# Dlouhodobé výsledky Rossovy operace

Dětské Kardiocentrum 2. LF UK a FN v Motole

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7. – 8. března 2019, Hotel Nové Adalbertinum, Hradec Králové

21. SYMPOSIUM PS CHLOPENNÍ A VROZENÉ SRDEČNÍ VADY V DOSPĚLOSTI ČKS

## Central Message

All valve substitutes provide suboptimal results in children, reflecting the urgent need for innovative repair and replacement options.

## Perspective

The balance of the risks and benefits of the various valve prostheses remains a point of discussion. This systematic review, encompassing a total of 3329 patients with 21,110 patient-years of follow-up, provides a comprehensive overview of the clinical benefits and limitations of the various aortic valve substitutes in children, crucial information to optimize the surgical decision-making process.

# Outcome a
# review and

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## ABSTRACT

**Objective:** Despit
valve replacement
after pediatric aort
case series. This sy
of reported outcon

**Methods:** A syste
pediatric aortic val
was conducted. St
patients were inclu

**Results:** Thirty-fo
review: 26 concern
prosthesis aortic va
valve replacement


choice in pediatric AVR.

vide suboptimal results
e urgent need for inno-
ement options.

**TABLE 4. Pooled outcome estimates after aortic valve replacement with mechanical prosthesis**

| Study | Early mortality % | Late mortality %/y | SUUD %/y | AV reoperation %/y | Reoperation for SVD/NSVD %/y | TE/VT %/y | Bleeding %/y | Endocarditis %/y |
|---|---|---|---|---|---|---|---|---|
| Abid (1992) | 12.50 (6.54-23.90) | 2.60 (1.41-4.79) | 0.13 (0.01-2.07) | 1.30 (0.54-3.10) | 0.78 (0.25-2.41) | 1.30 (0.54-3.10) | 0.52 (0.13-2.07) | 0.78 (0.25-2.41) |
| Cabalka (1995) | 5.56 (1.44-21.36) | 0.85 (0.12-6.02) | - | 0.43 (0.03-6.79) | 0.43 (0.03-6.79) | 0.85 (0.12-6.02) | 1.71 (0.43-6.75) | 0.43 (0.03-6.79) |
| Yamak (1995) | 8.11 (2.74-23.99) | 0.49 (0.03-7.83) | 0.49 (0.03-7.83) | 0.49 (0.03-7.83) | 0.49 (0.03-7.83) | 0.49 (0.03-7.83) | 0.49 (0.03-7.83) | 0.49 (0.03-7.83) |
| Champsaur (1997) | 12.96 (6.49-25.87) | 2.30 (1.04-5.07) | 0.19 (0.01-3.05) | 1.15 (0.37-3.54) | 1.15 (0.37-3.54) | 0.77 (0.19-3.05) | 0.38 (0.05-2.71) | - |
| Mazzitelli (1998) | 1.67 (0.11-26.04) | 1.52 (0.49-4.66) | 0.25 (0.02-4.02) | 2.53 (1.06-6.00) | 1.52 (0.49-4.66) | 1.01 (0.25-4.01) | 0.51 (0.07-3.57) | - |
| Lupinetti (1999) | 10.00 (4.35-22.97) | 1.48 (0.56-3.91) | 0.18 (0.01-2.94) | 3.69 (2.01-6.78) | 2.58 (1.24-5.37) | 1.11 (0.36-3.41) | 0.18 (0.01-2.94) | 0.74 (0.19-2.94) |
| Alexiou (2000) | 5.36 (1.78-16.11) | 0.74 (0.24-2.29) | 0.12 (0.01-1.97) | 0.74 (0.24-2.29) | 0.49 (0.12-1.97) | 0.49 (0.12-1.97) | 0.12 (0.01-1.97) | 0.12 (0.01-1.97) |
| Shanmugam (2005) | 0.91 (0.06-14.35) | 0.15 (0.02-1.07) | 0.08 (0.00-1.20) | 0.60 (0.23-1.60) | 0.45 (0.15-1.40) | 0.08 (0.00-1.20) | 0.15 (0.02-1.07) | 0.30 (0.08-1.20) |
| Ruzmetov (2006) | 6.38 (2.14-19.08) | 0.83 (0.27-2.56) | 0.14 (0.01-2.20) | 1.38 (0.58-3.30) | 0.83 (0.27-2.56) | 0.14 (0.01-2.20) | 0.14 (0.01-2.20) | 0.55 (0.14-2.20) |
| Burczynski (2007) | 0.91 (0.06-14.35) | 0.57 (0.14-2.26) | 0.14 (0.01-2.26) | 0.28 (0.04-2.01) | 0.14 (0.01-2.26) | 0.57 (0.14-2.26) | 0.14 (0.01-2.26) | 0.57 (0.14-2.26) |
| Masuda (2008) | 2.22 (0.32-15.43) | 0.48 (0.12-1.93) | 0.24 (0.03-1.71) | 0.48 (0.12-1.93) | 0.24 (0.03-1.71) | 0.97 (0.36-2.56) | - | 0.24 (0.03-1.71) |
| Alsoufi (2009) | 6.11 (3.12-11.95) | 1.75 (1.12-2.73) | - | 0.74 (0.37-1.47) | - | 0.37 (0.14-0.98) | 0.28 (0.09-0.85) | 0.09 (0.01-0.65) |
| Khan (2013) | 1.39 (0.09-21.78) | 0.60 (0.09-4.26) | - | 0.60 (0.09-4.26) | - | 1.21 (0.30-4.79) | - | - |
| **Pooled (random effects)** | **7.34 (5.21-10.34)** | **1.23 (0.85-1.79)** | **0.18 (0.08-0.41)** | **1.07 (0.68-1.68)** | **0.86 (0.53-1.42)** | **0.76 (0.53-1.09)** | **0.39 (0.22-0.68)** | **0.45 (0.27-0.75)** |
| Heterogeneity test | $\chi^2$ 14.78 ($P = .32$) $I^2 = 18\%$ | $\chi^2$ 18.79 ($P = .13$) $I^2 = 36\%$ | $\chi^2$ 1.22 ($P = 1.00$) $I^2 = 0\%$ | $\chi^2$ 25.57 ($P = .01$) $I^2 = 53\%$ | $\chi^2$ 14.81 ($P = .19$) $I^2 = 32\%$ | $\chi^2$ 9.62 ($P = .72$) $I^2 = 0\%$ | $\chi^2$ 7.97 ($P = .72$) $I^2 = 0\%$ | $\chi^2$ 5.67 ($P = .84$) $I^2 = 0\%$ |

Data expressed as percentage (95% CI). "-" = variable not reported. In case an event was reported not to occur, for pooling purposes it was assumed that 0.5 patient experienced the event. *SUUD*, Sudden, unexpected, unexplained death; *AV*, aortic valve; *SVD*, structural valve deterioration; *NSVD*, nonstructural valve dysfunction; *TE*, thromboembolism; *VT*, valve thrombosis.

