HYPERTENSION

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ESH and ESC Guidelines

2013 ESH/ESC Guidelines for the management of arterial hypertension

The Task Force for the management of arterial hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC)

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European Heart Journal 2013

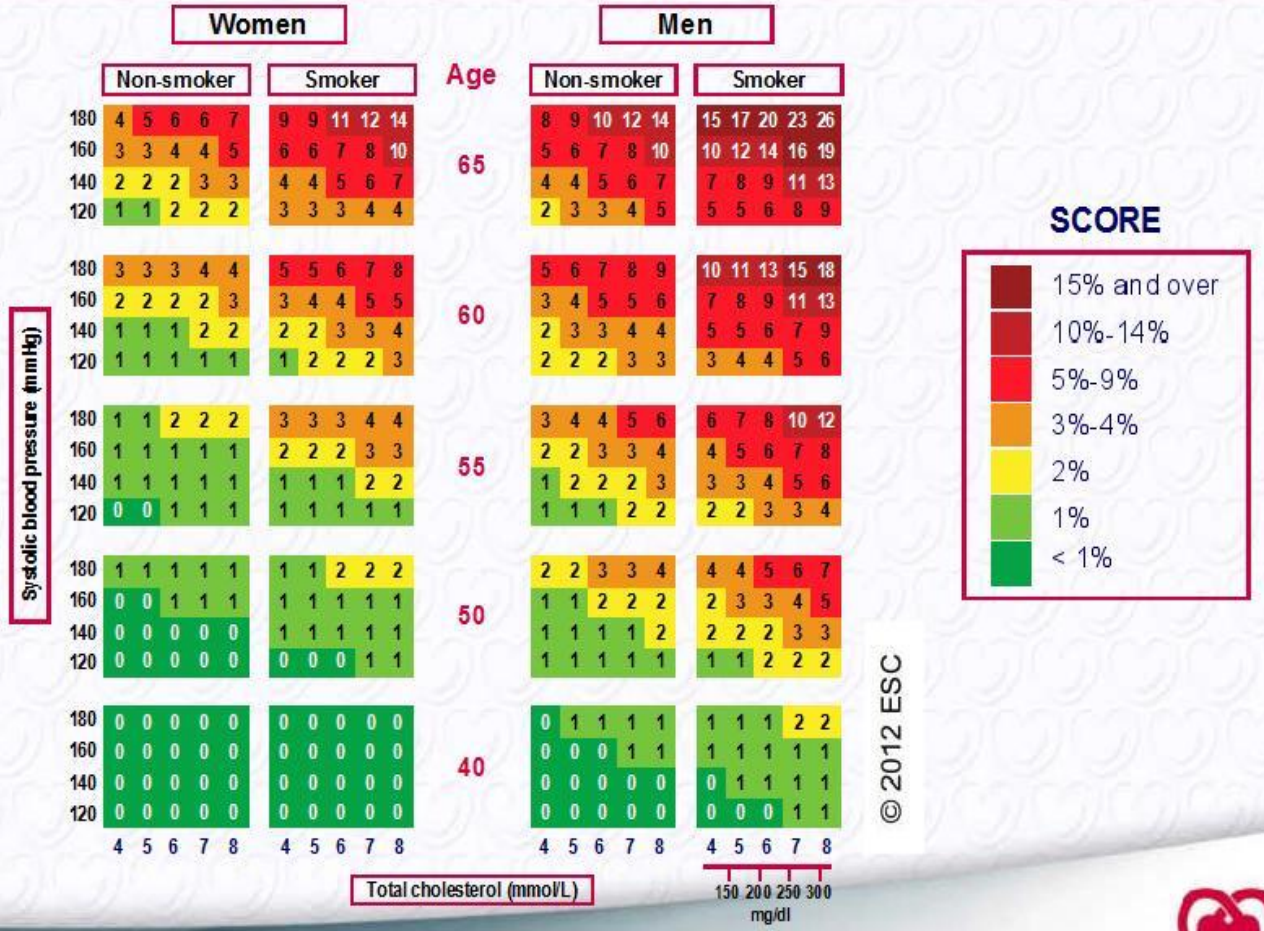
Journal of Hypertension 2013

Blood Pressure 2013

This calls for earlier intervention in the natural history of hypertension, before organ damage develops or when early damage can still be prevented.

The earlier the better

10 year risk of fatal CVD in low risk regions of Europe



European Heart Journal 2012:33;1635–1701
European Journal of Preventive Cardiology 2012;19: 4:585-667

www.escardio.org/guidelines

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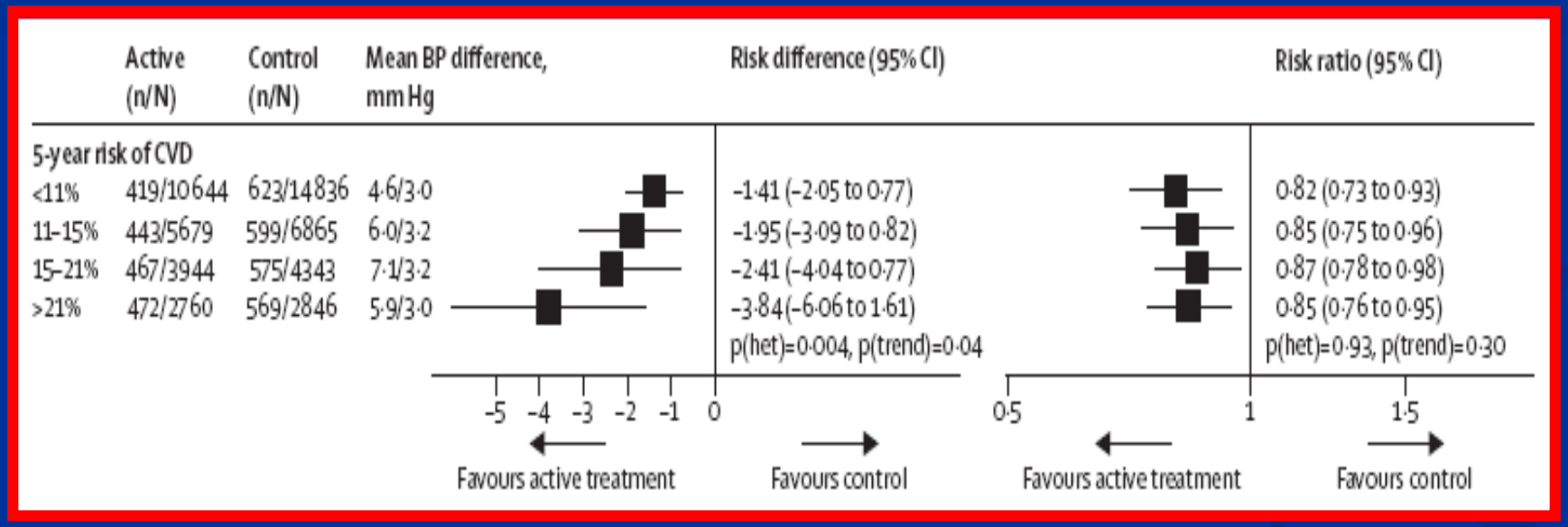
Initiation Of Lifestyle Changes And Antihypertensive Drug Treatment

Other risk factors, asymptomatic organ damage or disease	Blood Pressure (mmHg)			
	High normal SBP 130–139 or DBP 85–89	Grade 1 HT SBP 140–159 or DBP 90–99	Grade 2 HT SBP 160–179 or DBP 100–109	Grade 3 HT SBP ≥180 or DBP ≥110
No other RF	• No BP intervention	• Lifestyle changes for several months • Then add BP drugs targeting <140/90	• Lifestyle changes for several weeks • Then add BP drugs targeting <140/90	• Lifestyle changes • Immediate BP drugs targeting <140/90
1–2 RF	• Lifestyle changes • No BP intervention	• Lifestyle changes for several weeks • Then add BP drugs targeting <140/90	• Lifestyle changes for several weeks • Then add BP drugs targeting <140/90	• Lifestyle changes • Immediate BP drugs targeting <140/90
≥3 RF	• Lifestyle changes • No BP intervention	• Lifestyle changes for several weeks • Then add BP drugs targeting <140/90	• Lifestyle changes • BP drugs targeting <140/90	• Lifestyle changes • Immediate BP drugs targeting <140/90
OD, CKD stage 3 or diabetes	• Lifestyle changes • No BP intervention	• Lifestyle changes • BP drugs targeting <140/90	• Lifestyle changes • BP drugs targeting <140/90	• Lifestyle changes • Immediate BP drugs targeting <140/90
Symptomatic CVD, CKD stage ≥4 or diabetes with OD/RFs	• Lifestyle changes • No BP intervention	• Lifestyle changes • BP drugs targeting <140/90	• Lifestyle changes • BP drugs targeting <140/90	• Lifestyle changes • Immediate BP drugs targeting <140/90

Initiation Of Drug Treatment In Hypertension

Grade 2-3	Recommended (Promptly)	IA
Grade 1 / High CV risk	Recommended	IB
Grade 1 / Low CV risk	Should be considered	IIaB
Elderly	Recommended if SBP ≥ 160 mmHg (also > 80 ys of age)	IA
	May be considered if SBP 140-159 mmHg	IIbC
High normal BP	No drug treatment recommended	IIIA

