PCI eller CABG?

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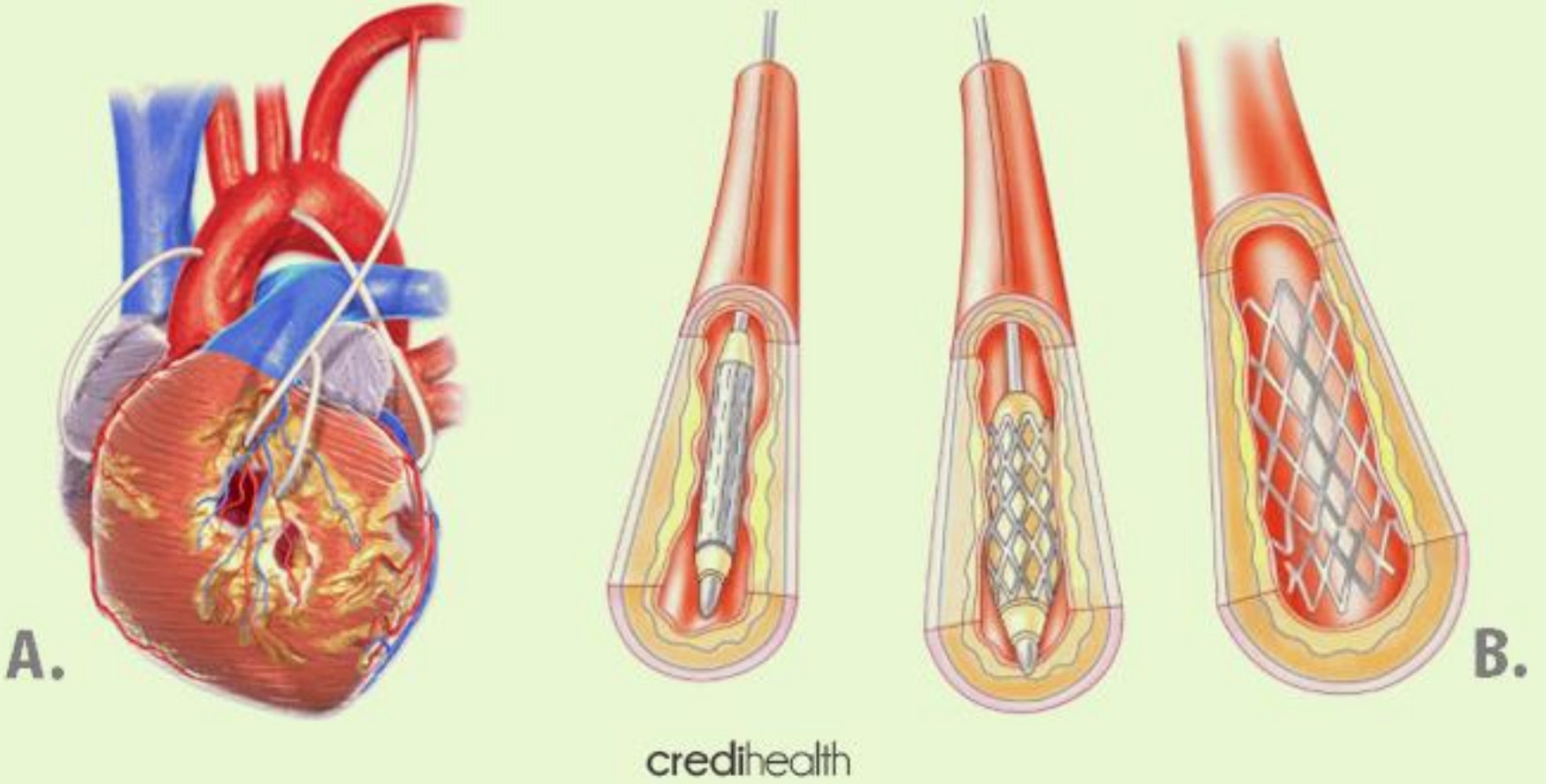
Evig kärlek ;)

Maximalinvasiv vs. Minimalinvasiv



Agenda

- Vad är CABG
- Vad är PCI
- Jämförande studier
- ESC Guidelines
- Komplikationer & ekonomi
- Vad händer efter respektive intervention
- Långsiktiga problem

Fall 1, man 60 år

- Skåning på affärsresa i Sthlm
- CBS och hjärtstopp
- AHLR, polis med deff inom 1 min, VF ->3 deff
- ROSC efter 20m min AHLR
- Vaken i ambulans, EKG visar LBBB – direkt till angiolab
- Tid HT, hjärtsvikt (EF 35-40%), utredd men tackat nej till angio

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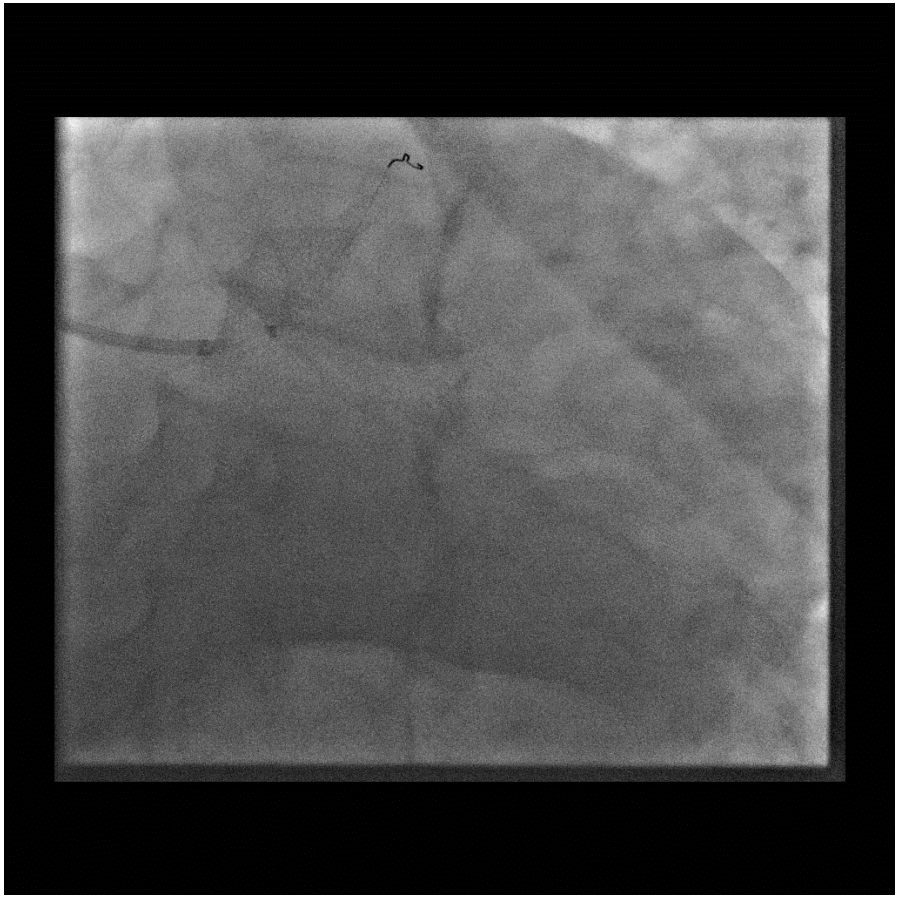
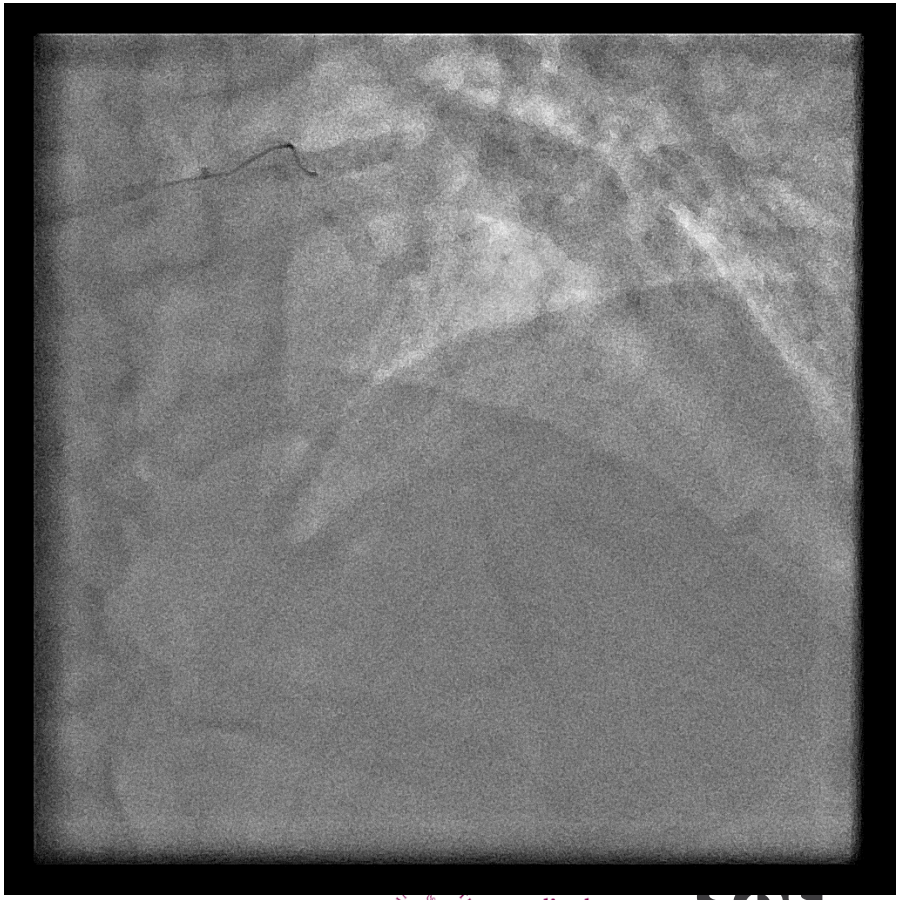
Fall 1

- Last remaining vessel!
- Vad gör vi först?
- CABG eller PCI?
- Varför?
- Tänkbara behandlingsalternativ?





CABG

(Coronary Artery By pass Grafting)

1967

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a
b

Vårdförlopp CABG

- Inskrivning dagen före op
- Träffar kirurg dagen före eller timmar före op
- Op dag 2 (2-4 timmar) ex sövning/väckning
- Extubation vanligen på IVA opdagen
- Postop thorax IVA 1-2 dagar
- Drän ut 1 dag efter op, Iv.smärtlindring
- Avdelning ca 7 dagar
- Rehab 7 dagar
- Sjukskrivning 2 månader

PCI

(Percutaneous Coronary Intervention)

1977

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Vårdförlopp PCI

- Inskrivning och möte med PCI operatör 1 vecka före ingrepp
- Kommer till avd samma dag som ingrepp
- Planerad PCI vanligen på fm
- Ingrepp 30 min-2 timmar
- Går hem samma dag på em
- Ingen smärtlindring (paracetamol)
- Sjukskrivning ca 1 vecka?

Kronisk kranskärlssjukdom

Indications for revascularization in patients with stable angina or silent ischaemia

Extent of CAD (anatomical and/or functional)		Class[a]	Level[b]
For prognosis	Left main disease with stenosis >50%.[c] [68–71]	I	A
	Proximal LAD stenosis >50%.[c] [62,68,70,72]	I	A
	Two- or three-vessel disease with stenosis >50% with impaired LV function (LVEF ≤35%).[c] [61,62,68,70,73–83]	I	A
	Large area of ischaemia detected by functional testing (>10% LV) or abnormal invasive FFR.[d] [24,59,84–90]	I	B
	Single remaining patent coronary artery with stenosis >50%.[c]	I	C
For symptoms	Haemodynamically significant coronary stenosis[c] in the presence of limiting angina or angina equivalent, with insufficient response to optimized medical therapy.[e] [24,63,91–97]	I	A

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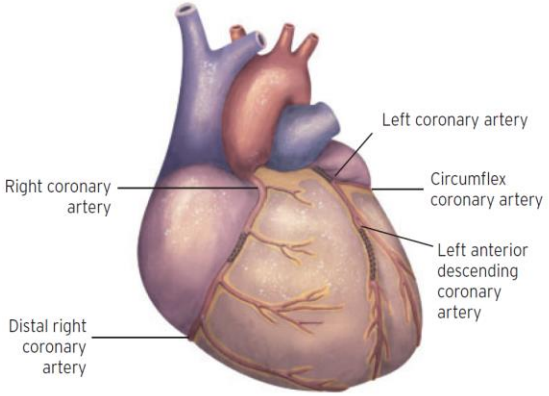
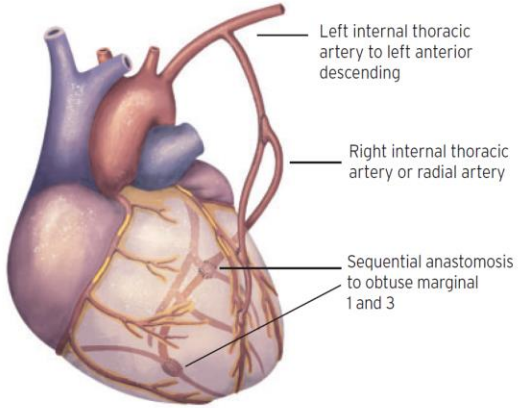
PCI



CABG



FAVOURS PCI

Clinical characteristics

Presence of severe co-morbidity (not adequately reflected by scores)

Advanced age/frailty/reduced life expectancy

Restricted mobility and conditions that affect the rehabilitation process

Anatomical and technical aspects

MVD with SYNTAX score 0–22

Anatomy likely resulting in incomplete revascularization with CABG due to poor quality or missing conduits

Severe chest deformation or scoliosis

Sequelae of chest radiation

Porcelain aorta[a]

FAVOURS CABG

Clinical characteristics

Diabetes

Reduced LV function (EF ≤35%)

Contraindication to DAPT

Recurrent diffuse in-stent restenosis

Anatomical and technical aspects

MVD with SYNTAX score ≥23

Anatomy likely resulting in incomplete revascularization with PCI

Severely calcified coronary artery lesions limiting lesion expansion

Need for concomitant interventions

Ascending aortic pathology with indication for surgery

Concomitant cardiac surgery

PCI eller CABG/ Ulf Jensen

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Randomiserande studier jmf PCI vs CABG

Stent type and year of publication	Study	N	Baseline characteristics					Primary endpoint[a]			Secondary endpoints[a]				
			Age (y)	Women (%)	Diabetes (%)	MV disease (%)	EF (%)	Definition	Y	Results	Y	Death	MI	Revasc	Stroke
DES															
PES 2009	SYNTAX[102]	1800	65	22	25	MV 61 LM 39	-	Death, MI, stroke, or repeat revasc	1	17.8 vs. 12.4%	5	13.9 vs. 11.4%	9.7 vs. 3.8%*	25.9 vs. 13.7%*	2.4 vs. 3.7%
SES 2011	Boudriot[103]	201	68	25	36	LM 100	65	Death, MI, or repeat revasc	1	13.9 vs. 19%	1	2 vs. 5%	3 vs. 3%	14 vs. 5.9%	-
SES 2011	PRECOMBAT[104]	600	62	24	32	LM 100	61	Death, MI, stroke, or TVR	1	8.7 vs. 6.7%[b]	2	2.4 vs. 3.4%	1.7 vs. 1.0%	9.0 vs. 4.2%*	0.4 vs. 0.7%
EES 2015	BEST[105]	880	64	29	41	MV 100	60	Death, MI, or TVR	2	11.0 vs. 7.9%	5	6.6 vs. 5.0%	4.8 vs 2.7%	13.4 vs. 6.6%	2.9 vs. 3.3%
BES 2016	NOBLE[106]	1201	66	22	15	LM 100	60	Death, MI, or TVR	5	15.4 vs. 7.2%	5	11.6 vs. 9.5%	6.9 vs. 1.9%*[c]	16.2 vs. 10.4%*	4.9 vs. 1.7%
EES 2016	EXCEL[107]	1905	66	24	30	LM 100	57	Death, MI, or stroke	3	15.4 vs. 14.7%[b]	3	8.2 vs. 5.9%	8.0 vs. 8.3%	13.4 vs. 6.6%*	2.3 vs. 2.9%

*P <0.05.

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Riskbedömning inför revaskularisering?

Recommendations on criteria for the choice between coronary artery bypass grafting and percutaneous coronary intervention

Recommendations	Class[a]	Level[b]
Assessment of surgical risk[c]		
It is recommended that the STS score is calculated to assess in-hospital or 30 day mortality, and in-hospital morbidity after CABG.[112,114,138]	I	B
Calculation of the EuroSCORE II score may be considered to assess in-hospital mortality after CABG.[112]	IIb	B
Assessment of CAD complexity		
In patients with LM or multivessel disease, it is recommended that the SYNTAX score is calculated to assess the anatomical complexity of CAD and the long-term risk of mortality and morbidity after PCI.[117–124]	I	B
When considering the decision between CABG and PCI, completeness of revascularization should be prioritized.[131,132,134–136]	IIa	B

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Heart team

Table 3 Multidisciplinary decision pathways, patient informed consent, and timing of revascularization

	ACS				
	Shock	**STEMI**	**NSTE-ACS**	**SCAD without *ad hoc* PCI indication according to Heart Team protocol**	**SCAD with *ad hoc* PCI indication according to Heart Team protocol**
Multidisciplinary decision-making	Not mandatory during the acute phase; mechanical circulatory support according to Heart Team protocol	Not mandatory during the acute phase	Not mandatory during the acute phase; after stabilization, recommended as in SCAD	Required	Not required
Informed consent	Witnessed verbal informed consent or family consent if possible without delay	Witnessed verbal informed consent may be sufficient unless written consent is legally required	Written informed consent[a]; in emergency cases witnessed verbal informed consent may be sufficient	Written informed consent[a]	Written informed consent[a]
Time to revascularization	Emergency: no delay	Emergency: no delay	Urgency: within 2 h to within 72 h depending on the risk criteria	Within 2 weeks for high-risk patients[b] and within 6 weeks for all other patients	*Ad hoc*
Procedure	Proceed with intervention based on best evidence/availability. *Ad hoc* treatment of culprit lesion, staged treatment of non-culprit lesions according to institutional protocol or Heart Team decision.	Proceed with intervention based on best evidence/availability. Non-culprit lesions treated according to institutional protocol or Heart Team decision.	Proceed with intervention based on best evidence/availability. Non-culprit lesions treated according to institutional protocol or Heart Team decision.	Allow for enough time from diagnostic catheterization to decide on the appropriate intervention.	Proceed with intervention according to institutional protocol defined by Heart Team.