**TABLE 2** Pooled outcome estimates after the Ross procedure (excluding studies that concerned only neonates and infants)

| Study | Early mortality % | Late mortality %/y | SUUD %/y | AV reoperation %/y | RVOT reoperation %/y | Reoperation for SVD/NSVD %/y | TE/VT %/y | Bleeding %/y | Endocarditis %/y |
|---|---|---|---|---|---|---|---|---|---|
| Gerosa (1991) | 11.63 (5.10-26.51) | 1.68 (0.71-4.01) | - | 1.68 (0.71-4.01) | 0.34 (0.05-2.38) | 0.34 (0.05-2.38) | 0.17 (0.01-2.69) | - | 1.68 (0.71-4.01) |
| Reddy (1998) | 2.44 (0.35-16.90) | 0.47 (0.03-7.50) | 0.47 (0.03-7.50) | 1.89 (0.48-7.45) | 0.47 (0.03-7.50) | 1.89 (0.48-7.45) | - | - | - |
| Elkins (2001) | 4.49 (2.28-8.85) | 0.31 (0.10-0.95) | - | 1.23 (0.70-2.16) | 0.92 (0.48-1.77) | 1.95 (1.25-3.05) | 0.05 (0.00-0.82) | - | 0.21 (0.05-0.82) |
| Simon (2001) | 1.67 (0.11-26.04) | 0.78 (0.11-5.46) | 0.39 (0.02-6.16) | 0.78 (0.11-5.46) | 0.39 (0.02-6.16) | 0.78 (0.11-5.46) | 0.39 (0.02-6.16) | 0.39 (0.02-6.16) | 0.39 (0.02-6.16) |
| Hazekamp (2005) | 5.66 (1.89-16.99) | 1.03 (0.33-3.17) | 0.17 (0.01-2.74) | 1.72 (0.72-4.09) | 1.03 (0.33-3.17) | 2.74 (1.39-5.44) | - | - | - |
| Bohm (2006) | 0.83 (0.05-13.17) | 0.95 (0.24-3.78) | 0.24 (0.01-3.79) | 0.24 (0.01-3.79) | 4.76 (2.60-8.72) | 4.76 (2.60-8.72) | 0.24 (0.01-3.79) | 0.24 (0.01-3.79) | 0.24 (0.01-3.79) |
| Kalavrouziotis (2006) | 1.43 (0.09-22.39) | 0.70 (0.10-4.91) | 0.35 (0.02-5.54) | 0.35 (0.02-5.54) | 1.39 (0.35-5.52) | 1.39 (0.35-5.52) | - | - | - |
| Ruzmetov (2006) | 1.23 (0.18-8.66) | 0.23 (0.03-1.65) | 0.12 (0.01-1.86) | 1.63 (0.78-3.40) | 1.40 (0.63-3.09) | 3.03 (1.77-5.17) | 0.12 (0.01-1.86) | 0.12 (0.01-1.86) | 0.12 (0.01-1.86) |
| Stewart (2007) | 1.09 (0.07-17.12) | 0.20 (0.01-3.20) | 0.20 (0.01-3.20) | 2.81 (1.35-5.83) | 0.40 (0.06-2.84) | 3.21 (1.62-6.35) | 0.20 (0.01-3.20) | 0.20 (0.01-3.20) | - |
| Kadner (2008) | 9.62 (4.18-22.12) | 1.61 (0.52-4.95) | 0.27 (0.02-4.27) | 1.07 (0.27-4.26) | 3.22 (1.47-7.08) | 4.29 (2.18-8.46) | 0.27 (0.02-4.27) | - | 0.27 (0.02-4.27) |
| Alsoufi (2009) | 2.33 (0.98-5.53) | 0.04 (0.00-0.65) | 0.04 (0.00-0.65) | 2.28 (1.58-3.29) | - | - | 0.04 (0.00-0.65) | 0.04 (0.00-0.65) | 0.16 (0.04-0.65) |
| El Behery (2009) | 4.88 (1.26-18.85) | 0.20 (0.01-3.24) | 0.20 (0.01-3.24) | 0.20 (0.01-3.24) | 1.63 (0.62-4.30) | 0.81 (0.20-3.23) | - | - | 0.81 (0.20-3.23) |
| Piccardo (2009) | 1.82 (0.26-12.68) | 0.66 (0.17-2.63) | 0.17 (0.01-2.64) | 0.99 (0.32-3.06) | 0.99 (0.32-3.06) | 0.66 (0.17-2.63) | - | - | 0.33 (0.05-2.34) |
| Charitos (2012) | 3.42 (1.80-6.50) | 0.58 (0.30-1.12) | 0.13 (0.03-0.52) | 0.91 (0.54-1.53) | 2.72 (2.02-3.67) | 2.98 (2.24-3.96) | 0.58 (0.30-1.12) | 0.03 (0.00-0.52) | 0.65 (0.35-1.20) |
| Talwar (2012) | 2.78 (0.40-19.19) | 1.40 (0.53-3.71) | 0.18 (0.01-2.80) | 1.75 (0.74-4.18) | 0.70 (0.18-2.79) | - | 0.18 (0.01-2.80) | 0.18 (0.01-2.80) | 0.70 (0.18-2.79) |
| Khan (2013) | 1.47 (0.21-10.29) | 0.44 (0.11-1.75) | - | 0.66 (0.21-2.03) | 3.51 (2.17-5.68) | - | - | - | - |
| Ruzmetov (2013) | 3.85 (1.27-11.67) | 0.58 (0.22-1.55) | 0.29 (0.07-1.16) | 2.91 (1.89-4.49) | 2.33 (1.44-3.78) | 5.24 (3.82-7.21) | - | - | - |
| Tan Tanny (2013) | 6.00 (2.76-13.03) | 0.55 (0.21-1.46) | 0.14 (0.02-0.97) | 1.23 (0.64-2.36) | 2.74 (1.78-4.22) | - | - | - | - |
| Luciani (2014) | 3.28 (1.78-6.03) | 0.47 (0.27-0.82) | 0.02 (0.00-0.31) | 1.44 (1.05-1.99) | 1.44 (1.05-1.99) | 2.77 (2.20-3.49) | 0.08 (0.02-0.31) | 0.02 (0.00-0.31) | 0.08 (0.02-0.31) |
| Bansal (2015) | 4.29 (2.26-8.12) | 0.05 (0.00-0.76) | 0.05 (0.00-0.76) | - | - | - | - | - | - |
| Nelson (2015) | 4.17 (2.27-7.64) | 0.66 (0.41-1.05) | - | 2.66 (2.11-3.36) | 2.20 (1.70-2.84) | - | - | - | - |
| **Pooled (random effects)** | **4.20 (3.37-5.22)** | **0.64 (0.49-0.84)** | **0.16 (0.09-0.29)** | **1.60 (1.27-2.02)** | **1.91 (1.50-2.44)** | **2.75 (2.13-3.53)** | **0.22 (0.11-0.43)** | **0.10 (0.04-0.27)** | **0.40 (0.22-0.73)** |
| Heterogeneity test | $\chi^2$ 28.78 ($P = .41$), $I^2 = 3\%$ | $\chi^2$ 23.77 ($P = .23$), $I^2 = 16\%$ | $\chi^2$ 6.32 ($P = .98$), $I^2 = 0\%$ | $\chi^2$ 40.97 ($P = .00$), $I^2 = 54\%$ | $\chi^2$ 44.49 ($P = .00$), $I^2 = 59\%$ | $\chi^2$ 35.59 ($P = .00$), $I^2 = 60\%$ | $\chi^2$ 12.09 ($P = .27$), $I^2 = 17\%$ | $\chi^2$ 4.08 ($P = .77$), $I^2 = 0\%$ | $\chi^2$ 21.60 ($P = .03$), $I^2 = 49\%$ |

