Aortální syndromy

od screeningu přes genetiku k prevenci a léčbě

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GUIDELINES

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EACTS/STS Guidelines for diagnosing and treating acute and chronic syndromes of the aortic organ

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ESC GUIDELINES

2024 ESC Guidelines for the management of peripheral arterial and aortic diseases

Developed by the task force on the management of peripheral arterial and aortic diseases of the European Society of Cardiology (ESC)

Endorsed by the European Association for Cardio-Thoracic Surgery (EACTS), the European Reference Network on Rare Multisystemic Vascular Diseases (VASCERN), and the European Society of Vascular Medicine (ESVM)

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Aorta posuzována jako orgán

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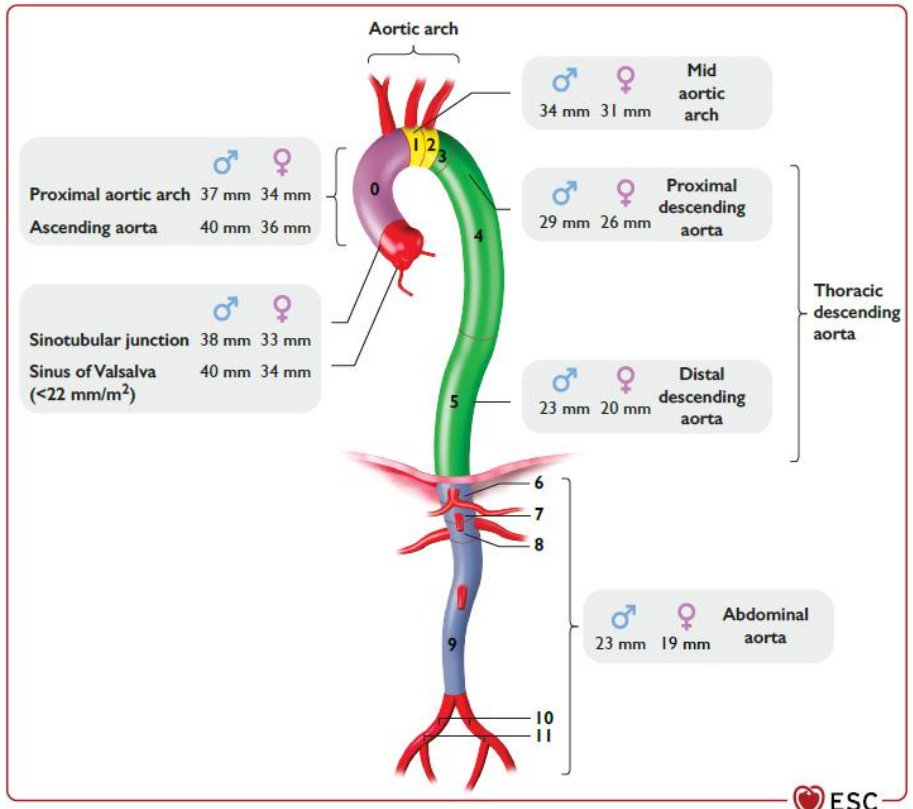
Aneuryzma aorty

Prevalence 1-3% populace (aneuryzma, disekce), až 10% u starších, incidence 5-10/100 000/rok
Dilatace : kořen + ascendentní aorta ≥ 40 mm (≥ 22mm/m2) , descendentní ≥ 29mm (≥ 16 mm/m2)

Růst : muži 0,9 mm/dekádu, ženy 0,7mm/dekádu,
BAV 0,6mm kořen a 0,3mm AA/rok , MFS 2,6 mm/r, LDS až 10mm/rok, ≥ 6cm 4,6mm/rok



Rychlý růst :
5mm/rok
3mm/rok 2 roky po sobě
3mm/rok u HTAD

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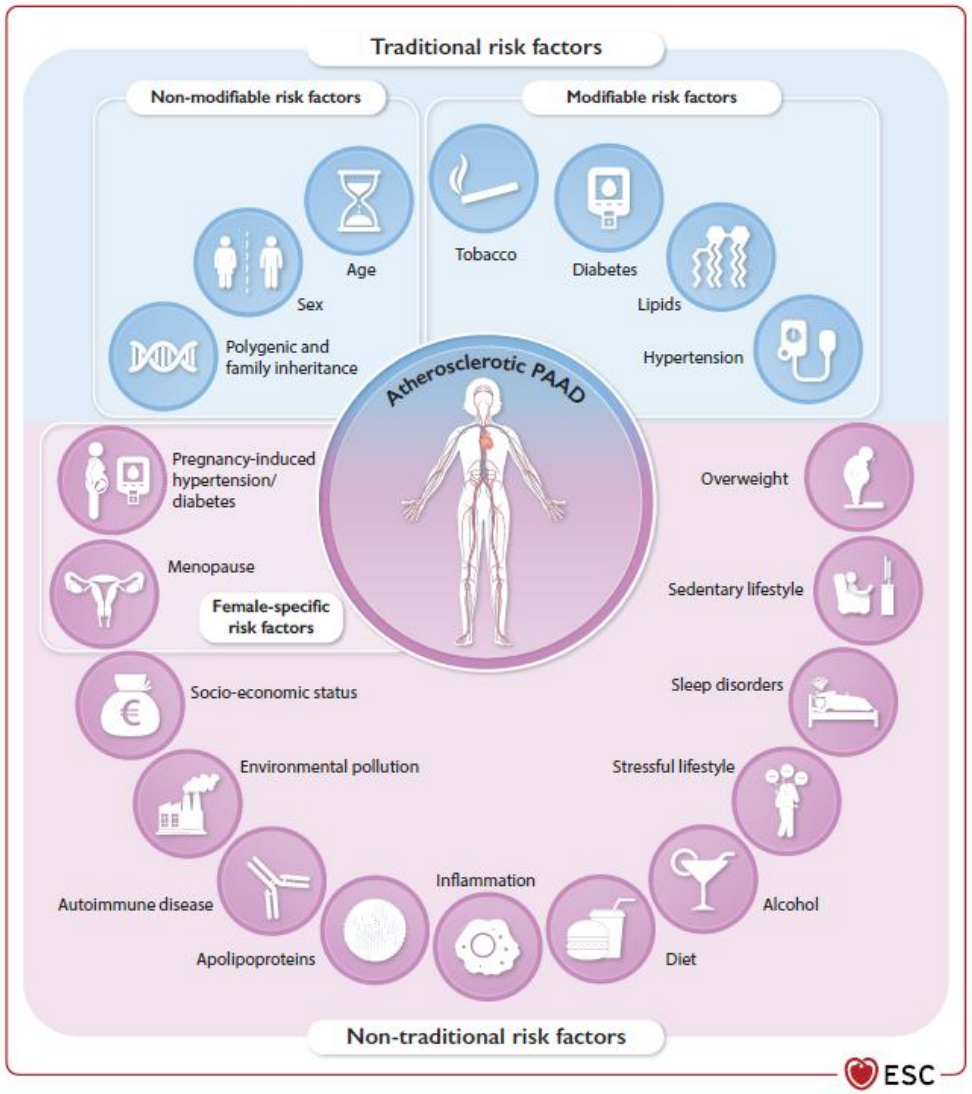
Etiologie aortálních aneuryzmat

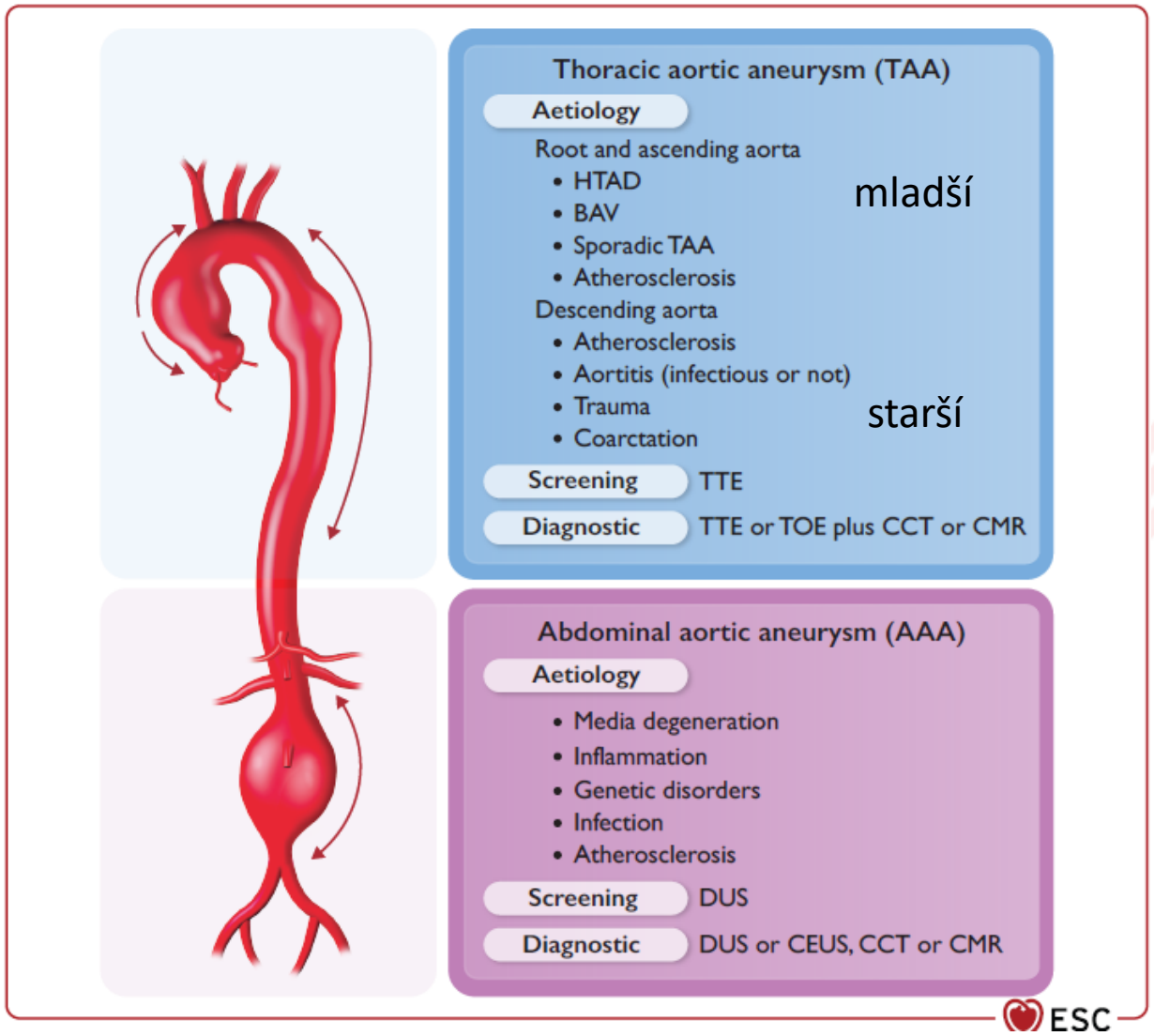
80% modifikovatelné rizikové faktory

4x větší riziko při ↑ LDL, hypertenze, kouření, DM

20% geneticky podmíněná aneuryzmata (AD)



