



Kleplijden en sport: Een praktisch overzicht

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Cardiologie UZA

Stafvergadering SPORTS 2/9/2009



Bronnen

- ESC Study Group of Sports Cardiology (Eur J of Cardiovasc Prev Rehabil)
- Bethesda Conference #36 Consensus Recommendations
- Working Groups of the AHA Committee on Exercise, Cardiac Rehabilitation, and Prevention



Kleplijden

- Incidentie van kleplijden neemt toe met de leeftijd – prevalentie stijgt eveneens
- Vaak insidieus en traag verloop van het kleplijden – vaak geen symptomen



Regelmatige sportinspanningen worden sterk gepromoot ...

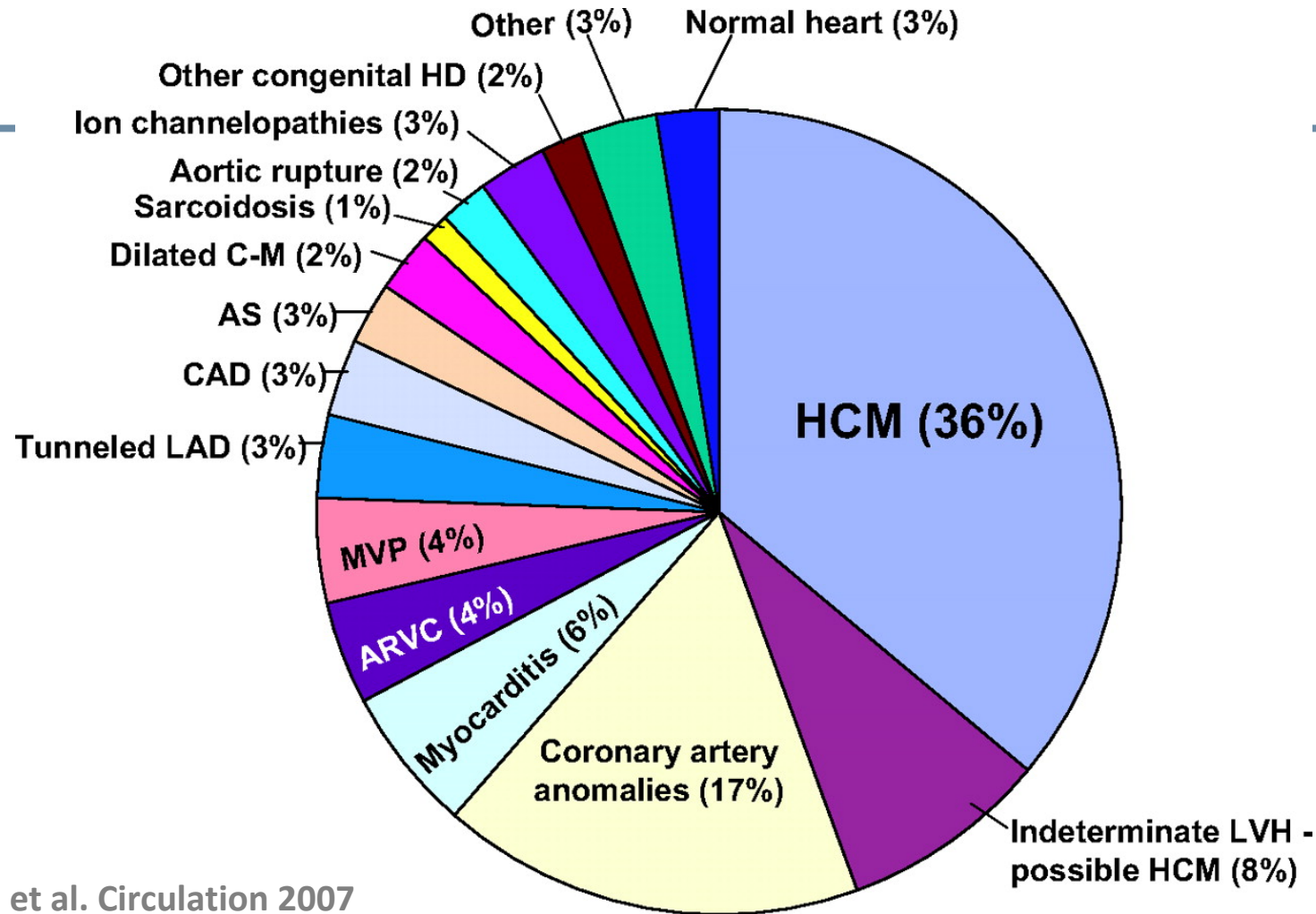




... en het aantal oudere sporters neemt toe



SCD bij jonge sporters



Maron B J, et al. Circulation 2007

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En dus ...

Belang van

- Adekwate screening
- Aangepast advies bij gekende hartproblematiek
 - CIHL
 - Kleplijden
 - Congenitale hartgebreken
 - Ritmestoornissen

Rekening houdend met de aard en de intensiteit van de inspanning (competitie vs recreatie)



Kleplijden en sport

- Echocardiografie is hoeksteen van diagnose en beleid
- Weinig richtlijnen bekend – effect van isometrische sportinspanningen op ventriculaire dysfunctie?

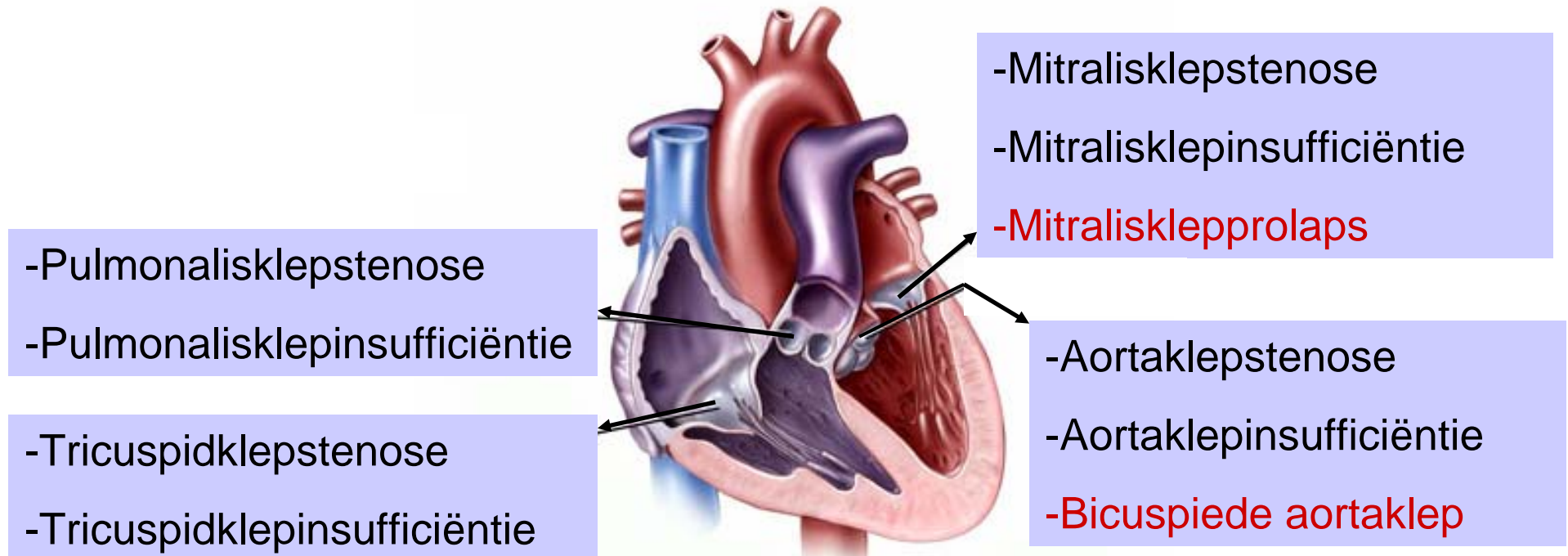
Increasing static component ↑	III. High (>50% MVC)	Bobsledding/luge,*† field events (throwing), gymnastics,*† martial arts,* sailing, sport climbing, water skiing,*† weight lifting,*† windsurfing*†	Body building,*† downhill skiing,*† skateboarding,*† snowboarding,*† wrestling*	Boxing,* canoeing/kayaking, cycling,*† decathlon, rowing, speed-skating,*† triathlon*†
	II. Moderate (20–50% MVC)	Archery, auto racing,*† diving,*† equestrian,*† motorcycling*†	American football,* field events (jumping), figure skating,* rodeoing,*† rugby,* running (sprint), surfing,*† synchronized swimming†	Basketball,* ice hockey,* cross-country skiing (skating technique), lacrosse,* running (middle distance), swimming, team handball
	I. Low (<20% MVC)	Billiards, bowling, cricket, curling, golf, riflery	Baseball/softball,* fencing, table tennis, volleyball	Badminton, cross-country skiing (classic technique), field hockey,* orienteering, race walking, racquetball/squash, running (long distance), soccer,* tennis
		A. Low (<40% max O ₂)	B. Moderate (40–70% max O ₂)	C. High (>70% max O ₂)
		Increasing dynamic component →		

