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THE EFFECT OF TRANSCATHETER AORTIC VALVE IMPLANTATION ON AORTIC STIFFNESS AND HEMODYNAMICS

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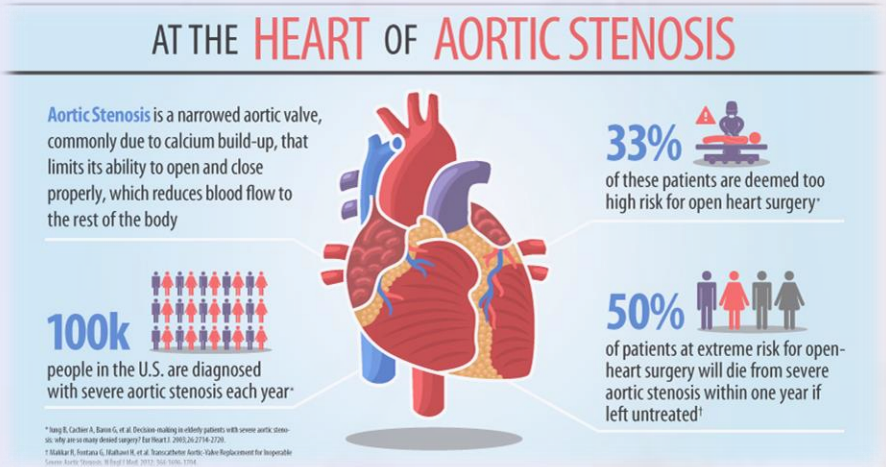
BACKGROUND
METHODS
RESULTS
CONCLUSIONS

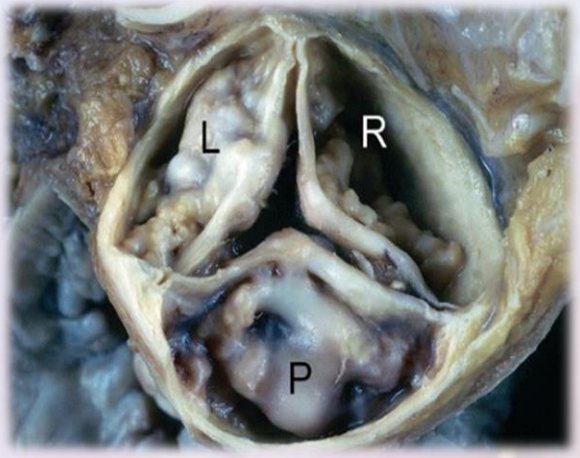

BACKGROUND

AORTIC STENOSIS

- The most common primary valve disease.
- Prevalence ↑ due to the ageing population, affecting 2-3% of individuals over 65 y.o.



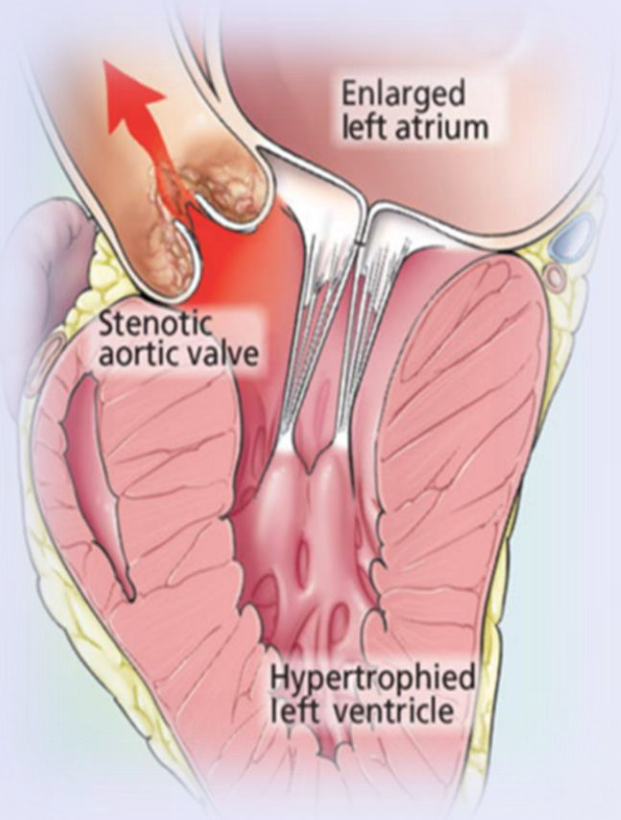
- Caused by:
  - ➢ Calcification →
    Calcific/ Degenerative/ Senile AS > 65 y.o.
  - ➢ Congenital abnormalities ≤ 65 y.o.
  - ➢ Post-inflammatory scarring