Blood pressure lowering treatment based on CV risk: a meta analysis



LANCET 2014;384:591-98. Blood pressure trialist collaboration

Blood pressure lowering treatment based on CV risk: a meta analysis

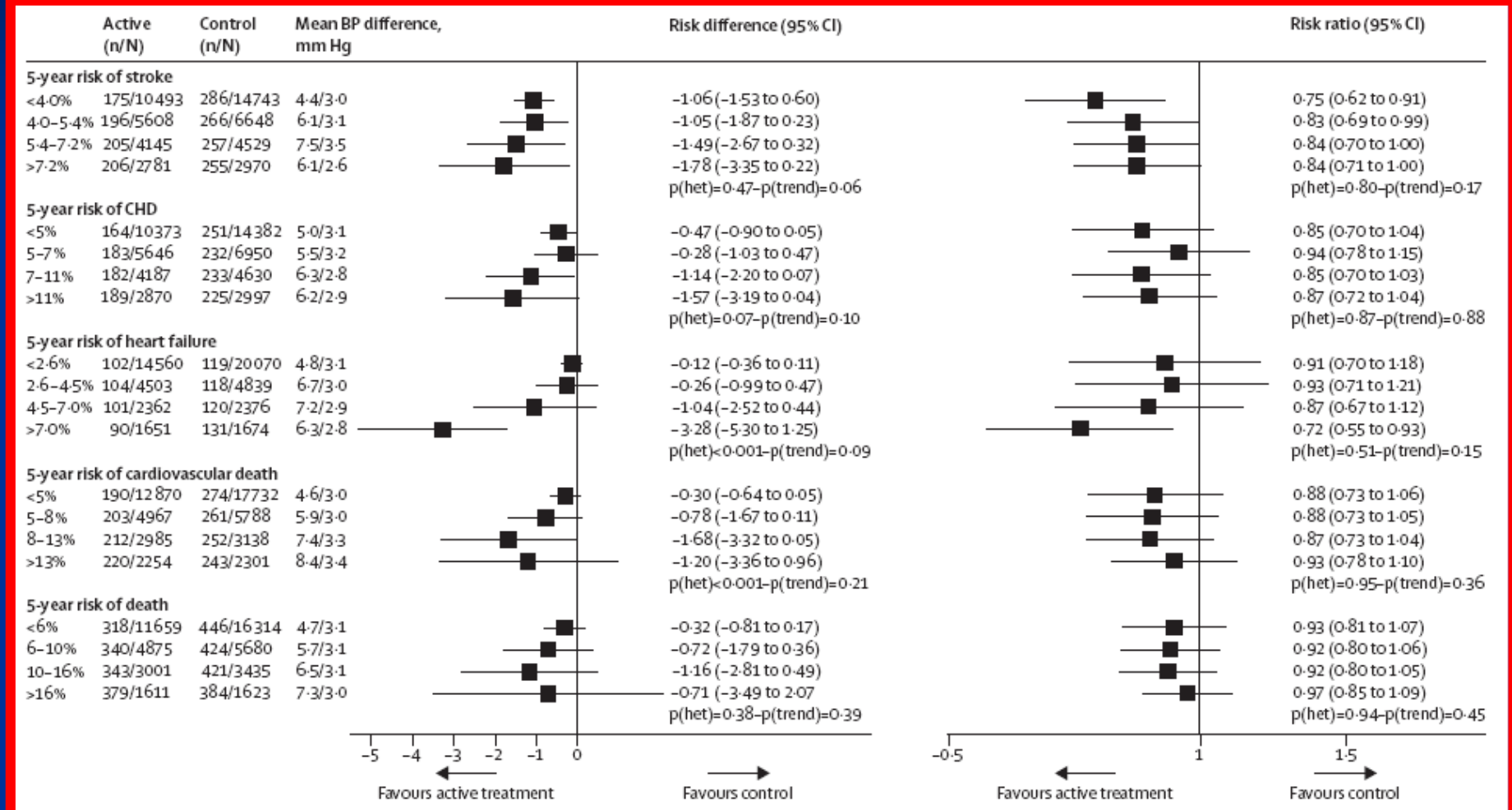
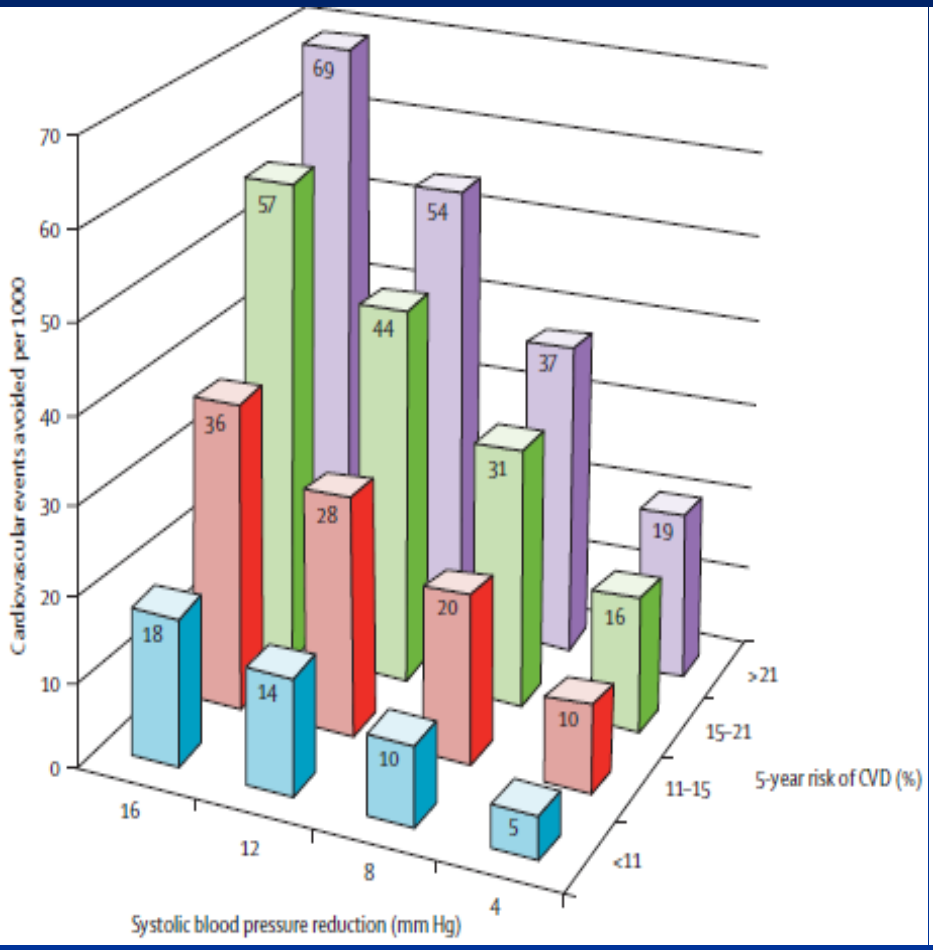
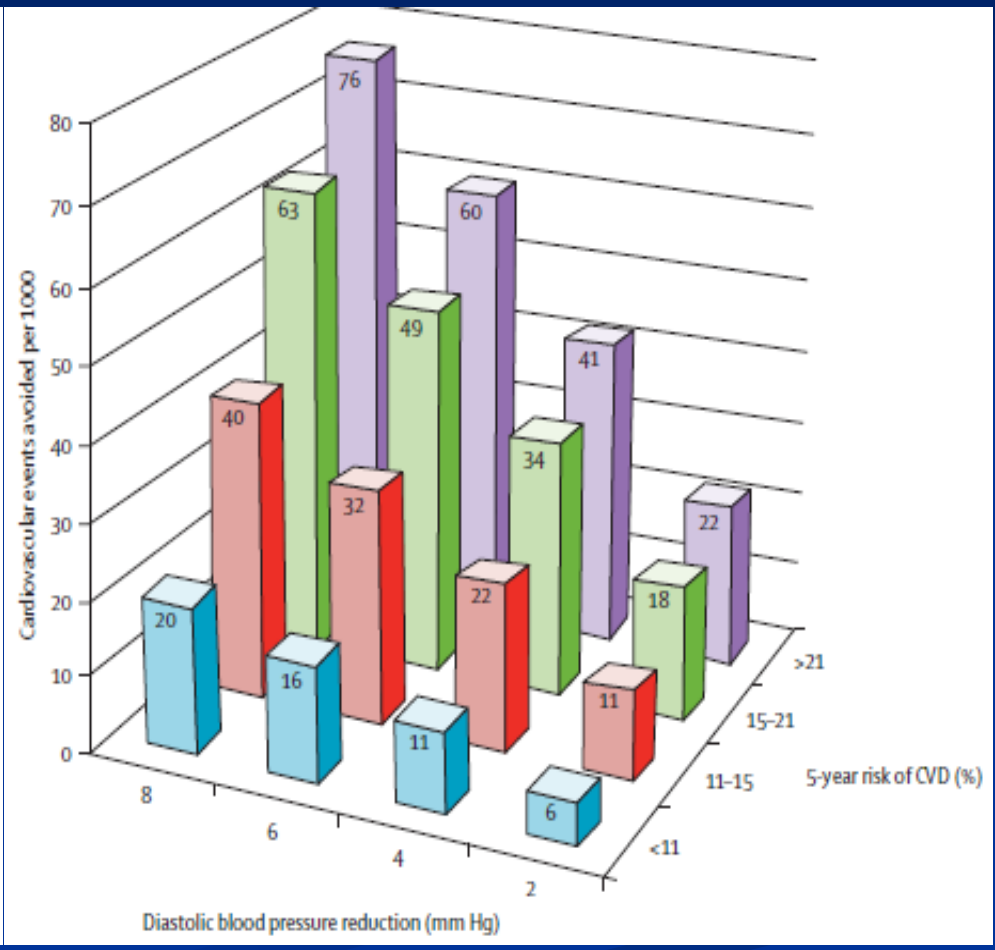


Figure 3: Effects of blood pressure reduction on absolute and proportional risks of coronary heart disease, stroke, heart failure, cardiovascular mortality, and all-cause mortality for patient groups defined by different baseline levels of risk of those outcomes

LANCET 2014;384:591-98. Blood pressure trialist collaboration

Blood pressure lowering treatment based on CV risk: a meta analysis

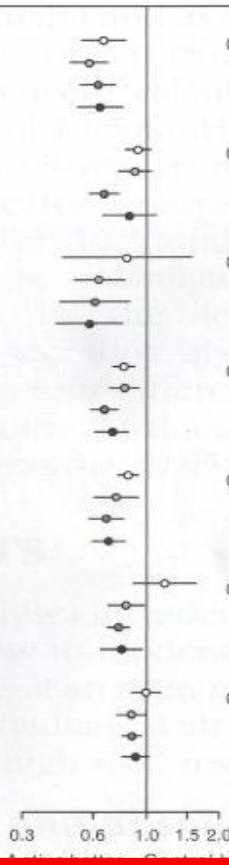




LANCET 2014;384:591-98. Blood pressure trialist collaboration

Effects of blood pressure lowering on outcome incidence in hypertension: Effects in patients at different level of CV risk- meta analysis

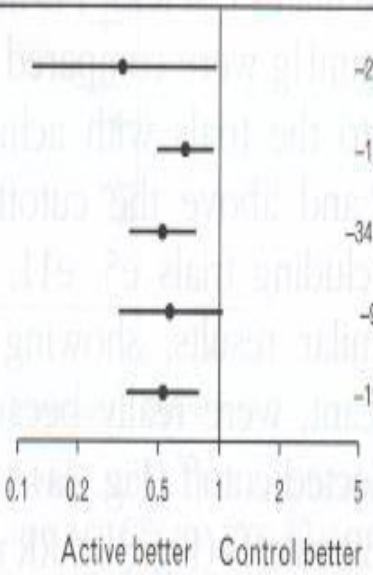
Outcome	CV risk	Trials (*n*)	Outcome risk (% in 5 y)	Difference SBP/DBP (mmHg)	Events (*n*/patients) Treated	Events (*n*/patients) Controls	Standardized RR (95% CI)	Standardized RR (95% CI)	*P*-value for trend	Absolute risk reduction 1000 pts/5 years (95% CI)	NNT 5 years (95% CI)
Stroke	Low-moderate	17	1.6	–6.3/–3.8	382/34666	599/40495	0.67 (0.53–0.83)		0.91	–5 (–7, –3)	185 (134, 363)
	High	8	4.6	–7.0/–3.6	591/22038	839/22105	0.59 (0.49–0.70)			–18 (–22, –13)	55 (45, 75)
	Very high	16	9.1	–6.2/–3.0	2429/45153	2917/44283	0.63 (0.52–0.75)			–31 (–39, –22)	32 (25, 46)
	Very very high	14	10.3	–8.5/–4.4	813/13833	943/12812	0.64 (0.51–0.80)			–34 (–45, –20)	29 (22, 51)
CHD	Low-moderate	19	1.7	–6.3/–3.9	607/35678	698/41066	0.90 (0.80–1.04)		0.49	–1 (–3, +1)	780 (289, –1440)
	High	8	6.4	–6.9/–3.5	1183/21387	1263/21266	0.88 (0.76–1.04)			–7 (–14, +1)	135 (68, –815)
	Very high	17	5.7	–6.1/–2.8	1749/45390	2070/44516	0.67 (0.57–0.78)			–18 (–23, –12)	55 (43, 81)
	Very very high	15	4.6	–8.5/–4.4	475/13891	467/12870	0.85 (0.65–1.11)			–6 (–16, +5)	166 (64, –194)
HF	Low-moderate	10	0.9	–5.5/–3.2	143/14214	149/13547	0.82 (0.44–1.57)		0.83	–1 (–5, +5)	806 (186, –203)
	High	4	3.0	–5.6/–2.8	333/15186	427/15213	0.63 (0.49–0.82)			–11 (–15, –5)	92 (67, 187)
	Very high	11	5.3	–5.8/–2.5	1093/33019	1307/32199	0.60 (0.43–0.86)			–20 (–29, –10)	50 (37, 107)
	Very very high	11	14.0	–7.9/–4.0	1097/12554	1238/11989	0.57 (0.41–0.82)			–54 (–74, –34)	18 (14, 25)
Stroke + CHD	Low-moderate	19	3.3	–6.2/–3.8	1001/35609	1297/40706	0.81 (0.73–0.91)		0.70	–6 (–9, –3)	167 (112, 334)
	High	7	10.7	–6.9/–3.6	1732/20998	1988/21065	0.81 (0.71–0.94)			–18 (–30, –6)	56 (33, 157)
	Very high	16	14.7	–6.2/–3.0	4172/45153	4973/44283	0.67 (0.59–0.76)			–46 (–56, –34)	22 (18, 29)
	Very very high	15	14.9	–8.5/–4.3	1288/13891	1410/12870	0.71 (0.60–0.84)			–41 (–55, –25)	24 (18, 41)
Stroke + CHD + HF	Low-moderate	10	4.1	–8.1/–4.3	847/22356	957/21648	0.84 (0.76–0.93)		0.76	–7 (–10, –3)	152 (101, 362)
	High	4	13.2	–5.6/–2.8	1539/15186	1773/15213	0.75 (0.61–0.93)			–30 (–50, –9)	33 (20, 108)
	Very high	12	19.2	–6.3/–2.8	4376/35202	5033/34412	0.69 (0.57–0.81)			–56 (–76, –35)	18 (13, 28)
	Very very high	12	30.5	–7.9/–4.0	2345/12614	2601/12049	0.69 (0.59–0.82)			–87 (–112, –62)	11 (9, 16)
CV death	Low-moderate	19	1.3	–6.2/–3.8	463/35609	508/40706	1.19 (0.86–1.65)		0.69	+3 (–2, +8)	
	High	8	3.5	–7.1/–3.6	604/21298	684/21375	0.83 (0.69–0.98)			–6 (–10, –1)	166 (98, 852)
	Very high	17	6.7	–6.3/–3.1	2022/45583	2276/44690	0.76 (0.68–0.86)			–15 (–20, –9)	64 (49, 109)
	Very very high	15	16.1	–8.5/–4.4	1488/13891	1498/12870	0.80 (0.64–0.98)			–28 (–54, –3)	32 (19, 312)
All-cause death	Low-moderate	21	3.0	–6.2/–3.8	1031/36936	1221/42633	1.00 (0.88–1.14)		0.79	0 (–4, +4)	
	High	11	6.7	–7.1/–3.7	1318/23135	1439/23027	0.87 (0.76–1.00)			–9 (–17, 0)	114 (59, ∞)
	Very high	19	12.7	–6.3/–3.1	4075/46027	4246/45125	0.88 (0.79–0.96)			–14 (–26, –5)	67 (39, 198)
	Very very high	16	24.4	–8.6/–4.4	2361/13951	2340/12930	0.88 (0.77–1.02)			–25 (–54, +4)	40 (18, –204)



Thomopoulos C, Parati G, Zanchetti A: J Hyp 2014, 32 :2305

Effects of BP lowering in trails with average baseline BP in grade 1 and average low-to-moderate CV risk

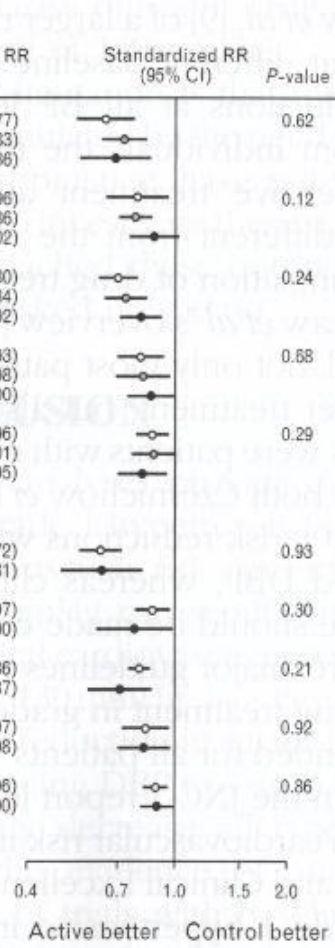
Outcome	Trials (*n*)	Baseline SBP/DBP (mmHg)	Difference SBP/DBP (mmHg)	Events (*n*/patients) Treated	Events (*n*/patients) Controls	RR (95% CI)	Standardized RR (95% CI)	Absolute risk reduction 1000 pts/5 years (95%CI)	NNT 5 years (95% CI)
Stroke	4	146/91	−7.1/−4.5	71/4061	110/4012	0.58 (0.34–0.99)	0.33 (0.11–0.98)	−21 (−26, −1)	47 (39, 1301)
CHD	5	145/91	−6.5/−4.2	114/4729	129/4246	0.75 (0.58–0.96)	0.68 (0.48–0.95)	−12 (−18, −2)	86 (55, 531)
Stroke + CHD	4	146/91	−7.1/−4.5	159/4061	227/4012	0.69 (0.57–0.85)	0.51 (0.36–0.75)	−34 (−43, −19)	29 (23, 54)
CV death	4	146/91	−7.1/−4.5	53/4061	74/4012	0.71 (0.50–1.01)	0.57 (0.32–1.02)	−9 (−14, +1)	110 (72, −2223)
All-cause death	4	146/91	−7.1/−4.5	90/4061	133/4012	0.67 (0.51–0.87)	0.53 (0.35–0.80)	−19 (−25, −8)	54 (40, 119)