Data expressed as percentage (95% CI). "-" = variable not reported. In case an event was reported not to occur, for pooling purposes it was assumed that 0.5 patient experienced the event. *SUUD*, Sudden, unexpected, unexplained death; *AV*, aortic valve; *RVOT*, right ventricular outflow tract; *SVD*, structural valve deterioration; *NSVD*, nonstructural valve dysfunction; *TE*, thromboembolism; *VT*, valve thrombosis.

# Náhrada aortální chlopně u dětí

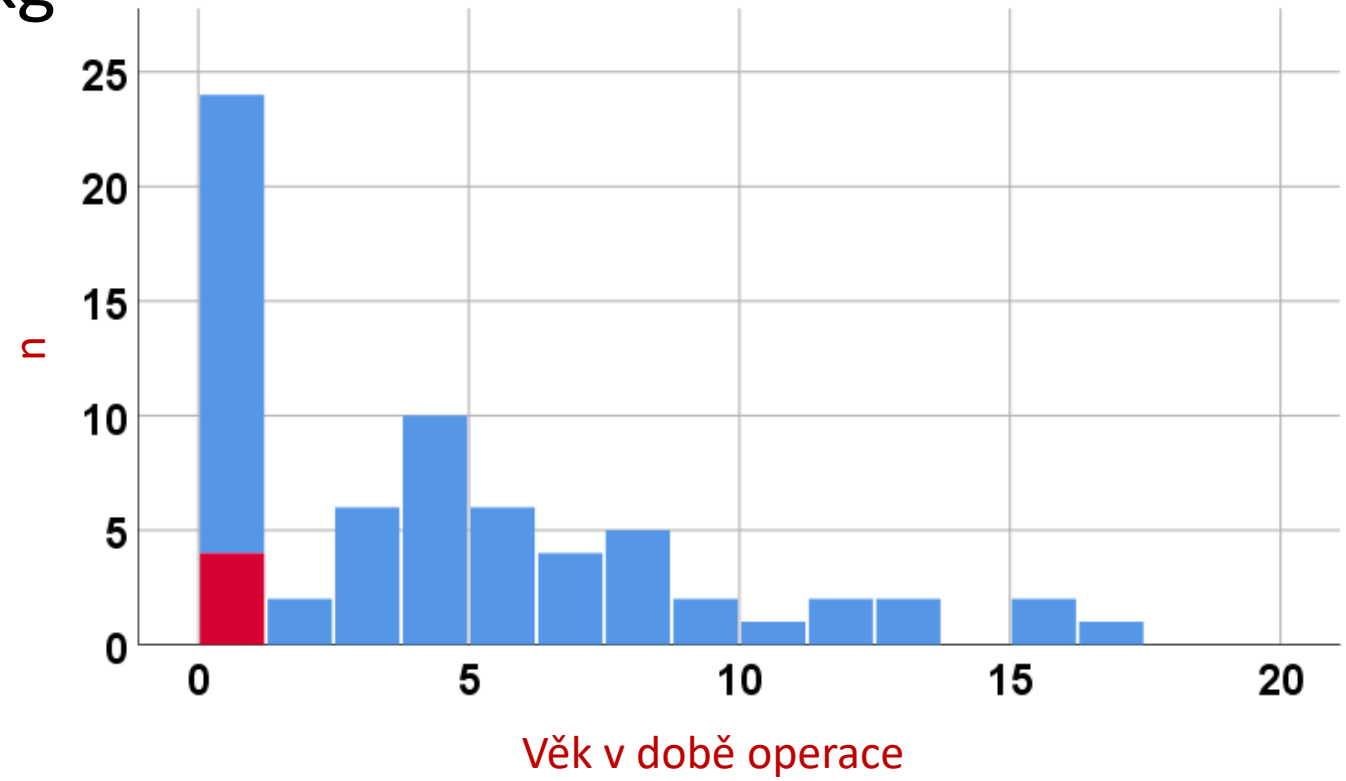
- Možnosti
  - Biologická nebo mechanická náhrada
  - Rossova operace
  - Náhrada aortálního kořene homograftem

# Metodika

- Strukturovaná databáze DKC
  - Období 1981 – 2017
- Křížové mapování s ÚZIS/registry
  - Úmrtnost – matrika zemřelých
  - Kardiochirurgické operace u sledovaných pacientů v dospělém věku
- End – pointy
  - Pravděpodobnost přežití
  - Pravděpodobnost přežití bez reoperace aortální chlopně
  - Pravděpodobnost přežití bez výkonu na RVOT

# Rossova operace

- n = 67
- Věk: medián 4,3 (0,02 – 17,4)  let
- Váha medián 14,8 (2,7 – 69,3) kg
- Úmrtí
  - Časná 4 (5,97%)
  - Pozdní 5 (7,46%)
- Předchozí výkony na aortální chlopni
  - N = 85
    - Chirurgické - 17
    - Katetrizační - 68