Etiologie a screening

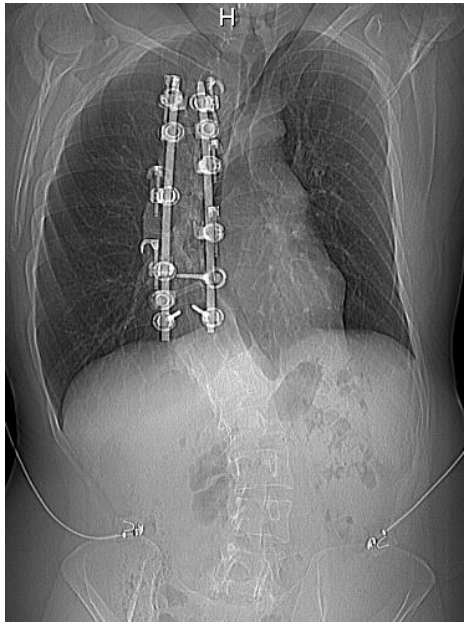


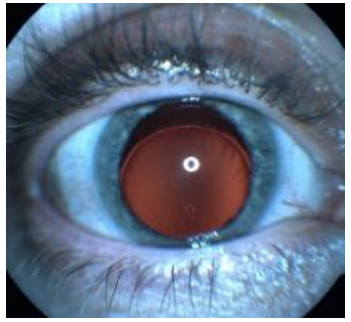
60% kořen a/nebo ascendentní aorta
10% oblouk
30% descendentní aorta

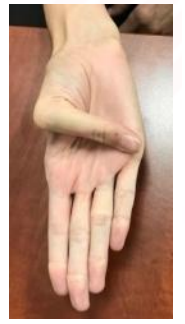
Screening for AAA with DUS:		
Is recommended in men aged ≥65 years with a history of smoking to reduce the risk of death from ruptured AAA.[221–224,234]	I	A
May be considered in men aged ≥75 years (irrespective of smoking history) or in women aged ≥75 years who are current smokers, hypertensive, or both.[227,228,235–237]	IIb	C
Family AAA screening with DUS:		
Is recommended for FDRs of patients with AAA aged ≥50, unless an acquired cause can be clearly identified.[231]	I	C

HTAD (heritable thoracic aortic disease)

Syndromová (sTAA)	**Nesyndromová (nsTAA)**
Kardiovaskulární projevy Systémové projevy (muskuloskeletální, kraniofaciální, oční, plicní, kožní…)	Kardiovaskulární projevy
Marfanův syndrom (MFS) Loeys-Dietzův syndrom (LDS) Turnerův syndrom (TS) Ehlers-Danlos syndrom typ IV vaskulární typ (vEDS)	Familiární hrudní aneuryzmata (FTAA) ACTA2, MYH11, MYLK, PRKG1… Sporadická aneuryzmata (sTAA) BAV aortopatie







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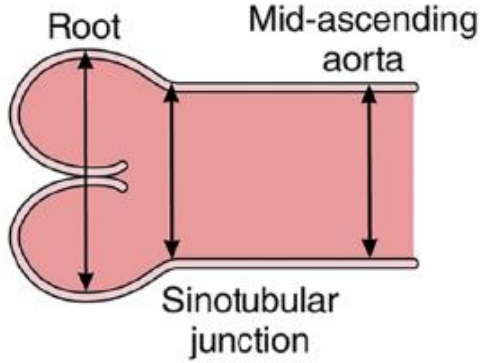
ECHO

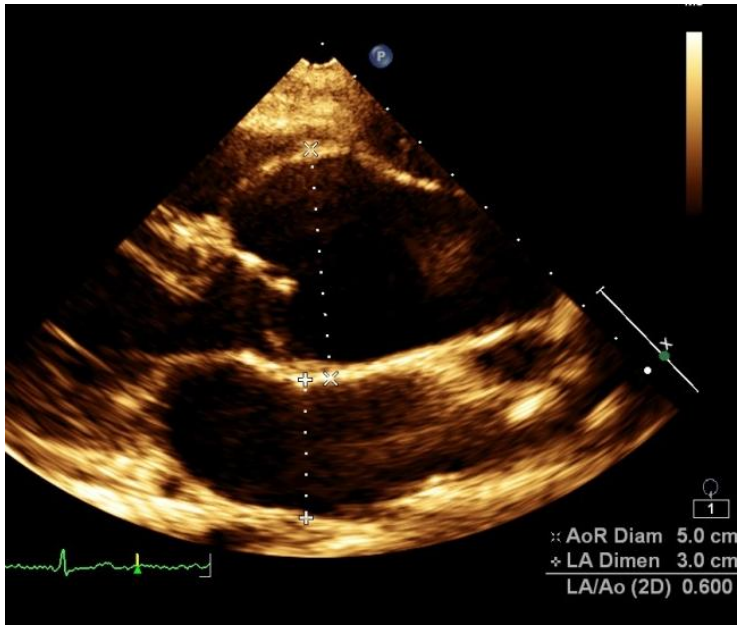
PLAX 1-2 mzž výše, leading-to-leading edge, endiastola

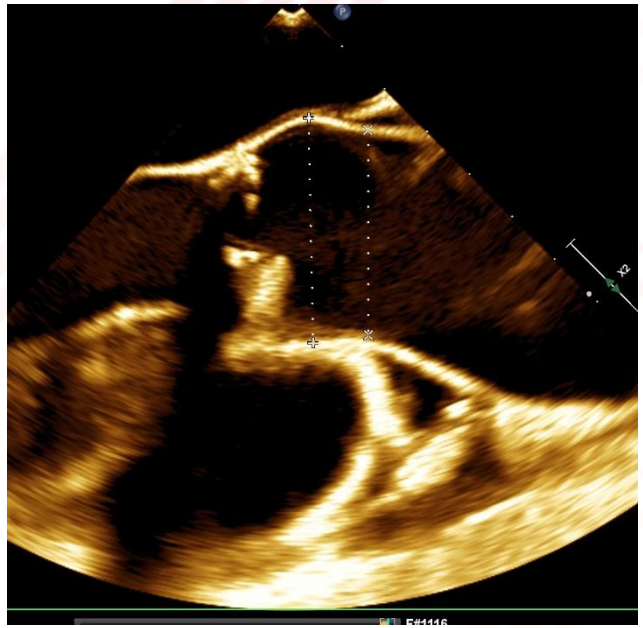
Měření anulu, kořene, STJ, ascendentní a descendentní aorty

Hodnocení chlopní

Asymetrie kořene > 5 mm (BAV, HTAD)

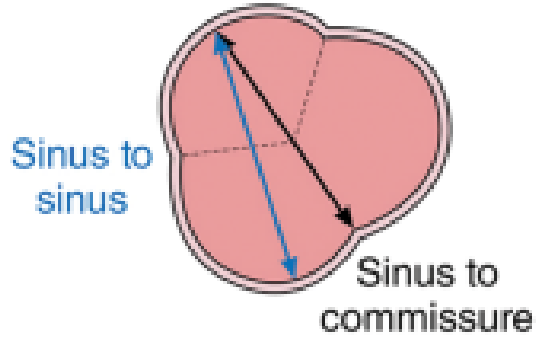


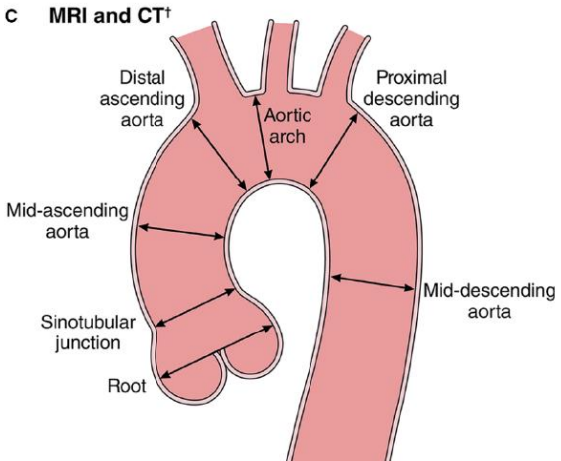


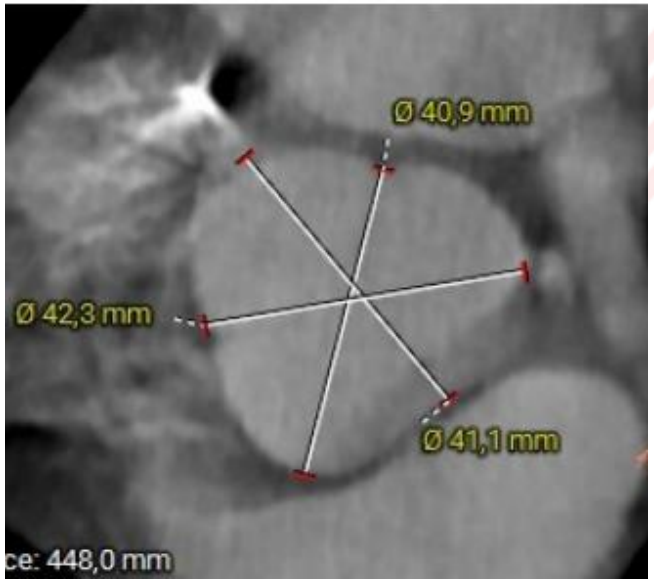


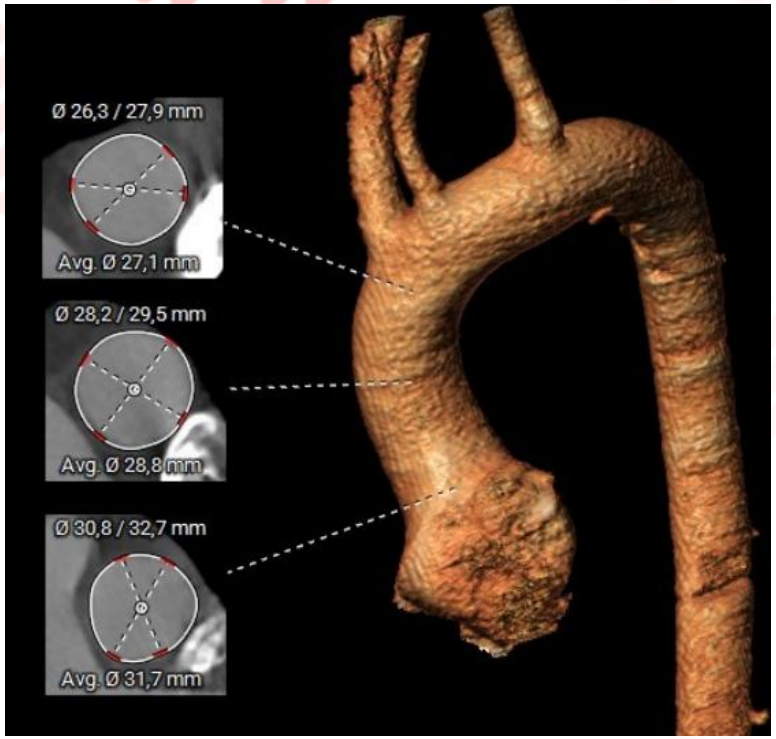
CT/MRI

- Provést u každého pacienta na počátku sledování (od karotid po pánevní tepny)
- **CT** - inner –to-inner edge v diastole, měření kolmo na centrline, double oblique
  - outer-to-outer edge při patologii stěny (IMH, aterom, trombus, disekce)
- **MRI** – preferováno hl.mladí, ženy ve fertilním věku, nativní bez KL