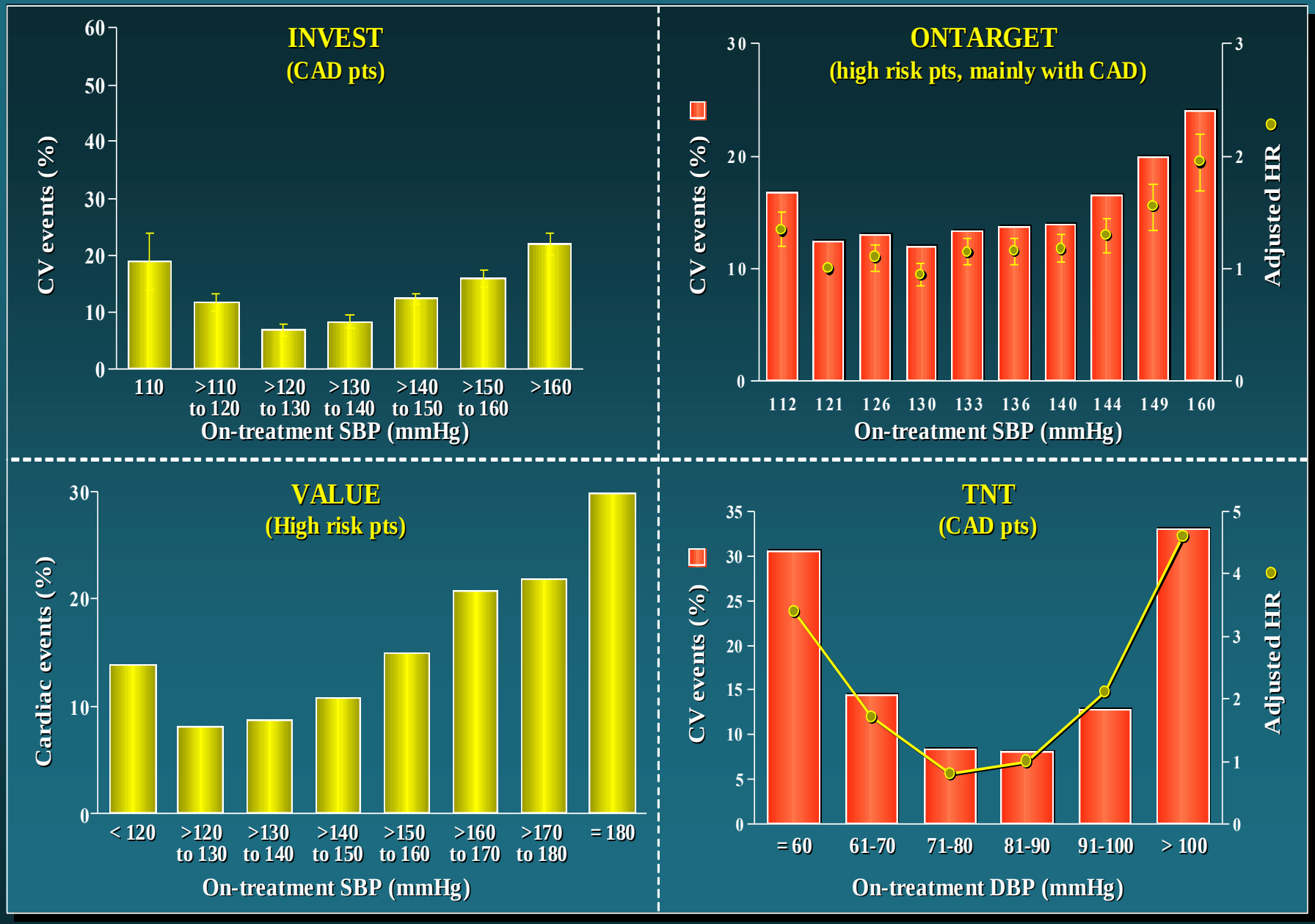
Zanchetti A: J Hyp 2014, 32 :2296-2304

Effects at different baseline and achieved blood pressure levels- overview and meta analysis of randomized trails

	Outcome	BP cut-off	Trials (*n*)	Difference SBP/DBP (mmHg)	Events (*n*/patients) Treated	Events (*n*/patients) Controls	RR (95% CI)	Standardized RR (95% CI)	*P*-value	Absolute risk reduction 1000 pts/5 years (95%CI)	NNT 5 years (95% CI)	*P*-value
(a) SBP	Stroke	140–149 vs 150–159	5	−12.6/−5.0	204/6562	272/5844	0.64 (0.53–0.76)	0.65 (0.54–0.77)	0.62	−19 (−24, −12)	52 (40, 78)	<0.001
		130–139 vs 140–149	13	−7.0/−3.7	1030/36655	1462/43081	0.75 (0.65–0.85)	0.73 (0.63–0.83)		−11 (−15, −7)	90 (67, 142)	
		120–129 vs 130–139	4	−6.3/−3.3	259/12185	340/12219	0.77 (0.66–0.90)	0.69 (0.55–0.86)		−9 (−14, −4)	106 (74, 231)	
	CHD	140–149 vs 150–159	5	−12.6/−5.0	194/6562	173/5844	0.78 (0.64–0.96)	0.79 (0.65–0.96)	0.12	−6 (−10, −1)	169 (100, 889)	0.37
		130–139 vs 140–149	14	−7.0/−3.7	1089/37213	1395/43634	0.82 (0.76–0.89)	0.77 (0.70–0.86)		−8 (−11, −5)	122 (94, 198)	
		120–129 vs 130–139	5	−6.3/−3.5	684/12853	727/12453	0.92 (0.83–1.01)	0.88 (0.75–1.02)		−7 (−15, +1)	136 (67, −827)	
	Stroke + CHD	140–149 vs 150–159	5	−12.6/−5.0	398/6562	445/5844	0.70 (0.61–0.79)	0.71 (0.62–0.80)	0.24	−24 (−31, −16)	42 (32, 61)	0.26
		130–139 vs 140–149	14	−7.0/−3.7	2153/37559	2866/43381	0.79 (0.72–0.86)	0.73 (0.64–0.84)		−21 (−28, −13)	47 (36, 76)	
		120–129 vs 130–139	4	−6.3/−3.3	917/12185	1055/12219	0.87 (0.80–0.95)	0.81 (0.71–0.92)		−17 (−26, −7)	59 (39, 140)	
	CV death	140–149 vs 150–159	5	−12.6/−5.0	291/6562	299/5844	0.79 (0.68–0.93)	0.80 (0.70–0.93)	0.68	−13 (−19, −5)	77 (52, 215)	0.097
		130–139 vs 140–149	14	−7.0/−3.7	919/37559	1153/43381	0.87 (0.77–0.99)	0.82 (0.69–0.98)		−6 (−9, −1)	176 (103, 1040)	
		120–129 vs 130–139	5	−9.3/−4.5	325/12615	377/12626	0.86 (0.74–1.00)	0.86 (0.74–1.00)		−5 (−9, 0)	216 (117, ∞)	
	All-cause death	140–149 vs 150–159	5	−12.6/−5.0	583/6562	570/5844	0.86 (0.77–0.96)	0.87 (0.78–0.96)	0.29	−16 (−27, −5)	61 (37, 195)	0.22
		130–139 vs 140–149	14	−7.0/−3.7	1699/37213	2051/43634	0.92 (0.83–1.01)	0.89 (0.76–1.01)		−6 (−13, −1)	164 (76, −1785)	
		120–129 vs 130–139	5	−6.4/−3.4	682/12615	773/12626	0.88 (0.80–0.97)	0.81 (0.70–0.95)		−12 (−19, −3)	83 (53, 315)	
(b) DBP	Stroke	85–89 vs 90–94	5	−11.0/−6.0	235/17362	405/17279	0.58 (0.50–0.68)	0.62 (0.55–0.72)	0.93	−9 (−11, −7)	110 (93, 149)	<0.001
		75–79 vs 80–84	8	−5.6/−2.8	1526/28405	1781/27799	0.78 (0.68–0.89)	0.63 (0.49–0.81)		−32 (−42, −17)	31 (24, 57)	
	CHD	85–89 vs 90–94	4	−11.2/−6.0	698/16322	831/16239	0.85 (0.75–0.97)	0.87 (0.78–0.97)	0.30	−7 (−11, −2)	151 (89, 654)	0.99
		75–79 vs 80–84	10	−5.4/−2.4	650/29631	662/28586	0.90 (0.81–1.00)	0.78 (0.61–1.00)		−7 (−11, 0)	149 (87, ∞)	
	Stroke + CHD	85–89 vs 90–94	4	−11.2/−6.0	896/16322	1157/16239	0.77 (0.71–0.84)	0.80 (0.75–0.86)	0.21	−14 (−18, −10)	69 (55, 99)	0.014
		75–79 vs 80–84	8	−5.6/−2.8	2146/28405	2435/27799	0.82 (0.73–0.92)	0.71 (0.58–0.87)		−38 (−52, −18)	26 (19, 55)	
	CV death	85–89 vs 90–94	4	−11.2/−6.0	404/16322	490/16239	0.81 (0.69–0.96)	0.83 (0.72–0.97)	0.92	−5 (−8, −1)	196 (119, 1111)	0.45
		75–79 vs 80–84	9	−5.6/−2.9	945/28835	992/28206	0.91 (0.83–0.99)	0.84 (0.70–0.98)		−8 (−15, −1)	123 (68, 948)	
	All-cause death	85–89 vs 90–94	5	−11.0/−6.0	805/17362	919/17279	0.88 (0.80–0.96)	0.89 (0.82–0.96)	0.86	−6 (−10, −2)	171 (105, 472)	0.25
		75–79 vs 80–84	11	−5.5/−2.9	2162/29600	2183/28961	0.95 (0.90–1.00)	0.90 (0.81–1.00)		−11 (−21, 0)	88 (48, ∞)	

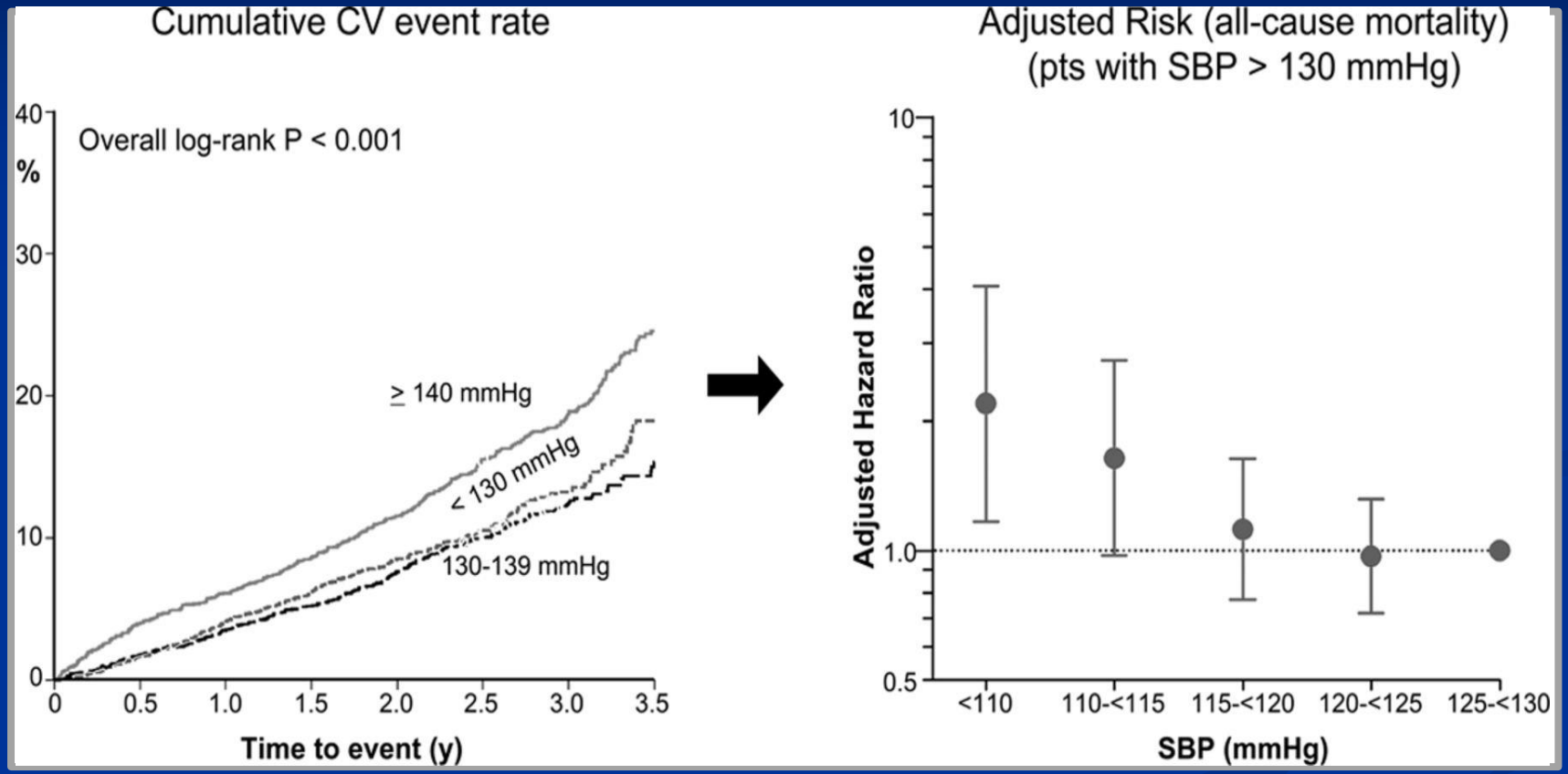


Zanchetti A: J Hyp 2014, 32 :2296-2304


INVEST
(CAD pts)
CV events (%)
60
50
40
30
20
10
0
110
>110 to 120
>120 to 130
>130 to 140
>140 to 150
>150 to 160
>160
On-treatment SBP (mmHg)
ONTARGET
(high risk pts, mainly with CAD)
CV events (%)
Adjusted HR
30
20
10
0
3
2
1
0
112
121
126
130
133
136
140
144
149
160
On-treatment SBP (mmHg)
VALUE
(High risk pts)
Cardiac events (%)
30
20
10
0
< 120
>120 to 130
>130 to 140
>140 to 150
>150 to 160
>160 to 170
>170 to 180
= 180
On-treatment SBP (mmHg)
TNT
(CAD pts)
CV events (%)
Adjusted HR
35
30
25
20
15
10
5
0
5
4
3
2
1
0
= 60
61-70
71-80
81-90
91-100
> 100
On-treatment DBP (mmHg)

14276 M

The cumulative event incidence of primary outcome (nonfatal myocardial infarction, nonfatal stroke, and all-cause mortality in 6400 patients with diabetes mellitus of the INVEST trial in whom systolic blood pressure (SBP) remained ≥140 mm Hg or was reduced to between 130 and 139 mm Hg and <130 mm Hg (left).

