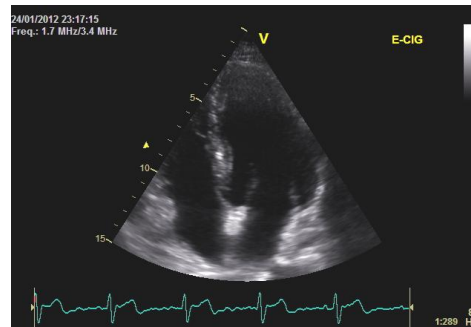




Vs.



## Acute effects of using an electronic nicotine-delivery device (e-cigarette) on myocardial function: comparison with the effects of regular cigarettes

K. Farsalinos, D. Tsiapras, S. Kyrzopoulos, M. Savvopoulou, E. Avramidou, D. Vassilopoulou, V. Voudris

Department of Cardiology, Onassis Cardiac Surgery Center, Athens, Greece

Director: V. Voudris

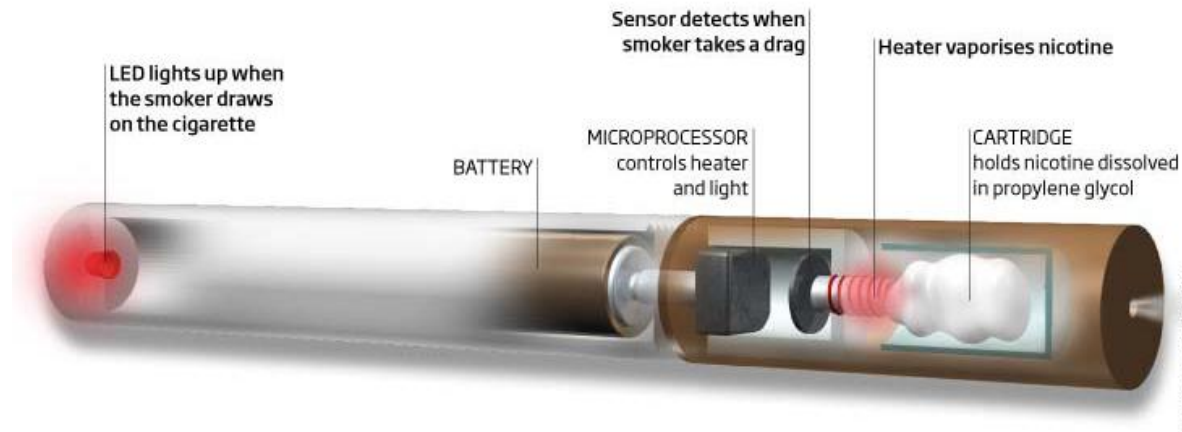


# Conflict of interest

All authors report no COI



# What is it?





# What is it?



## Liquid contents

- Glycerol
- Propylene glycol
- Flavorings
- Nicotine (optional)



# Why should we study it?

- Invented in 2003 by a Chinese pharmacist
- On the market for several years, as an alternative to cigarette smoking
- Several millions of people are using it
- Interesting characteristics: nicotine delivery, dealing with psychological addiction, no side-stream smoking
- Laboratory analysis showed that it contains no or traces of nitrosamines, no PAH
- WHO has asked for clinical studies to be performed, because these products should be regulated
- Regulation is imminent but no clinical studies to be based on

**CVD is an important cause of morbidity and mortality  
in smokers**



# Study protocol

## ◎ Background

Several studies have shown that acute smoking inhalation has adverse effects on myocardial function (Kyriakides et al, Eur Heart J 1992, Lichodziejewska et al, Chest 2007)

## ◎ Purpose

To study whether e-cigarette use has any immediate adverse effects on cardiac function compared to using tobacco cigarette.



