Aortenstenose
Wann konservative, operative, interventionelle Therapie ?

FWAmann

HerzGefässZentrum Zürich
Klinik im Park

Severe Aortic Stenosis

Mean gradient > 40 mmHg

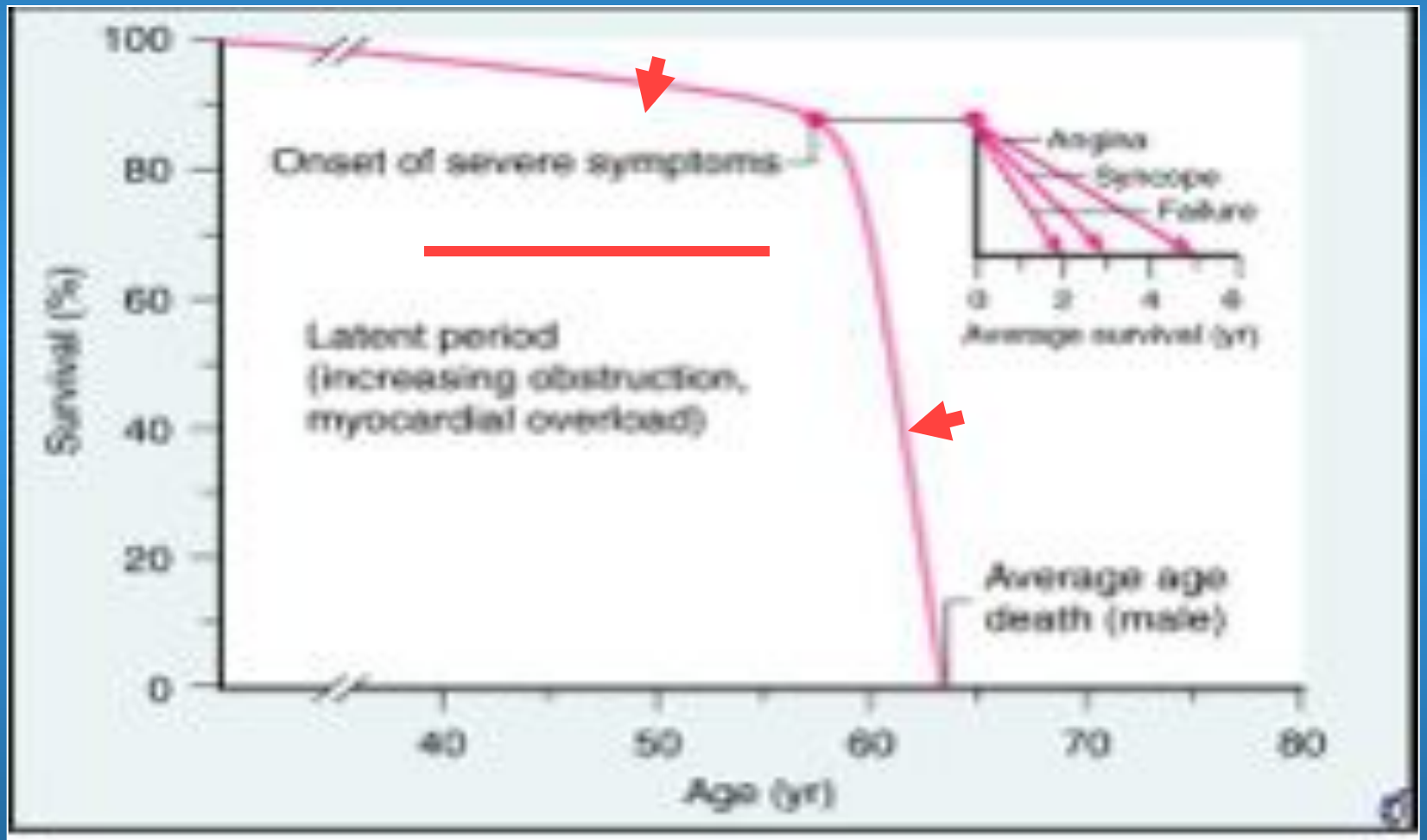
AVA < 1.0 cm2

Peak velocity > 3.5 m/s

Incidence: 4.6% of individuals > 75 ys

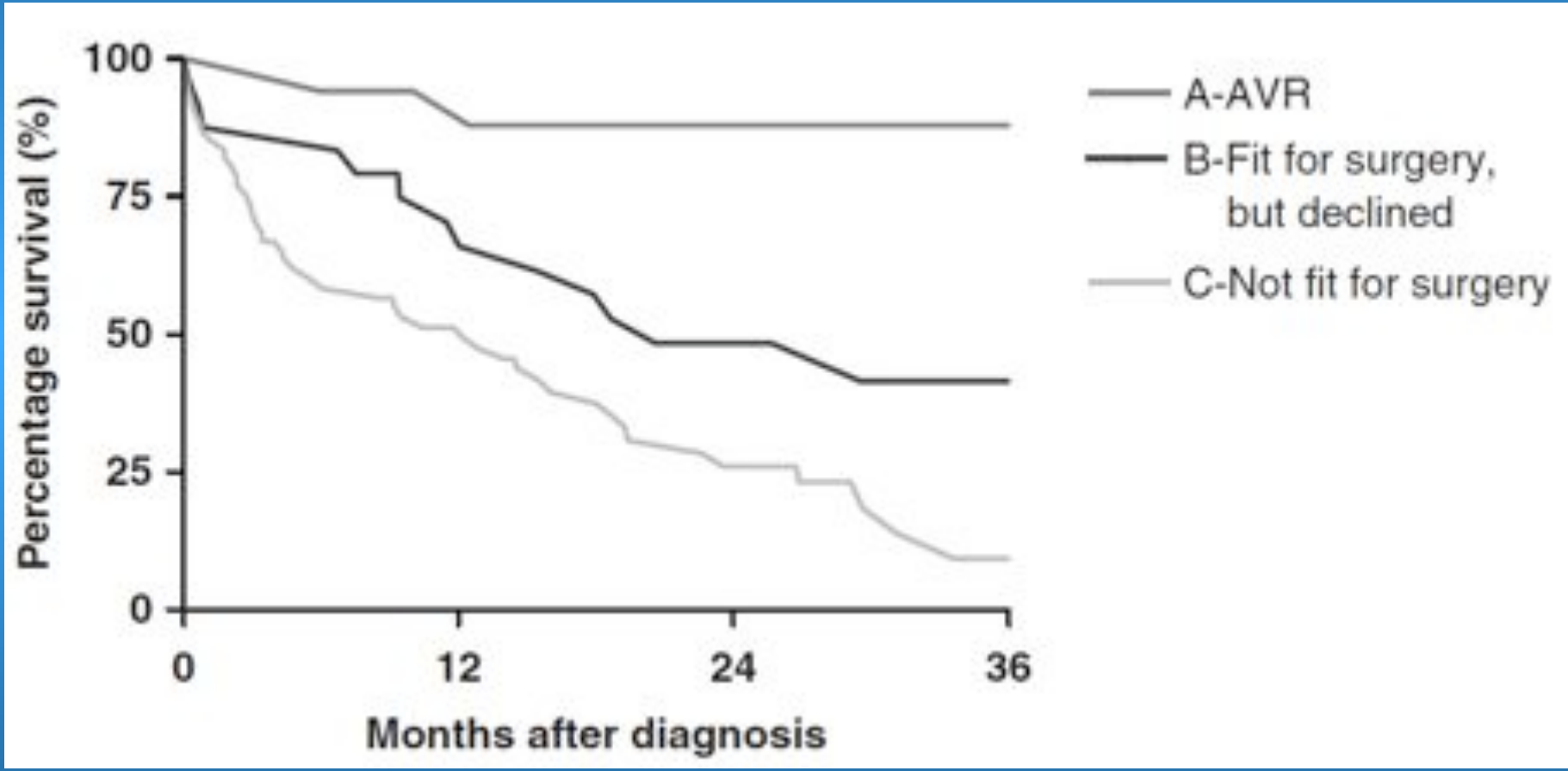
Marked individual variability for symptoms and pathophysiologic effect

Course of Aortic Stenosis



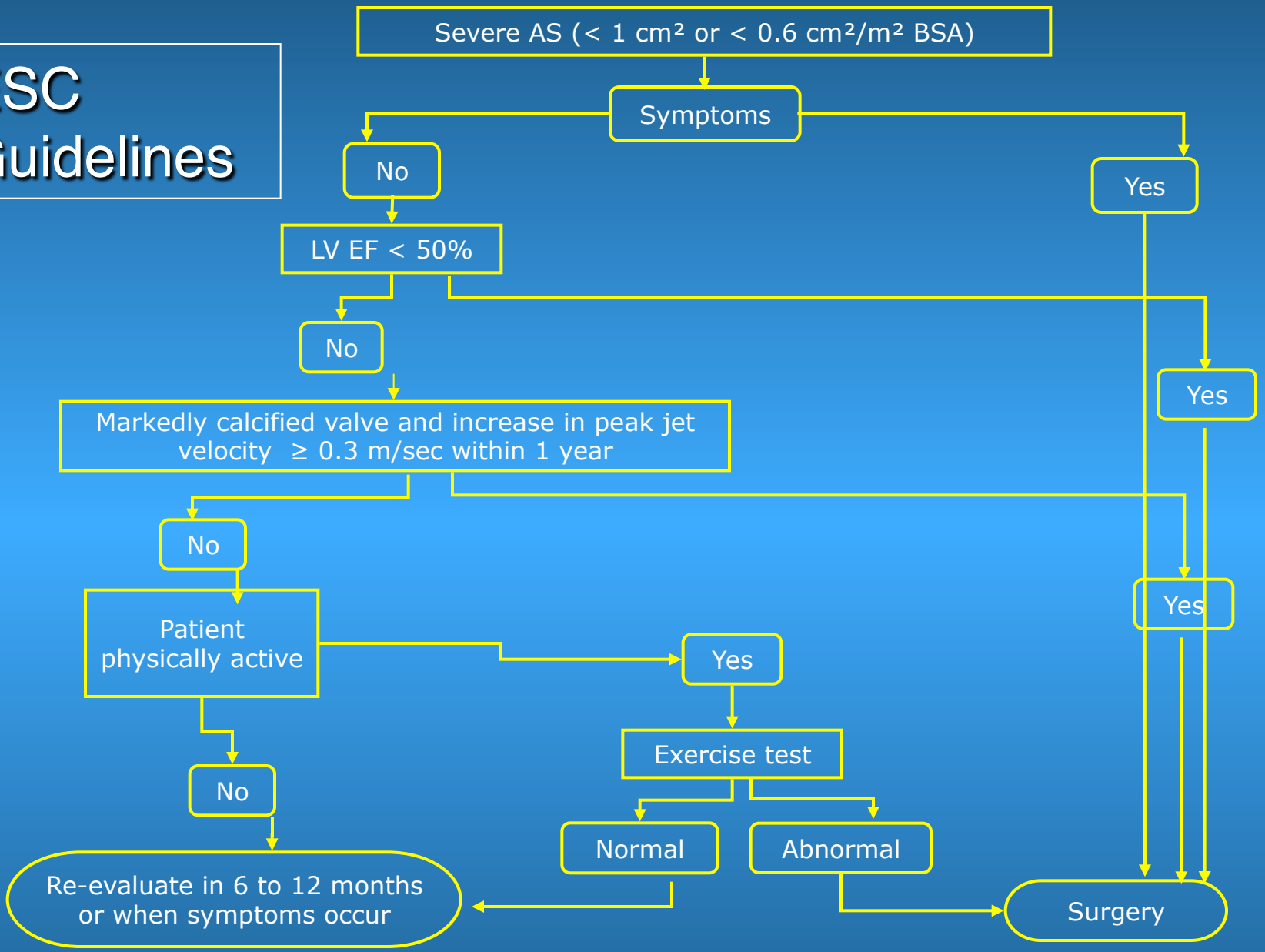
Ross J, Braunwald E Circulation 38; SuppV: 61 1968

Impact of Therapy on Prognosis in severe AS



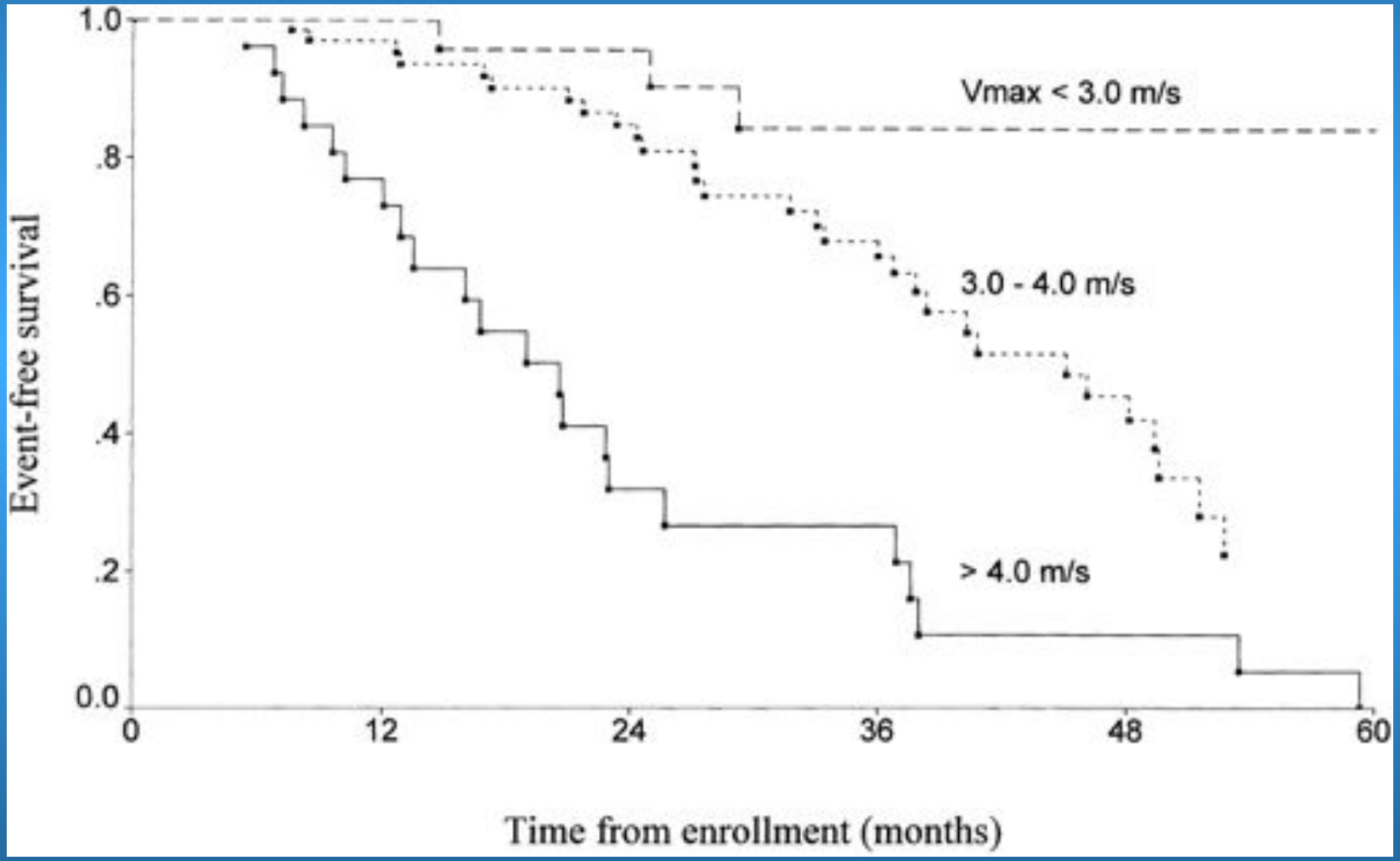
P. Kojodjojo et al. Q J Med 2008;101:567-573

