Hypertension and microvascular dysfunction

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End-organ Damage in Hypertension: Cardiac and Coronary Alterations

Left ventricle

- Interstitial fibrosis
- Cardiomyocyte hypertrophy
- Diastolic dysfunction
- Intramyocardial pressure

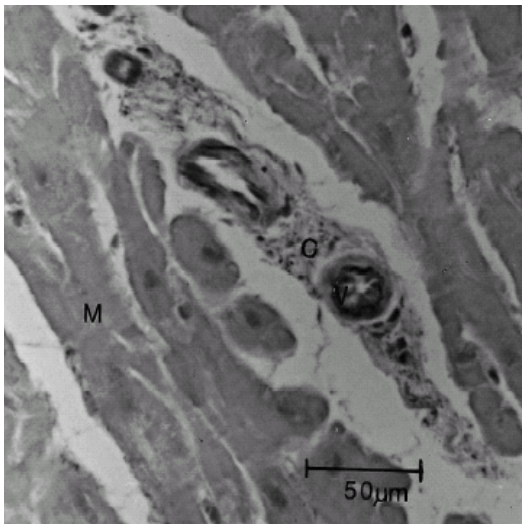
Coronary

- Endothelial dysfunction
- Capillary rarefaction
- Arteriolar remodelling
- Perivascular fibrosis

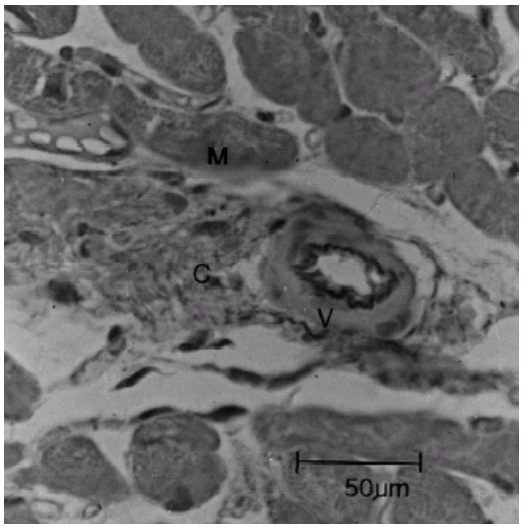
Adapted from Camici PG, Crea F. *N Engl J Med.* 2007;356-830-40.