# Study protocol

## ◎ Design

### Inclusion criteria

All subjects healthy, no risk factors for CVD

Smokers:  $\geq 5$  years smoking history,  $\geq 15$  cig/d

e-cigarette users:  $\geq 1$  month use, quit smoking

### Exclusion criteria

Medications, recent infection, echocardiographic findings of hypertrophy, dilatation and more than mild valve regurgitation



# Study protocol

## ◎ Design

4h abstinence from caffeine, food and smoking/e-cigarette use

Echocardiography: GE VIVID 7, EchoPac

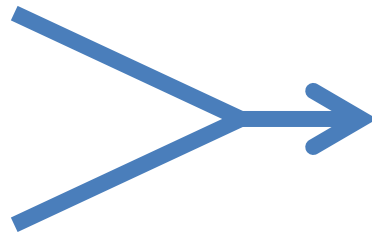
Cigarette used: 1mg nicotine, 10mg tar, 10mg CO

E-cigarette liquid used: 11mg/ml nicotine (**Nobacco**, USA MIX)

Smokers  
N=20

e-cigarette  
users  
N=22

(All had quit smoking for > 1 month)



Baseline  
echocardiogram

Second  
echocardiogram



- Smoking 1 cigarette (smokers)
- e-cigarette use for 7 minutes (e-cigarette users)

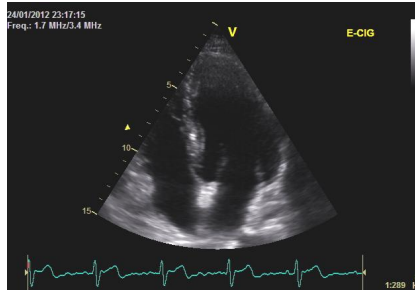




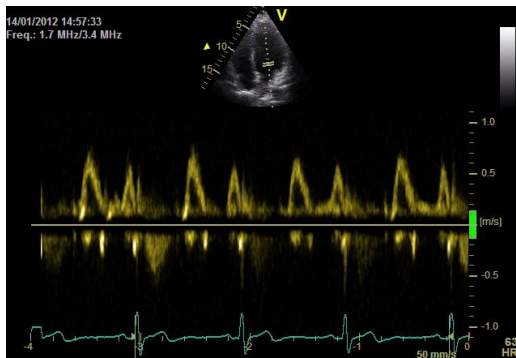


# Study protocol

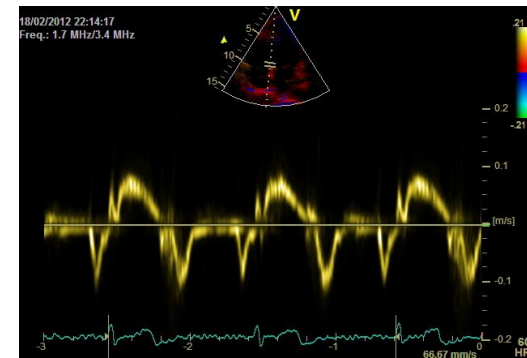
## ◎ Design



(LV volumes, LV mass, LA, LVEF)



(E, A, E/A, DT, IVRT, IVRTc)



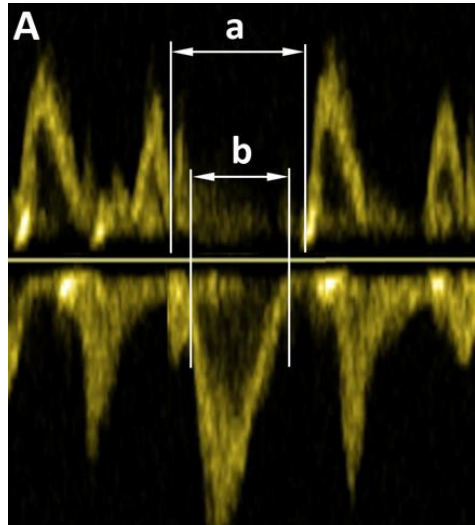
(Sm, Em, Am, Em/Am, E/Em)



