High pulse pressure as a predictor of mortality in elderly patients

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Pulse pressure = Systolic BP – Diastolic BP

Background

- Pulse pressure (PP) values increase with age
- A high PP is a strong risk factor for cardiovascular pathologies
- Its impact on mortality in elderly patients has not been established

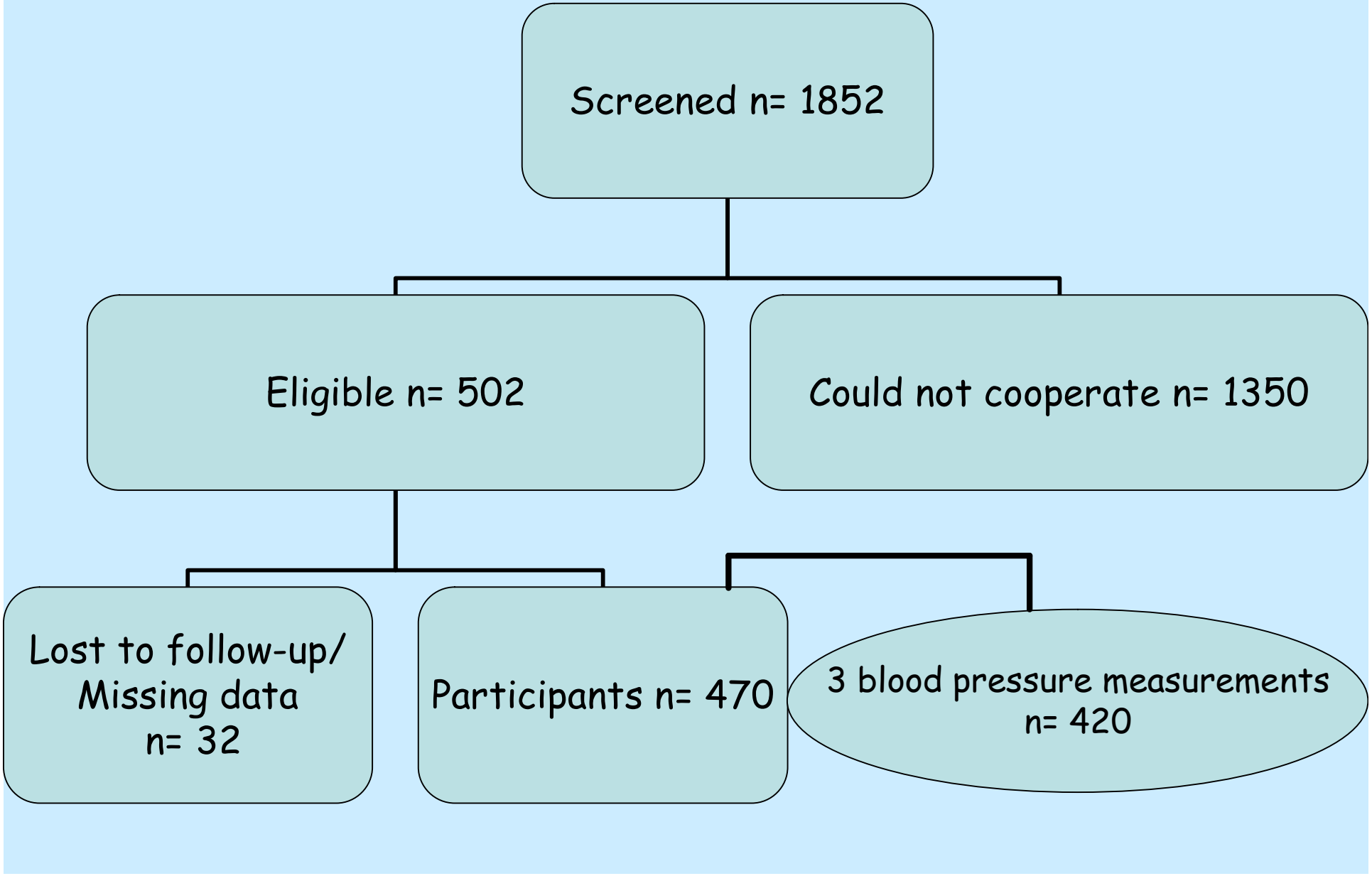
Objective

- To evaluate the effect of high PP on mortality among hospitalized elderly patients

Patients and Methods

- The records of 470 patients admitted to our ward between 1999 – 2000 were reviewed
- Blood pressure values were measured x3 during a day
- Patients were followed-up until August 31st, 2004 (mean follow-up: 3.46 ± 1.87 years)
- Mortality data were extracted from death certificates

Patients dispensation



Statistical analysis

- PP of 62.5 mmHg was determined as the cut-off point beyond which higher mortality rate was found (ROC Curve analysis)
- Distributions of continuous variables were assessed by the Kolmogorov-Smirnov test ($p < 0.01$)
- The t-test or the Mann-Whitney U were used to compare continuous variables
- The chi square test was used to assess associations categorical variables
- Cox proportional hazards was used with 95% confidence intervals
- All tests are two-sided and considered significant at $p < 0.05$