Arteriolar remodelling in arterial hypertension

Normal subject



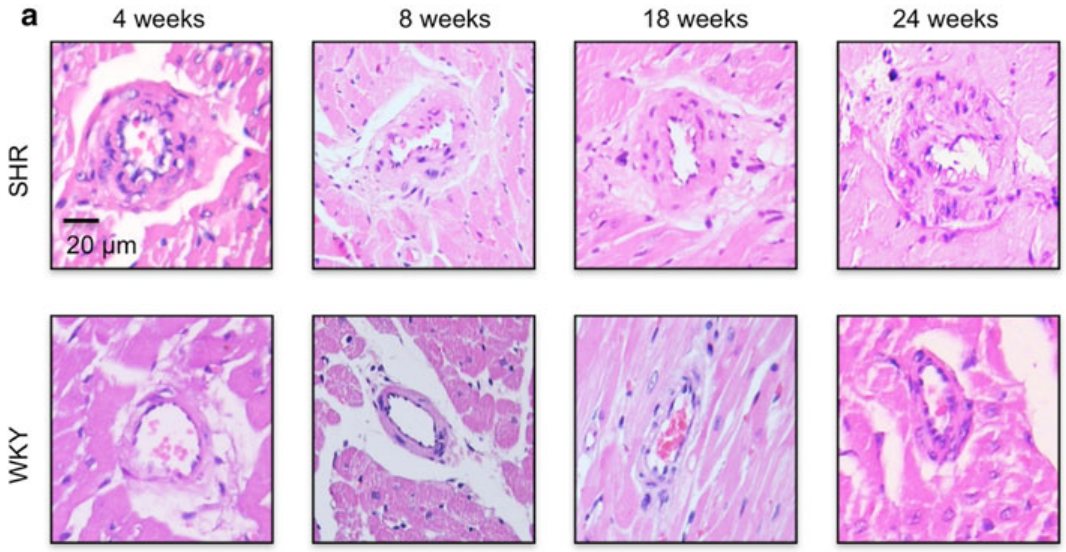
Hypertensive

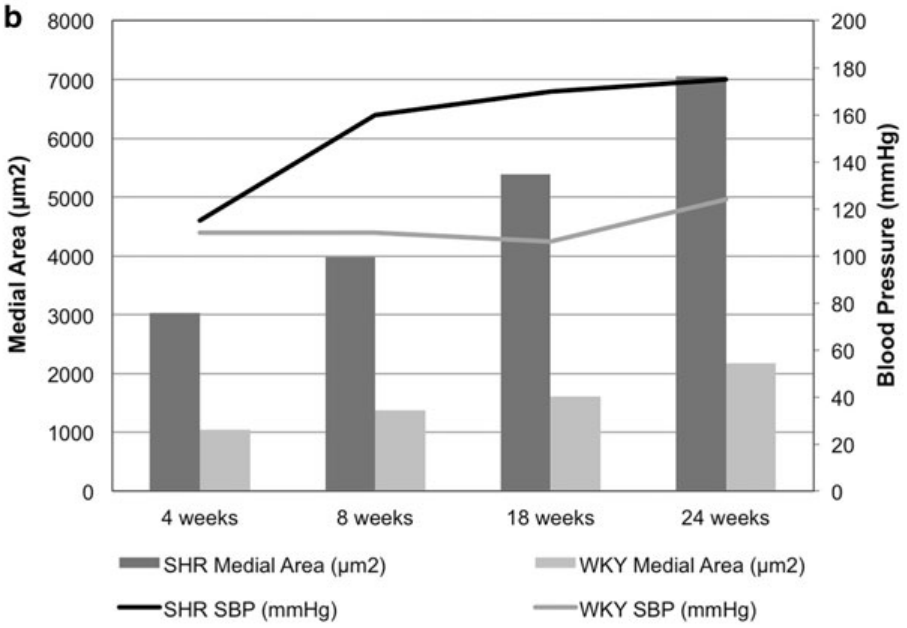


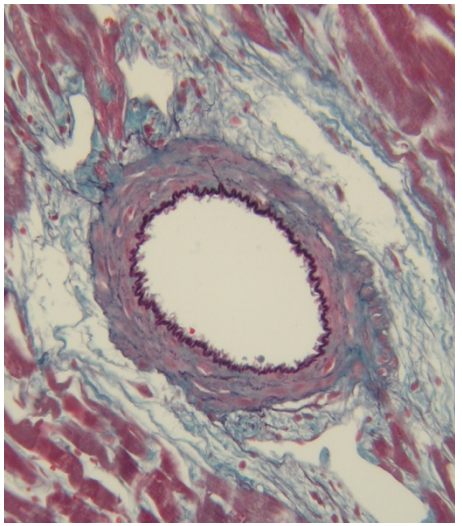
- Increased perivascular fibrosis
- Thickening of the wall of intramyocardial arterioles
- Increased wall/lumen ratio
- Capillary rarefaction

Camici & Crea N Engl J Med. 2007;356:830-40

Coronary arteriolar remodelling precedes onset of hypertension In the SHR model







Basic Res Cardiol (2013) 108:316
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ORIGINAL CONTRIBUTION

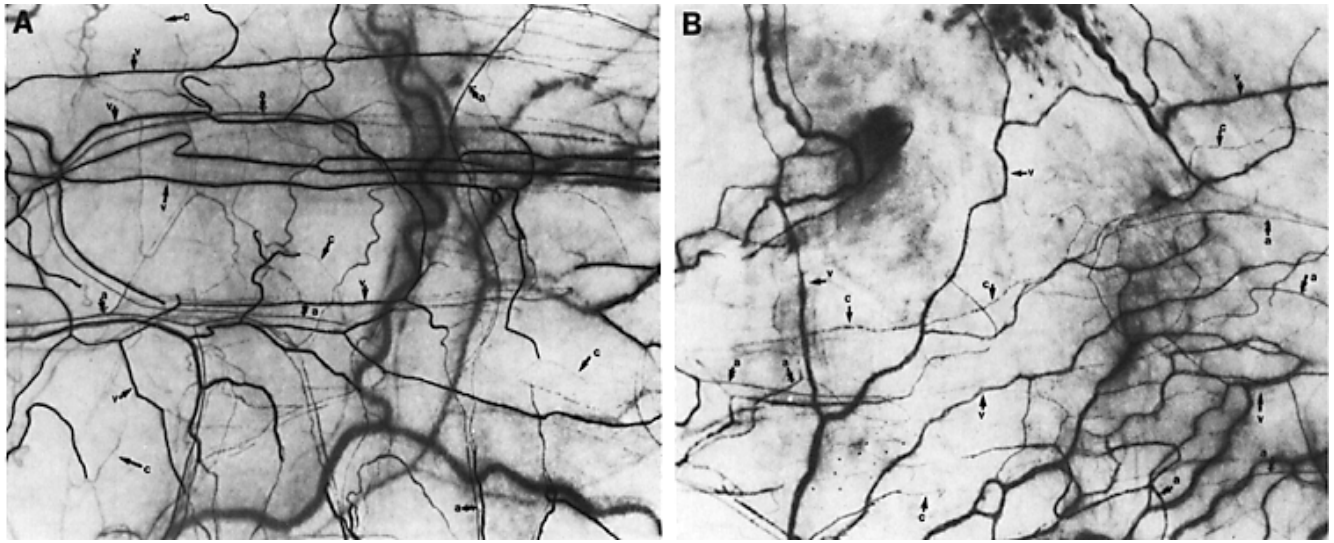
Mapping genetic determinants of coronary microvascular remodeling in the spontaneously hypertensive rat

Massimiliano Mancini · Enrico Petretto · Christina Kleinert · Angela Scavone · Tisham De · Stuart Cook · Jan Silhavy · Vaclav Zidek · Michal Pravenec · Giulia d'Amati · Paolo G. Camici