ESC Guidelines



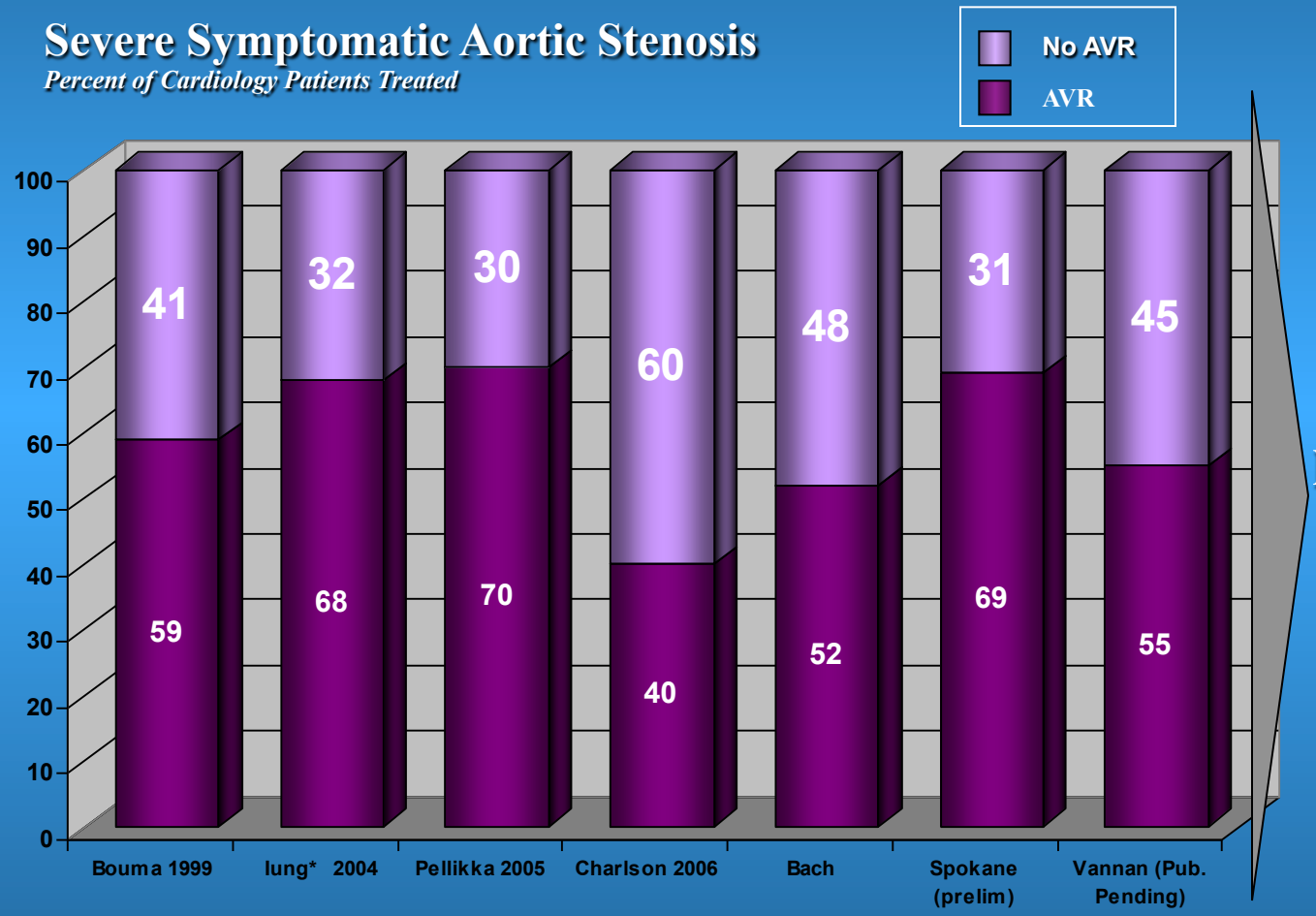
(ESC Guidelines on Valvular Heart Disease Eur Heart J 2007;28:230-68)

What about Asymptomatic Patients?



Otto CM Circulation 1997;95:2262

At least 30-60% of Cardiologists' AS Patients Go Untreated



Under-treatment especially prevalent among patients managed by *Primary Care* physicians

1. Bouma B J et al. To operate or not on elderly patients with aortic stenosis: the decision and its consequences. Heart 1999;82:143-148
2. Iung B et al. A prospective survey of patients with valvular heart disease in Europe: The Euro Heart Survey on Valvular Heart Disease. European Heart Journal 2003;24:1231-1243 (*includes both Aortic Stenosis and Mitral Regurgitation patients)
3. Pellikka, Sarano et al. Outcome of 622 Adults with Asymptomatic, Hemodynamically Significant Aortic Stenosis During Prolonged Follow-Up. Circulation 2005
4. Charlson E et al. Decision-making and outcomes in severe symptomatic aortic stenosis. J Heart Valve Dis2006;15:312-321

Reasons for „Undertreatment“ in severe Symptomatic AS

- Life expectancy <1 Year
- Co-morbidities
- Very old age
- Very high Euroscore/STS Score („inoperable“)
- Too sick to recover: LV-function, kachexia
- Delayed correct grading and treatment decision (eg dyspnea for other reasons, low flow/low gradient AS)
- Patients decision

First successful percutaneous aortic valve implantation

Candidates for Transcatheter AVI

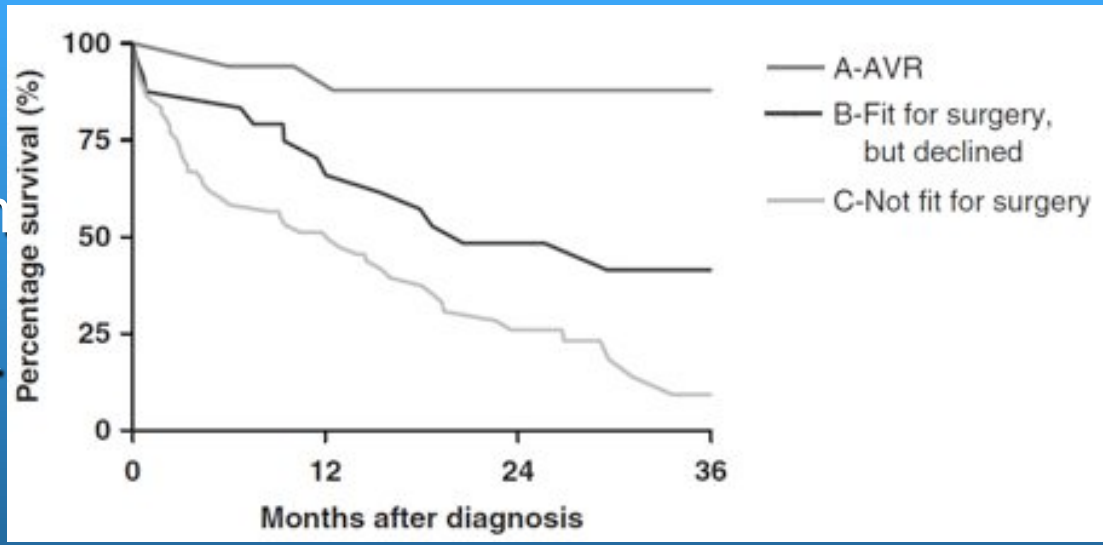
Older age (frailty)

Logistic EuroSCORE > 20%, STS > 10

Symptomatic severe AS (AVA<0.8cm2)

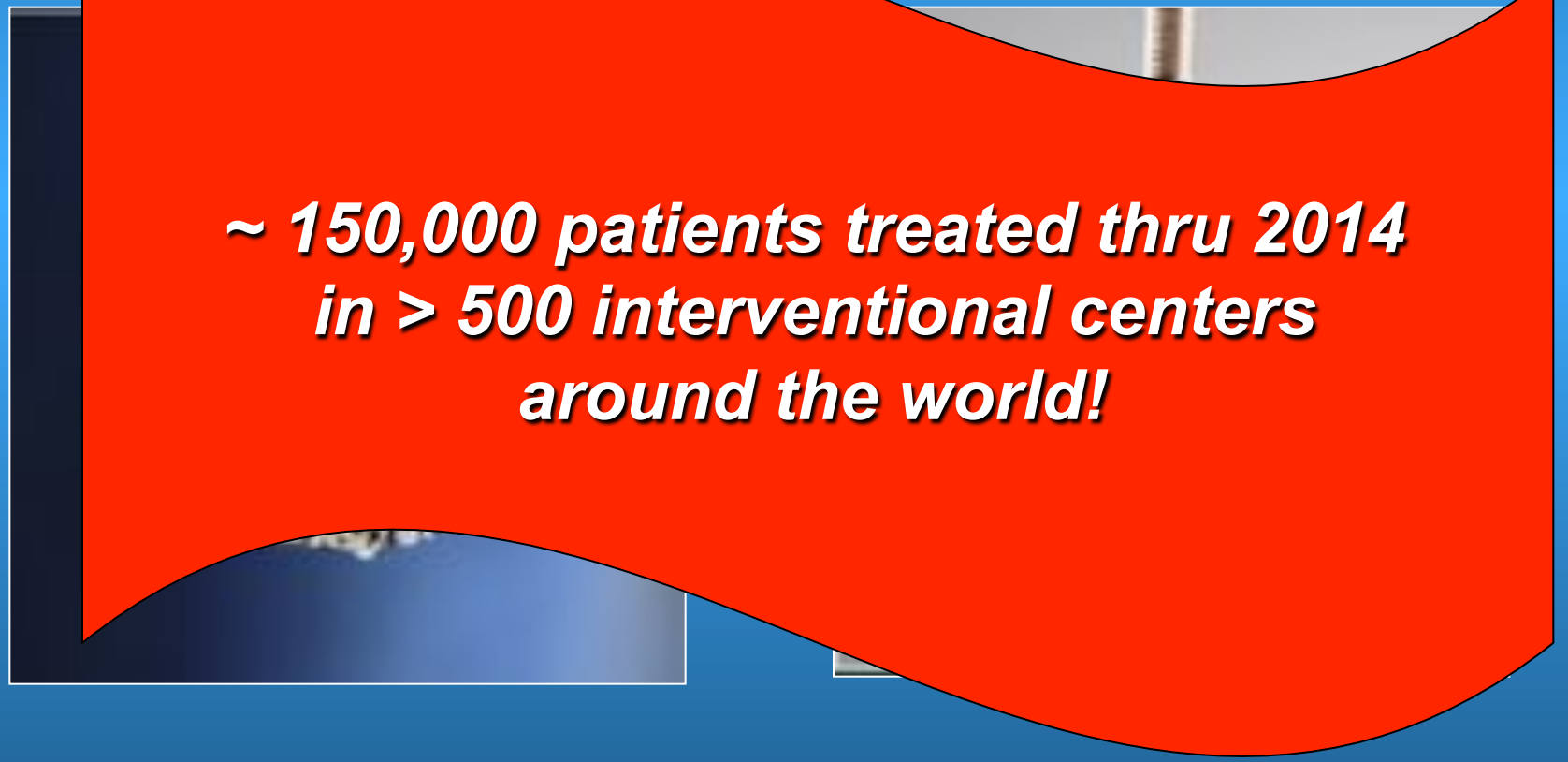
Medical conditions that preclude surgery and not captured within the predictive score

- Porcelain aorta
- Radiation to sternum, deformities, burns
- Severe COPD, liver



P. Kojodjojo et al. Q J Med 2008;101:567-573

Transcatheter Aortic Valve Implantation (TAVI)