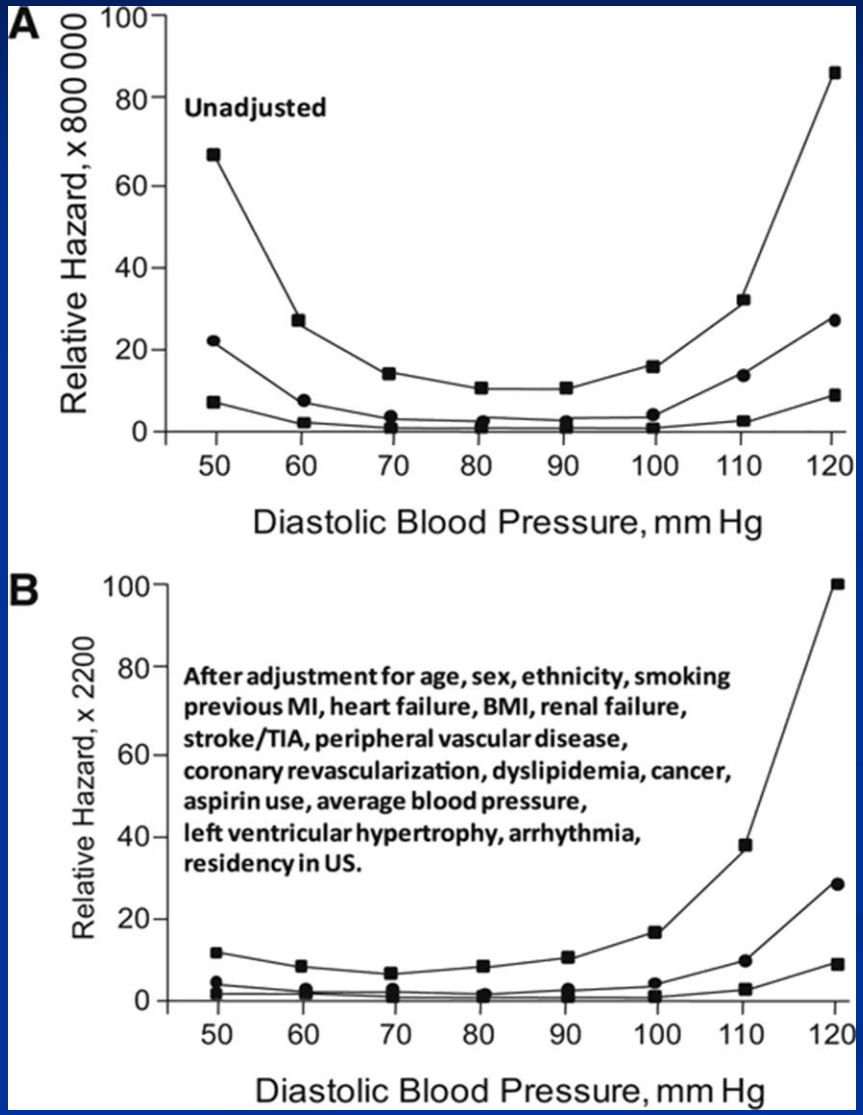


Mancia G , and Grassi G Hypertension. 2014;63:29-36

Patients with achieved diastolic pressure ≤ 60mmHg vs 81-90mmHg

- ≈ 10 years older
- Higher rate of previous MI (47% vs 29%)
- Higher rate of previous stroke (12% vs 6%)
- Higher rate of heart failure (22% vs 4%)
- Higher rate of diabetes (44% vs 26%)
- Higher rate of cancer (11% vs 2%)

Unadjusted (A) and adjusted (B) relation between achieved (average in-treatment) diastolic blood pressure and risk of primary outcome in hypertensive patients with coronary artery disease enrolled in the International Verapamil-Trandolapril Study.



American Heart Association.

Verdecchia P et al. Hypertension. 2014;63:37-40

Canadian Hypertension Education Program 2014

- New Recommendation:

‘When decreasing SBP to target levels in patients with established CHD (especially if systolic hypertension is present) be cautious when the DBP is ≤ 60mmHg because of concerns that myocardial ischaemia might be exacerbated.

Conclusions J Curve

- There is a J-Curve at around 60 mmHg
- The data suggest excess mortality and morbidity is going to occur in frail elderly and these individuals cannot benefit from risk reduction programmes
- One should monitor diastolic pressure closely below 65mmHg

AHA/ACC/ASH Scientific Statement2015

3.3. Recommendations

1. The <140/90-mm Hg BP target is reasonable for the secondary prevention of cardiovascular events in patients with hypertension and CAD (*Class IIa; Level of Evidence B*).
2. A lower target BP (<130/80 mm Hg) may be appropriate in some individuals with CAD, previous MI, stroke or transient ischemic attack, or CAD risk equivalents (carotid artery disease, PAD, abdominal aortic aneurysm) (*Class IIb; Level of Evidence B*).
3. In patients with an elevated DBP and CAD with evidence of myocardial ischemia, the BP should be lowered slowly, and caution is advised in inducing decreases in DBP to <60 mm Hg in any patient with diabetes mellitus or who is >60 years of age. In older hypertensive individuals with wide pulse pressures, lowering SBP may cause very low DBP values (<60 mm Hg). This should alert the clinician to assess carefully any untoward signs or symptoms, especially those resulting from myocardial ischemia (*Class IIa; Level of Evidence C*).

Breaking News on Hypertension
September, 11, 2015
New York, NY

National Heart Lung and Blood Institute (NHLBI) released breakthrough findings on the National Institute of Health's (NIH)

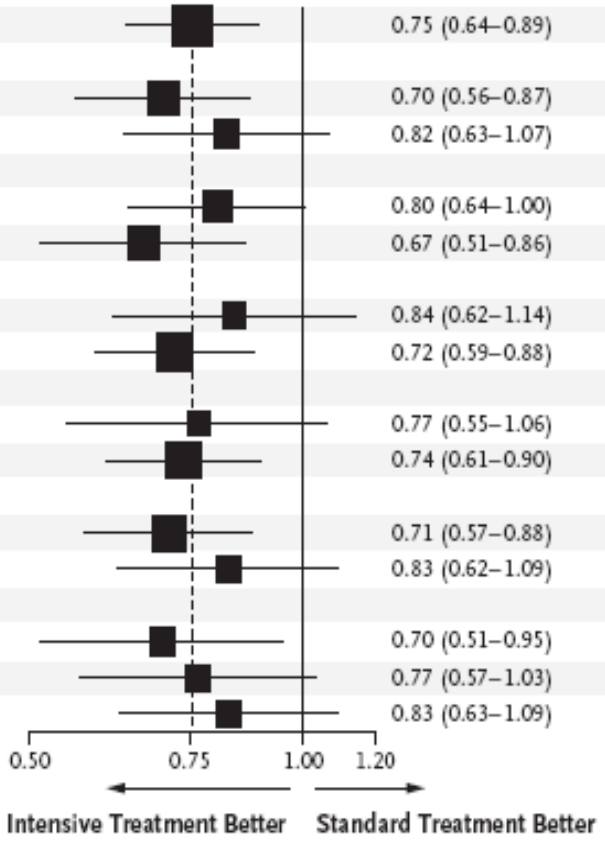
Systolic Blood Pressure Intervention Trial (SPRINT)

which demonstrates that intensive management of systolic blood pressure to less than 120 mm Hg significantly reduces the risk of cardiovascular disease and risk of death in a population of adults 50 years of age or over.

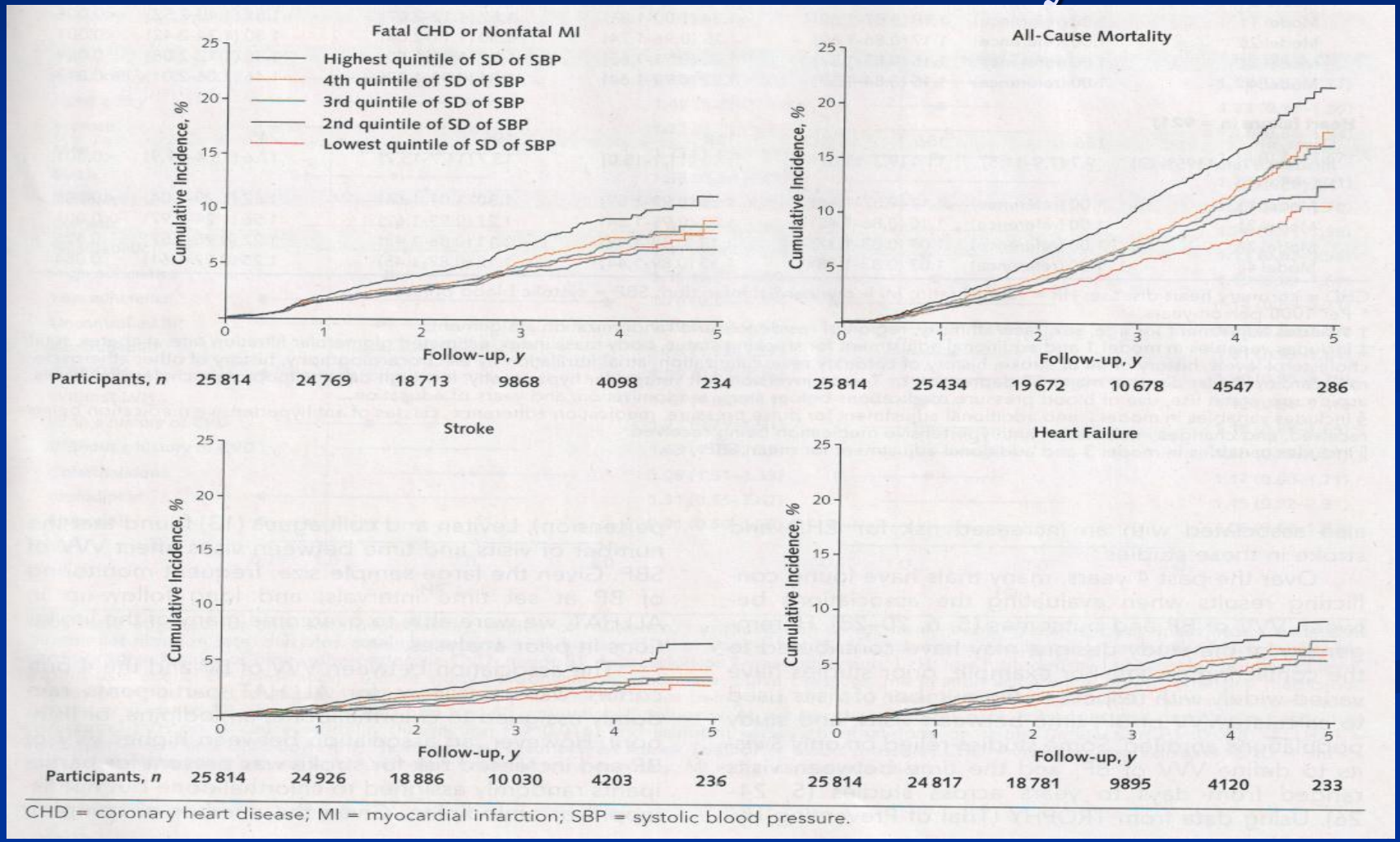
The NHLBI announced blood pressure intervention was ended early so that the results could be disseminated quickly. A paper will be published in the next few months.