FIGURE 78–1 Classification of sports. This classification is based on peak static and dynamic components achieved during competition. The increasing dynamic component is related to the estimated percent of maximal oxygen uptake (max O₂) achieved and results in an increasing cardiac output. The increasing static component is related to the estimated percent of maximal voluntary contraction (MVC) attained and results in an increasing blood pressure. The lowest total cardiovascular demands are shown in green and the highest in red. Blue, yellow, and purple depict low moderate, moderate, and high moderate total cardiovascular demands. * = danger of bodily collision; † = increased risk if syncope occurs.

(From Mitchell JH, Haskell W, Snell P, Van Camp SP: Task Force 8: Classification of sports. *J Am Coll Cardiol* 45:1364, 2005, with permission from the American College of Cardiology Foundation.)



Soorten kleppathologie

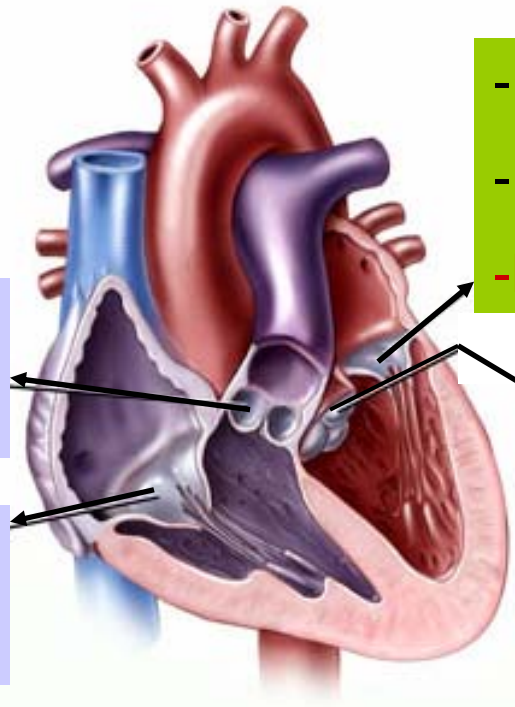




Soorten kleppathologie

-Pulmonalisklepstenose
-Pulmonalisklepinsufficiëntie

-Tricuspidklepstenose
-Tricuspidklepinsufficiëntie

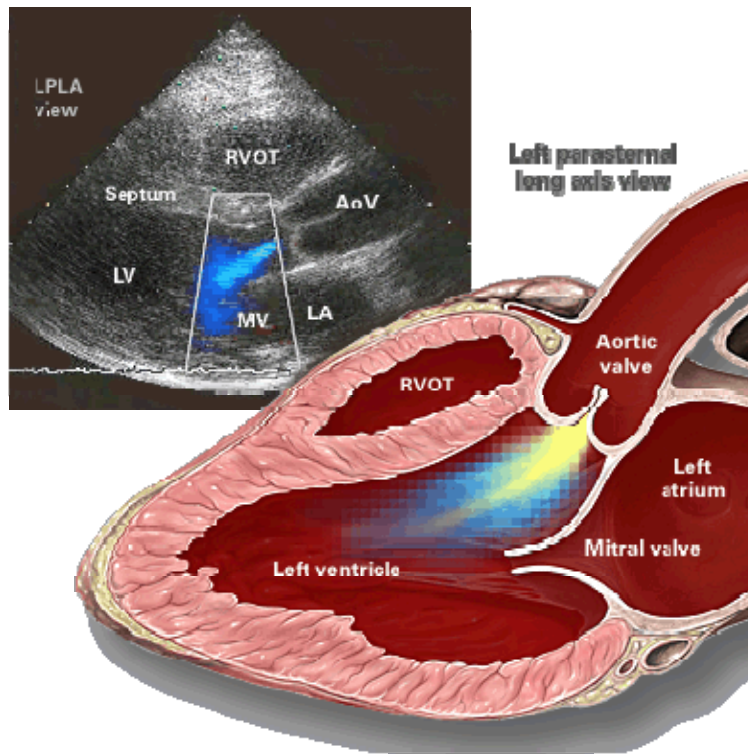


-Mitralisklepstenose
-Mitralisklepinsufficiëntie
-Mitralisklepprolaps

-Aortaklepstenose
-Aortaklepinsufficiëntie
-Bicuspiede aortaklep



Aortaklepinsufficiëntie



- **Etiologie:** AGR – bicuspede aortaklep - aortadilatatie (Marfan)
- **Chronische LV overbelasting** → compensatoire mechanismen → → hartfalen
- **Symptomen:**
 - palpitaties
 - atypische thoracale last
 - dyspnoe
- **Klinisch onderzoek:** diastolische soufflé, grote pulse pressure



Aortaklepinsufficiëntie

- Dynamische inspanningen verhogen de hartslag, waardoor kortere regurgitatie tijd
- Regelmatige duurtraining induceert bradycardie, waardoor verlenging van de regurgitatie tijd en in de hand werken van de LV dysfunctie
- Statische inspanningen verhogen afterload
→ lekkage neemt toe



Sportrichtlijnen AI

- Inspanningsmogelijkheden zijn afhankelijk van
 - Ernst van de AI
 - Intensiteit en type van inspanning



Sportrichtlijnen AI

- Dagelijkse inspanningen zijn steeds toegelaten
- Competitiesporten:

Milde AI Normal LV functie LVEDD <35mm	Matige AI Geen symptomen LVEDD 60-65mm	Milde tot matige AI Ventriculaire aritmie bij inspanning of in rust	Ernstige AI	AI Dilatatie van de aorta ascendens (>50mm)
Alle sporten	Laag dynamische en laag statische sporten Zesmaandelijke opvolging	Geen competitiesporten	Geen competitiesport Verdere evaluatie met het oog op heelkunde	Geen competitiesporten

Aortaklepsclerose/stenose



	Aortic Valve Abnormality			
	<i>None</i>	<i>Sclerosis</i>	<i>Stenosis</i>	<i>Valve Replacement</i>
TABLE 75-16	Prevalence of Aortic Valve Abnormalities Detected by Echocardiography in the Cross-sectional Cardiovascular Health Study of 5201 Medicare Subjects over 65 Years of Age*			
All subjects	3736 (72%)	1329 (26%)	88 (2%)	23 (0.4%)
Women	2249 (76%)	641 (22%)	43 (1.5%)	12 (0.4%)
Men	1487 (67%)	688 (31%)	45 (2%)	11 (0.5%)
65-74 y old	2684 (78%)	697 (20%)	43 (1.3%)	16 (0.5%)
Women	1654 (82%)	344 (17%)	20 (1.0%)	9 (0.4%)
Men	1030 (73%)	353 (25%)	23 (1.6%)	7 (0.5%)
75-84 y old	962 (62%)	542 (35%)	37 (2.4%)	7 (0.5%)
Women	546 (66%)	259 (31%)	22 (2.7%)	3 (0.4%)
Men	416 (58%)	283 (39%)	15 (2.1%)	4 (0.6%)
85+ y old	90 (48%)	90 (48%)	8 (4%)	0 (0%)
Women	49 (56%)	38 (43%)	1 (1%)	0
Men	41 (41%)	52 (52%)	7 (7%)	0

Data are expressed as number (%) of subjects.

*Reproduced from Stewart BF, Siscovick D, Lind BK, et al with permission. J Am Coll Cardiol. 29(3):630-634, 1997.

(Reproduced from Stewart BF, Siscovick D, Lind BK, et al with permission. J Am Coll Cardiol. 29(3):630-634, 1997.)