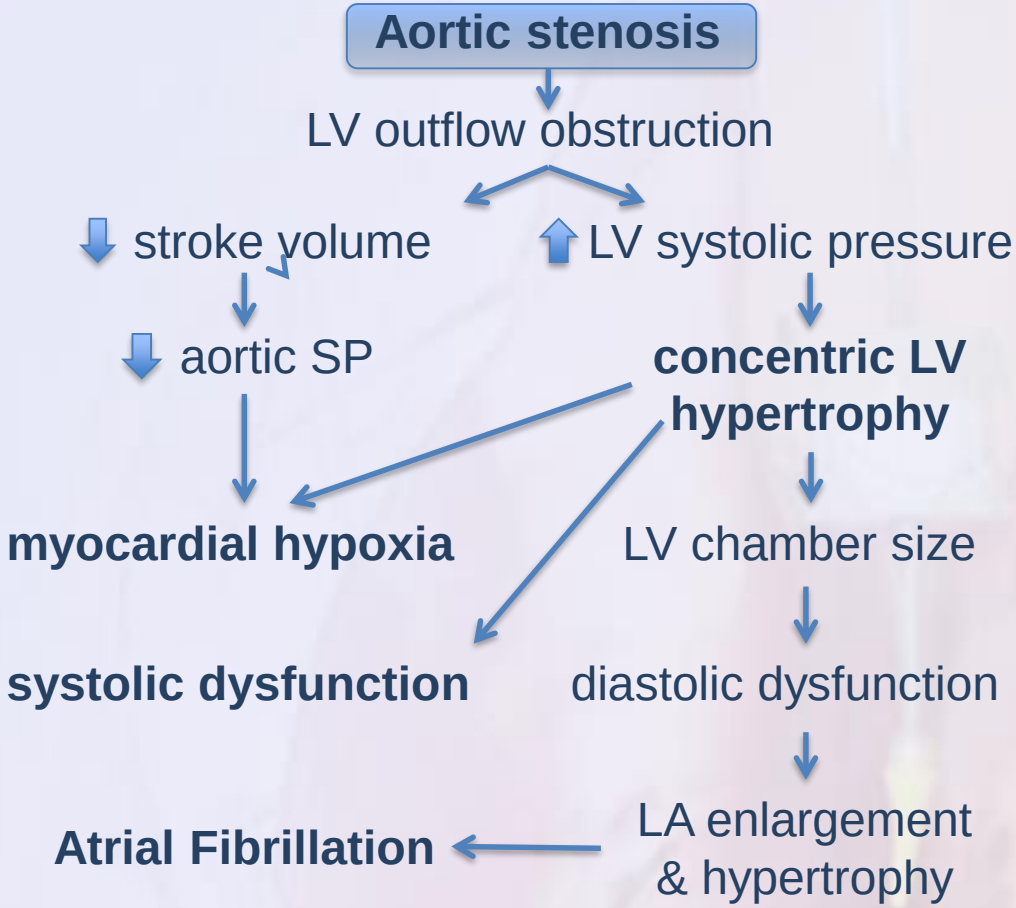


- Risk factors: similar to CAD

AORTIC STENOSIS

- It has detrimental effects on the cardiovascular system.