Kronisk kranskärlsjukdom

Recommendation for the type of revascularization in patients with stable coronary artery disease with suitable coronary anatomy for both procedures and low predicted surgical mortality[d]

Recommendations according to extent of CAD	CABG		PCI	
	Class[a]	Level[b]	Class[a]	Level[b]
One-vessel CAD				
Without proximal LAD stenosis.	IIb	C	I	C
With proximal LAD stenosis.[68,101,139–144]	I	A	I	A
Two-vessel CAD				
Without proximal LAD stenosis.	IIb	C	I	C
With proximal LAD stenosis.[68,70,73]	I	B	I	C
Left main CAD				
Left main disease with low SYNTAX score (0 - 22).[69,121,122,124,145–148]	I	A	I	A
Left main disease with intermediate SYNTAX score (23 - 32).[69,121,122,124,145–148]	I	A	IIa	A
Left main disease with high SYNTAX score (≥33).[c] [69,121,122,124,146–148]	I	A	III	B
Three-vessel CAD without diabetes mellitus				
Three-vessel disease with low SYNTAX score (0 - 22).[102,105,121,123,124,135,149]	I	A	I	A
Three-vessel disease with intermediate or high SYNTAX score (>22).[c] [102,105,121,123,124,135,149]	I	A	III	A
Three-vessel CAD with diabetes mellitus				
Three-vessel disease with low SYNTAX score 0–22.[102,105,121,123,124,135,150–157]	I	A	IIb	A
Three-vessel disease with intermediate or high SYNTAX score (>22).[c] [102,105,121,123,124,135,150–157]	I	A	III	A

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Komplikationer PCI vs CABG

SYNTAX

Table 3. Clinical End Points Occurring in the Hospital or after Discharge, According to Study Group.*

Variable	PCI	CABG	P Value	Relative Risk with PCI (95% CI)
	no./total no. (%)			
Major adverse cardiac or cerebrovascular event				
In hospital	39/896 (4.4)	47/870 (5.4)	0.31	0.81 (0.53–1.22)
30 Days after procedure	54/895 (6.0)	45/866 (5.2)	0.45	1.16 (0.79–1.71)
6 Mo after randomization	111/893 (12.4)	85/860 (9.9)	0.09	1.26 (0.96–1.64)
12 Mo after randomization	159/891 (17.8)	105/849 (12.4)	0.002	1.44 (1.15–1.81)
Death, stroke, or MI	68/891 (7.6)	65/849 (7.7)	0.98	1.00 (0.72–1.38)
Death	39/891 (4.4)	30/849 (3.5)	0.37	1.24 (0.78–1.98)
From cardiac causes	33/891 (3.7)	18/849 (2.1)	0.05	1.75 (0.99–3.08)
From cardiovascular causes	1/891 (0.1)	3/849 (0.4)	0.36†	0.32 (0.03–3.05)
From noncardiovascular causes	5/891 (0.6)	9/849 (1.1)	0.24	0.53 (0.18–1.57)
Stroke	5/891 (0.6)	19/849 (2.2)	0.003	0.25 (0.09–0.67)
MI	43/891 (4.8)	28/849 (3.3)	0.11	1.46 (0.92–2.33)
Repeat revascularization‡	120/891 (13.5)	50/849 (5.9)	<0.001	2.29 (1.67–3.14)
CABG	25/891 (2.8)	11/849 (1.3)	0.03	2.17 (1.07–4.37)
PCI	102/891 (11.4)	40/849 (4.7)	<0.001	2.43 (1.71–3.46)
Graft occlusion or stent thrombosis§	28/848 (3.3)	27/784 (3.4)	0.89	0.96 (0.57–1.62)
Acute (at ≤1 day)	2/896 (0.2)	3/870 (0.3)	0.68†	0.65 (0.11–3.86)
Early (within 2–30 days)	18/893 (2.0)	3/868 (0.3)	0.001	5.83 (1.72–19.73)
Late (within 31–365 days)	9/874 (1.0)	21/854 (2.5)	0.02	0.42 (0.19–0.91)

EXCEL

	PCI (n=948)	CABG (n=957)	RR [95%CI]	P-value
30-Day peri-procedural MAE, any	8.1%	23.0%	0.35 [0.28, 0.45]	<0.001
- Death*	0.9%	1.0%	0.91 [0.39, 2.23]	0.83
- Stroke*	0.6%	1.3%	0.50 [0.19, 1.34]	0.16
- Myocardial infarction*	3.9%	6.2%	0.63 [0.42, 0.95]	0.02
- Ischemia-driven revascularization*	0.6%	1.4%	0.47 [0.18, 1.22]	0.11
- TIMI major/minor bleeding	3.7%	8.9%	0.42 [0.28, 0.61]	<0.001
- Transfusion ≥2 units	4.0%	17.0%	0.24 [0.17, 0.33]	<0.001
- Major arrhythmia**	2.0%	15.8%	0.13 [0.08, 0.20]	<0.001
- Surgery/radiologic procedure	1.1%	4.0%	0.27 [0.13, 0.53]	<0.001
- Renal failure†	0.5%	2.4%	0.22 [0.08, 0.57]	<0.001
- Sternal wound dehiscence	0.0%	1.9%	0.03 [0.00, 0.45]	<0.001
- Infection requiring antibiotics	2.3%	13.6%	0.17 [0.11, 0.27]	<0.001
- Prolonged intubation (>48 hours)	0.4%	2.9%	0.14 [0.05, 0.41]	<0.001
- Post-pericardiotomy syndrome	0.0%	0.4%	0.11 [0.01, 2.08]	0.12

*Adjudicated events; others are site-reported. **SVT requiring cardioversion, VT or VF requiring treatment, or bradyarrhythmia requiring temporary or permanent pacemaker. †Serum creatinine increased by ≥0.5 mg/dL from baseline or need for dialysis.

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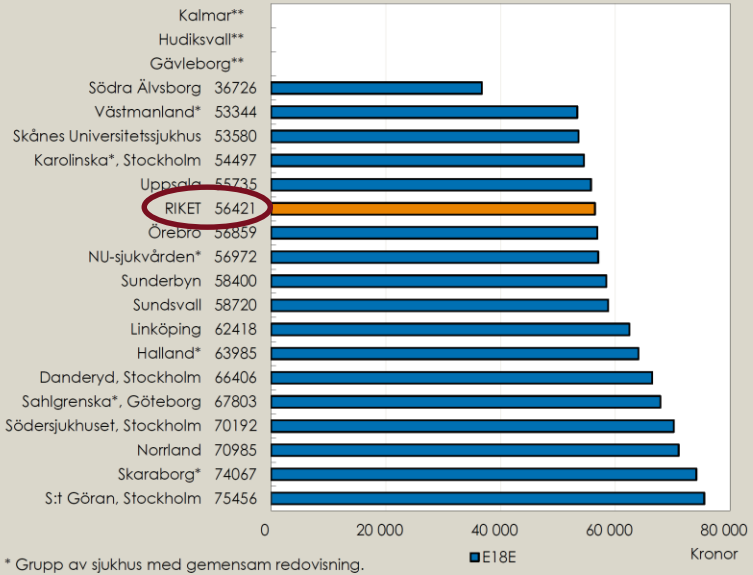
Syntax och EXCEL

Komplikationer	CABG	PCI
Hjärtinfarkt	3,3-6,2%	3,9-4,8%
Stroke	1,3-2,2%	0,6%
Blödning	8,9%	3,7%
Infektion	13,6%	2,3%
Mediastinit	1,9%	0%
Mortalitet	1,0-3,5%	0,9-4,4%

Ekonomi

Diagram 2. Kostnad per vårdtillfälle vid PCI vid infarkt

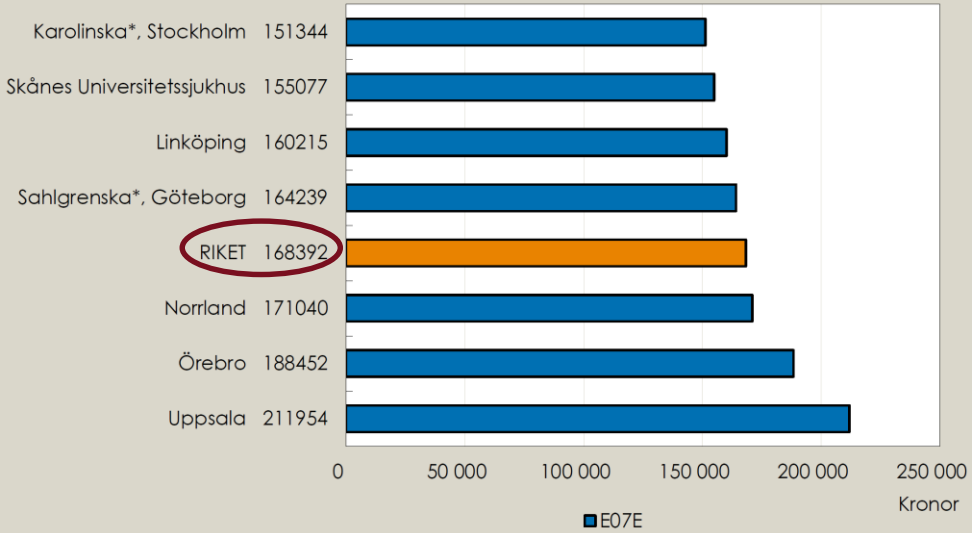
Kostnad per vårdtillfälle vid PCI vid infarkt, utan komplikation (E18E). Avser enbart sjukhus med 30 eller fler vårdtillfällen. Exklusive ytterfallskostnader inom slutenvården, 2013.



* Grupp av sjukhus med gemensam redovisning.
** Sjukhus som avböjt medverkan i denna sammanställning.
Källa: KPP-databasen (SKL)

Diagram 3. Kostnad per vårdtillfälle vid bypass-operation

Kostnad per vårdtillfälle vid koronar bypass-operation, utan komplikation (E07E). Avser enbart sjukhus med 30 eller fler vårdtillfällen. Exklusive ytterfallskostnader inom slutenvården, 2013.



* Grupp av sjukhus med gemensam redovisning.
Källa: KPP-databasen (SKL)

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Kostnader vid komplikationer

Table 2. Observed Study Complication Rates by Study Complication Category for Entire Study Population

Complications	Study Population, %	Patients, No. (n = 114,233)
Patients with ≥1 study complication		
Any study complication	13.64	15,579
Septicemia	0.95	1083
Post-op infection	1.11	1271
Post-op stroke	1.28	1466
New-onset hemodialysis	0.84	961
Post-op ARDS	5.96	6812
Reoperation	1.54	1761
Hemorrhage or post-op shock	4.94	5648
Patients with 1 study complication		
Only 1 study complication (any)	10.99	12,558
Septicemia	0.51	585
Post-op infection	0.69	790
Post-op stroke	0.93	1065
New-onset hemodialysis	0.68	780
Post-op ARDS	4.76	5441
Reoperation	0.26	301
Hemorrhage or post-op shock	3.15	3596
Study complications, No.		
0	86.36	98,654
1	10.99	12,558
2	2.31	2644
≥3	0.33	377

Table 3. Observed Average Unadjusted and Incremental Hospital Resource Utilization Associated With Treating Beneficiaries Who Experienced Selected Study Complications

Complications	Average Cost, Mean ± SD $	Incremental Cost of Complication, $	Average LOS, Mean ± SD Days	Incremental LOS of Complication
All patients	32,201 ± 23,059	NA	9.9 ± 7.8	NA
All patients without a study complication	29,477 ± 17,358	NA	9.0 ± 5.8	NA
Patients with any study complication	49,445 ± 40,578	+19,968	15.9 ± 13.9	+6.9
Patients with a given complication vs all other patients				
Any septicemia	90,843 ± 71,594	+ 59,204	31.0 ± 24.5	+21.3
Any post-op infection	67,115 ± 65,450	+35,307	25.2 ± 23.2	+ 15.5
Any post-op stroke	50,514 ± 36,392	+18,552	16.8 ± 12.5	+ 7.0
Any new-onset hemodialysis	46,167 ± 34,536	+14,085	15.7 ± 11.4	+ 5.8
Any post-op adult respiratory distress syndrome	53,097 ± 43,302	+ 22,222	17.1 ± 14.5	+ 7.7
Any reoperation	50,720 ± 37,800	+18,809	14.1 ± 11.4	+ 4.2
Any hemorrhage or post-op shock	43,894 ± 31,943	+12,302	13.0 ± 9.9	+ 3.3
No. of study complications vs no study complications				
0	29,477 ± 17,358	NA	9.0 ± 5.8	NA
1	45,850 ± 35,547	+16,373	14.9 ± 12.4	+ 5.9
2	60,980 ± 51,809	+31,503	19.2 ± 18.0	+ 10.2
≥3	88,304 ± 65,343	+58,827	27.2 ± 19.9	+ 18.2

All incremental cost and LOS values are significantly ($p < 0.001$) different from zero.

LOS = length of stay; NA = not applicable.

The Frequency and Cost of Complications Associated With Coronary Artery Bypass Grafting Surgery: Results from the United States Medicare Program

(Ann Thorac Surg 2008;85:1980–7)

PCI eller CABG/ Ulf Jensen

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Definition ”Full revaskularisering”

TABLE 1. Different Definitions of Complete Revascularization as Found in the Literature

Revascularization	Definition
Complete anatomic revascularization	
Unconditional	All stenotic vessels are revascularized, irrespective of size and territory supplied.
Conditional	All stenotic vessels greater than a defined diameter are revascularized, OR All stenotic main-branch vessels are revascularized.
Complete functional revascularization	All ischemic myocardial territories are reperfused; areas of old infarction with no viable myocardium are not required to be reperfused.
Complete numeric revascularization	The number of stenotic vessels must equal the number of distal anastomoses applied.
Complete revascularization by a predetermined scoring cutoff value	Scoring of stenoses in different vessels at different locations (weightings may be used). The overall extent of disease is a continuous variable, the treatment is another variable, and the posttreatment score determines completeness of revascularization.
Anatomic	Irrespective of viable myocardium
Functional	Jeopardy score: The postrevascularization score is calculated on the basis of the amount of remaining myocardium at risk.

Complete Revascularization, Andrew T.L. Ong, MBBS, FRACP; Patrick W. Serruys, MD, PhD, ***(Circulation. 2006;114:249-255.)***

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Culprit lesion - varför gör vi mer?

- **STEMI**
  - Oftast lätt att avgöra – kan vara svårare vid flerkärlssjuka (EKG)
- **NSTEMI**
  - Inte alltid lätt att avgöra – svårt vid flerkärlssjuka (EKG, TTE, Ic diagnostik)
- **Instabil angina**
  - Inte alltid lätt att avgöra – svårt vid flerkärlssjuka (Ic diagnostik)
- **Stabil angina**
  - Kräver ofta intrakoronar diagnostik (FFR, IFR, OCT, IVUS, NIRS) eller utredning med myokardscint/stressEKO

Spelar öppna kärl ngn roll?

Stabil Angina Pectoris

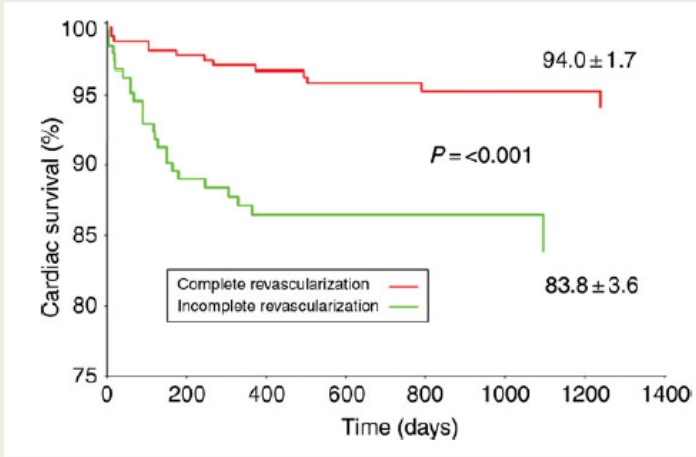
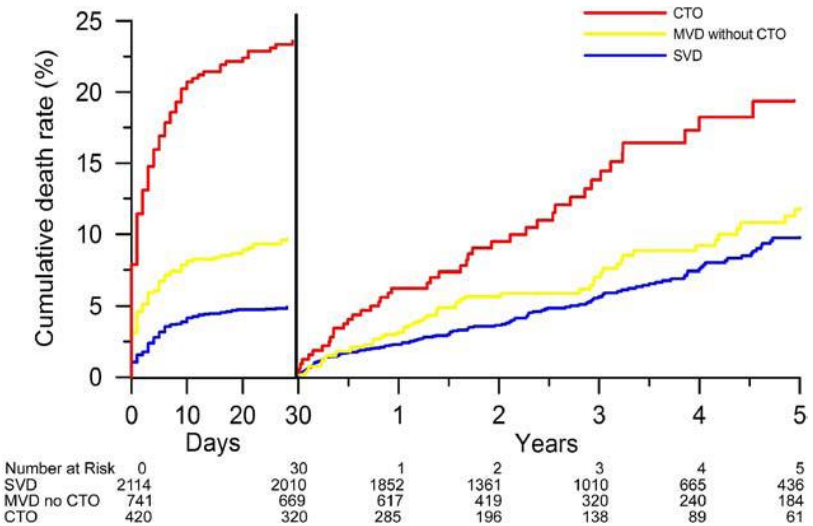


Figure 2 Kaplan–Meier analysis of cardiac survival in patients with complete revascularization when compared to patients with incomplete revascularization.