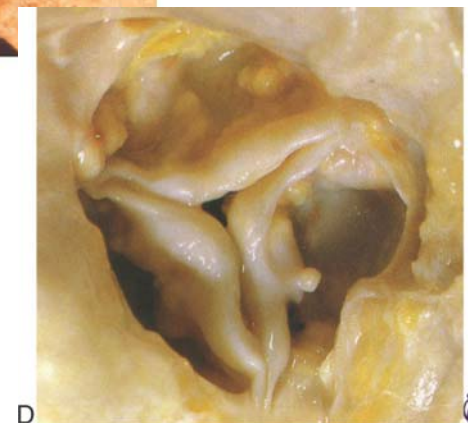
Aortaklepstenose

- **Etiologie:** AGR – degeneratief – bicuspede klep
- **Outflowobstructie** → LVH → compliantie van het linker ventrikel ↓ - diastolische dysfunctie
- **Silentius verloop** tot klepopp. $<1\text{cm}^2$
- **Symptomen:**
 - syncope/vertigo
 - angor
 - inspanningsdyspnoe
 - verminderde inspanningstolerantie
- **Klinisch onderzoek:** systolische soufflé, gesplitste tweede harttoon



C

(Courtesy of William C. Roberts, MD.)



D

(From: Mande H. Patel © 2014 Atlas of Valvular Heart Disease. Singapore, Churchill Livingstone, 198, pp 4 and 151.)



Sportrichtlijnen AS

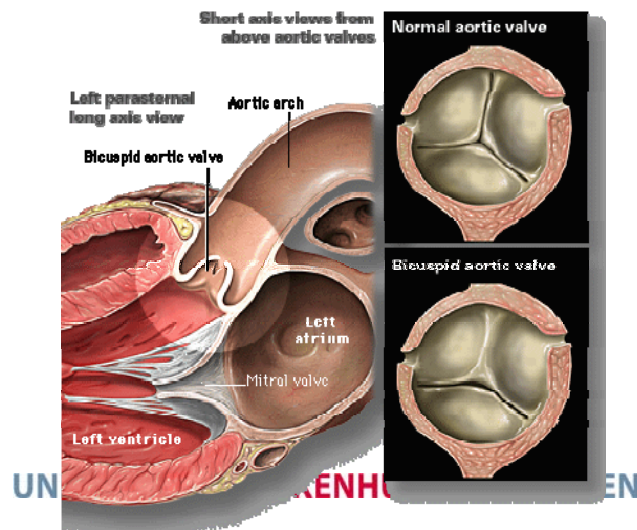
Lichte AS Geen symptomen	Syncope Angina Vertigo Onafhankelijk van stenosegraad	Matige AS Geen symptomen Normale LV functie (rust en inspanning)	Matige AS en LV dysfunctie of LVH (>15mm) of ernstige AS en/of aorta ascendens dilatatie
Lage en matige statische en lage en matige dynamische sporten *	Geen competitiesport Verdere uitwerking noodzakelijk	Lage statische en dynamische sporten	Geen competitiesport Verdere uitwerking noodzakelijk

*: inspanningstest toont minstens een normaal inspanningsvermogen, met normaal bloeddrukverloop, zonder symptomen, zonder ST-depressie, zonder ventriculaire ritmestoornissen; normale LV functie en dimensies



Bicuspede aortaklep

- Belangrijkste oorzaak van kleplijden bij personen <50 jaar
- Verantwoordelijk voor ~3% van de SCD bij jonge sporters
- Cave dilatatie van de aortawortel / aorta ascendens
- Vaak ook aortaklepinsufficiëntie



(Courtesy of William C. Roberts, MD.)



Sportrichtlijnen bicuspede aortaklep

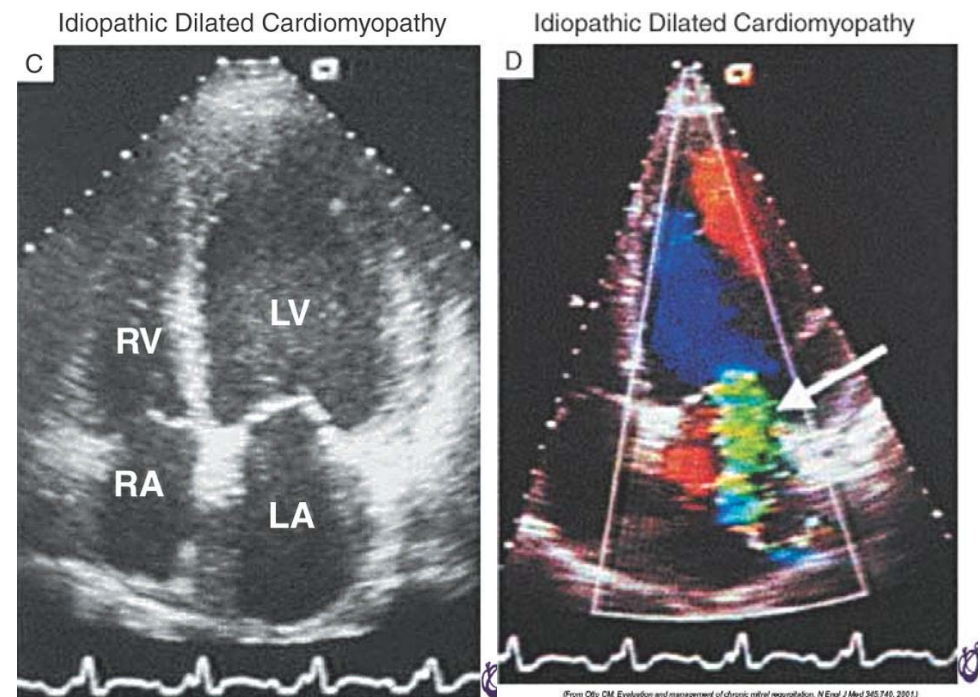
- Afhankelijk van :
 - Ernst van de aortaklepstenose
 - Ernst van de aortaklepinsufficiëntie
 - Aanwezigheid van dilatatie van de aortawortel
 - Ao diameter < 40mm: geen beperkingen
 - Ao diameter tussen 40 en 45mm: enkel lage en matige statische en dynamische sportinspanningen – cave trauma
 - Ao diameter > 45mm: enkel lage intensiteitssporten



Mitralisklepinsufficiëntie

- **Etiologie:**
 - primair (klepbladen: MVP of AGR)
 - secundair (CIHL of cardiomyopathie)
- Meestal **trage evolutie** van gecompenseerde naar gedecompenseerde toestand
- **Symptomen:**
 - Vermoeidheid
 - Dyspnoe
- **Klinisch onderzoek:** sterke pulsatie over de A. carotis, systolische soufflé

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Sportrichtlijnen MI

- Inspanning heeft variabel effect op lekkagevolume -
statische inspanningen verhogen BD → meer MI

Lichte tot matige MI Sinusaal Normale LV functie Normale LV dimensies Normale inspanningstest	Lichte tot matige MI Sinusaal Normale systolische LV functie in rust Milde LV dilatatie	Lichte tot matige MI Duidelijk vergroot LV (>60mm)/Verminderde LV functie (<50%) Ernstige MI	VKF en antico
Alle sporten Controle 1x per jaar	Milde tot matige dynamische en milde tot matige statische sporten Controle 1x per jaar	Geen sportinspanningen Verdere evaluatie noodzakelijk	Geen sporten met verhoogd traumarisico



Mitralisklepprolaps (MVP)

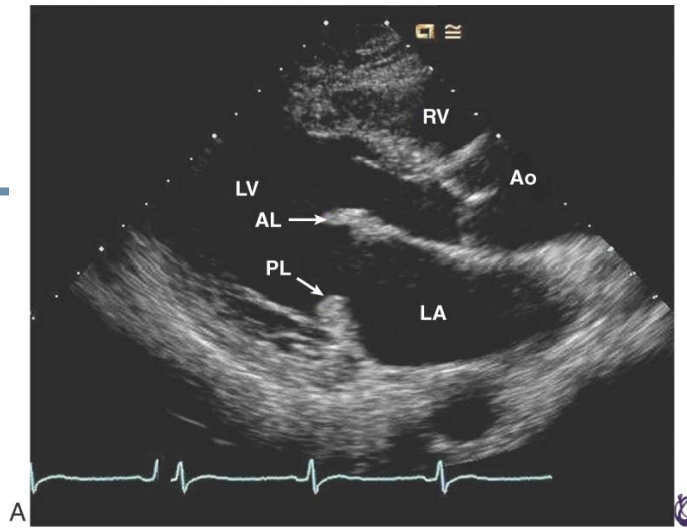
- MVP Komt voor bij 2,4% van de bevolking
- Voornamelijk bij vrouwen, 20-50 jaar oud
- Kan gepaard gaan met lage bloeddruk, orthostatische hypotensie, palpitaties, angst
- Zo geen ritmestoornissen, geen klachten en geen MI: Benigne verloop
 - Normale levensstijl
 - Follow-up alle 3 tot 5 jaar