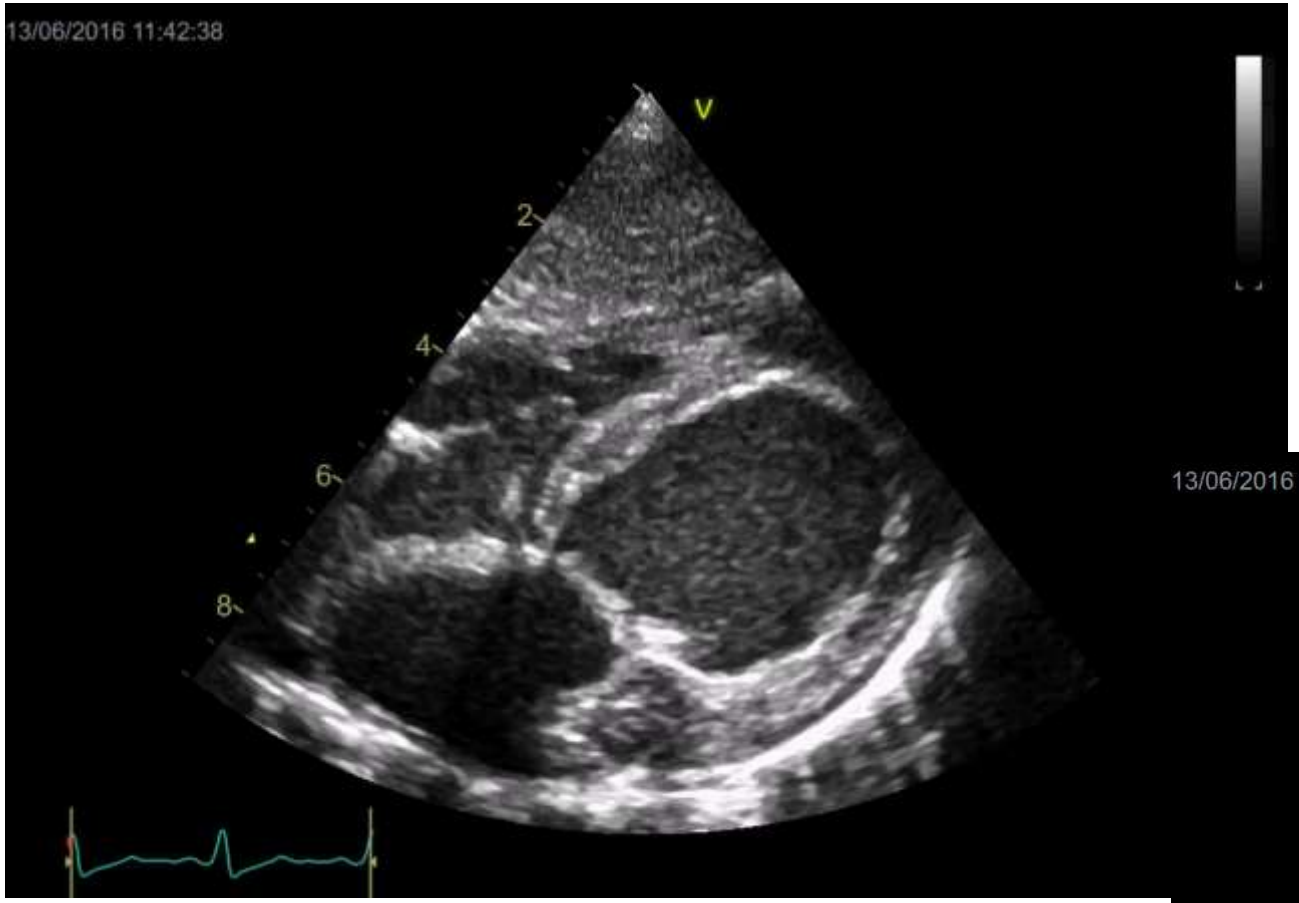


# Pacient N.D.

- Věk 6 měsíců, váha 7,1kg
- Stenóza a insuficience aortální chlopně (AS 81/45, AI 3)
- Mitrální insuficience 2. st
- Fibroelastóza levé komory
- Stav po katetrizační valvuloplastice ve věku 1 dne

