



# **The Correlation Between Blood Flow in the Coronary Microcirculation During Angiography and the Blood Flow in the Retinal Arterioles**

Yaron Arbel, Amir Sternfeld, Shmuel Banai, Adiel Barak, Burgansky-Eliash Zvia, Amir Halkin, Shlomo Berliner, Itzhak Herz, Gad Keren, Ardon Rubinstein, Ariel Finkelstein

Departments of Cardiology, Ophthalmology, Internal Medicine “D” and “E”, Metabolic clinic, Tel Aviv Sourasky Medical Center, Tel Aviv, affiliated to the Sackler School of Medicine, Tel Aviv University, Tel Aviv, Israel, Department of Ophthalmology, The Edith Wolfson Medical Center, Sackler School of Medicine, Tel Aviv University, Tel Aviv, Israel



# Conflict of Interest

- None to declare



# Introduction

- 30% of AP found to have normal coronaries
- “Slow Coronary Flow” (SCF) described in 1972
- SCF strongly related to microvascular damage
- SCF patients have worse prognosis
- Treating SCF patients might improve prognosis

Circulation 2008;117:e25-146.

Int Heart J 2009;50:407-419.

Clinical hemorheology and microcirculation 2012;52:5-14.

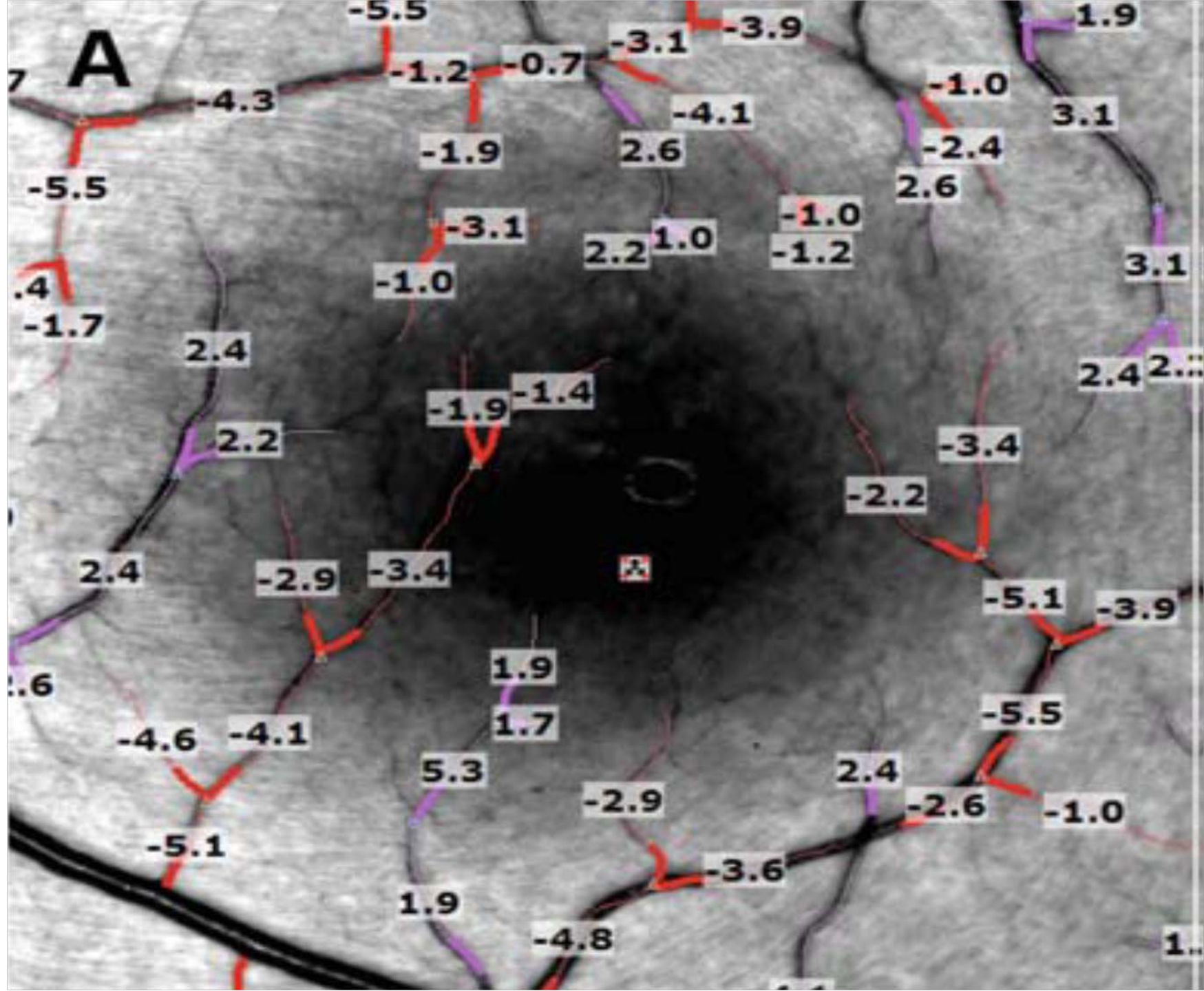
JAMA 2009;301:1468-1474.





