,3	82	87	82	80	74	90	171
45	10	10	6,3	6	5,8	5,6	88	88	88	88	90	96	176	9,7	9,2	5,9	5,7	5,6	5,4	84	80	78	74	69	75	162

RESULTS

In a comparison of the calibre of the common iliac, superficial femoral, and popliteal arteries, a significant relationship emerged in each given subject (*Fig. 1A and 1B*), both in the men and in the women. With respect to the remaining parameters, separate analyses of the two sexes yields greater clarity. Males: Age ranged from 65 to 90 years, weight from 52 to 103 kg, and height from 153 to 186 cm. The mean arterial calibre are presented in *Tab. 4*. The Student t test was applied to paired samples for the iliac, femoral, and popliteal arteries to evaluate whether there was a statistically significant difference between the calibre of the arteries of the right side with respect to the left. A statistically significant difference was found only in the iliac artery, in which the calibre and Windsor indices were greater in the right as compared to the left (see averages of the 3 arteries). The results were as follows. Right: 1) There was a statistically significant relationship between mean calibre and Windsor indices, calculated in both posterior tibialis and dorsalis pedis arteries ($p < 0.01$; *Tab. 3, A-C*); 2) there was a statistically significant correlation between mean calibre and age ($p < 0.05$; tab. 3E); and 3) there was no correlation between mean calibre and weight (p = ns) or between mean calibre and

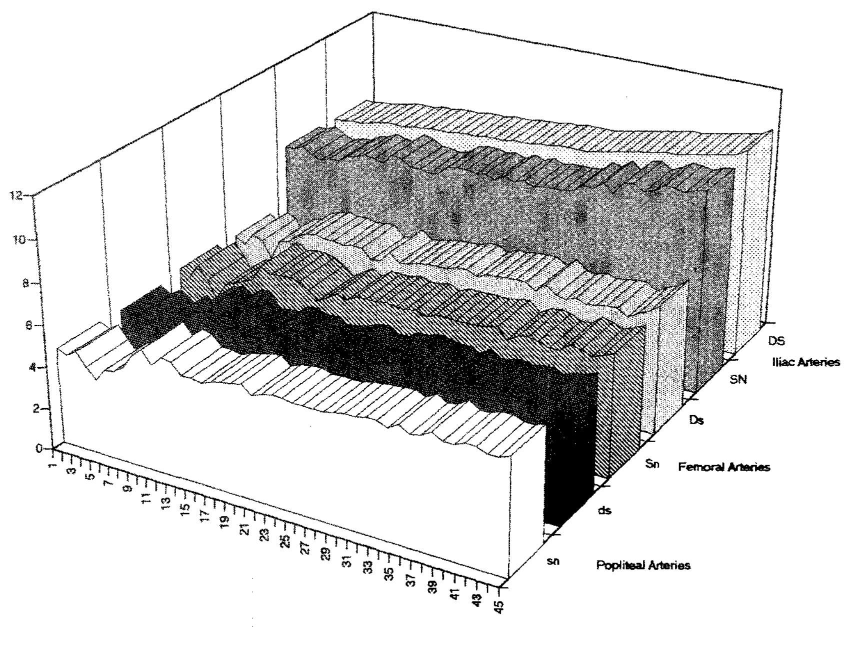

Fig. 1A — Relationship among the calibres of the common iliac, superficial femoral and popliteal arteries in Males.