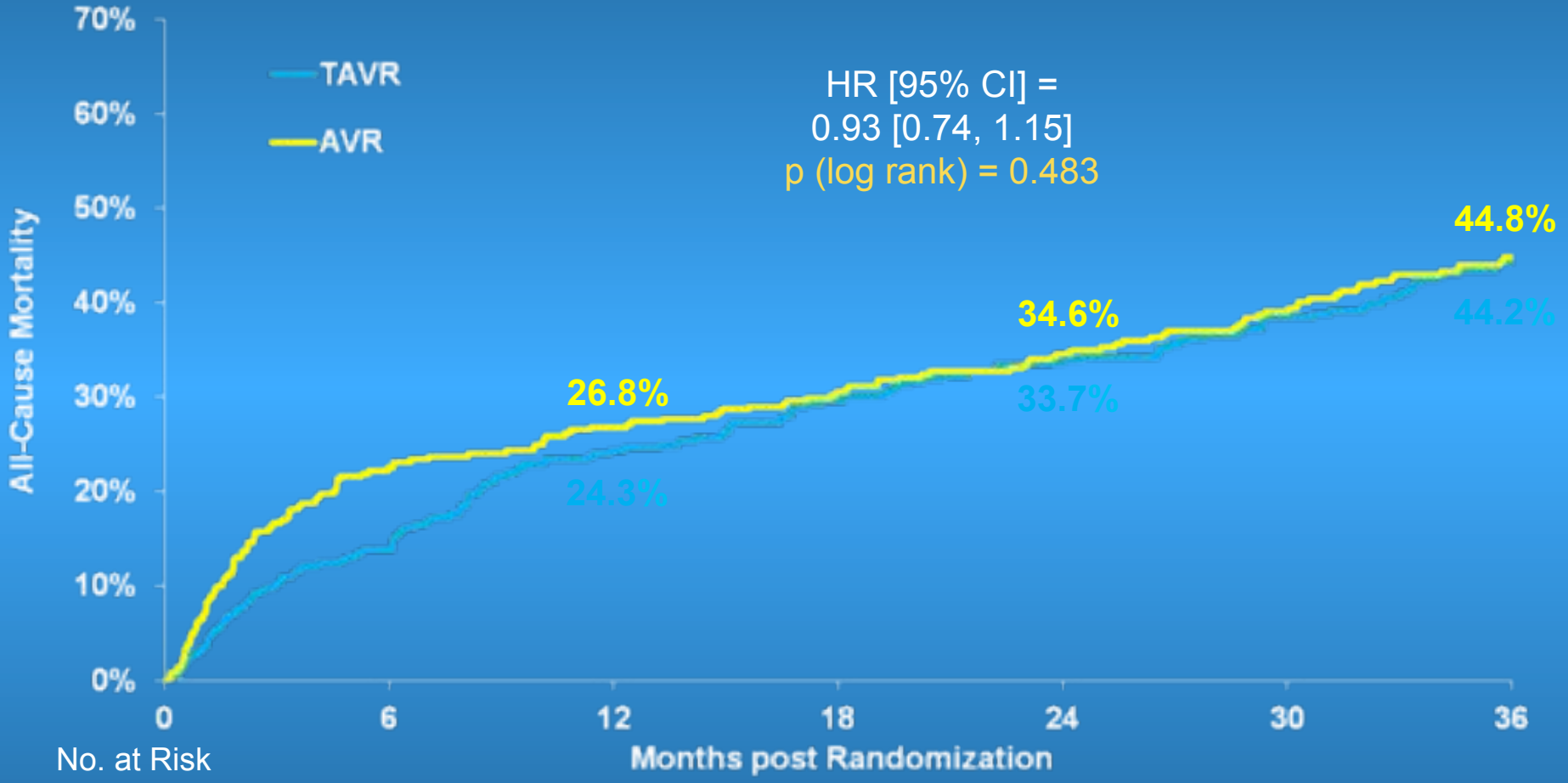
~ 150,000 patients treated thru 2014 in > 500 interventional centers around the world!

TAVI Experience

- Randomized studies
  - PARTNER A,B
  - US extreme/high risk pivotal trials
  - PARTNER II
  - SURTAVI
- Registries
  - International (SOURCE)
  - Country registries
  - Local expirience

Survival With TAVI Not Significantly Different to sAVR at 3 years

All-Cause Mortality at 3 Years (ITT)

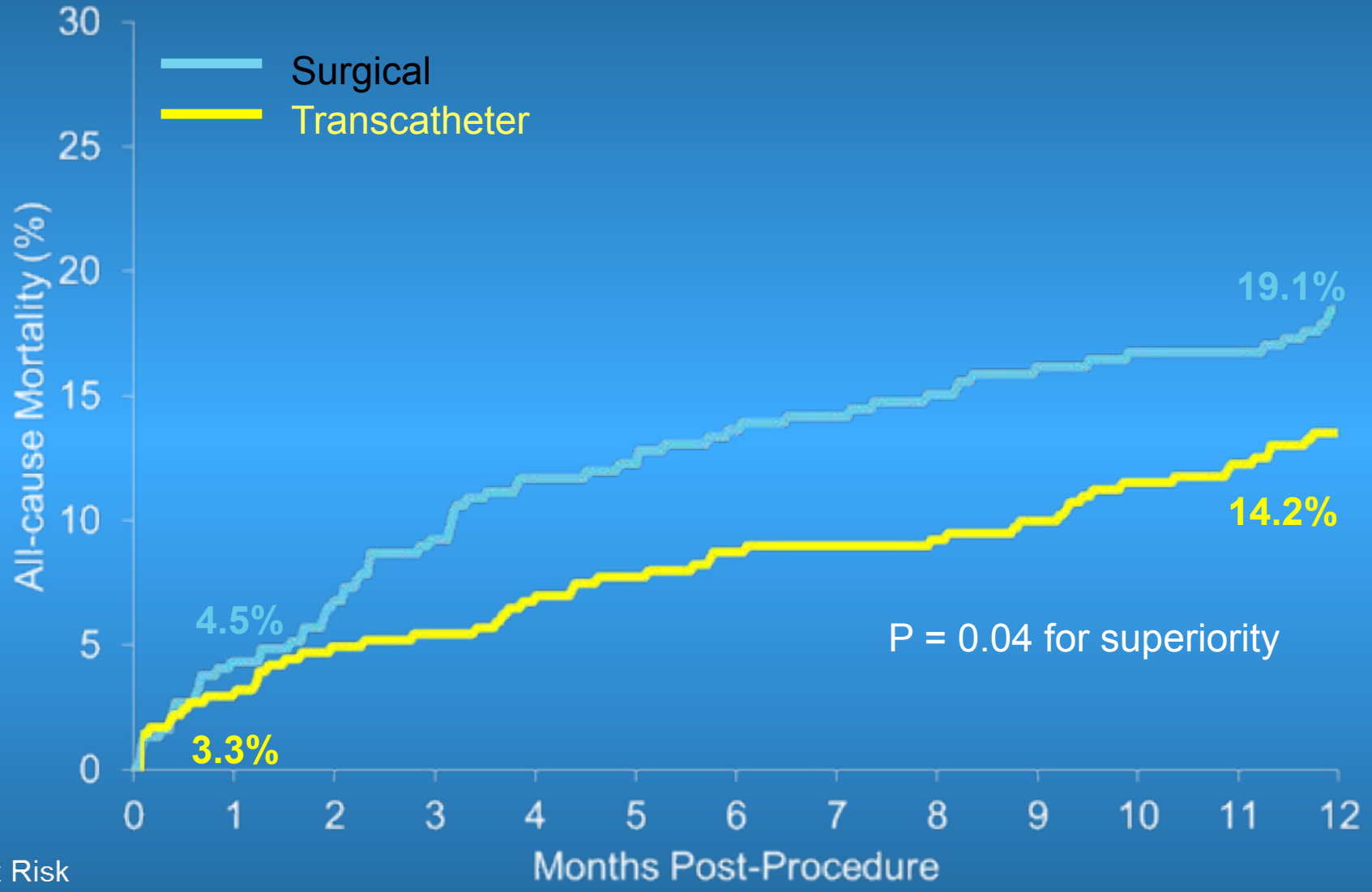


No. at Risk

TAVR	348	298	261	239	222	187	149
AVR	351	252	236	223	202	174	142

Primary Endpoint: 1 Year All-cause Mortality

ACC 2014



No. at Risk					
Surgical	357	341	297	274	
Transcatheter	390	377	353	329	

Indications for Transcatheter Aortic Valve Implantation

	Class	Level
TAVI should only be undertaken with a multidisciplinary "heart team" including cardiologists and cardiac surgeons and other specialists if necessary.	I	C
TAVI should only be performed in hospitals with cardiac surgery on-site.	I	C
TAVI is indicated in patients with severe symptomatic AS who are not suitable for AVR as assessed by a " heart team" and who are likely to gain improvement in their quality of life and to have a life expectancy of more than 1 year after consideration of their comorbidities.	I	B
TAVI should be considered in high risk patients with severe symptomatic AS who may still be suitable for surgery, but in whom TAVI is favoured by a "heart team" based on the individual risk profile and anatomic suitability.	IIa	B

European Heart Journal 2012 - doi:10.1093/eurheartj/ehs109 & European Journal of Cardio-Thoracic Surgery 2012 - doi:10.1093/ejcts/ezs455).

FH 1934

Long history of dyspnoe

- COPD Gold III, FEV1 < 1000 ml
- chronic oxygen therapy

Chronic anemia

- angiodysplasia of coecum, colon ascendens

June 2010

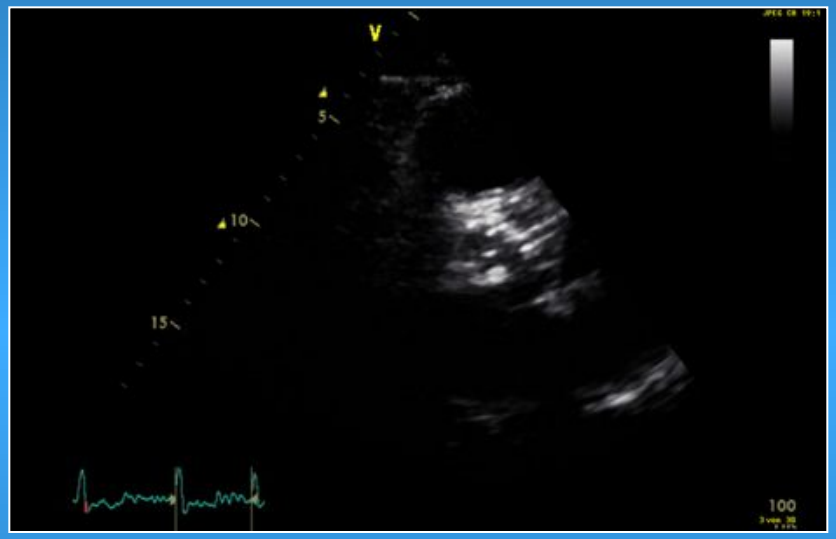
- hospitalisation because of severe heart failure
- new ? AF
- diagnosis of AS
- referred for evaluation of TAVI

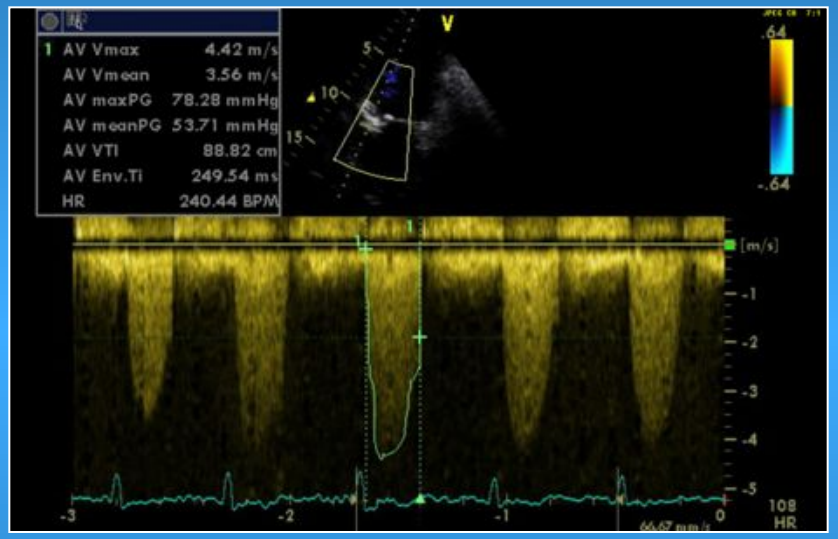
Is TAVI

Appropriate ?

Feasible ?

ECHO-Doppler





Severe calcified aortic stenosis (ECHO)

mean gradient 54 mmHg, Vmax 4,42m/sec

annulus diameter 23 mm

FH 1934 Heart catheterization

Severe aortic stenosis
Normal coronaries
Pulmonary hypertension
    sPAP 90 mmHg, PCW 35 mmHg
COPD GOLD III
Renal insufficiency (GFR 45 ml)
Chronic anemia