# Introduction

- Retinal microvascular imaging allows direct non invasive systemic assessment
- Retinal Functional Imager (RFI) measures microvascular blood flow velocity
- Correlation between coronary and retinal microcirculation was examined
- Help differentiate chest pain from cardiac origin





# Background

- Slow myocardial perfusion and retinal arteriolar narrowing
- Retinal microvascular narrowing and systemic microvascular damage
- Retinal microvascular narrowing and coronary artery disease
- RFI showed increased microvascular blood flow velocity in DM2 patients

Hypertension 2006;47:975-981.

Hypertension 2008;51:119-126.

The American Journal of Medicine 2010;123:374 e371-377.

Retina 2012;232:112-119.



# Methods

- 28 Normal Coronaries were recruited
- Coronary angiograms were analyzed using Corrected TIMI Frame Count (CTFC)
- Retinal arterioles flow measured using RFI
- Data regarding medical history and risk factors was collected
- Statistical analysis included coronary flow, retinal flow and conventional risk factors





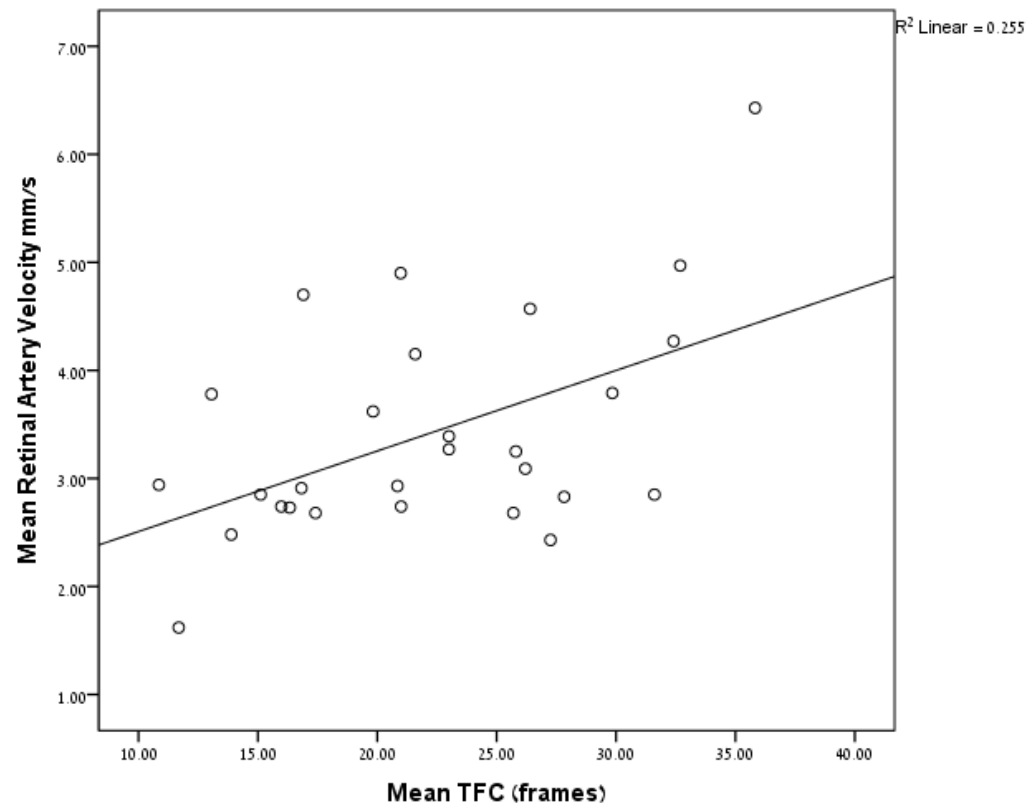
# Exclusion Criteria

- Narrowing of coronary arteries shown angiographically
- Significant valvular disease
- ST elevation in ECG
- Clinically significant congestive heart failure
- Diopter above +6/ below -6
- Any type of retinal disease (DR, AMD, etc.)
- Any previous ophthalmic surgery
- Any disease that prevents imaging the retina



# Results

- Correlation between CTFC and retinal arteriolar blood flow velocity.