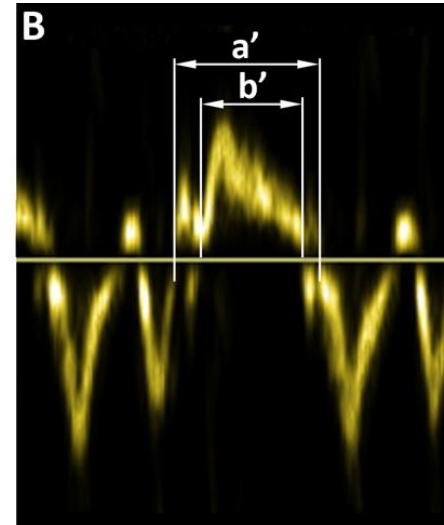
# Study protocol

## Design

$$\text{MPI} = (a-b)/b$$



$$\text{tMPI} = (a'-b')/b'$$



Myocardial Performance Index  
measured by Doppler flow (MPI) and  
tissue Doppler (tMPI)

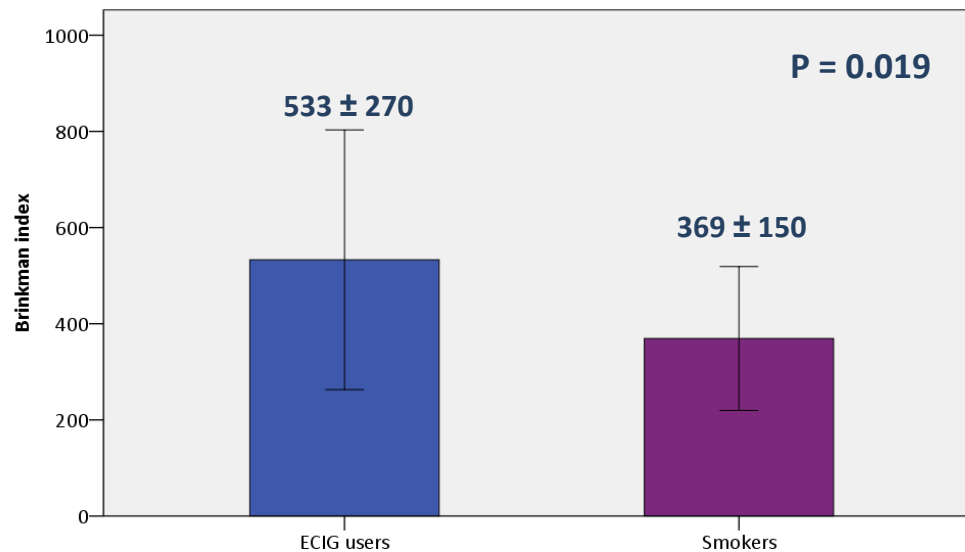


# Study protocol

## Results

Electronic cigarette users were previously heavy smokers ( $29 \pm 11$  vs.  $23 \pm 7$  cigs/d,  $P = 0.046$ )

They had quit smoking for  $93 \pm 65$  days, they were using the device for  $95 \pm 64$  days





# Study protocol

## Results

	Smokers (n=20)	ECIG users (n=22)	P-value
Age (years)	36 ± 5	36 ± 5	0.971
Body-mass index (kg/m <sup>2</sup> )	25.3 ± 2.5	26.5 ± 2.4	0.129
Body-surface area (m <sup>2</sup> )	2.02 ± 0.22	2.09 ± 0.15	0.292
Systolic BP (mmHg)	125 ± 10	127 ± 9	0.479
Diastolic BP (mmHg)	76 ± 6	77 ± 7	0.913
Heart rate (per minute)	67 ± 8	67 ± 9	0.915
LVEDV (ml)	115 ± 23	120 ± 22	0.459
LVESV (ml)	45 ± 8	47 ± 10	0.492
SV (ml)	70 ± 17	73 ± 14	0.497
Ejection fraction (%)	60 ± 4	61 ± 4	0.578
LAd	35 ± 4	34 ± 4	0.688
LAVi (ml/m <sup>2</sup> )	22 ± 5	20 ± 5	0.122
LVMi (g/m <sup>2</sup> )	63 ± 10	68 ± 13	0.154