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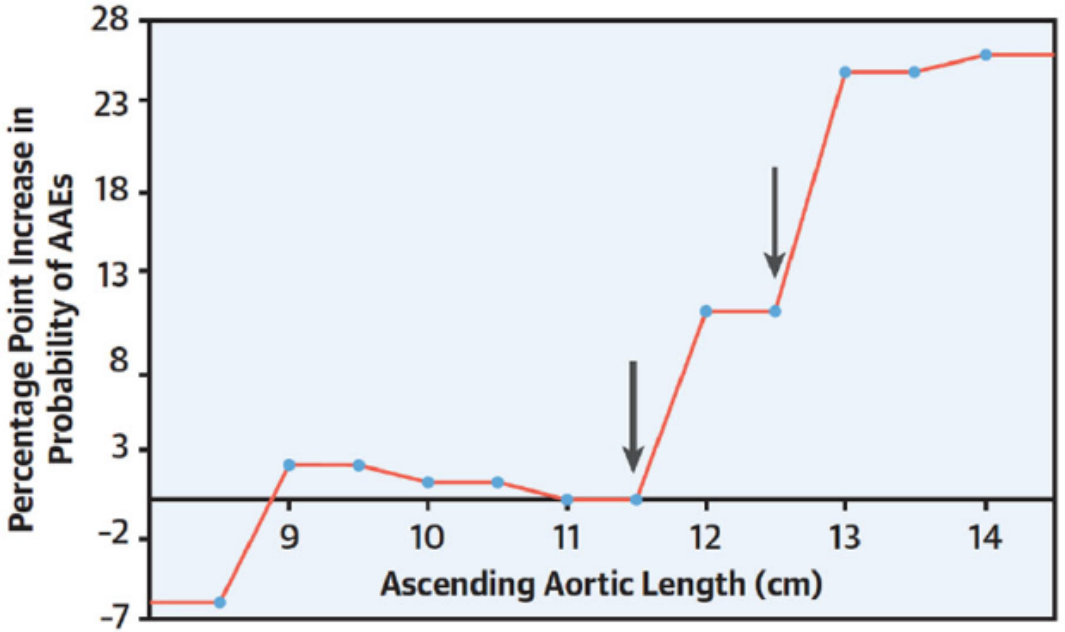
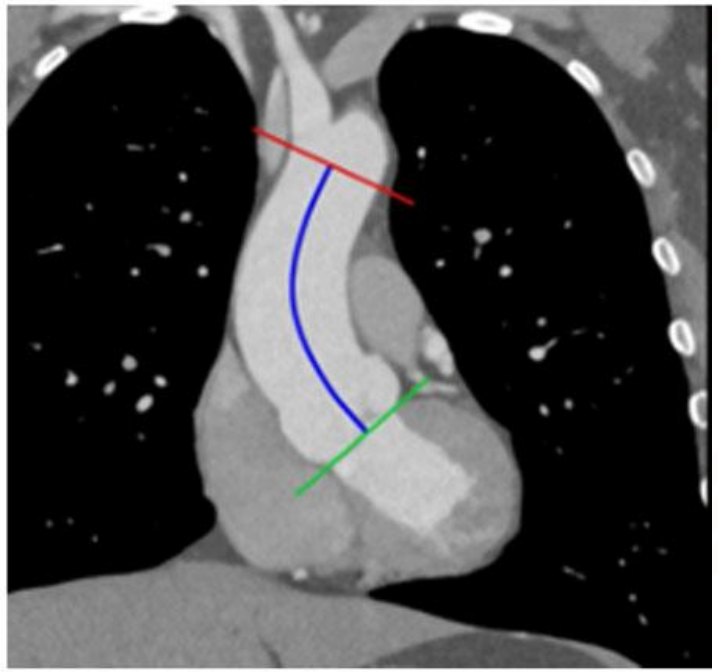
Délka ascendentní aorty

≥ 11 cm = vyšší riziko aortálních komplikací
Riziková je elongace kořene

An ascending aortic length exceeding 110 mm should be considered as a risk factor for aortic events when indicating elective surgery for aortic aneurysms.	IIa	B





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Zobrazení aorty

Recommendations	Class[a]	Level[b]
It is recommended that aortic diameters are measured at pre-specified anatomical landmarks, and the largest diameter of the section be perpendicular to the longitudinal axis.[134,135]	I	C
It is recommended in cases of serial imaging of the aorta over time to use the same imaging modality with the same measurement method.[159]	I	C
It is recommended to consider renal function, pregnancy, age, and history of allergy to contrast media to select the optimal imaging modality with minimal radiation exposure and lowest iatrogenic risk, except for emergency cases.[159–161]	I	C
If an increase of ≥3 mm per year in aortic diameters by TTE is observed, confirmation by CCT/CMR should be considered.[137,159]	IIa	C

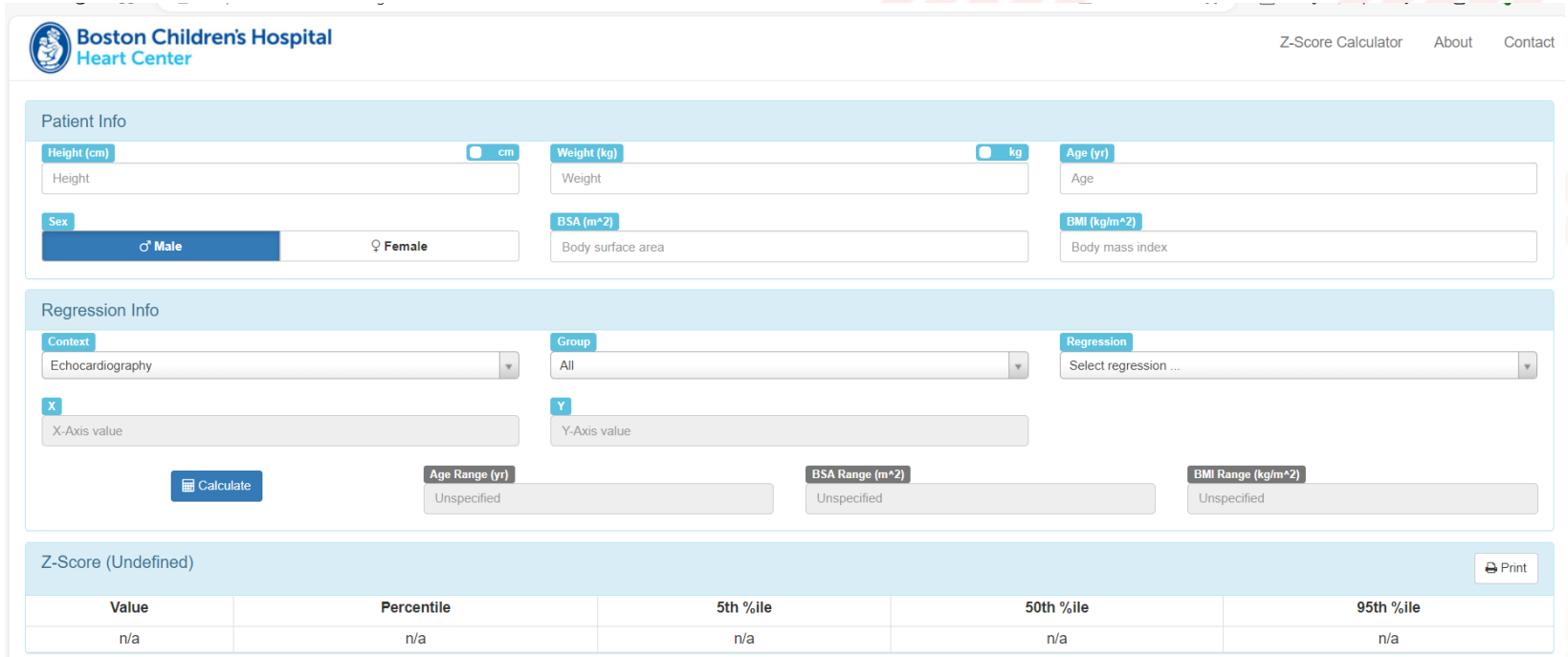
- Správnost měření
- Srovnávat identickou metodu
- Při asymetrii kořene reportovat nejdelší diametr
- Volit šetrnou metodu (opakované zobrazování, alergie na KL, CKD, mladí, ženy ve fertilním věku)
- Při ECHO progresi ≥ 3mm/rok doplnit CT/MRI

Indexy lépe korelují s rizikem disekce

- Aortic size index (ASI ……cm/BSA)
- Aortic height index (AHI …….cm/m) …..≥ 32mm/m 12% riziko aortální komplikací
- CSA – height ratio….. ≥ 10 cm2/m snížené přežívání
- Z-score (Boston) - pediatrie

https://www.marfan.fr/accueil/z-score-calculus/

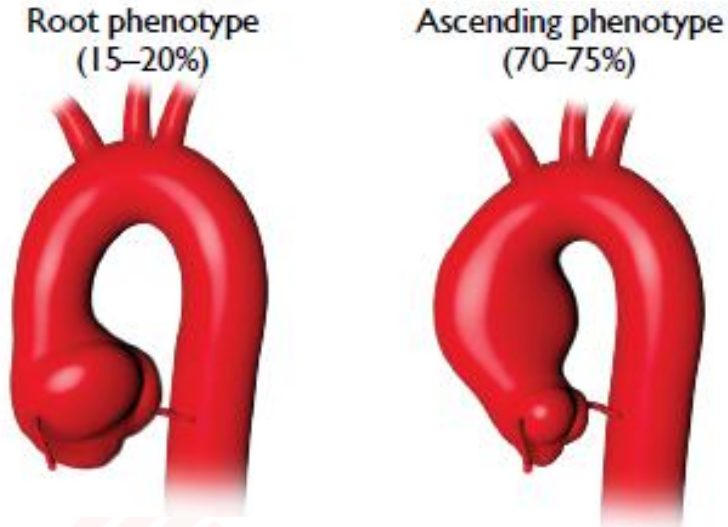
https:// marfan.org/dx/z-score-adults/

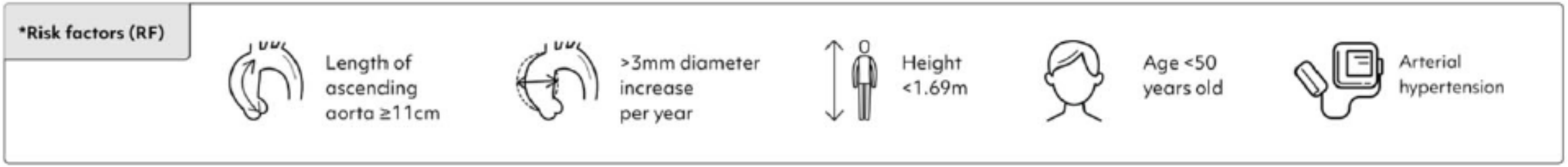


GL 2024 = progres v indikačních kritériích
Operace při aortě ≥ 50 mm + rizikových faktorech

Co nově musíme při indikaci zohlednit ?