B. La microcirculation victime de l'HTA
Quels mécanismes ?

Raréfaction artériolocapillaire

Normotendus Hypertendus

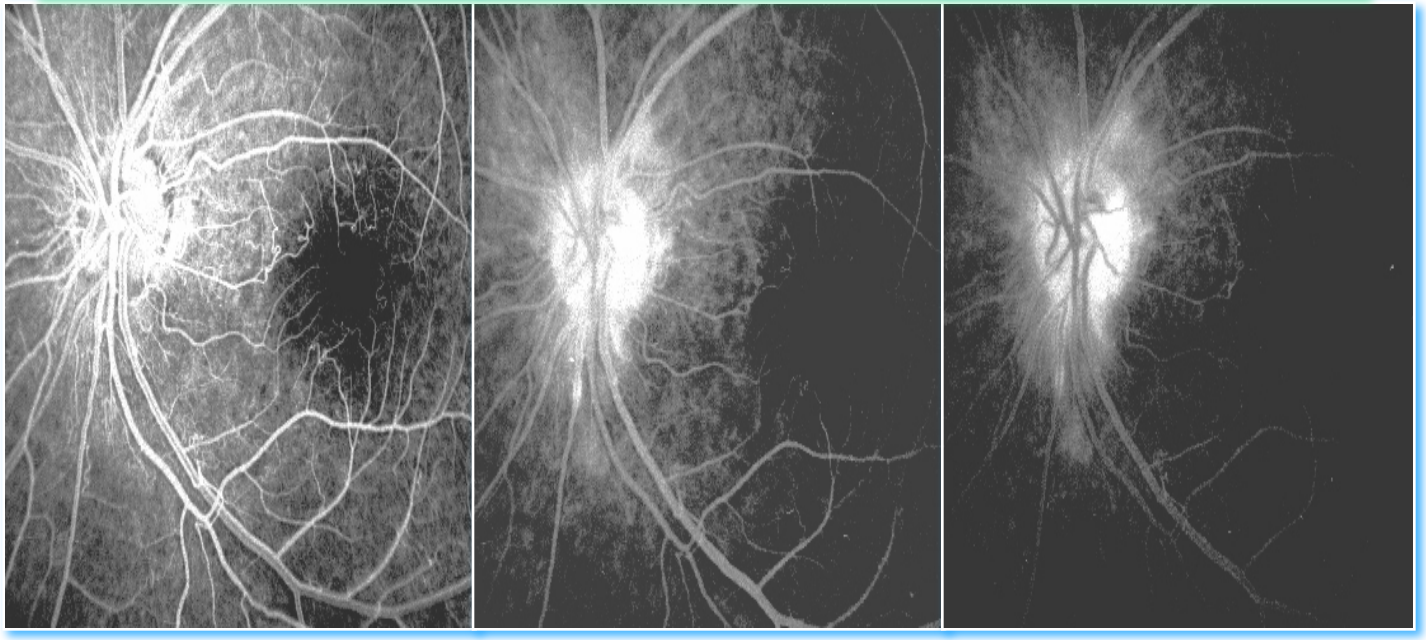


Raréfaction artériolocapillaire observée chez l'HT au niveau de l'avant bras

Sullivan J. *Hypertension.* 1993

B. La microcirculation victime de l'HTA 2. Quelles conséquences pour l'hypertendu ?

Rétinopathie hypertensive



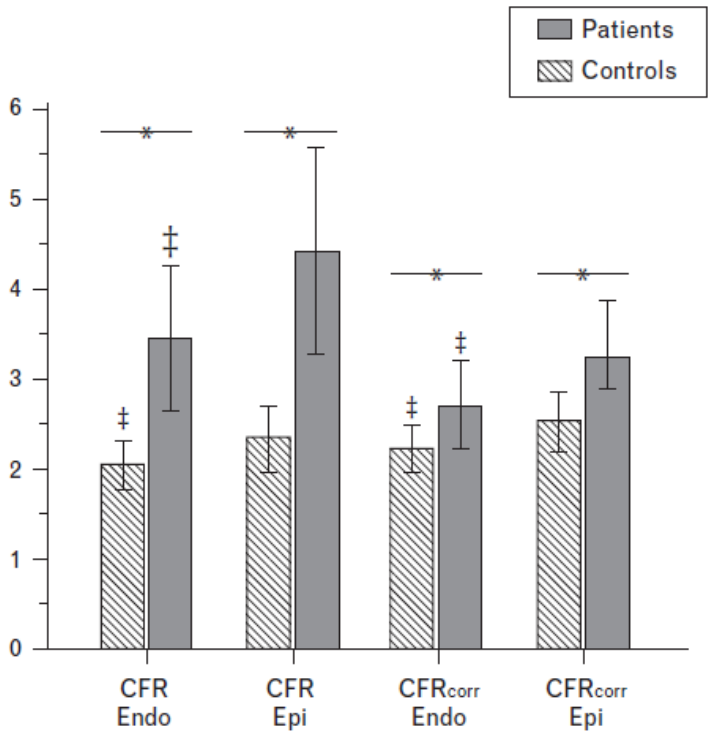
Stade 1 Stade 2 Stade 3

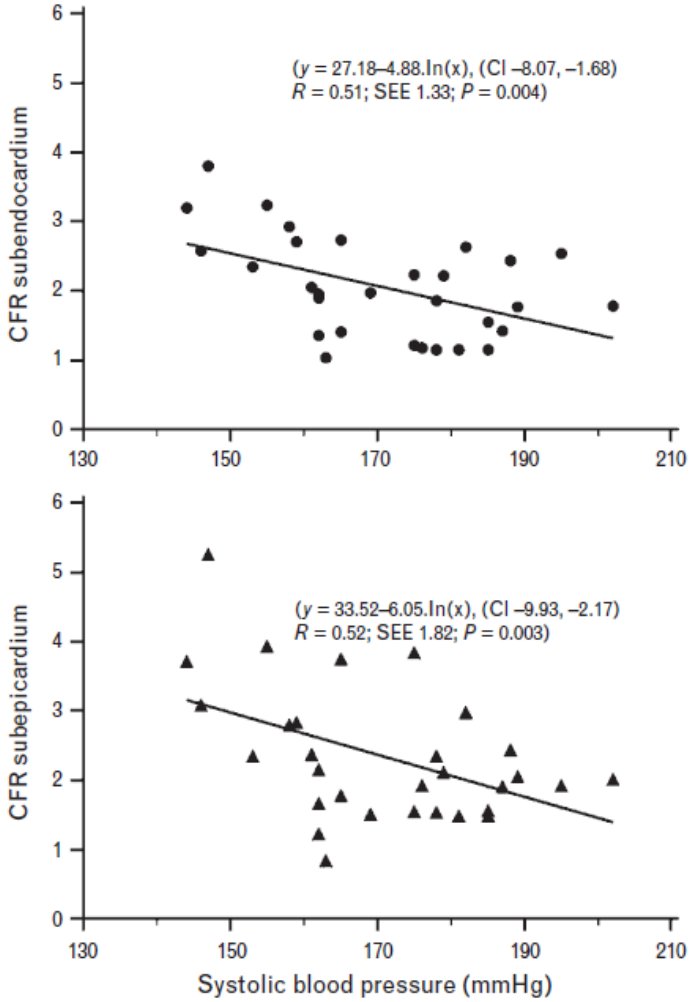
Raréfaction artériolocapillaire observée lors de la rétinopathie hypertensive