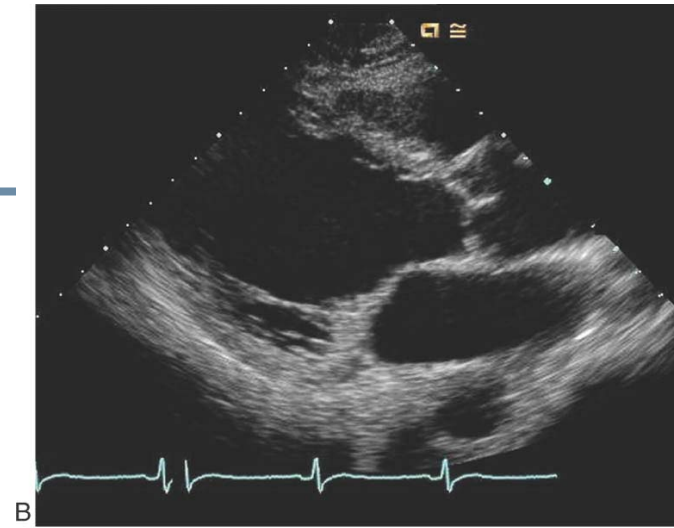
Mitralisklepprolaps

- Echter: spectrum van ritmestoornissen kan voorkomen (premature contracties, tachycardieën, bradycardieën)
- Meer MVP bij WPW-patiënten en bij patiënten met verlengd QT interval
- Verhoogd risico op SCD – zeker als belangrijke MI (1,9%/jaar)
- Dus als MVP en
 - palpitaties, ijlhoofdigheid, vertigo of syncope
 - lang QT of ventriculaire aritmie
 - prolaps van beide klepbladen
 - Verdere (electrofysiologische) uitwerking noodzakelijk

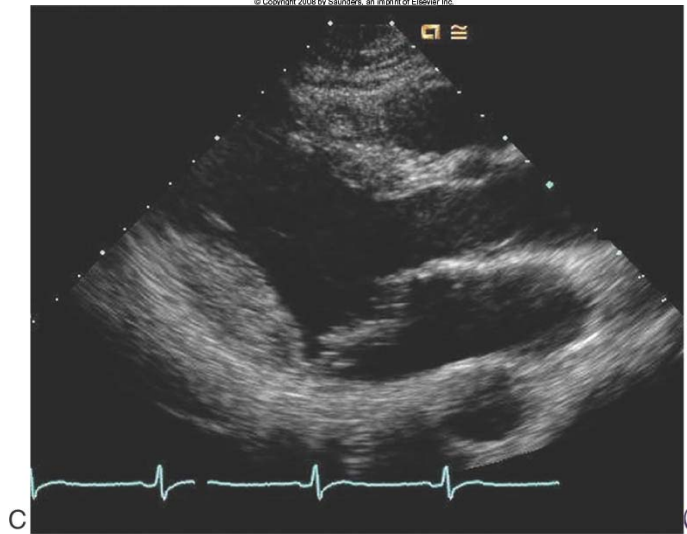
Mitralisklepprolaps: TTE



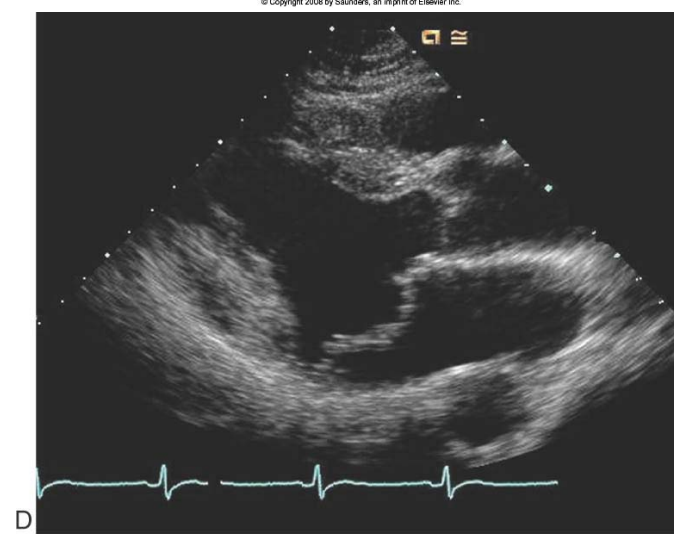
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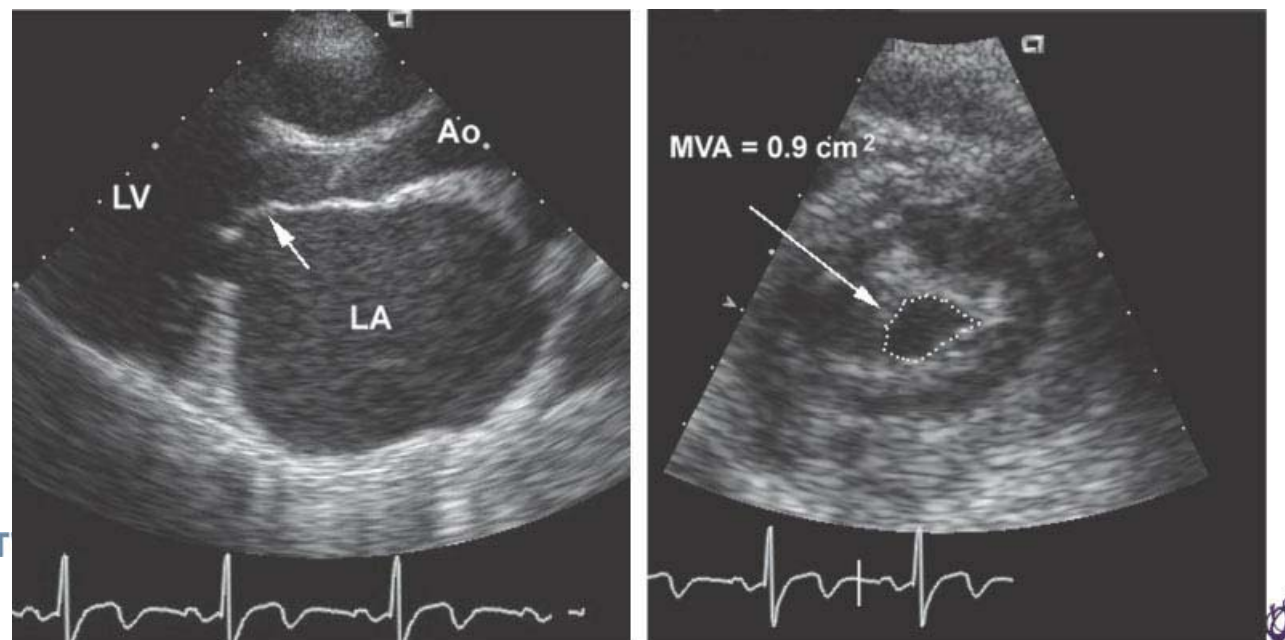
Sportrichtlijnen MVP

- Intensieve sportbeoefening mag, tenzij MVP met
 - Syncope met aritmie
 - Positieve familiale anamnese
 - Complexe ventriculaire ritmestoornissen/SVT
 - Matige tot ernstige MI
 - Long QT-interval
 - Linker ventrikeldysfunctie
- Geen competitiesport
- Geen zware isometrische inspanningen (vb. gewichtheffen) als belangrijke MI of klepabnormaliteiten



Mitralisklepstenose

- **Etiologie:** meestal AGR → incidentie ↓
- **Flowobstructie** over mitralisklep → linker atriumoverbelasting → overbelasting longcirculatie → rechter hartoverbelasting
- Zelden SCD





Mitralisklepstenose

- Symptomen:
 - Dyspnoe
 - Hemoptysis
 - Rechter hartfalen
 - Thoracale pijn
 - VKF - embolen
- Klinisch onderzoek:
 - Rechter hartoverbelasting
 - VKF
 - Diastolische ruis



Sportrichtlijnen MS

- Sport: PCWP stijgt, risico op longoedeem – effecten op termijn?
- Symptoomgelimiteerde inspanningen

Lichte MS Sinusaal	Lichte MS VKF	Matige / Ernstige MS Sinusaal of VKF
Alle sporten, uitgezonderd combinatie van hoog dynamisch en hoog statisch (IIIc)	Lage en matige statische sporten Lage en matige dynamische sporten Geen contactsporten	Lage dynamische en lage statische sporten Geen contactsporten



Wat na klepheelkunde?

