Aorta stenosis

Temesvári András

Aorta stenosis, a probléma jelentősége

- A 65 év feletti emberek 25%-nak megvastagodott az aorta billentyűje
- 75 év felett 3%-nak súlyos aorta stenosisa van
- Időskorban a leggyakoribb billentyűhiba, amely műtétet igényel (EHS 2004)
- GOKI évi 238 aorta/308 billentyű műtét (77%)
- Mortalitás 2010-ben: 2,5%

Kiemelt témák

- Mi határozza meg az aorta stenosis súlyosságát
- Stress echocardiográfia jelentősége
- Percutan aorta billentyű beültetés szempontjai

Aorta stenosis

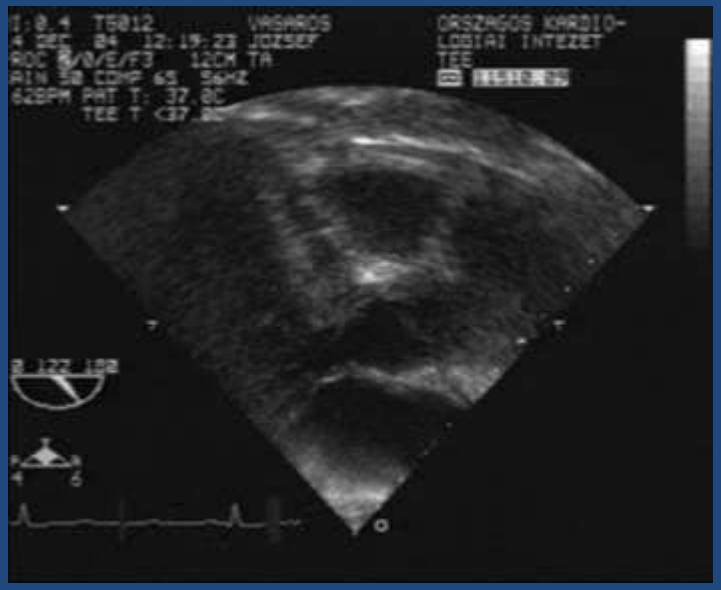
Localisatio szerint:

- Valvularis
- Subvalvularis
- Supravalvularis

Aetiologia szerint:

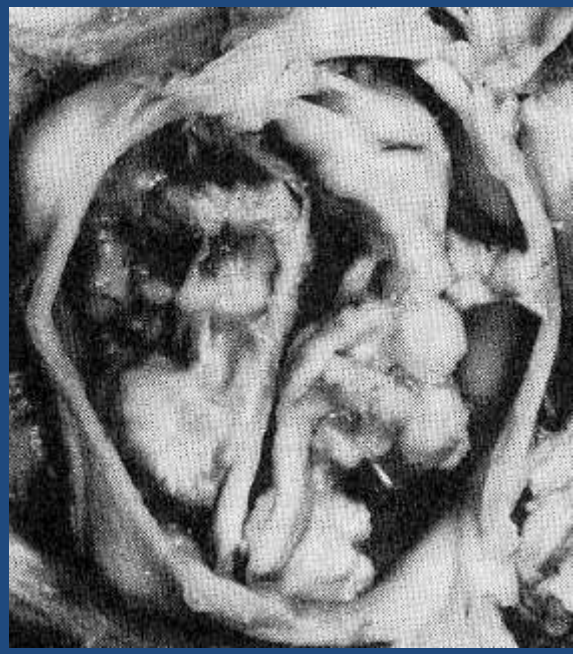
- Congenitális
- Reumás
- Degenerativ

Subaorticus stenosis

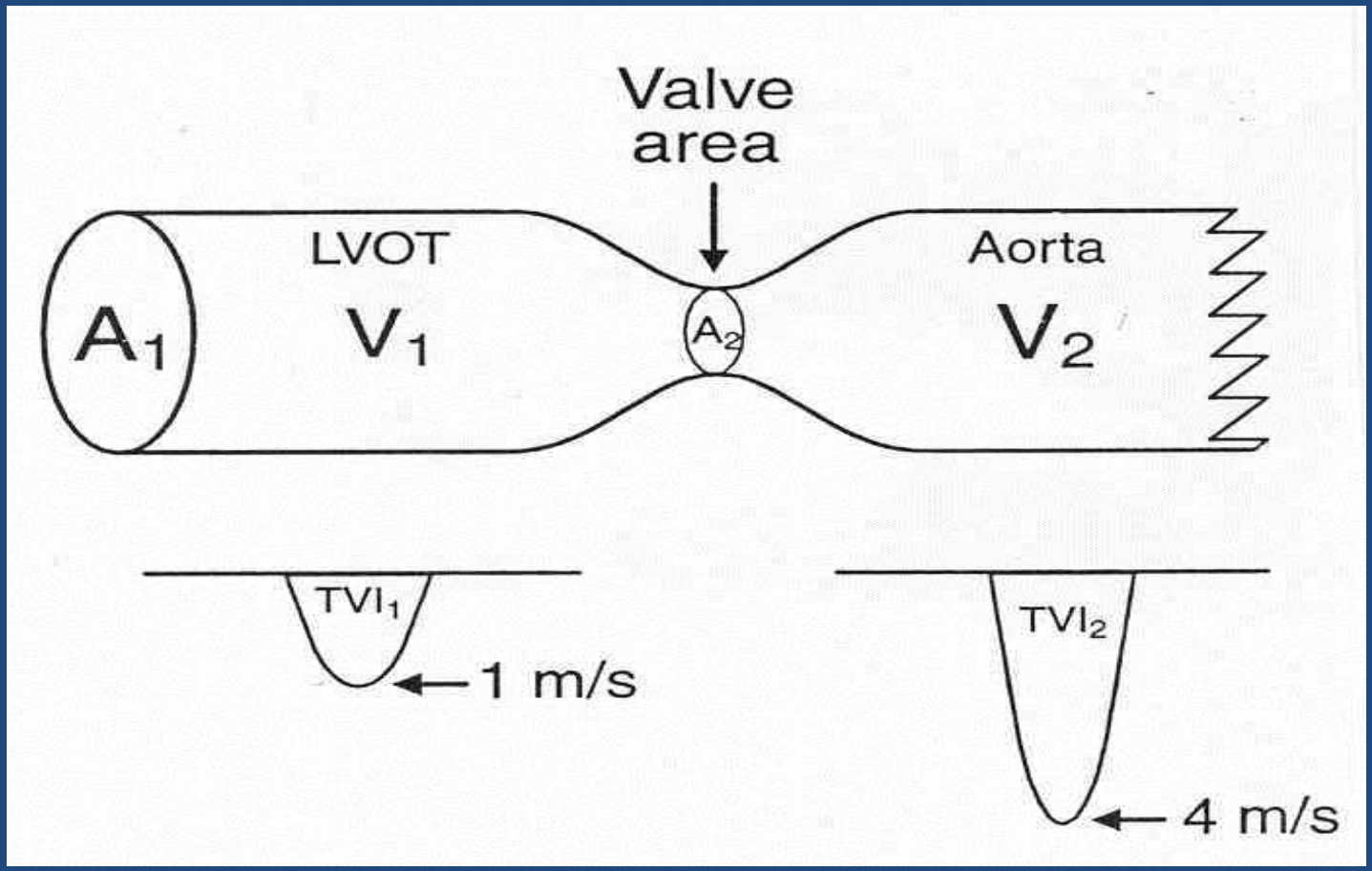


Supravalvularis stenosis

Az aorta stenosis mechanizmusai

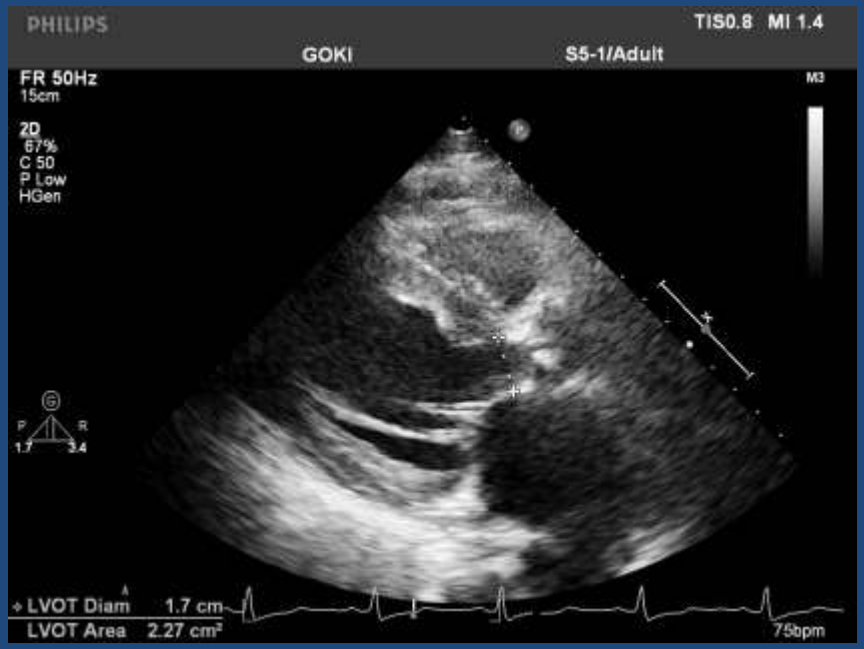


Area számítás

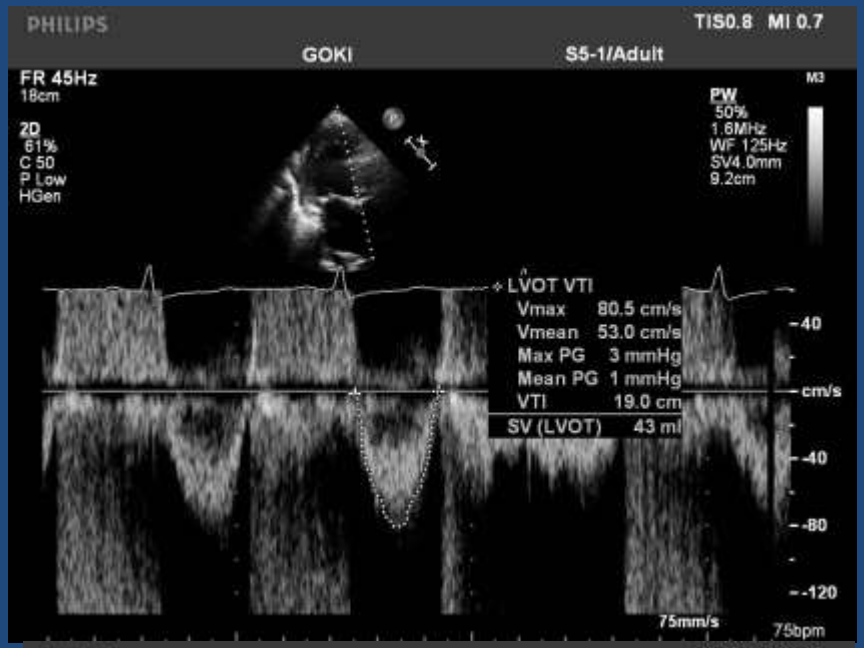


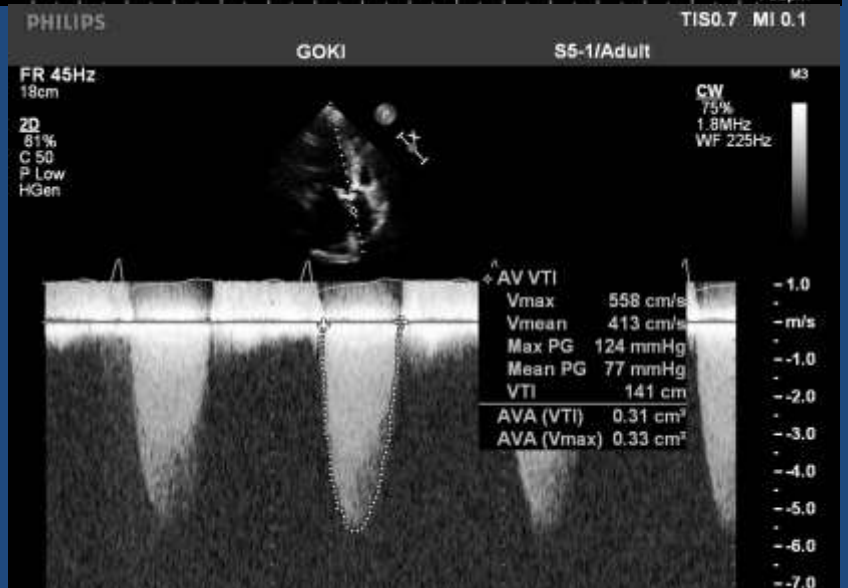
Area mérés

LVOT



LVOT sebesség integrál, AS sebesség integrál





1. Műtéti indikáció: Súlyos aorta stenosis

- Grádiens grádiens legyen nagyobb 40 (50) hgmm-nél
- Area legyen kisebb 1 cm2-nél
- Milyen a bal kamra systolés functio (EF)?
- Milyen a perctérfogat (verővolumen)?