Fenotyp aorty - root x ascending
Délka ascendentní aorty ≥ 11cm
Rychlost růstu - 3mm/rok
BSA < 1,69 m
Věk < 50 let
Nízké operační riziko
Zkušenost pracoviště
U HTAD rozměry aorty při disekci u příbuzných





Indikaci k operaci - BAV

Surgery for an ascending aortic aneurysm located at the root or tubular tract, either with TAV or BAV, is recommended when the maximum aortic diameter is ≥55 mm.	I	B
Surgery for BAV-related aortopathy with 'root phenotype' is recommended when the maximum aortic diameter is ≥50 mm.	I	B
In patients with low surgical risk[e] and 'ascending phenotype' dilatation, both with TAV and BAV, surgical treatment should be considered when the maximum aortic diameter is >52 mm.	IIa	C
In patients with low surgical risk and 'ascending phenotype' BAV-related aortopathy, surgery should be considered at a maximum diameter ≥50 mm if any of the following is present: • age <50 years • short stature (<1.69 m)[f] • ascending aortic length >11 cm[g] • aortic diameter growth rate >3 mm/year • family history of the acute aortic syndrome • aortic coarctation • refractory hypertension • shared decision with the patient[h] • concomitant non-aortic valve cardiac surgery	IIa	C

Indikace k operaci - TAV

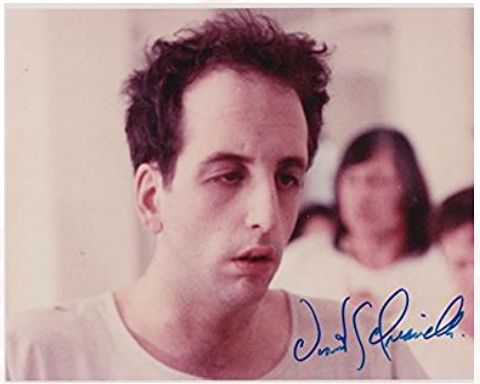
Surgery for TAV-associated aneurysms with 'root phenotype' should be considered when the maximum aortic diameter is ≥50 mm in a low-surgical-risk setting.[d]	IIa	B
In patients with low surgical risk[e] and 'ascending phenotype' dilatation, both with TAV and BAV, surgical treatment should be considered when the maximum aortic diameter is >52 mm.	IIa	C
In patients with non-syndromic TAV with 'ascending phenotype', in a low-surgical-risk setting,[d] surgery may be considered at a maximum diameter ≥50 mm if any of the following is present: • age <50 years • short stature (<1.69 m)[f] • ascending aortic length >11 cm[g] • aortic diameter growth rate >3 mm/year • refractory hypertension • shared decision with the patient[h]	IIb	C

Indikace k operaci MFS a Turnerův sy

Surgery is indicated in patients with MFS who have aortic root disease with a maximal aortic sinus diameter ≥50 mm.[70,172,1466–1468]	I	B
Surgery should be considered in patients with MFS who have an aortic root aneurysm with a maximal aortic sinus diameter ≥45 mm and additional risk factors.[c,1467,1469]	IIa	C

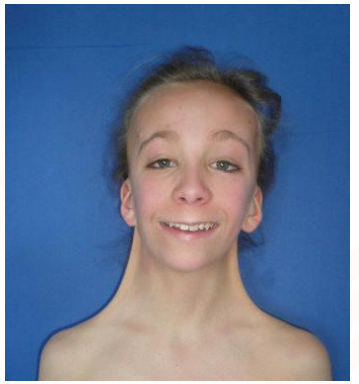
Rizikové faktory MFS:

- RA disekce
- plánovaná gravidita
- nekontrolovaná hypertenze
- progrese > 3mm/rok



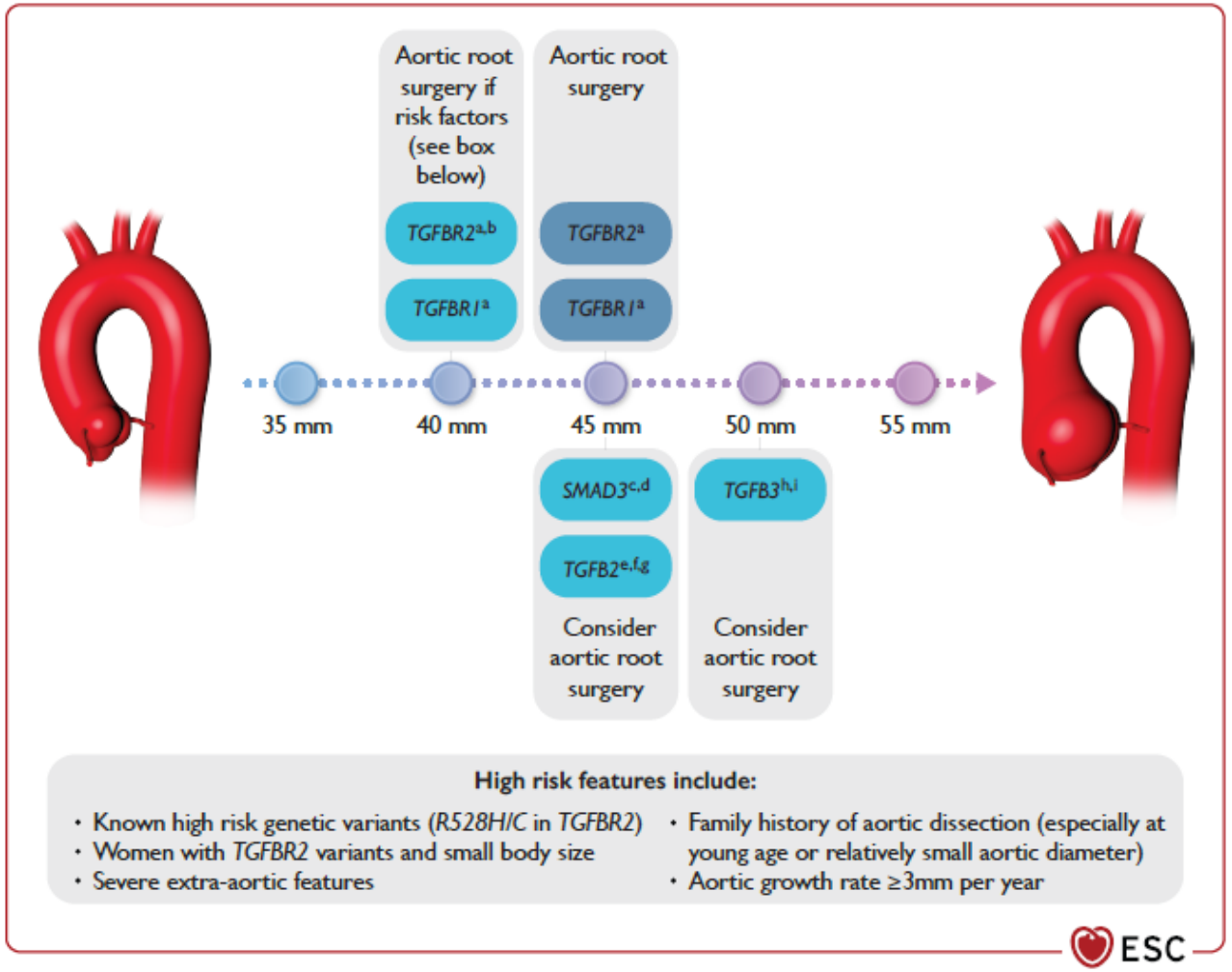
Turnerův syndrom

Elective surgery for aneurysms of the aortic root and/or ascending aorta should be considered in women with TS who are ≥15 years of age, have an ascending ASI >23 mm/m^2, an AHI >23 mm/m, a z-score >3.5, and have associated risk factors for aortic dissection[c] or are planning pregnancy.[70,1417,1421]	IIa	C



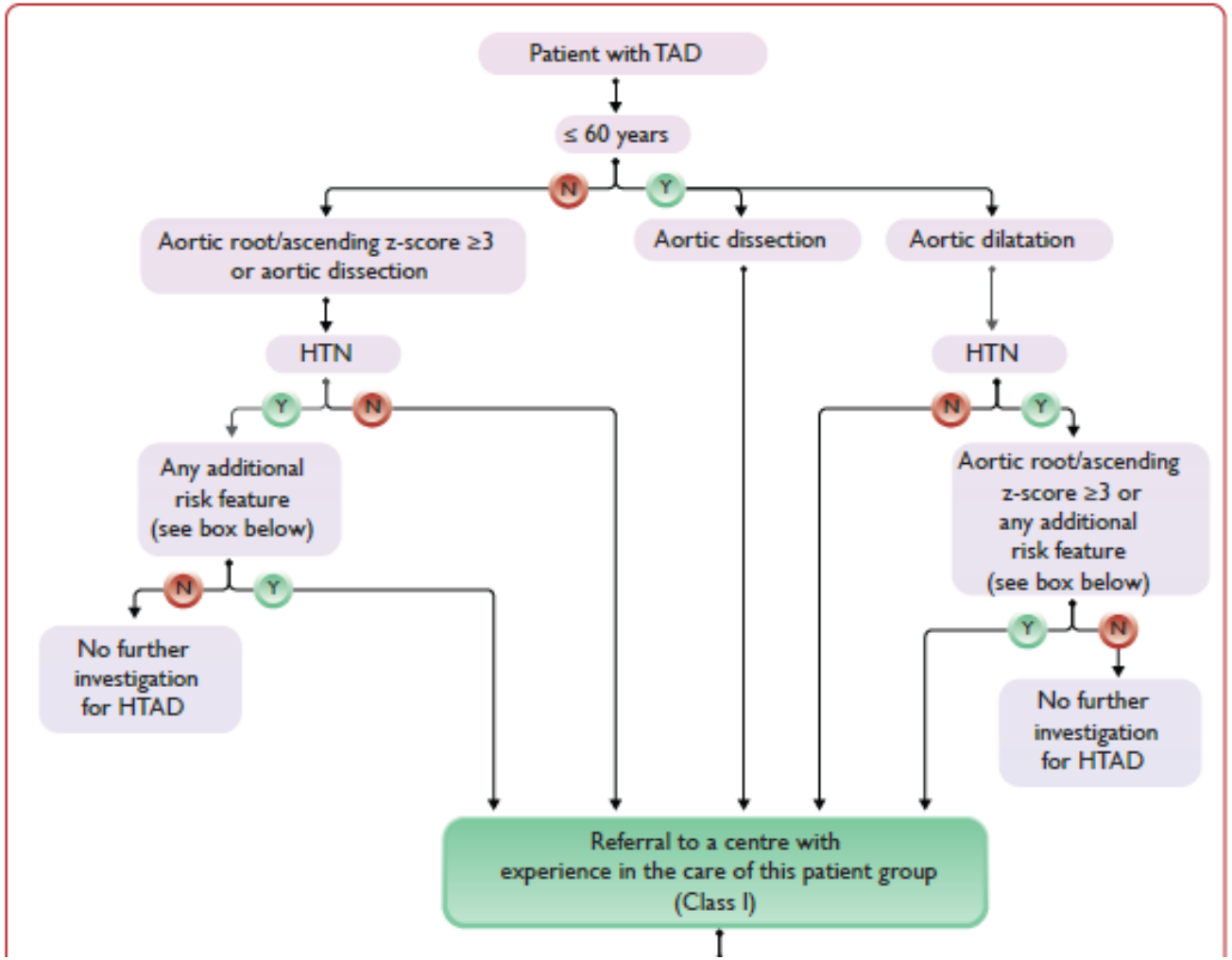
RF TS: BAV, koarktace aorty, elongace transverzální aorty, hypertenze

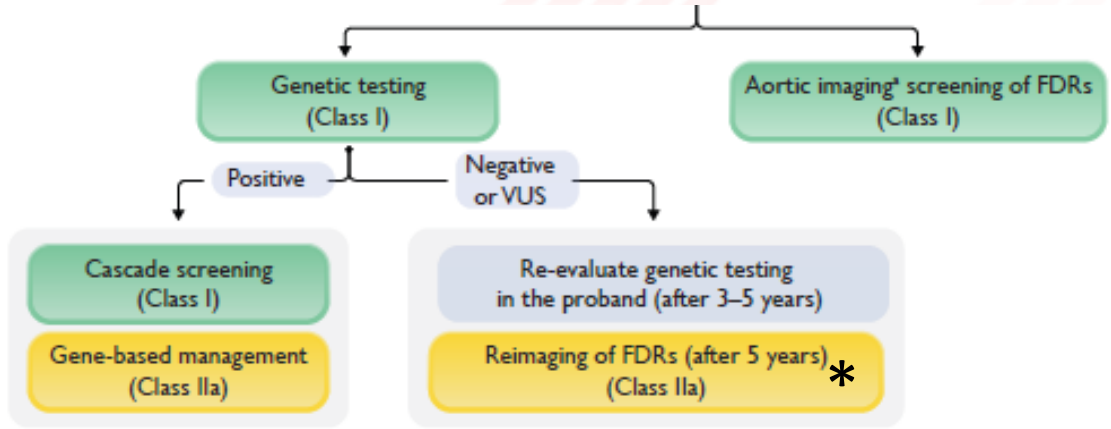
Indikace k operaci Loyes-Dietzův sy



6 podtypů LDS

Kdy indikovat genetické vyšetření?