A Randomized trails invasive vs standard BP control- SPIRIT Trail

Subgroup	Intensive Treatment	Standard Treatment	Hazard Ratio (95% CI)	P Value for Interaction
	no. of patients with primary outcome/total no. (%)			
Overall	243/4678 (5.2)	319/4683 (6.8)	0.75 (0.64–0.89)	
Previous CKD				0.36
No	135/3348 (4.0)	193/3367 (5.7)	0.70 (0.56–0.87)	
Yes	108/1330 (8.1)	126/1316 (9.6)	0.82 (0.63–1.07)	
Age				0.32
<75 yr	142/3361 (4.2)	175/3364 (5.2)	0.80 (0.64–1.00)	
≥75 yr	101/1317 (7.7)	144/1319 (10.9)	0.67 (0.51–0.86)	
Sex				0.45
Female	77/1684 (4.6)	89/1648 (5.4)	0.84 (0.62–1.14)	
Male	166/2994 (5.5)	230/3035 (7.6)	0.72 (0.59–0.88)	
Race				0.83
Black	62/1454 (4.3)	85/1493 (5.7)	0.77 (0.55–1.06)	
Nonblack	181/3224 (5.6)	234/3190 (7.3)	0.74 (0.61–0.90)	
Previous cardiovascular disease				0.39
No	149/3738 (4.0)	208/3746 (5.6)	0.71 (0.57–0.88)	
Yes	94/940 (10.0)	111/937 (11.8)	0.83 (0.62–1.09)	
Systolic blood pressure				0.77
≤132 mm Hg	71/1583 (4.5)	98/1553 (6.3)	0.70 (0.51–0.95)	
>132 to <145 mm Hg	77/1489 (5.2)	106/1549 (6.8)	0.77 (0.57–1.03)	
≥145 mm Hg	95/1606 (5.9)	115/1581 (7.3)	0.83 (0.63–1.09)	



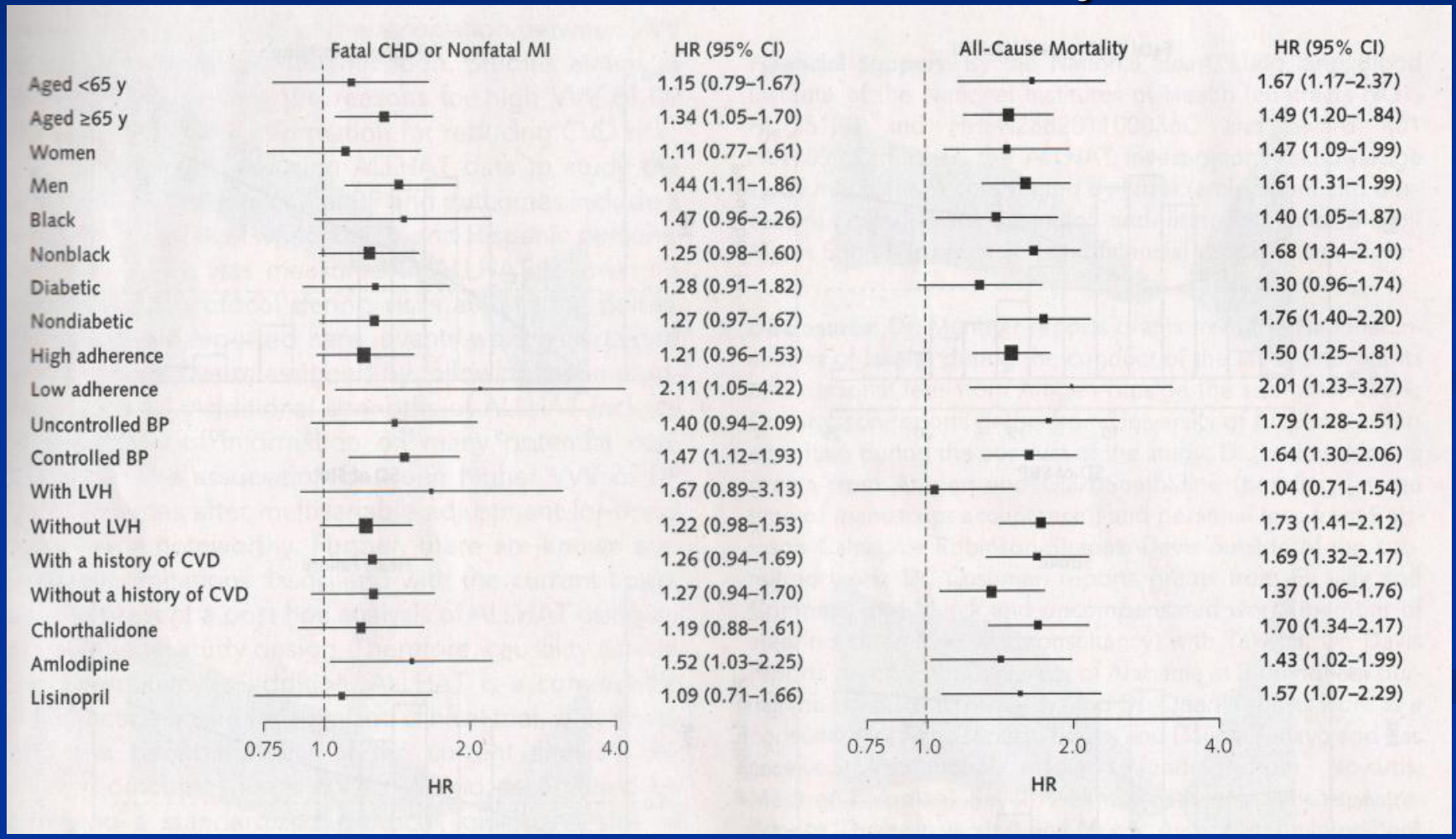
Visit-to-Visit Variability of BP and CHD, Stroke, HF and Mortality-A cohort Study ALLHAT Post hoc Analysis



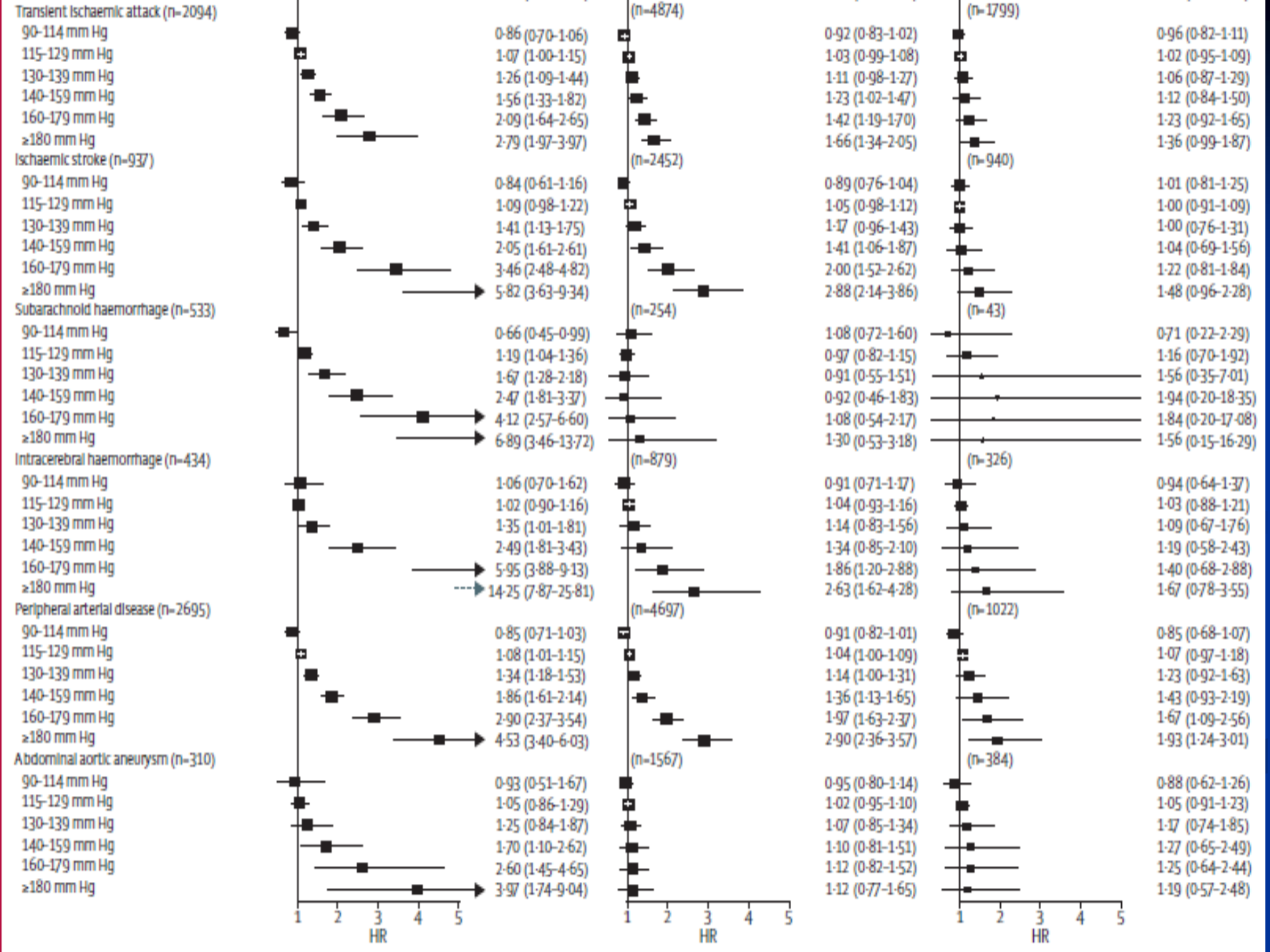
CHD = coronary heart disease; MI = myocardial infarction; SBP = systolic blood pressure.

Muntner P et all. Annals of internal Medicine 2015; 163: 329

Visit-to-Visit Variability of BP and CHD, Stroke, HF and Mortality-A cohort Study ALLHAT Post hoc Analysis



Muntner P et all. Annals of internal Medicine 2015; 163: 329


Transient ischaemic attack (n=2094)
90–114 mm Hg
115–129 mm Hg
130–139 mm Hg
140–159 mm Hg
160–179 mm Hg
≥180 mm Hg
0·86 (0·70–1·06)
1·07 (1·00–1·15)
1·26 (1·09–1·44)
1·56 (1·33–1·82)
2·09 (1·64–2·65)
2·79 (1·97–3·97)
(n=4874)
0·92 (0·83–1·02)
1·03 (0·99–1·08)
1·11 (0·98–1·27)
1·23 (1·02–1·47)
1·42 (1·19–1·70)
1·66 (1·34–2·05)
(n=1799)
0·96 (0·82–1·11)
1·02 (0·95–1·09)
1·06 (0·87–1·29)
1·12 (0·84–1·50)
1·23 (0·92–1·65)
1·36 (0·99–1·87)
Ischaemic stroke (n=937)
90–114 mm Hg
115–129 mm Hg
130–139 mm Hg
140–159 mm Hg
160–179 mm Hg
≥180 mm Hg
0·84 (0·61–1·16)
1·09 (0·98–1·22)
1·41 (1·13–1·75)
2·05 (1·61–2·61)
3·46 (2·48–4·82)
5·82 (3·63–9·34)
(n=2452)
0·89 (0·76–1·04)
1·05 (0·98–1·12)
1·17 (0·96–1·43)
1·41 (1·06–1·87)
2·00 (1·52–2·62)
2·88 (2·14–3·86)
(n=940)
1·01 (0·81–1·25)
1·00 (0·91–1·09)
1·00 (0·76–1·31)
1·04 (0·69–1·56)
1·22 (0·81–1·84)
1·48 (0·96–2·28)
Subarachnoid haemorrhage (n=533)
90–114 mm Hg
115–129 mm Hg
130–139 mm Hg
140–159 mm Hg
160–179 mm Hg
≥180 mm Hg
0·66 (0·45–0·99)
1·19 (1·04–1·36)
1·67 (1·28–2·18)
2·47 (1·81–3·37)
4·12 (2·57–6·60)
6·89 (3·46–13·72)
(n=254)
1·08 (0·72–1·60)
0·97 (0·82–1·15)
0·91 (0·55–1·51)
0·92 (0·46–1·83)
1·08 (0·54–2·17)
1·30 (0·53–3·18)
(n=43)
0·71 (0·22–2·29)
1·16 (0·70–1·92)
1·56 (0·35–7·01)
1·94 (0·20–18·35)
1·84 (0·20–17·08)
1·56 (0·15–16·29)
Intracerebral haemorrhage (n=434)
90–114 mm Hg
115–129 mm Hg
130–139 mm Hg
140–159 mm Hg
160–179 mm Hg
≥180 mm Hg
1·06 (0·70–1·62)
1·02 (0·90–1·16)
1·35 (1·01–1·81)
2·49 (1·81–3·43)
5·95 (3·88–9·13)
14·25 (7·87–25·81)
(n=879)
0·91 (0·71–1·17)
1·04 (0·93–1·16)
1·14 (0·83–1·56)
1·34 (0·85–2·10)
1·86 (1·20–2·88)
2·63 (1·62–4·28)
(n=326)
0·94 (0·64–1·37)
1·03 (0·88–1·21)
1·09 (0·67–1·76)
1·19 (0·58–2·43)
1·40 (0·68–2·88)
1·67 (0·78–3·55)
Peripheral arterial disease (n=2695)
90–114 mm Hg
115–129 mm Hg
130–139 mm Hg
140–159 mm Hg
160–179 mm Hg
≥180 mm Hg
0·85 (0·71–1·03)
1·08 (1·01–1·15)
1·34 (1·18–1·53)
1·86 (1·61–2·14)
2·90 (2·37–3·54)
4·53 (3·40–6·03)
(n=4697)
0·91 (0·82–1·01)
1·04 (1·00–1·09)
1·14 (1·00–1·31)
1·36 (1·13–1·65)
1·97 (1·63–2·37)
2·90 (2·36–3·57)
(n=1022)
0·85 (0·68–1·07)
1·07 (0·97–1·18)
1·23 (0·92–1·63)
1·43 (0·93–2·19)
1·67 (1·09–2·56)
1·93 (1·24–3·01)
Abdominal aortic aneurysm (n=310)
90–114 mm Hg
115–129 mm Hg
130–139 mm Hg
140–159 mm Hg
160–179 mm Hg
≥180 mm Hg
0·93 (0·51–1·67)
1·05 (0·86–1·29)
1·25 (0·84–1·87)
1·70 (1·10–2·62)
2·60 (1·45–4·65)
3·97 (1·74–9·04)
(n=1567)
0·95 (0·80–1·14)
1·02 (0·95–1·10)
1·07 (0·85–1·34)
1·10 (0·81–1·51)
1·12 (0·82–1·52)
1·12 (0·77–1·65)
(n=384)
0·88 (0·62–1·26)
1·05 (0·91–1·23)
1·17 (0·74–1·85)
1·27 (0·65–2·49)
1·25 (0·64–2·44)
1·19 (0·57–2·48)
1
2
3
4
5
HR
1
2
3
4
5
HR
1
2
3
4
5
HR

Journal of Hypertension:
July 2015 - Volume 33 - Issue 7 - p 1321–1341
doi: 10.1097/HJH.0000000000000614
Reviews

Effects of blood pressure-lowering on outcome incidence in hypertension: 5. Head-to-head comparisons of various classes of antihypertensive drugs – overview and meta-analyses

Thomopoulos, Costas[a]; Parati, Gianfranco[b]; Zanchetti, Alberto[c]