Melyik a fontosabb: grádiens vagy area?

Lehet-e jó systolés functio (EF) mellett csökkent verővolumen (áramlás)?

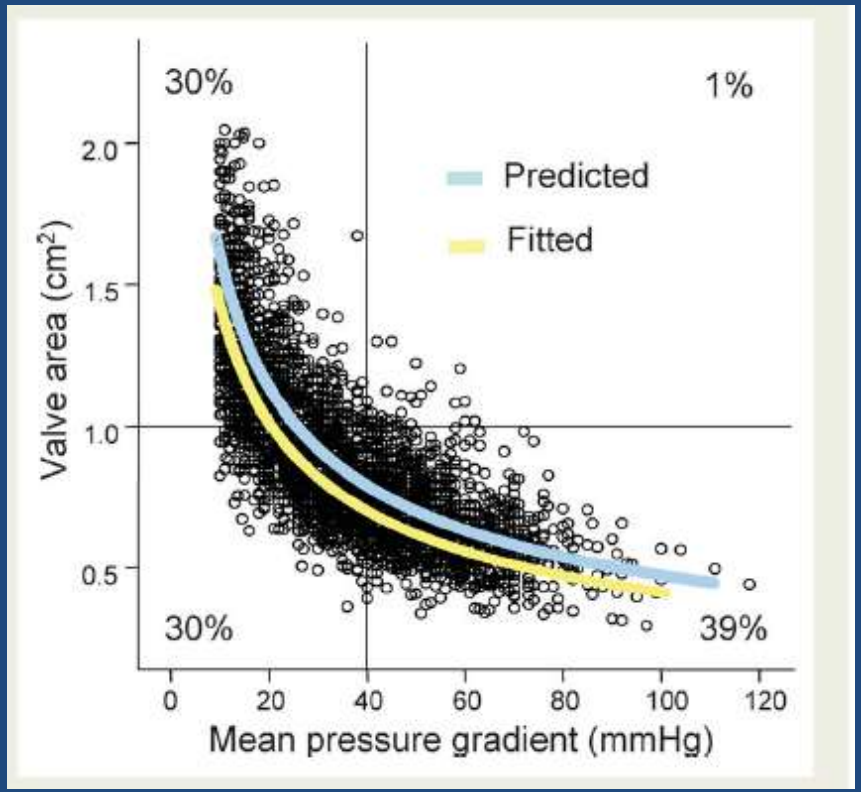
Aorta billentyű area (AVA) és átlagos grádiens viszonya

Table I Relation of the aortic valve area to the gradient

Aortic valve area (cm^2)	Mean gradient (mmHg)
4	1.7
3	2.9
2	6.6
1	26
0.9	32
0.8	41
0.7	53
0.6	73
0.5	105

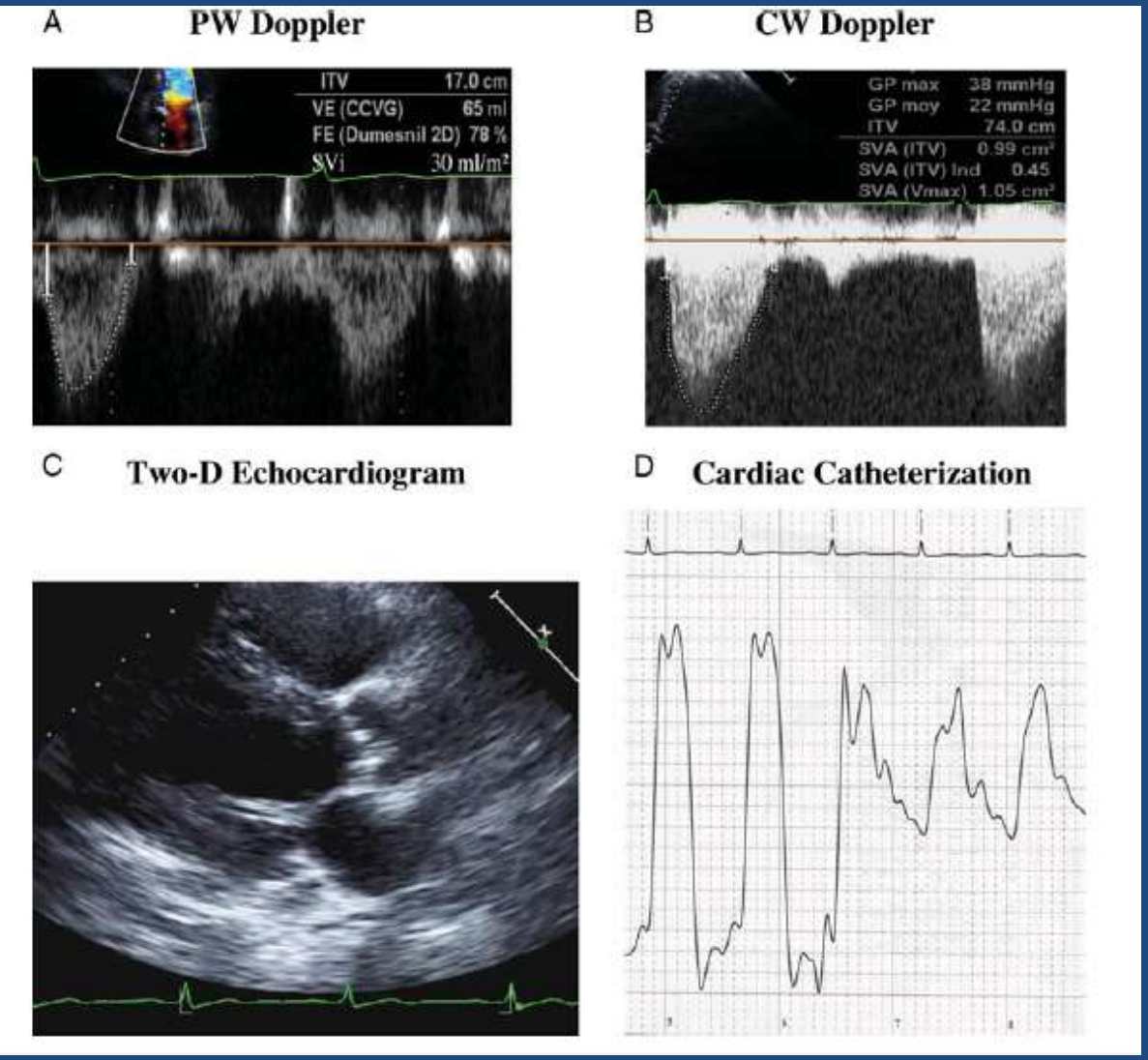
Reproduced with permission from Carabello[4]. Data were derived with the Gorlin formula:

$$\text{Aortic valve area} = \frac{\text{cardiac output} \div (\text{systolic ejection period} \times \text{heart rate})}{44.3\sqrt{\text{mean gradient}}}$$



Circulation. 2007;115:2856-2864.

Index eset



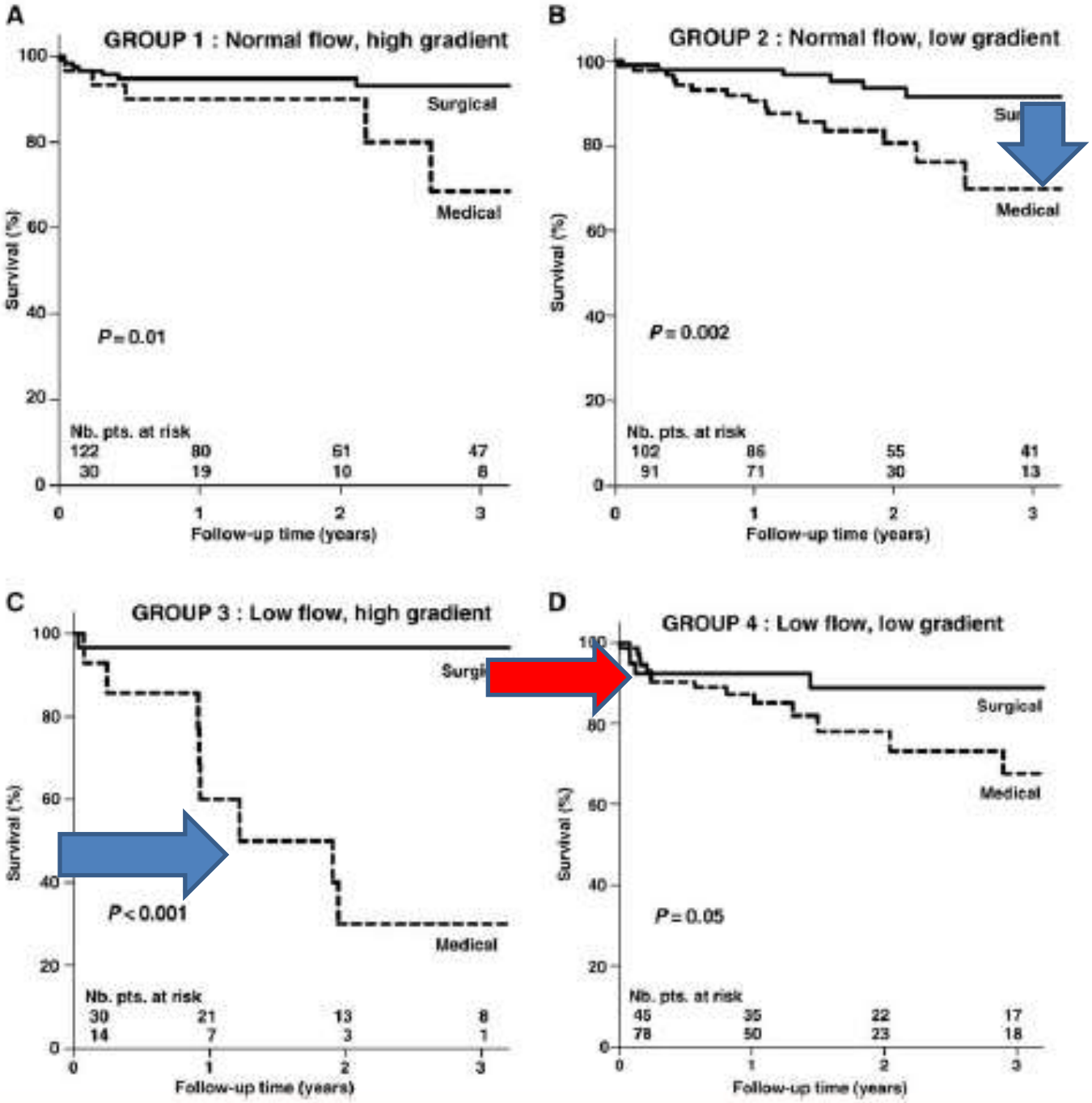
Hypertrofiás bal kamra
Jó EF: 78%
Jelentősen emelkedett
Bal kamrai végdiastolés
Nyomás (35Hgmm)
Hypertonia

European Heart Journal (2010) **31**, 281–289

Ind?