# Operace

- Ross-Konnova operace
- Excize endokardiální fibroelastózy
- EC 288 minut
- Svorka na aortě 182 minut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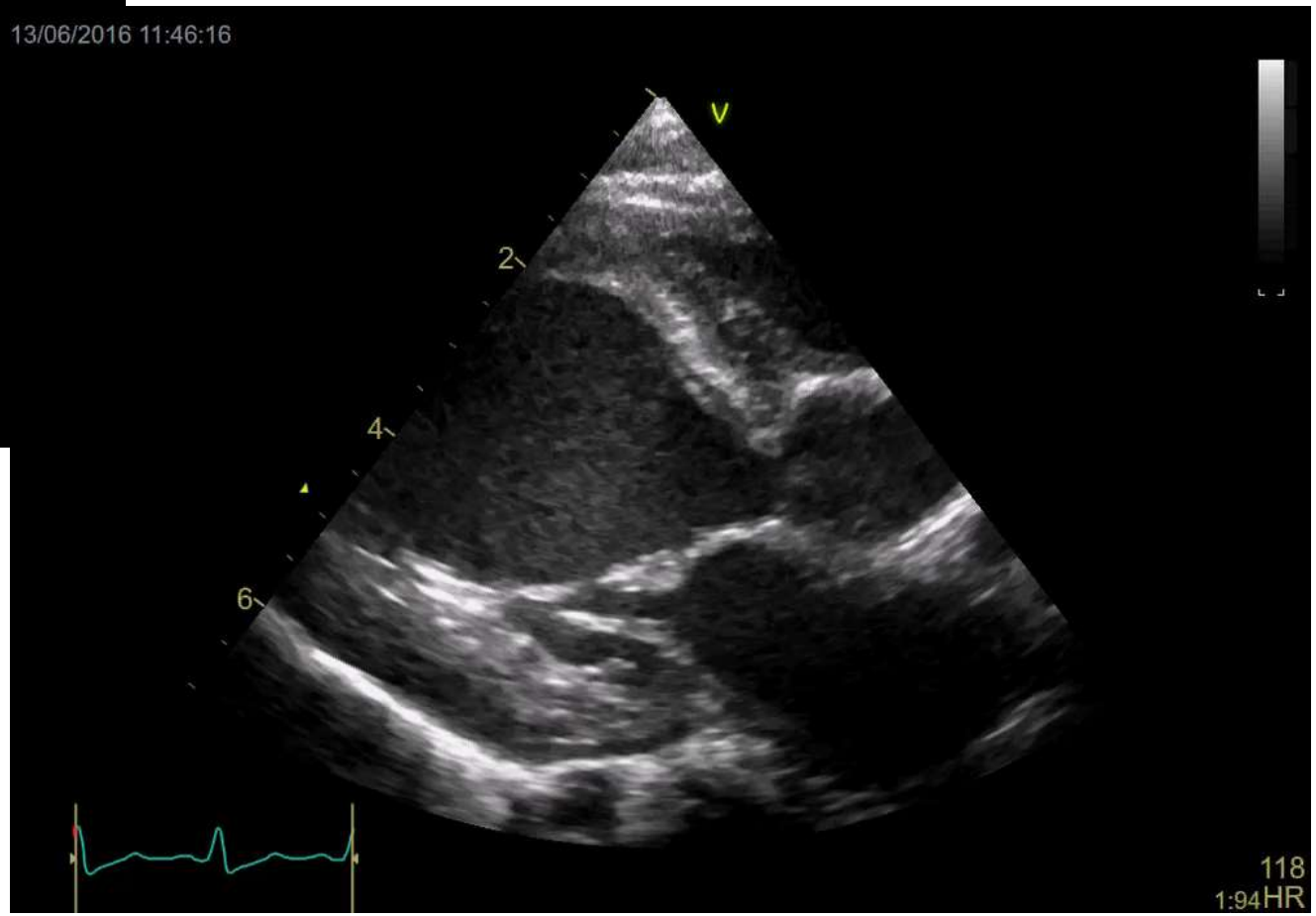
V
2
4
6
