Heart and Kidney

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High Prevalence of CVD in CKD & ESRD

	CAD (Clinical)	LVH (Echo)	CHF (Clinical)
GP	5-12*	20†	5‡
CRI	NA	25-50 (varies with renal function)§	NA
HD	40‖	75¶	40‖
PD	40‖	75¶	40‖
RTR	15#	50**	NA

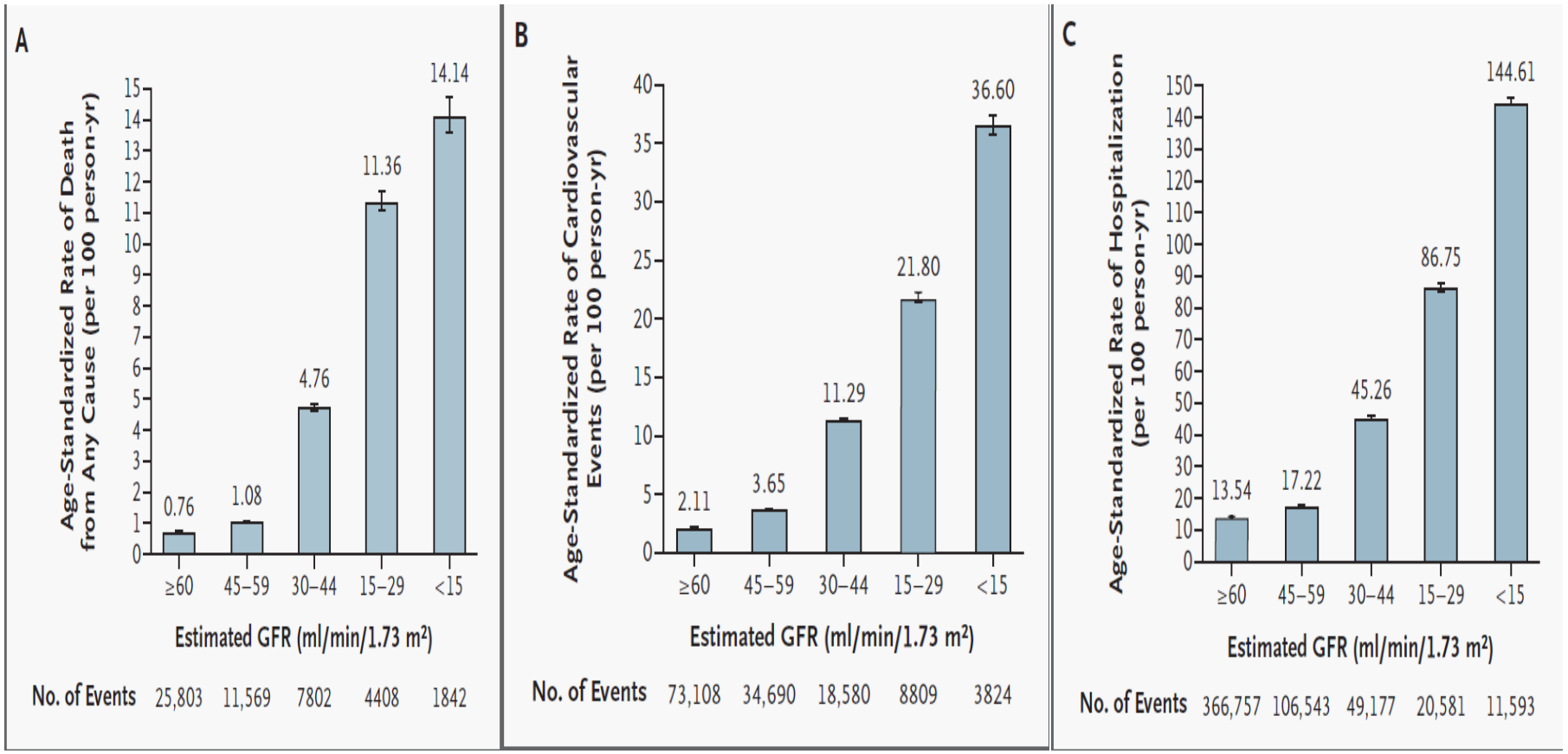
Foley RN et al, AJKD 1998; 32(suppl 3):S112-9

High CV Mortality in ESRD

	All	Men	Women	White	Black	Diabetic	Nondiabetic
GP	0.28	0.28	0.27	0.29	0.23	0.80	0.26
HD	9.12	9.38	8.83	11.18	6.68	11.09	7.78
PD	9.24	10.27	8.14	10.76	6.07	13.22	7.09
RTR	0.54	0.59	0.43	0.53	0.56	1.11	0.39