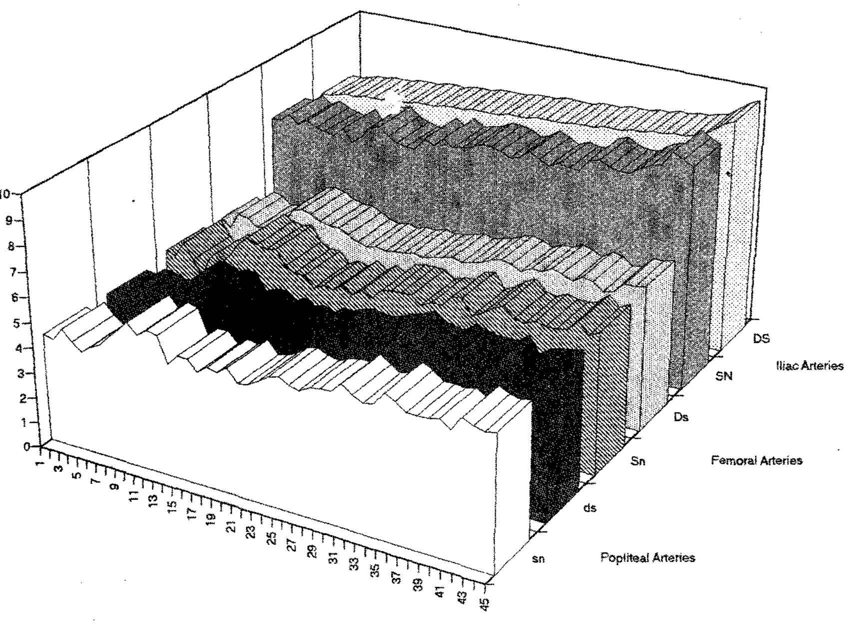

Fig. 1B — Relationship among the calibres of the common iliac, superficial femoral and popliteal arteries in Females.

height (p = ns). Left: 1) There was a statistically significant correlation between mean calibre and Windsor indices calculated at the levels of both the posterior tibialis ($p < 0.05$; *Tab. 3B*) and dorsalis pedis arteries ($p < 0.01$; *Tab. 3D*; 2) there was a statistically significant correlation between mean caliber and age ($p < 0.05$; *Tab. 3F*); and 3) there was no statistically significant correlation between mean caliber and body weight (p = ns) or between mean caliber and height (p = ns). Females: Age ranged from 64 to 89 years, weight from 49 to 90 kg, and height from 153 to 166 cm. The mean calibers of the three arteries are presented in *Table 4*. The Student's t test for paired samples of the three arteries did not reveal a statistically significant predominance of one side over the other (se *Tab. 5*). With respect to the coefficients of correlation between mean caliber and Windsor indices, the results were as follows. Right: 1) There was a statistically significant correlation between mean caliber and Windsor indices calculated at the levels of both the posterior tibialis and dorsalis pedis arteries ($p < 0.01$ *Tab. 2, A-C*); 2) there was a statistically significant correlation between age and mean calibre ($p < 0.05$; *Tab. 2E*); and 3) there was no correlation between mean calibre and weight (p = ns) or between mean calibre and height (p = ns). Left: 1) There was a statistically significant correlation between mean calibre and Windsor indices calculated at the levels of both the

TABLE 2 - *Females. Right Side. Relationship between mean calibre (of iliac, femoral and popliteal arteries) and: A: malleolar Windsor index; C: dorsal pedis Windsor index; E: age. Left Side. Relationship between mean calibre (of iliac, femoral and popliteal arteries) and: B: malleolar Windsor index; D: dorsal pedis Windsor index; F: age.*