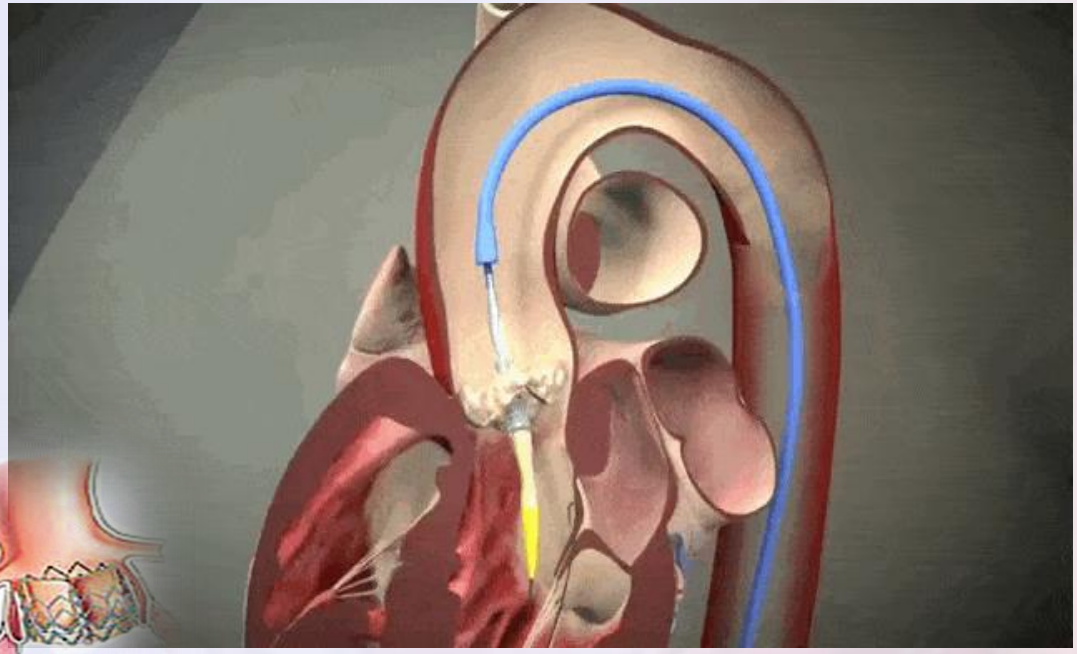


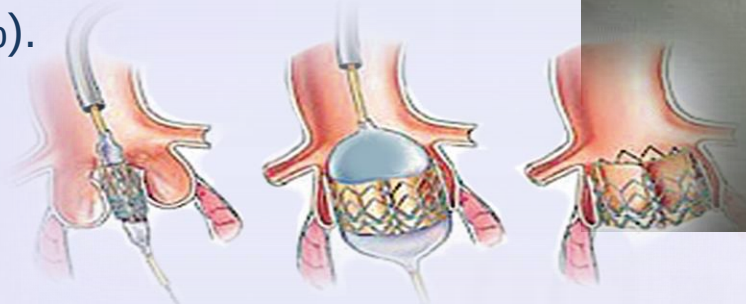
DIAGNOSIS AND TREATMENT

- Echocardiography is the key diagnostic and grading tool.

	Mild	Moderate	Severe
Peak velocity (m/s)	2.6 – 2.9	3.0 – 4.0	≥4.0
Mean gradient (mmHg)	< 20	20 – 40	≥40
AVA (cm^2)	>1.50	1.0 – 1.5	<1.0
Indexed AVA (cm^2/m^2)	>0.85	0.60 – 0.85	<0.6
Velocity ratio	>0.50	0.25 – 0.50	<0.25

- **Transcatheter Aortic Valve Implantation (TAVI)** is a promising new technique, implemented mainly on symptomatic, high-surgical risk patients (STS, EuroSCORE II > 4%).





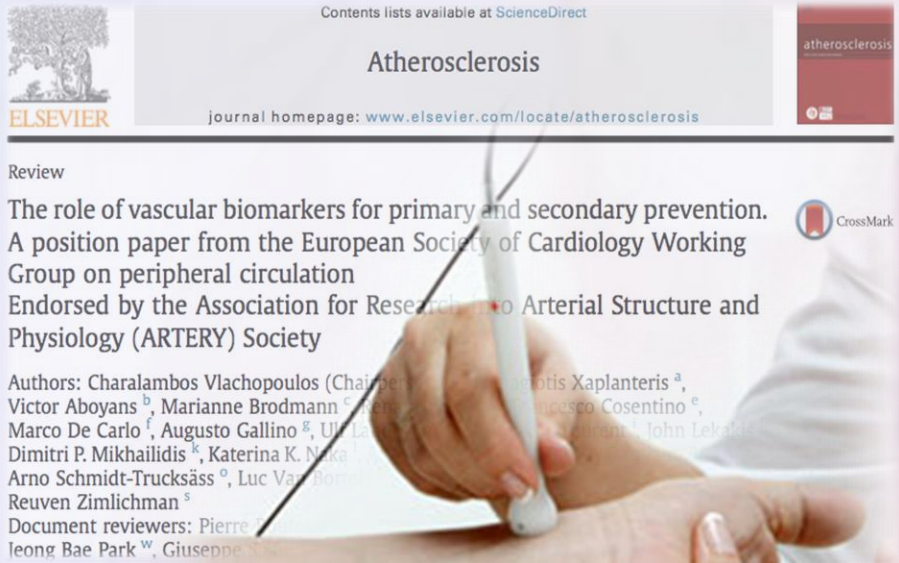
VASCULAR BIOMARKERS

- Reflect the cumulative impact of traditional risk factors on the arterial wall, in interaction with genetic background.