8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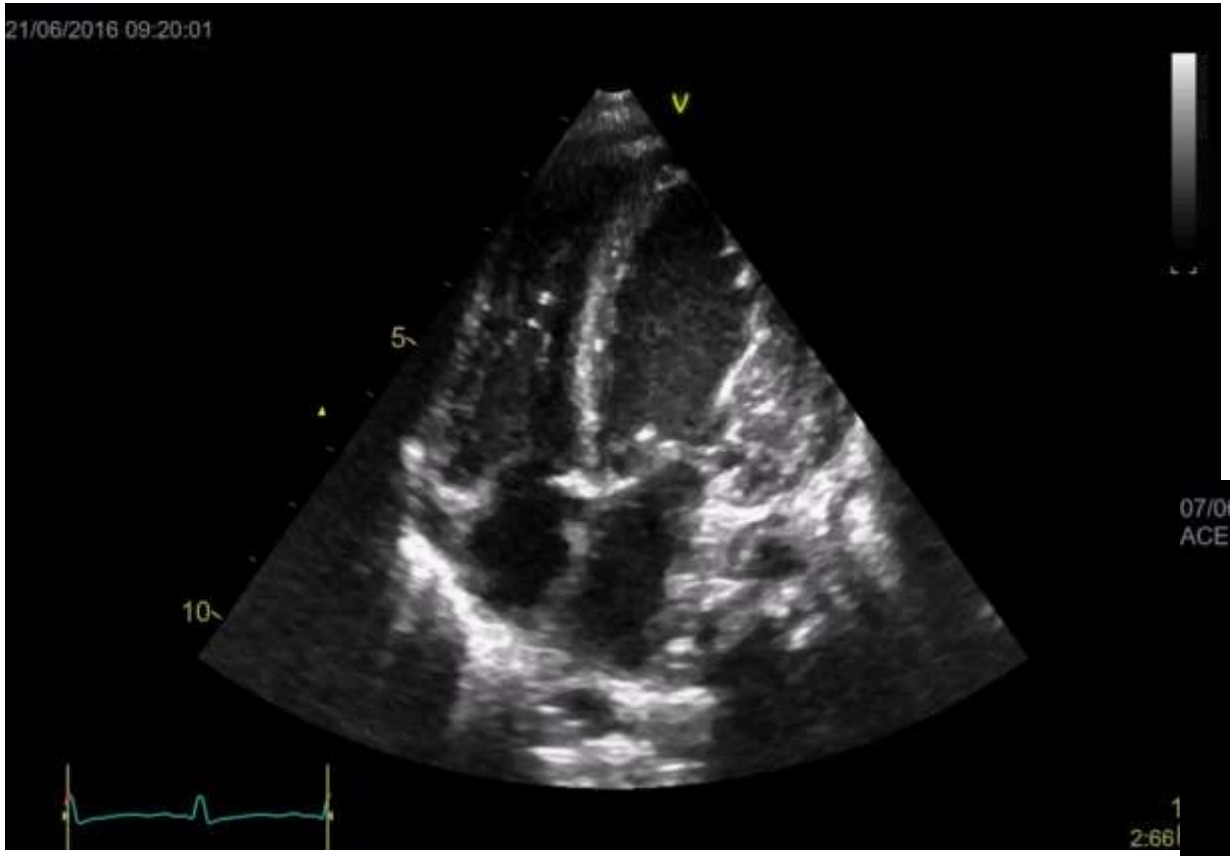
V
2
4
6
118
1:94HR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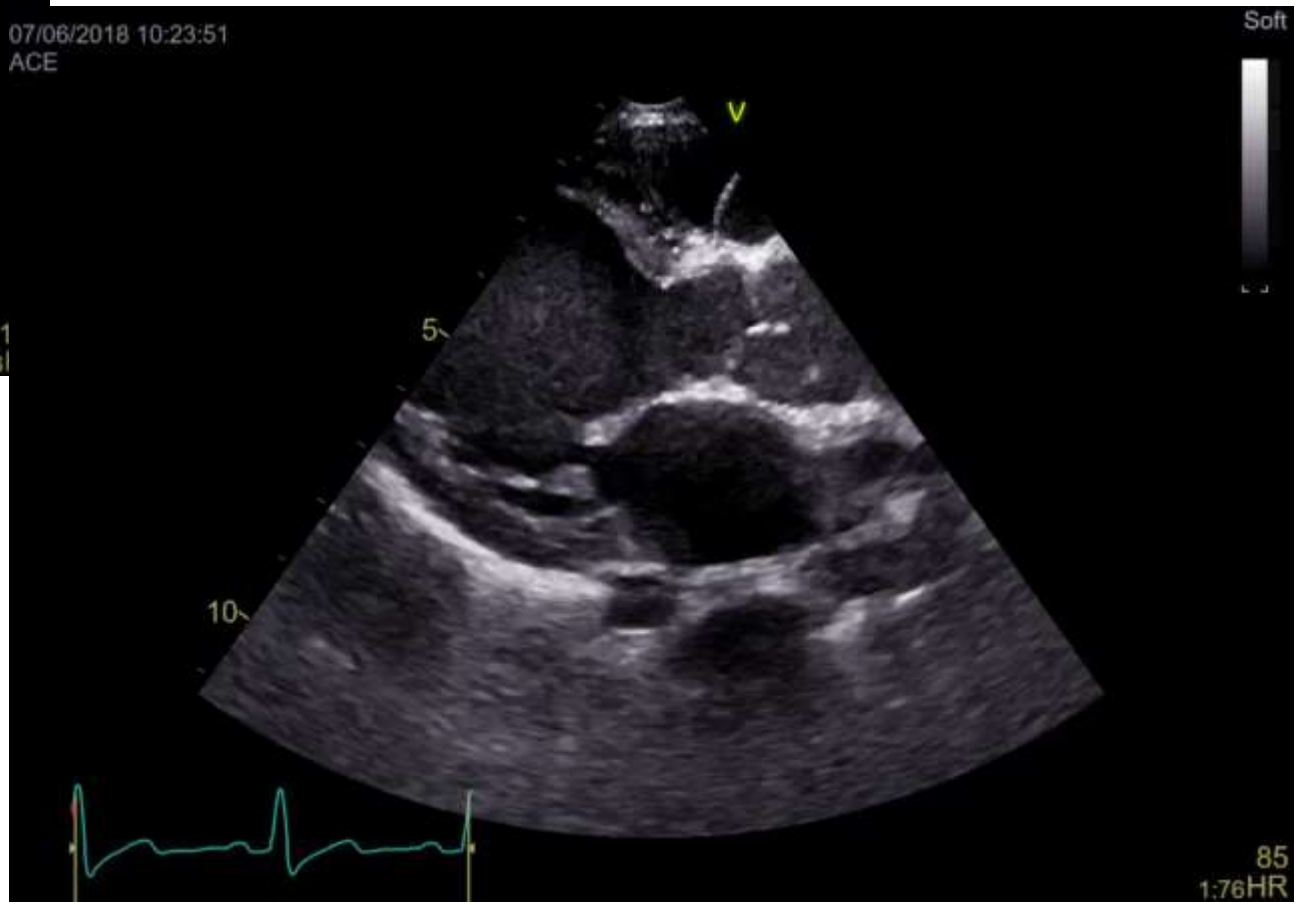
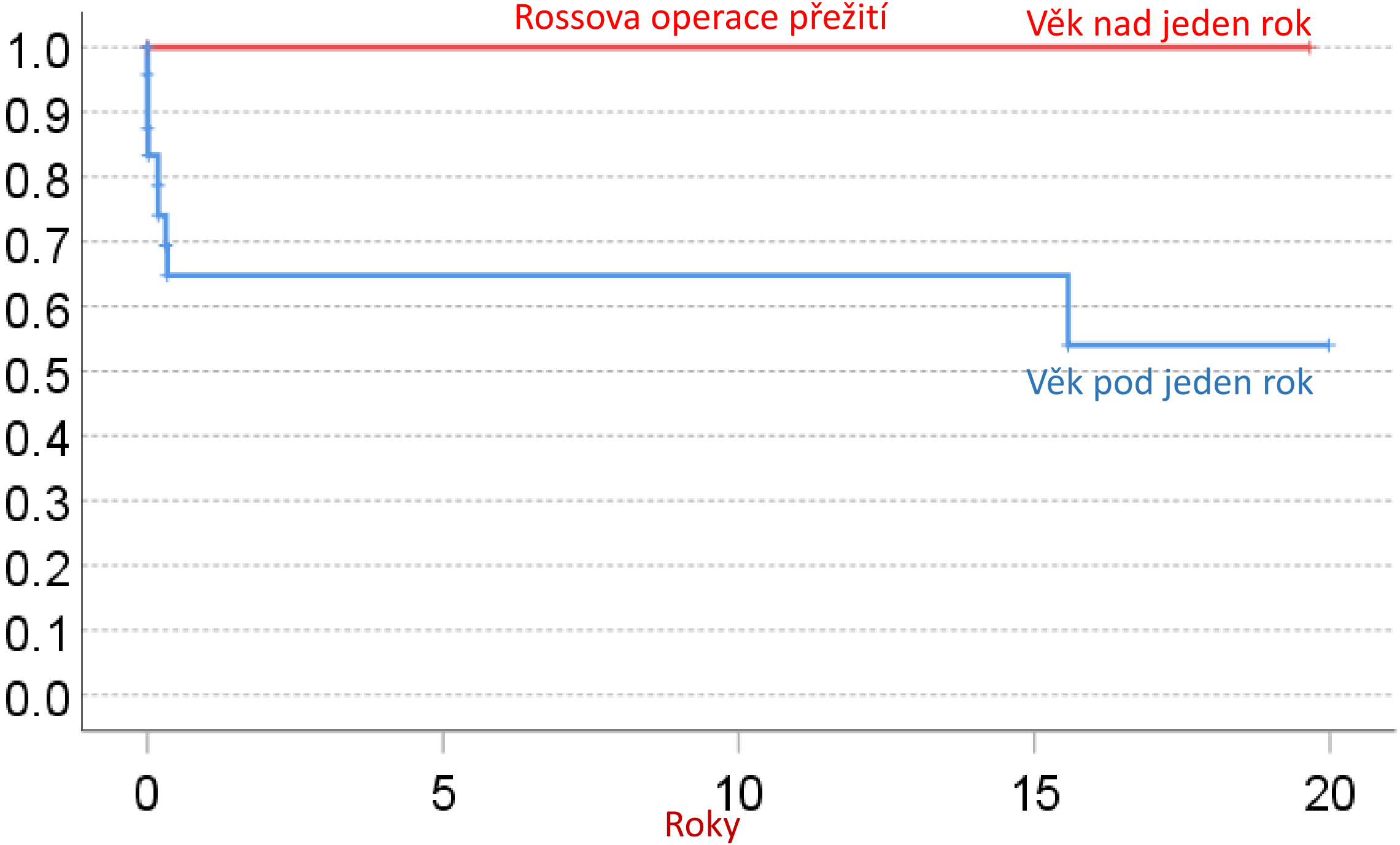
V
5
10