Logistic EUROScore 24.48%
New EUROScore 9.2 %

TAVI Assessment

Severe AS

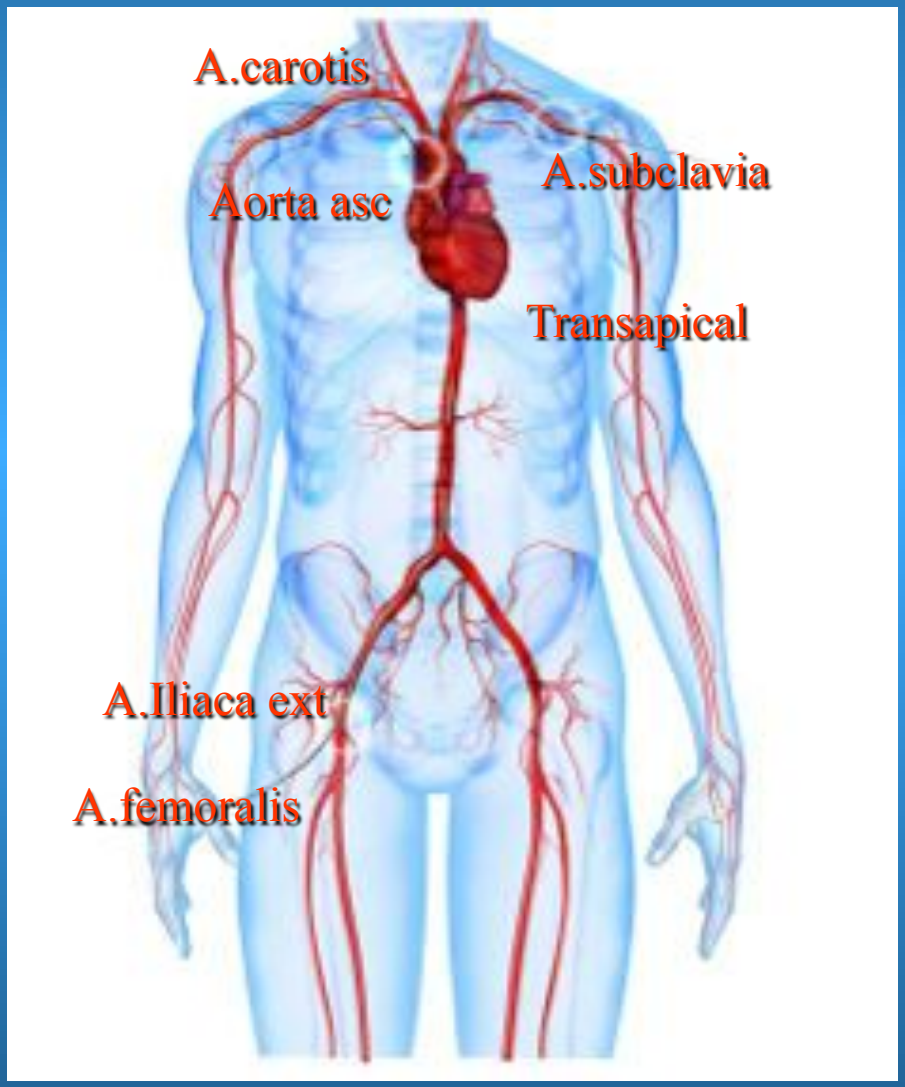
Aortic valve suitable for TAVI

CAD

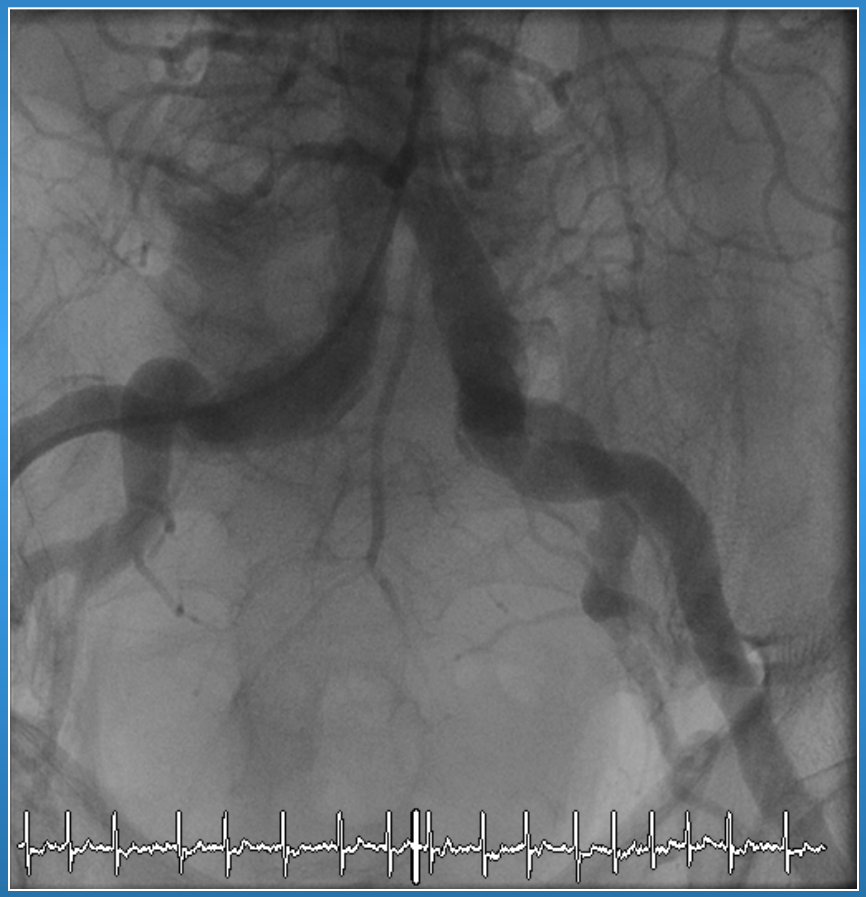
Vascular access

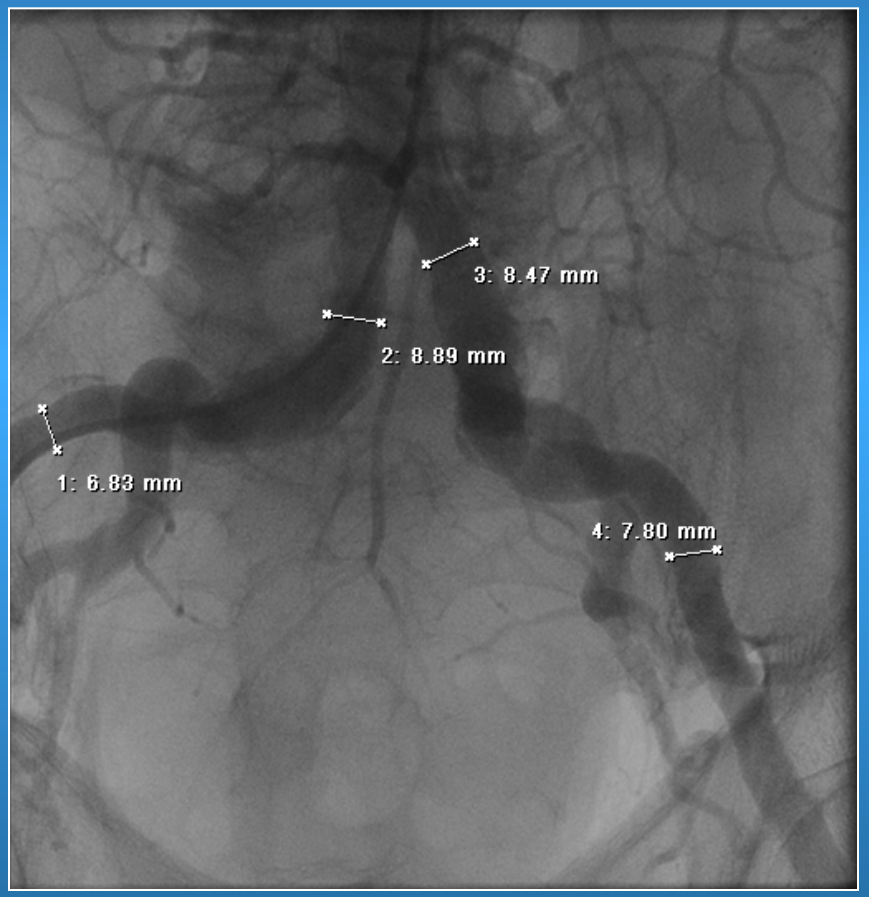
Additional assessment (frailty, mental status, comorbitities)

TAVI Arterial Access



FH 1934 Angio or CT Patency, Diameter, Tortuosity and Calcification of femoro-iliac Vessels



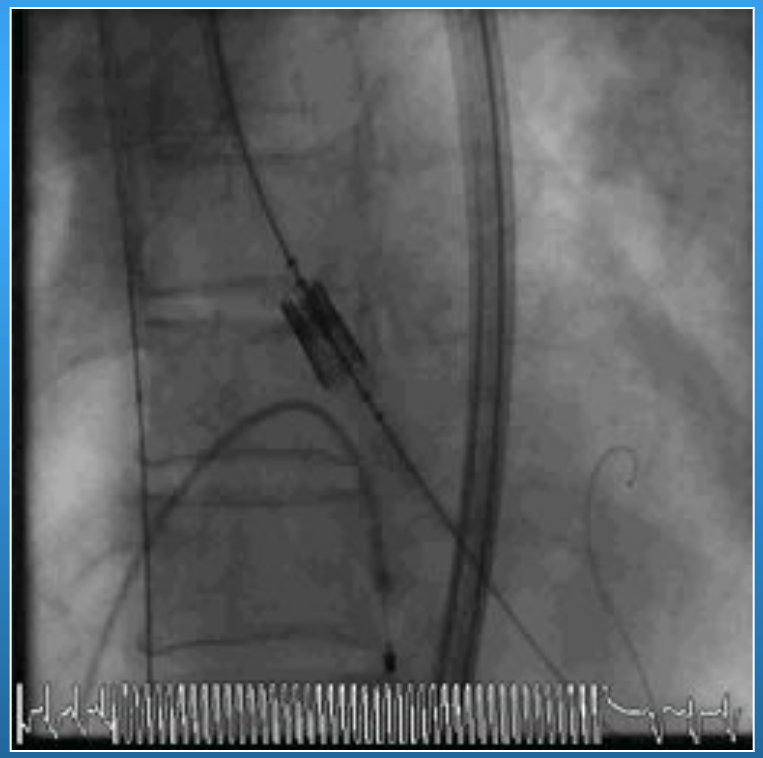


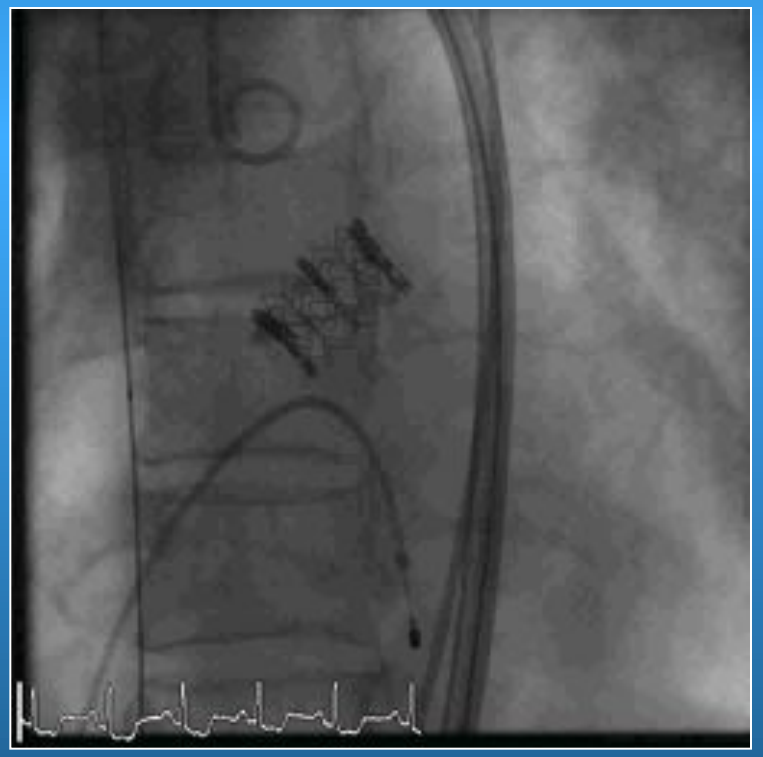
Suprainguinal Catheter Access for TAVI

FH 1934

Transfemoral implantation of an Edwards Novaflex 26mm bioprosthesis on July 19,2010

in local anesthesia (no additional sedation)





FH 1934

Uneventful peri- and postprocedural course

TTE on July 20.
normal functioning bioprosthesis
mean gradient 11 mmHg
minimal paravalvular AR
mild MR

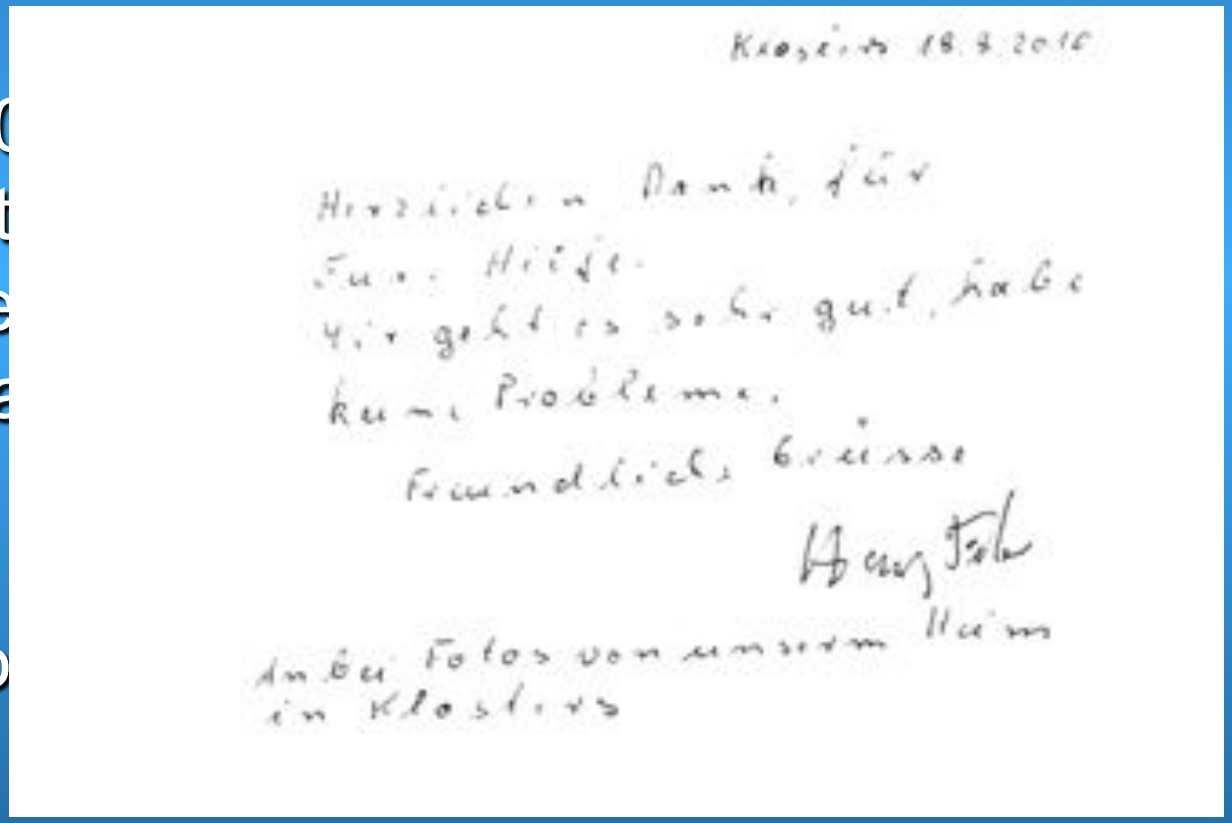
Discharged home after 7 days

FH 1934

Uneventful peri- and postprocedural course

TTE on July 20
- normal funct
- mean gradie
- minimal para
- mild MR

Discharged ho



Nothing could probably go wrong, could it?