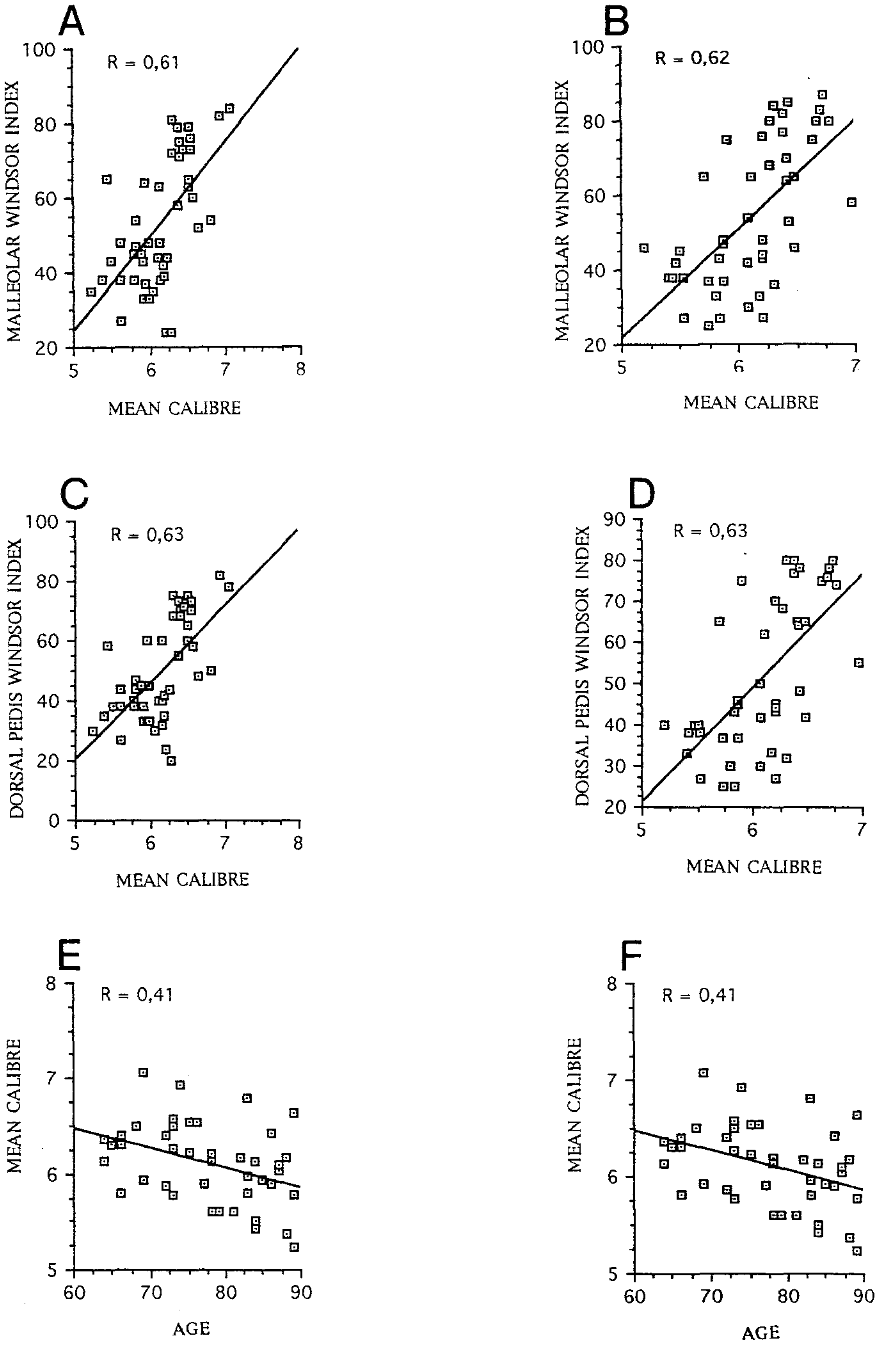

TABLE 3 - *Males. Right Side. Relationship between mean calibre (of iliac, femoral and popliteal arteries) and: A: malleolar Windsor index; C: dorsal pedis Windsor index; E: age. Left Side. Relationship between mean calibre (of iliac, femoral and popliteal arteries) and: B: malleolar Windsor index; D: dorsal pedis Windsor index; F: age.*