Results

Table 1. Patient characteristics by pulse pressure group

Population charachteristics	PP>62.5mmHg	PP≤62.5mmHg	P value
	n=304	n=116	
Age (years)	81.28 ± 6.72	81.57± 6.49	0.621
Sex (% females)	55.90	44.00	0.028 ←
Vital status (%dead)	**50.99**	**39.66**	**0.038** ←
BMI (kg/m2)	25.44 ± 4.28	24.71 ± 4.72	0.131
Comorbidities (%)			
Hypertension	69.64	44.83	<0.0001 ←
Ischemic heart disease	54.46	61.21	0.210
Congestive heart failure	28.38	34.78	0.200
Diabetes	**31.91**	**21.55**	**0.037** ←
Chronic renal failure	19.74	27.59	0.082
Atrial fibrilation	15.56	29.57	0.001
Smokers	14.77	19.82	0.217

Table 1. Patient characteristics by pulse pressure group cont

Hemodynamic values (mmHg)	PP>62.5mmH	PP≤62.5mmHg	P
Heart rate (bpm)	79.47±11.67	82.17±13.22	0.043
Systolic blood pressure	151.49±17.78	121.20±12.25	<0.0001
Diastolic blood pressure	73.42±11.26	65.80±10.20	<0.0001
Mean arterial pressure	99.97±12.57	93.28±12.42	<0.0001
Pulse pressure	78.06±11.32	55.40±5.80	<0.0001
Prescribed medications (%)			
Diuretics	31.25	37.07	0.256
ACE/ARBS*	31.25	30.17	0.831
Calcium channel blockers	32.24	24.14	0.105
Nitrates	25.33	28.45	0.516
Beta blockers	19.08	17.24	0.665
Tranquilizers	27.96	25.00	0.542

*ACE/ARBS=ACE inhibitors, angiotensin receptor blockers

Table 2: Laboratory tests by pulse pressure group

Laboratory parameters	PP≤62.5mmHg	PP>62.5mmHg	P value
Hb (gr/dL)	12.13 ± 1.68	12.37 ± 1.71	0.182
Glucose (mg/dL)	122.22 ± 50.96	113.18 ± 34.35	0.295
Urea (mg/dL)	42.37 ± 20.71	43.01 ± 22.83	0.967
Creatinine (mg/dL)	1.17 ± 0.57	1.16 ± 0.59	0.747
Potassium (mEq/L)	4.19 ± 0.47	4.22 ± 0.47	0.539
Sodium (mEq/L)	139.35 ± 3.38	139.46 ± 3.78	0.790
TSH (mIU/L)	2.72 ± 7.13	3.43 ± 10.71	0.389
B_{12} (pmol/L)	487.44 ± 400.24	418.08 ± 304.85	0.374
Folic acid (nmol/L)	**8.26 ± 4.53**	**7.36 ± 4.27**	**0.055**
Albuminuria (mg/dL)	18.78 ± 56.51	15.58 ± 53.36	0.208
Glycuria (mg/dL)	30.69 ± 163.38	9.96 ± 94.23	0.252