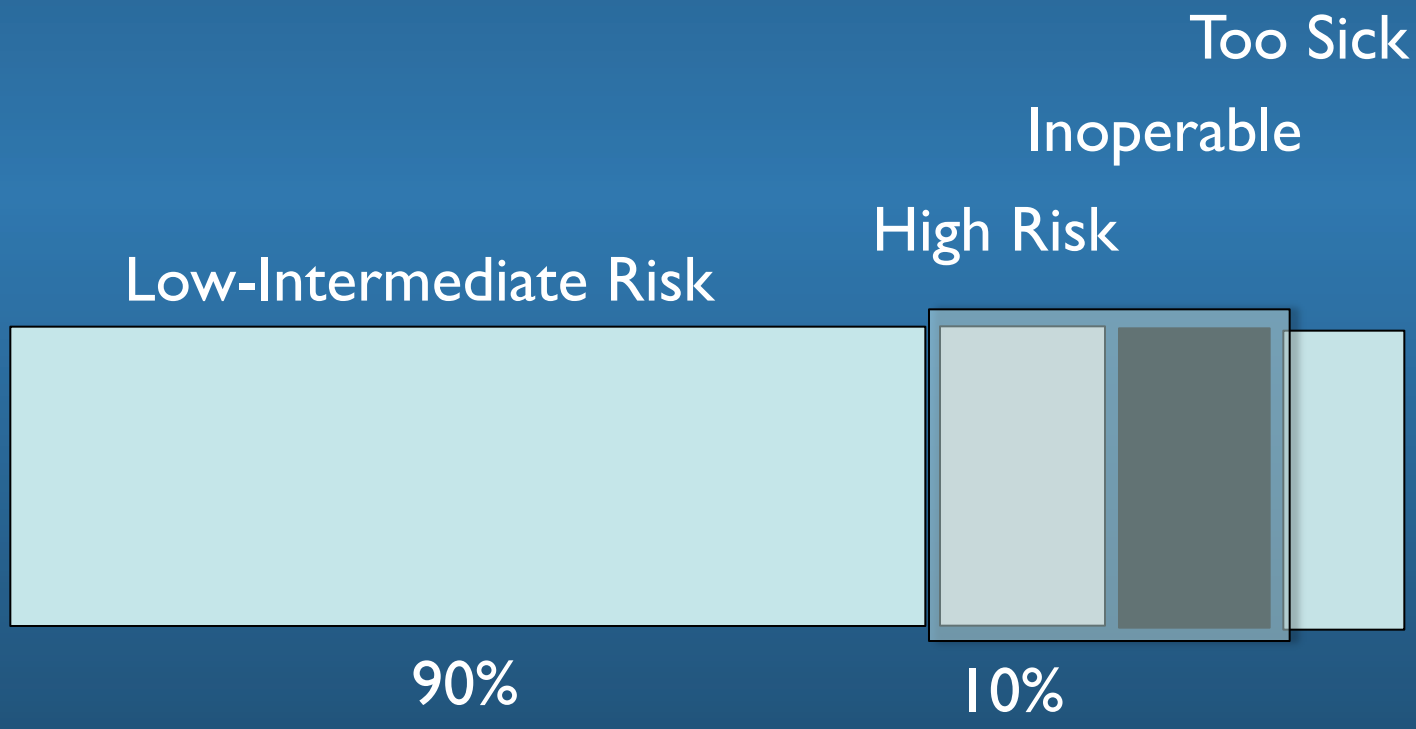
TAVI Issues

- Patient selection
- Access problems (vascular complications)
- Stroke
- Paravalvular AR
- Complete AV block
- Long-term data (10+ years) missing

TAVI Categories

(risk is a continuum)

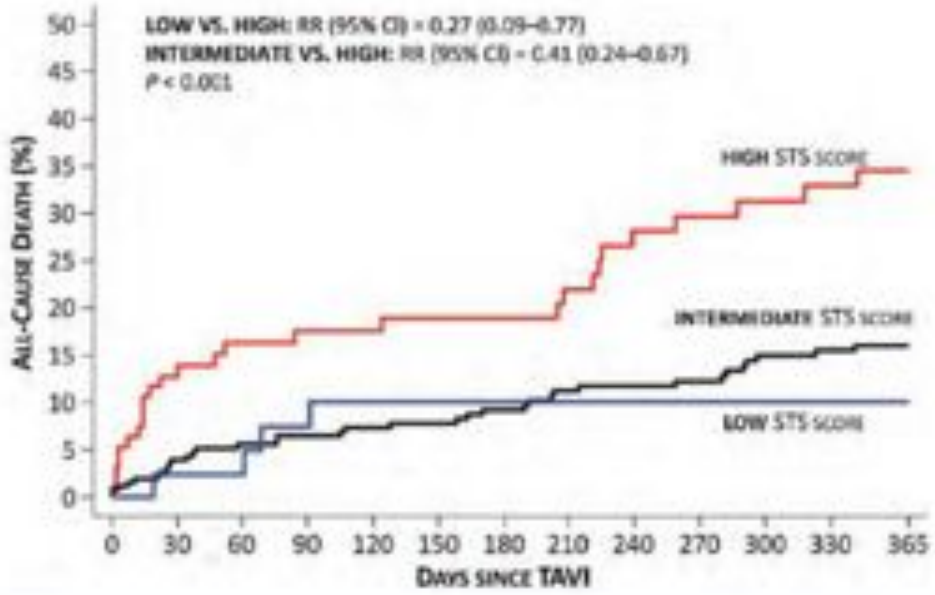
Operable AS patients

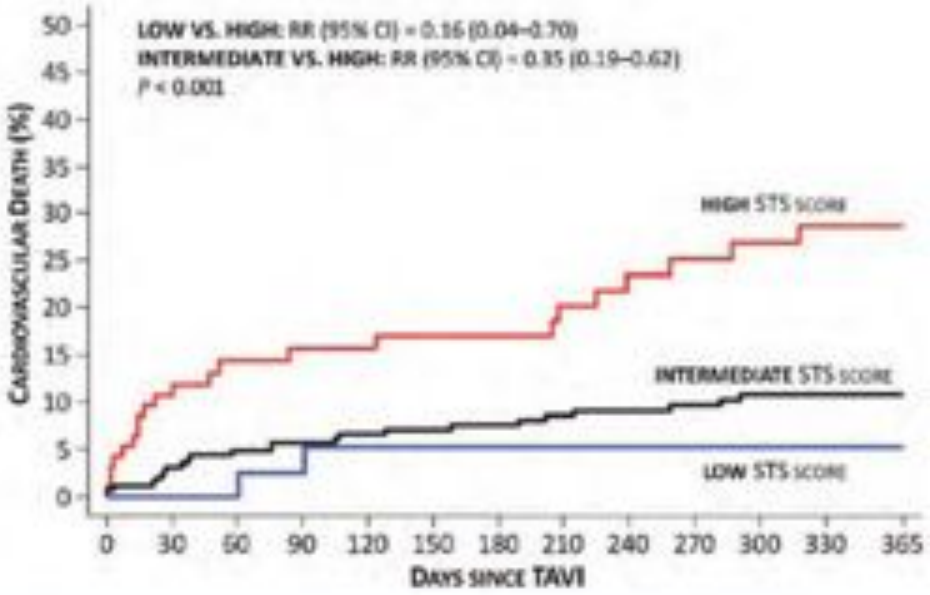


Clinical outcomes of patients with estimated low or intermediate surgical risk undergoing transcatheter aortic valve implantation

Peter Wenaweser[1†*], Stefan Stortecky[1†], Sarah Schwander[1], Dik Heg[2], Christoph Huber[3], Thomas Pilgrim[1], Steffen Gloekler[1], Crochan J. O'Sullivan[1], Bernhard Meier[1], Peter Jüni[2], Thierry Carrel[3], and Stephan Windecker[1,2]

Cut-off <3, 3-8, >8





AS in Octogenerians
sAVR vs TAVI

- Risk of procedure
- Improvement in symptoms
- Gain/loss of quality months-years
- Durability
- Patient preferance

Who Is Too Sick for TAVI?

Patients in whom the presence of multiple comorbidities, especially frailty, overwhelm the likelihood of functional recovery despite successful TAVI

TAVI **Medical therapy**

Porcelain aorta
Hostile chest
RIMA/LIMA anatomy

Severe COPD
Liver cirrhosis

Dementia

Severe frailty

HerzGefässZentrum Zürich
Klinik im Park

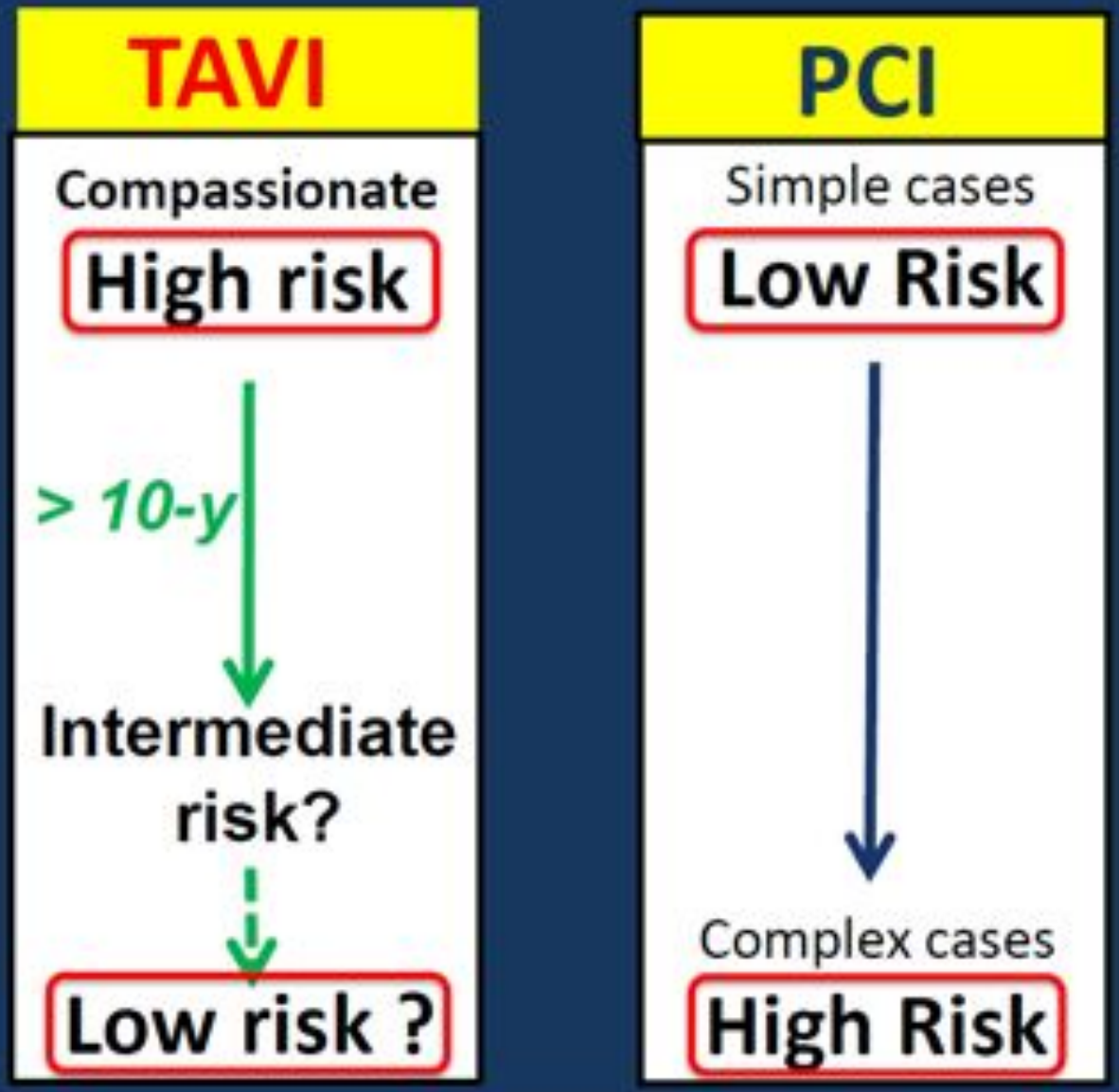
Severe AS in 2014

- High incidence of AS with aging population
  - 4.6 % in individuals > 75 y
- Problems with “watchful” waiting (in the guidelines)
  - Late symptom reporting (adjustment of life style)
  - Higher surgical risk in symptomatic pts
  - Irreversible myocardial damage
  - Low gradient/ low EF AS
- Search for symptoms
  - Positive stress test, biomarkers (BNP)
- Correct diagnosis (Physical exam, ECHO)
  - Risk for rapid progression with calcification, Vmax increase of 0.3 m/sec within 1 year
  - CAD, hypertensive CMP, comorbidities