Group 1 **'Normal flow, high gradient'** SVi > 35 mL/m² Gradient > 40 mmHg *n* = 152 (30%) Indexed AVA = 0.4±0.1 cm²/m² LVEDD = 48±5 mm LVEDVI = 59±13 mL/m² Z_{va} = 4.2±0.8 mmHg/mL/m² AVR = 80%	**Group 2** **'Normal flow, low gradient'** SVi > 35 mL/m² Gradient ≤ 40 mmHg *n* = 193 (38%) Indexed AVA = 0.5±0.1 cm²/m² LVEDD = 48±5 mm LVEDVI = 58±13 mL/m² Z_{va} = 4.0±0.6 mmHg/mL/m² AVR = 53%
Group 3 **'Low flow, high gradient'** SVi ≤ 35 mL/m² Gradient > 40 mmHg *n* = 44 (8 %) Indexed AVA = 0.3±0.1 cm²/m² LVEDD = 43±5 mm LVEDVI = 48±12 mL/m² Z_{va} = 6.0±1.2 mmHg/mL/m² AVR = 68%	**Group 4** **'Low flow, low gradient'** SVi ≤ 35 mL/m² Gradient ≤ 40 mmHg *n* = 123 (24%) Indexed AVA = 0.5±0.1 cm²/m² LVEDD = 46±5 mm LVEDVI = 53±11 mL/m² Z_{va} = 5.2±1.3 mmHg/mL/m² AVR = 36%

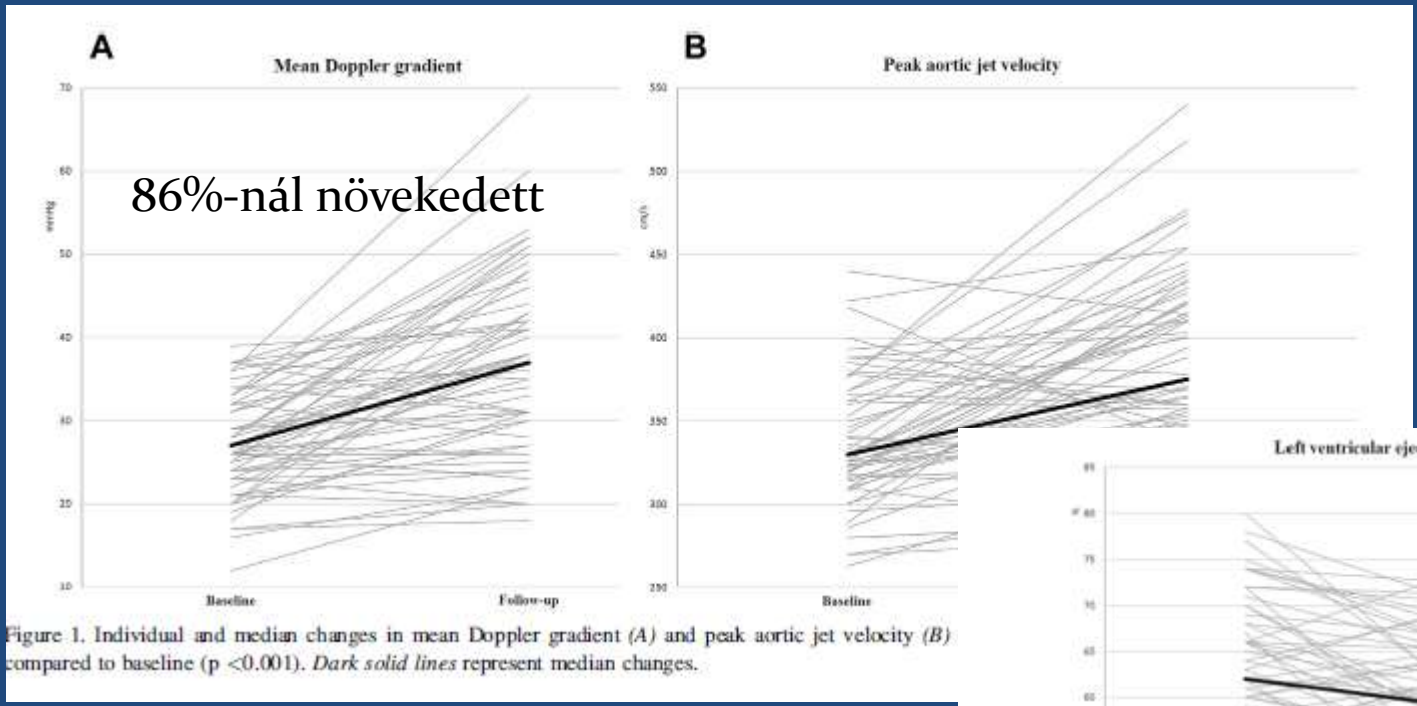
European Heart Journal (2010) **31**, 281–289


A
GROUP 1 : Normal flow, high gradient
Surgical
Medical
P = 0.01
Nb. pts. at risk
122 80 61 47
30 19 10 6
Survival (%)
Follow-up time (years)
B
GROUP 2 : Normal flow, low gradient
Medical
P = 0.002
Nb. pts. at risk
102 86 55 41
91 71 30 13
Survival (%)
Follow-up time (years)
C
GROUP 3 : Low flow, high gradient
P < 0.001
Medical
Nb. pts. at risk
30 21 13 8
14 7 3 1
Survival (%)
Follow-up time (years)
D
GROUP 4 : Low flow, low gradient
Surgical
Medical
P = 0.05
Nb. pts. at risk
45 35 22 17
78 50 23 18
Survival (%)
Follow-up time (years)

Mi lehet a mechanizmusa?

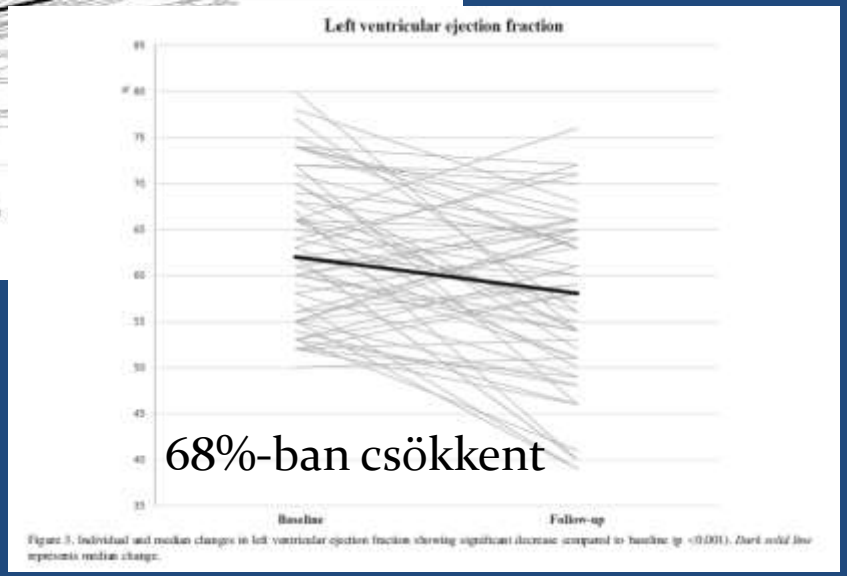
- Bal kamra hypertrofia, szűkebb üregek, EF a normális alsó határán (bal kamra concentrikus remodelling)
- Csökkent longitudinális, megtartott radiális functio (csökkent bal kamra strain)
- Rossz compliance miatt csökkent telődés (mitrális beáramlás)
- Vascularis compliance csökkentés

Progression of Low-Gradient, Low-Flow, Severe Aortic Stenosis With Preserved Left Ventricular Ejection Fraction



86%-nál növekedett

Figure 1. Individual and median changes in mean Doppler gradient *(A)* and peak aortic jet velocity *(B)* compared to baseline ($p < 0.001$). *Dark solid lines* represent median changes.



68%-ban csökkent

Figure 3. Individual and median changes in left ventricular ejection fraction showing significant decrease compared to baseline (p <0.001). *Dark solid line* represents median change.

Am J Cardiol 2015;116:612–617

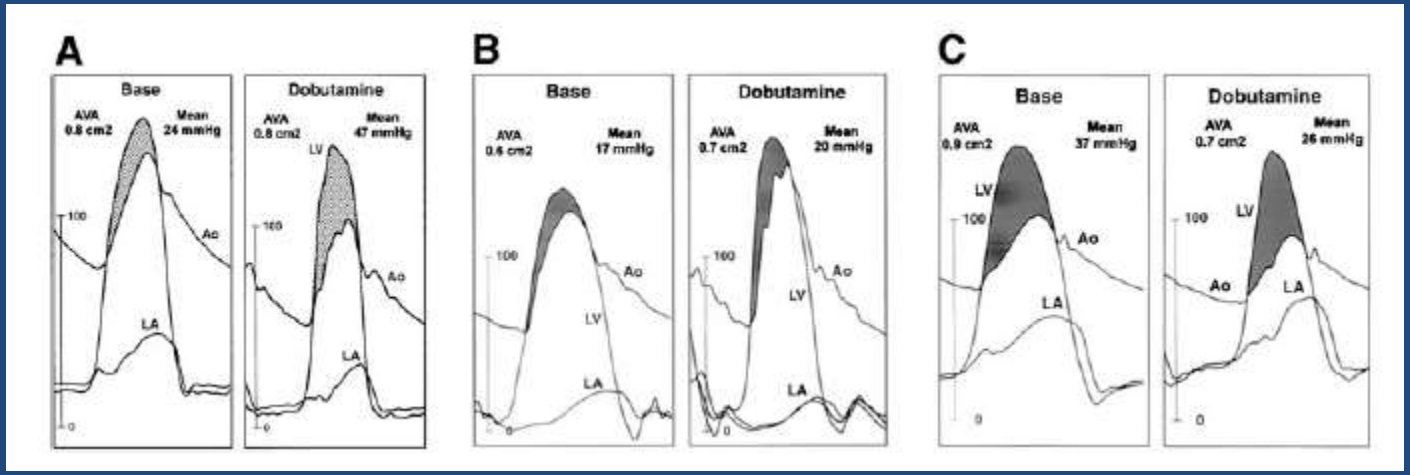
Table 2 Comprehensive Doppler-echocardiographic examination of aortic stenosis

Quantification of valvular obstruction
Maximal velocity
Mean gradient
Aortic valve area
Indexed aortic valve area
Energy loss index
Quantification of vascular load
Peripheral blood pressure
Systemic arterial compliance
Systemic vascular resistance
Quantification of global LV haemodynamic load
Valvulo-arterial impedance
Quantification of LV geometry
LV end-diastolic internal diameter
LV end-diastolic volume index
Relative wall thickness
Quantification of LV systolic function
LVOT stroke volume index
Cardiac index
Ejection fraction by Simpson method
Ejection fraction by Dumesnil method
Mid-wall fractional shortening

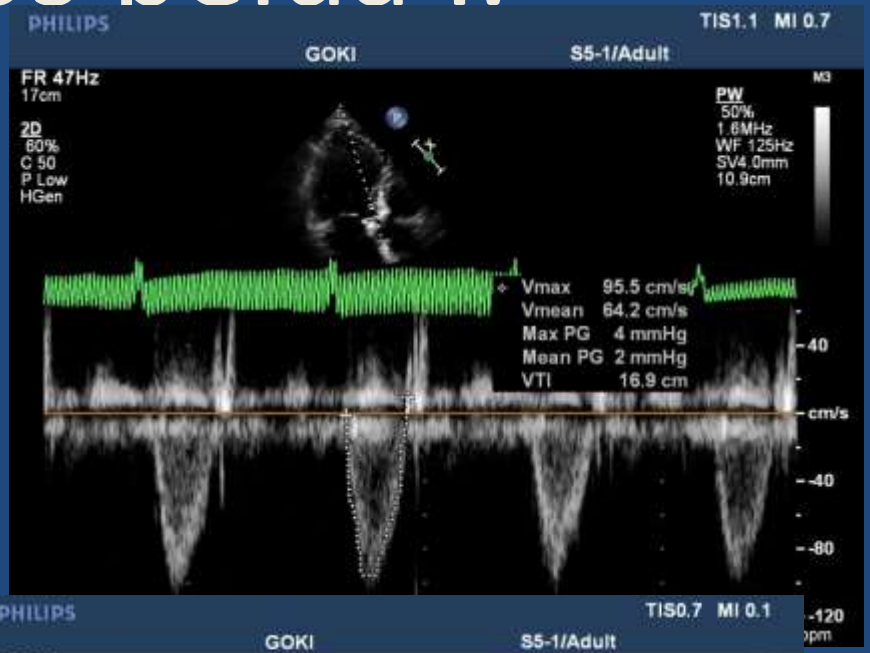
2. Stress echocardiográfia aorta stenosisban (low CO mellett)

1. **Súlyos-e az aorta stenosis (átlagos grádiens 40 Hgmm-t eléri-e)**
2. **Van-e contractilis reserve (VTI növekedés>20%)**

Egy invaziv példasor



Egy stress echos példa I.



Egy stress echos példa II.

Egy stress echos példa III.