European Heart Journal (2008) **29**, 2336–2342
doi:10.1093/eurheartj/ehn357

AKS-STEMI



Cumulative risk of death during the first 30 days after primary PCI and thereafter for patients with singlevessel disease (SVD), multivessel disease (MVD), and a chronic total occlusion(CTO).

Claessen et al. JACC: CARDIOVASCULAR INTERVENTIONS, VOL. 2, NO. 11, 2009
Impact of a CTO in a Non-IRA After STEMI NOVEMBER 2009:1128–34

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Long-Term Outcome of Incomplete Revascularization After Percutaneous Coronary Intervention in SCAAR (Swedish Coronary Angiography and Angioplasty Registry)

Kristina Hambraeus, MD, PhD,[a,b] Karin Jensevik, MSc,[c] Bo Lagerqvist, MD, PhD,[b,c] Bertil Lindahl, MD, PhD,[b,c] Roland Carlsson, MD, PhD,[d] Ramin Farzaneh-Far, MD,[e] Thomas Kellerth, MD,[f] Elmir Omerovic, MD, PhD,[g] Gregg Stone, MD, PhD,[h] Christoph Varenhorst, MD, PhD,[b,c] Stefan James, MD, PhD[b,c]

JACC: CARDIOVASCULAR INTERVENTIONS VOL. 9, NO. 3, 2016

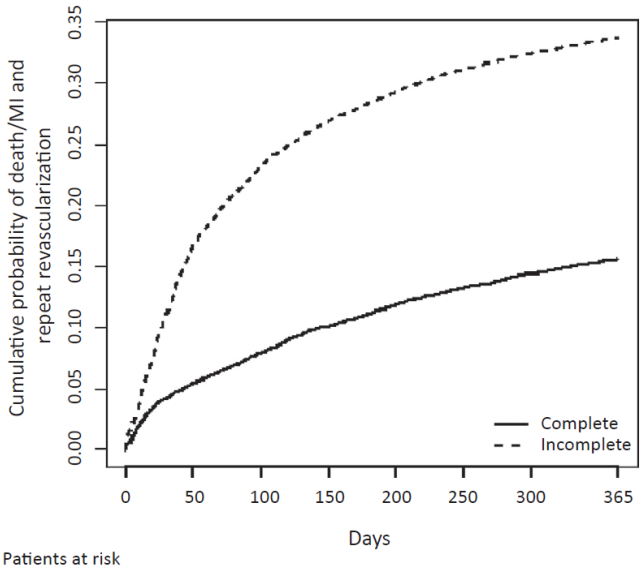
TABLE 4 Events During 1 Year of Follow-Up

	Incomplete Revascularization (n = 15,165)	Complete Revascularization (n = 8,177)	All (N = 23,342)
Death	1,080 (7.1)	307 (3.8)	1,387 (5.9)
Revascularization PCI	3,107 (20.5)	698 (8.5)	3,805 (16.3)
Revascularization CABG	594 (3.9)	108 (1.3)	702 (3.0)
Revascularization total	3,580 (23.6)	763 (9.3)	4,343 (18.6)
Myocardial infarction	1,570 (10.4)	492 (6.0)	2,062 (8.8)
Combined outcome of death/MI	2,470 (16.3)	754 (9.2)	3,224 (13.8)
Combined outcome of death/MI/revascularization	5,071 (33.4)	1,254 (15.3)	6,325 (27.1)

Values are n (%).

CABG = coronary artery bypass graft surgery; MI = myocardial infarction; PCI = percutaneous coronary intervention.

FIGURE 2 Kaplan-Meier Graph of the Probability of Death, MI, and Repeat Revascularization Up to 1 Year of Follow-Up for Patients With Complete Versus Incomplete Revascularization



CONCLUSIONS

Incomplete revascularization at the time of hospital discharge in patients with multivessel disease undergoing PCI is associated with a high risk of recurrent 1-year adverse cardiac events.

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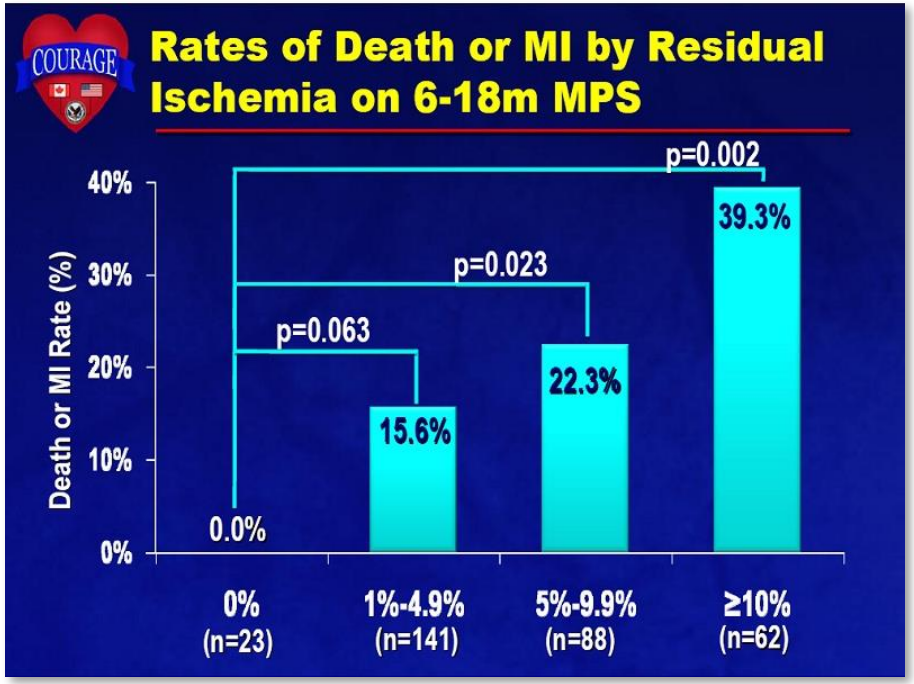
Ischemibörda och överlevnad



Indications for revascularization in patients with stable angina or silent ischaemia

Extent of CAD (anatomical and/or functional)		Class[b]	Level[c]
For prognosis	Left main disease with stenosis >50%[a]	I	A
	Any proximal LAD stenosis >50%[a]	I	A
	Two-vessel or three-vessel disease with stenosis > 50%[a] with impaired LV function (LVEF<40%)[a]	I	A
	Large area of ischaemia (>10% LV)	I	B
	Single remaining patent coronary artery with stenosis >50%[a]	I	C
For symptoms	Any coronary stenosis >50%[a] in the presence of limiting angina or angina equivalent, unresponsive to medical therapy	I	A

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Vad är skillnaden på en 99% stenos och 100% stenos vid stabil angina?

Vanligaste svaret = PCI vid 99%, ej PCI vid 100%

Rätt svar = 1% -> samma behandling

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”Starkaste faktorn för inkomplett revaskularisering är förekomst av kronisk ocklusion oavsett metod”

Ong et al. Circulation 2006;114:249-255

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ESC guidelines kroniska ocklusioner

Recommendations for the treatment of specific lesion subsets

Recommendations	Class[a]	Level[b]	Ref[c]
DES should be considered for PCI of ostial lesions.	IIa	B	769–772
For PCI of bifurcation lesions, stent implantation in the main vessel only, followed by provisional balloon angioplasty with or without stenting of the side branch, should be the preferred treatment.	IIa	A	725–731
Percutaneous recanalization of CTOs should be considered in patients with expected ischaemia reduction in a corresponding myocardial territory and/or angina relief.	IIa	B	740–743, 745
Retrograde recanalization of CTOs may be considered after a failed anterograde approach or as the primary approach in selected patients.	IIb	C	

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Komplett vs. inkomplett revaskularisering enligt SYNTAX Trial

- SYNTAX score är en anatomisk bedömning av kranskärlssjukdomens omfattning och komplexitet
- Residual SYNTAX score *definition*
  - *Komplett revaskularisering = 0 Residual SYNTAX score*
  - *Inkomplett revaskularisering = >0 Residual SYNTAX score*

Exempel Residual Syntax score

- Anterior STEMI – PPCI med DES mot mellersta LAD
- Angio visade förutom ockluderad LAD

- Bifurkationsstenos i höger kranskärl (PDA/PLA) > 20mm lång

  Syntax score 5

- Ockluderad marginalgren

  Syntax score 11

Residual Syntax score = 16

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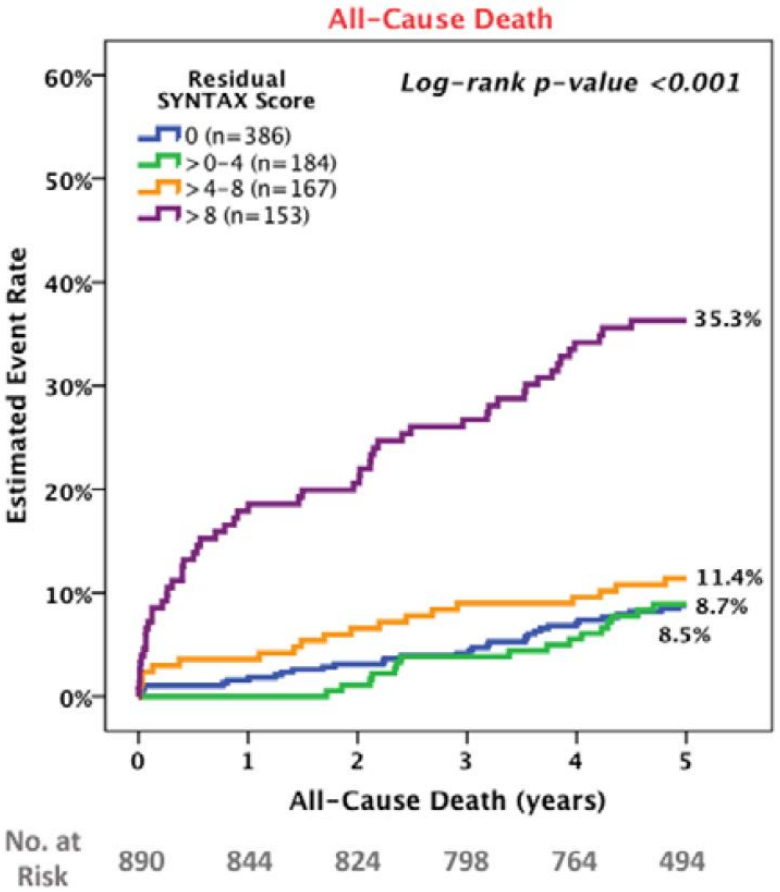

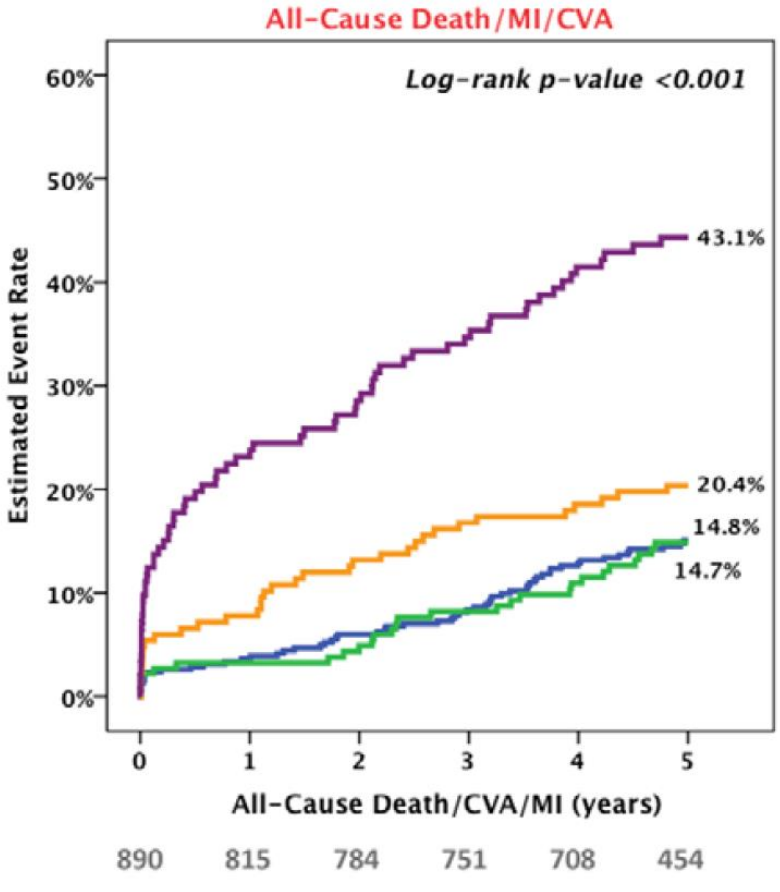

Farooq et al.(*Circulation*. 2013;128:141-151.)

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Komorbiditet och val av metod

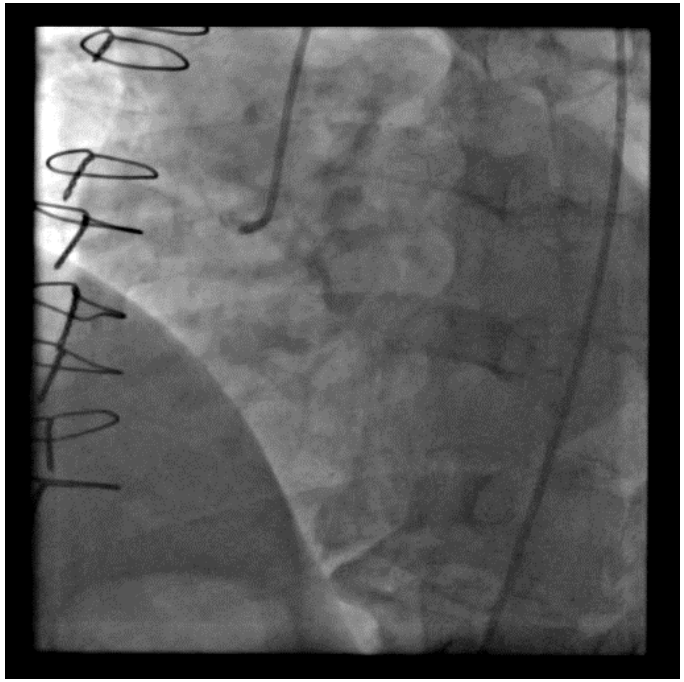
- Svår lungsjukdom (KOL, fibros, astma, emfysem)
- Koagulationsrubbning (Jehovas vittne)
- Maligniteter
- Tid stroke/hjärnblödning
- Njurinsufficiens
- Demenssjukdom
- Klaffsjukdom

Ålderns roll vid val av intervention

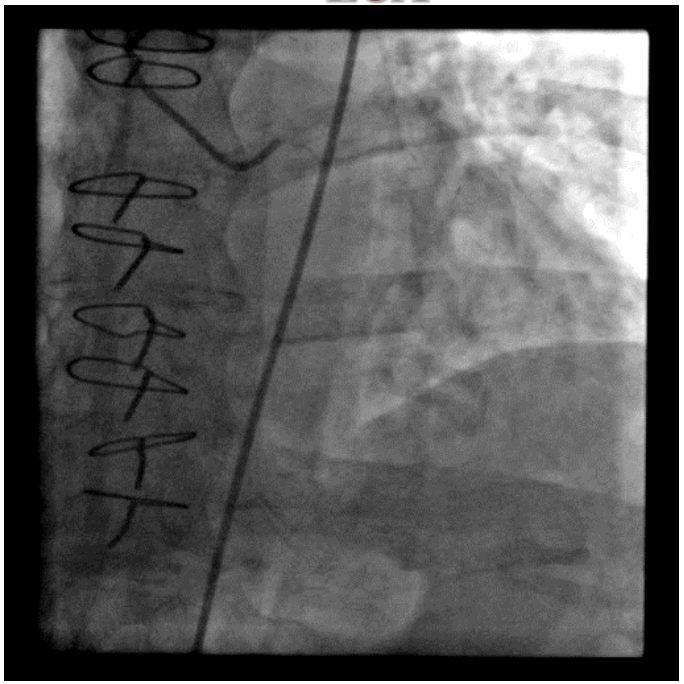
- Se bortom 10 års överlevnad?
- 30-70% av vengraften ockluderar efter 10 år
- Tidigt graftberoende vs senare graftberoende
- Ökad risk graftberoende post CABG vid tät HS stenos
- Sämre resultat vid PCI mot graft om återkommande angina

CABG vid 48 års ålder
100% graftberoende vid 61 års ålder

RCA



LCA



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Målkärl vid PCI post CABG

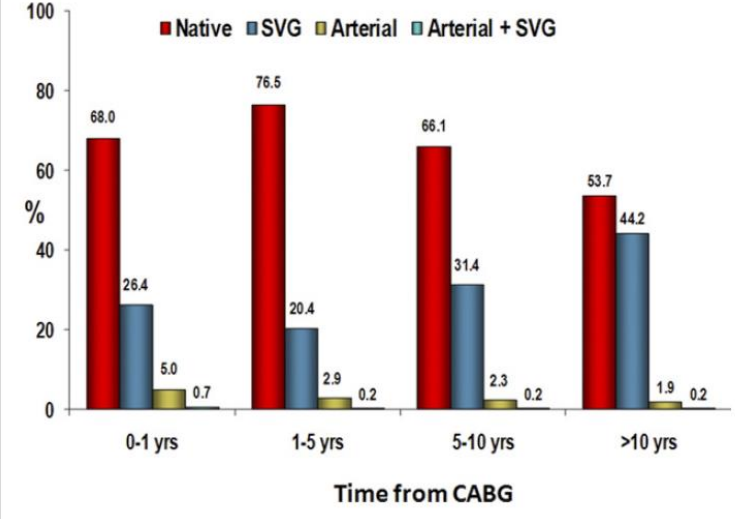

Figure 1. Target Vessel in Patients With Prior CABG

Comparison of the percutaneous coronary intervention target vessel in patients with prior coronary artery bypass graft surgery (CABG) surgery during different time intervals from CABG. $p < 0.001$. SVG = saphenous vein graft.