# Study protocol

## Results

### Haemodynamic changes

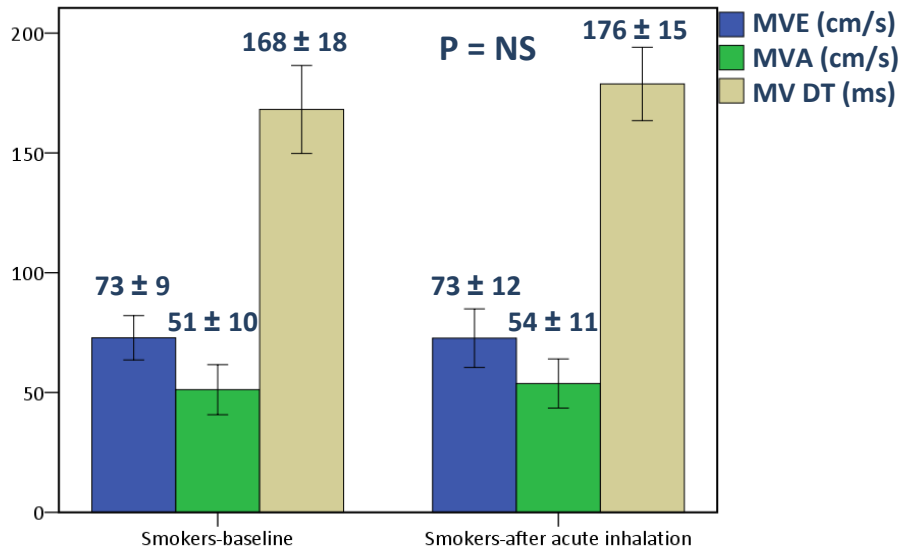
	Smokers (n=20)	ECIG users (n=22)	P-value (smokers intra-group)	P-value (ECIG users intra- group)	P-value (inter- group after inhalation)
SBP (mmHg)	135 ± 7	128 ± 10	< 0.001	0.433	0.028
DBP (mmHg)	80 ± 7	81 ± 6	< 0.001	0.001	0.57
HR bpm	74 ± 8	68 ± 10	< 0.001	0.245	0.055
Ejection fraction (%)	60 ± 4	62 ± 4	0.317	0.224	0.571

- Smoking increased SBP by 7.6%, DBP by 6.3% and HR by 10.4%
- ECIG use increased DBP by 4.4%

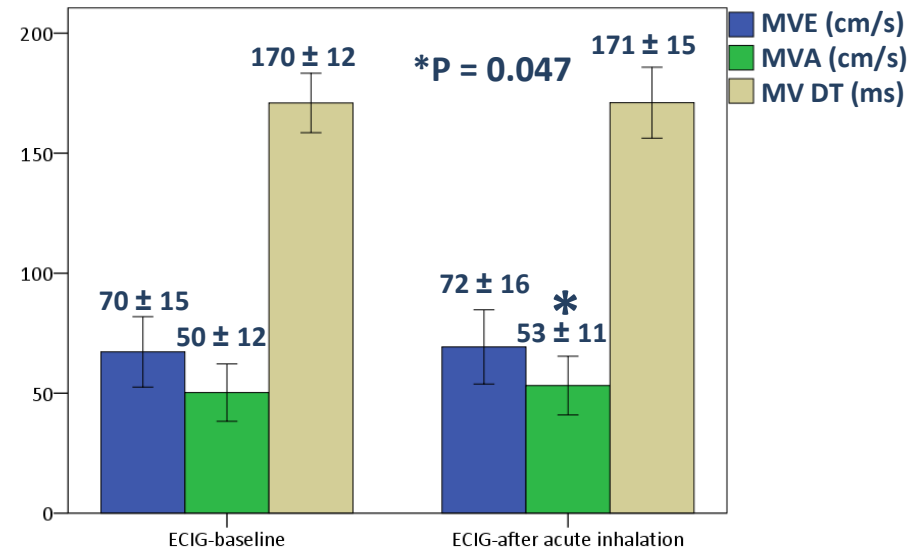


# Study protocol

## Results



$E/A = 1.48 \pm 0.35 \rightarrow E/A = 1.38 \pm 0.31$   
( $P = 0.026$ )