Any additional risk feature

Syndromic features of:	Family history of (either one):
• Marfan syndrome	• TAD
• Loeys-Dietz syndrome	• Peripheral/intracranial artery aneurysm
• Vascular Ehlers-Danlos syndrome	• Unexplained Sudden death <60 years

*

Imaging screening of family members of patients with TAD with risk factors for HTAD[c] in whom no (likely) pathogenic variant is identified should be considered starting at age 25, or 10 years below the youngest case, whichever is younger. If the initial screening is normal, continued screening every 5 years until the age of 60 should be considered.[25]	IIa	C

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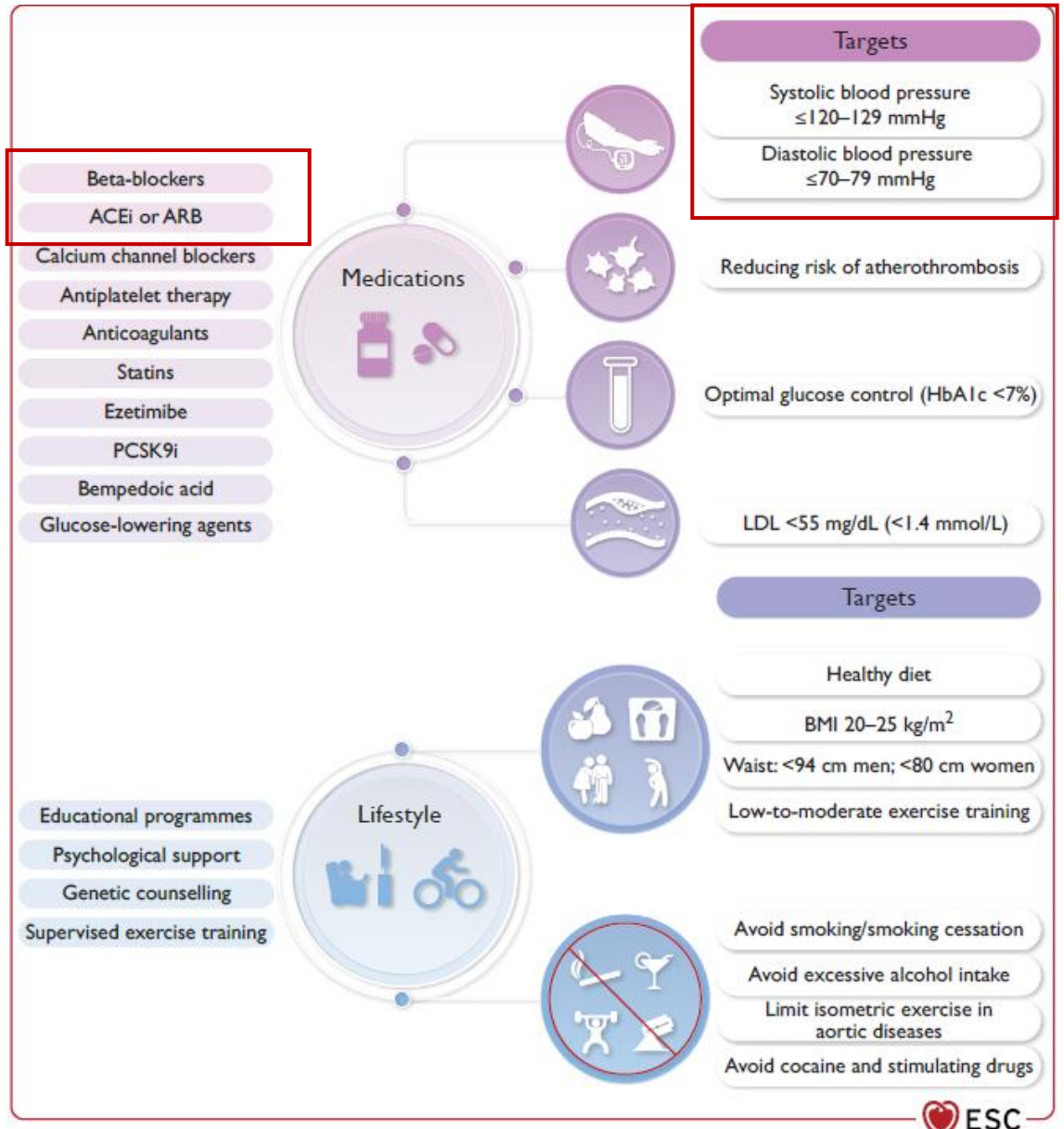
Farmakoterapie a životní styl



In patients with PAAD and hypertension, ACEIs or ARBs should be considered as first-line antihypertensive therapy.[307,312]	IIa	B
An individualized, more lenient BP goal (e.g. <140/90 mmHg) should be considered in:[301] • Age ≥85 years • Residential care • Symptomatic orthostatic hypotension	IIa	C
An individualized, more lenient BP goal (e.g. <140/90 mmHg) may be considered in:[301] • Clinically severe frailty at any age • Limited life expectancy (<3 years)	IIb	C

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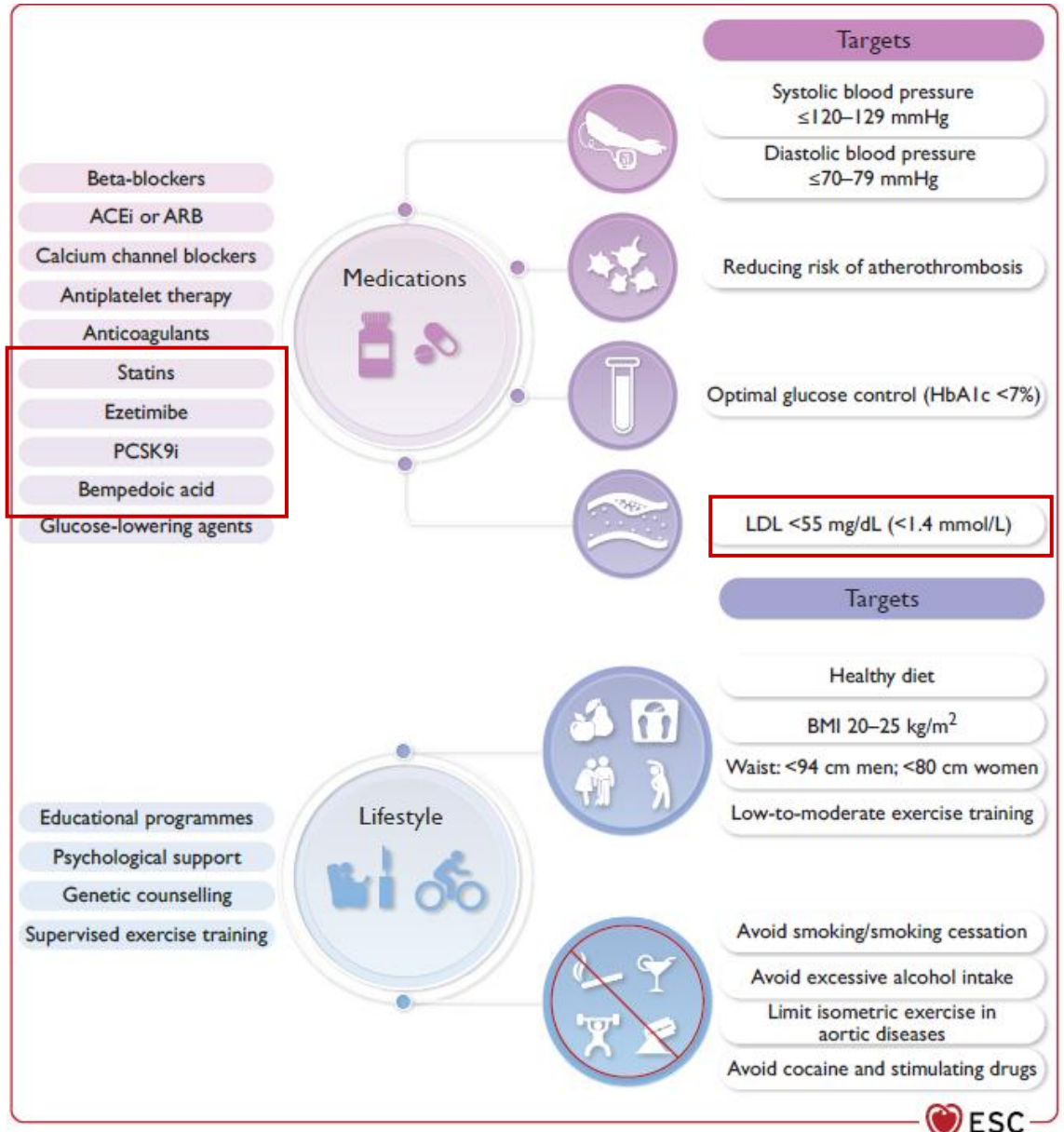
Farmakoterapie a životní styl



An ultimate LDL-C goal of <1.4 mmol/L (55 mg/dL) and a >50% reduction in LDL-C vs. baseline are recommended in patients with atherosclerotic PAAD.[19,242,246,300,335]	I	A
If the target LDL-C level is not achieved on maximally tolerated statins and ezetimibe, treatment with a PCSK9 inhibitor is recommended in patients with atherosclerotic PAAD, to achieve target values.[372,373]	I	A
For statin-intolerant patients with atherosclerotic PAAD, at high CV risk, who do not achieve their LDL-C goal on ezetimibe, it is recommended to add bempedoic acid either alone or in combination with a PCSK9 inhibitor.[361]	I	B
Statins for the reduction of growth and rupture of AAA should be considered.[347–349,352,354]	IIa	B