Brilakis et al. JACC Cardiovasc Interven 2011; vol 4 No 8

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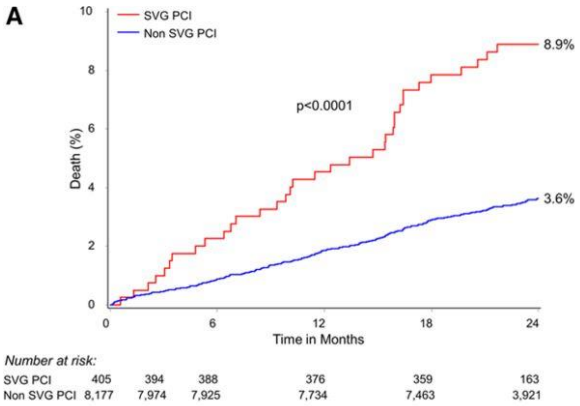
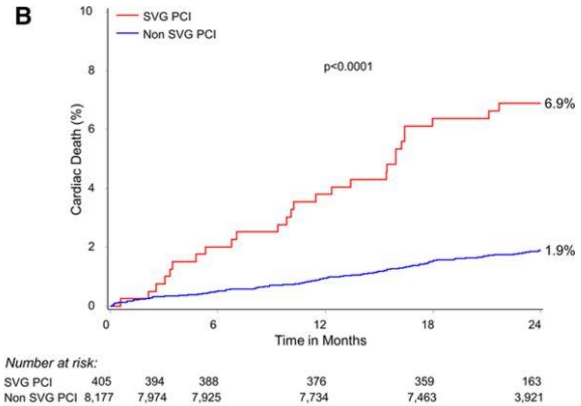
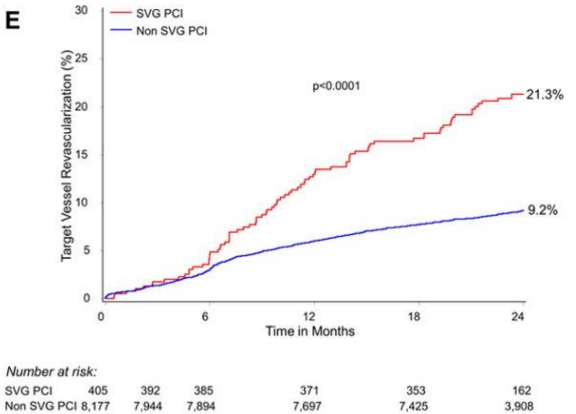
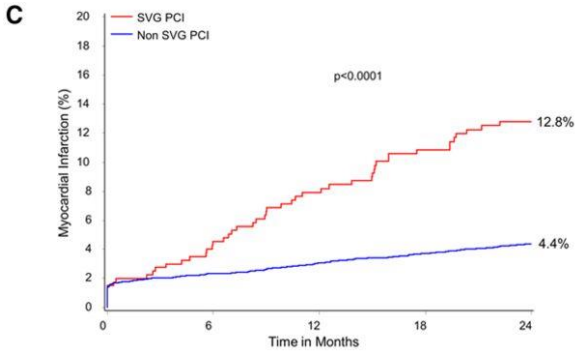
PCI mot vengraft

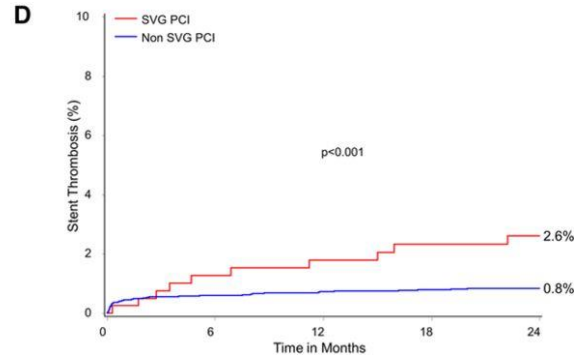
Redfors et al. Circ Cardiovasc Interv. 2017 May;10(5).

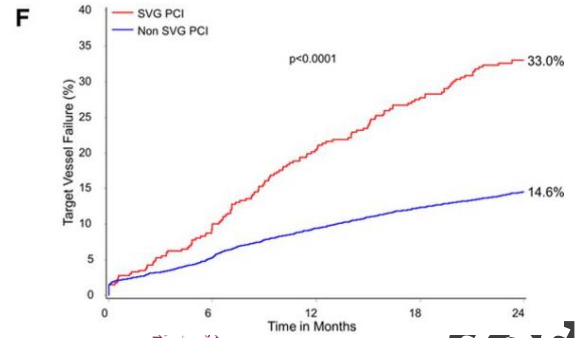












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Att öppna ockluderade vengraft

- Låg successrate- **68%**
- Embolic protection device - **62%**
- Distal embolisering - **>10%**
- No reflow fenomen
- Trombektomy - **47%**
- Procedurrelaterad AMI
- Hög risk ISR– **68%**
- Ocklusion frekvens – **23%**

Al-Lamee et al. Am J Cardiol 2010;106:17211727

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Vad påverkar resultatet efter revaskularisering?

- Teknik vid CABG (heterogen)?
- Teknik vid PCI (homogen)?
- Stenosens karaktär (diameter, längd)
- Stenosgrad
- Medicinering före/under/efter ingrepp/2:nd prevention
- Bakgrundssjukdomar

Öppetstående graft till icke sign stenoser

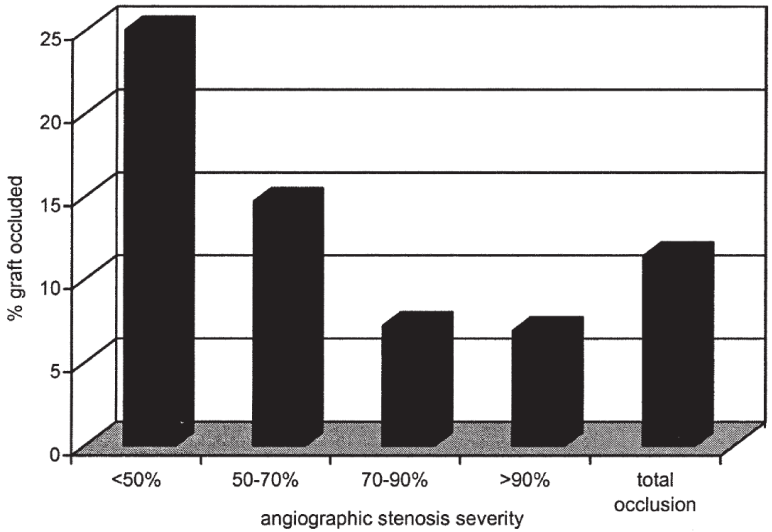

Fig 2. The relation between angiographic stenosis severity and graft failure after angiographic follow-up at 1 year.

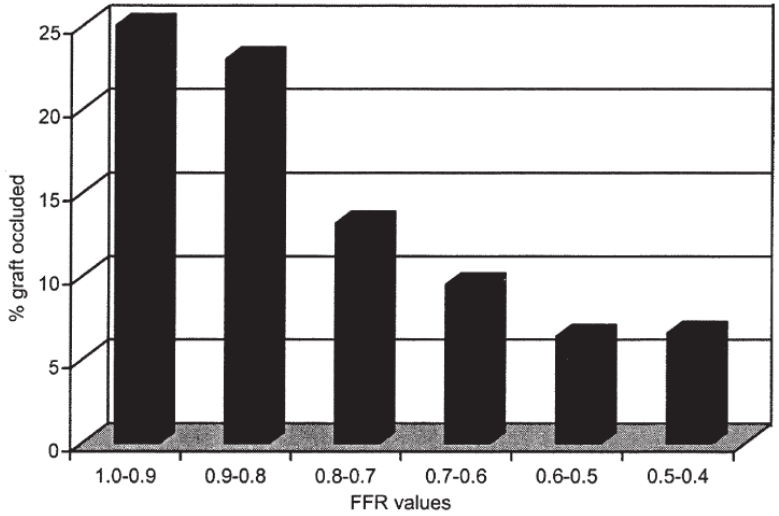

Fig 3. The relation between functional stenosis severity established by fractional flow reserve (FFR) measurements and graft failure at angiographic follow-up after 1 year.

(Ann Thorac Surg 2007;83:2093–7)

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Öppetstående vengraft?

Table 1. Saphenous Vein Graft Occlusion Rates From Selected Studies

Study/First Author (Ref. #)	1 Year	5 Years	10 Years
PRAGUE-4 (1)	41 (per patient on-pump)	NA	NA
	51 (per patient off-pump)	NA	NA
PREVENT IV (2)	41.7 (per patient)	NA	NA
	26.6 (per SVG)	NA	NA
Fitzgibbon et al. (3)	19 (per SVG)	25 (per SVG)	40 (per SVG)
RIGOR (4)	31 (per patient)	NA	NA
	19 (per SVG)	NA	NA
Halabi et al. (5)	39.3 (per patient)	NA	NA
Khot et al. (6)	30.1 (SVG)	NA	NA
ROOBY (7)	28.7 (per patient on-pump)	NA	NA
	36.5 (per patient off-pump)	NA	NA
Goldman et al. (8)	20 (per patient)	31 (per patient)	39 (per patient)

Values are %.

NA = not available; PREVENT IV = Project of Ex Vivo Vein Graft Engineering via Transfection; RIGOR = Reduction in Graft Occlusion Rates; ROOBY = Veterans Affairs Randomized On/Off Bypass study.

Lee *et al.* JACC: CARDIOVASCULAR INTERVENTIONS, VOL. 4, NO. 8, 2011 AUGUST 2011:831–43

>35% ockluderade efter 1 år

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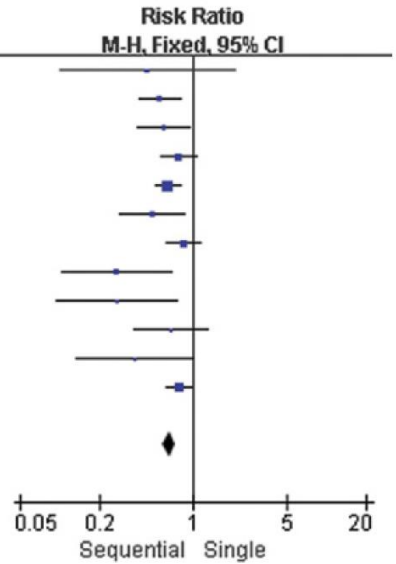
Sekventiell vs. Individuell SVG

Ocklusions frekvens

Study or Subgroup	Sequential Events	Sequential Total	Single Events	Single Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Campeau 1975	2	49	8	88	0.9%	0.45 [0.10, 2.03]
Christenson 1998	474	3791	24	108	7.5%	0.56 [0.39, 0.81]
Dion 2001	40	166	18	45	4.6%	0.60 [0.38, 0.94]
Eschenbruch 1981	44	361	155	984	13.4%	0.77 [0.57, 1.06]
Farsak 2003	105	543	149	491	25.2%	0.64 [0.51, 0.79]
Gao 2010	25	512	20	202	4.6%	0.49 [0.28, 0.87]
Kieser 1986	62	376	74	379	11.9%	0.84 [0.62, 1.15]
Kim 2010	5	192	24	244	3.4%	0.26 [0.10, 0.68]
Meurala 1982	4	75	17	85	2.6%	0.27 [0.09, 0.76]
Silva 2009	17	90	12	43	2.6%	0.68 [0.36, 1.29]
Souza 2002	4	108	32	316	2.6%	0.37 [0.13, 1.01]
Vural 2001	145	575	97	300	20.6%	0.78 [0.63, 0.97]
Total (95% CI)		**6838**		**3285**	**100.0%**	**0.67 [0.60, 0.74]**
Total events	927		630			

Heterogeneity: Chi² = 15.75, df = 11 (P = 0.15); I² = 30%

Test for overall effect: Z = 7.30 (P < 0.00001)



Ann Thorac Surg;2011 Oct;92(4):1292-8.

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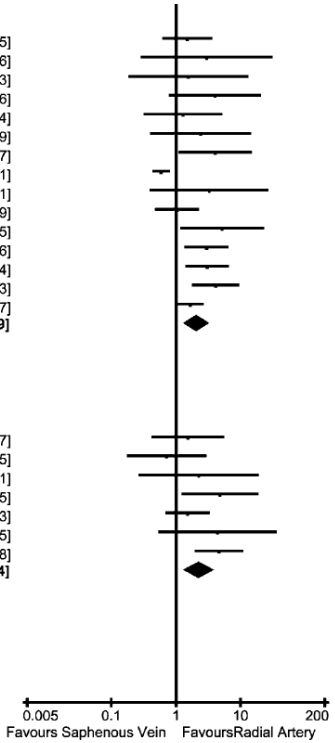
SVG or RA

Mid-term patency (1-5 years)						
Amano et al	213	229	71	79	3.5%	1.50 [0.62, 3.65]
Calafiore et al	98	101	11	12	1.1%	2.97 [0.28, 31.06]
Cho et al	6	7	180	227	1.3%	1.57 [0.18, 13.33]
Gaudino et al	38	40	33	40	1.9%	4.03 [0.78, 20.76]
Hayward et al	33	37	32	37	2.3%	1.29 [0.32, 5.24]
Ikeda et al	24	26	20	24	1.7%	2.40 [0.40, 14.49]
Kazaz et al	136	139	123	134	2.5%	4.05 [1.11, 14.87]
Khot et al	204	398	174	272	5.0%	0.59 [0.43, 0.81]
Kim et al	8	9	86	121	1.3%	3.26 [0.39, 27.01]
Moran et al	35	51	44	65	3.7%	1.04 [0.48, 2.29]
Muneretto et al	53	55	97	116	2.1%	5.19 [1.16, 23.15]
Oz et al	57	65	163	231	3.7%	2.97 [1.35, 6.56]
Schwann et al	44	54	72	122	3.8%	3.06 [1.41, 6.64]
Yle et al	160	174	36	49	3.6%	4.13 [1.79, 9.53]
Zacharias et al	111	157	95	161	4.6%	1.68 [1.05, 2.67]
Subtotal (95% CI)		**1542**		**1690**	**42.2%**	**2.06 [1.29, 3.29]**
Total events	1220		1237			
Heterogeneity: Tau² = 0.49; Chi² = 51.31, df = 14 (P < 0.00001); I² = 73%						
Test for overall effect: Z = 3.03 (P = 0.002)						
Late patency (> 5 years)						
Angelini et al	17	20	118	150	2.5%	1.54 [0.42, 5.57]
Cameron et al	55	62	33	36	2.3%	0.71 [0.17, 2.95]
Cho et al	6	7	165	227	1.3%	2.25 [0.27, 19.11]
Collins et al	56	59	35	44	2.3%	4.80 [1.22, 18.95]
Hadinata et al	59	68	160	197	3.8%	1.52 [0.69, 3.33]
Kim et al	8	9	78	121	1.3%	4.41 [0.53, 36.45]
Possati et al	76	84	49	73	3.5%	4.65 [1.94, 11.18]
Subtotal (95% CI)		**309**		**848**	**17.0%**	**2.28 [1.32, 3.94]**
Total events	277		638			
Heterogeneity: Tau² = 0.13; Chi² = 8.01, df = 6 (P = 0.24); I² = 25%						
Test for overall effect: Z = 2.95 (P = 0.003)						



T. Athanasiou et al. / European Journal of Cardio-thoracic Surgery 40 (2011) 208–220

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Sekventiell SVG vs. total arteriel revaskularisering

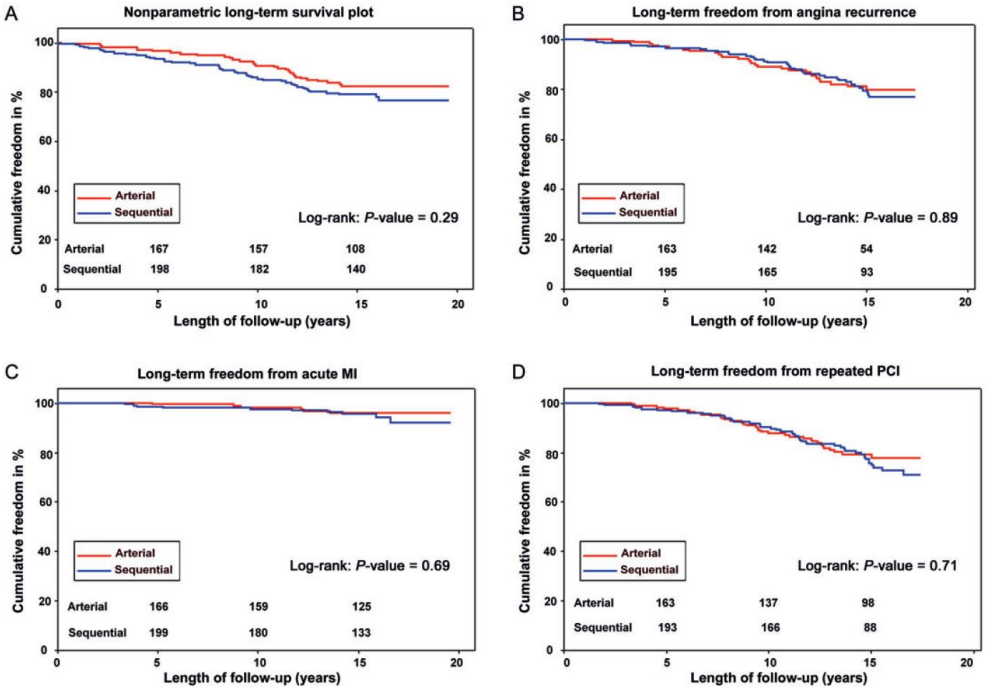

Figure 1: Non-parametric plots of freedom from primary outcomes at follow-up; Kaplan–Meier comparison between the ART group and the SV group. (**A**) Long-term cumulative survival; (**B**) long-term freedom from angina recurrence; (**C**) long-term freedom from repeated percutaneous coronary intervention (PCI); (**D**) long-term freedom from acute myocardial infarction (MI).