Európai multicentrikus vizsgálat

- Bevétel: area<1cm2, EF<35, átlag grádiens<30 Hgmm
- 217 consective beteg
- 1990-2005
- DSE: 83/217,
- contractilis reserve, ha VTI növekedése<20%

(J Am Coll Cardiol 2008;51: 1466–72)

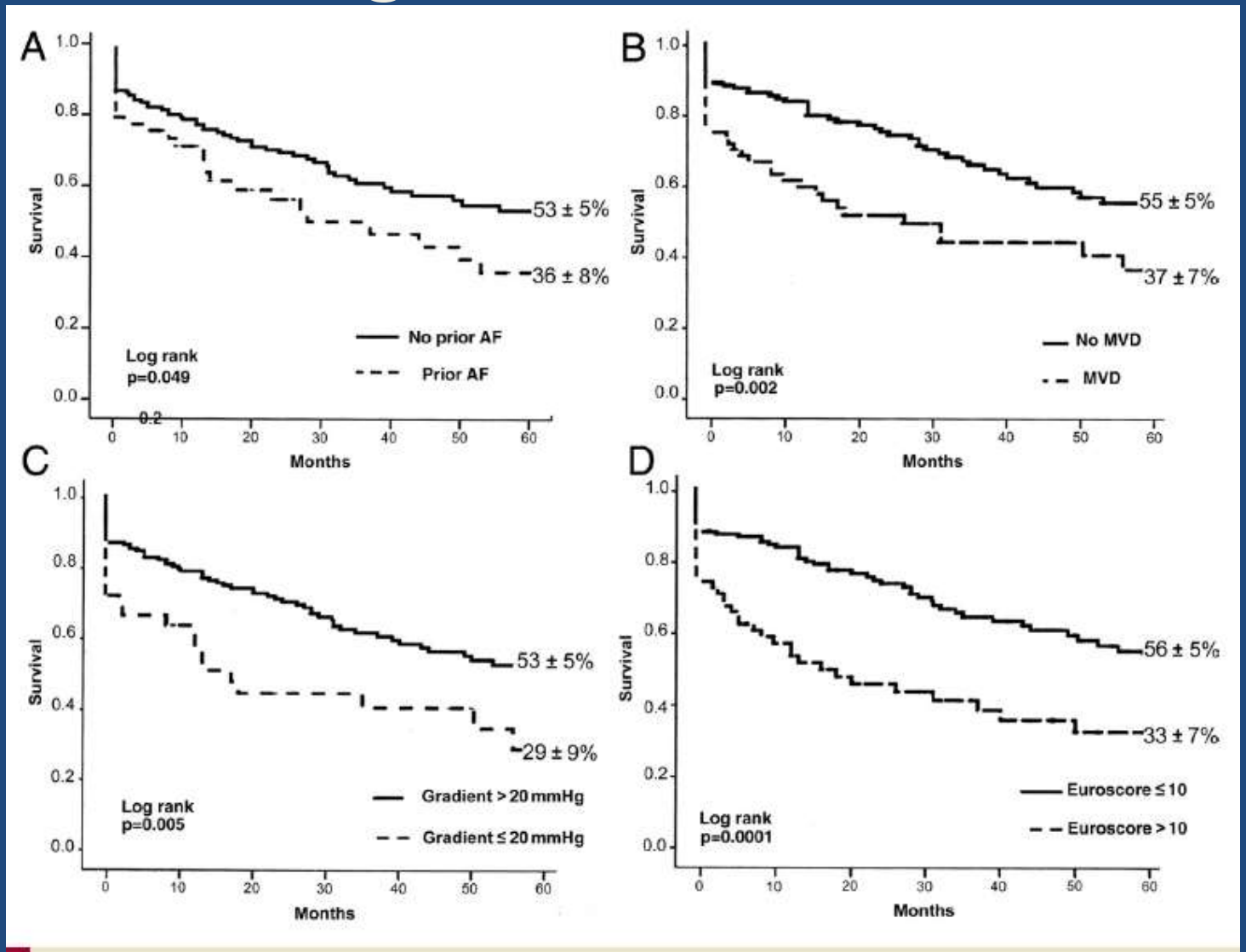
Periop. mortalitás: 16%

- Magasabb Euroscore
- Nagyon alacsony átlaggrádiens
- Nagyon alacsony EF
- Szívelégtelenség
- Több-ér betegség

Multivariációs vizsgálat:

- EF<20%,
- contractilis reserv hiánya DSE-n
- Több-ér betegség

5 éves túlélés meghatározói: AF, 3ér bet., grádiens, euroscore



Intraop. DSE

Table 2. Baseline and Procedural (During DSE) Hemodynamics for the Cases Presented

	Case 1		Case 2	
	Baseline	DSE	Baseline	DSE
Heart rate (beats/min)	85	95	80	88
Blood pressure (mmHg)	90/55	120/65	94/49	115/70
Central venous pressure (mmHg)	13	10	15	15
Pulmonary artery pressure (mmHg)	34/17	35/15	42/20	39/20
Cardiac output (L/min)	2.7	4.0	2.5	3.8
Aortic valve area (cm^2)	0.77-0.79	1.42-1.44	0.77-0.87	0.87-0.94

Journal of Cardiothoracic and Vascular Anesthesia, Vol 20, No 6 (December), 2006: pp 862-866

Contractilis reserve nélküli betegek műtéte

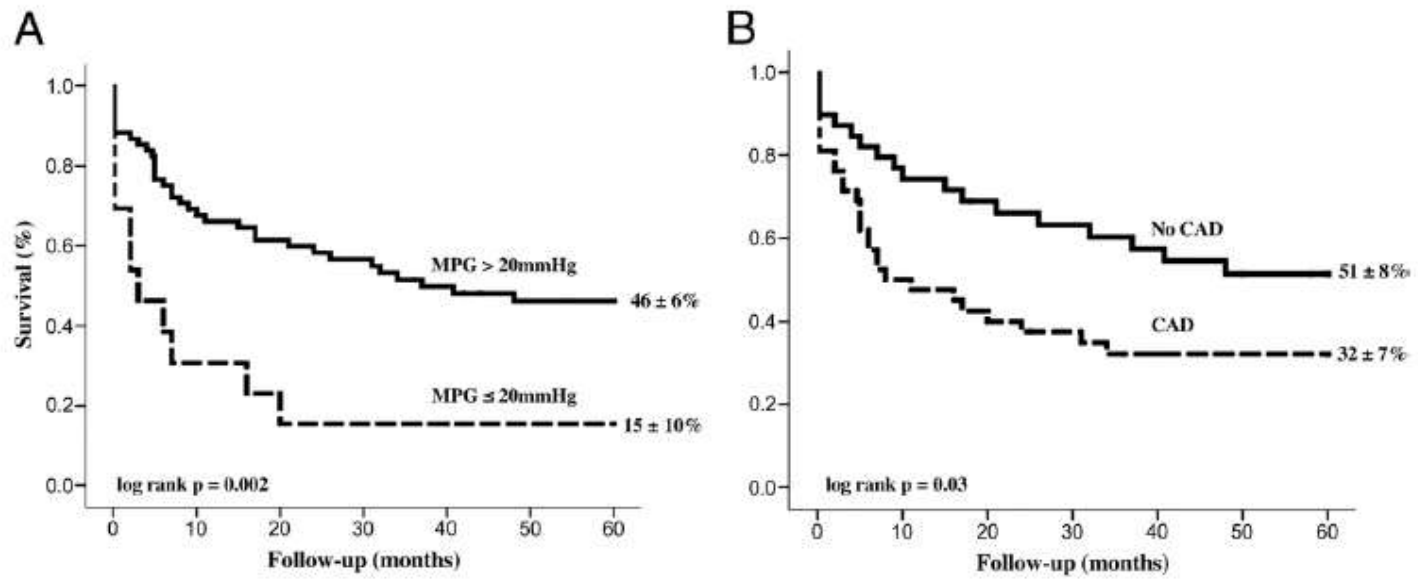


Figure 2 **Influence of MPG and CAD on Survival in LF/LGAS Patients Without CR on DSE**

Kaplan-Meier estimates of the probability of survival of the total population (n = 81) according to: (**A**) mean pre-operative transvalvular gradient (MPG) ≤20 and >20 mm Hg, and (**B**) presence of significant coronary artery disease (CAD). Abbreviations as in Figure 1.

(J Am Coll Cardiol 2009;53:1865–73)

Contractilis reserve nélküli betegek műtéte

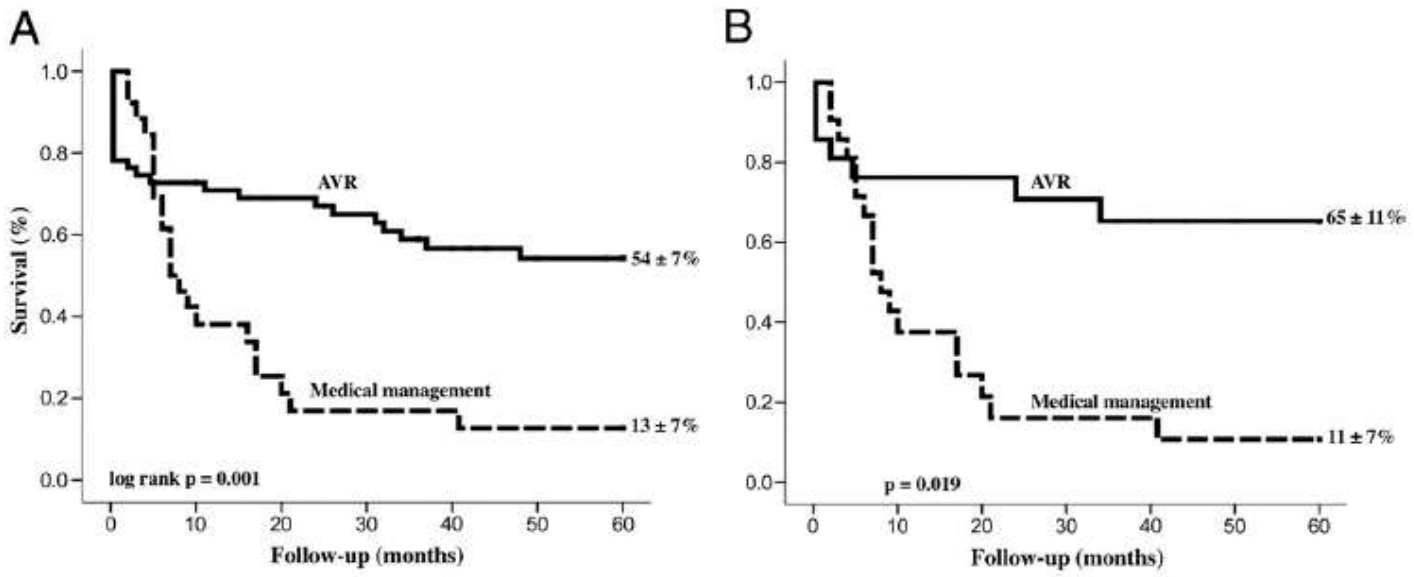


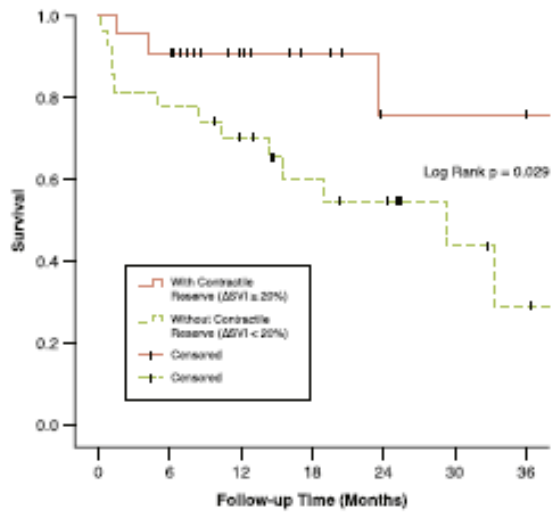
Figure 4 **Prognostic Impact of AVR in LF/LGAS Patients Without CR on DSE**

Kaplan-Meier estimates of the probability of survival according to whether aortic valve replacement (AVR) was performed: **(A)** total population (n = 81), and **(B)** matched patients (n = 42). Abbreviations as in Figure 3.

(J Am Coll Cardiol 2009;53:1865–73)

Dobutamin TAVI előtt, LFLG aorta stenosis esetén

FIGURE 1 Kaplan-Meier Survival Curves of Patients With Low-Gradient Severe Aortic Stenosis With and Without Flow Reserve



Kaplan-Meier survival curves of patients with low-gradient aortic stenosis who underwent dobutamine stress echocardiography; stratified by flow reserve (FR) (+FR: stroke volume index [SVI] >20%, n = 22; −FR: SVI <20%, n = 27).