Abstract

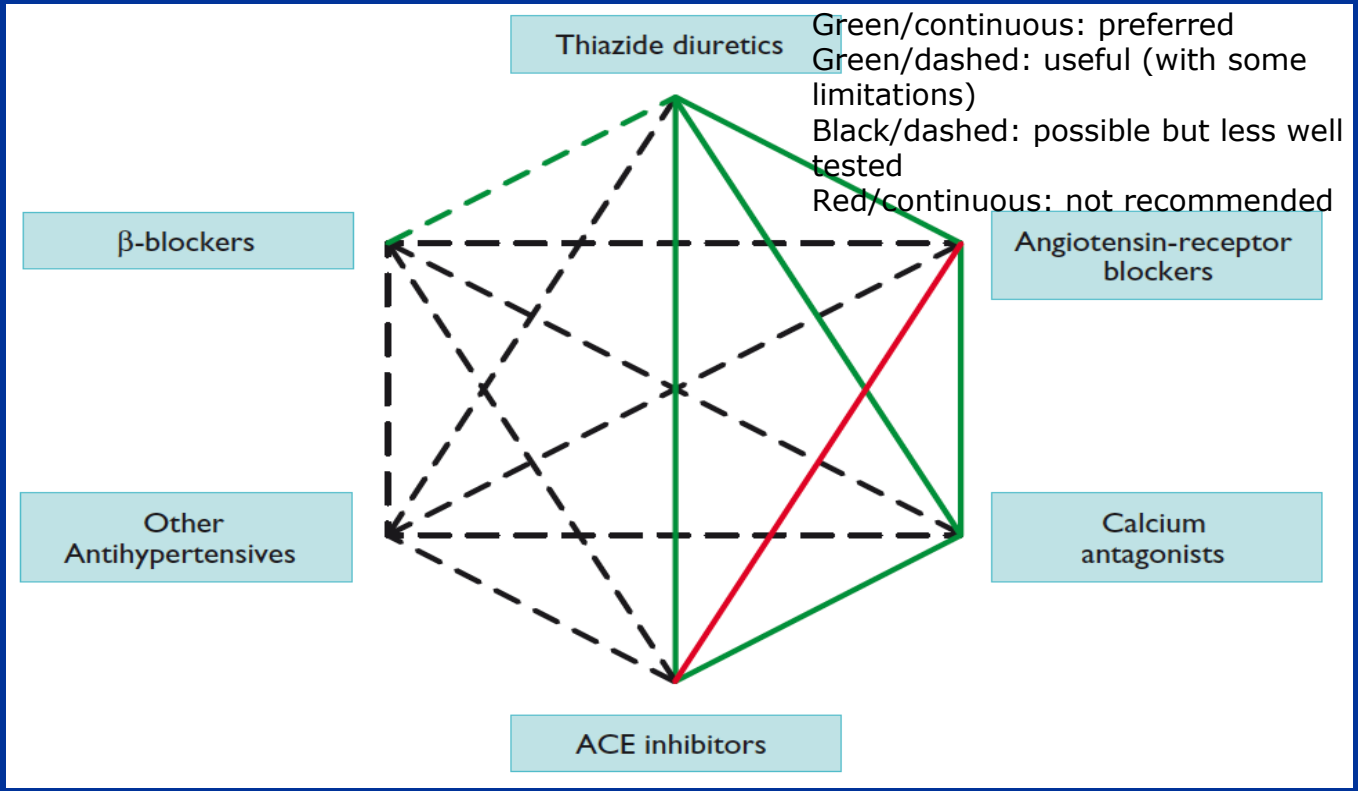
Background and objectives: We have recently published an overview and meta-analysis of the effects of the five major classes of blood pressure-lowering drugs on cardiovascular outcomes when compared with placebo. However, possible differences in effectiveness of the various classes can correctly be estimated only by head-to-head comparisons of different classes of agents. This has been the objective of a new survey and meta-analysis.

Methods: A database search between 1966 and August 2014 ide ntified 50 eligible randomized controlled trials for 58 two-drug comparisons (247 006 patients for 1 029 768 patient-years). Risk ratios and their 95% confidence intervals of seven outcomes were estimated by a random-effects model.

Results: The effects of all drug classes are not significantly different on most outcomes when their blood pressure effect is equivalent. However, there are also significant differences involving almost all classes of drugs. When compared to all other classes together, diuretics are superior in preventing heart failure; beta-blockers less effective in preventing stroke; calcium antagonists superior in preventing stroke and all-cause death, but inferior in preventing heart failure; angiotensin-converting enzyme inhibitors more effective in preventing coronary heart disease and less in preventing stroke; angiotensin receptor blockers inferior in preventing coronary heart disease; and renin–angiotensin system blockers more effective in preventing heart failure. When stratifying randomized controlled trials according to total cardiovascular risk, no drug class was found to change in effectiveness with the level of risk.

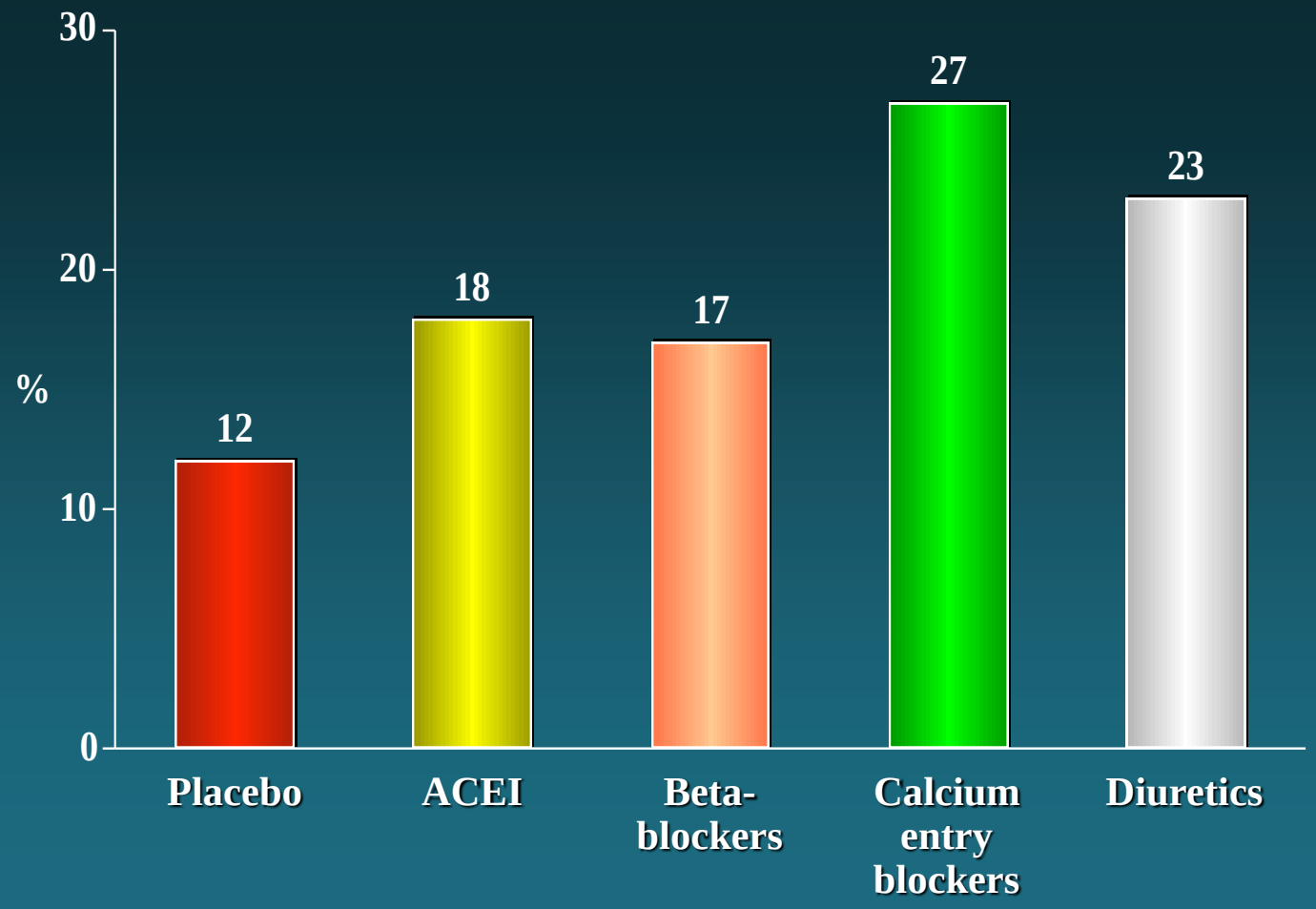
Conclusions: The results of all available evidence from head-to-head drug class comparisons do not allow the formulation of a fixed paradigm of drug choice valuable for all hypertensive patients, but the differences found may suggest specific choices in specific conditions, or preferable combinations of drugs.

Possible combinations of antihypertensive drug classes



Only dihydropyridines to be combined with β-blockers (except for verapamil or diltiazem for rate control in AF)
Thiazides + β-blockers increase risk of new onset DM
ACEI + ARB combination discouraged (IIIA)

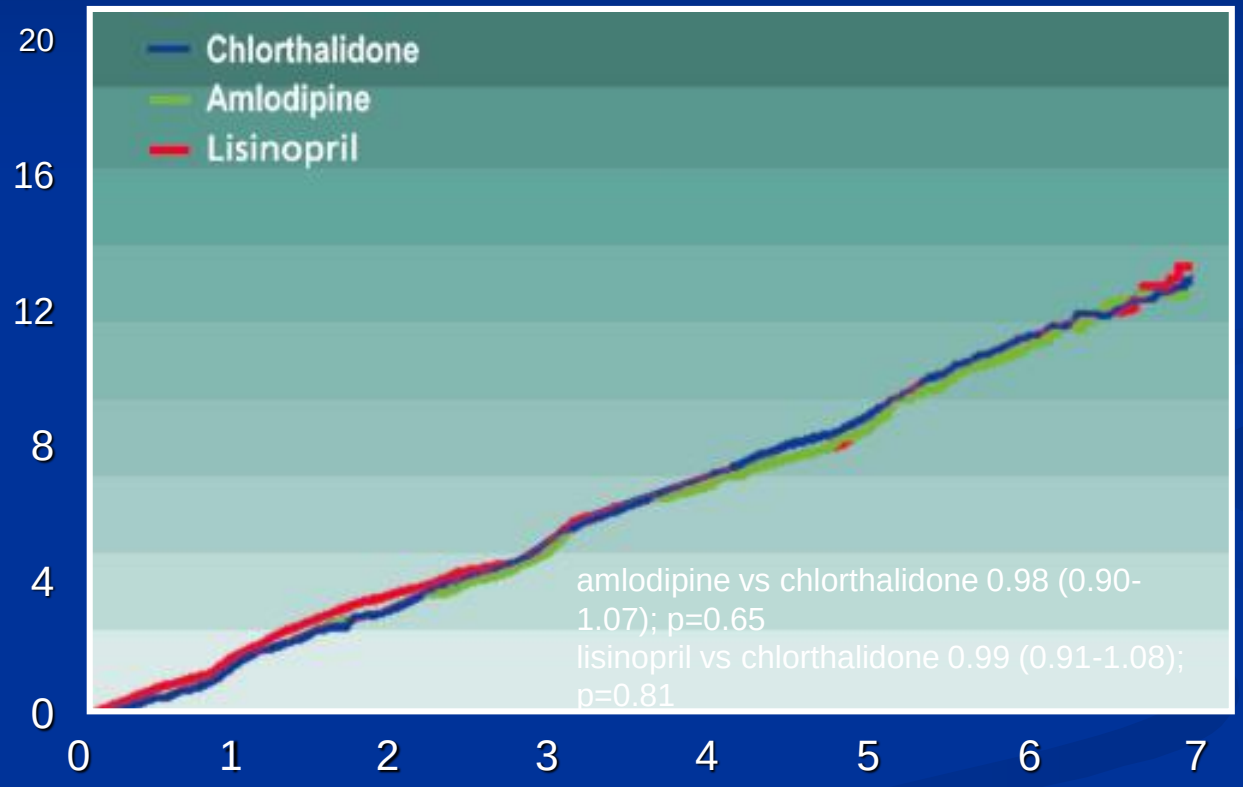
Percentage of Patients Reaching a Target SBP of Less than 140 mmHg with Different Classes of Antihypertensive Agents



Morgan et al., J Hypertens 2001; 14: 241-247

ALLHAT: Results

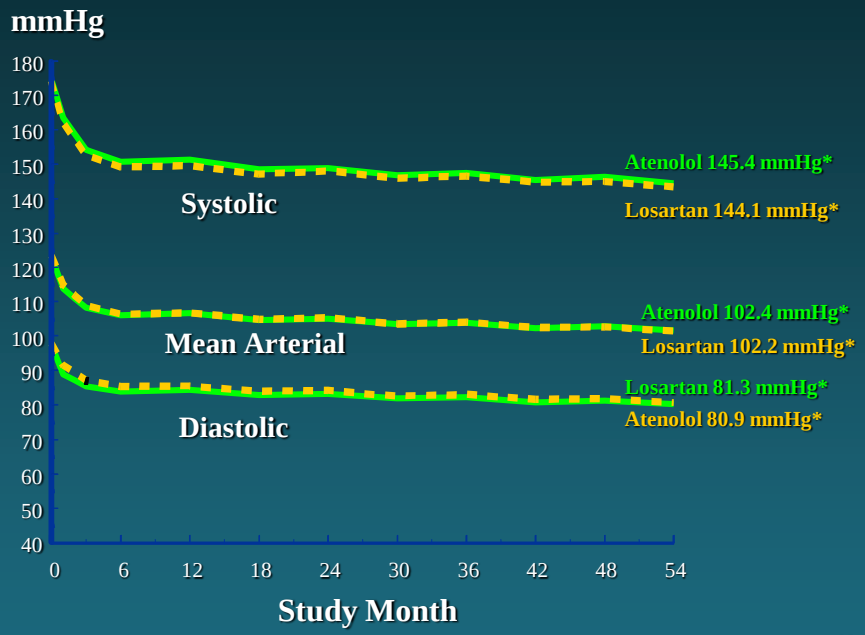
No significant difference was observed between amlodipine and the diuretic or lisinopril and the diuretic in the primary end point



1. ALLHAT Officers. JAMA 2002;288:(23):2981-2997.

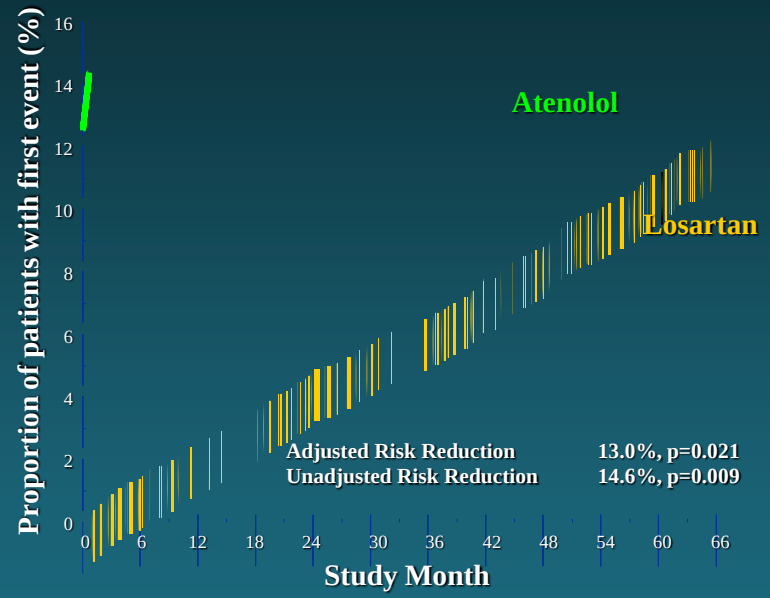
BP Reduction and CV Events in LIFE

BP



* Mean BP at last visit

Composite of CV death, stroke and MI



Number at Risk												
Losartan	4605	4524	4460	4392	4312	4247	4189	4112	4047	3897	1889	901
Atenolol	4588	4494	4414	4349	4289	4205	4135	4066	3992	3821	1854	876

Dahlöf B et al Lancet 2002; 359: 995-1003

This calls for earlier intervention in the natural history of hypertension, before organ damage develops or when early damage can still be prevented.