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ESC guidelines CABG

2014 ESC/EACTS Guidelines on myocardial revascularization

Procedural aspects of CABG

Recommendations	Class[a]	Level[b]	Ref.[c]
It is recommended to perform procedures in a hospital structure and by a team specialized in cardiac surgery, using written protocols.	I	B	635,636
Endoscopic vein harvesting should be considered to reduce the incidence of leg wound complications.	IIa	A	577,578,580–582, 637,638
Routine skeletonized IMA dissection should be considered.	IIa	B	586–589
Skeletonized IMA dissection is recommended in patients with diabetes or when bilateral IMAs are harvested.	I	B	586–589
Complete myocardial revascularization is recommended.	I	B	594,598,600
Arterial grafting with IMA to the LAD system is recommended.	I	B	602,603,639
Bilateral IMA grafting should be considered in patients <70 years of age.	IIa	B	165,606–610,640, 641
Use of the radial artery is recommended only for target vessels with high-degree stenosis.	I	B	618,642
Total arterial revascularization is recommended in patients with poor vein quality independently of age.	I	C	-
Total arterial revascularization should be considered in patients with reasonable life expectancy.	IIa	B	643
Minimization of aortic manipulation is recommended.	I	B	442,644
Off-pump CABG should be considered for subgroups of high-risk patients in high-volume off-pump centres.	IIa	B	626,627,629
Off-pump CABG and/or no-touch on-pump techniques on the ascending aorta are recommended in patients with significant atherosclerotic disease of the ascending aorta in order to prevent perioperative stroke.	I	B	443
Minimally invasive CABG should be considered in patients with isolated LAD lesions.	IIa	C	
Electrocardiogram-triggered CT scans or epiaortic scanning of the ascending aorta should be considered in patients over 70 years of age and/or with signs of extensive generalized atherosclerosis.	IIa	C	–
Routine intraoperative graft flow measurement should be considered.	IIa	C	–

”Sverige 1-2% BITA”
Person M, Sartipy U; Curr Card Rep (2018) 20:4
Dalén et al.; PLoS One.2014;9(1)

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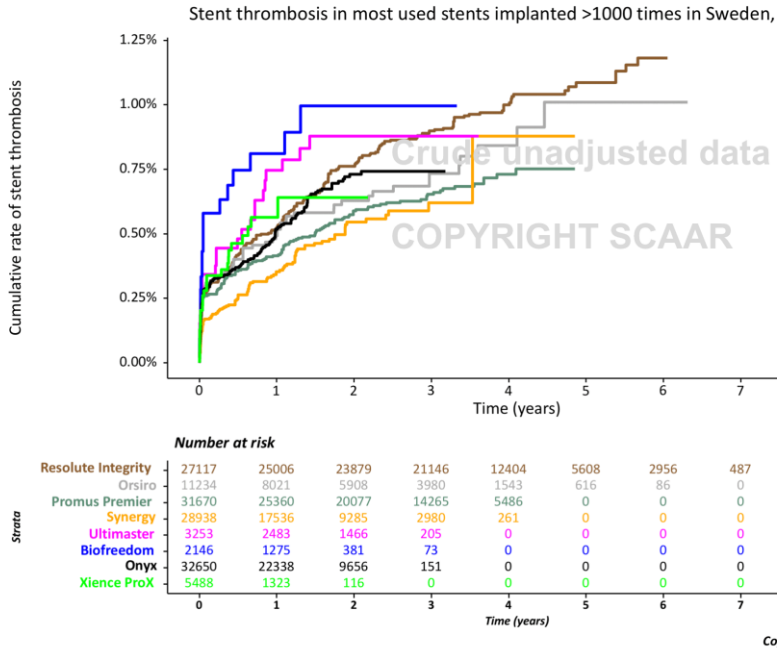
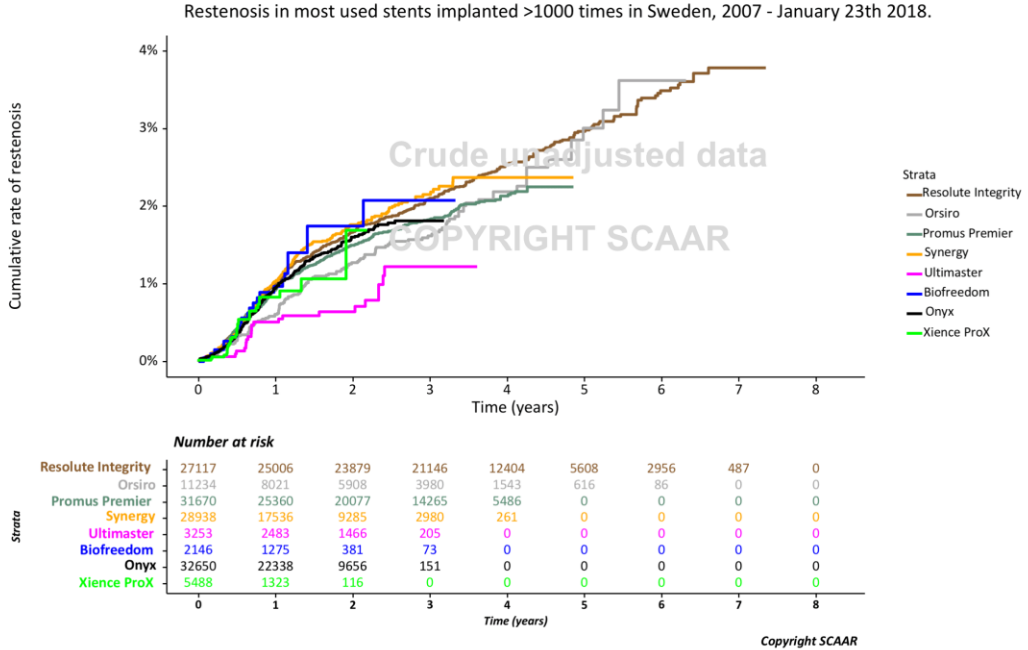
Resultat för vanligaste DES i Sverige 2007-2018





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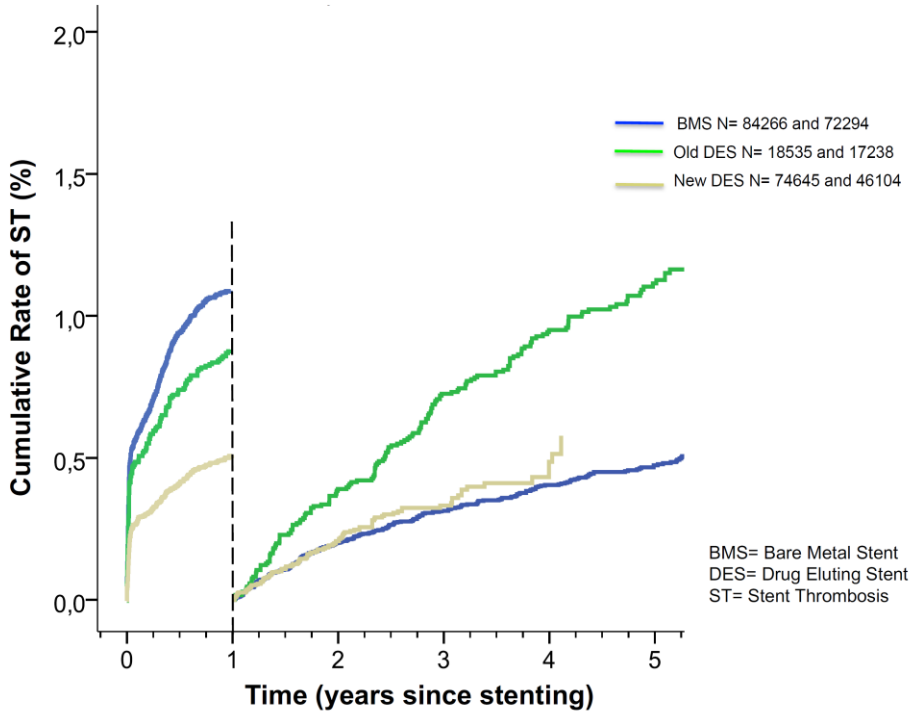
Risk för stenttrombos med nya DES



Clinical Research in Cardiology 2018, Varenhorst et al.

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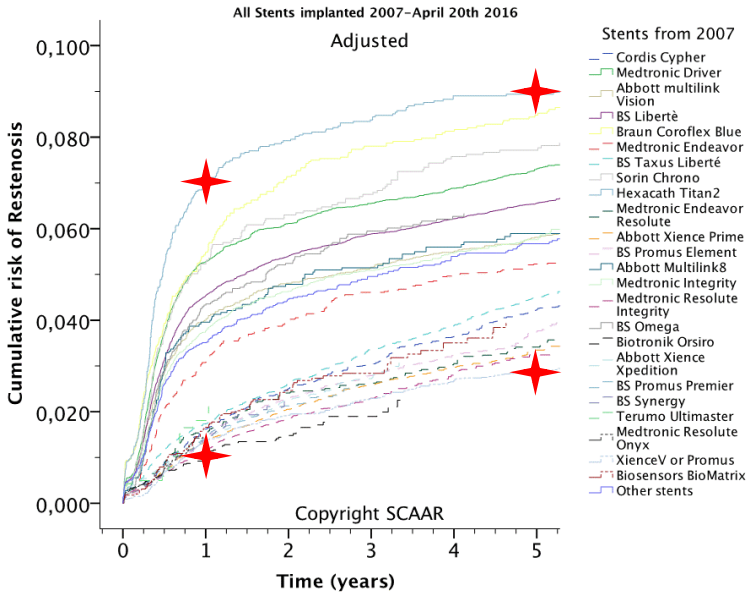
Öppetstående kärl

Graft vs. DES

Graft	Patency @ 1 år	Patency @ 4-5 år	Patency @ ≥ 10 år	Ref.
SVG	75-95%	65-85%	32-71%	473-477
RA	92-96%	90%	63-83%	473-474, 478-480
LIMA	>95%	90-95%	88-95%	475, 480
RIMA	>95%	>90%	65-90%	475

2014 ESC/EACTS Guidelines on myocardial revascularization



Annual SCAAR restenosis report 2016

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Öppetstående kärl efter 5 år

Rank	Method	Patency rate
1	DES	91-97%
2	LIMA	90-95%
3	RIMA	>90%
4	Total arterial revasc	~90%
4	Sequential SVG	~90%
6	RA	<90%
7	SVG	65-85%

Jensen U, CTO Fundamentals Live, 2016, Amsterdam

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Dålig idé med vengraft till kroniska ocklusioner!

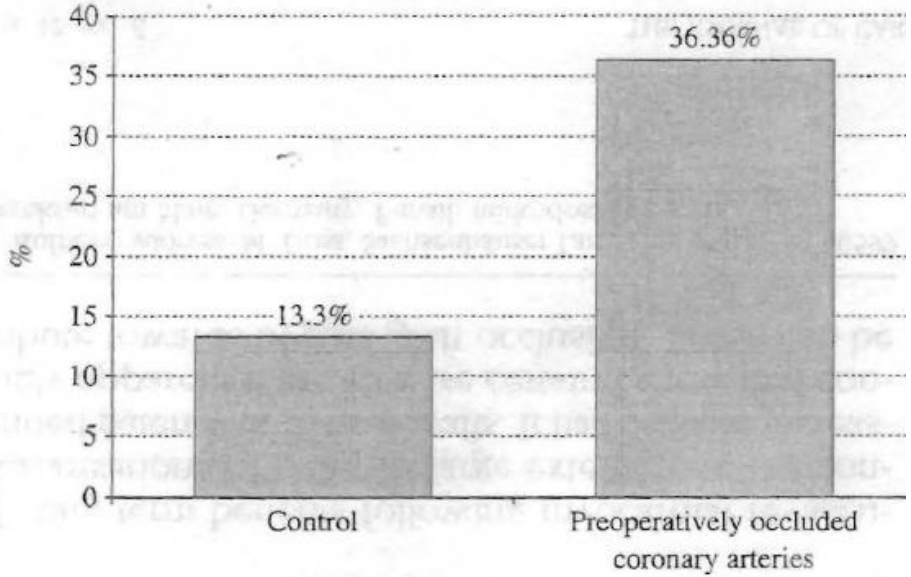

Fig. 1.—Bypass occlusion per patient one month postoperatively.

J Cardiovasc Surg 2001 Dec;42(6):719-21

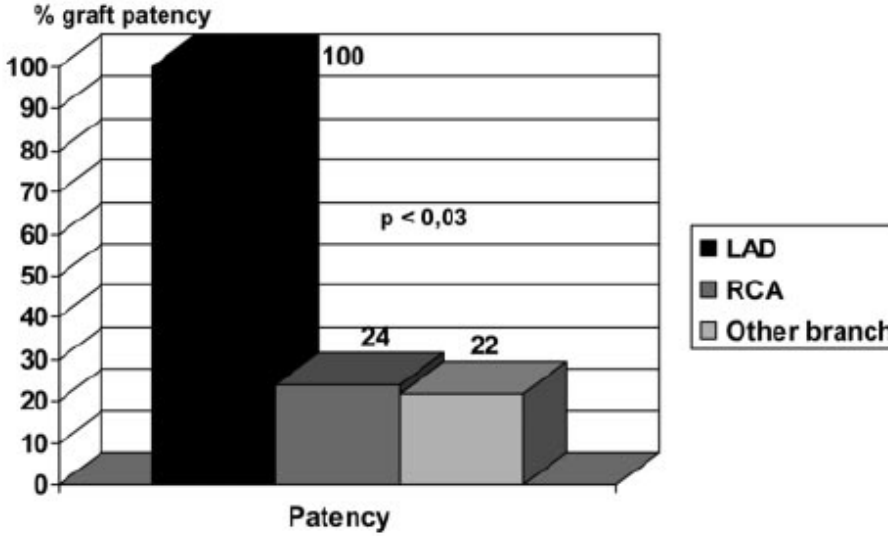

Figure 4. Percent graft patency in chronic collateralized total coronary occlusions.

(*Circulation*. 2004;110:3418-3423.)