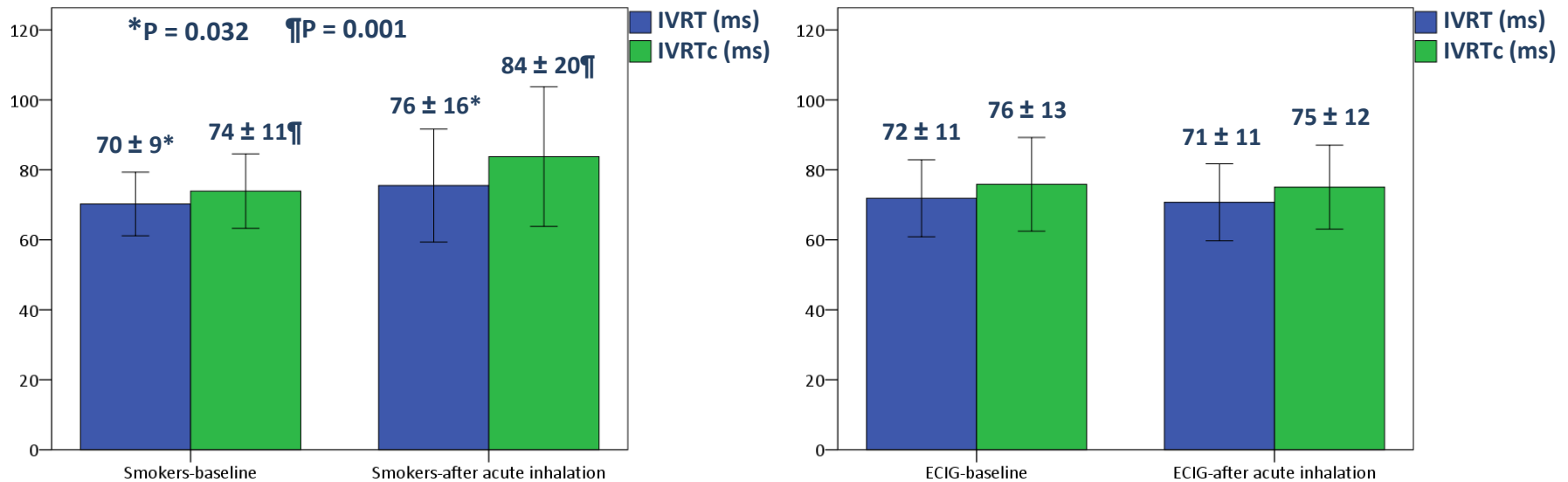
$E/A = 1.44 \pm 0.34 \rightarrow E/A = 1.38 \pm 0.31$   
( $P = 0.054$ )