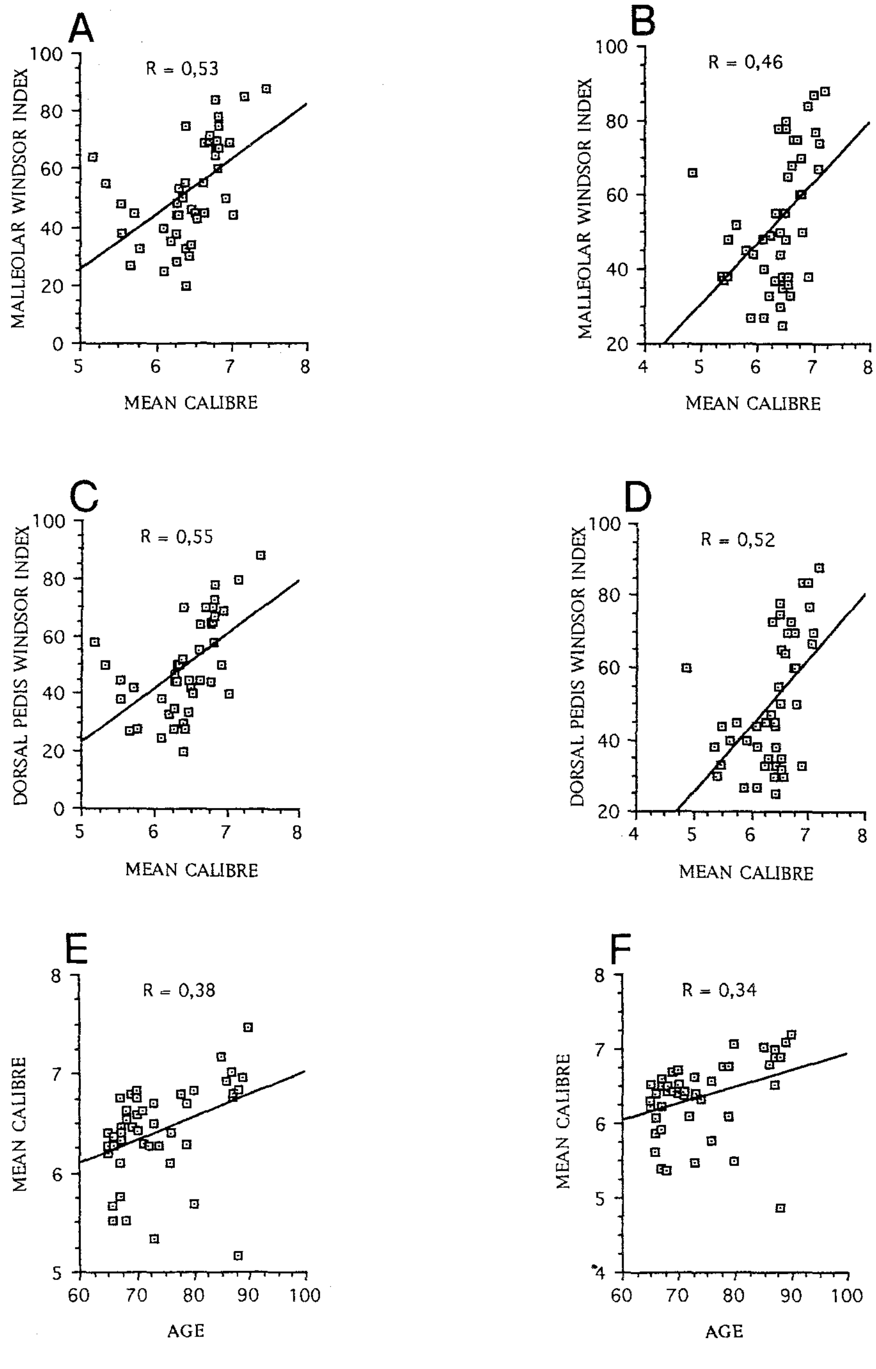

TABLE 4 - *All values are mm.* ± *S.D.*

Arterial Calibre	Males		Females	
	Right	Left	Right	Left
Common Iliac Artery	8.59±0.73	8.51±0.73	8.15±0.54	8.10±0.55
Femoral Artery	5.48±0.45	5.42±0.48	5.21±0.40	5.20±0.45
Popliteal Artery	5.21±0.44	5.16±0.46	5.02±0.40	5.01±0.43

TABLE 5 - *Relationship between two sides.*

Arteries	Males		Females	
	t	*p*	t	*p*
Common Iliac Artery	2.68	<0,05	1.64	ns
Femoral Artery	1.83	ns	0.27	ns
Popliteal Artery	2.00	ns	0.19	ns

posterior tibialis ($p<0.05$; *Tab. 2B*) and dorsalis pedis arteries ($p<0.01$; *Tab. 2D*); 2) there was a statistically significant correlation between mean calibre and age ($p<0.05$; *Tab. 2F*); and 3) there was no statistically significant correlation between mean caliber and weight (p = ns) or between mean calibre and height (p = ns).

DISCUSSION AND CONCLUSIONS

It is only logical that higher degrees of arterial stenosis correspond with a larger hemodynamic workload (Brice, 1964; Flanagan, 1977; Blackshear *et al.*, 1980; Franceschi 1980; Macchi, 1985) and that a large hemodynamic force at the level of the stenosis is associated with symptomatology and greater clinical complications (Baker *et al.*, 1978; Fronek *et al.*, 1978; Franceschi, 1980). However, in our opinion, the relationship between the original arterial caliber and the hemodynamic significance of the stenosis is also extremely interesting. As in the carotid bed, in which there is a significant relationship among arterial calibre, residual lumen in the stenotic artery, and original arterial caliber, the situation is analogous in the peripheral bed also in terms of symptomaticity and the frequency and significance of neurological events (Macchi *et al.*, 1993). it appears that, given equal degrees of stenosis, subjects with smaller vessel lumens are subject to greater clinical and hemodynamic complications in both beds. At the carotid level, the symptomaticity and frequency of neurological events indirectly reflect the significance of the pathology. At the peripheral level, measurements of the arterial pressures in the posterior tibialis and dorsalis pedis arteries provide an immediate, non-invasive, reproducible, and quantifiable hemodynamic parameter. In this study also, the dimensional homogeneity of the arterial vessels confirms that there is a consistent relationship between the various segments of the circulatory tree (Fazzari 1929, Macchi *et al.*, 1993) in a given subject. Furthermore, it suggests that the size of the arterial lumen is inversely related to the occurrence of occlusive events as a consequence of atherosclerotic disease. Fundamentally, the clinical significance of these findings may be summarized by two considerations. First, as in the carotid bed, in the assessment of peripheral vascular disorders, defining the degree of stenosis in an artery involved by an arteriosclerotic process is absolutely inadequate without also defining the residual lumen. Second, in the peripheral bed, it is impossible to prognosticate correctly or to institute therapy without measuring pressure. Patients with smaller arteries are at higher risk from atherosclerosis and therefore require greater attention and observation.