The earlier the better

Treatment strategies in special conditions

- White Coat Hypertension
- Masked Hypertension
- Elderly
- Young Adults
- Women
- Diabetes Mellitus
- Metabolic Syndrome
- Obstructive Sleep Apnoea
- Diabetic / Non-diabetic Nephropathy
- Cerebrovascular Disease
- Heart Disease
- Atherosclerosis / Arteriosclerosis / Peripheral Artery Disease
- Sexual Dysfunction
- Resistant Hypertension
- Malignant Hypertension
- Hypertensive Emergencies / Urgencies
- Perioperative Management of Hypertension
- Renovascular Hypertension
- Primary Aldosteronism

Perioperative management of hypertension: Therapy

CV Risk at the Peri-operative Period
The Size of the Problem in the Europe

- ✓ **7 million major surgical procedures annually with MI rate 2-3% and CV mortality 0.5-1.5%**
- ✓ **More than 150.000 patients suffered from major cardiac complication**
- ✓ **In the age group 75+, 12% of the women and 18% of the men have some degree of CVD**
- ✓ **By the year 2020, the elderly population will be increased by >50% and the annually conducted procedures by 25%**

CV Risk at the Peri-Operative Period
The Size of the Problem

- ✓ **Hypertension is a leading cause of death and disability in most Western societies**
- ✓ **Hypertension is the most frequent preoperative abnormality in surgical patients, with an overall prevalence of 20–25%.**
- ✓ **Preexisting hypertension is the most common medical reason for postponing surgery.**

Dix, P, Howell, Br J Anaesth 2001; 86:789.

Peri-Operative Hypertension

Hypertension occuring in the pre-operative, intra-operative or post-operative period.

Importance:

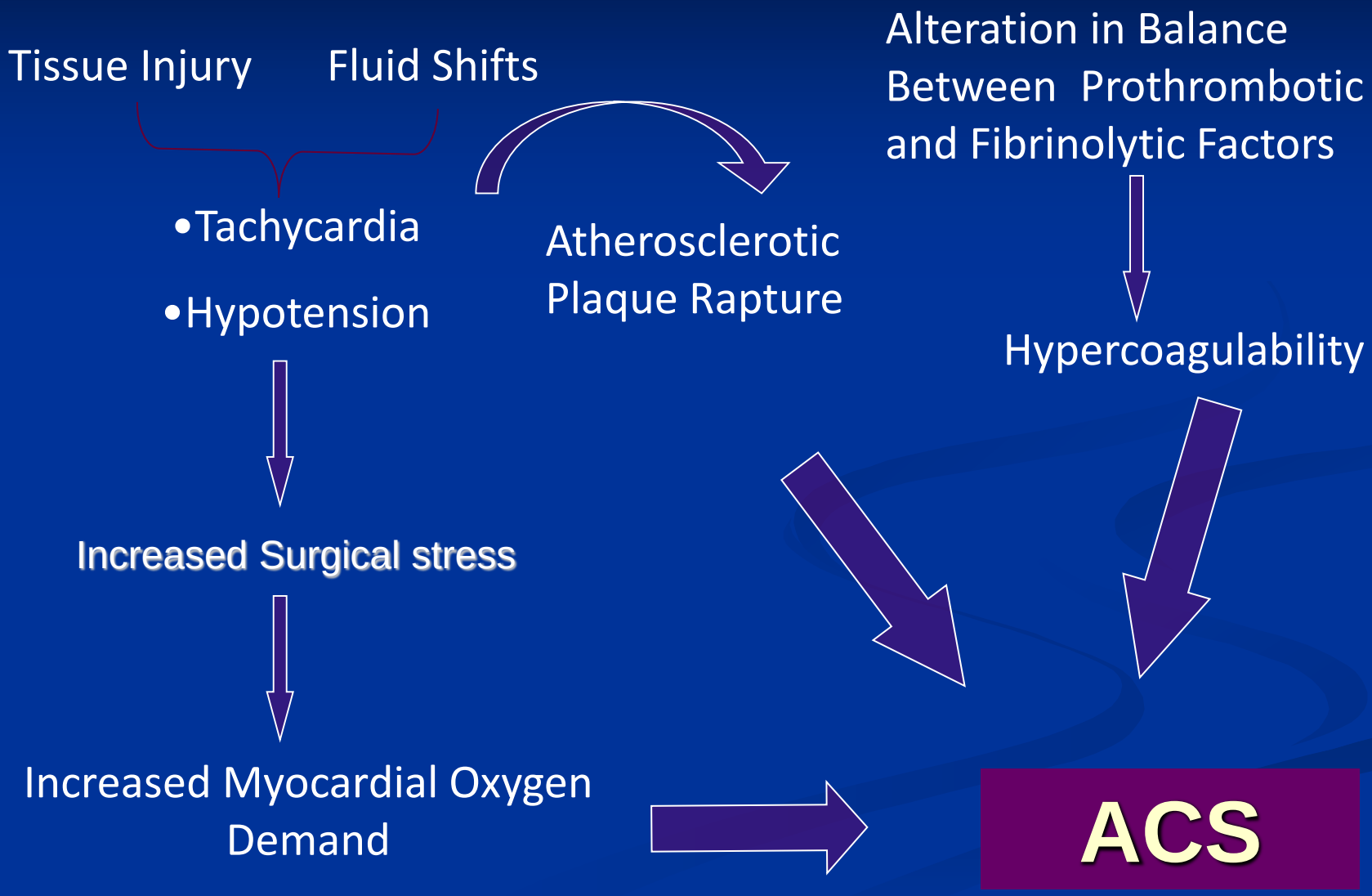
- ✓ Increased risk of cardiovascular events
- ✓ Increased post-operative morbidity and mortality
- ✓ Association with end-organ damage

Effects of Peri-Operative Hypertension

CVS effects:

- ✓ Increased BP→ ↑ afterload & myocardial oxygen demand → myocardial oxygen supply and demand imbalance.
- ✓ Chronic ↑ BP → myocardial hypertrophy → myocardial oxygen supply and demand imbalance
- ✓ Hypertrophied myocardium → decreased compliance → abnormal diastolic filling

Surgical Risk for Cardiac Events: Pathophysiology



Revised Cardiac Risk Index

Six Major Predictors:

1. **Ischemic Heart Disease**
2. **Cerebrovascular Disease**
3. **Heart Failure**
4. **Insulin Depended Diabetes Mellitus**
5. **Impaired Renal Function**
6. **High Risk Surgery**

✓ Each predictor contributes equally 1 point

Score	Risk
0	0.4%
1	0.9%
2	7%
>3	11%

Lee TH, Marcantonio ER, Mangione CM, Thomas EJ, Polanczyk CA, Cook EF, Sugarbaker DJ, Donaldson MC, Poss R, Ho KK, Ludwig LE, Pedan A, Goldman L. Derivation and prospective validation of a simple index for predictionof cardiac risk of major noncardiac surgery. Circulation 1999;100:1043–1049.

BP Response During Anesthesia

- **During the induction of anesthesia**, sympathetic activation can cause the BP to rise by 20 - 30 mmHg and the HR to increase by 15 - 20 bpm in normotensive individuals. **These responses may be more pronounced in patients with untreated hypertension**

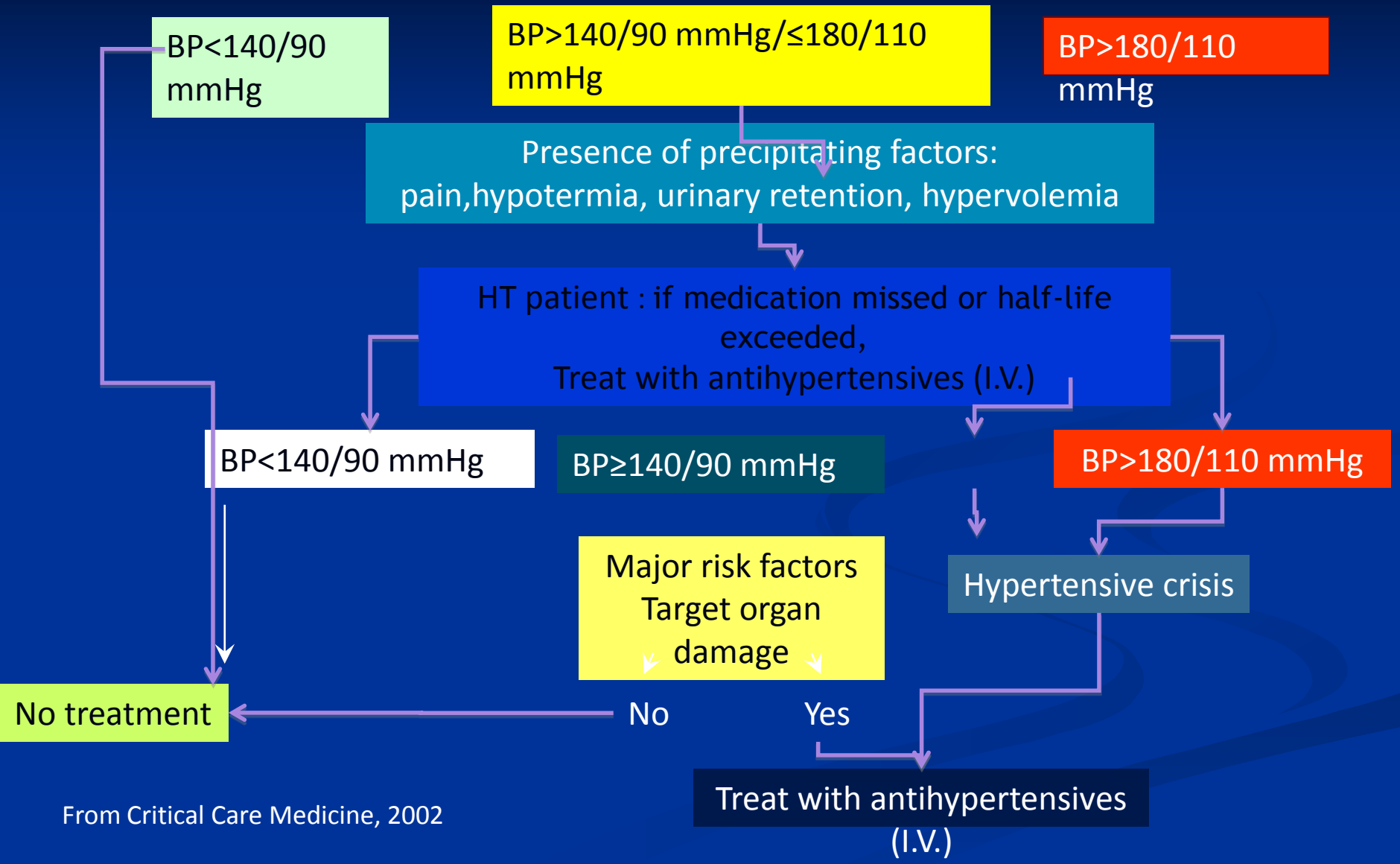
- **As the period of anesthesia progresses**, patients with preexisting hypertension are more likely to experience **intraoperative BP lability** (either hypotension or hypertension), which may lead to myocardial ischemia

- **During the immediate postoperative period** as patients recover from the effects of anesthesia, BP and HR slowly increase

- **There is no evidence of superiority of any specific anaesthetic agent in non-cardiac surgery**

Wolfsthal, SD Med Clin North Am 1993; 77:349.