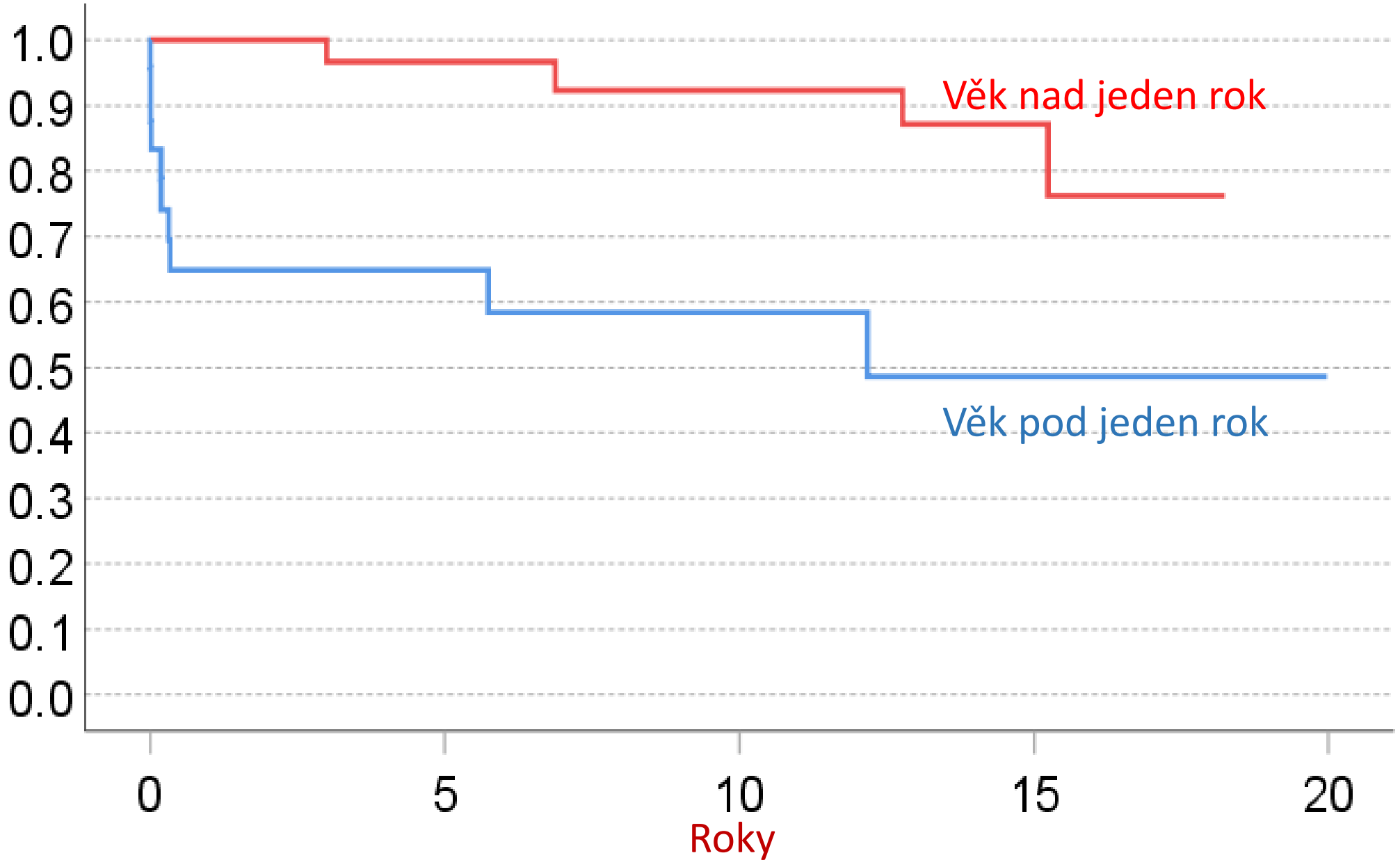

07/06/2018 10:23:51
ACE
Soft
V
5
10
85
1:76HR

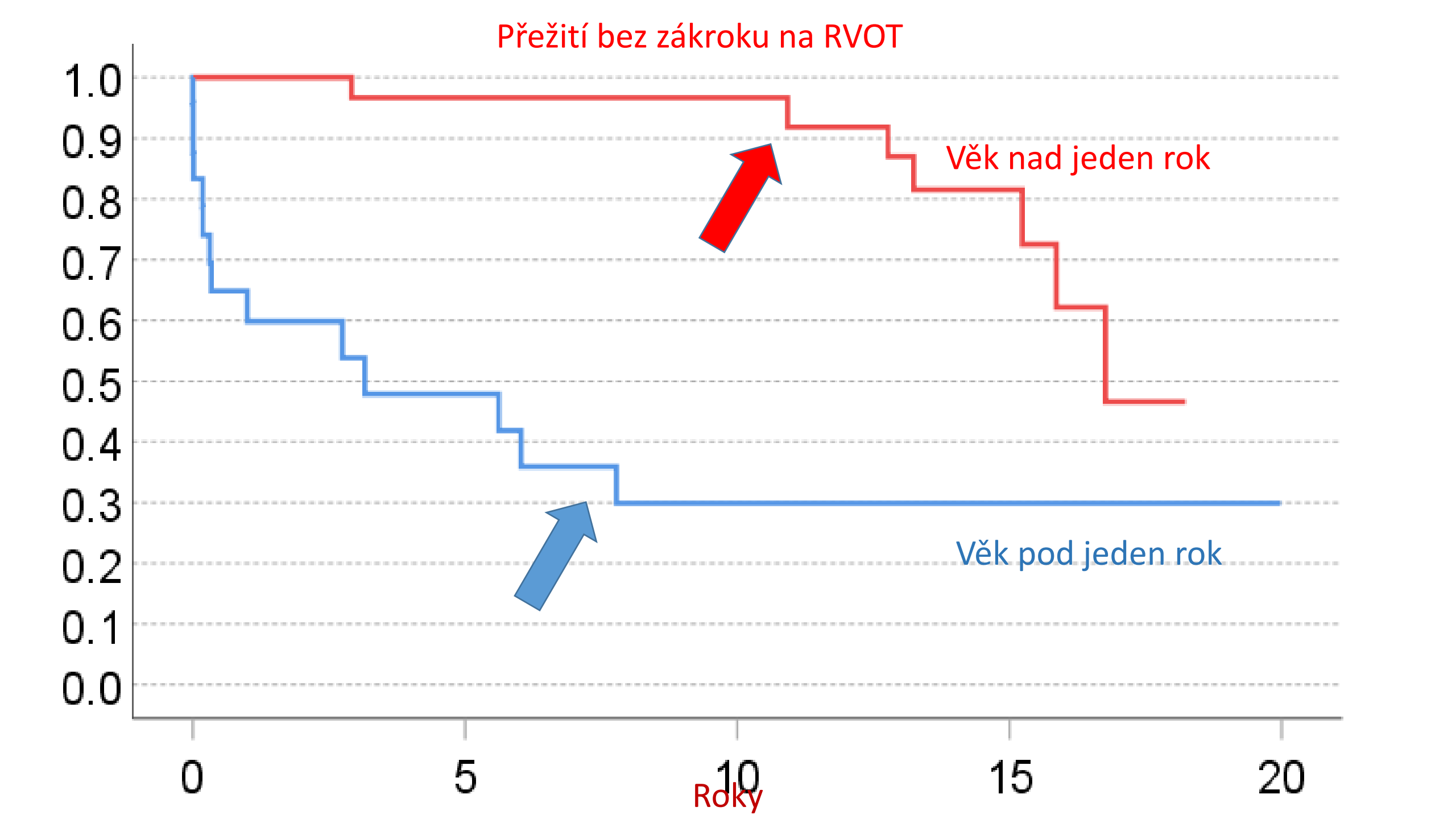
# Follow up – 2 roky po operaci

- AS 0
- AI 1
- MI 1
- “PS“ (konduit) 13 Torr


Rossova operace přežití
Věk nad jeden rok
Věk pod jeden rok
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
5
10
15
20
Roky