Severe AS in 2014

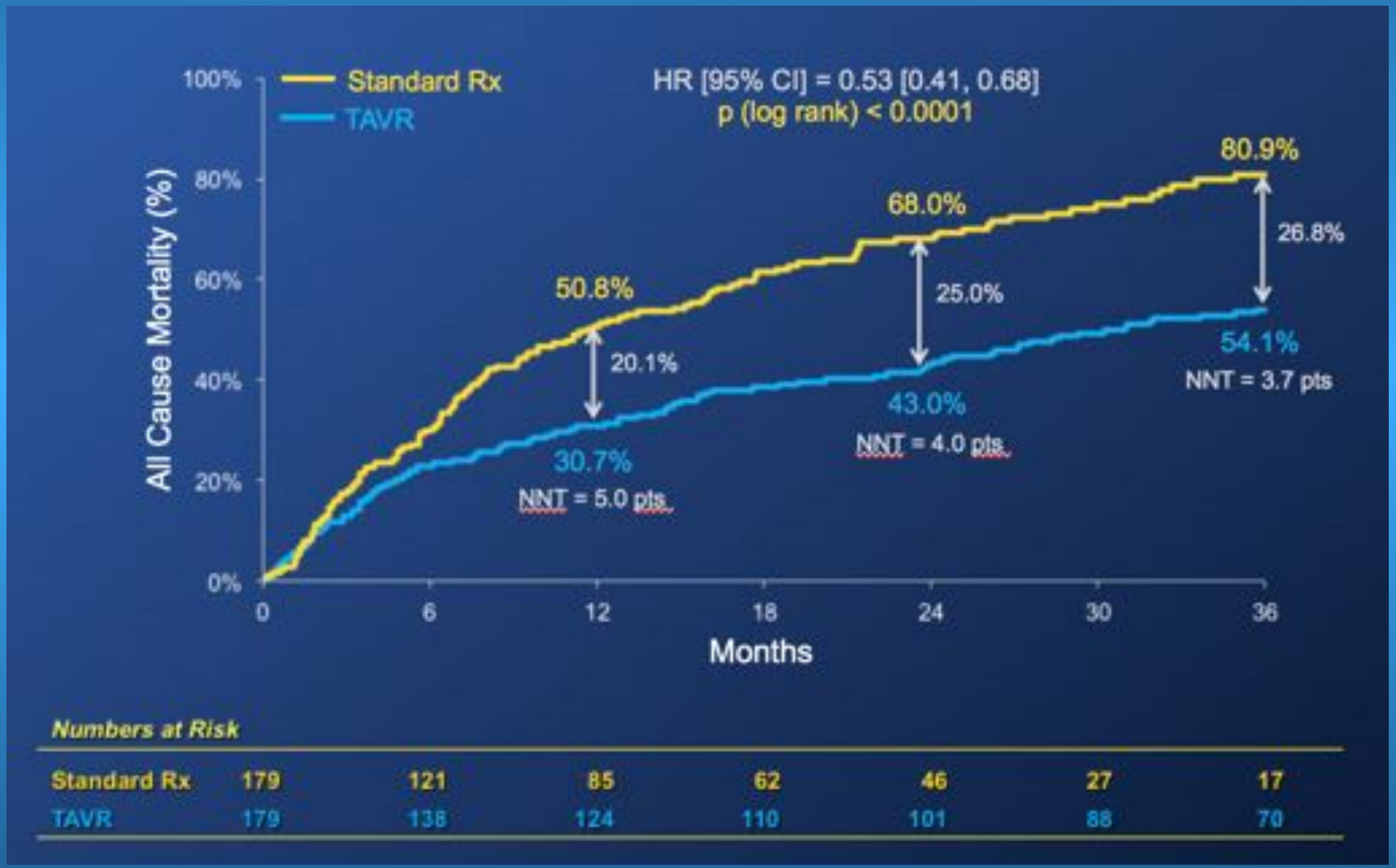
- There is no conservative treatment option for AS
- Patients with severe aortic stenosis should be referred to a valve center early
- In patients with high surgical risk and in the very elderly, TAVI is the preferred treatment of severe AS (with clinical and anatomic restrictions)

The unusual and highly challenging pathway of TAVR



PARTNER Trial Cohort B – 3-year Outcomes

All Cause Mortality (ITT) Crossover Patients Censored at Crossover



SOURCE: S. R. Kapadia | TCT 2012 | Miami | October 22, 2012

Corevalve High Risk: Study Purpose

Compare the safety and effectiveness of TAVR with the CoreValve prosthesis to surgical valve replacement in symptomatic patients with severe aortic stenosis at increased surgical risk

Adams DH, Popma JJ, Reardon MJ, et al. New Engl J Med 2014; *in press.*

Baseline Demographics

Characteristic	TAVR N=390	SAVR N=357
Age, years	83.1 ± 7.1	83.2 ± 6.4
Men, %	53.1	52.4
STS Predicted Risk of Mortality, %	7.3 ± 3.0	7.5 ± 3.4
Logistic EuroSCORE, %	17.7 ± 13.1	18.6 ± 13.0
NYHA Class III/IV, %	85.6	86.8
Prior Coronary-artery Bypass Surgery	29.5	31.1
Diabetes Mellitus, %	34.9*	45.4*
Insulin Requiring Diabetes, %	11.0	13.2
Prior Stroke, %	12.6	14.0
Modified Rankin 0 or 1, %	74.5	87.2
Modified Rankin > 1, %	25.5	12.8
STS Severe Chronic Lung Disease, %	13.3	9.0

*P < 0.01

Aortenklappe

Aortenstenose

Abnützung/Degeneration

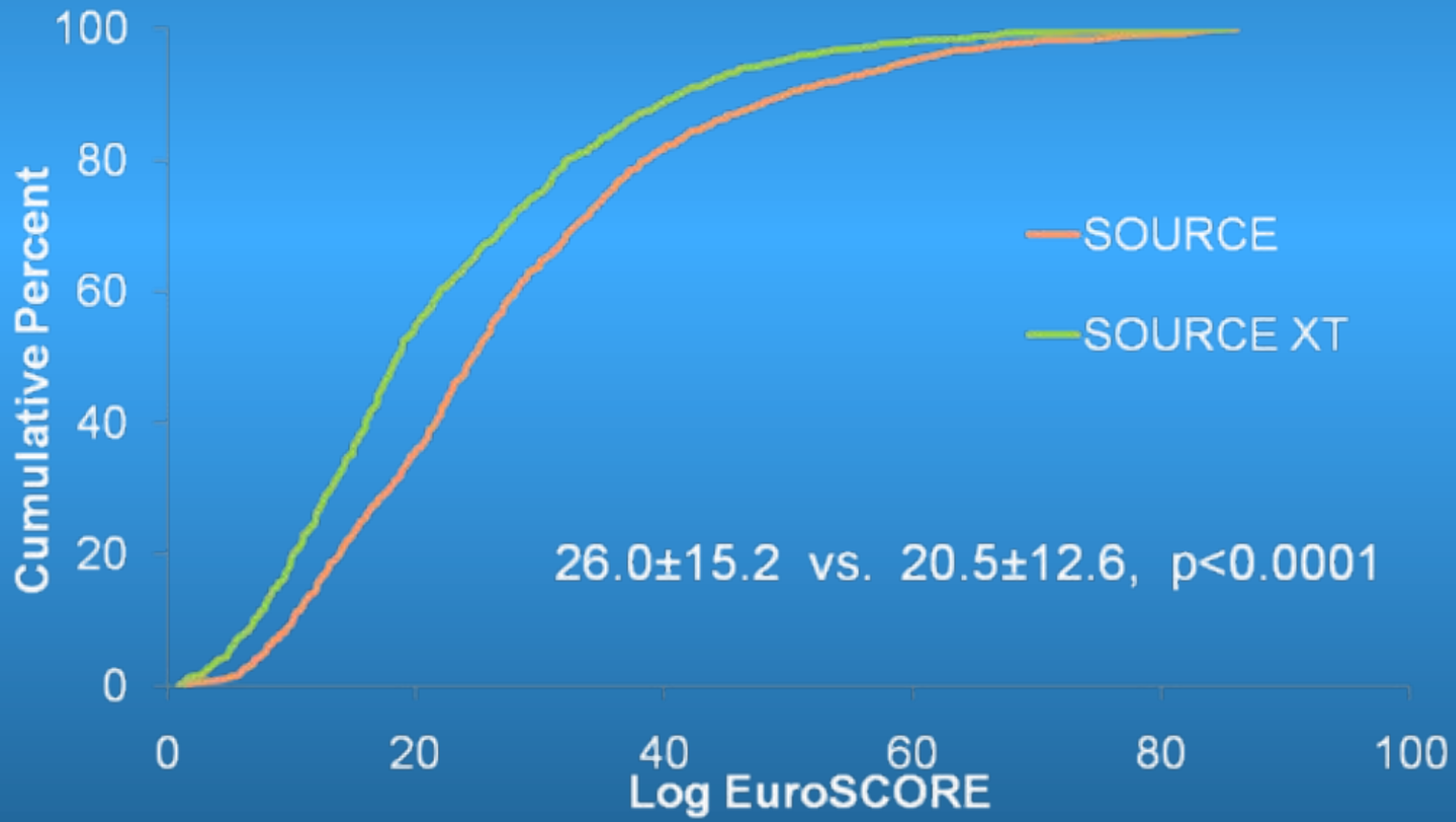
Alter

Hoher Blutdruck

Hypercholesterinämie

Infektionen

Euro Score Over Time From SOURCE to SOURCE XT



HerzGefässZentrum Zürich
Klinik im Park

Corevalve high risk
Baseline Demographics

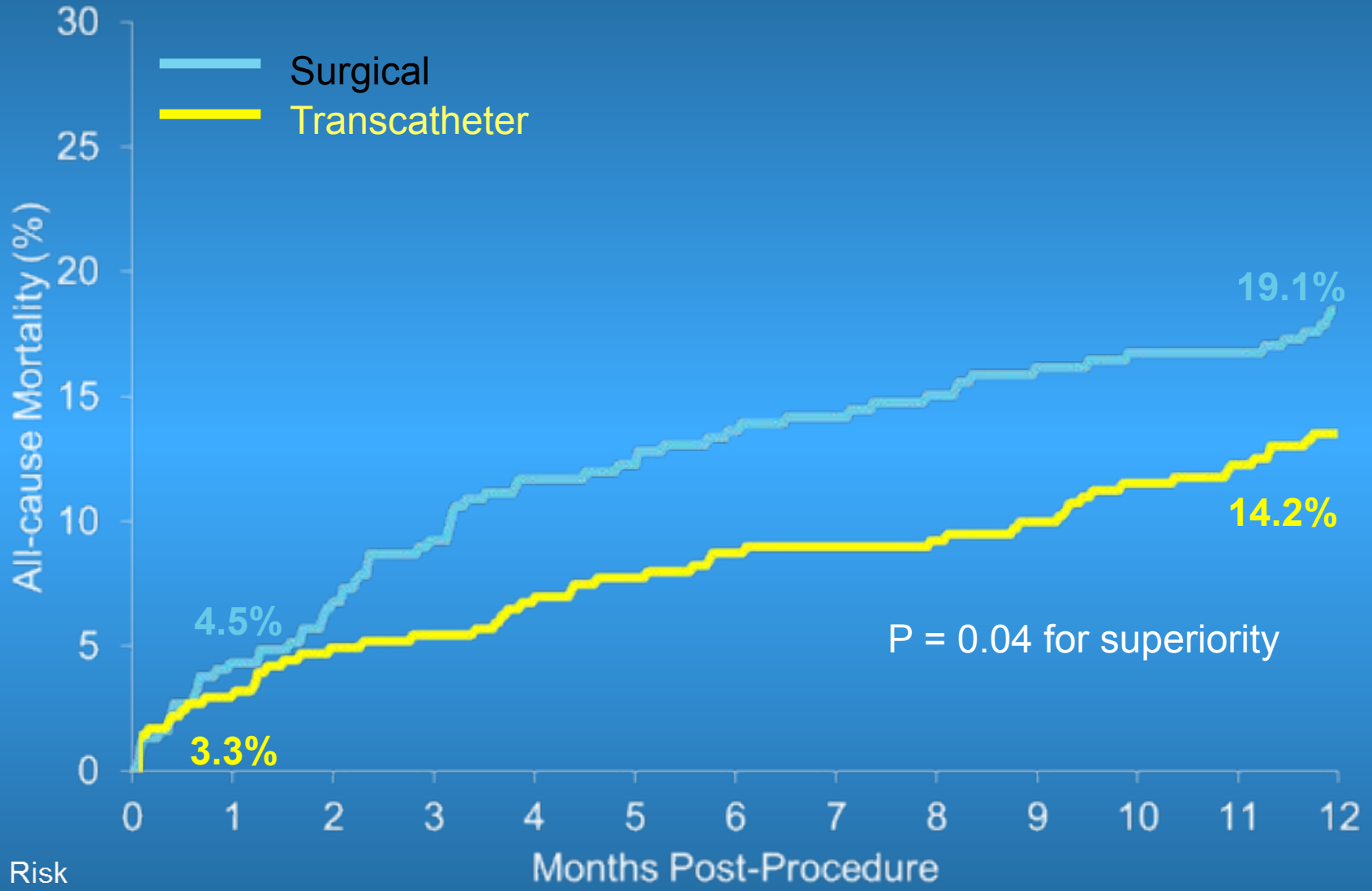
Characteristic	TAVR N=390	SAVR N=357
Age, years	83.1 ± 7.1	83.2 ± 6.4
Men, %	53.1	52.4
STS Predicted Risk of Mortality, %	7.3 ± 3.0	7.5 ± 3.4
Logistic EuroSCORE, %	17.7 ± 13.1	18.6 ± 13.0
NYHA Class III/IV, %	85.6	86.8
Prior Coronary-artery Bypass Surgery	29.5	31.1
Diabetes Mellitus, %	34.9*	45.4*
Insulin Requiring Diabetes, %	11.0	13.2
Prior Stroke, %	12.6	14.0
Modified Rankin 0 or 1, %	74.5	87.2
Modified Rankin > 1, %	25.5	12.8
STS Severe Chronic Lung Disease, %	13.3	9.0