- Exhibit incremental predictive utility for future fatal and non-fatal cardiovascular events as well as all-cause mortality.

- **Carotid-femoral pulse wave velocity** (**cfPWV**) is the “gold standard” biomarker of aortic stiffness (IIa/A).

- **Brachial-ankle pulse wave velocity** (**baPWV**) and **central hemodynamics/wave reflections** provide additional information (IIb/B).

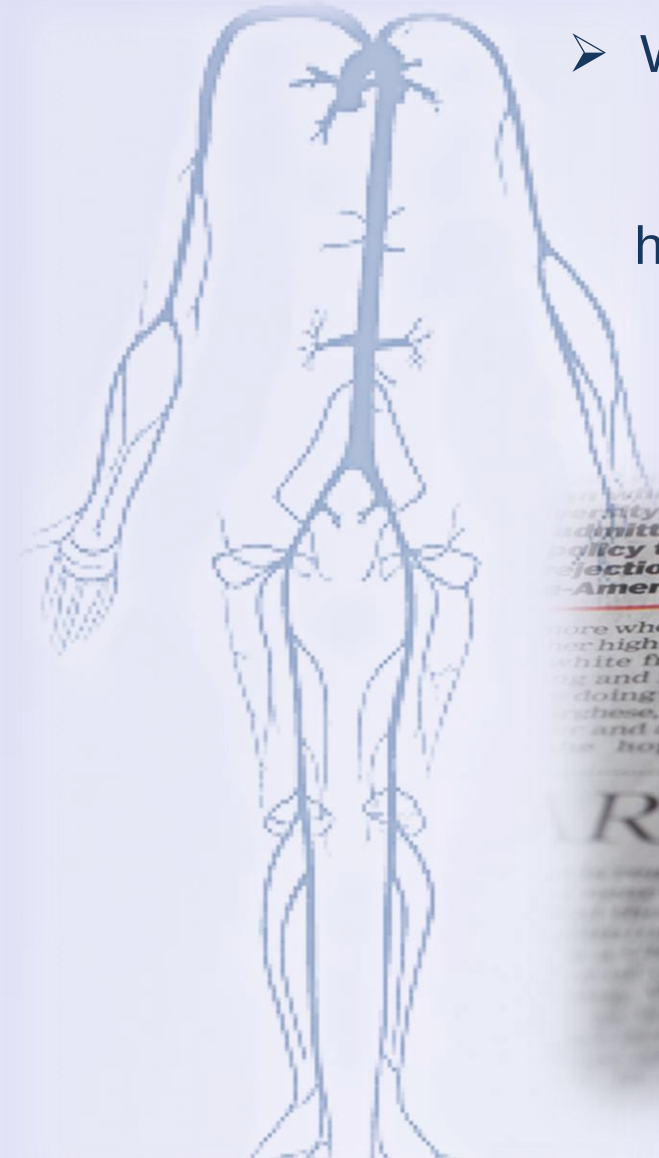


CURRENT KNOWLEDGE

AUTHOR	PATIENTS	AGE (years)	SEVERITY OF AORTIC STENOSIS	METHODS	DESIGN, FOLLOW-UP STAGES	INDICES	RESULTS	CONCLUSION
Vavura-nakis et al, 2012, Greece	n=30 (14 male)	79.9±4.7	AVA 0.61 ±0.16 cm^2 AVPG 83.8±26.5 mmHg AVMG 50.1±16.2 mmHg	M-mode Echocardio-graphy, Sphygmo-manometry, ECG recording	Cross-sectional: 2-3 days pre-procedurally, 7-8 days post-procedurally	SBP, DBP, MBP AD, ASI	SBP unchanged ↓ DBP, ↓ MBP AD, ASI unchanged	TAVI does not alter the elastic properties of the ascending aorta in the early post-procedural period.
Katsanos et al, 2013, Netherlands and Canada	n=116 (49% male)	81±8	Severe – AVA < 1.0cm^2 AVMG > 40mmHg	Transthoracic echocardio-graphy and simultaneous sphygmo-manometry for Systemic Arterial Compliance, Z_{va}, Systemic Vascular Resistance	Cross-sectional and prospective stage: pre-procedurally, 1 month post-procedurally, 12 months post-procedurally	SBP, DBP, MBP, PP, HR Zva, SAC, Systemic vascular resistance, NYHA class, LV indices	Post-procedurally ↓Zva SAC and systemic vascular resistance unchanged	The reduction of global LV pressure afterload after TAVI is mainly attributed to a significant increase in AVA and an associated decrease in pressure gradient, not to an improvement in systemic arterial or vascular compliance.