Courtesy of Dr Bernard Levy

The blunting of coronary flow reserve in hypertension with left ventricular hypertrophy is transmural and correlates with systolic blood pressure

Ornella Rimoldi[a,b,c], Stuart D. Rosen[b], and Paolo G. Camici[a,b,d]





Journal of Hypertension 2014

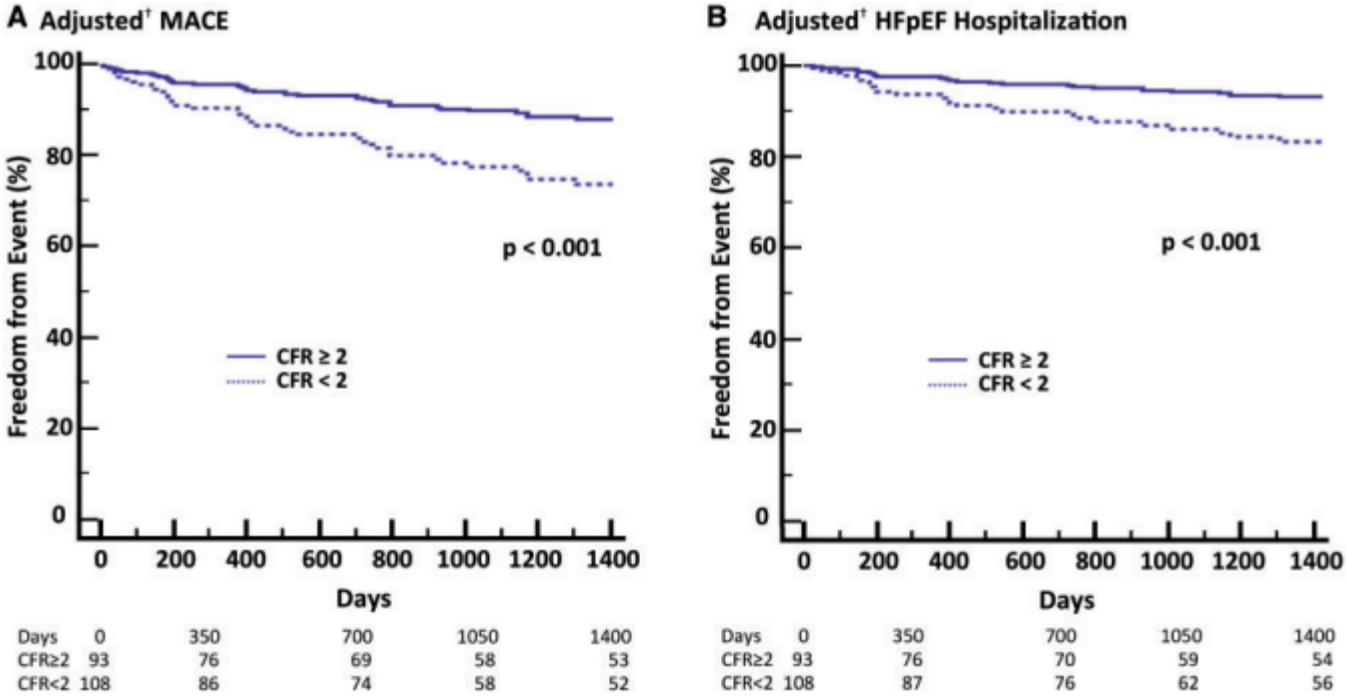
ESC European Society of Cardiology
European Heart Journal (2018) **39**, 840–849
doi:10.1093/eurheartj/ehx721

Coronary microvascular dysfunction and future risk of heart failure with preserved ejection fraction

Viviany R. Taqueti[1]*, Scott D. Solomon[1], Amil M. Shah[1], Akshay S. Desai[2], John D. Groarke[2], Michael T. Osborne[3], Jon Hainer[1], Courtney F. Bibbo[1], Sharmila Dorbala[1], Ron Blankstein[1], and Marcelo F. Di Carli[1]

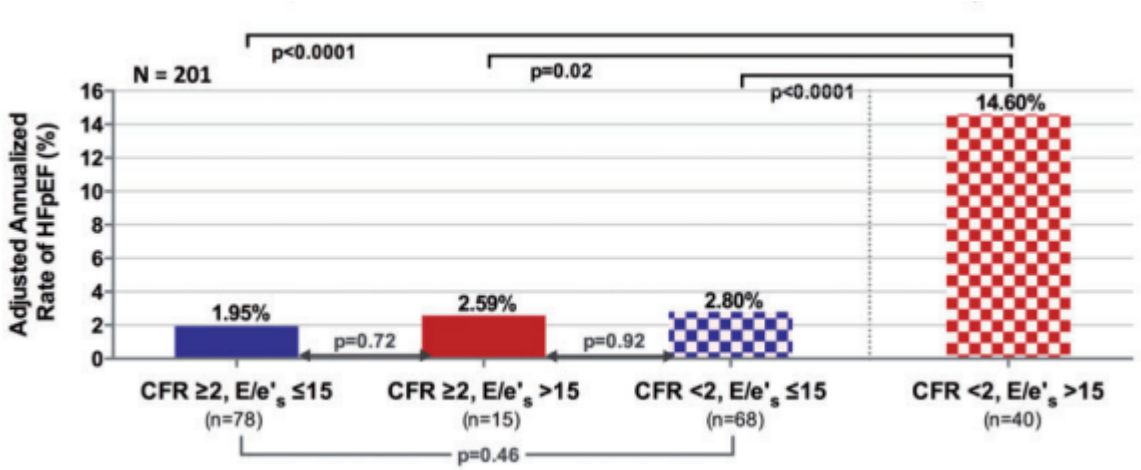
Table 1 Baseline characteristics of patients by coronary flow reserve