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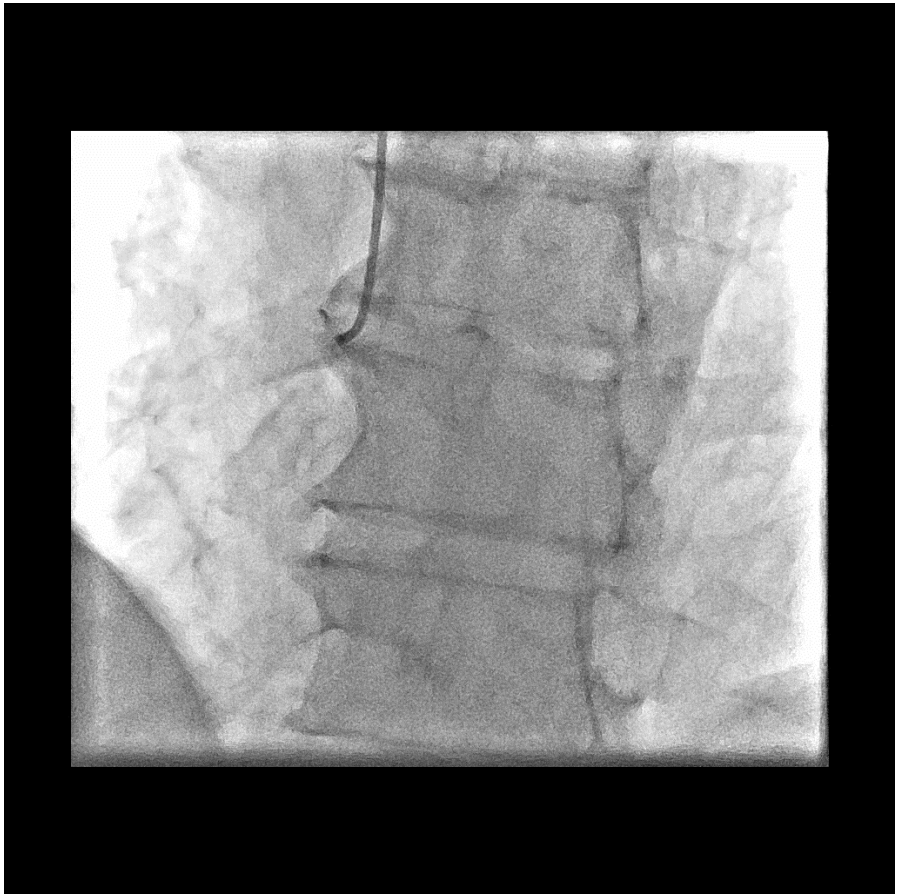
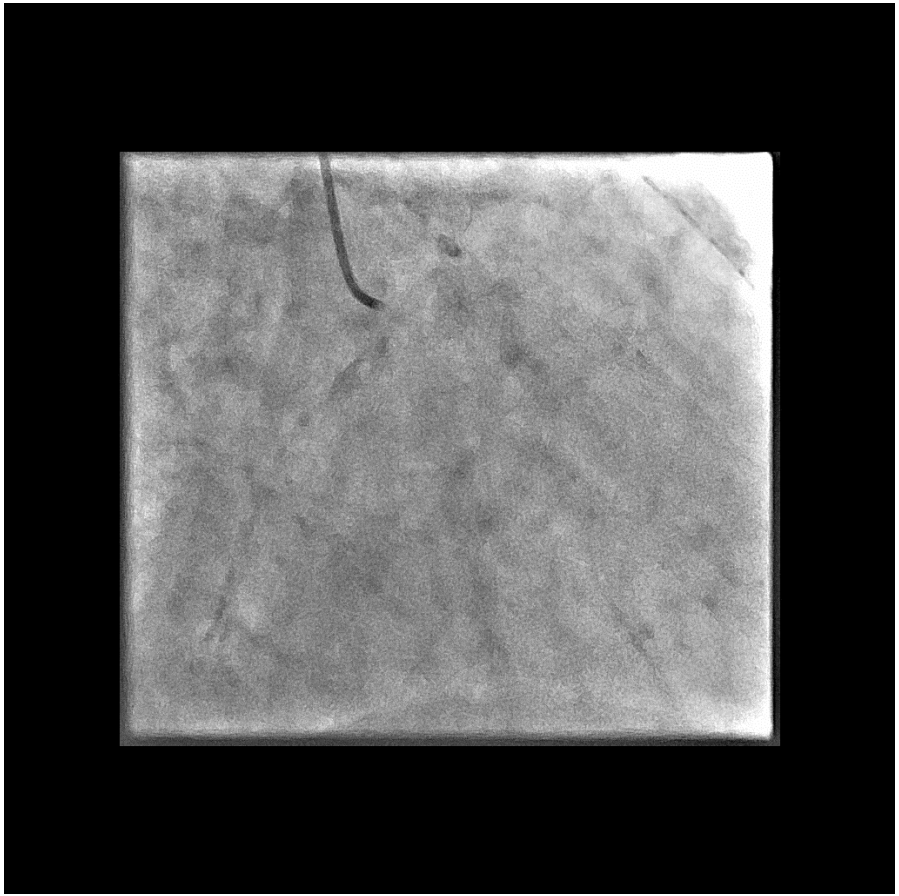
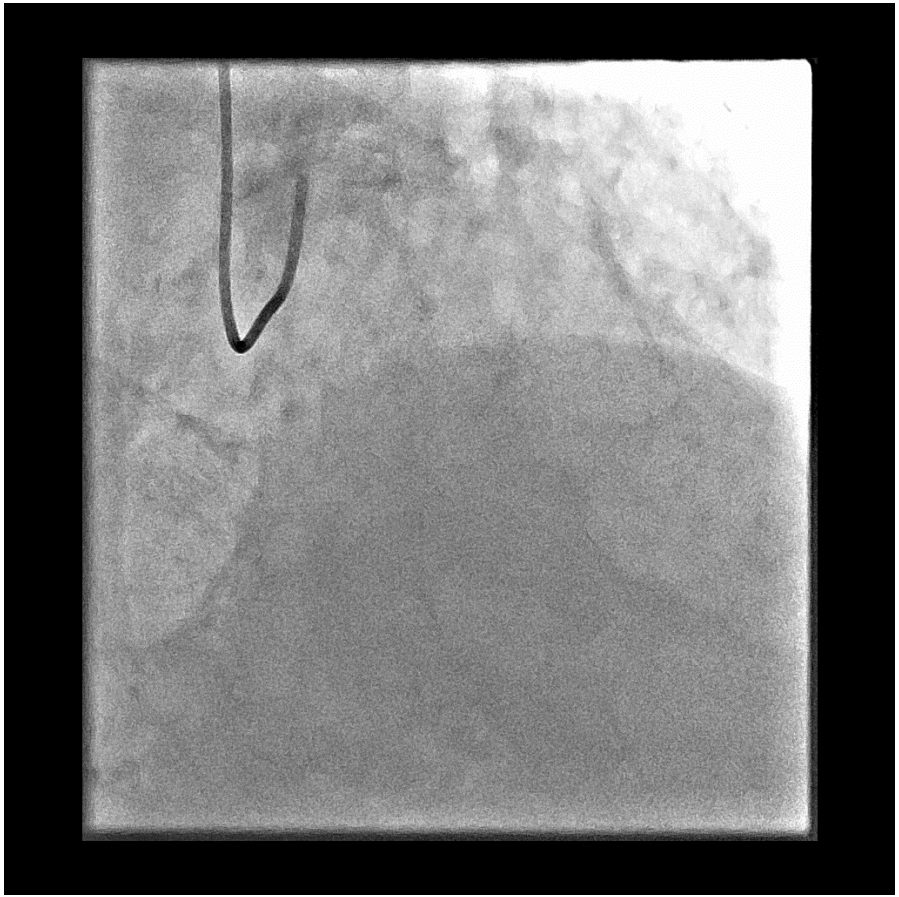
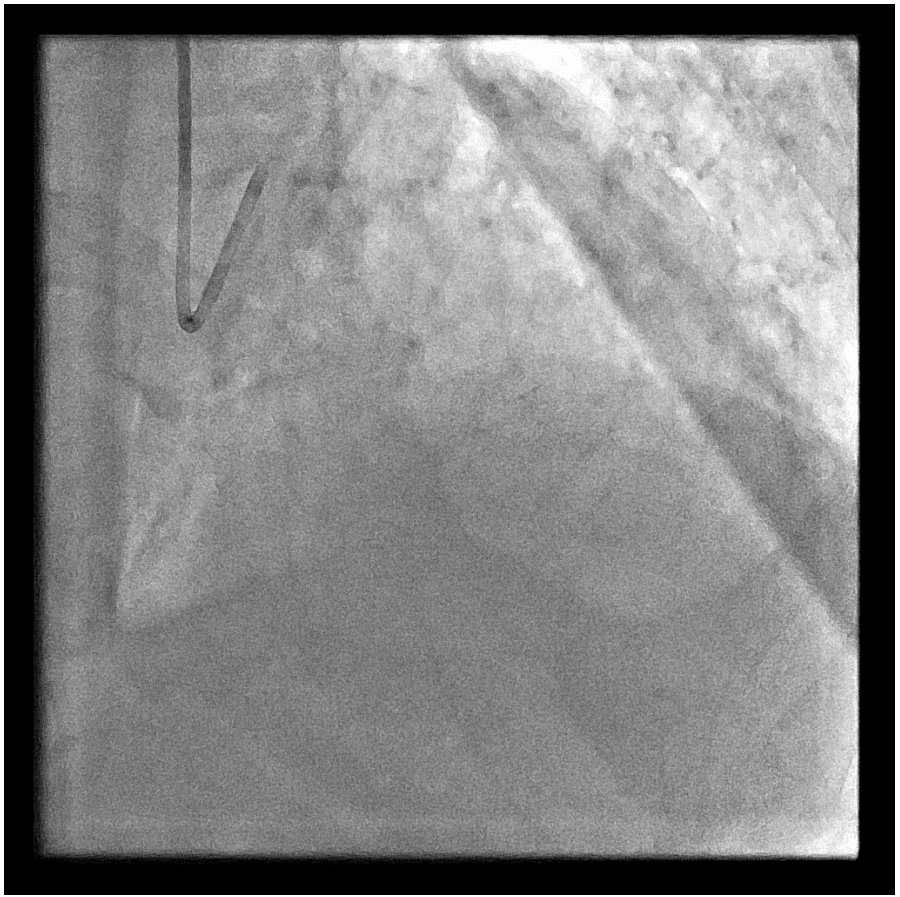
Fall 2, man 72 år

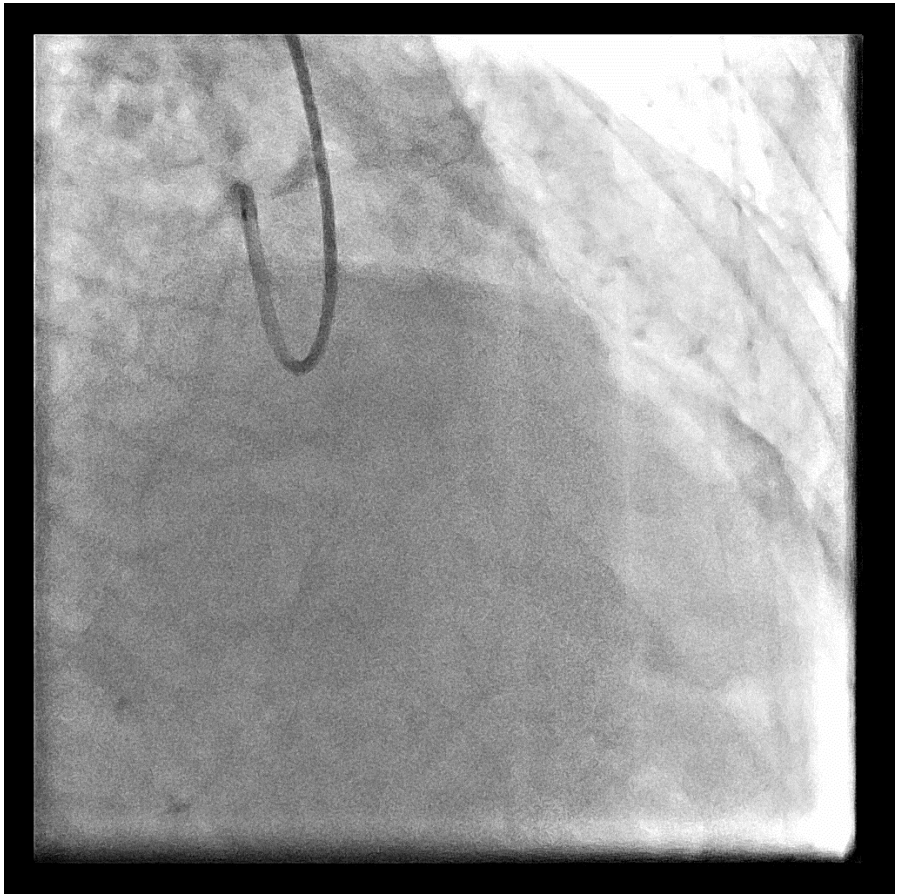
- Söker akut pga av dyspne
- Rökare, KOL, HT, DVT
- Förkyld 1 månad, sen 3 veckor bensvullnad
- Kort gångsträcka, 20 min att gå 100 m
- Ortopne, sitter och sover
- Rtg pulm: utbredda bilat infiltrat
- CRP 28, trop t 52, NTproBNP 6500, krea 127
- EKG utan ST-T förändringar











Fall 2

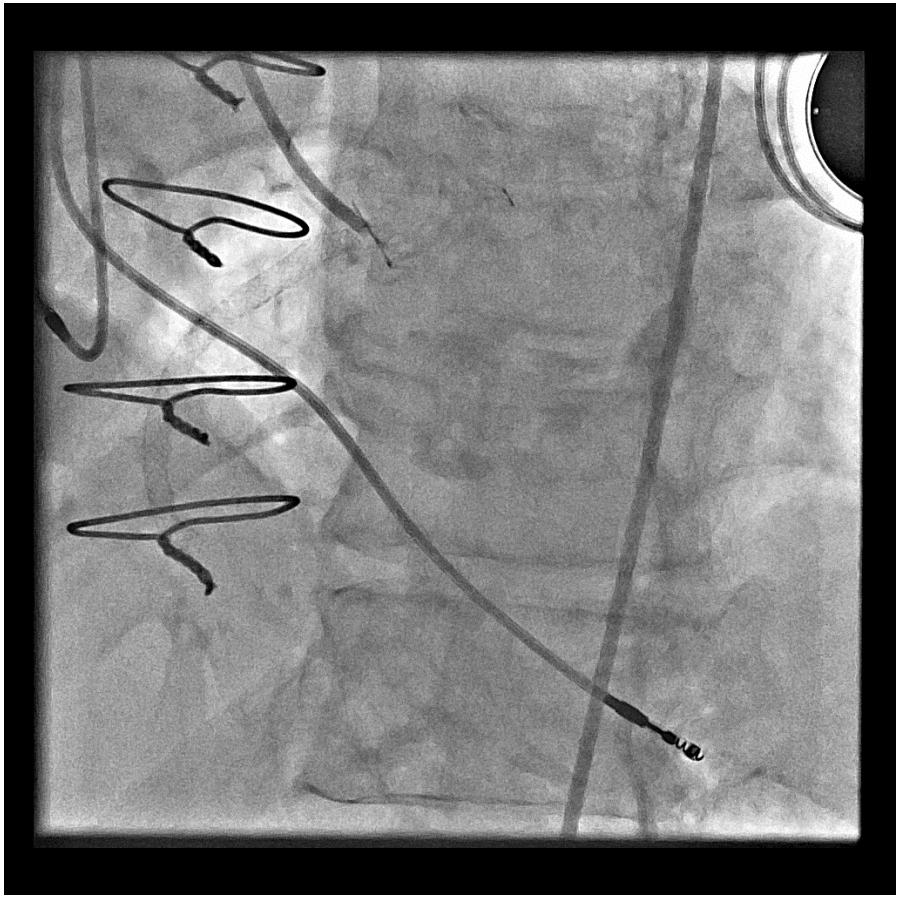
- Angio visar utbredd koronarsjukdom
- Ischemisk kardiomyopati
- EKO: EF 29%, generell hypokinesi
- CABG eller PCI?
- Risk score
  - Syntax score = 25
  - STS score = 2% mortalitet, 1,2% stroke, förlängd resptid 8%
  - Euro score = 5,8%

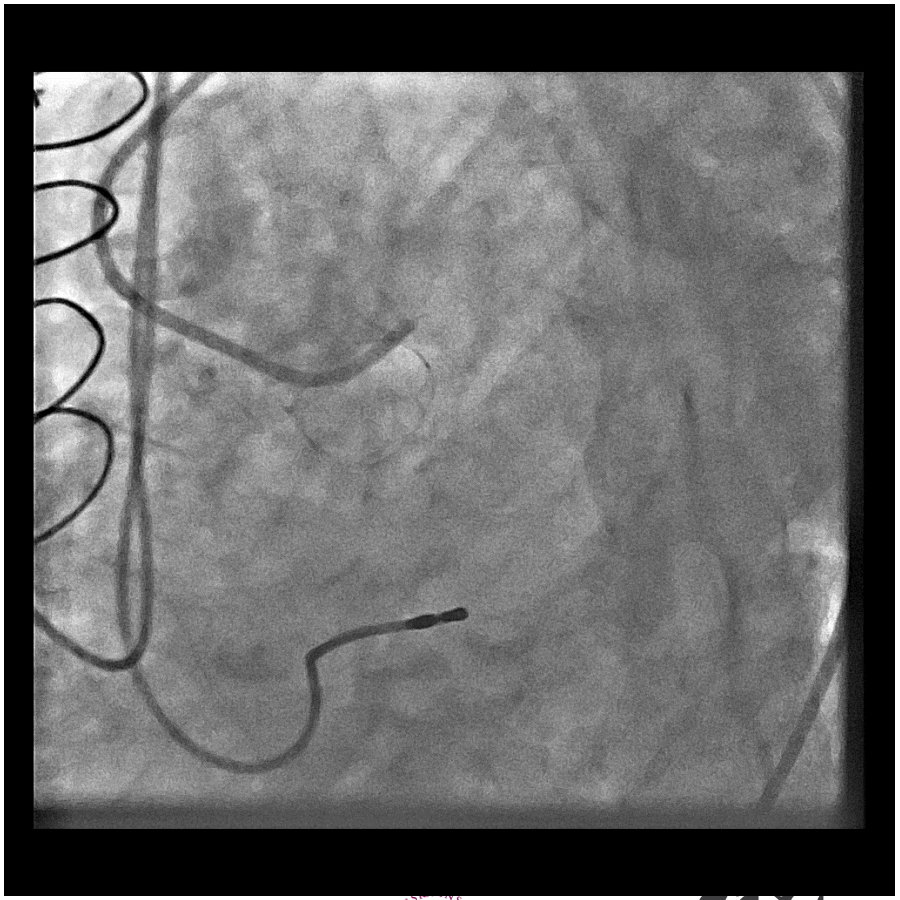
Vad är mitt budskap då?