Vizzardi et al, 2014, Italy and Nether-lands	n=15 (6 male)	83 ± 5	Severe – AVPG 83±28 mmHg AVMG 49±19 mmHg	Transtho-racic echocardio-graphy, Sphygmo-manometry, ECG recording	Cross-sectional and prospective stage: pre-procedurally, 6 months post-procedurally, 12 months post-procedurally	SBP, DBP, MBP, AD, ASI	At 6 months: SBP, DBP, MBP unchanged, ↑AD, ↓ASI - At 12 months: no data for SBP, DBP, MBP, ↑AD, ↓ASI	Aortic elastic properties improve at 6 and 12 months after TAVI.
Musa et al, 2016, United Kingdom	n=72 (51 male) n_{TAVI}=32	76±8 - TAVI patients: 81±6.3 vs. 72.8± 7.0	Severe - AVA ≤1.0 cm^2	Transtho-racic echocardio-graphy, Transeso-phageal echocardio-graphy, Sphygmo-manometry, Cardiovascu-lar Magnetic Resonance (CMR)	Prospective: pre-procedurally, 6 months post-procedurally	Aortic distensi-bility(asc and desc aorta) PWV, Brachial SBP, DBP, MBP, PP, HR	6 mo post-op in TAVI: unchanged distensibility and PWV, PP unchanged ↓AVPG, AVMG ↓ Zva Improved LV function	The treatment of symptomatic severe aortic valve stenosis by TAVI was not associated with an increase in aortic stiffness.
Bruschi et al, 2017, Italy	n=30 (15 male) n_{TAVI}= 15	79.3±6.3	Severe - TAVI patients: AVPG 86.5 mmHg AVMG 52.1 mmHg	Transtho-racic echocardio-graphy, Sphygmo-manometry, Pulse wave assessment	Cross-sectional: Pre-procedurally, 1 week post-procedurally	PWV, SBP, DBP, MBP, PP, HR, AVMG, AVPG, LVEF	PWV unchanged, LVEF unchanged, ↓SBP, ↓DBP, ↓MBP ↓AVMG, AVPG	Aortic stiffness, as assessed by PWV, does not seem to change in the early post-procedural period of TAVI.

- Little research has been conducted so far on the effects of TAVI on the elastic properties of the aorta.
- The findings for aortic stiffness so far are ambiguous. The majority of studies show no change in aortic stiffness measurement after the procedure.

AIM OF THE STUDY



- We sought to investigate the effect that the repair of severe AS by TAVI has on the elastic properties of the aorta and central hemodynamics, using robust vascular biomarkers with proven predictive value, as well as novel ones.