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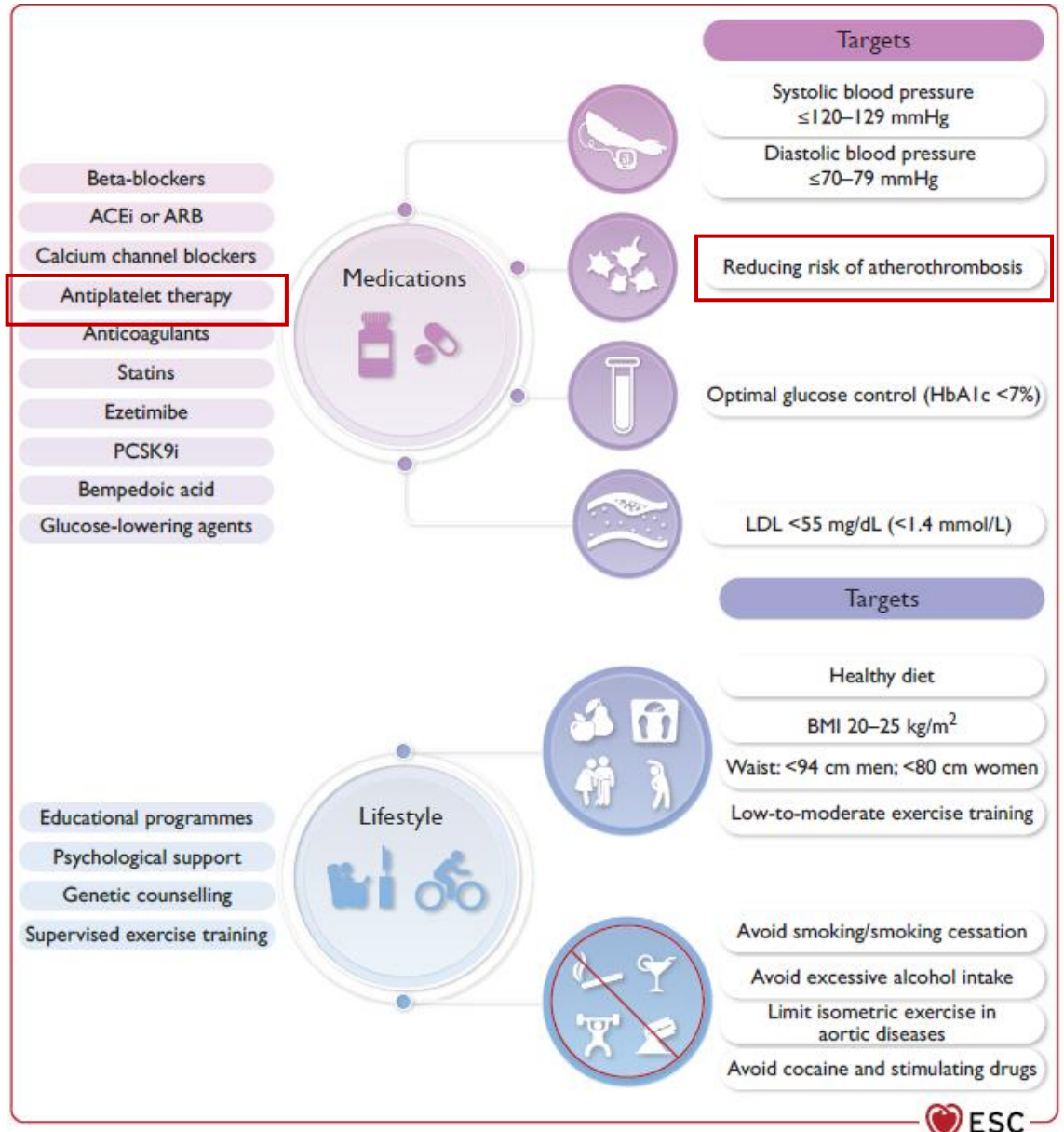
Farmakoterapie a životní styl



SAPT with clopidogrel or low-dose aspirin should be considered in severe/complex plaques.[193,666,861,863]	IIa	C
Anticoagulation[861] or DAPT[863] are not recommended in aortic plaques since they present no benefit and increase bleeding risk.[666]	III	C
In patients with an embolic event and evidence of an aortic arch atheroma, SAPT is recommended to prevent recurrences.[666,865,866]	I	C

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Farmakoterapie a životní styl u HTAD

BB, ARBs (losartan, irbesartan)

Celiprolol (redukuje vaskulární morbiditu u vEDS)

Vyvarovat se izometrické zátěži a kontaktním sportům

Nevhodná farmaka: CaB, fluorochinolony, triptany

In patients with MFS, treatment with either a BB or an ARB, in maximally tolerated doses (unless contraindicated), is recommended to reduce the rate of aortic dilatation.[1461,1462]	I	A
In patients with MFS, the use of both a BB and an ARB, in maximally tolerated doses (unless contraindicated), should be considered to reduce the rate of aortic dilatation.[1463,1464]	IIa	A

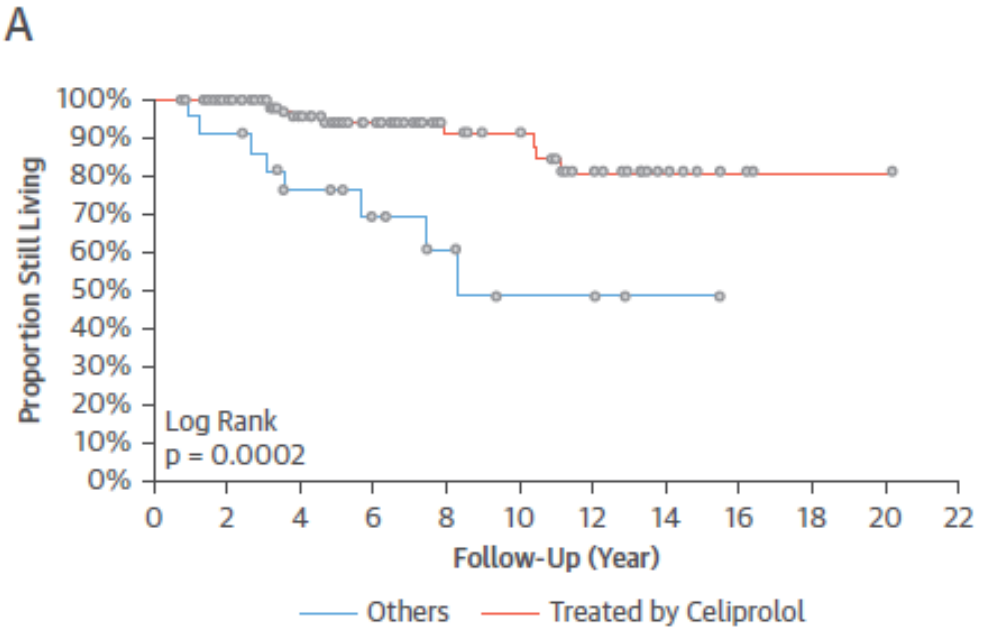
Losartan reduces aortic dilatation rate in adults with Marfan syndrome: a randomized controlled trial

Maarten Groenink[1,2,3*], Alexander W. den Hartog[1,2†], Romy Franken[1,2†], Teodora Radonic[4], Vivian de Waard[5], Janneke Timmermans[6], Arthur J. Scholte[7], Maarten P. van den Berg[8], Anje M. Spijkerboer[3], Henk A. Marquering[3,9], Aeilko H. Zwinderman[1,4], and Barbara J.M. Mulder[1,2]

Irbesartan in Marfan syndrome (AIMS): a double-blind, placebo-controlled randomised trial

Michael Mullen, Xu Yu Jin*, Anne Child, A Graham Stuart, Matthew Dodd, José Antonio Aragon-Martin, David Gaze, Anatoli Kiotsekoglou, Li Yuan, Jiangting Hu, Claire Foley, Laura Van Dyck, Rosemary Knight, Tim Clayton, Lorna Swan, John D R Thomson, Guliz Erdem, David Crossman, Marcus Flather, on behalf of the AIMS Investigators†*

FIGURE 3 Kaplan-Meier Survival Analysis of vEDS Patients in Groups I and II *COL3A1* Pathogenic Variants, According to Celiprolol Treatment



Frank et al. JACC 2019, Baderkhan et l. Eur J Vasc Endovasc Surg 2021

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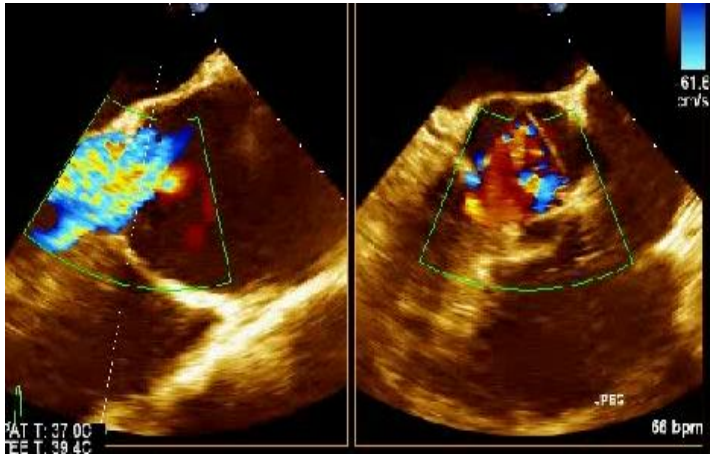
Chirurgické řešení



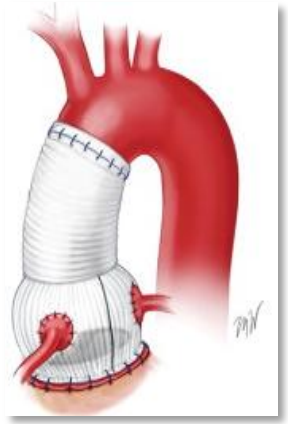
Záchovné operace (David, Yacoub)

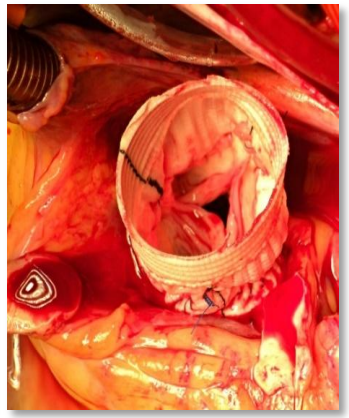
PEARS (ExoVasc)

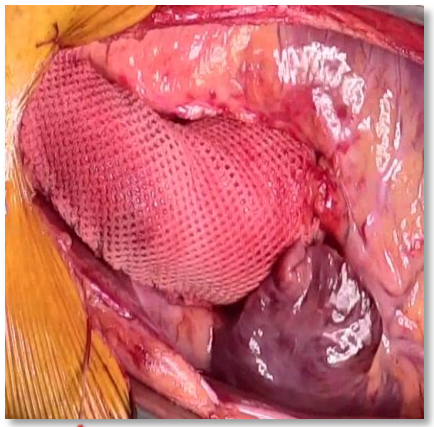
Bentallova operace - konduit s chlopní (mech, bio)

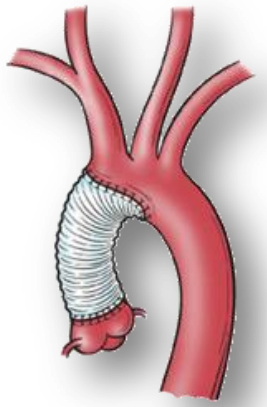
Suprakoronární náhrada ascendentní aorty

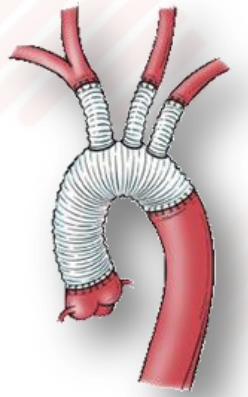
Náhrada aortálního oblouku/ FET (frozen elephant trunk)











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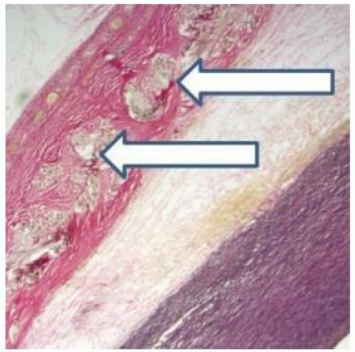
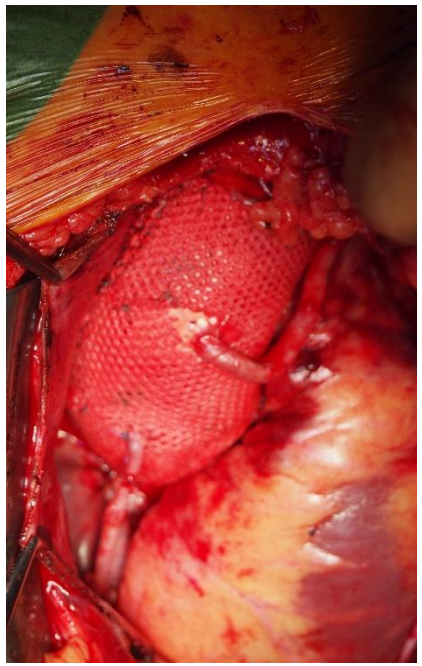
PEARS (1192 pac. k 3.1.2025)