- Afhankelijk van
 - Type klepingreep (mechanische klep of bioprothese)
 - Localisatie van de klep
 - Gradiënt over de klep
 - Aard van de sportinspanning
- Evaluatie van klep en LV functie dienen te gebeuren in rust en tijdens inspanning (inspanningsechocardiografie)
- Jaarlijkse controle met inspanningstest en echocardiografie is aangewezen



Wat na klepheelkunde?

- Asymptomatische patiënten, normale LV functie, normale inspanningscapaciteit: lage en matige statische en dynamische sporten
- Indien orale antico: geen contactsporten
- Indien significante klepdysfunctie: geen competitiesport



Besluit

- Toenemend aantal (oude) sporters met kleplijden
- Klepprobleem \leftrightarrow sportstop
- Anamnese – klinisch onderzoek – bijkomend onderzoek (cardioloog) met echocardiografie
- Aangepast trainingsadvies – ook competitiesport is vaak nog mogelijk
- Ook na klepoperaties is sporten mogelijk

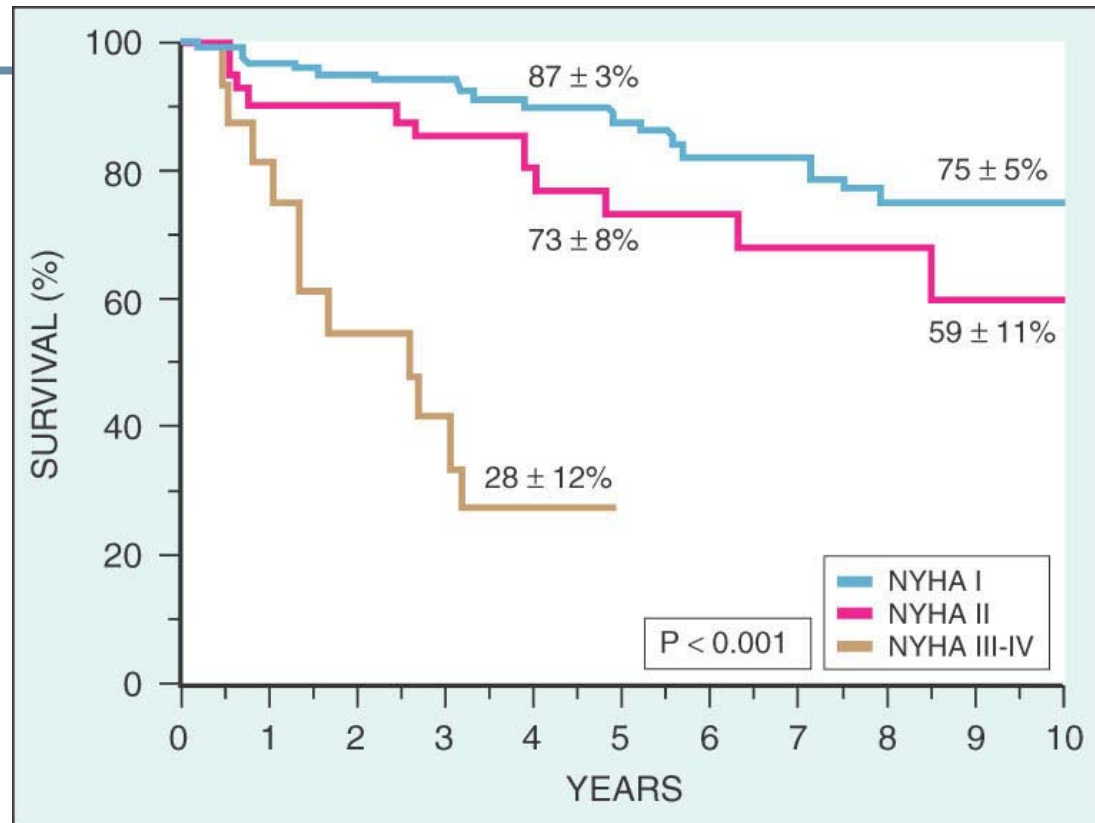


Besluit

- Regelmatig opvolging is noodzakelijk
- Belang van screening, zowel bij seniors als bij jonge sporters (voorkomen van SCD)



Aortaklepinsufficiëntie: natuurlijk verloop

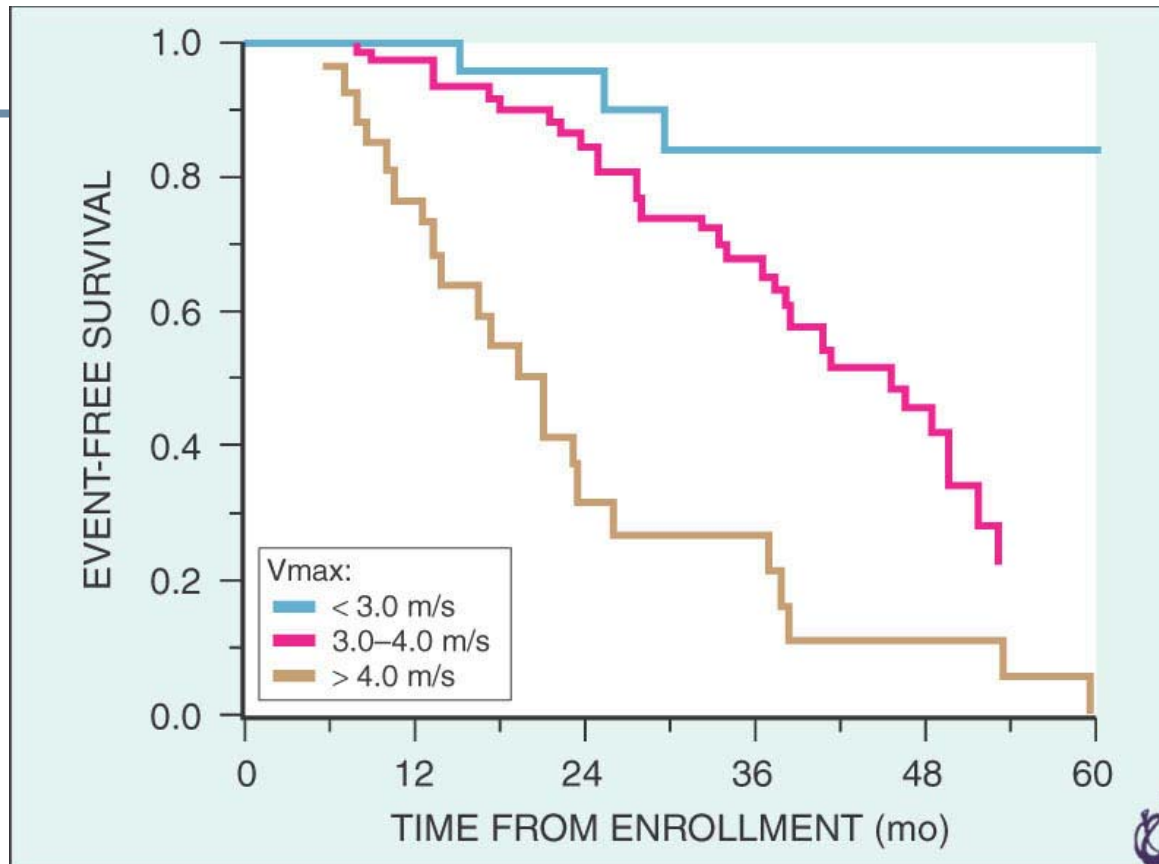


(From Dujardin KS, Enriquez-Sarano M, Scheff HV, et al: Mortality and morbidity of aortic regurgitation in clinical practice: A long-term follow-up study. *Circulation* 99:1851, 1999.)