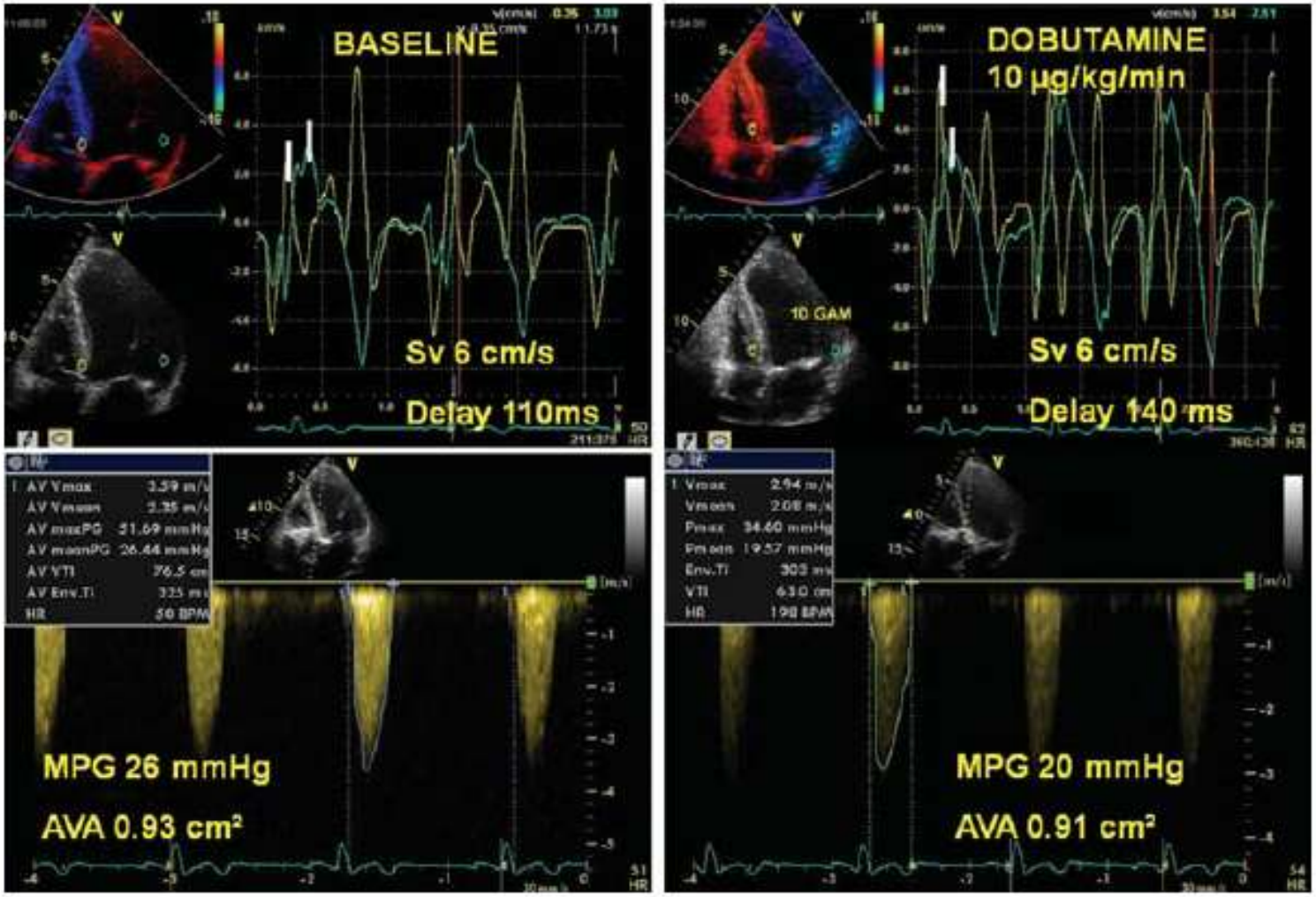
Műtéthez hasonlóan jelentősen rosszabb a **prognozisa** a flow reserve nélküli betegeknek.

Multivariatios predictorok:

- COPD
- Női nem
- SVI<20ml

JACC: CARDIOVASCULAR IMAGING, VOL. 8, NO. 3, 2015
MARCH 2015:379–83

Dynamic left ventricular dyssynchrony: a potential cause of no contractile reserve in patients with low-gradient aortic stenosis



European Journal of Echocardiography
doi:10.1093/ejechocard/jep079

3. Percutan billentyűk

Figure 1 Profile of the Edwards SAPIEN Transcatheter Heart Valve

The Edwards SAPIEN transcatheter aortic prosthesis is mounted on a balloon-expandable stainless steel stent that is placed in the subcoro bovine pericardial prosthesis is attached to the stent and treated with an anticalcification treatment. The stent has a polyethylene terephtha decreases perivalvular leaks.

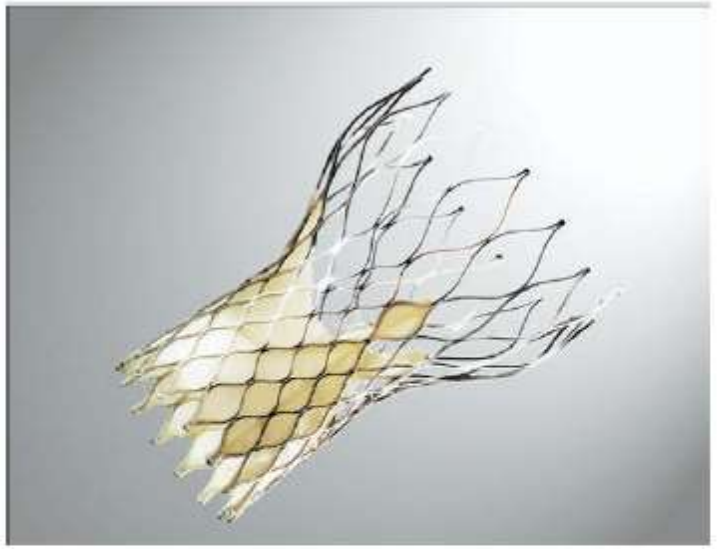
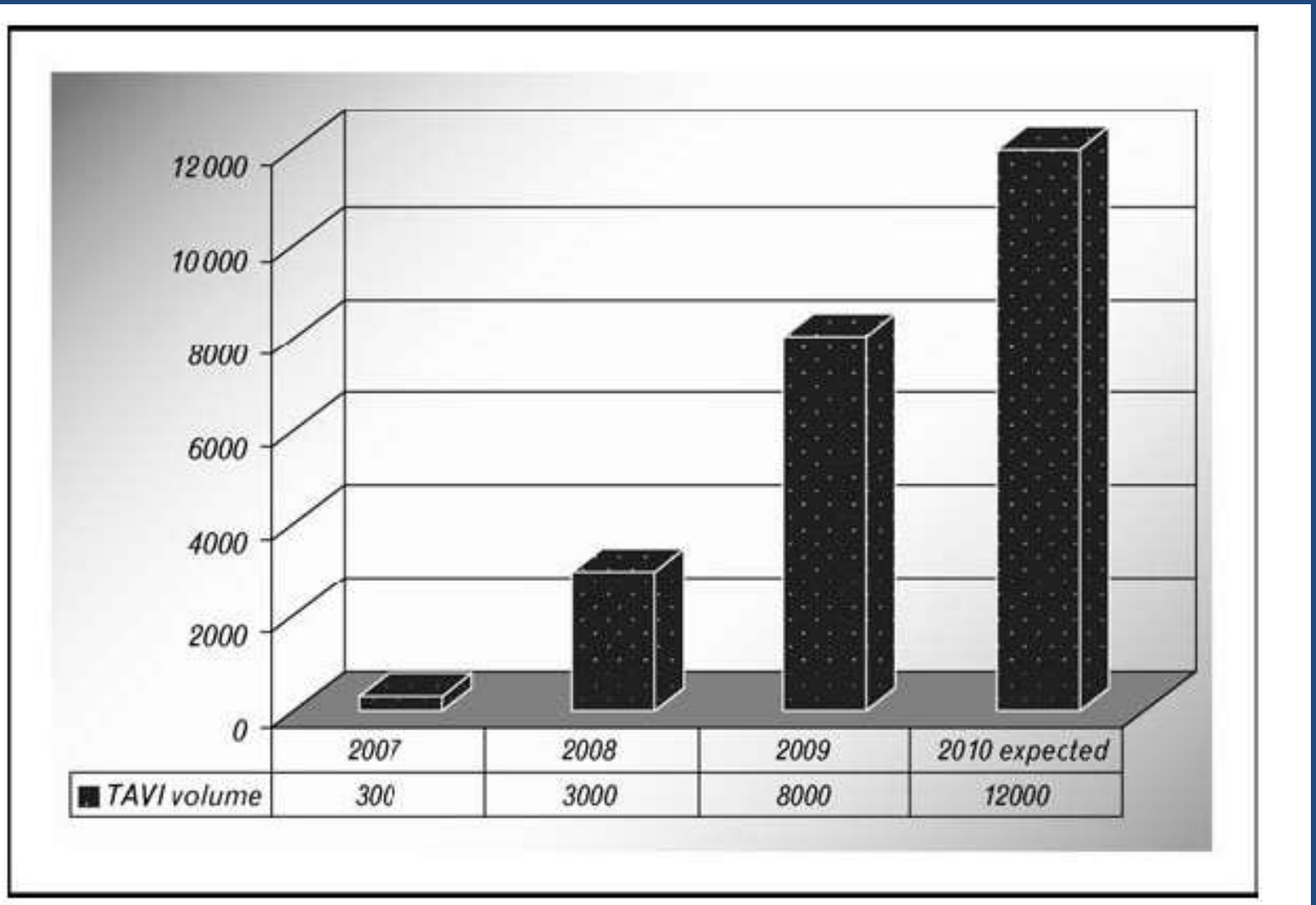


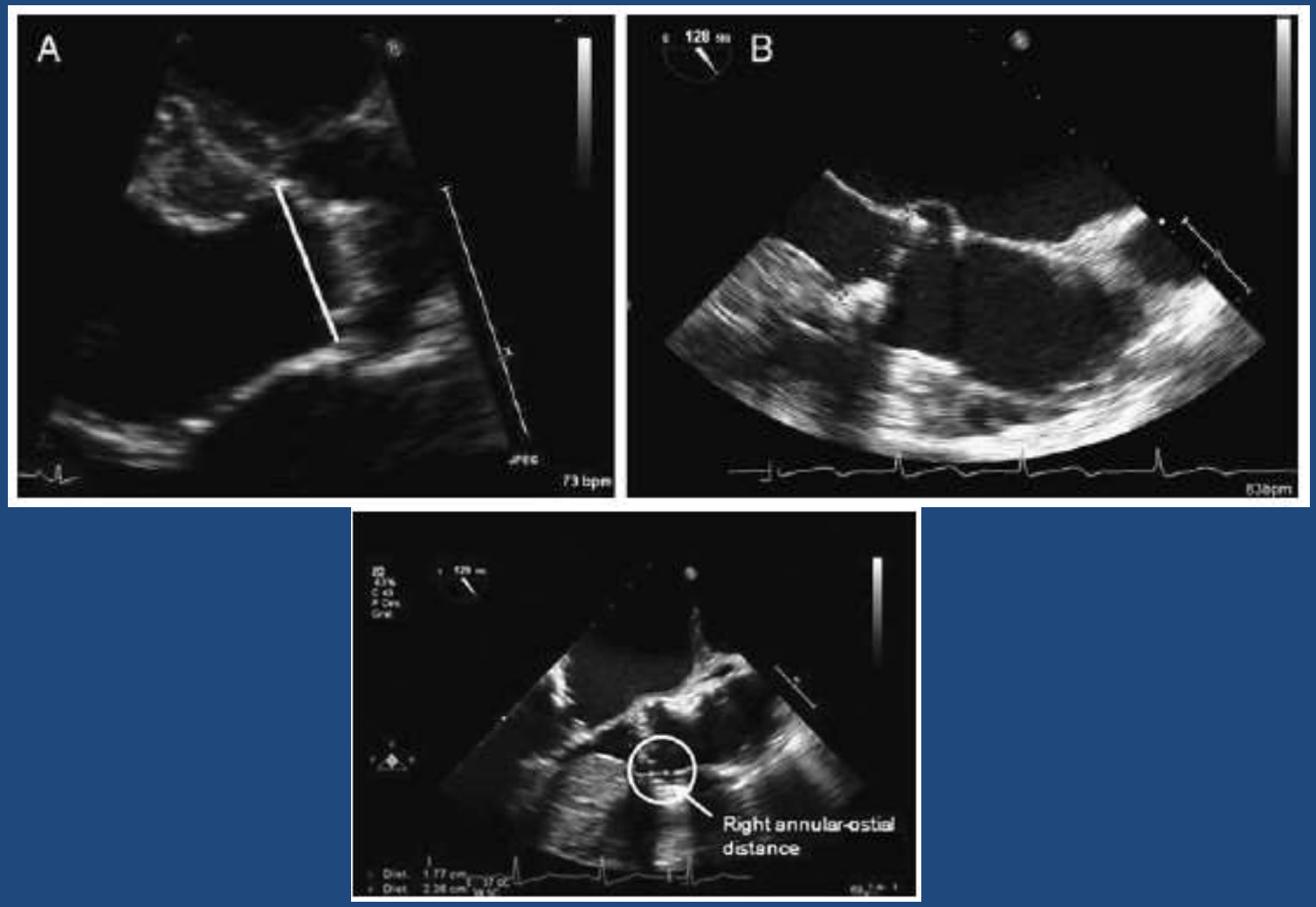
Figure 2 Profile of the CoreValve ReValving System

The CoreValve transcatheter aortic heart valve is a self-expanding nitinol frame porcine pericardium prosthesis developed for the treatment of aortic stenosis, regurgitation, and failing surgical bioprosthesis. The frame has 3 distinct functional levels with different radial and hoop strengths. The valve is placed across the left ventricular outflow tract and extends into the aortic root.