METHODS

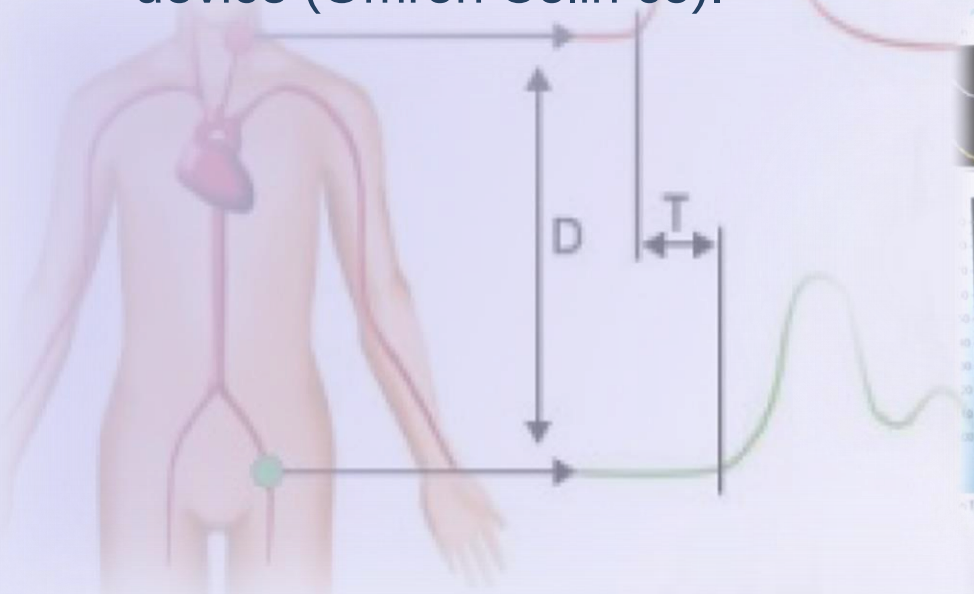
STUDY POPULATION AND DESIGN

- We performed an observational study.
- 67 patients with severe symptomatic aortic stenosis scheduled for TAVI visited our unit on 2 different occasions.

- Measurements were performed before TAVI (pre) and prior to discharge (post), according to the standardized conditions to avoid physiological confounders.

MEASUREMENT OF AORTIC STIFFNESS

- Carotid-femoral PWV was calculated with a validated noninvasive device (Complior, Artech Medical).
- Central hemodynamics and wave reflections were measured (SphygmoCor; AtCor).
- Brachial-ankle PWV and ABI were measured with an oscillometric device (Omron Colin co).




RESULTS

RESULTS

- The 67 patients fulfilled the criteria for TAVI and underwent the procedure in the Department of Cardiology of Hippokration Hospital.

➢ **Baseline characteristics and CV risk factors**

Age (years)	80.49 ± 8
Male gender, n (%)	31 (46.3)
EuroSCORE (%)	24.65 ± 9.7
BMI	26.89 ± 4.17
Cigarette smoking, n (%)	5 (7.46)
Systolic BP (mmHg)	145.83 ± 20.6
Diastolic BP (mmHg)	73.35 ± 11.4
Pulse Pressure (mmHg)	72.48 ± 19.44
Mean BP (mmHg)	100.05 ± 13.41
Hypertension, n (%)	50 (74.63)
NYHA class III-IV, n (%)	64 (95.5)
CAD, n (%)	25 (37.31)
Stroke/TIA, n (%)	5 (7.46)
Diabetes Mellitus, n (%)	17 (25.37)
Dyslipidemia, n (%)	33 (49.25)
Peripheral Artery Disease, n (%)	9 (13.43)
Chronic Kidney Disease, n (%)	9 (13.43)

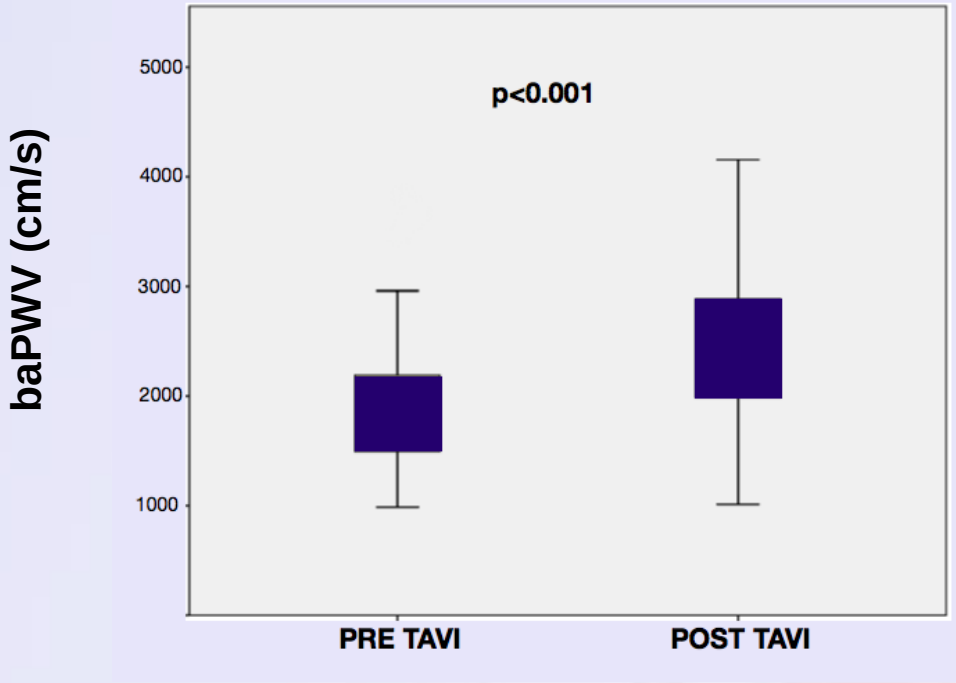
➢ **Baseline echocardiographic study and vascular biomarkers**