Libby et al. Braunwald's Heart Disease

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Aortaklepstenose: natuurlijk verloop

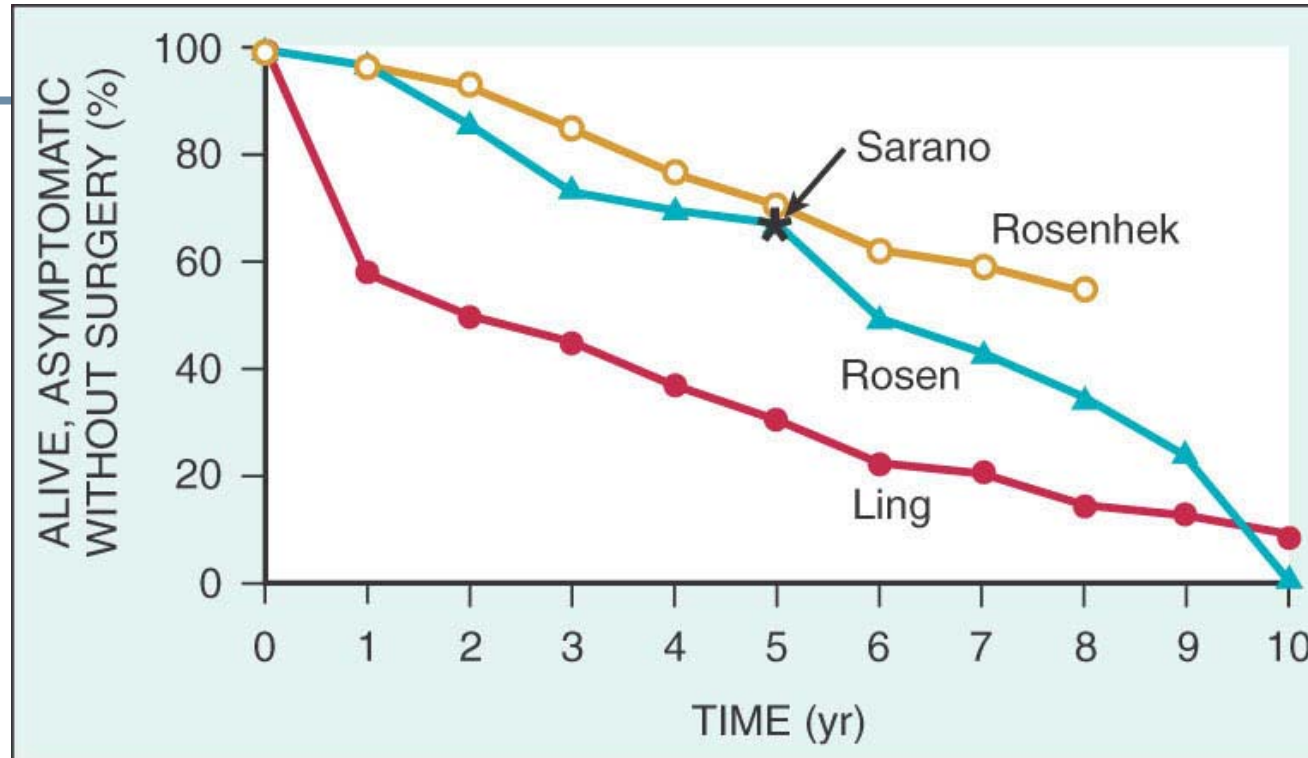


(From Otto CM, Burwash IG, Legget ME, et al: A prospective study of asymptomatic valvular aortic stenosis: Clinical, echocardiographic, and exercise predictors of outcome. *Circulation* 95:2262, 1997.)

Libby et al. Braunwald's Heart Disease

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Mitralisklepinsufficiëntie: natuurlijk verloop



(Modified from Ling LH, Enriquez-Sarano M, Seward JB, et al: Clinical outcome of mitral regurgitation due to flail leaflet. *N Engl J Med* 335:1417, 1996; Rosen SF, Borer JS, Hochreiter C, et al: Natural history of the asymptomatic patient with severe mitral regurgitation secondary to mitral valve prolapse and normal right and left ventricular performance. *Am J Cardiol* 74:374, 1994; Enriquez-Sarano M, Avierinos JF, Messika-Zeitoun D, et al: Quantitative determinants of the outcome of asymptomatic mitral regurgitation. *N Engl J Med* 352:875, 2005; and Rosenhek R, Rader F, Klear U, et al: Outcome of watchful waiting in asymptomatic severe mitral regurgitation. *Circulation* 113:2238, 2006.)



Libby et al. Braunwald's Heart Disease

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Gemiddelde levensverwachting stijgt

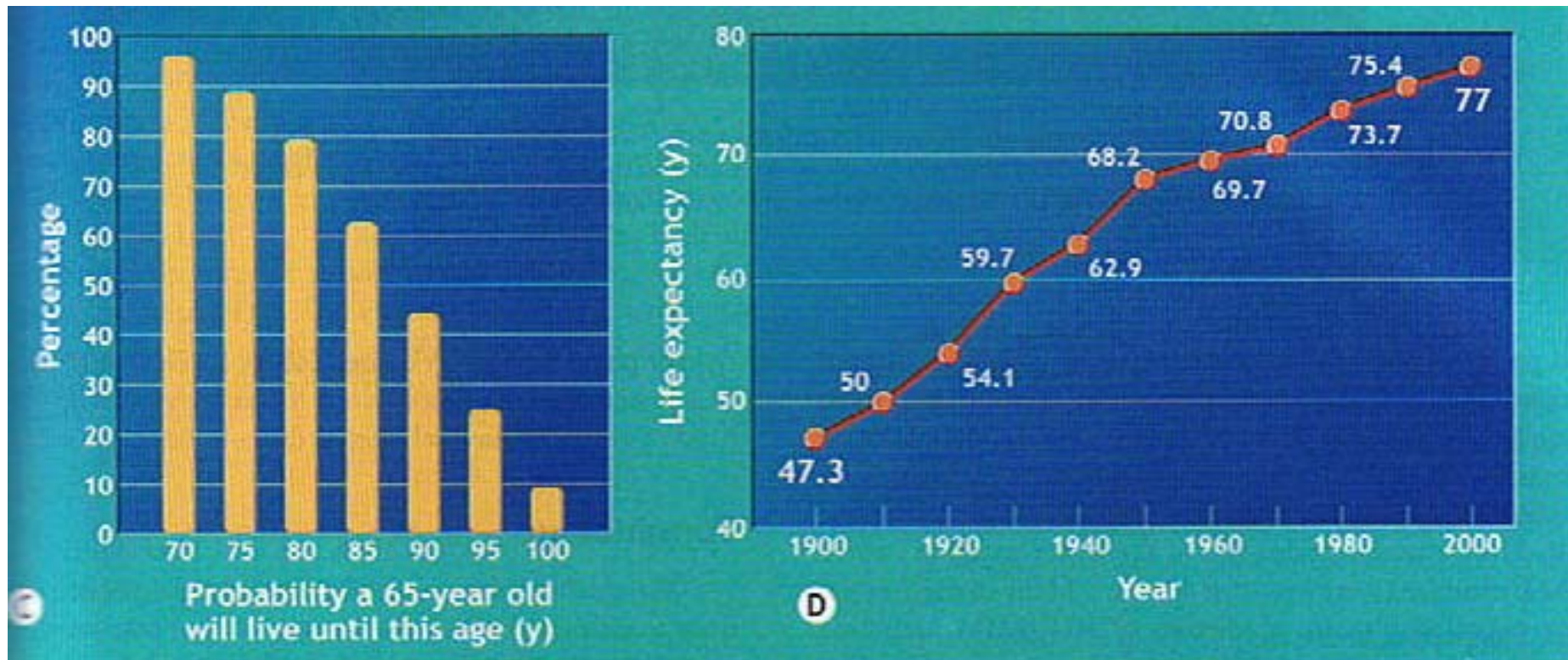




TABLE 78–3

American Heart Association Consensus Panel Recommendations for Preparticipation Athletic Screening

Family History

1. Premature sudden cardiac death
2. Heart disease in surviving relatives younger than 50 years old

Personal History

3. Heart murmur
4. Systemic hypertension
5. Fatigue
6. Syncope/near-syncope
7. Excessive/unexplained exertional dyspnea
8. Exertional chest pain

Physical Examination

9. Heart murmur (supine/standing)
10. Femoral arterial pulses (to exclude coarctation of aorta)
11. Stigmata of Marfan syndrome
12. Brachial blood pressure measurement (sitting)

From Maron BJ, Douglas PS, Graham TP, et al: Task Force 1: Preparticipation screening and diagnosis of cardiovascular disease in athletes. *J Am Coll Cardiol* 45:1322, 2005, with permission from the American College of Cardiology Foundation.