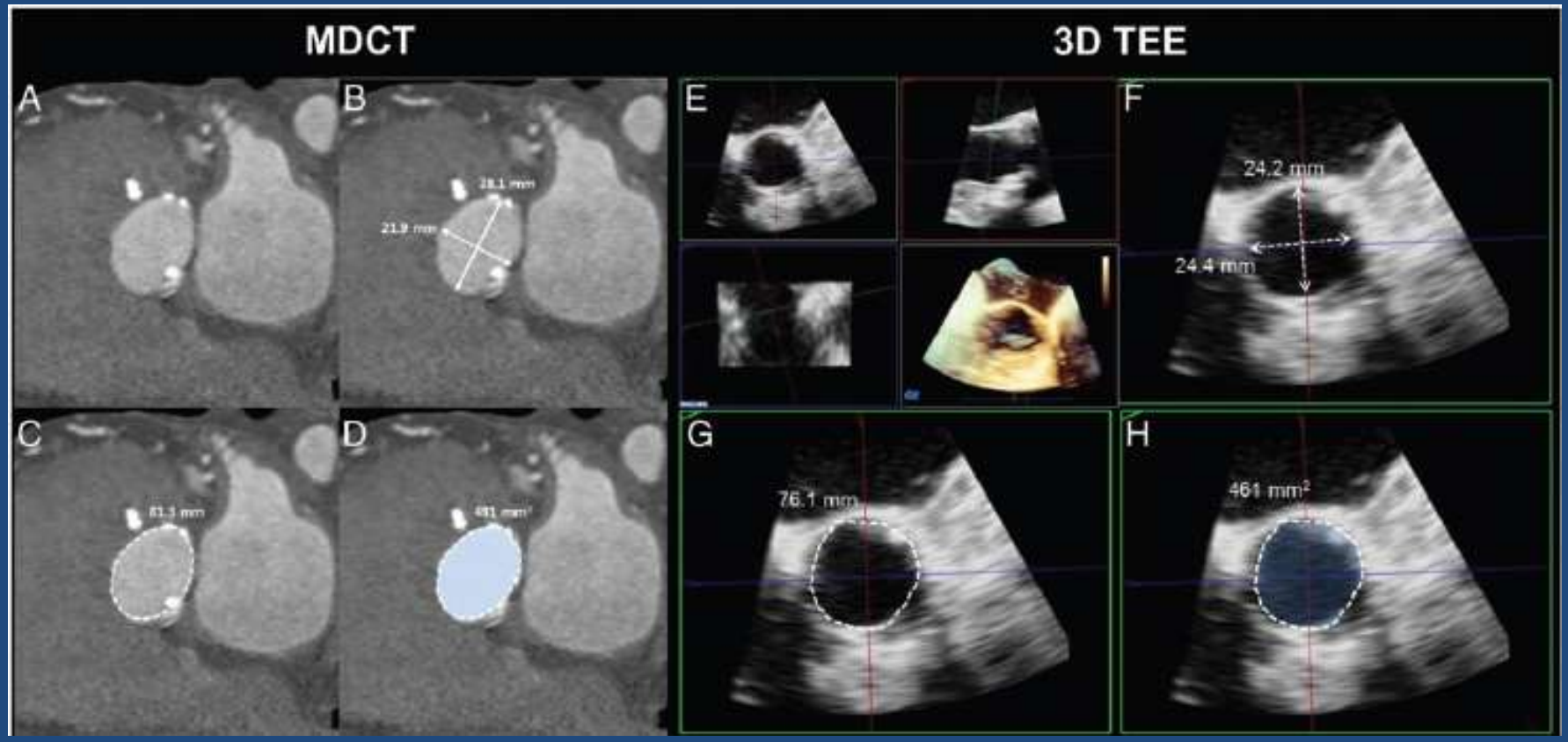
Percutan beültetett aorta billentyűk száma



Mi az, amit az echosnak mérni kell?



Optimális mérés a paravalvularis regurgitatio csökkentésére



Melyik az optimális mérés?

Table I **Three-dimensional aortic annulus measurements proposed for transcatheter aortic valve size selection**

Dimension	Three-dimensional measurement approach	Effects on paravalvular AR
Minimum diameter	Shortest diameter measured in the cross-sectional view of the aortic annulus	Increased risk of paravalvular AR and valve migration due to prosthesis undersizing[22]
Maximum diameter	Largest diameter measured in the cross-sectional view of the aortic annulus	Risk of paravalvular AR is minimized compared with minimum diameter,[22] but increased risk of annulus rupture if prosthesis is oversized by ≥20%[23,24]
Mean diameter	(maximum diameter + minimum diameter)/2	Risk of paravalvular AR is reduced when compared with using minimum diameter[20,22]
Perimeter	Planimetered perimeter of the aortic annulus in the cross-sectional view of the aortic annulus	Risk of paravalvular AR is minimized compared with minimum diameter[22]
Area	Planimetered area of the aortic annulus in the cross-sectional view of the aortic annulus	Integration of area measured with MDCT led to a reduction in paravalvular AR in a prospective multicentre observational study[19]

AR, aortic regurgitation; MDCT, multi-detector computed tomography; TAVI, transcatheter aortic valve implantation; TEE, transoesophageal echocardiography.

PAVI haemodynamica

Table 3 Doppler Echocardiographic Data According to Type of Aortic Bioprosthesis

	PAVI	SAVR-ST	SAVR-SL	p Value
LVEF, %				
Discharge	59 ± 12*	56 ± 11	55 ± 14	0.053
Follow-up	59 ± 17	62 ± 18	60 ± 16	0.255
Mean transaortic gradient, mm Hg				
Discharge	10 ± 4*	13 ± 5*†	14 ± 6*†	<0.001
Follow-up	10 ± 4*	13 ± 5*†	9 ± 4*‡§	<0.001
Effective orifice area, cm^2				
Discharge	1.61 ± 0.40*	1.29 ± 0.25*†	1.38 ± 0.38*†	<0.0001
Follow-up	1.50 ± 0.36*	1.33 ± 0.28*†	1.57 ± 0.49*‡§	0.001
Indexed effective orifice area, cm^2/m^2				
Discharge	0.90 ± 0.26*	0.76 ± 0.16*†	0.80 ± 0.21*†	0.003
Follow-up	0.87 ± 0.18*	0.78 ± 0.17*†	0.90 ± 0.27‡§	0.019
Severe prosthesis-patient mismatch, n (%)				
Discharge	5 (11)	13 (26)†	14 (28)†	0.042
Follow-up	3 (6)	14 (28)†	10 (20)†	0.007

The p values presented refer to the intergroup comparisons. *Significant difference ($p < 0.05$) versus baseline. †Significant difference ($p < 0.05$) versus PAVI. ‡Significant difference ($p < 0.05$) versus SAVR-ST. §Significant difference ($p < 0.05$) versus discharge.
Abbreviations as in Table 1.

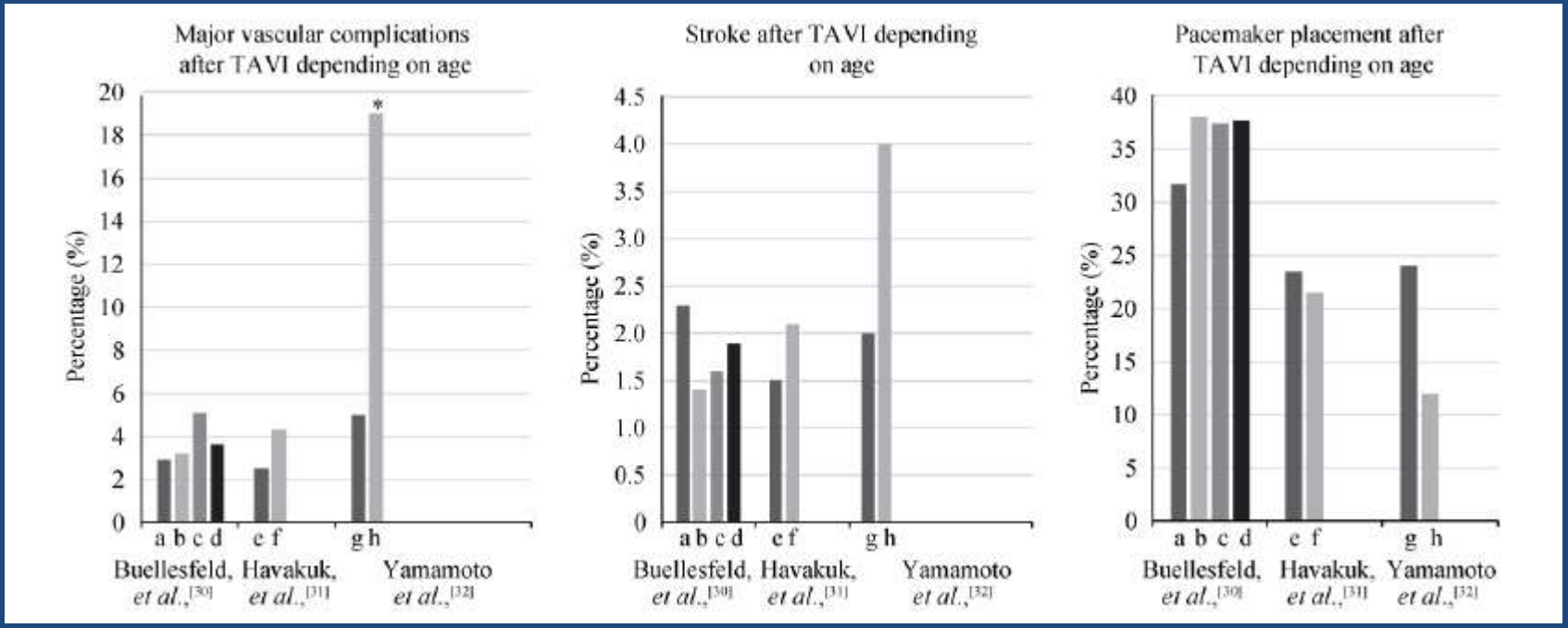
Table 4 Aortic Regurgitation Data at Discharge and at Follow-Up Grouped According to Type of Aortic Bioprosthesis

	PAVI	SAVR-ST	SAVR-SL	p Value
Aortic regurgitation at discharge				
None	6 (12)	31 (62)*	33 (66)*	<0.0001
Trivial	19 (38)	14 (28)	11 (22)	
Mild	21 (42)	5 (10)*	6 (12)*	
Moderate	4 (8)	0 (0)	0 (0)	
Severe	0 (0)	0 (0)	0 (0)	
Aortic regurgitation at follow-up				
None	11 (22)	26 (52)*	33 (66)*	<0.0001
Trivial	13 (26)	18 (36)	9 (18)	
Mild	23 (46)	5 (10)*	8 (16)*	
Moderate	3 (6)	1 (2)	0 (0)	
Severe	0 (0)	0 (0)	0 (0)	