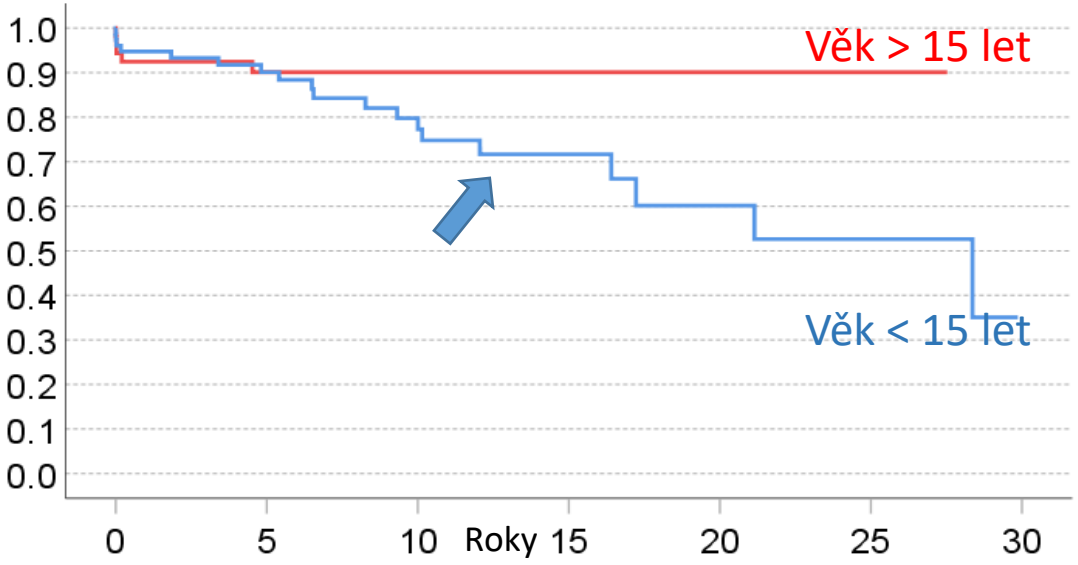
# Rossova operace – přežití bez výkonu na aortální chlopni



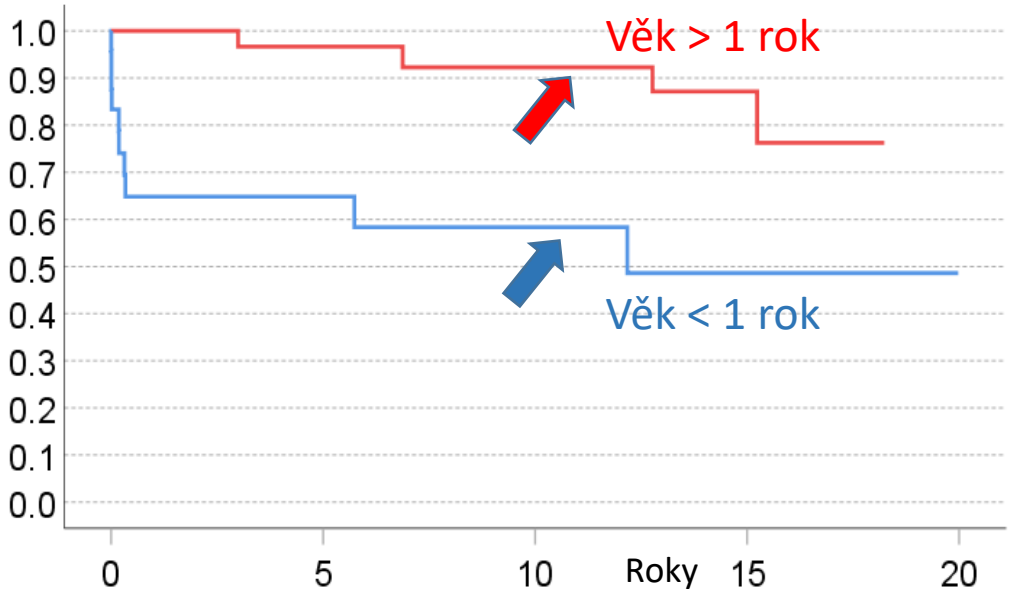

Přežití bez zákroku na RVOT
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Věk nad jeden rok
Věk pod jeden rok
0
5
10
15
20
Roky

# AVR vs Ross

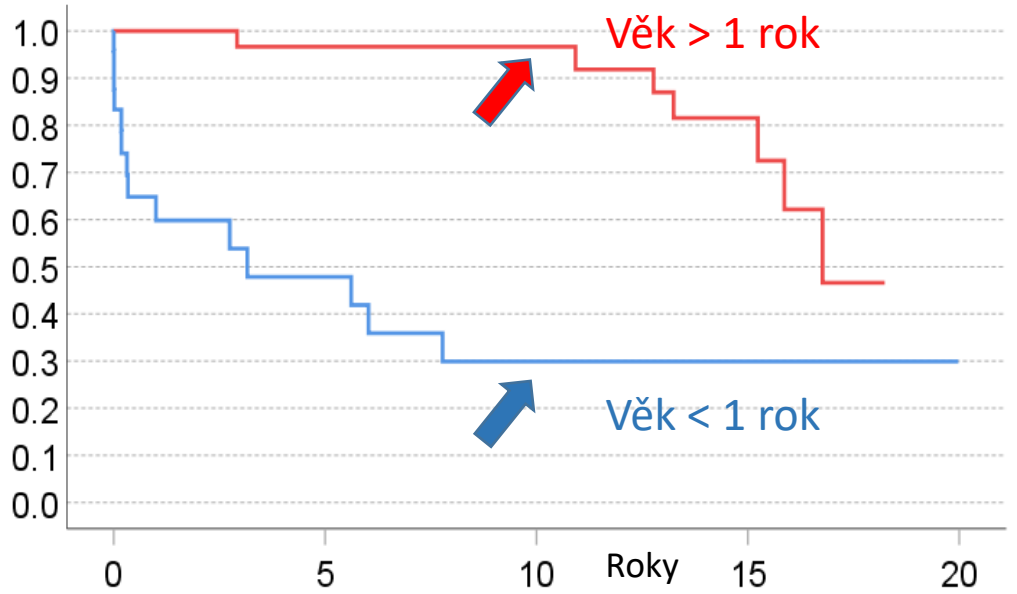
AVR: Pravděpodobnost přežití bez renáhrady




Rossova operace – přežití bez výkonu na aortální chlopni




Rossova operace - přežití bez výkonu na RVOT



# Závěr

- Věk <1 rok
  - Jedinou možností Rossova operace (ev. Ross-Konno)
  - Spojená s vysokou mortalitou a pravděpodobností reintervence na AoV či RVOT
- Věk 1 - 15 let
  - Náhrada aortální chlopně má vyšší pravděpodobnost chirurgických reintervencí ve srovnání s Rossovou operací
- Věk >15 let
  - Výsledky srovnatelné, není však srovnatelná kvalita života vzhledem k doživotní antikoagulaci