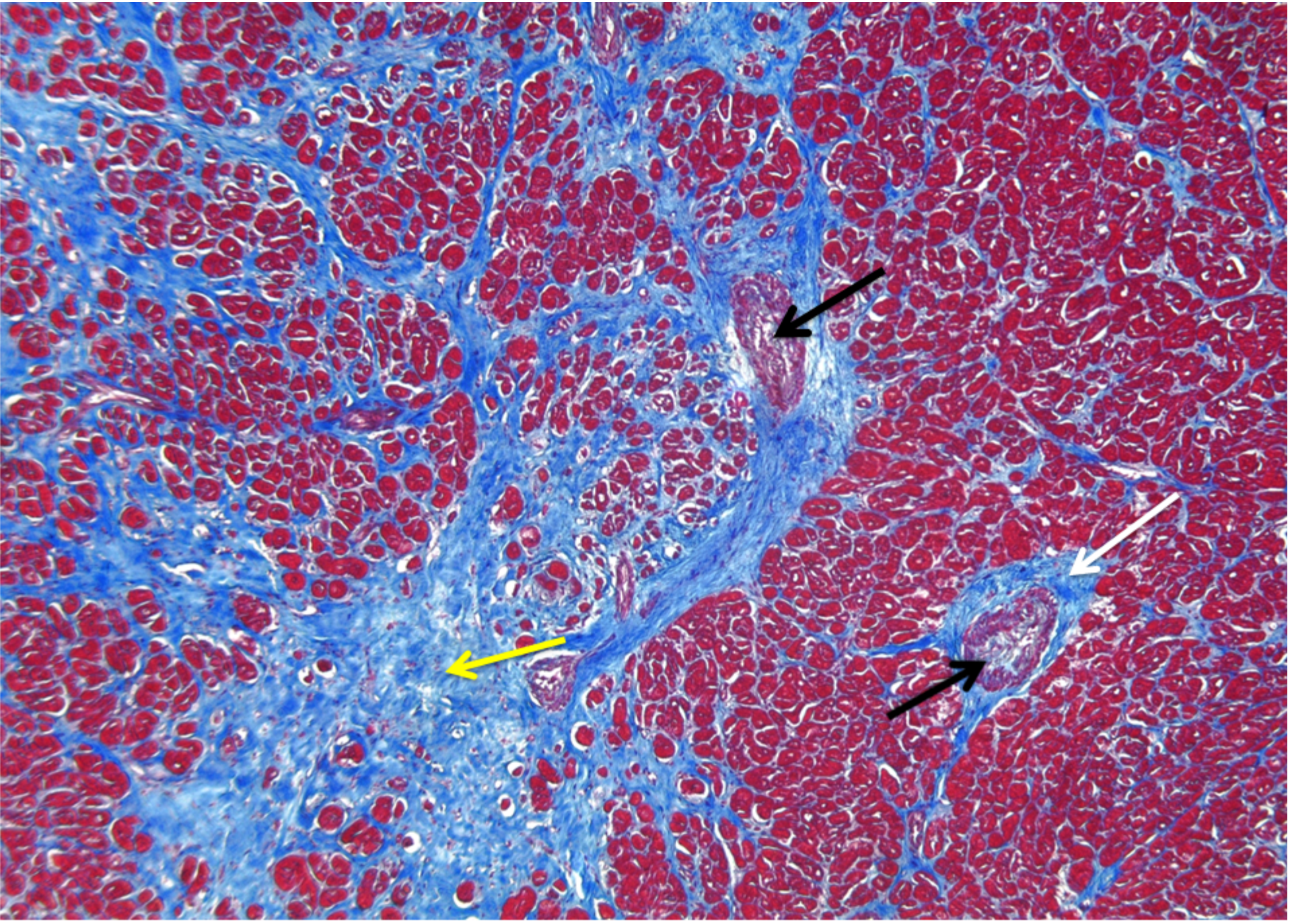
Characteristics	Overall (*N* = 201)	Coronary flow reserve		P-value[a]
		≥2 (*n* = 93)	<2 (*n* = 108)	
Demographic characteristics				
Age,[b] years (Q1–Q3)	66 (57–79)	64 (57–75)	67 (57–81)	0.30
Female gender (%)	130 (64.7)	63 (67.7)	67 (62.0)	0.46
White race (%)	100 (49.8)	50 (53.8)	50 (46.3)	0.32
Body mass index[b] (kg/m2)	28.7 (24.9–34.3)	29.2 (25.2–32.9)	27.7 (24.7–35.9)	0.96
Pretest clinical score[b,c]	12 (9–15)	12 (10–15)	13 (9–15)	0.67
Medical history				
Hypertension (%)	152 (75.6)	71 (76.3)	81 (75.0)	0.87
Dyslipidaemia (%)	129 (64.2)	55 (59.1)	74 (68.5)	0.19
Diabetes mellitus (%)	66 (32.8)	33 (35.5)	33 (30.6)	0.55
Current smoker (%)	16 (8.0)	8 (8.6)	8 (7.4)	0.80
Family history of CAD (%)	38 (18.9)	17 (18.3)	21 (19.4)	0.86
Atrial fibrillation (%)	18 (9.0)	6 (6.5)	12 (11.1)	0.32
Renal hemodialysis (%)	5 (2.5)	1 (1.1)	4 (3.7)	0.38



*Cardiovascular death or hospitalization for myocardial infarction or heart failure.