- ✓ Vad gäller öppetstående kärl verkar DES inte vara sämre än CABG
- ✓ Om man tror på konceptet full revaskularisering ska alla flödesbegränsande lesioner i kärl > 2mm åtgärdas – även kroniska ocklusioner
- ✓ Vid CABG följs ej rekommendationer om huvudsakligen arteriella graftalternativ hos yngre patienter
- ✓ Vid CABG i ung ålder skapas problem för revaskularisering >10 år
- ✓ Om remiss för CABG -> tryckmätning av samtliga mottagarkärl
- ✓ PCI mot vengraft är ett dåligt alternativ jmf mot nativa kärl
- ✓ Vengraft till kroniska ocklusioner är ett dåligt alternativ jmf med PCI

Fall 3, kvinna 74 år

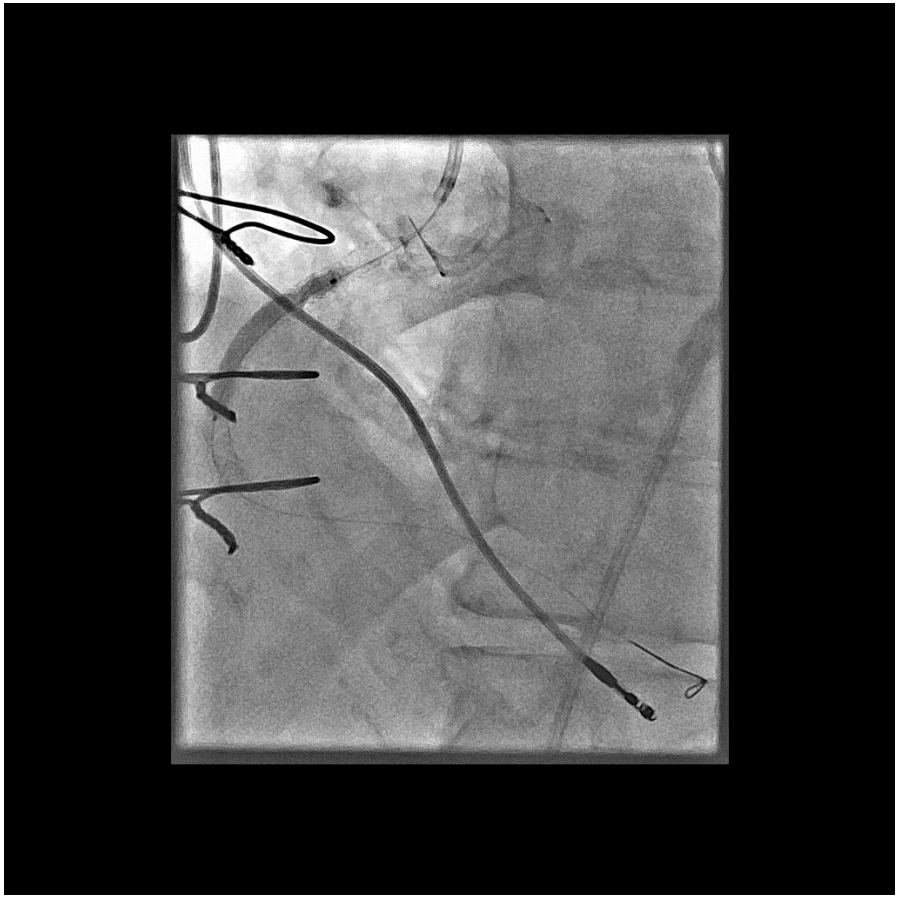
- Söker för lättväckt bröstsmärta sedan 3v.
- Tid AS, op AVR 2012, HT, DDD PM pga AV block III
- Ischemisk hjärtsjukdom, PCI mot CTO RCA okt -18, 3 DES
- EF normal
- Angio visar:

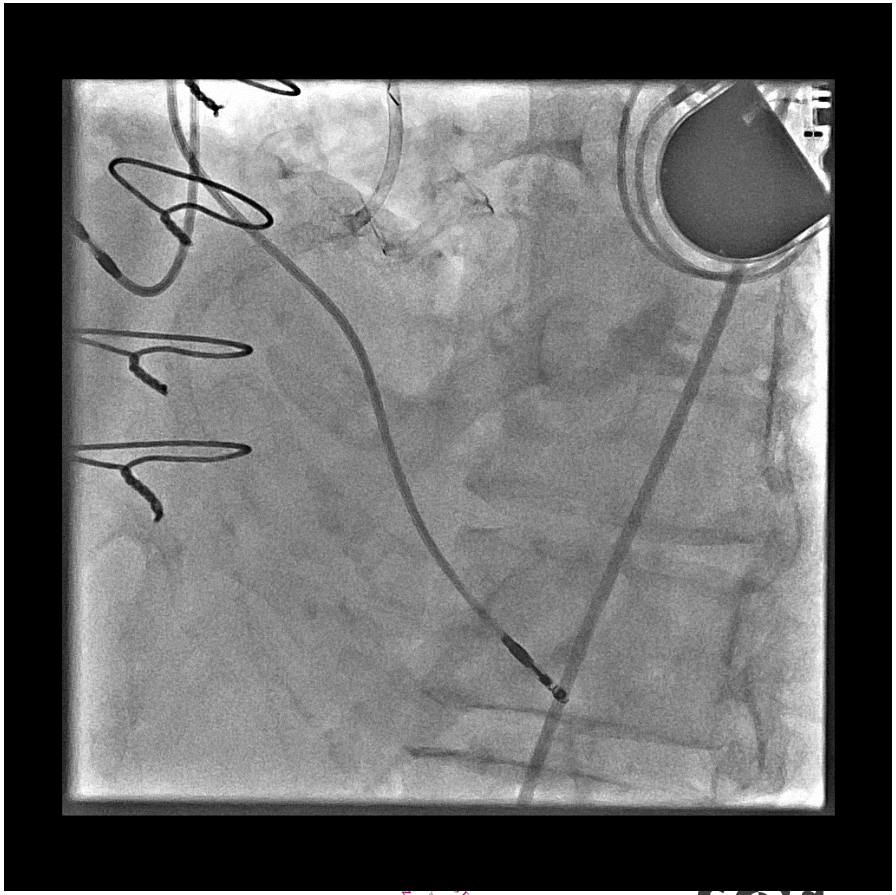




Fall 3

- Åtgärd?
- CABG eller PCI?





Tack!

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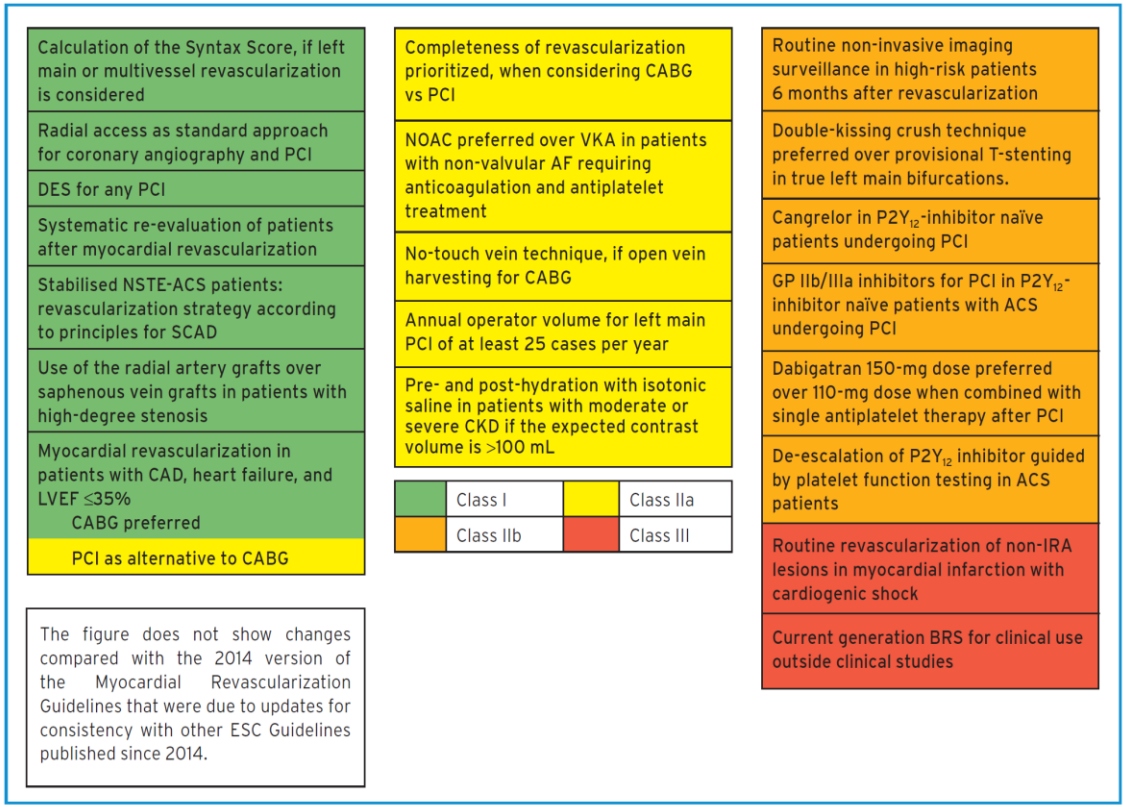
2.1 What is new in the 2018 Guidelines?



ACS = acute coronary syndromes; AF = atrial fibrillation; BRS = bioresorbable scaffolds; CABG = coronary artery bypass grafting; CAD = coronary artery disease; CKD = chronic kidney disease; DES = drug-eluting stents; FFR = fractional flow reserve; GP = glycoprotein; IRA = infarct-related artery; LVEF = left ventricular ejection fraction; NOAC = non-vitamin K oral anticoagulants; NSTEMI = non-ST-elevation; PCI = percutaneous coronary intervention; SCAD = stable coronary artery disease; VKA = vitamin K antagonists.

2018 ESC/EACTS Guidelines on myocardial revascularization

CABG eller PCI enligt ESC guidelines

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UPGRADES

For PCI of bifurcation lesions, stent implantation in the main vessel only, followed by provisional balloon angioplasty with or without stenting of the side branch
Immediate coronary angiography and revascularization, if appropriate, in survivors of out-of-hospital cardiac arrest and an ECG consistent with STEMI
Assess all patients for the risk of contrast-induced nephropathy
OCT for stent optimization

DOWNGRADES

Distal protection devices for PCI of SVG lesions
Bivalirudin for PCI in NSTE-ACS
Bivalirudin for PCI in STEMI
PCI for MVD with diabetes and SYNTAX score <23
Platelet function testing to guide antiplatelet therapy interruption in patients undergoing cardiac surgery
EuroSCORE II to assess in-hospital mortality after CABG

	Class I		Class IIa
	Class IIb		Class III

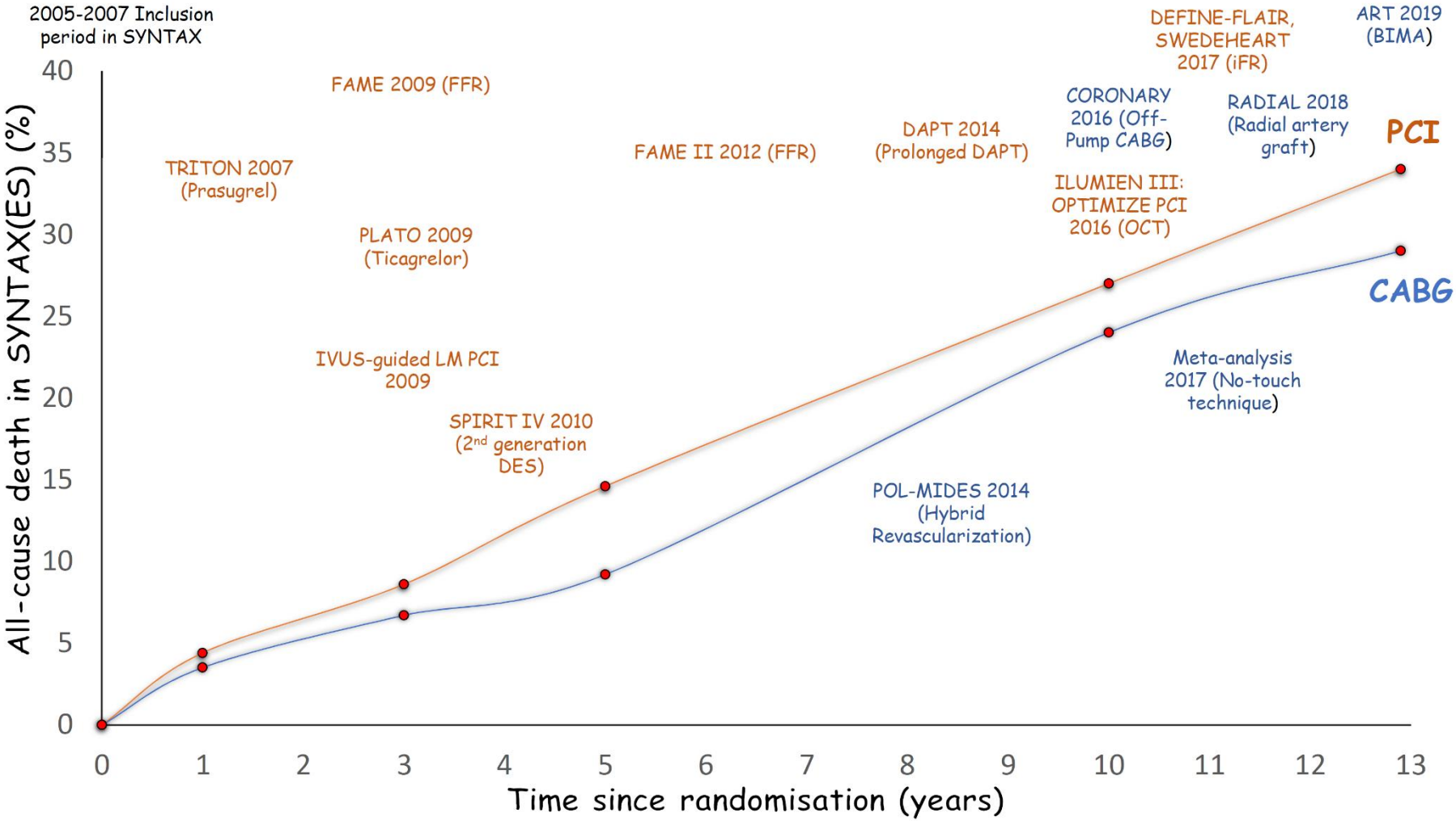
The figure does not show changes compared with the 2014 version of the Myocardial Revascularization Guidelines that were due to updates for consistency with other ESC Guidelines published since 2014.

Riskbedömning inför revaskularisering

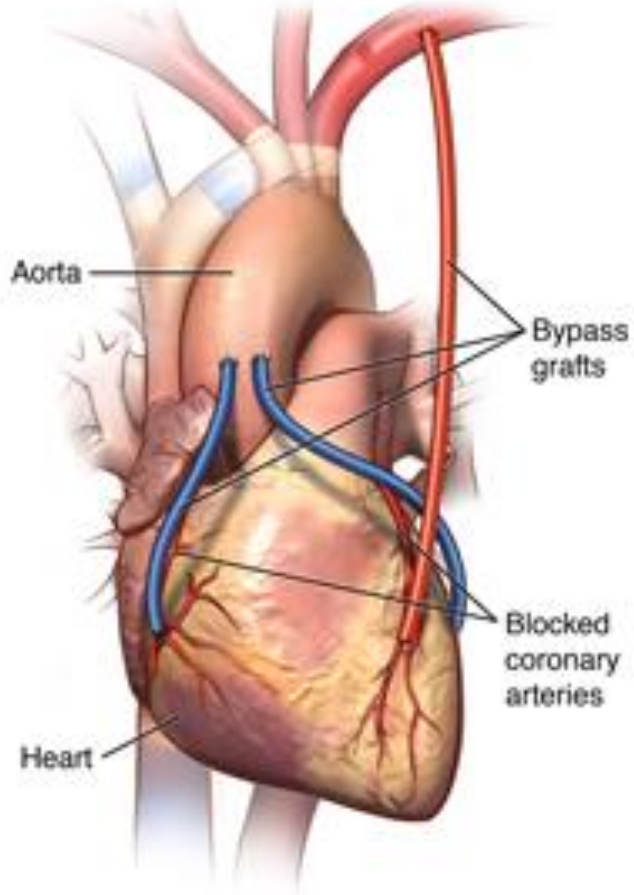
- SYNTAX score
  - Inför ställningstagande till PCI eller CABG
- Euroscore
  - Inför CABG
- STS score
  - Inför CABG

Jämförande relevanta studier

- SYNTAX
- NOBLE
- EXCEL
- FAME III


2005-2007 Inclusion period in SYNTAX
DEFINE-FLAIR, SWEDEHEART 2017 (iFR)
ART 2019 (BIMA)
FAME 2009 (FFR)
CORONARY 2016 (Off-Pump CABG)
RADIAL 2018 (Radial artery graft)
PCI
TRITON 2007 (Prasugrel)
FAME II 2012 (FFR)
DAPT 2014 (Prolonged DAPT)
ILUMIEN III: OPTIMIZE PCI 2016 (OCT)
PLATO 2009 (Ticagrelor)
CABG
IVUS-guided LM PCI 2009
Meta-analysis 2017 (No-touch technique)
SPIRIT IV 2010 (2nd generation DES)
POL-MIDES 2014 (Hybrid Revascularization)
All-cause death in SYNTAX(ES) (%)
0
5
10
15
20
25
30
35
40
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Time since randomisation (years)

Coronary artery bypass graft (CABG)



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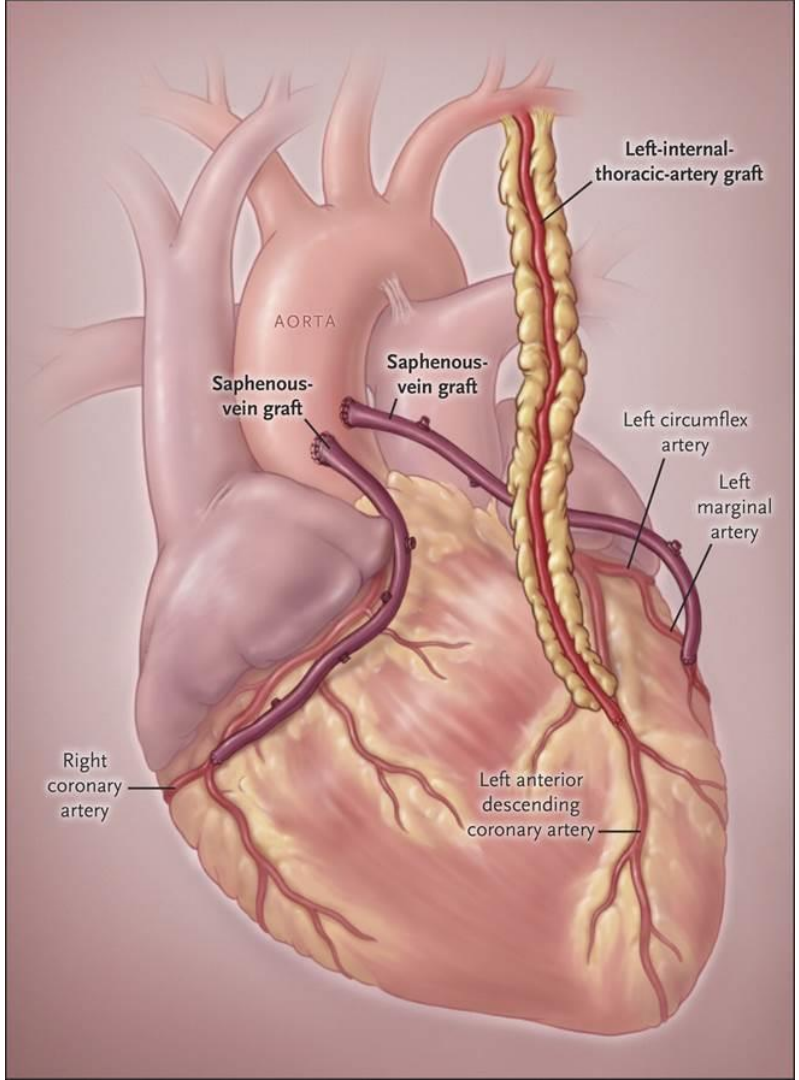