- ExoVasc® Personalised External Aortic Root Support (PEARS)
- Individualizovaná polyesterová síťovaná protéza vyrobená dle CT/MR 3D tiskem
- Operace ze sternotomie, s/bez ECC, inkorporace protézy do adventicie, neovaskularizace
- Indikace: aorta < 55 mm , AoR ≤ 1.st.
- Kontraindikace: aorta ≥ 55-60 mm, středně významná a významná aortální vada





Výsledky léčby externí podpory aortálního kořene a ascendentní aorty u prvních 100 pacientů v České republice

(Outcomes of personalised external aortic root support implantation in 100 patients in the Czech Republic)

Petr Němec[a,b], Jan Pirk[c], Ivo Skalský[d], Tomáš Matějka[e], Pavel Žáček[f], Tomáš Grus[g], Vilém Rohn[h], Petr Šantavý[ch], Alice Krebsová[c], Ondrej Szárszoi[c], Lydie Tauchenová[c], Daniela Žáková[a,b], Radka Kočková[c], Petr Fila[a,b]

[a] *Centrum kardiovaskulární a transplantační chirurgie, Brno*
[b] *Klinika kardiovaskulární a transplantační chirurgie, Lékařská fakulta Masarykovy univerzity, Brno*
[c] *Klinika kardiovaskulární chirurgie, Institut klinické a experimentální medicíny, Praha*
[d] *Kardiochirurgické oddělení, Nemocnice Na Homolce, Praha*
[e] *Dětské kardiocentrum, 2. lékařská fakulta Univerzity Karlovy a Fakultní nemocnice v Motole, Praha*
[f] *Kardiochirurgická klinika, Lékařská fakulta Univerzity Karlovy a Fakultní nemocnice Hradec Králové, Hradec Králové*
[g] *II. chirurgická klinika – kardiovaskulární chirurgie, 1. lékařská fakulta Univerzity Karlovy a Všeobecná fakultní nemocnice v Praze, Praha*
[h] *Klinika kardiovaskulární chirurgie, 2. lékařská fakulta Univerzity Karlovy a Fakultní nemocnice v Motole, Praha*
[ch] *Kardiochirurgická klinika, Lékařská fakulta Univerzity Palackého a Fakultní nemocnice Olomouc, Olomouc*

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Algoritmus sledování

ECHO – screeningová metoda

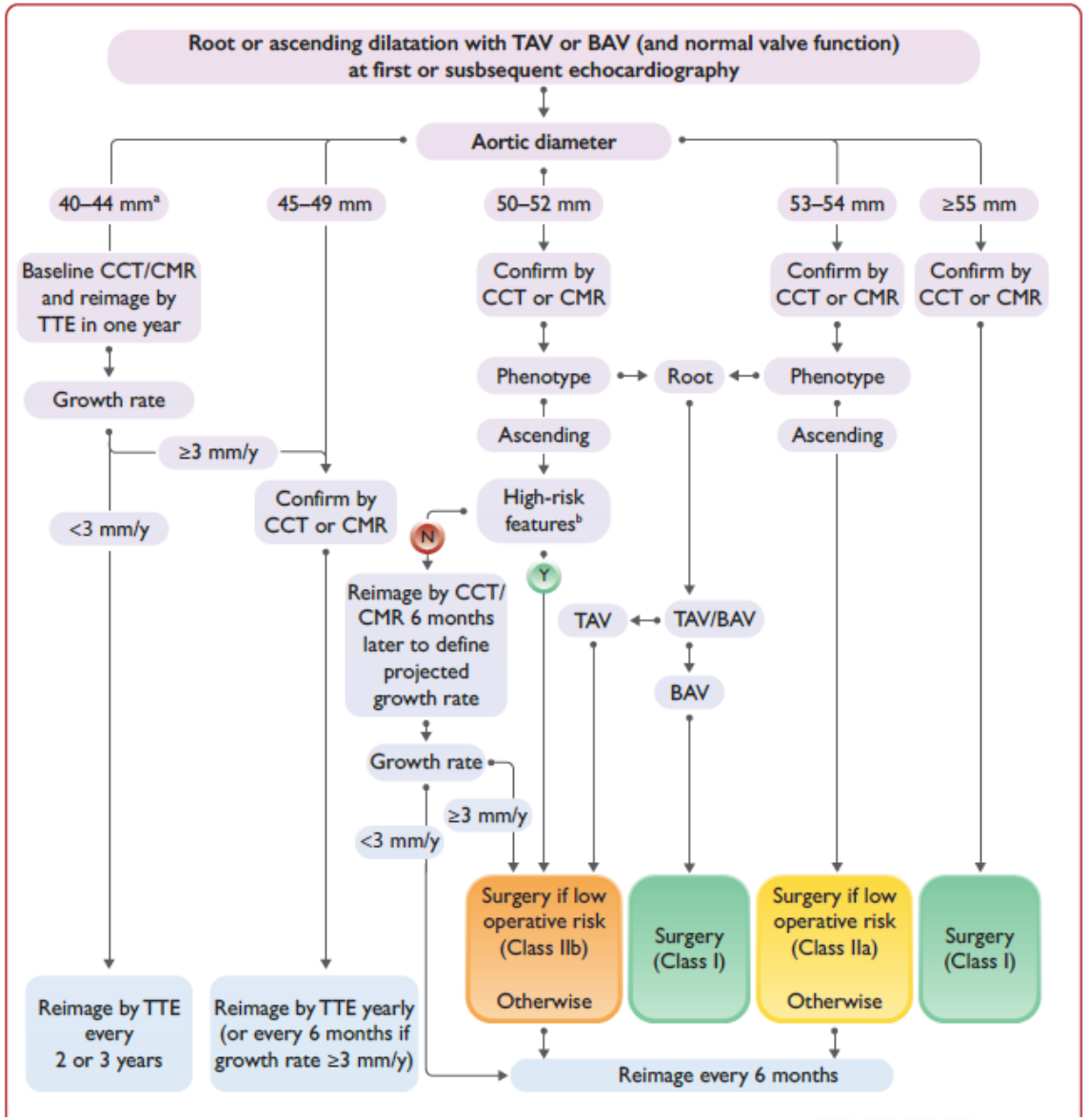
CT/ MR - při diagnoze ≥ 40mm (iniciální)

- při progresi ≥ 3mm/rok IIaC
- při diskrepanci ve sledování
- perioperační management

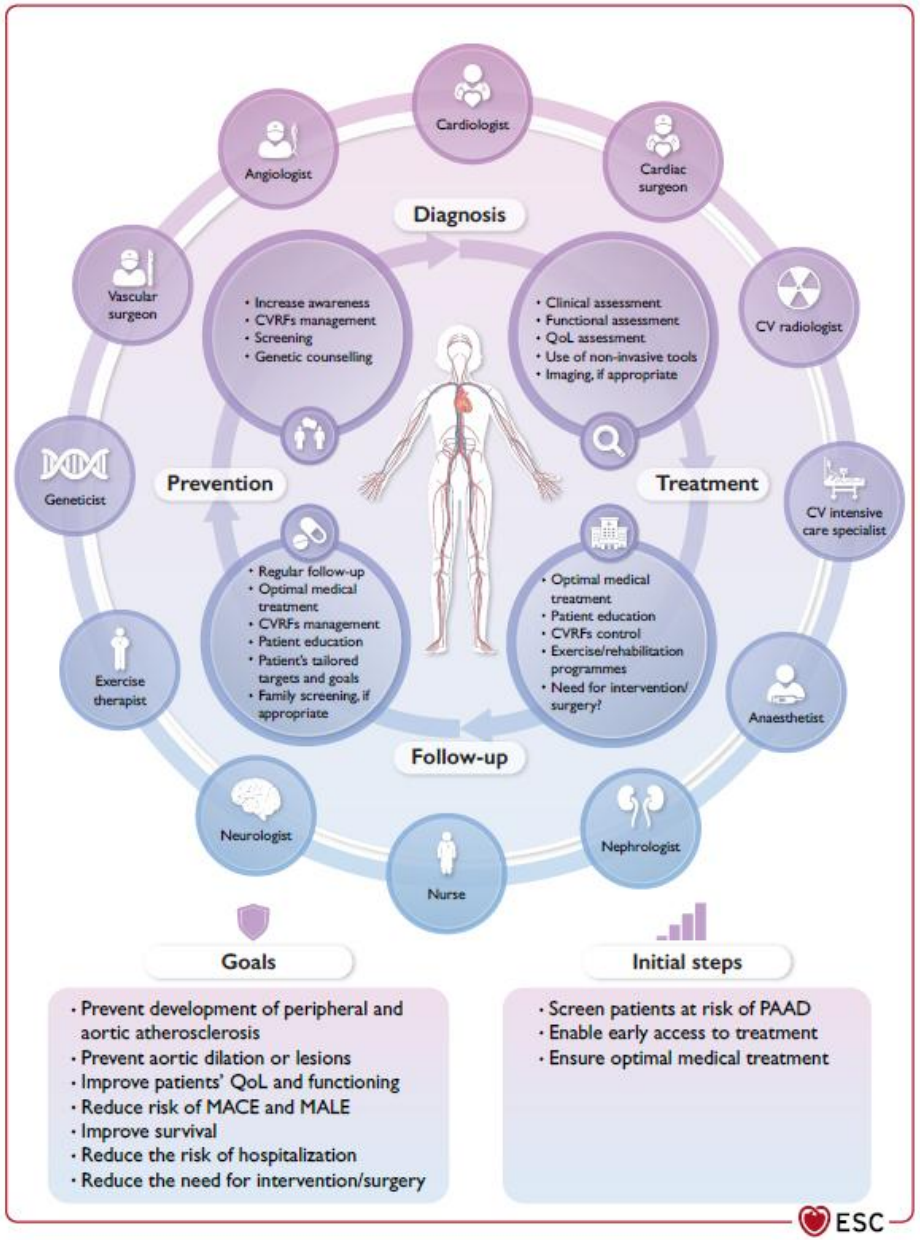
BAV - ECHO u 1.st.příbuzných s root fenotypem nebo izolovanou AoR IC

u všech IIaB

HTAD dle typu mutace a diametru



Komplexní multidisciplinární přístup



Závěry

- V prevenci TAA je zásadní zdravý životní styl, nekuřáctví, léčba HT, HLP a DM.
- Genetické testování je doporučeno u pacientů do 60ti let při dilataci aorty bez přítomnosti klasických rizikových faktorů a po disekci aorty.
- Chirurgická léčba zlepšuje prognózu pacientů. Opodstatnění pro chirurgický výkon při nižších kritériích je s ohledem na fenotyp aorty, délku ascendentní aorty, typ mutace, dynamiku růstu, RA…
- Preferovány jsou záchovné operace. PEARS představuje slibnou metodu v léčbě dilatace kořene či ascendentní aorty.
- Nemocní mají být celoživotně sledování ve specializovaných centrech umožňujících multidisciplinární přístup.