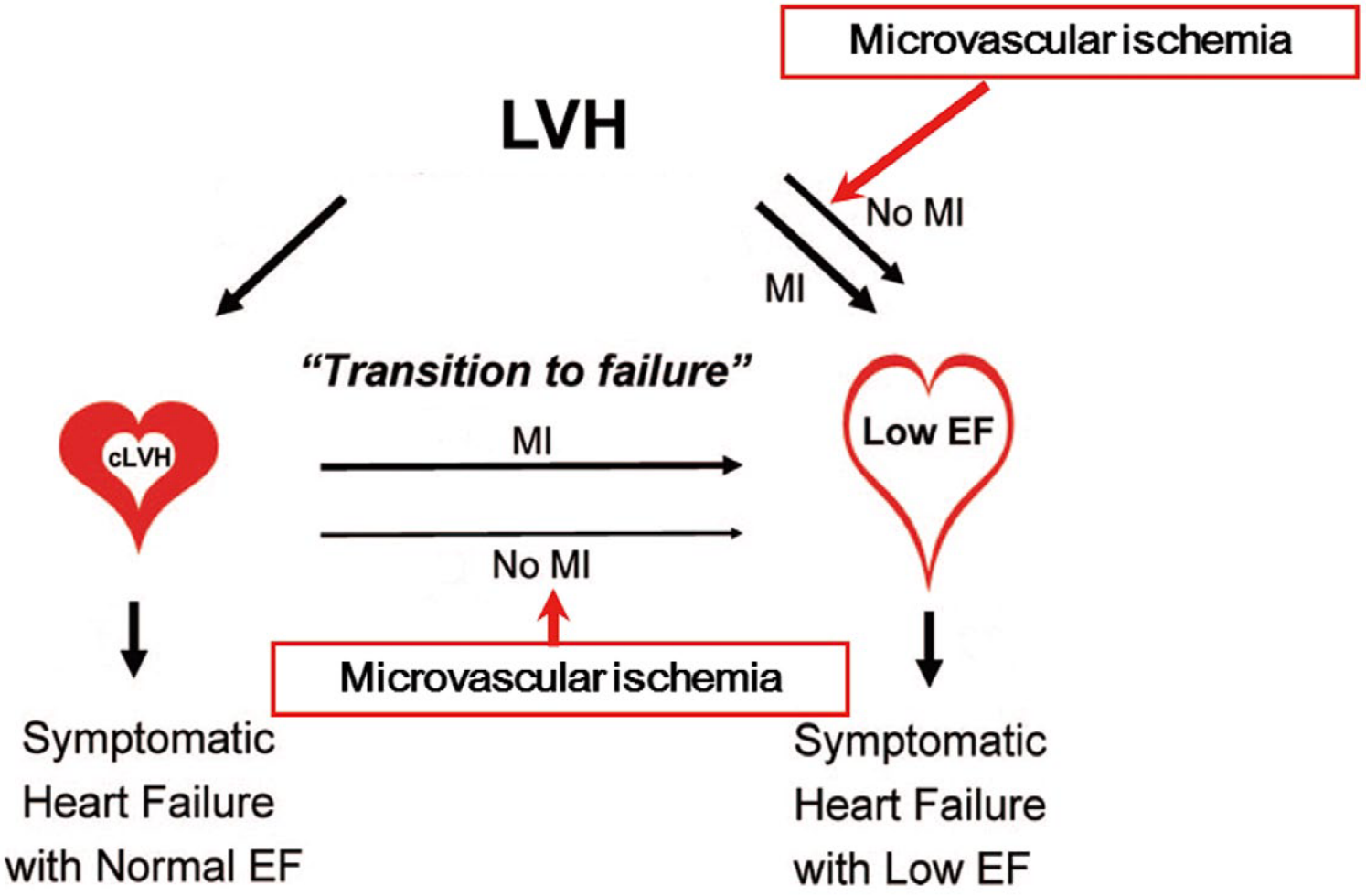
†Adjusted for pretest clinical score, history of atrial fibrillation, estimated glomerular filtration rate <60 ml•min^{-1}•1.73m^{-2}, detectable troponin, left ventricular ejection fraction and E/e'$_{septal}$ >15.





Lazzeroni D, Rimoldi O and Camici PG Circulation J 2016

The pathway from hypertension to HF
"*Role of microvascular ischemia*"



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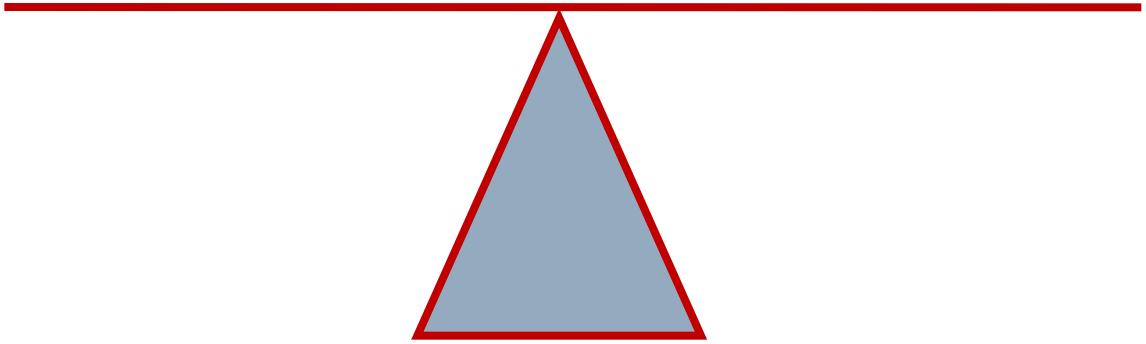
Pro- and anti-growth stimuli

The homeostasis of vascular tissue is achieved through a balanced equilibrium between stimulator and inhibitor signals of cell growth

Stimulators
angiotensin II
aldosterone
deoxycorticost.
endothelin
catecholamine

Inhibitors
nitric oxide
bradykinin
prostaglandin
ANP
glucocort.