Table 3: Major causes of death by pulse pressure group

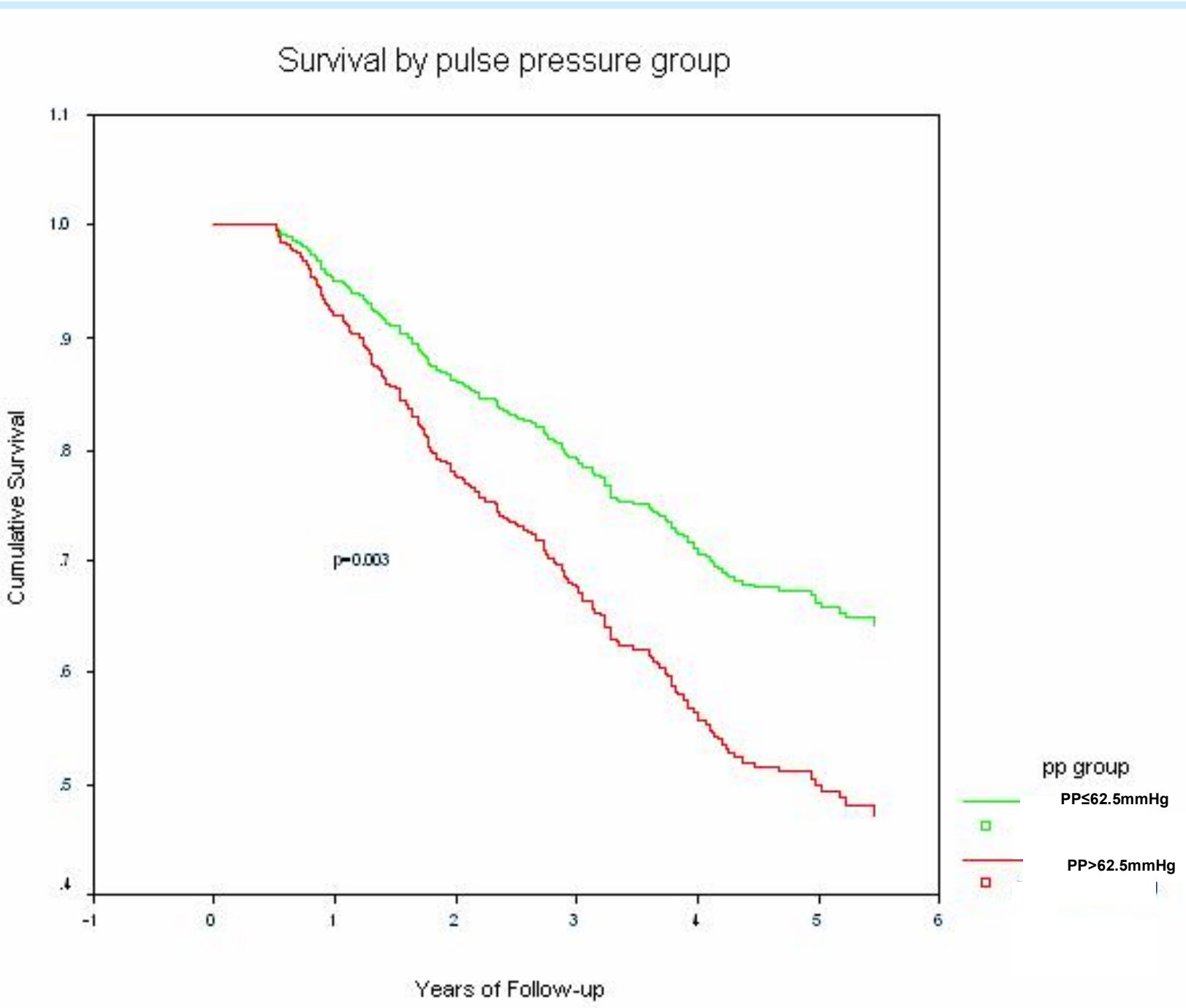
Cause of death	PP>62.5 mmHg		PP≤62.5 mmHg		P
	n	Died (%)	n	Died (%)	
CVD*	236	22.4	93	19.8	0.572
Sepsis	225	26	99	14.7	**0.013**
CVA**	289	4.9	110	4.2	0.92
Cancer	289	4.9	109	6	0.651

*CVD=cardiovascular disease
**CVA=cerebrovascular accident

Table 4. Cox model of survival from all cause mortality

	HR	CI 95%	P value
Pulse pressure (≤62.5mmHg)	**0.59**	**(0.42-0.84)**	**0.003**
Age (years)	1.099	(1.07-1.13)	<0.0001
Male sex*	1.609	(1.21-2.14)	0.001
Diabetes mellitus	1.686	(1.23-2.31)	0.001
Atrial fibrillation	1.427	(1.02-2.00)	0.039
Heart rate (bpm)	1.017	(1.01-1.03)	0.004

*Although the pulse pressure was significantly higher in women, male sex was significantly associated with increased mortality after controlling for age, pulse pressure, diabetes, atrial fibrilation and heart rate


Survival by pulse pressure group
Cumulative Survival
1.1
1.0
.9
.8
.7
.6
.5
.4
p=0.003
-1
0
1
2
3
4
5
6
Years of Follow-up
pp group
PP≤62.5mmHg
PP>62.5mmHg

Discussion

- Some studies, in younger patients support our findings
- Other studies, both in middle aged and elderly, are less consistent (d/t methodological differences)
- High PP was associated **only** with **non**cardiovascular mortality, like in Kikuya M. et al. (*Stroke. 2007)* and Willum-Hansen T. et al. (*Circulation. 2006*)
- A sample bias? A 'survivors effect'?

Discussion cont.

- The rate of sepsis was significantly higher in those with a high PP
- A high PP is a marker of arterial stiffness
- Rate of D.M. was higher in this group
- D.M. contributes to arterial stiffness:
  a. Non-enzymatic glycolization of the arterial wall
  b. Atherosclerosis
- This group was biologically older, more vulnerable to stress conditions like sepsis
- ∴ **A high PP could be a marker of (biological) aging**

Discussion cont.

- In our study high PP was mainly due to high systolic BP
- Mortality was also high in studies with high PP d/t low diastolic pressure
- ∴ **High PP is associated with increased mortality**
- Does lowering PP reduce mortality?
- Tx of systolic BP lowers also diastolic pressure
- Elderly patients benefit from Tx of sys. HTN but vulnerable to low diastolic BP
- Currently – no selective Tx for sys. HTN
- ∴ **A high PP – a marker of aging/poor health;**
  Not a target of Tx (Perhaps in the future?)

Summary

- A higher mortality rate was found among hospitalized elderly patients with PP > 62.5 mmHg
- The PP > 62.5 mmHg retained it's significance as a predictor of mortality even when factors like age, gender, diabetes mellitus, atrial fibrillation and heart rate were taken into account

Thank you!!!