Treatment Algorithm Of Perioperative Hypertension



From Critical Care Medicine, 2002

Preoperative β blockers

- ✓Controversial
- ✓Proven to be beneficial in cardiac surgeries
- ✓For non-cardiac surgeries good results in high-risk patients but not in low-risk patients (NEJM 1996, 2005)

  - ✓Associated with lesser incidences of perioperative ischemia
  - ✓Intraoperative hypotension, precipitation of asthamatic attack, major disadvantage

POISE Trial

- ✓ The biggest randomized controlled trial (N=8351)
- ✓ Patients with known CVD or >3 risk factors or major vascular surgery

✓100 mg metoprolol 2h prior operation

✓100 mg metoprolol 6h after operation

✓100 mg metoprolol maintenance dose 12h later

- **30% decrease in non-fatal MI**
- **33% increase in total mortality**
- **2 fold increase in strokes**

Probably due to Metoprolol Induced Hypotension and low HR

Risk Reduction using B-blockers

Lee index >3 → Significant decrease in mortality

Lee index = 1 or 2 → No significant difference

Lee index = 0 → Increase in mortality

Preoperative b-blocker withdrawal → Increase in mortality

Association of b-blocker Therapy with Risks of Adverse CV Events and Deaths in Patients with Ischemic Heart Disease Undergoing Noncardiac Surgery: Danish Cohort Study

28.263 pts with CHD, non cardiac surgery

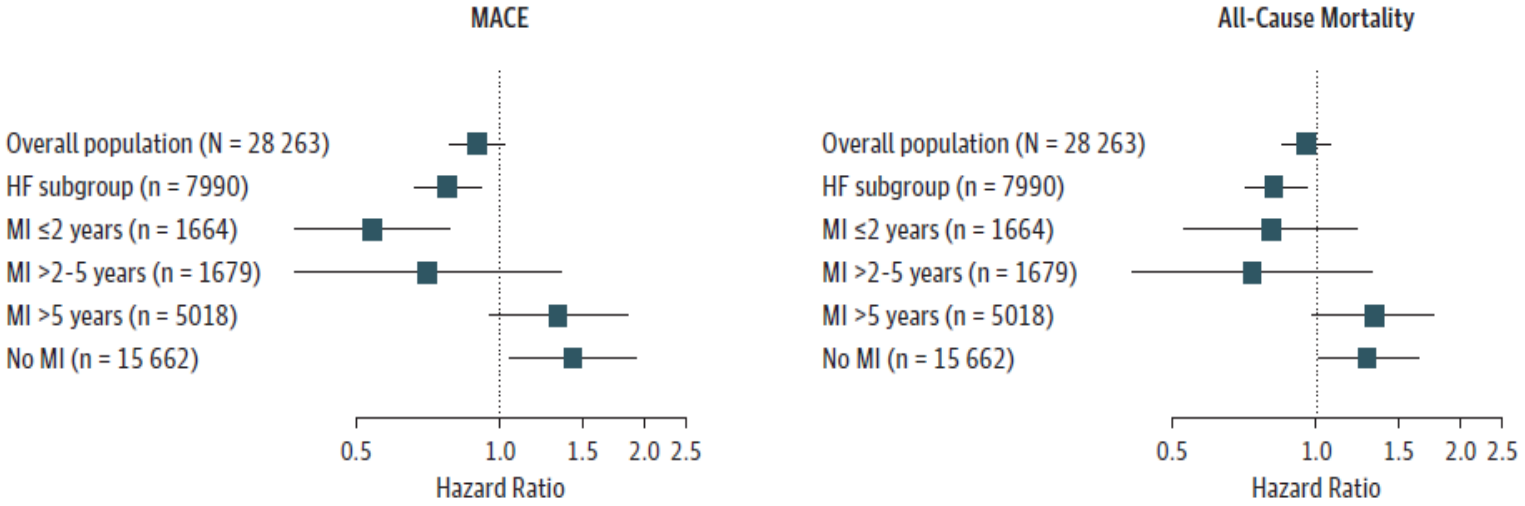
Table 2. Crude Numbers of Events

Characteristic	No. (%)			
	Heart Failure		No Heart Failure	
	β-Blockers (n = 4262)	No β-Blockers (n = 3728)	β-Blockers (n = 7419)	No β-Blockers (n = 12 854)
30-d MACE	361 (8.0)	434 (12.0)	216 (3.0)	363 (3.0)
Nonfatal stroke	1 (0.02)	5 (0.1)	13 (0.2)	29 (0.2)
Nonfatal MI	67 (1.6)	57 (1.5)	57 (0.8)	121 (0.9)
Cardiovascular death	293 (7.0)	372 (10.0)	146 (2.0)	213 (2.0)
30-d All-cause mortality	427 (10.0)	558 (15.0)	279 (4.0)	509 (4.0)

Andersson C et al. JAMA Intern Med 2014;174:336

Association of b-blocker Therapy with Risks of Adverse CV Events and Deaths in Patients with Ischemic Heart Disease Undergoing Noncardiac Surgery

Figure 1. Hazard Ratios Associated With β-Blockers in Different Subgroups of Patients



The effects associated with β-blockers differed in patients with and without heart failure (HF) ($P < .001$ for interactions between β-blockers and HF for both end points). Among the subgroup without HF, the hazard ratios associated with β-blockers were further dependent on a history of MI and time elapsed since the most recent MI (for interaction between β-blockers and MI categories, $P < .001$ for MACE and $P = .02$ for all-cause mortality). Analysis was adjusted for all variables from Table 1 plus calendar year for surgery. MACE indicates major adverse cardiovascular events (nonfatal ischemic stroke, acute myocardial infarction, and cardiovascular death); MI, myocardial infarction.

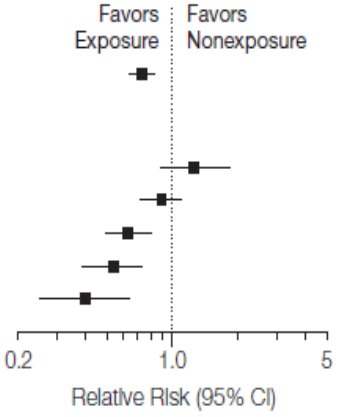
Andersson C et al. JAMA Intern Med 2014;174:336

Association of Perioperative b-blockade with Mortality and CV Morbidity Following Major Noncardiac Surgery

Figure 1. Thirty-Day Mortality Propensity Model

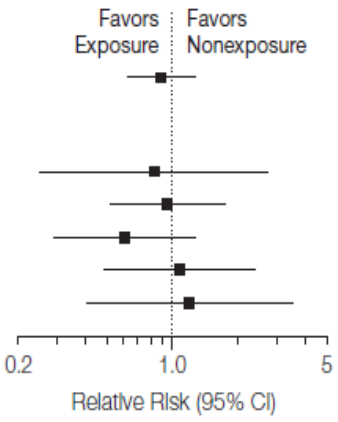
A All surgery

	No. of Patients		No. of Deaths	
	Exposed	Not Exposed	Exposed	Not Exposed
All Patients	37 805	37 805	426	583
No. of Revised Cardiac Risk Index predictors				
0	12 250	12 250	67	53
1	16 057	16 057	166	186
2	6795	6795	111	176
3	2090	2090	59	110
>4	613	613	23	58



B Vascular surgery

	No. of Patients		No. of Deaths	
	Exposed	Not Exposed	Exposed	Not Exposed
All Patients	3999	3999	55	62
No. of Revised Cardiac Risk Index predictors				
0	857	857	5	6
1	1593	1593	20	21
2	1033	1033	11	18
3	403	403	13	12
>4	113	113	6	5



…perioperative b-blocker exposure was associated with lower rates of 30-day all-cause mortality in patients with 2 or more Revised Cardiac Risk Index factors

London MJ et al. JAMA 2013;309:1704

Recommendations on ACE inhibitor use

For a hypertensive patient already receiving ACE inhibitors they should be discontinued 24 hours before surgery and resume after patient's endovascular volume has been stabilized. When they are prescribed for heart failure their discontinuation at the preoperative phase should be examined more carefully

Effects of Discontinuation of AIIA Before Surgery on Hemodynamic Events In Hypertensive Patients Crhonically Treated With AIIA

	Group I (AIIA withdrawn)	Group II (AIIA given)	p
Systolic blood pressure			
Preinduction	159 ± 24	151 ± 26	NS
Postinduction	126 ± 33	109 ± 24	NS
Intubation	136 ± 34	121 ± 33	NS
Lowesr value	159 ± 24	151 ± 26	NS
Episodes of hypotension (No.)	1 ± 1	2 ± 1	<0.01
Patients with at least 1 episode (No.)	12	19	<0.01
Duration of episodes (min)	3 ± 4	8 ± 7	<0.01
Patients receiving ephedrine (No.)	12	17	NS
Dose of ephedrine (mg)	10 ± 10	15 ± 9	NS
Patients receiving neosynephrine	0	5	<0.02

Bertrand M et Al., Anesth Analg 2001;92:26-30

- CONTINUE antihypertensive medications in patients undergoing scheduled non-cardiac surgery *until the day of surgery*

- CONTINUE β-blockers and centrally acting antihypertensive drugs, otherwise rebound phenomena, including increase in BP and HR.

- STOP in patients with preserved LVEF ACE inhibitors 24 hours before surgery, at least, and RESTART as soon as possible after hemodynamic and volume stabilization.

Recommendations On Calcium Channel Blockers

Recommendations	Class[a]	Level[b]
It is recommended that calcium channel blockers be continued during non-cardiac surgery in patients with Prinzmetal angina pectoris	I	C
Heart rate-reducing calcium channel blockers, in particular diltiazem, may be considered before non-cardiac surgery in patients who have contra-indications to β-blockers	IIb	C
Routine use of calcium channel blockers to reduce the risk of perioperative cardiovascular complications is not recommended	III	C

[a]Class of recommendation
[b]Level of evidence

Perioperative hypertension: parenteral drugs

SUSTAINED
SBP ≥180 mmHg
and/or
DBP ≥110 mmHg

Hypertensive Emergency

IMMEDIATE BP REDUCTION
to minimize
the ongoing target organ damage
May require monitoring
in an intensive care unit and parenteral drugs.

Hypertensive Urgency

REDUCE BP GRADUALLY
<160/100 mm Hg
AVOID aggressive BP reductions:
may cause organ hypoperfusion.
Parenteral drugs in case of emergent or urgent surgery

Parenteral antihypertensive drugs in the perioperative setting: properties and preferred conditions

Agent (Dose)	Onset of action	Half-life	Duration of action	Mechanism of action	Preferred hypertensive condition
Enaprilat (0.5-5 mg bolus)	15 min.	35-38 h	4-6 h	Angiotensin-converting enzyme inhibitor	-Replacement of oral ACE inhibition in the perioperative setting -Congestive heart failure

Parenteral antihypertensive drugs in the perioperative setting: properties and preferred conditions

Nicardipine (5-10 µg/Kg/min bolus) (1-3 µg/Kg/min infusion)	15 min.	45 min.	1-4 hours	Dihydropyridine type calcium antagonist Direct arterial vasodilator Increase in stroke volume and coronary blood flow Anti-ischemic properties	-Coronary artery disease -Heart failure -Acute renal failure -Acute cerebrovascular disease
Clevidipine (2mg/h titrated by doubling the dose every 3 min. to maximum of 32 mg/h)	2-4 min.	2 min.	5-15 min		

Parenteral antihypertensive drugs in the perioperative setting: properties and preferred conditions

Metoprolol (5mg boluses every 2-5 min up to 15 mg over 15 min)	5 min.	3-7h	15-19h	Beta-1 selective blocker	-Replacement of oral beta-blocker in the perioperative setting -Beta blocker withdrawal -Tachycardia
Esmolol (infusion, 50-250 µg/Kg/min)	1-2 min.	2-10 min.	10-20 min.	Beta-1 selective blocker	-Tachycardia -Beta blocker withdrawal -Aortic dissection

Parenteral antihypertensive drugs in the perioperative setting: properties and preferred conditions

Labetalol (bolus 2-10 mg, infusion 2.5-30 µg/Kg/min)	5-10 min.	5.5 hours	3-6 hours	Non selective beta blocker with alpha-1 blocking (at higher dose)	-Peripartum hypertension -Cardiac or cerebral ischemia -Aortic dissection -Pheochromocytoma
Phentolamine (1-4 mg boluses)	1-2 min.	20min	15-30min	Non selective alpha-blocker	-Pheochromocytoma (catecholamine excess)

Parenteral antihypertensive drugs in the perioperative setting: properties and preferred conditions

Nitroglycerin (infusion 20-200 µg/min, titration against BP)	5 min.	3 min.	<3-5 min.	Strong venodilator with mild peripheral arterial dilation -Coronary artery vasodilation -Reduction of left ventricular preload -Reduction of oxygen demand	-Acute myocardial ischemia -Established coronary artery disease -Acute pulmonary edema

Table 1. Parenteral antihypertensive drugs in the perioperative setting: properties and preferred conditions

Sodium nitroprusside (infusion 0.3-2 µg/Kg/min)	Immediate	2 min	1-2 min	Arterial and venous vasodilation	-Failure of other agents -Urgent reduction of severe acute hypertension
Urapidil (12.5-25 mg bolus followed by infusion of 5-40mg/h)	3-5 min	2.7 h	4-6 h	Alpha blocker and central serotonin agonist activity	-Pheochromocytoma -Pre-eclampsia

Perioperative Management of HTN: Key Issues-1

- Some surgical procedure are associated with a high incidence of HTN: carotid endoarteriectomy, head and neck surgery, aortic and peripheral vascular surgery
- BP levels > 180/110 mmHg should be controlled prior to surgery; for elective surgery (cardiac, vascular), effective BP control can be achieved over several days to weeks of outpatient treatment
- Uncontrolled HTN before surgery is associated with wider fluctuations of BP during induction of anesthesia and intubation and may increase the risk for perioperative ischemic events
- Surgical candidates with controlled HTN should mantain their medications until the time of surgery (except for ACEI and ARB's), and therapy should be re-instituted as soon as possible postoperatively

Mod. from JNC VII

Perioperative Management Of HTN: Key Issues-2

- **If a patients develops intraoperative HTN**, it is necessary ascertain that other causes of HTN have been ruled out (hypercapnia, distend bladder, hypertemia, hypoxia)
- **In urgent situations,** rapidly acting parenteral agents can be utilizied to achieve BP control very rapidly
- **Sudden intraoperative HTN** is managed by the same parenteal antihypertensive agents that are utilized in the management of hypertensive emergencies
- **HTN is very common in the early postoperative period** and is related to increased sympathetic tone and vascular resistance that follows pain and increased intravascular volume, and may require parenteral drug and/ or (if possible) the re-insitution of previous oral treatment.

Mod. from JNC VII