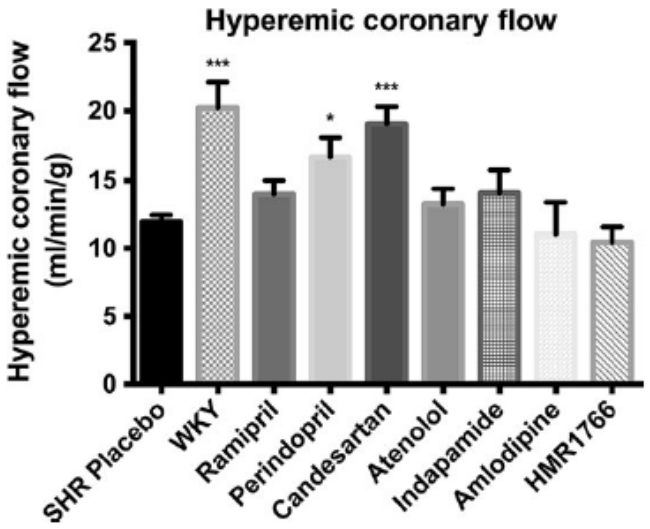


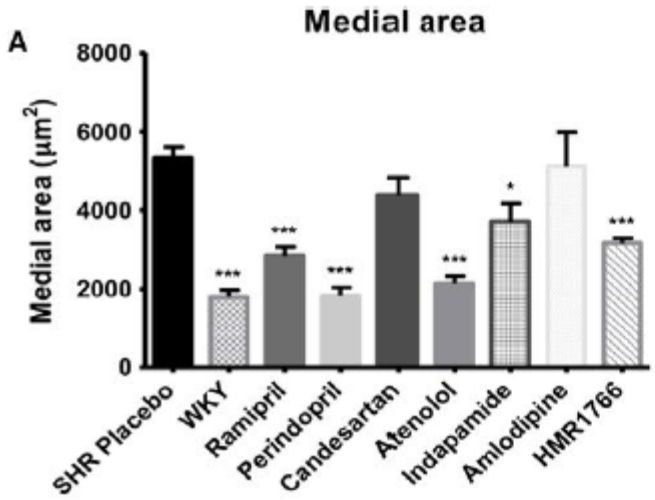
ORIGINAL ARTICLE

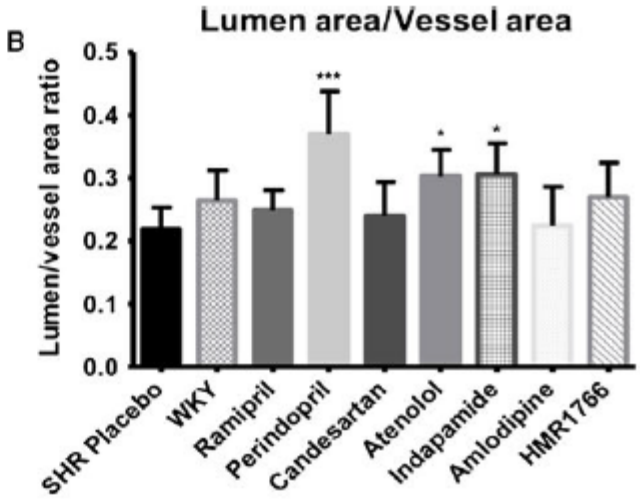
WILEY Microcirculation

Effect of different drug classes on reverse remodeling of intramural coronary arterioles in the spontaneously hypertensive rat

Massimiliano Mancini[1,a] | Angela Scavone[2,a] | Carmem Luiza Sartorio[2] | Rocco Baccaro[2] | Christina Kleinert[2] | Angelina Pernazza[3] | Veronica Buia[2] | Martina Leopizzi[3] | Giulia d'Amati[3] | Paolo G. Camici[2]