**p = 0.03**

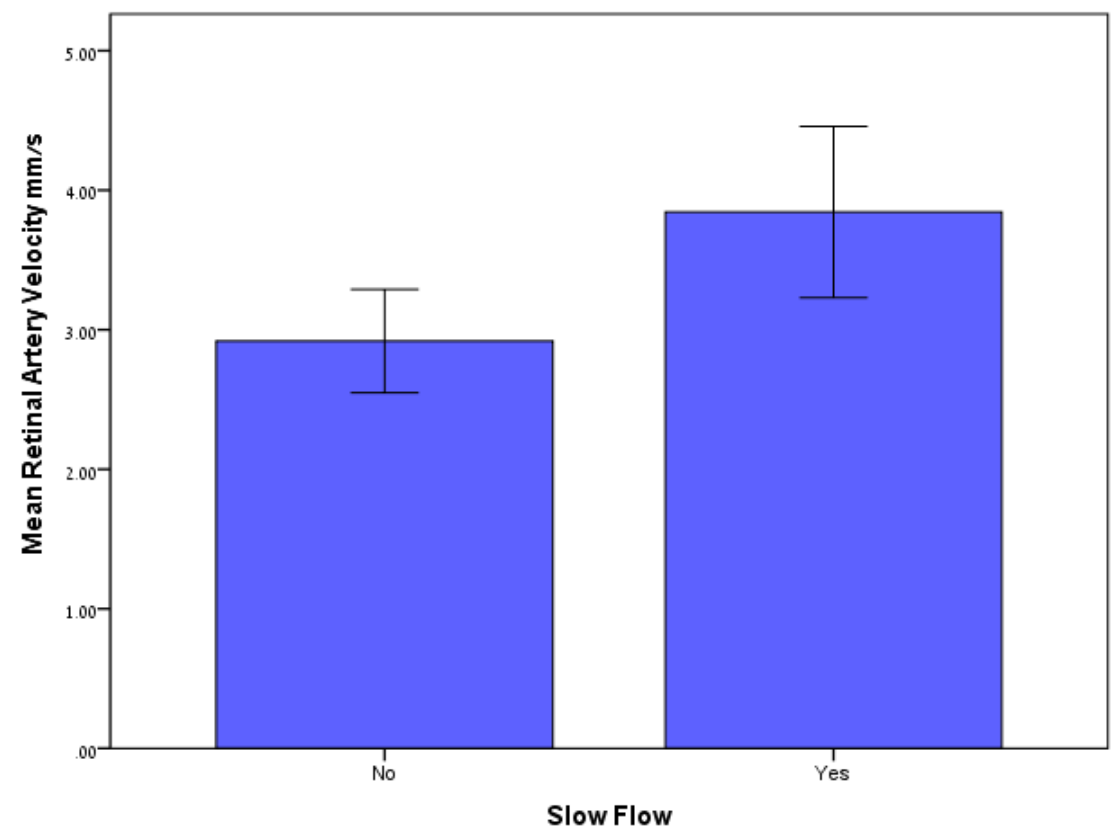


# SCF Vs. NCF

- Patients were divided to “slow coronary flow” (SCF) and “normal coronary flow” (NCF) subgroups
- The subdivision was according to values well established in the literature
- 13 patients were NCF and 15 SCF