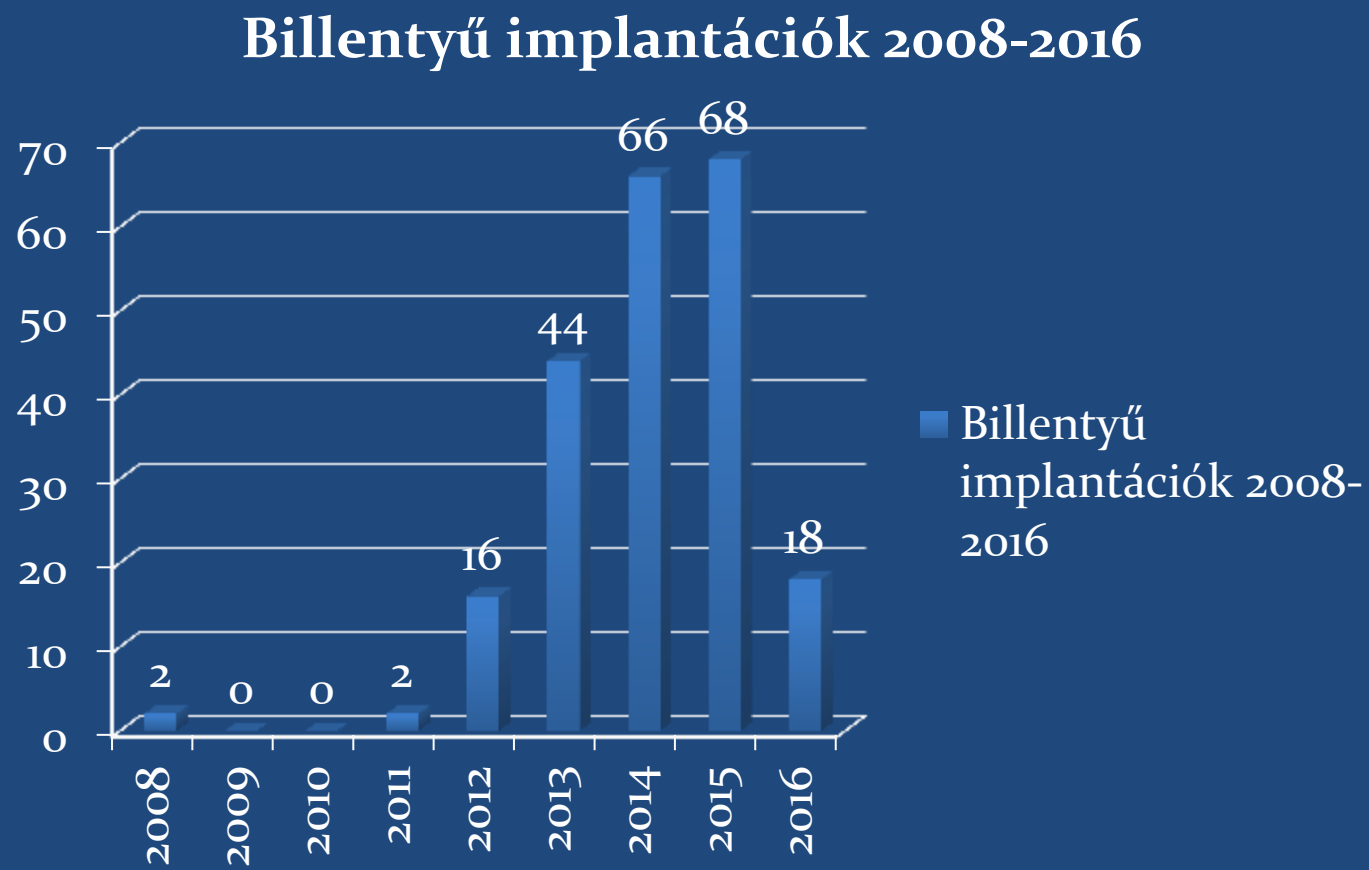
Values are n (%). *Significant difference ($p < 0.05$) versus PAVI.
Abbreviations as in Table 1.