*P < 0.01

HerzGefässZentrum Zürich
Klinik im Park

Primary Endpoint: 1 Year All-cause Mortality

ACC 2014



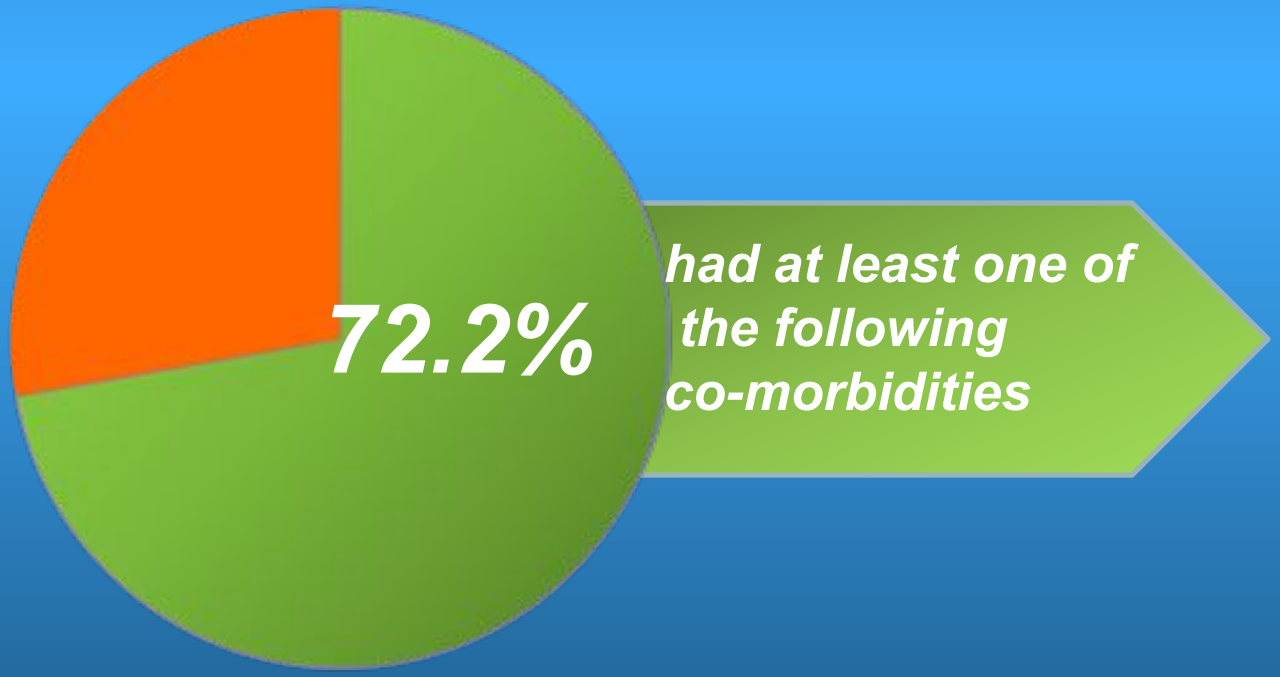
No. at Risk					
Surgical	357	341	297		274
Transcatheter	390	377	353		329

HerzGefässZentrum Zürich
Klinik im Park

Co-Morbidities

Not considered in the Euro Score Assessment

Patients with Euro Score < 20
N=1550



- *Porcelain Aorta*
- *Liver Disease*
- *Frailty=6*
- *Cancer*
- *Severe Pulmonary Hypertension*
- *Dialysis*

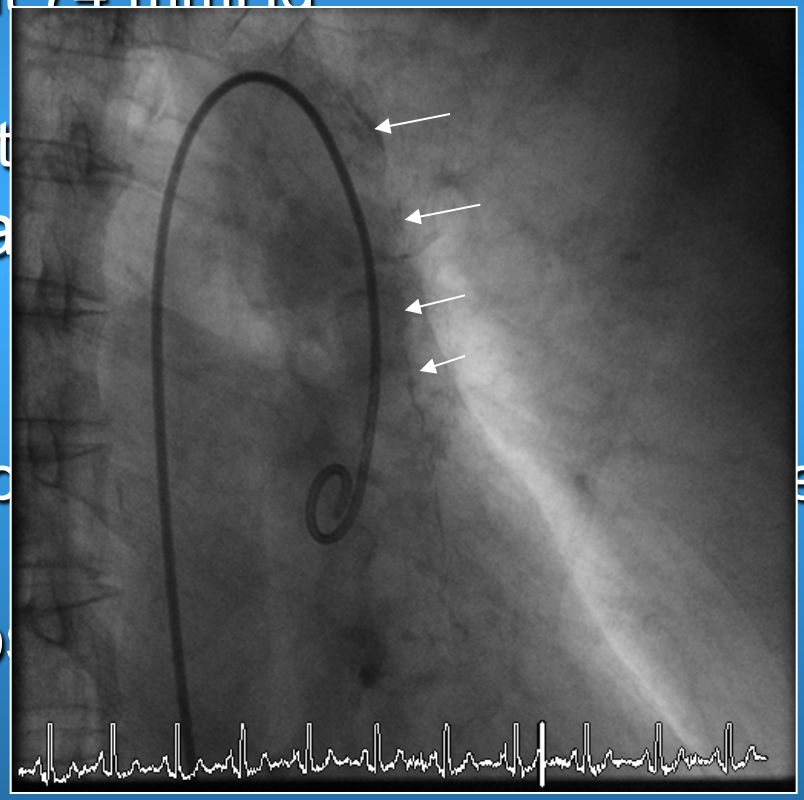
HerzGefässZentrum Zürich
Klinik im Park

63 year old lady with severe AS

- Severe AS
  - Mean systolic gradient 74 mmHg
  - NYHA III
  - Mild pulmonary hypertension
- Coronary artery disease
  - Post LCX stenting
- Radiation therapy for Morbus Hodgkin 1965
  - Postactinic stenoses of carotid and subclavian artery
  - Porcelain aorta
- Euroscore 5.41, Euroscore2 1.32, STS 1.5

63 year old lady with severe AS

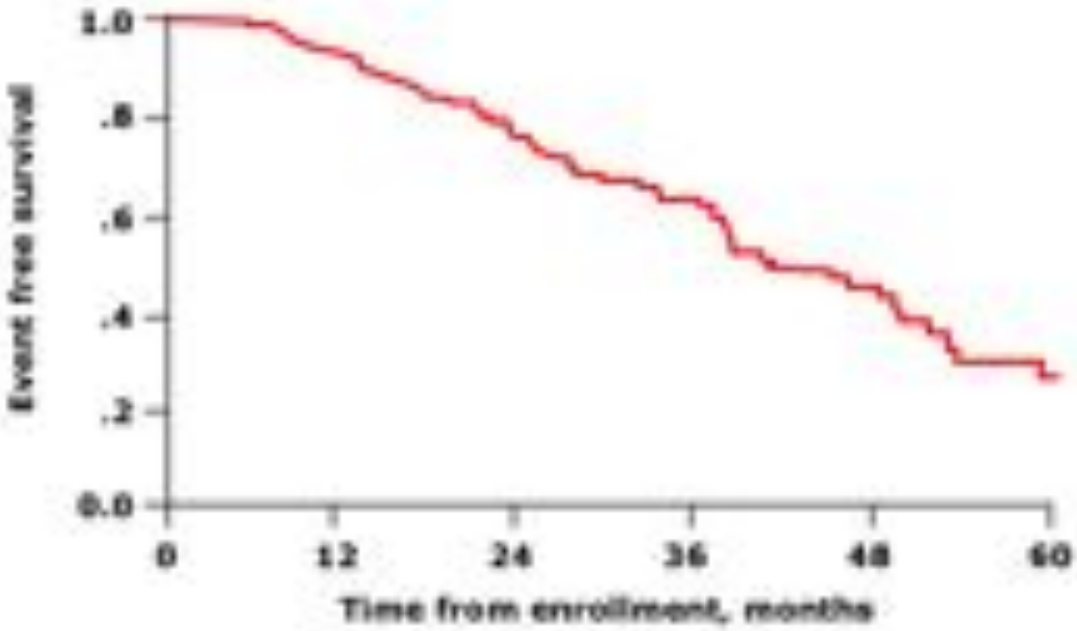
- Severe AS
  - Mean systolic gradient 74 mmHg
  - NYHA III
  - Mild pulmonary hypert
- Coronary artery disea
  - Post LCX stenting
- Radiation therapy for
  - Postactinic stenoses o ery
  - Porcelain aorta
- Euroscore 5.41, Euro



63 year old lady with severe AS

- TAVI transfemoral
- with SapienEdwards 23 mm June 2008
- Uneventful course
  - Active (running, biking)
  - No cardiac symptoms
  - Mean gradient 12 mm HG, minimal AR
  - No signs of valve degeneration

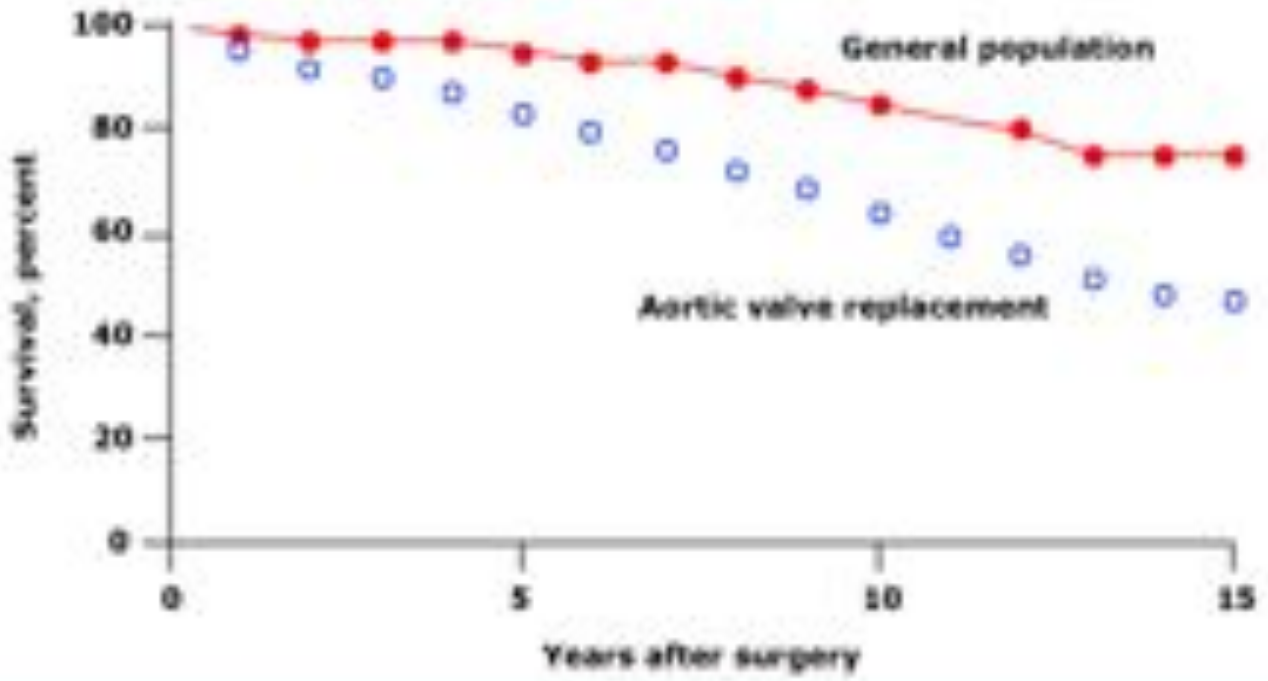
Survival in asymptomatic aortic stenosis



Kaplan-Meier analysis shows survival without valve replaement for 123 patients with valvular aortic stenosis who were intially asymptomatic.

Data from Otto CM, Burwash IG, Legget ME, et al. Circulation 1997; 95:2262.

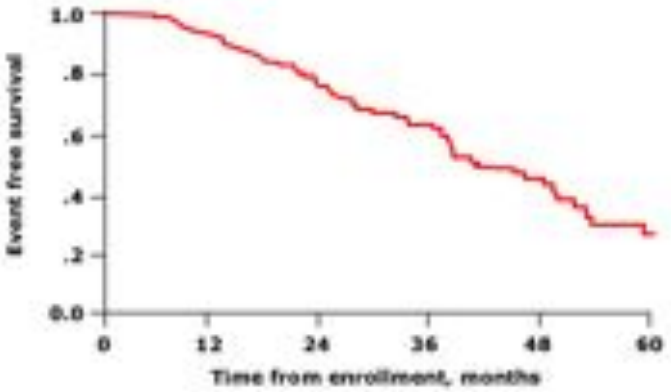
Long-term mortality in patients undergoing AVR



Among 2227 patients undergoing aortic valve replacement who survived the first postoperative month, the observed long-term mortality (open blue circles) is higher during the entire follow-up period when compared to that expected in the general population (closed red circles).

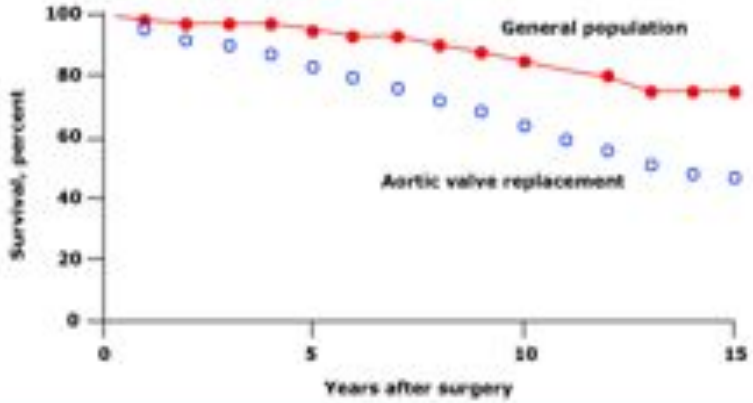
Data from Kvidal P, Bergstrom R, Horte LG, Stahle E. J Am Coll Cardiol 2000; 35:747.

Survival in asymptomatic aortic stenosis



Kaplan-Meier analysis shows survival without valve replaeme
for 123 patients with valvular aortic stenosis who were intial
asymptomatic.
Data from Otto CM, Burwash IG, Legget ME, et al. Circulation 1997; 95:2262.

Long-term mortality in patients undergoing AVR



Among 2227 patients undergoing aortic valve replacement who survived the first postoperative month, the observed long-term mortality (open blue circles) is higher during the entire follow-up period when compared to that expected in the general population (closed red circles).
Data from Kvidal P, Bergstrom R, Horte LG, Stahle E. J Am Coll Cardiol 2000; 35:747.