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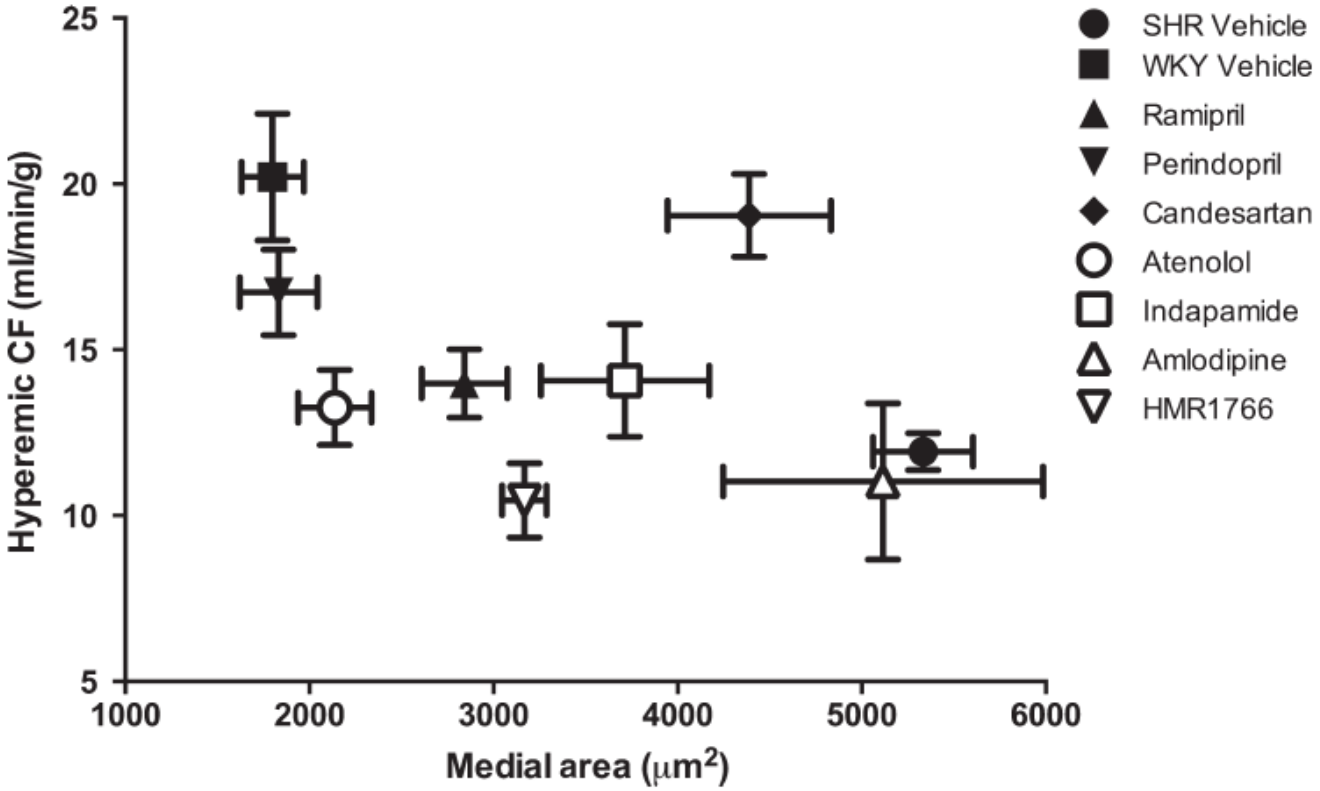
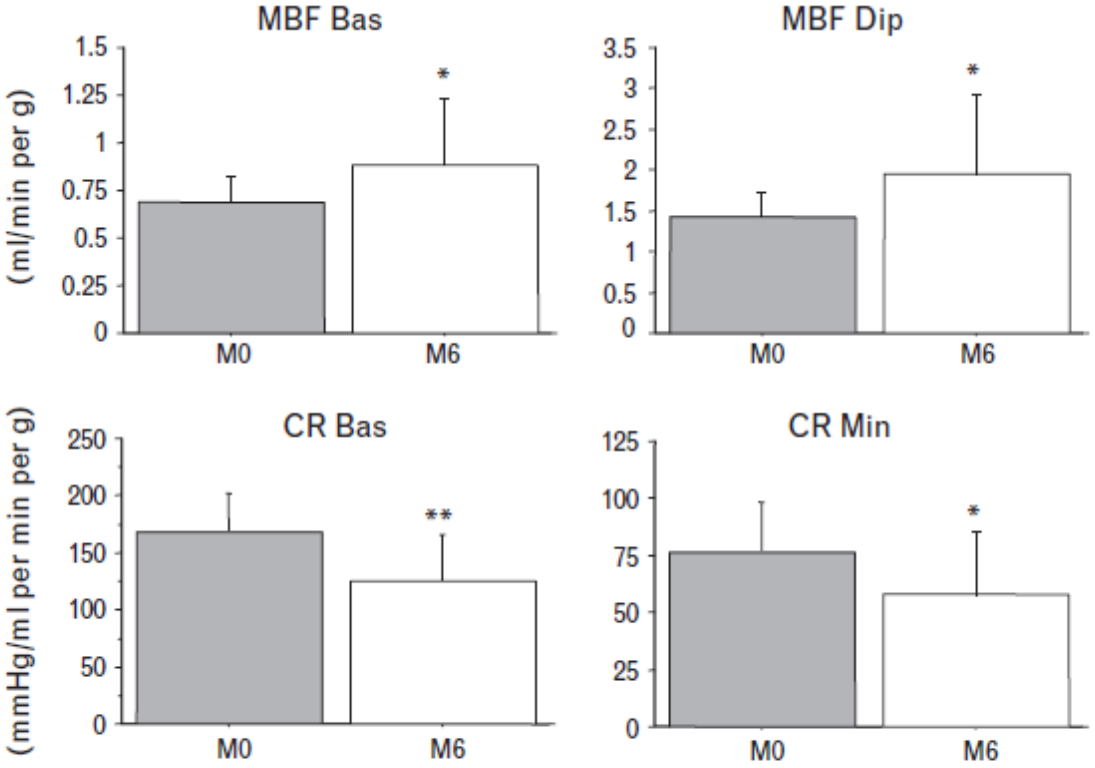


Perindopril and indapamide reverse coronary microvascular remodelling and improve flow in arterial hypertension

Danilo Neglia[a], Enza Fommei[a], Anabel Varela-Carver[b], Massimiliano Mancini[c], Sergio Ghione[a], Massimo Lombardi[a], Patrizia Pisani[a], Howard Parker[b], Giulia D'amati[c], Luigi Donato[a] and Paolo G. Camici[b,d]



Patient study. (Top panels) Baseline (MBF Bas) and hyperaemic myocardial blood flow (MBF Dip) and (bottom panels) baseline (CR Bas) and minimal (dipyridamole) coronary resistance (CR Min) at initiation (M0) and after 6 months of treatment (M6). $*P < 0.05$ and $**P < 0.01$ M0 vs. M6.

Journal of Hypertension 2011, 29:364–372