J Am Coll Cardiol 2009;53:1883–91

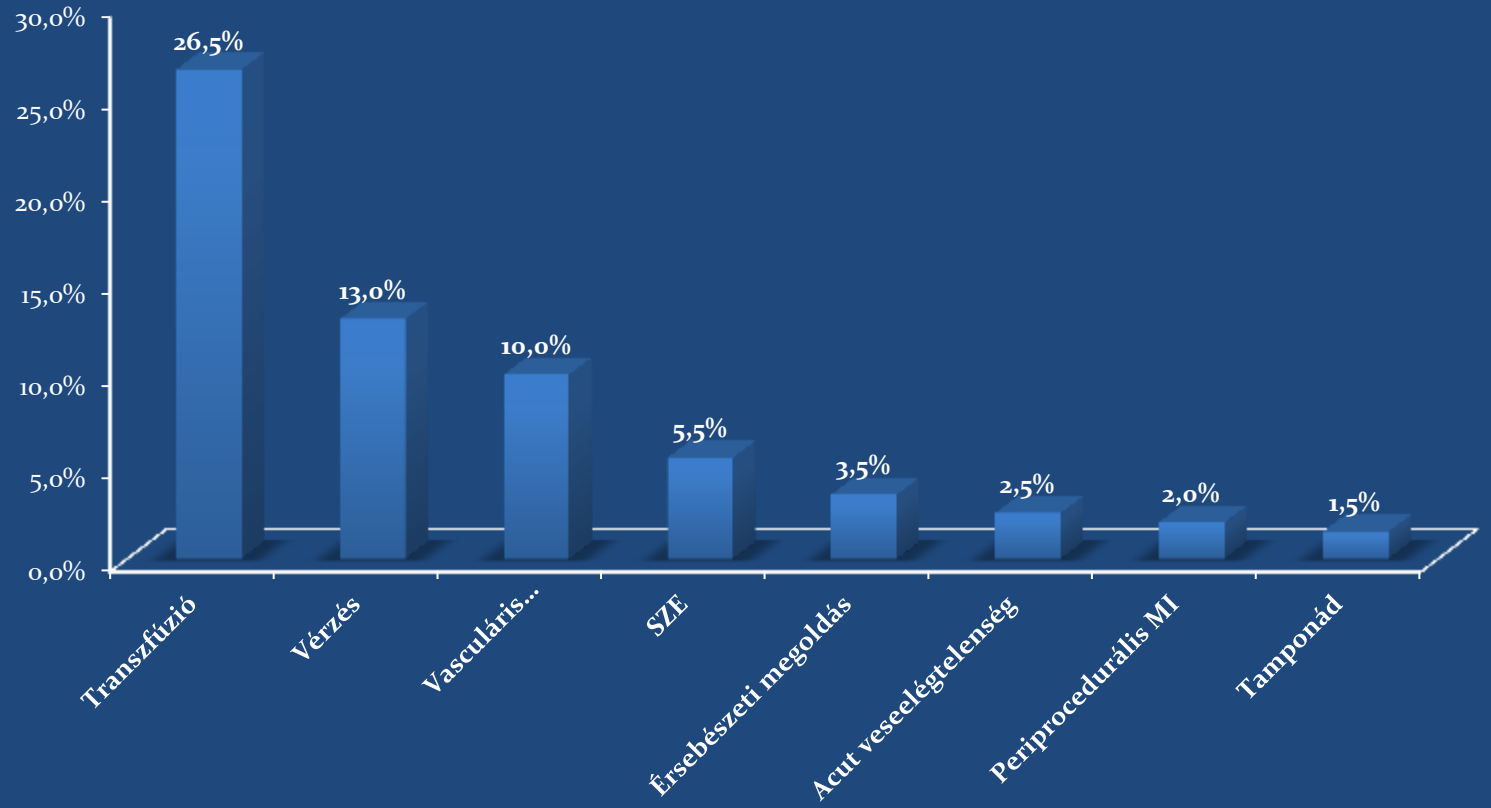
Szövődmények



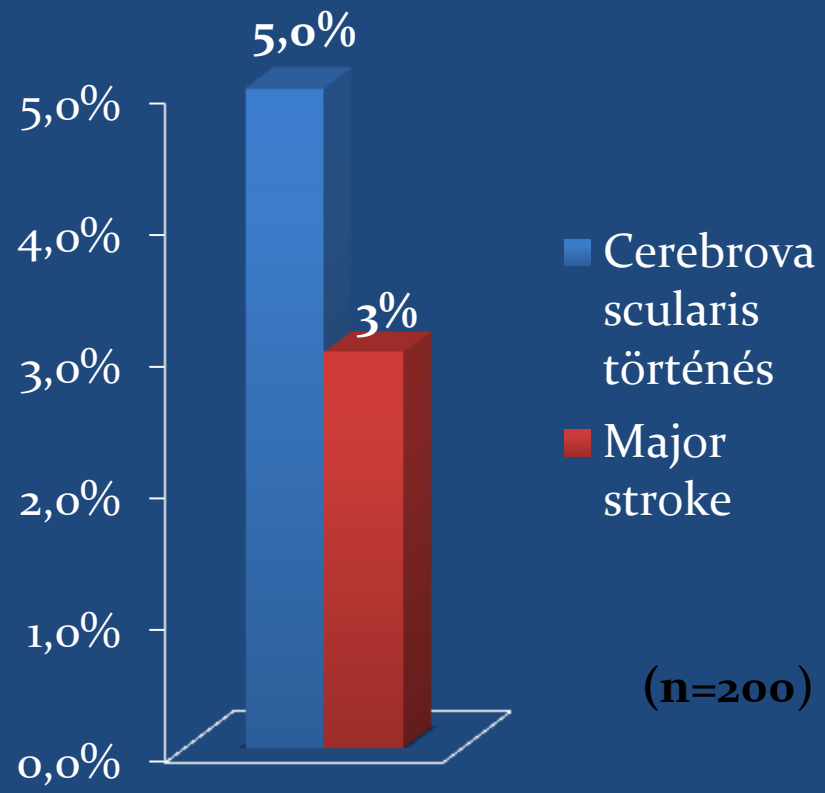
GOKI TAVI esetek

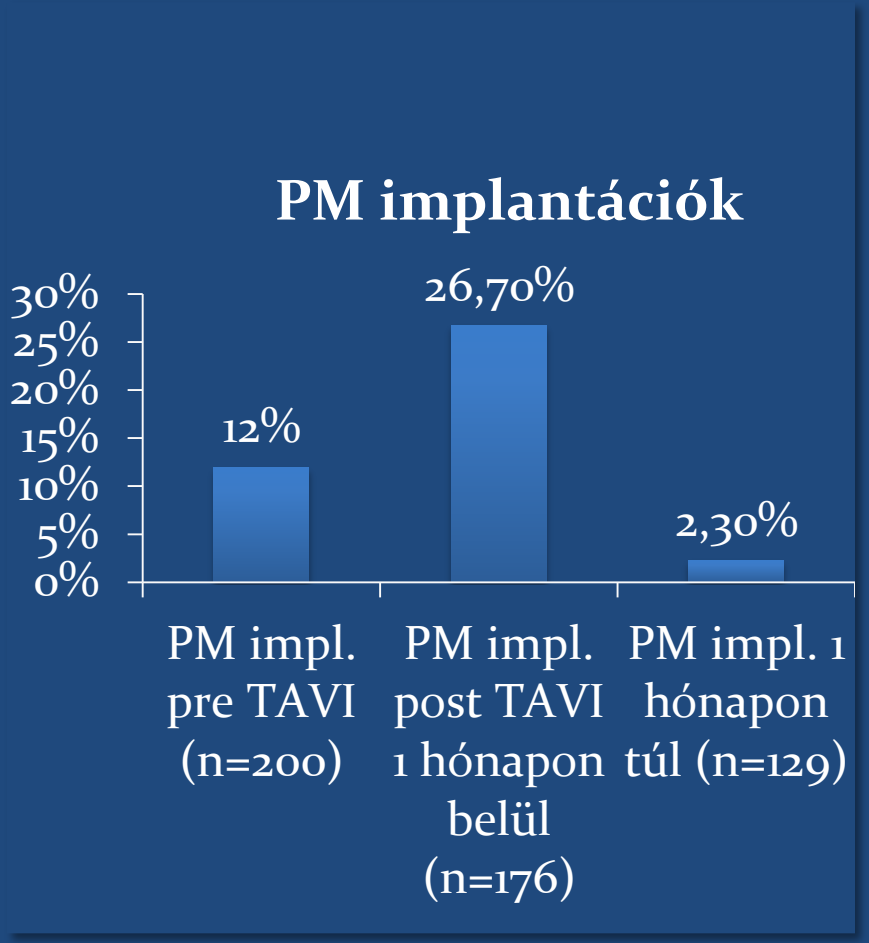


Szövődmények

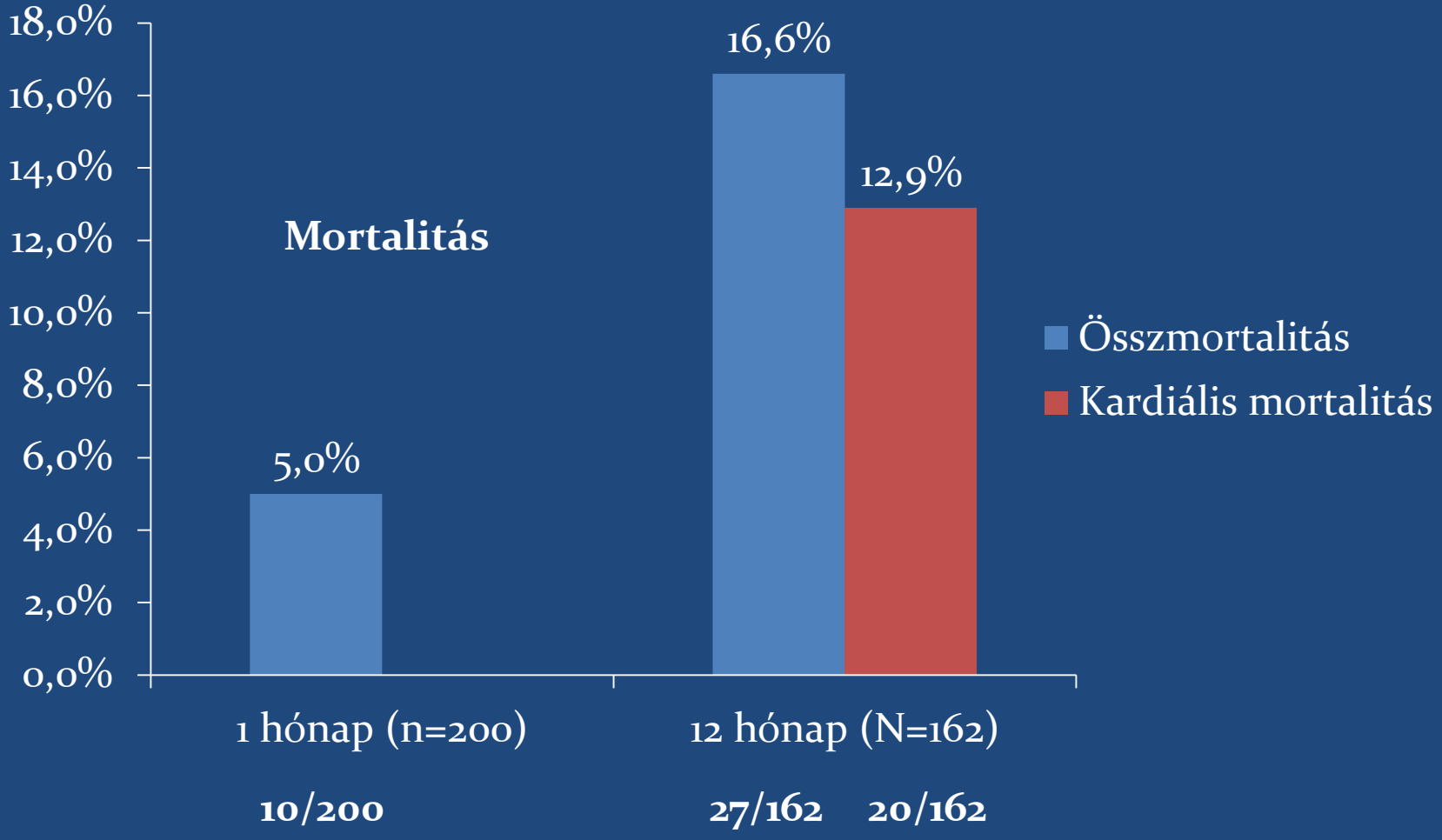


Szövődmények





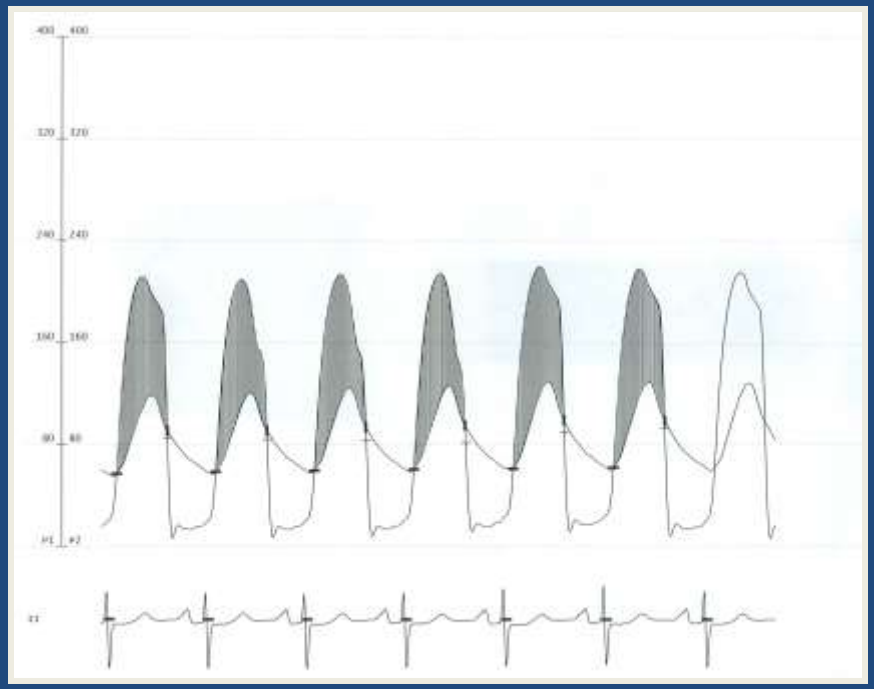
Az első 200 beteg: mortalitás



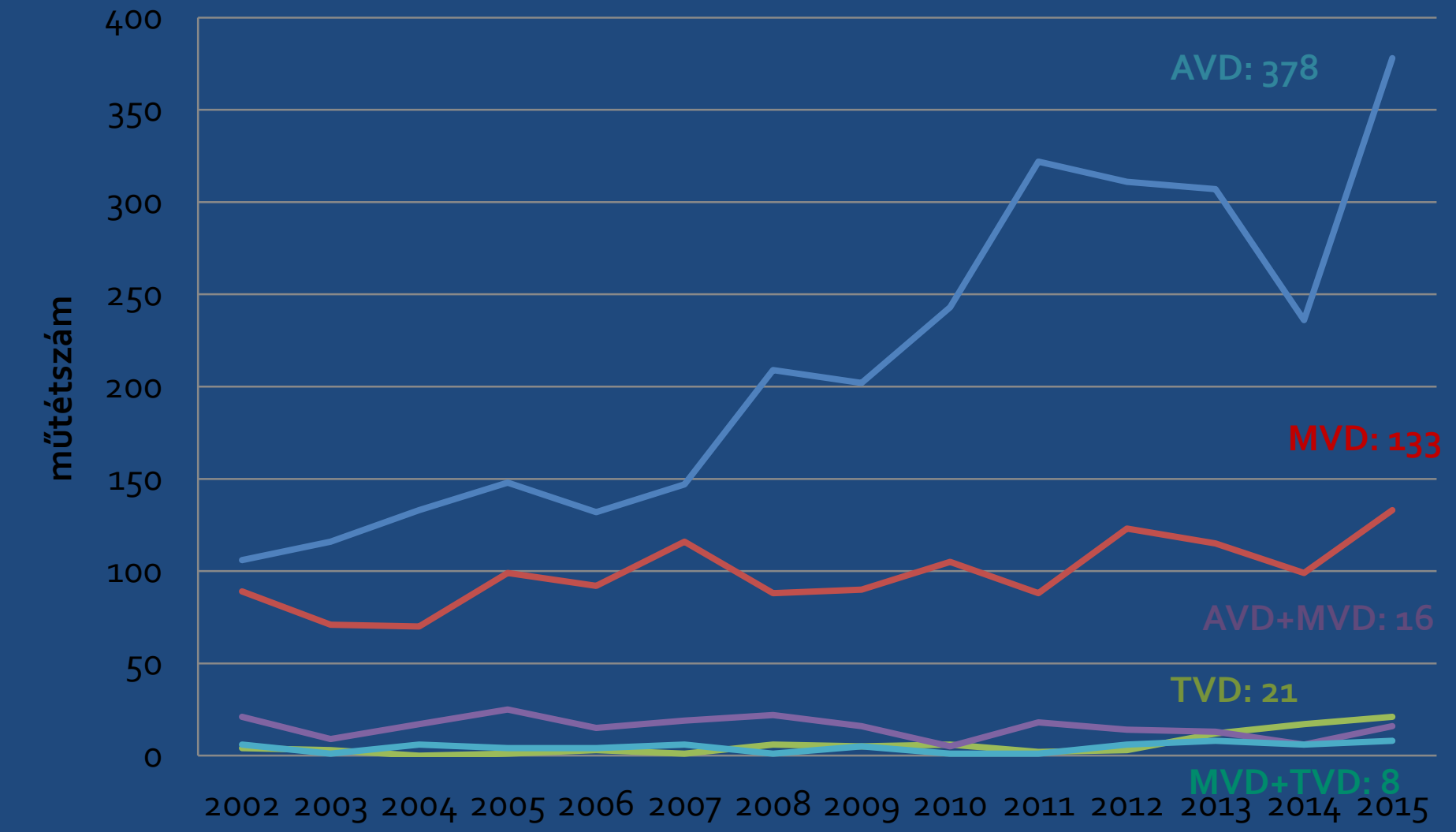
Jelenlegi fő megállapítások

- Jobb a percutan aorta billentyű, mint a gyógyszeres kezelés nagy sebészi kockázatú betegeknek a túlélés és a bal kamra functio szempontjából
- Az európai regiszterekben javult a periprocedurális siker és a korai halálozás a transfemoralis és transapicalis implantatio során egyaránt
- CoreValve és Sapien (Edwards) billentyűről gyűlt össze a legtöbb adat

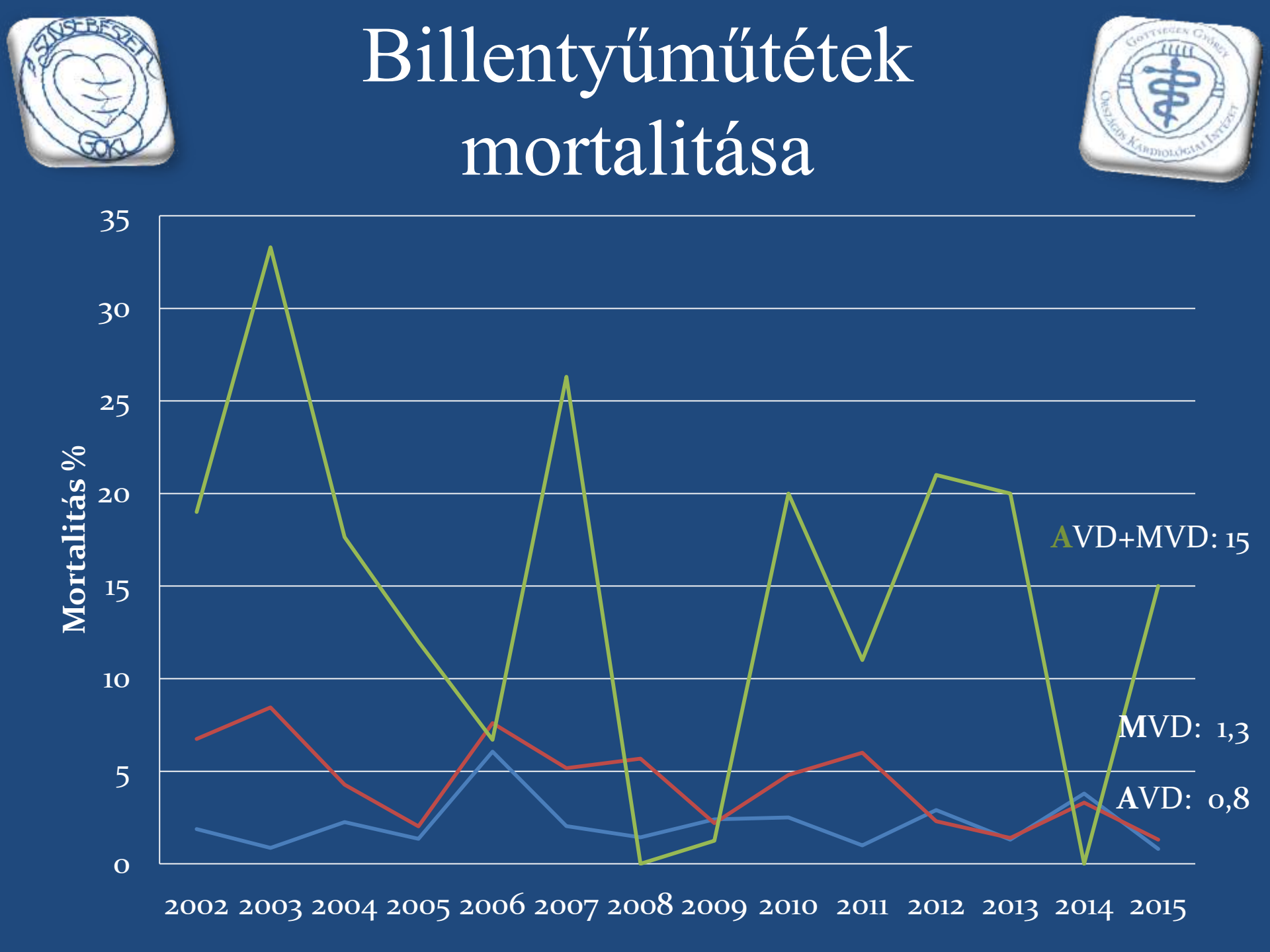
Egy példa



Billentyűműtétek alakulása



Billentyűműtétek mortalitása



Összefoglalás

- Aorta stenosis a leggyakoribb műtétet igénylő billentyűhiba
- Súlyos aorta stenosis meghatározása a grádiens és area alapján ellentmondásos, area a fontosabb!
- Stress echocardiográfia segítségével a csökkent cardiac output mellett kiválaszthatók a műtétet igénylő esetek, becsülhető a kockázat (contractilis reserv kimutatása)
- Percutan aorta billentyű beültetés meghódította Európát