(From Maron BJ, Douglas PS, Graham TP, et al: Task Force 1: Preparticipation screening and diagnosis of cardiovascular disease in athletes. *J Am Coll Cardiol* 45:1322, 2005, with permission from the American College of Cardiology Foundation.)

TABLE 78-4 American Heart Association Risk Classification for Exercise Training

Class A: Apparently Healthy Individuals

This classification includes the following:

- (A1) Children, adolescents, men younger than 45 yr, and women younger than 55 yr who have no symptoms or known presence of heart disease or major coronary risk factors
- (A2) Men 45 years old or older and women 55 years old or older who have no symptoms or known presence of heart disease and with fewer than 2 major cardiovascular risk factors
- (A3) Men 45 years old or older and women 55 years old or older who have no symptoms or known presence of heart disease and with 2 or more major cardiovascular risk factors

Activity guidelines: No restrictions other than basic guidelines

Supervision required: None

ECG and blood pressure monitoring: Not required

Note: Persons classified as Class A2 and particularly Class A3 should undergo a medical examination and possibly a medically supervised exercise test before engaging in vigorous exercise.

Class B: Presence of Known, Stable Cardiovascular Disease with Low Risk for Complications with Vigorous Exercise, but Slightly Greater Than for Apparently Healthy Individuals

This classification includes individuals with any of the following diagnoses:

1. CAD (angina, myocardial infarction, coronary revascularization, abnormal exercise test, and abnormal coronary angiograms) whose condition is stable and who have the clinical characteristics outlined below
2. Valvular heart disease—excluding severe valvular stenosis or regurgitation with the clinical characteristics as outlined below
3. Congenital heart disease—risk stratification for patients with congenital heart disease should be guided by the 26th Bethesda Conference recommendations (36th Bethesda Conference report)
4. Cardiomyopathy—ejection fraction \leq 30%; includes stable patients with heart failure with clinical characteristics as outlined below; not hypertrophic cardiomyopathy or recent myocarditis
5. Exercise test abnormalities that do not meet any of the high risk criteria outlined in class C below

Clinical Characteristics: (Must Include All of the Following)

1. New York Heart Association (NYHA) Class I or II
2. Exercise capacity \geq 6 METs
3. No evidence of “congestive” heart failure
4. No evidence of myocardial ischemia or angina at rest nor on the exercise test at or below 6 METs
5. Appropriate rise in systolic blood pressure during exercise
6. Absence of sustained or nonsustained ventricular tachycardia at rest or with exercise
7. Ability to satisfactorily self-monitor intensity of activity

Activity guidelines: Activity should be individualized with exercise prescription provided by qualified individuals and approved by primary health care provider.

Supervision required: Medical supervision during initial prescription session is beneficial. Supervision is provided by appropriate, trained, nonmedical personnel for other exercise sessions until the individual understands how to monitor his or her activity.

Medical personnel should be trained and certified in Advanced Cardiac Life Support (ACLS).

Nonmedical personnel should be trained and certified in Basic Life Support (which includes cardiopulmonary resuscitation).

ECG and blood pressure monitoring: Useful during the early prescription phase of training, usually 6 to 12 sessions.

Class C: Those at Moderate to High Risk for Cardiac Complications During Exercise and/or Unable to Self-Regulate Activity or Understand Recommended Activity Level

This classification includes individuals with any of the following diagnoses:

1. CAD with the clinical characteristics outlined below
2. Valvular heart disease—excluding severe valvular stenosis or regurgitation with the clinical characteristics as outlined below
3. Congenital heart disease—risk stratification for patients with congenital heart disease should be guided by the 36th Bethesda Conference recommendations (36th Bethesda Conference report)
4. Cardiomyopathy—ejection fraction $<$ 30%; includes stable patients with heart failure with clinical characteristics as outlined below; not hypertrophic cardiomyopathy or recent myocarditis
5. Complex ventricular arrhythmias not well controlled

Clinical Characteristics (Any of the Following)

1. NYHA Class III or IV
2. Exercise test results
 - Exercise capacity $<$ 6 METs
 - Angina or ischemic ST depression at a workload $<$ 6 METs
 - Fall in systolic blood pressure below resting levels during exercise
 - Nonsustained ventricular tachycardia with exercise
3. Previous episode of primary cardiac arrest (i.e., cardiac arrest that did not occur in the presence of an acute myocardial infarction or during a cardiac procedure)
4. A medical problem that the physician believes may be life threatening

Activity guidelines: Activity should be individualized with exercise prescription provided by qualified individuals and approved by primary health care provider.

Supervision: Medical supervision should exist during all exercise sessions until safety is established.

ECG and blood pressure monitoring: Continuous monitoring during exercise sessions is recommended until safety is established, which is usually 12 sessions or more.

Note: Class C patients who have successfully completed a series of supervised exercise sessions may be reclassified to Class B providing that the safety of exercise at the prescribed intensity is satisfactorily established by appropriate medical personnel, and that the patient has demonstrated the ability to self-monitor.

Class D: Unstable Disease with Activity Restriction: Exercise for Conditioning Purposes Is Not Recommended

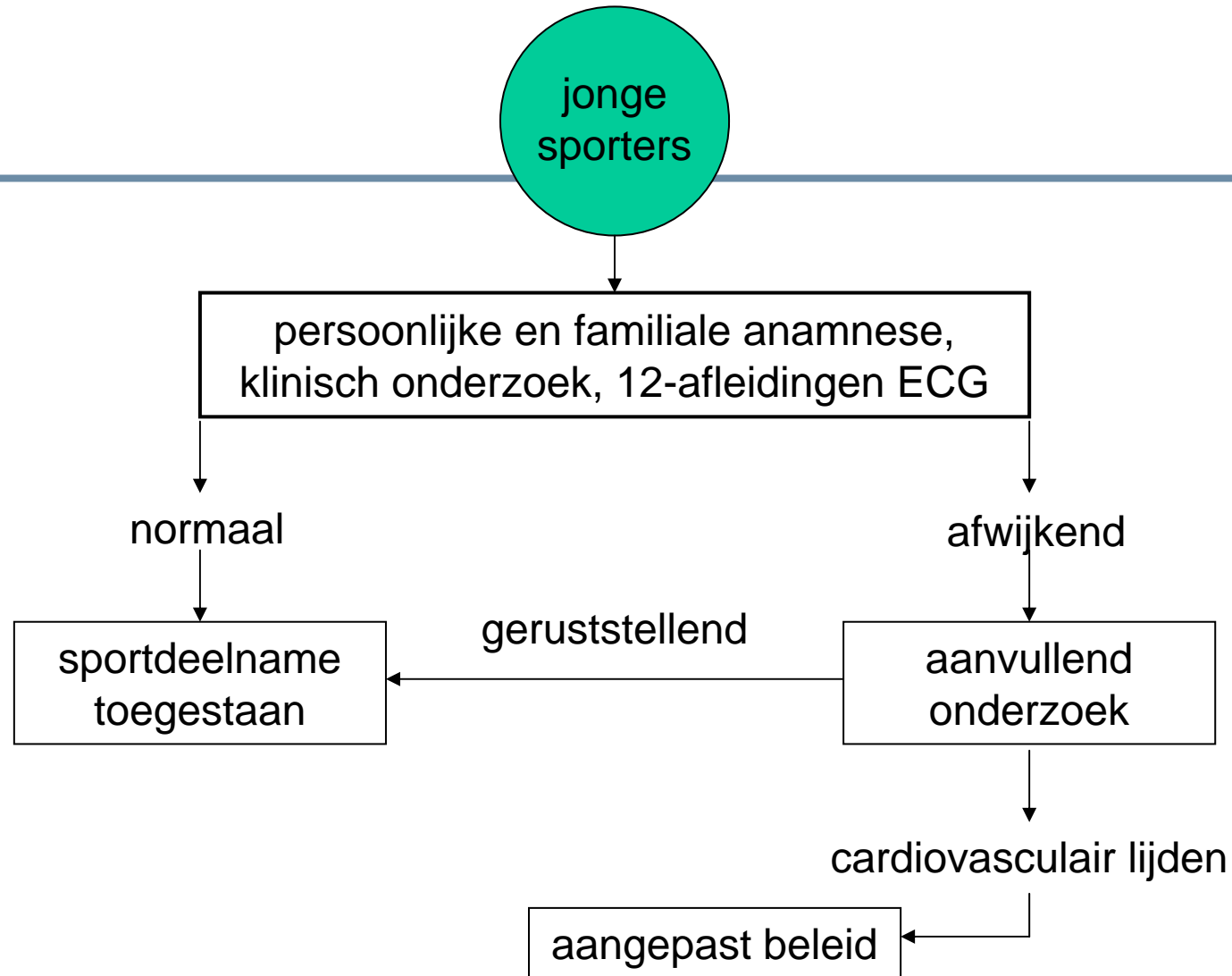
This classification includes individuals with any of the following conditions:

1. Unstable ischemia
2. Severe and symptomatic valvular stenosis or regurgitation
3. Congenital heart disease—criteria for risk that would prohibit exercise conditioning in patients with congenital heart disease should be guided by the 36th Bethesda Conference recommendations (36th Bethesda Conference report)
4. Heart failure that is not compensated
5. Uncontrolled arrhythmias
6. Other medical conditions that could be aggravated by exercise

Activity guidelines: No activity is recommended for conditioning purposes. Attention should be directed to treating the subject and restoring patient to Class C or better. Daily activities must be prescribed on the basis of individual assessment by the subject's personal physician.



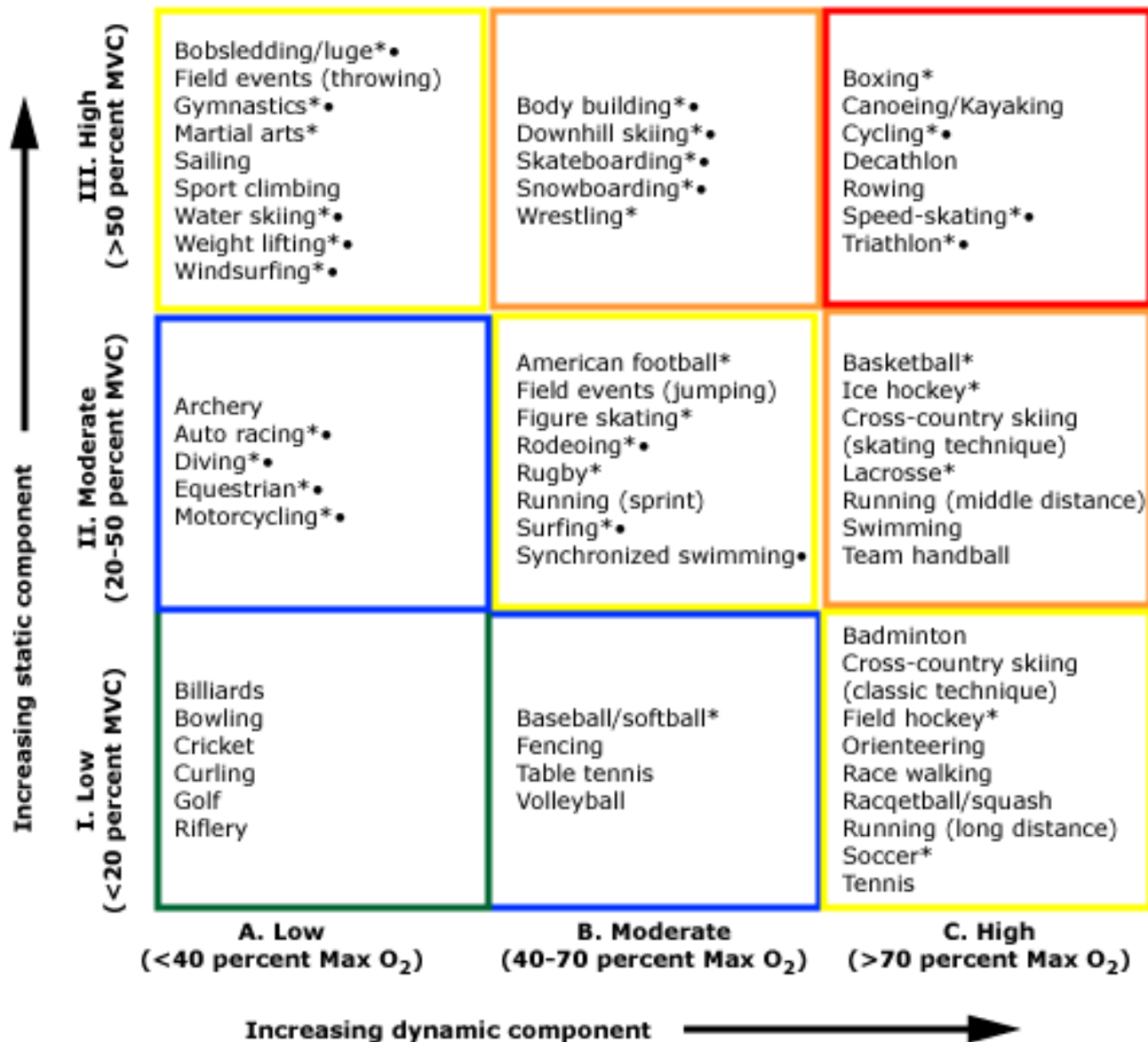
Screeningsprotocol bij jonge sporters



Increasing static component ↑	III. High (>50% MVC)	Bobsledding/luge,*† field events (throwing), gymnastics,*† martial arts,* sailing, sport climbing, water skiing,*† weight lifting,*† windsurfing*†	Body building,*† downhill skiing,*† skateboarding,*† snowboarding,*† wrestling*	Boxing,* canoeing/kayaking, cycling,*† decathlon, rowing, speed-skating,*† triathlon*†
	II. Moderate (20–50% MVC)	Archery, auto racing,*† diving,*† equestrian,*† motorcycling*†	American football,* field events (jumping), figure skating,* rodeoing,*† rugby,* running (sprint), surfing,*† synchronized swimming†	Basketball,* ice hockey,* cross-country skiing (skating technique), lacrosse,* running (middle distance), swimming, team handball
	I. Low (<20% MVC)	Billiards, bowling, cricket, curling, golf, riflery	Baseball/softball,* fencing, table tennis, volleyball	Badminton, cross-country skiing (classic technique), field hockey,* orienteering, race walking, racquetball/squash, running (long distance), soccer,* tennis
		A. Low (<40% max O ₂)	B. Moderate (40–70% max O ₂)	C. High (>70% max O ₂)
		Increasing dynamic component →		

FIGURE 78–1 Classification of sports. This classification is based on peak static and dynamic components achieved during competition. The increasing dynamic component is related to the estimated percent of maximal oxygen uptake (max O₂) achieved and results in an increasing cardiac output. The increasing static component is related to the estimated percent of maximal voluntary contraction (MVC) attained and results in an increasing blood pressure. The lowest total cardiovascular demands are shown in green and the highest in red. Blue, yellow, and purple depict low moderate, moderate, and high moderate total cardiovascular demands. * = danger of bodily collision; † = increased risk if syncope occurs.

(From Mitchell JH, Haskell W, Snell P, Van Camp SP: Task Force 8: Classification of sports. *J Am Coll Cardiol* 45:1364, 2005, with permission from the American College of Cardiology Foundation.)



Mitchell JH, et al. J Am Coll Cardiol 2005

UNIVERSITAIR ZIEKENHUIS ANTWERPEN



Sudden Cardiac Death (SCD)

- 5,6% van de jaarlijkse mortaliteit (V.S.)
- Risico op SCA (sudden cardiac arrest) x6 – x10 indien gekende hartkwaal
- Oorzaken SCD
 - <35 jaar (1/100.000): congenitale aandoeningen - >6% tgv kleppathologie
 - >35 jaar (“masters”) (1/15.000): coronaire pathologie