Děkuji za pozornost

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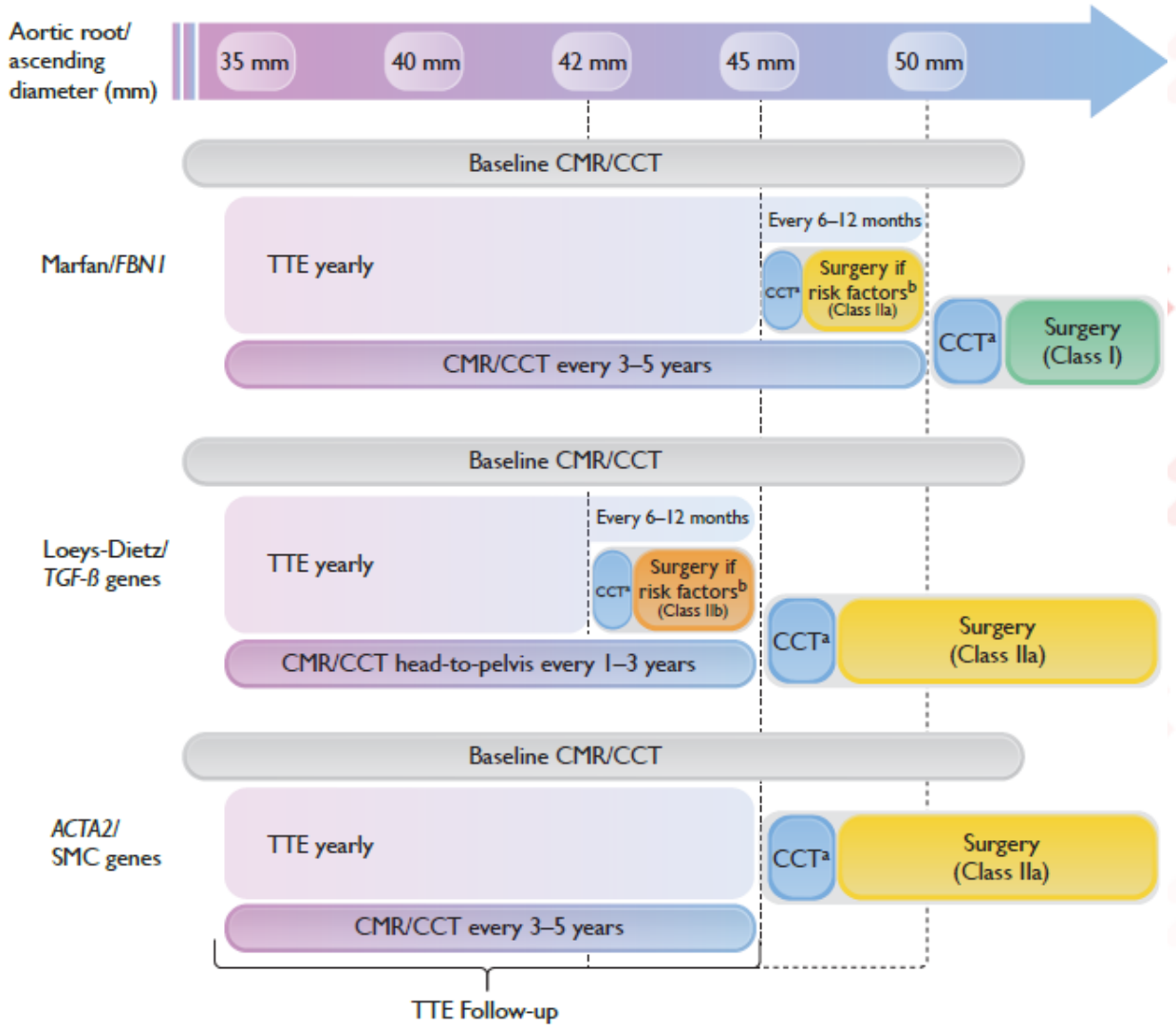
Sportovní aktivity

	Low risk	Low-intermediate risk	Intermediate risk	High risk
Diagnosis	• Aorta <40 mm in BAV or tricuspid valve • Turner syndrome without aortic dilatation	• MFS or other HTAD syndrome without aortic dilatation • Aorta 40–45 mm in BAV or tricuspid valve • After successful thoracic aorta surgery for BAV or other low risk situation	• Moderate aortic dilatation (40–45 mm in MFS or other HTAD; 45–50 mm in BAV or tricuspid valve, Turner syndrome ASI 20–25 mm/m^2, tetralogy of Fallot <50 mm) • After successful thoracic aorta surgery for MFS or HTAD	• Severe aortic dilatation (>45 mm in MFS or other HTAD, >50 mm in BAV or tricuspid valve, Turner syndrome ASI >25 mm/m^2, tetralogy of Fallot >50 mm) • After surgery with sequelae
Advice	• All sports permitted with preference for endurance over power sports	• Avoid high and very high intensity exercise, contact, and power-sports. • Preference for endurance over power sports	• Only skill sports or mixed or endurance sports at low intensity	• Sports are (temporarily) contra-indicated
Follow-up	Every 2–3 years	Every 1–2 years	Every 6 months to 1 year	Re-evaluation after treatment

Algoritmus u HTAD



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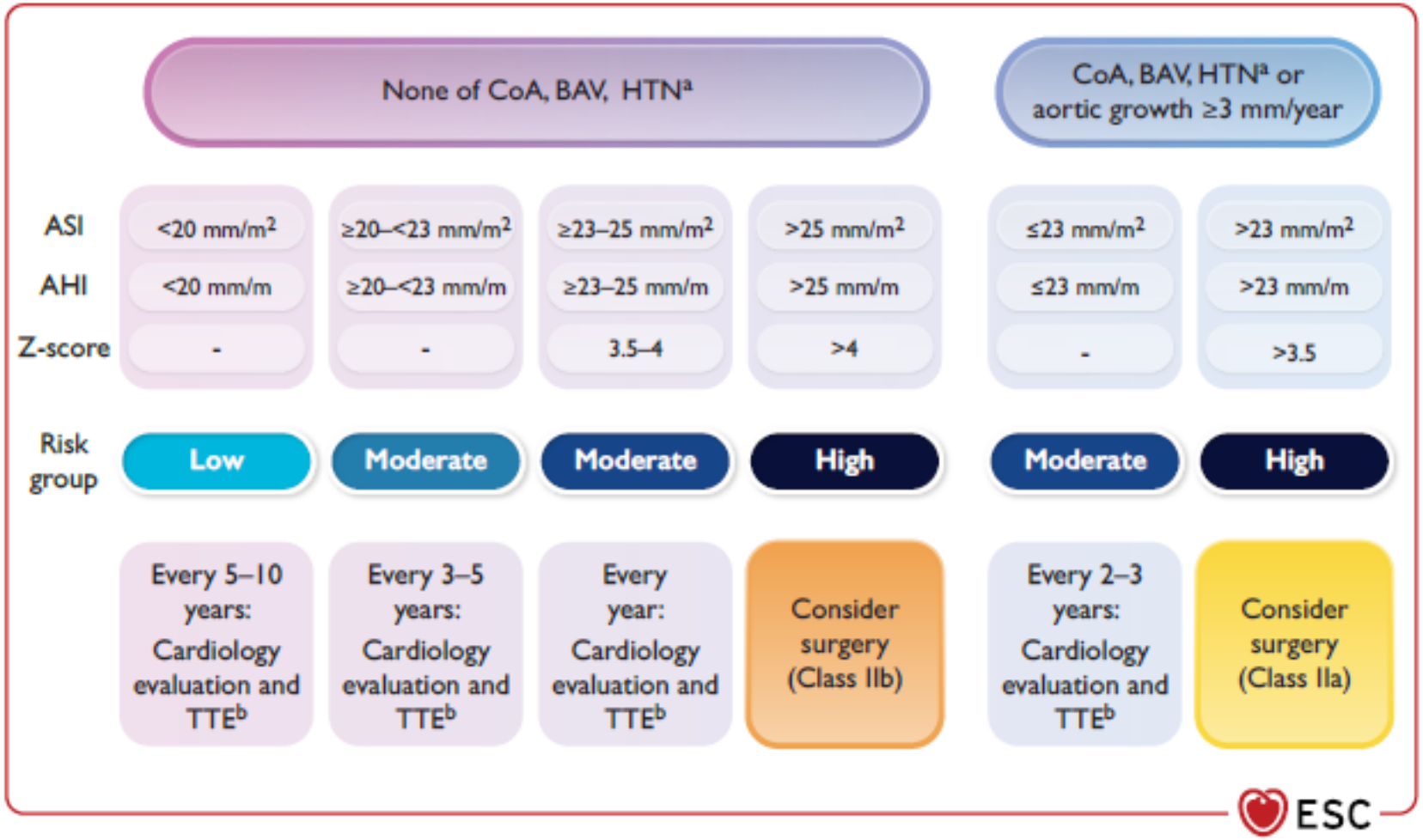
Turnerův syndrom algoritmus



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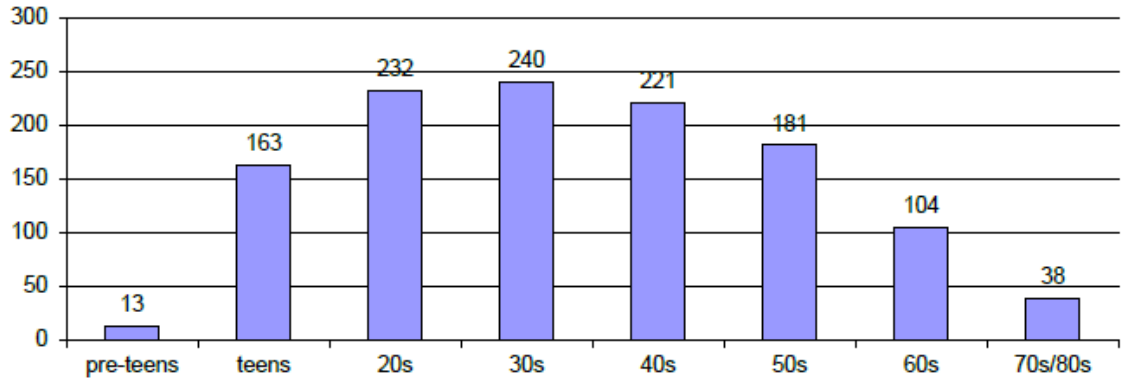
- ExoVasc® Personalised External Aortic Root Support (PEARS)
- Celosvětově od r. 2004 **1192 pacientů ve 53 centrech** (11 v ČR) – data k 3.1.2025

PEARS – Patients' ages

The age range of patients treated is from 3 to 80 with the following age distribution:



- Marfan syndrome – 405 (38 patients having concurrent mitral repair)
- Loeys-Dietz syndrome - 67 (3 patients having concurrent mitral repair)
- Bicuspid Aortic Valve disease – 152 (4 patients having concurrent mitral repair)
- Idiopathic aortic dilation/other – 226 (inc. Turner's Syndrome, SMAD3, MYBCP3, NOS & FAAP)
- ACTA2 mutation – 3
- Ehlers Danlos Syndrome – 4 (1 patient having concurrent mitral repair)
- Tetralogy of Fallot - 4
- Transposition of the great arteries repaired by an arterial switch operation - 11
- Post free-standing root Ross op. autograft dilation – 20
- Aortic valve disease treated by the Ross Procedure – 200 (1 patient having concurrent mitral repair)
- Case Report Form yet to be received – 143

Ing. Tal Golesworthy (1956)