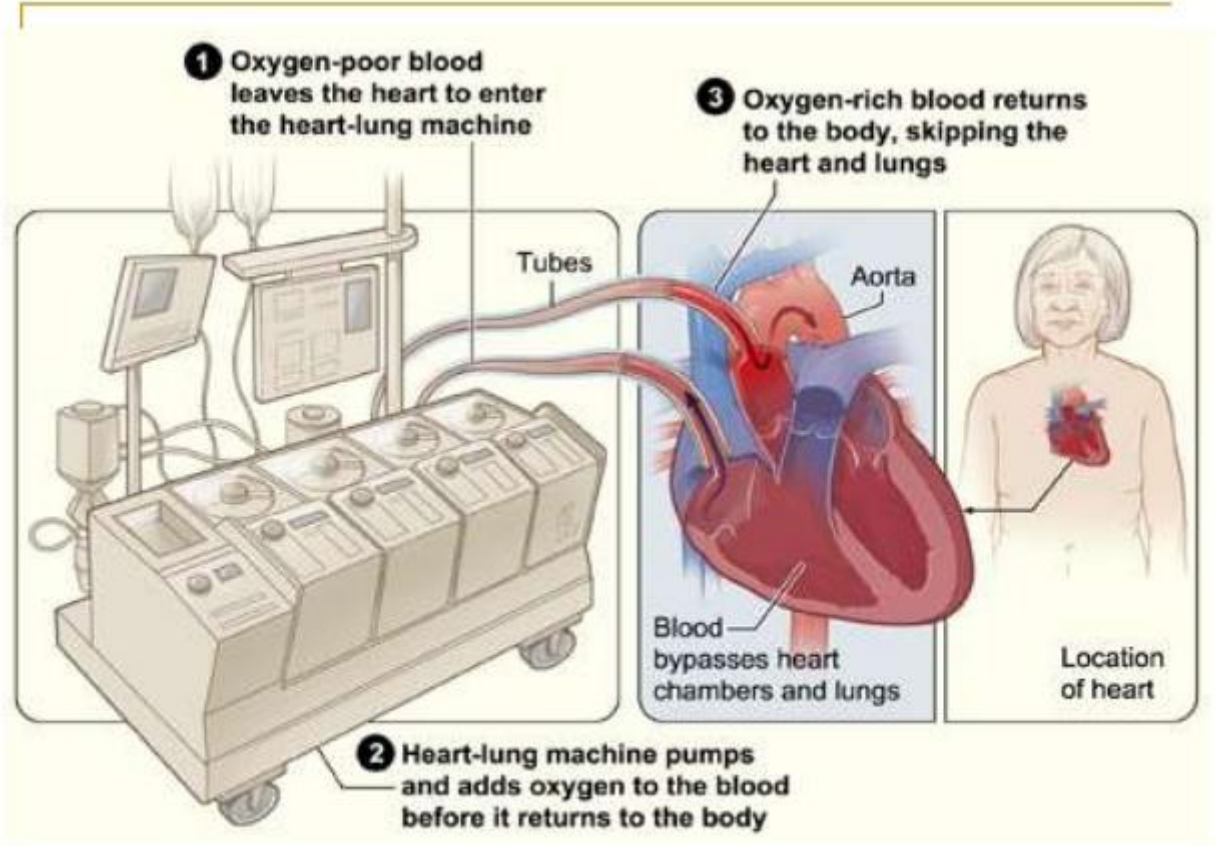

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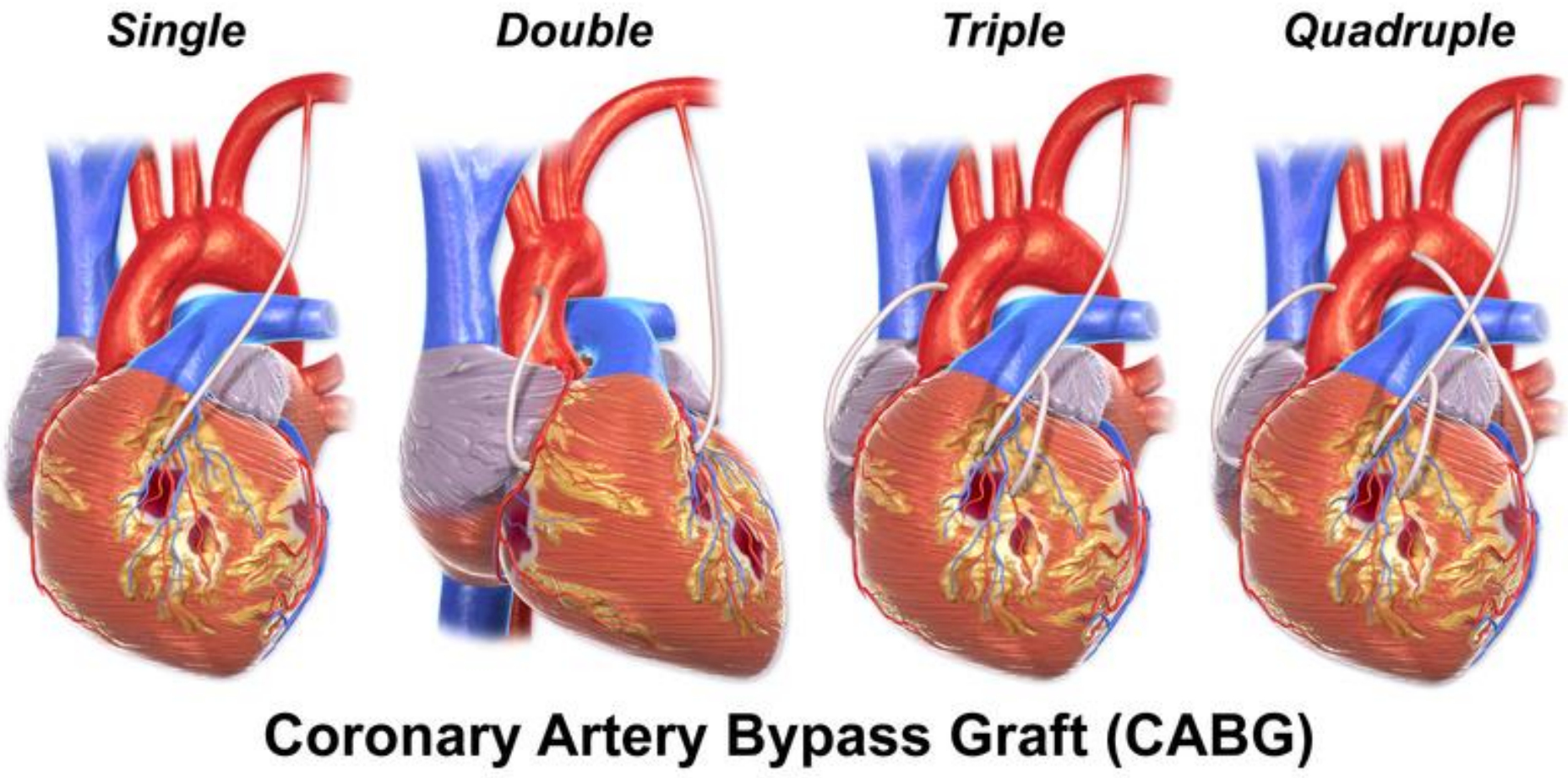

Syntax trial

Patients were treated with the intention of achieving complete revascularization of all vessels at least 1.5 mm in diameter with stenosis of 50% or more, as identified by the local interventional cardiologist and cardiac surgeon.

A higher proportion of patients had complete revascularization after CABG than after PCI (63.2% vs. 56.7%, P=0.005).

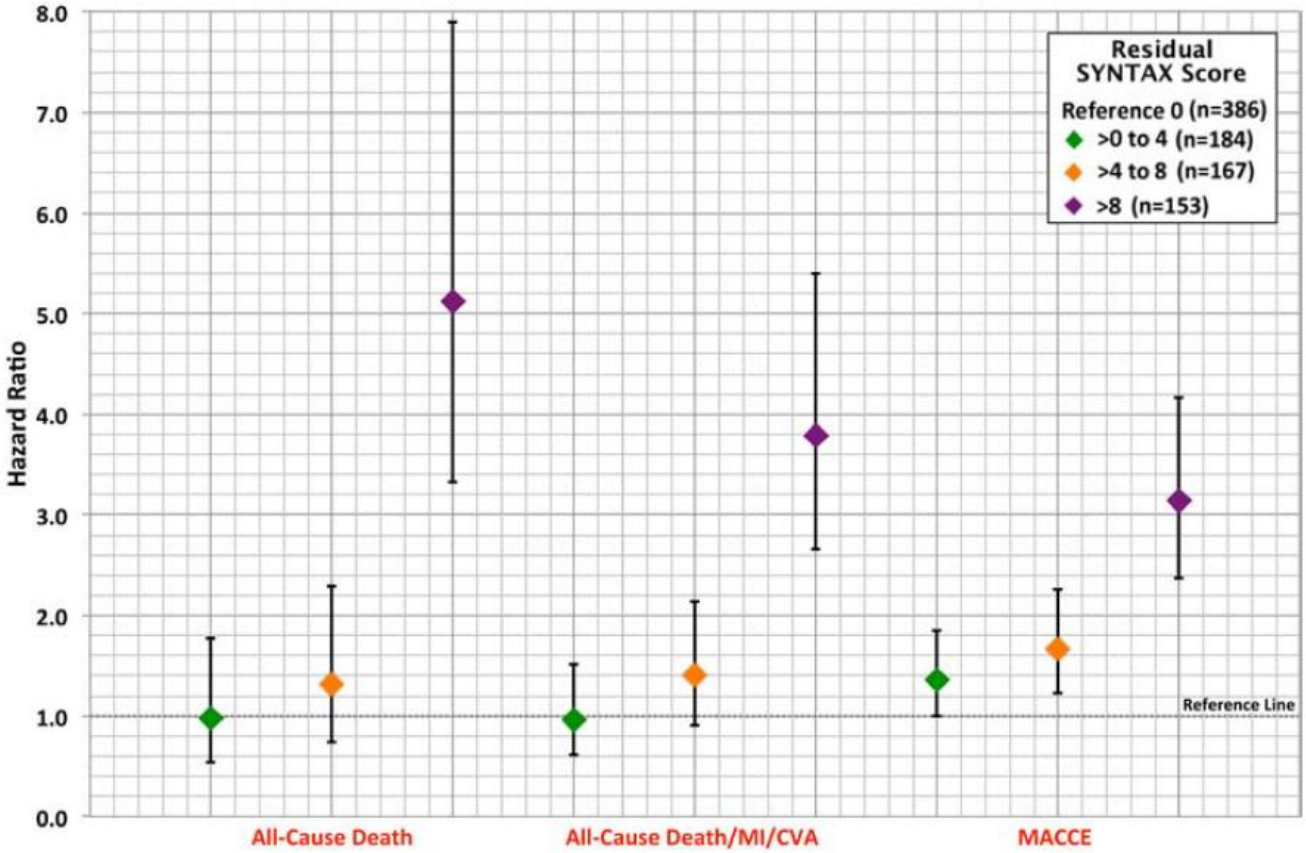

Figure 3. Five-year clinical outcomes stratified by tertiles of the residual Synergy Between Percutaneous Coronary Intervention With Taxus and Cardiac Surgery (SYNTAX) Score (incomplete revascularization, >0). Hazard ratios (HR) are relative to complete revascularization (Reference Line, residual SYNTAX Score 0). HR for tertiles of the residual SYNTAX Score (>0) are shown. The error bars represent 95% confidence intervals. A residual SYNTAX Score 10.0 was associated with a doubling of 5-year all-cause death. A residual SYNTAX Score of 10.7 and 11.3 respectively lead to a doubling of 5 year all-cause death/MI/CVA and 5 year MACCE. CVA indicates cerebrovascular accident; MACCE, major adverse cardiac and cerebrovascular events; and MI, myocardial infarction.

Farooq et al. (*Circulation*. 2013;128:141-151.)

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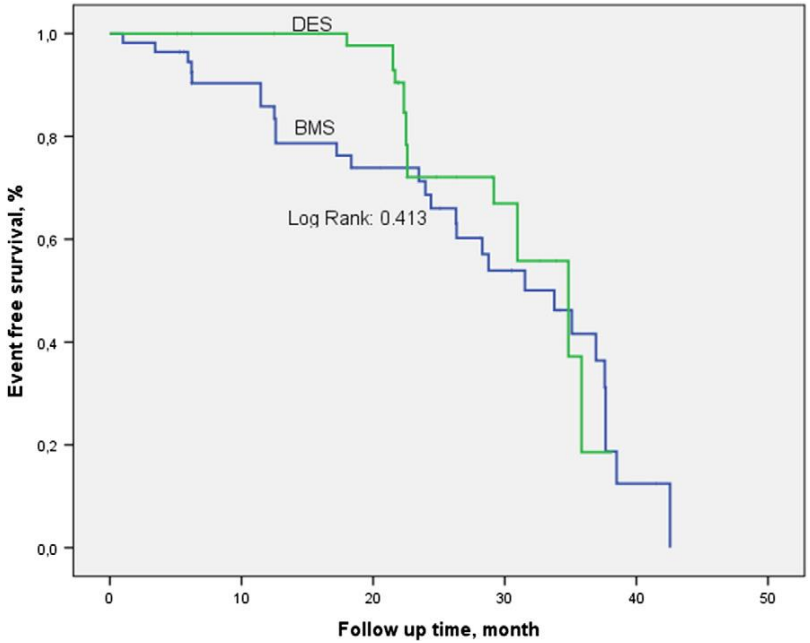
PCI mot vengraft



Clinical outcomes at long term follow-up.

Parameters	BMS group (n: 56)	DES group (n: 51)	p
One year outcomes			
Composite MACE, n (%)	20 (35.7)	8 (15.7)	0.02
TVR, n (%)	19 (33.9)	6 (11.8)	0.01
Myocardial infarction, n (%)	5 (9.1)	4 (8)	1.00
Mortality, n (%)	2 (3.6)	1 (2)	1.00
Total follow up time outcomes			
Composite MACE, n (%)	30 (53.6)	18 (35.3)	0.08
TVR, n (%)	22 (39.3)	14 (27.5)	0.223
Myocardial infarction, n (%)	9 (16.1)	7 (813.7)	0.791
Mortality, n (%)	3 (5.4)	2 (3.9)	1.00

MACE: major adverse cardiac event, TVR: target vessel revascularization; BMS, bare metal stent; DES, drug eluting stent.

International Journal of the Cardiovascular Academy 1 (2015) 37–40

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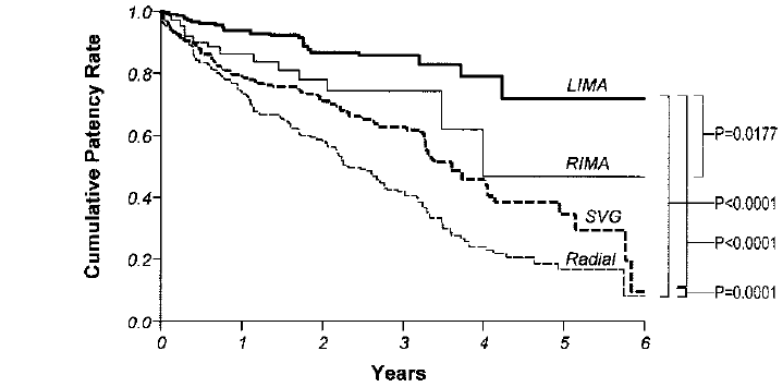
En annan studie!

Ej refererad till!



Numbers at Risk:							
LIMA	265	146	89	38	17	3	0
RIMA	75	37	22	10	4	0	0
SVG	267	157	114	63	27	7	0
Radial	392	220	136	64	24	8	0

Figure 2. Kaplan-Meier curves of cumulative patency rates according to type of bypass graft. Radial artery grafts were associated with worst patency rate of all graft types. 4 LIMA, 2 RIMA, 5 SVG, and 6 radial grafts were not included in this curve because time since CABG could not be determined reliably.

Khot UN et al. Circulation 2004; 109:2086-2091

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CABG Sverige 2001-2015

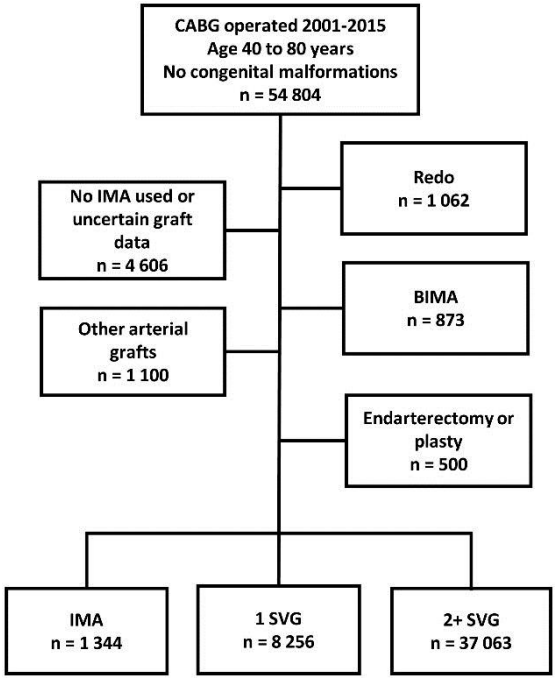

Table 3. Summary of data for first postoperative angiographies.

	IMA	1 SVG	2+ SVG
Total number	370	1649	6621
Indications			
STEMI	5.9%	5.8%	5.6%
NSTEMI or unstable angina	39.7%	42.5%	43.9%
Stable angina	45.9%	42.6%	40.5%
Other	8.4%	9.0%	10.0%
CAD symptoms			
Graft failure	21.4%	41.6%	61.1%
No data	8.6%	6.3%	4.8%
Other indications			
Graft failure	0.0%	18.8%	32.5%
No data	41.9%	12.1%	9.7%

Janiec et al. Scandinavian Cardiovascular Journal 2018

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