AVA (cm^2)	0.65 ± 0.15
Indexed AVA (cm^2/m^2)	0.36 ± 0.07
Mean Pressure Gradient (mmHg)	50.14 ± 12.86
LVEF (%)	51.3 ± 8.97
LV Hypertrophy, n (%)	9 (13.43)
Aortic Systolic BP (mmHg)	135.23 ± 20.035
Aortic Diastolic BP (mmHg)	75.32 ± 10.87
Aortic Mean BP (mmHg)	100.43 ± 13.19
AIx (%)	37.06 ± 11.23
AIx@75 (%)	35.05 ± 12.07
cfPWV (m/s)	7.73 ± 1.48
baPWV (cm/s)	1870.65 ± 534.67
ABI	0.93 ± 0.18

RESULTS

- Comparing the results after the procedure with the baseline measurements, a statistically significant increase in measurements of arterial stiffness was observed.

  - **cfPWV**: 7.7 ± 1.5 m/s vs. 8.3 ± 1.85 m/s (p=0.006)
  - **baPWV**: 1870.7 ± 534.7 cm/s vs. 2449.5 ± 646 cm/s (p<0.001)

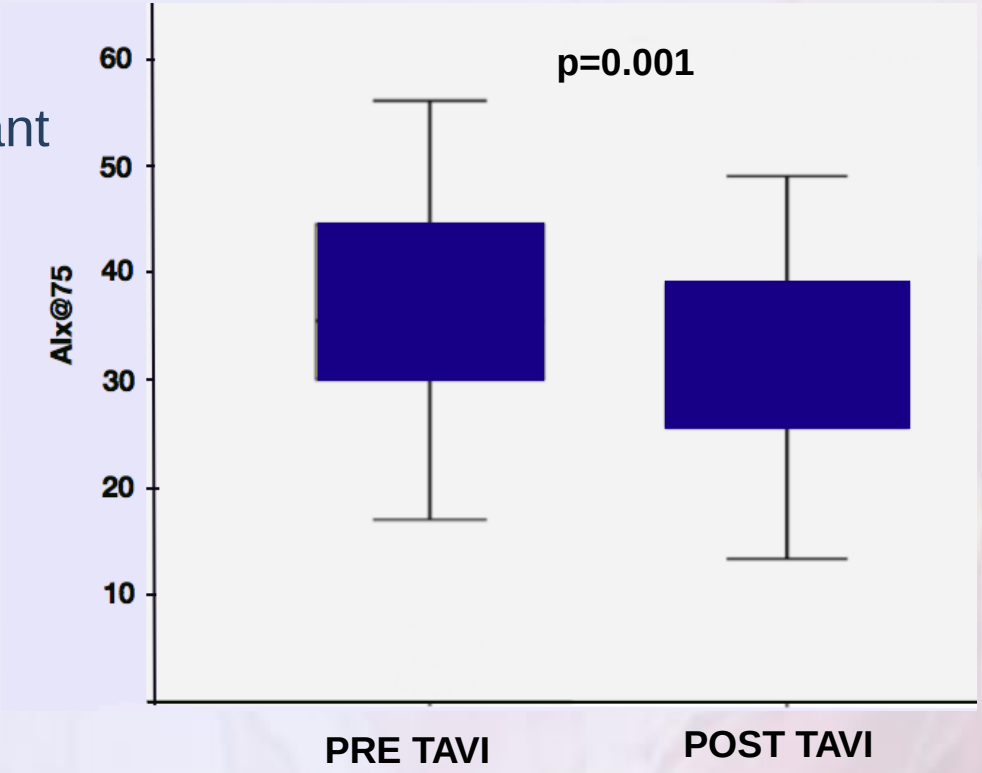


RESULTS

- At the same time, a statistically significant decrease in wave reflections was observed:

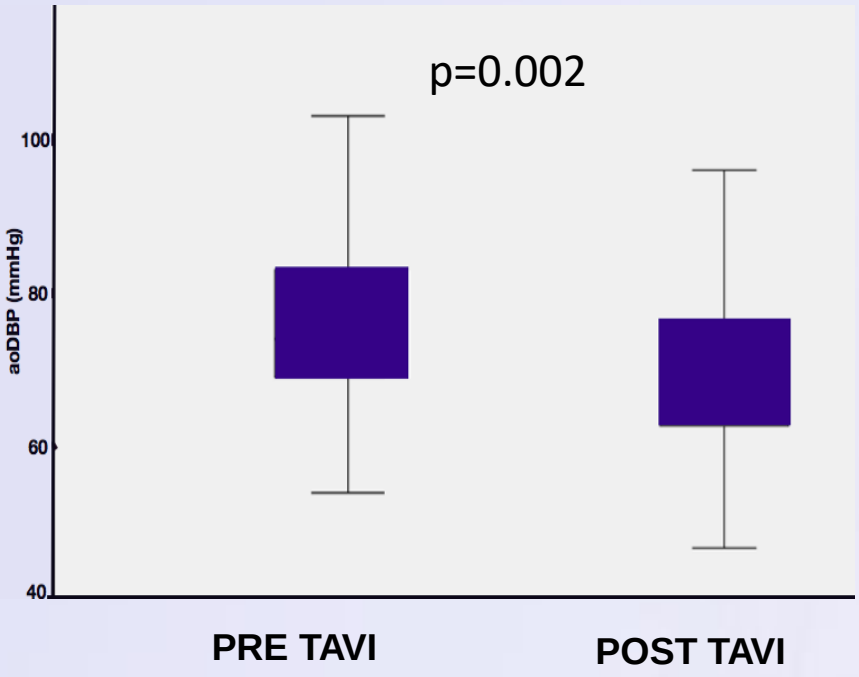
➢ **AIx:** 37.60 ± 11.17 % vs. 27.96 ± 8.9 % (p=0.001)
➢ **AIx@75**: 35.05 ± 12.07 % vs. 28.74 ± 8.44 % (p=0.001)

- There was also a significant increase in **SEVR** (125 ± 28 % vs. 139 ± 39 % , p=0.008).



RESULTS

- As far as central pressures are concerned, we observed:
  - a non-significant decrease in aoSBP:
    135.2 ± 20 mmHg vs. 131.5 ± 20.3 mmHg
  - a significant decrease in aoDBP:
    75.3 ± 10.9 mmHg vs. 71.4 ± 12 mmHg (p=0.002)



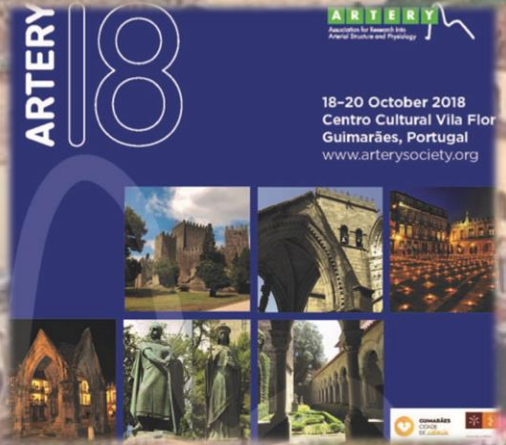
- Peripheral blood pressures:
  - SBP did not increase significantly:146±21 mmHg vs.148±21 mmHg
  - PP increased significantly:
    73 ± 19 mmHg vs. 78 ± 16 mmHg (p=0.047)
  - DBP decreased significantly:
    73 ± 12 mmHg vs. 70 ± 11 mmHg (p=0.05)


CONCLUSIONS

CONCLUSIONS

- Patients with aortic valve stenosis:
  - present initially with lower than expected baseline values of arterial stiffness indices, probably due to the dampening of the pulse wave through the stenotic valve.
  - post-procedurally in the acute phase they exhibit an increase in measurements of arterial stiffness, accompanied by an improvement of wave reflections. Despite the observed decrease in SBP, aortic stiffness seems to be “unmasked” after the relief of the LV outflow obstruction.
  - The decrease of Aix indicating improvement of wave reflections could reflect a response of peripheral vasodilation to the acute hemodynamic changes after TAVI.
- Our findings on the short-term hemodynamic results of this promising method of aortic valve repair could contribute to future decision-making about the treatment of AVS, assisting both in risk-stratification and in the follow-up of these patients.

Thank you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