Transmitral flow



# Study protocol

## Results

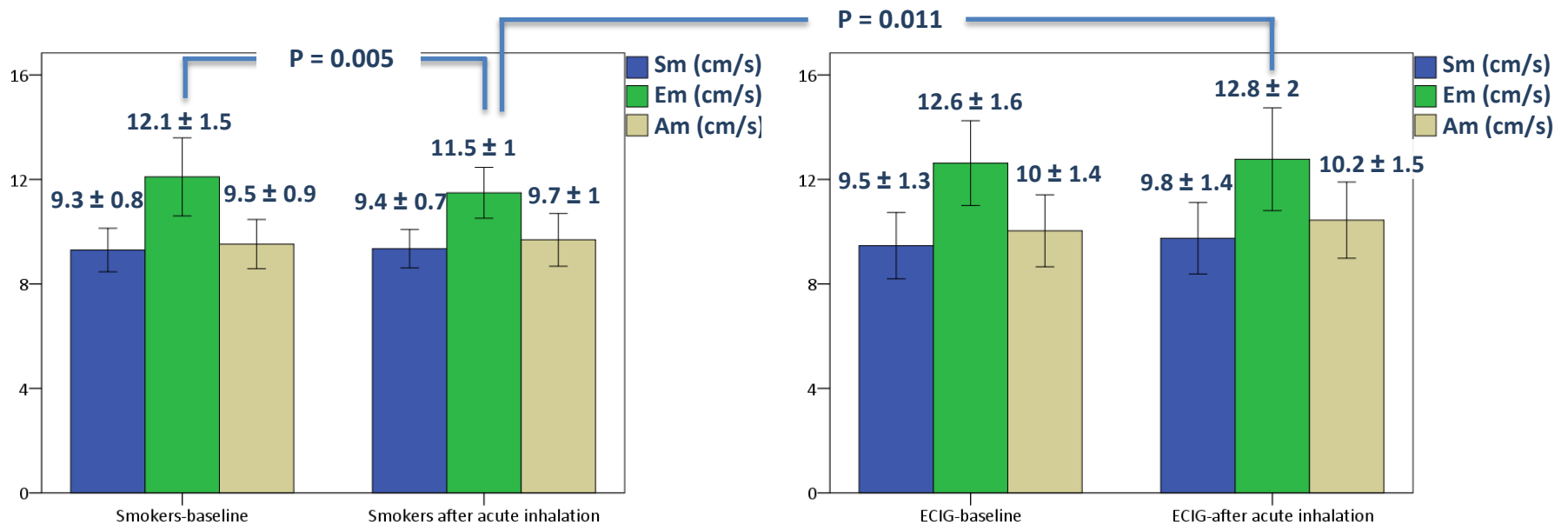


IVRT, IVTRc



# Study protocol

## Results



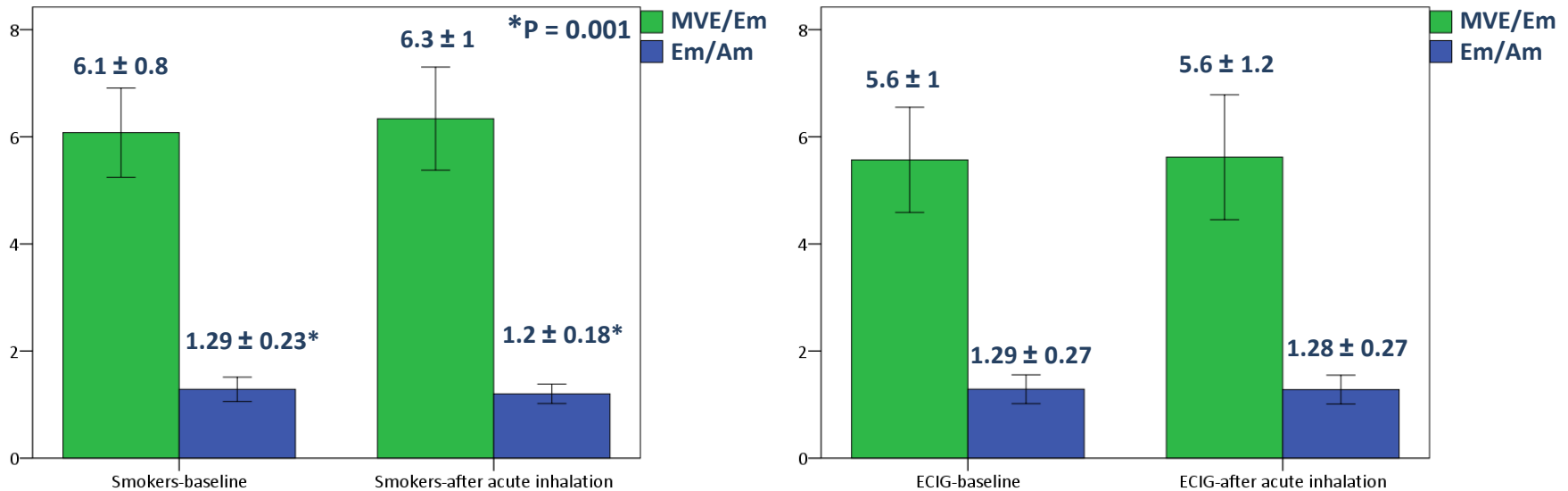
Mitral annulus velocities





# Study protocol

## Results

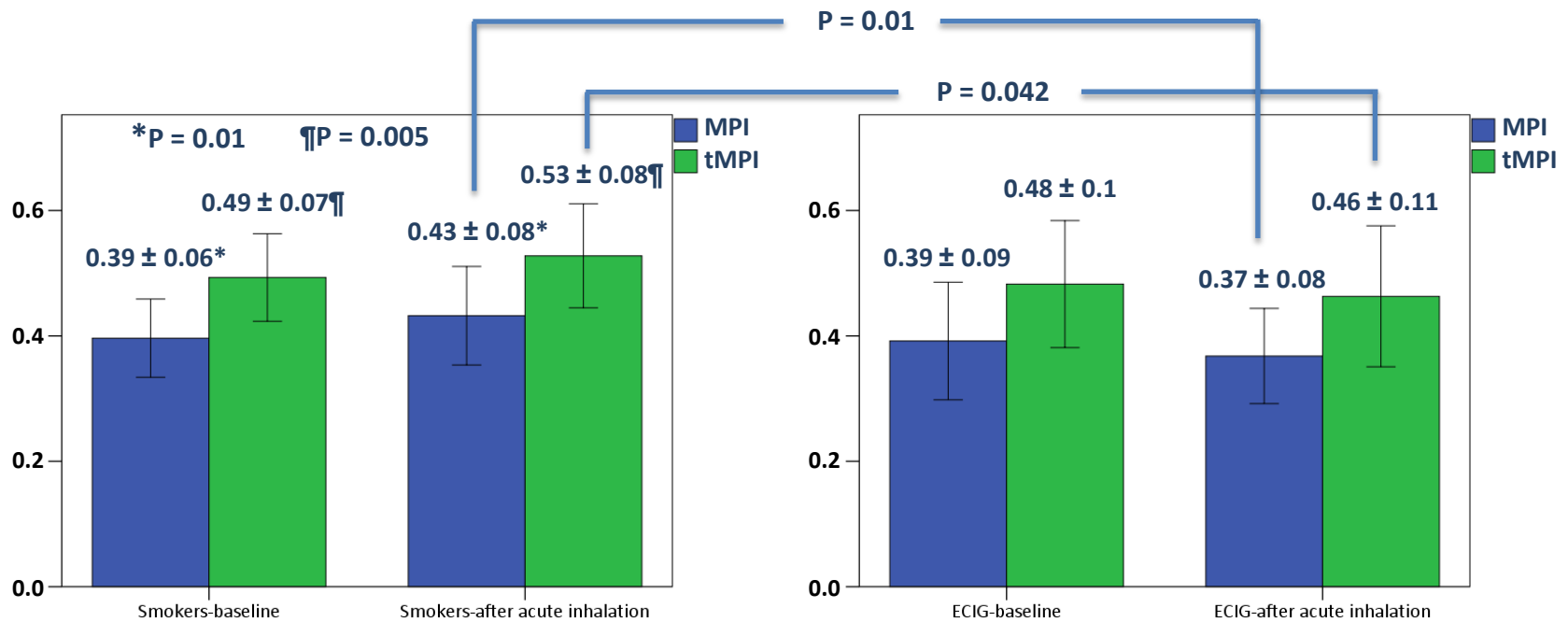


E/Em, Em/Am



# Study protocol

## Results



MPI, tMPI



# Smoking vs electronic cigarette

## ◎ Conclusions

Haemodynamics: greater elevation in BP and HR from smoking compared to ECIG, although we used liquid with nicotine concentration of 11mg/ml

Cardiac function: diastolic function acutely impaired in smokers, in accordance to previous studies

No difference in diastolic function observed in experienced ECIG users

### Potential mechanisms

Less nicotine absorbed (Bullen et al, Tob Control 2010)

Absence of combustion and different chemical composition, leading to less free radicals created and absorbed.

***THANK YOU***