# SCF Vs. NCF



**p = 0.022**

Error bars: 95% CI

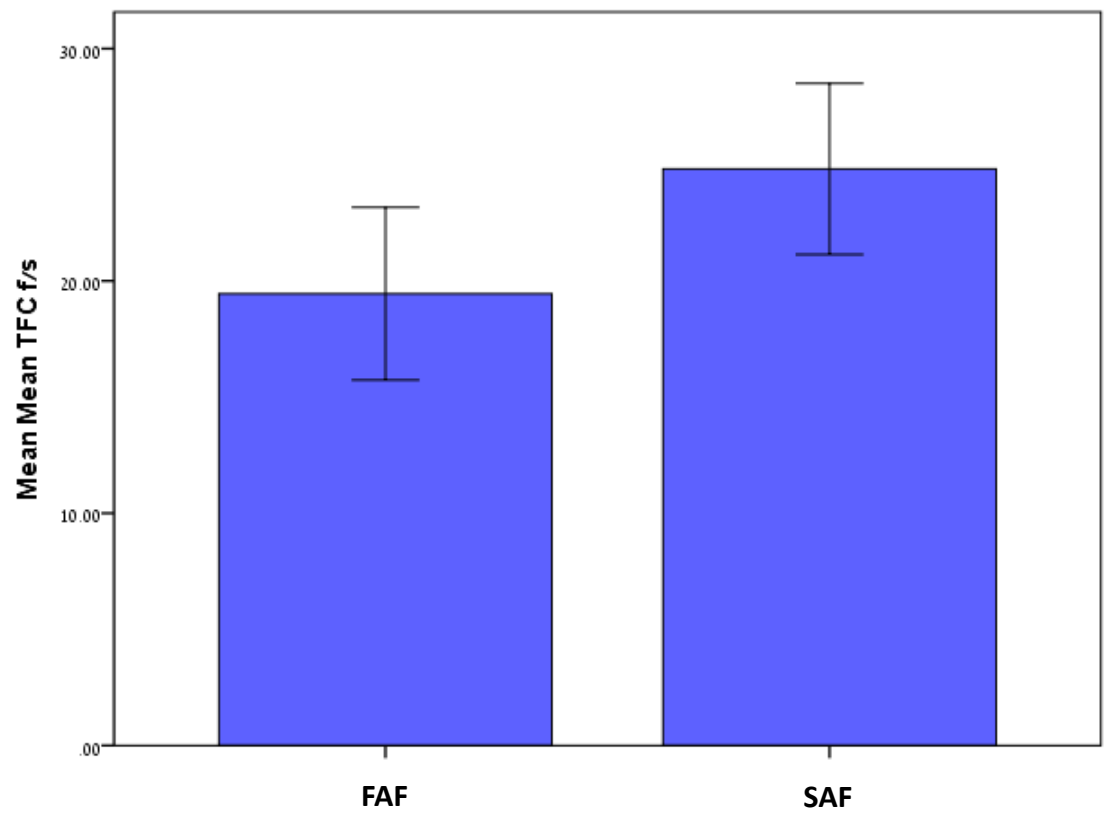


## SAF Vs. FAF

- We divided the patients according to the median retinal arterial flow velocity
- Half were considered as “Slow Arterial Flow” (SAF) and the other half “Fast Arterial Flow” (FAF)



# SAF Vs. FAF

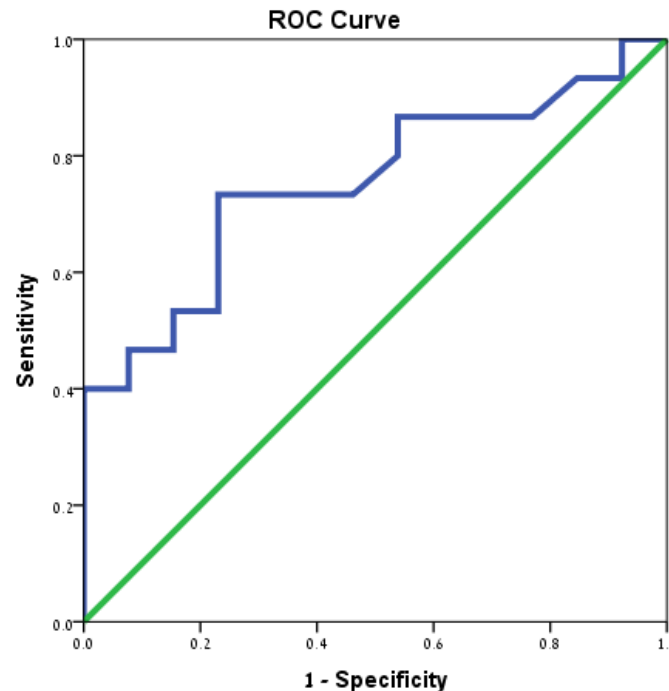


**p = 0.035**



# ROC Curve

- The ability of RFI to correctly diagnose SCF
- Cutoff 3.015 mm/sec showed 73.3% sensitivity and 76.9% specificity



$p = 0.02$

Diagonal segments are produced by ties.

Why?





# Discussion

- SCF strongly related to endothelial dysfunction
- Endothelial dysfunction
  - Increased vasoconstrictors
  - Reduced vasodilators
  - Calcification and hardening of blood vessels
- Reduces velocity in large vessels d/t endothelial dysfunction
- Increased velocity in microcirculation d/t hardening and reduced density (Bernoulli)

Coronary artery dis. 2003;14:155-161

N Engl J Med. 1993;328:1659-1664

Investigative ophthalmology & visual science 2012;53:7943-7949.

Retina 2012;32:112-119



# Conclusions

- Retinal arteriolar flow velocity as part of assessing AP patients
- Helps differentiate cardiac from non cardiac pain
- Easy, non-invasive follow up after response to treatments
- A larger research needed to establish connection



Thank You!



# Slow Coronary Flow

- CTFC above the mean +2 SD
  - LAD → 41 frames
  - RCA → 26 frames
  - LCX → 30 frames