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REFERENCES

Ammar AD, Wilson RL, Travers H, Lin JJ, Fara SJ, Chang FC. 1984. Intraplaque Hemorrhage: its significance in cerebrovascular disease. Amer J Surg 148: 840-843.

Baker DW, Forster FK, Daigle RE. 1978. Doppler principles and tecniques in ultrasound: its application in medicine and biology. Ed Elsevier Amsterdam, Holland.

Bartynski WS, Darbouze P, Nemir P jr. 1984. Significance of ulcerated plaque in transient cerebral ischemia. Amer J Surg 141: 353-357.

Blackshear WM jr, Phillips DJ, Chikos PM, Harley JD, Thiele BL, Strandness DE jr. 1980. Cartotid artery velocity patterns, in normal and stenotic vessels. Stroke 11: 67-71.

Brice JG, Dowsett DJ, Lowe RD. 1964: Haemodynamic effects of carotid artery stenosis. Brit Med J II, 1363-1366.

Brown PM, Johnston KW. 1982: The difficulty of quantifying the severity of carotid stenosis. Surgery 92: 468-473.

Berguer R, Hwang NH. 1974. Critical arterial stenosis: a theoretical and experimental solution. Ann Surg 180: 39-50.

Edwards JH, Kircheff II, Riles T, Imparato A. 1979. Angiographically undetected ulceration of the carotid bifurcation as a cause of embolic stroke. Radiology 132: 369-373.

Fazzari I. 1929. Esiste un rapporto costante tra i vari segmenti dell'albero vascolare? Endocr e Pat Cost IV: 1-7.

Flanagan PD, Tullis JP, Streeter VL, Whitehouse WM, Frey WG, Stanley JC. 1977: Multiple subcritical arterial stenoses: effect on poststenotic pressure and flow. Ann Surg 186: 663-668.

Franceschi C. 1980. L'indagine vascolare con ultrasonografia doppler. Ed Masson Italia Milano.

Fronek A, Coel M, Bernstein EF. 1978. The importance of combined multisegmental pressure and doppler flow velocity studies in the diagnosis of periferal arterial occlusive disease. Surgery 84: 840-847.

Kassam M, Johnston KW, Cobbold RSC. 1985. Quantitative estimation of spectral broadening for the diagnosis of carotid arterial disease: method and in vitro results. Ultrasound Med biol 11: 425-433.

Ku DN, Giddens DP, Zarins CK, Glagov S. 1985. Pulsatile flow and atherosclerosis in the human carotid bifurcation. Positive correlation between plaque location and flow and oscillatin schear stress. Arteriosclerosis 5: 293-302.

Langlois Y, Roederer GO, Chan A, Phillips DJ. Beach KW, Martin D, Chikos PM, Strandness DE jr. 1983. Evaluating carotid artery disease. Ultrasound Med Biol 9: 51-63.

Macchi C. 1985. La Patologia dei tronchi sovraaortici nel paziente anziano: diagnostica ragionata. La Rivista del Medico Pratico 115, Gerontologia 7: 35-45.

Macchi C, Catini C. 1993. The anatomy and clinical significance of the collateral circulation between the internal and external carotid arteries through the ophtalmic artery. It J Anat Embryol 98, 1: 23-29.

Macchi C, Simoni R, Gori G. 1991. Diagnosi e prevenzione dell'ictus nel paziente anziano mediante l'utilizzo di nuove metodiche. Diagnosis 3, 2: 105-109.

Macchi C, Giannelli F, Catini C. 1993. The measurement of the calibers of the branches of the aortic arch: a statistical investigation of 430 living subjects using ultrasonic tomography. It J Anat Embryol 98, 2: 69-79.

Macchi C, Catini C, Giannelli F. 1993. The original caliber of the carotid artery as a possible risk factor for complications of atherosclerosis.

Moore WS, Hall AD. 1968. Ulcerated atheroma of the carotid artery, a caruse of transient cerebral ischemia. Amer J Surg 116: 237-242.

Pizzetti F, Macchi C, Giardini S, Gori G, Simoni R. 1992. La chirurgia della carotide extracranica nella prevenzione dell'ictus. Senior 3: 16-26.

Von Reutern M, Budingen HS. 1992. Sonografia doppler extra ed intracranica. Centro Scientifico Editore Torino, 154-164.

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