ACC/AHA Guideline Summary: Indications for aortic valve replacement (AVR) in aortic stenosis (AS)

Class I - There is evidence and/or general agreement that AVR is indicated in patients with AS in the following settings
• Symptomatic severe AS.
• Severe AS in patients undergoing coronary artery bypass graft surgery or surgery on the aorta or other heart valves.
• Severe AS with a left ventricular ejection fraction less than 50 percent.
Class IIa - The weight of evidence or opinion is in favor of the usefulness of AVR in patients with AS in the following setting
• Moderate AS in patients undergoing coronary artery bypass graft surgery or surgery on the aorta or other heart valves.
Class IIb - The weight of evidence or opinion is less well established for the usefulness of AVR in patients with AS in the following settings
• Severe AS in asymptomatic patients who have an abnormal response to exercise such as the development of symptoms or hypotension.
• Severe AS in asymptomatic patients with a high likelihood of rapid progression (as determined by age, valve calcification, and coronary heart disease).
• Severe AS in asymptomatic patients in whom surgery might be delayed at the time of symptom onset.
• Mild AS in patients undergoing coronary artery bypass graft surgery in whom there is evidence, such as moderate to severe valve calcification, that progression may be rapid.
• Extremely severe AS (aortic valve area less than 0.6 cm^2, mean gradient greater than 60 mmHg, and aortic jet velocity greater than 5.0 m/sec) in asymptomatic patients in whom the expected operative mortality is 1 percent or less.
Class III - There is evidence and/or general agreement that AVR for AS is not useful in in the following settings
• For the prevention of sudden cardiac death in asymptomatic patients who have none of the class IIa or IIb findings.

Data from Bonow RO, Carabello BA, Chatterjee K, et al. 2008 Focused update incorporated into the ACC/AHA 2006 guidelines for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 1998 Guidelines for the Management of Patients With Valvular Heart Disease): endorsed by the Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons. Circulation 2008; 118:e523.

63 year old lady with severe AS

- Severe AS
  - Mean systolic gradient 74 mmHg
  - NYHA III
  - Mild pulmonary hypertension
- Coronary artery disease
  - Post LCX stenting
- Euroscore 5.41, Euroscore2 1.32, STS 1.5

Severity of aortic stenosis in adults

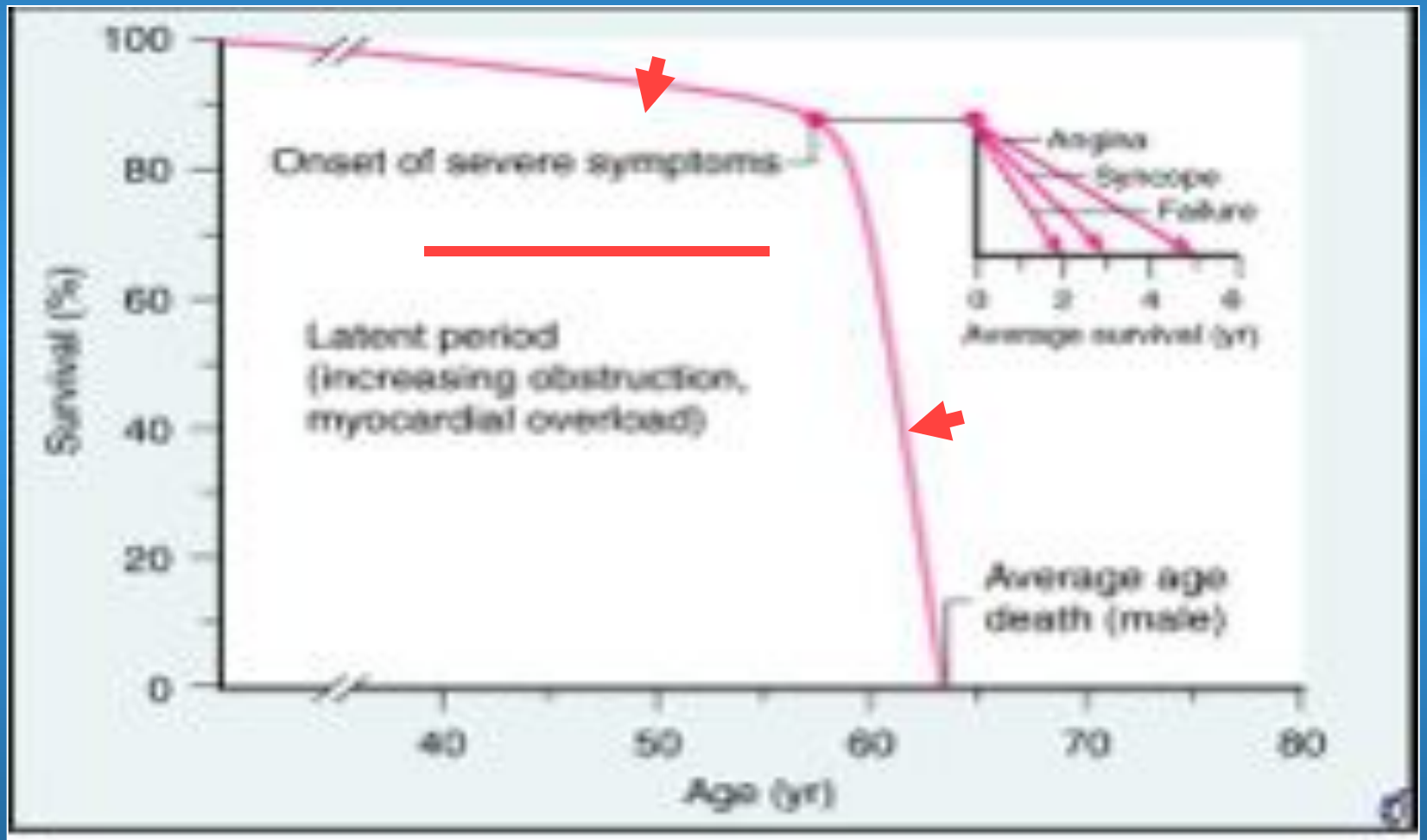
	Aortic jet velocity (m/sec)	Mean gradient (mmHg)	Valve area (cm^2)
Normal	≤2.0	<5	3.0 to 4.0
Mild	<3.0	<25	>1.5
Moderate	3.0 to 4.0	25 to 40	1.0 to 1.5
Severe	>4.0	>40	<1.0*

Critical aortic stenosis has been defined hemodynamically as a valve area <0.75 cm^2 and/or an aortic jet velocity >5.0 m/sec. However, the decision about valve replacement is not based solely on hemodynamics, as some patients who meet these criteria are asymptomatic, while others with less severe measurements are symptomatic. In patients with severe aortic stenosis who also have a low cardiac output state, the aortic jet velocity and mean gradient may be lower than indicated above (low-gradient aortic stenosis).

* Severe aortic stenosis is also considered to be present if the valve area indexed by body surface area is <0.6 cm^2/m^2.

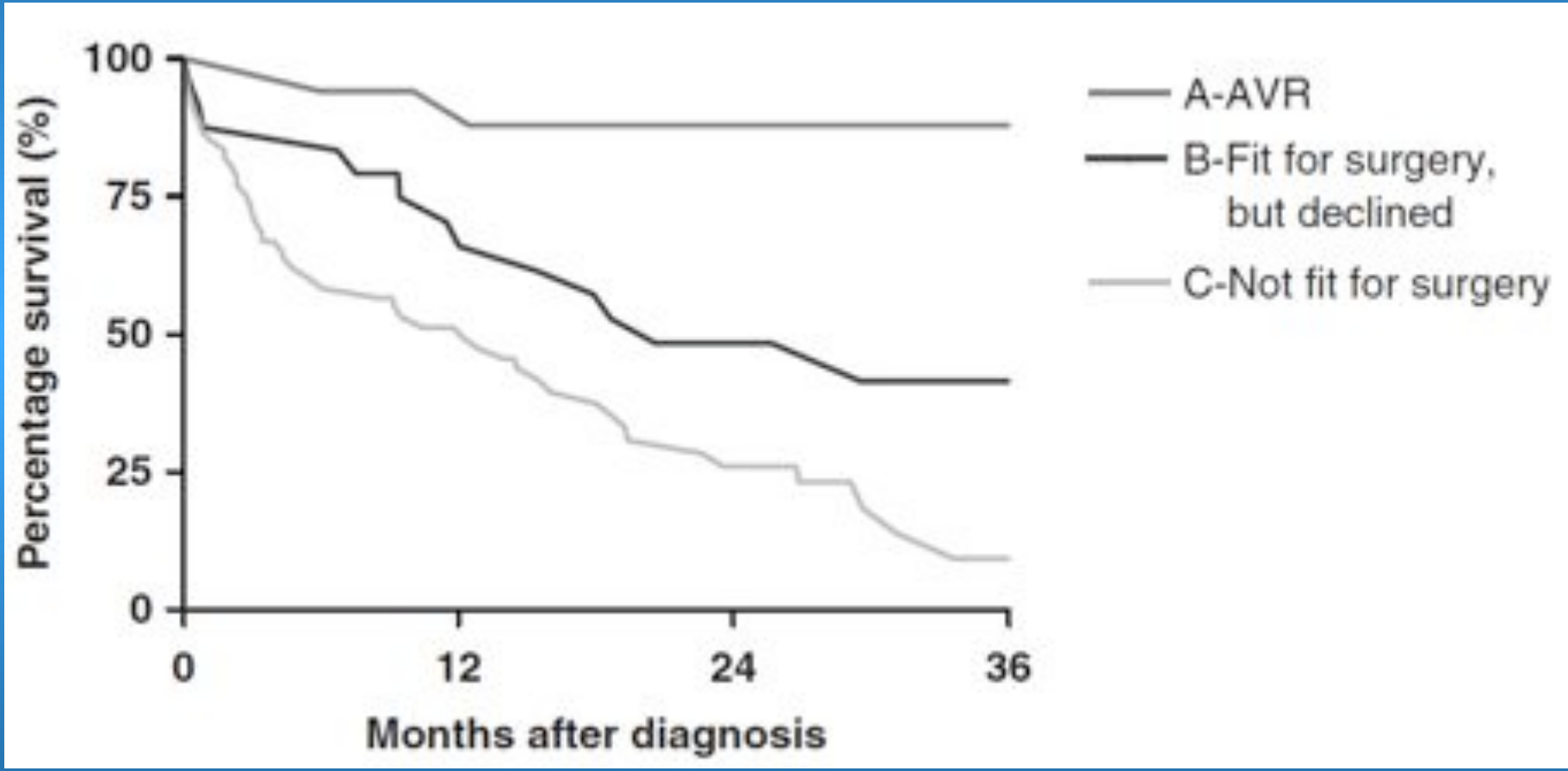
Adapted from: Bonow RO, Carabello BA, Chatterjee K, et al. 2008 Focused update incorporated into the ACC/AHA 2006 guidelines for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 1998 Guidelines for the Management of Patients With Valvular Heart Disease): endorsed by the Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons. Circulation 2008; 118:e523.

The Message in Short
The „Wait for Symptoms“ Strategy



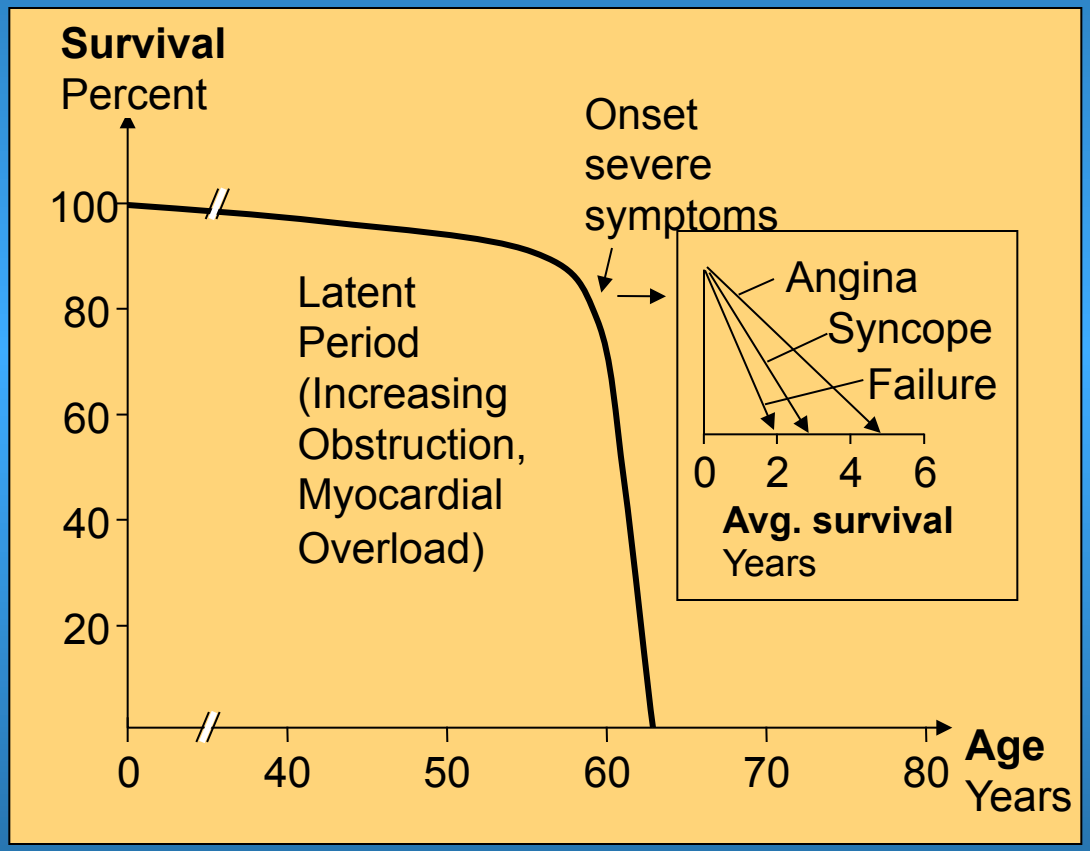
Ross J, Braunwald E Circulation 38; SuppV: 61 1968

Impact of Therapy on Prognosis in severe AS



P. Kojodjojo et al. Q J Med 2008;101:567-573

Aortic stenosis is life-threatening and progresses rapidly



"Survival after onset of symptoms is 50% at two years and 20% at five years."[1]

"Surgical intervention [for severe AS] should be performed promptly once even … minor symptoms occur."[2]

Sources: [1] S.J. Lester et al., "The Natural History and Rate of Progression of Aortic Stenosis," *Chest* 1998

[2] C.M. Otto, "Valve Disease: Timing of Aortic Valve Surgery," *Heart* 2000

Chart:: Ross J Jr, Braunwald E. Aortic stenosis. *Circulation*. 1968;38 (Suppl 1):61-7.