Foley RN et al, AJKD 1998; 32(suppl 3):S112-9

CKD Increased Risks of Death, CV Events & Hospitalization



Go AS et al, NEJM 2004;351:1296-305

Cardiorenal Syndrome

CRS general definition:
Disorders of the heart and kidneys whereby acute or chronic dysfunction in one organ may induce acute or chronic dysfunction of the other

Acute CRS (Type 1)
Acute worsening of cardiac function leading to renal dysfunction

Chronic CRS (Type 2)
Chronic abnormalities in cardiac function leading to renal dysfunction

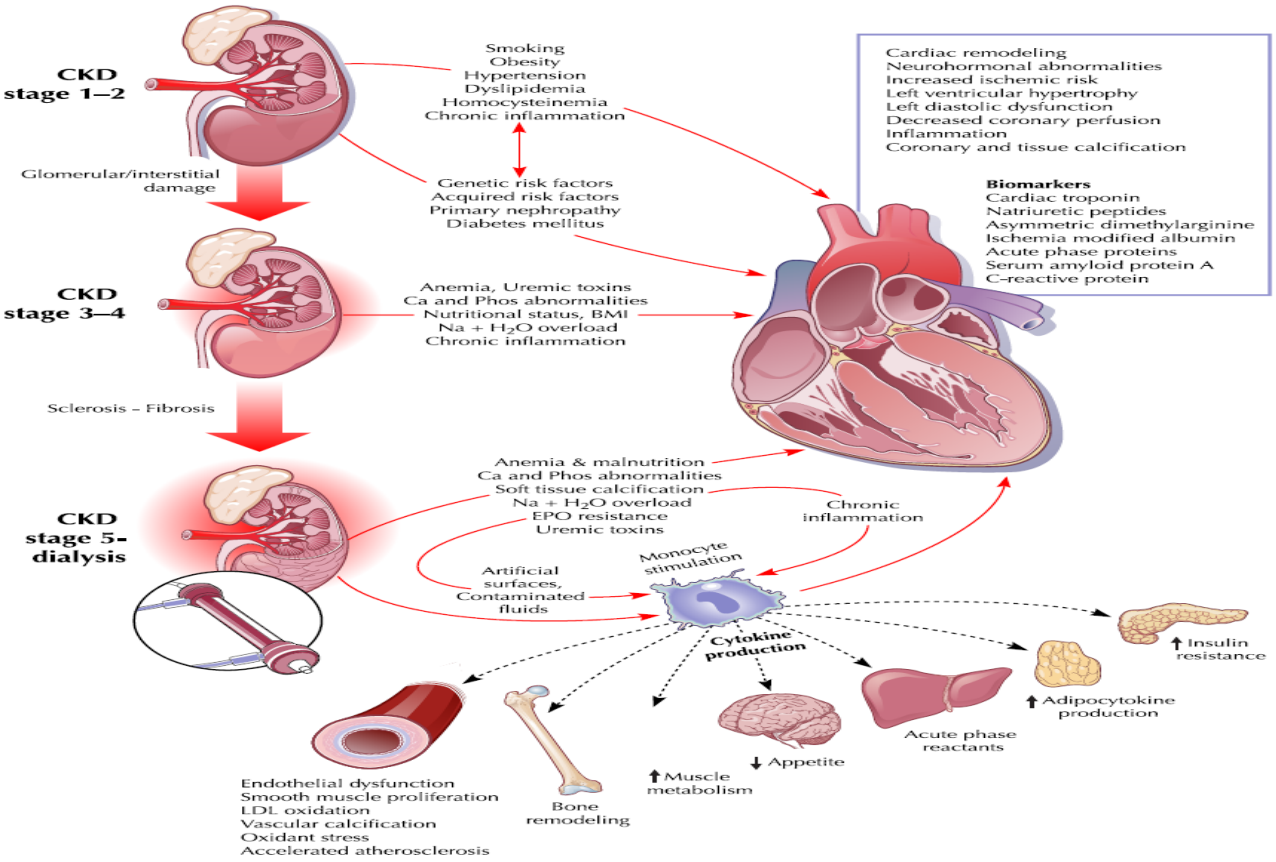
Acute Renocardiac Syndrome (Type 3)
Acute worsening of renal function causing cardiac dysfunction

Chronic Renocardiac Syndrome (Type 4)
Chronic abnormalities in renal function leading to cardiac disease

Secondary CRS (Type 5)
Systemic conditions causing simultaneous dysfunction of the heart and kidney

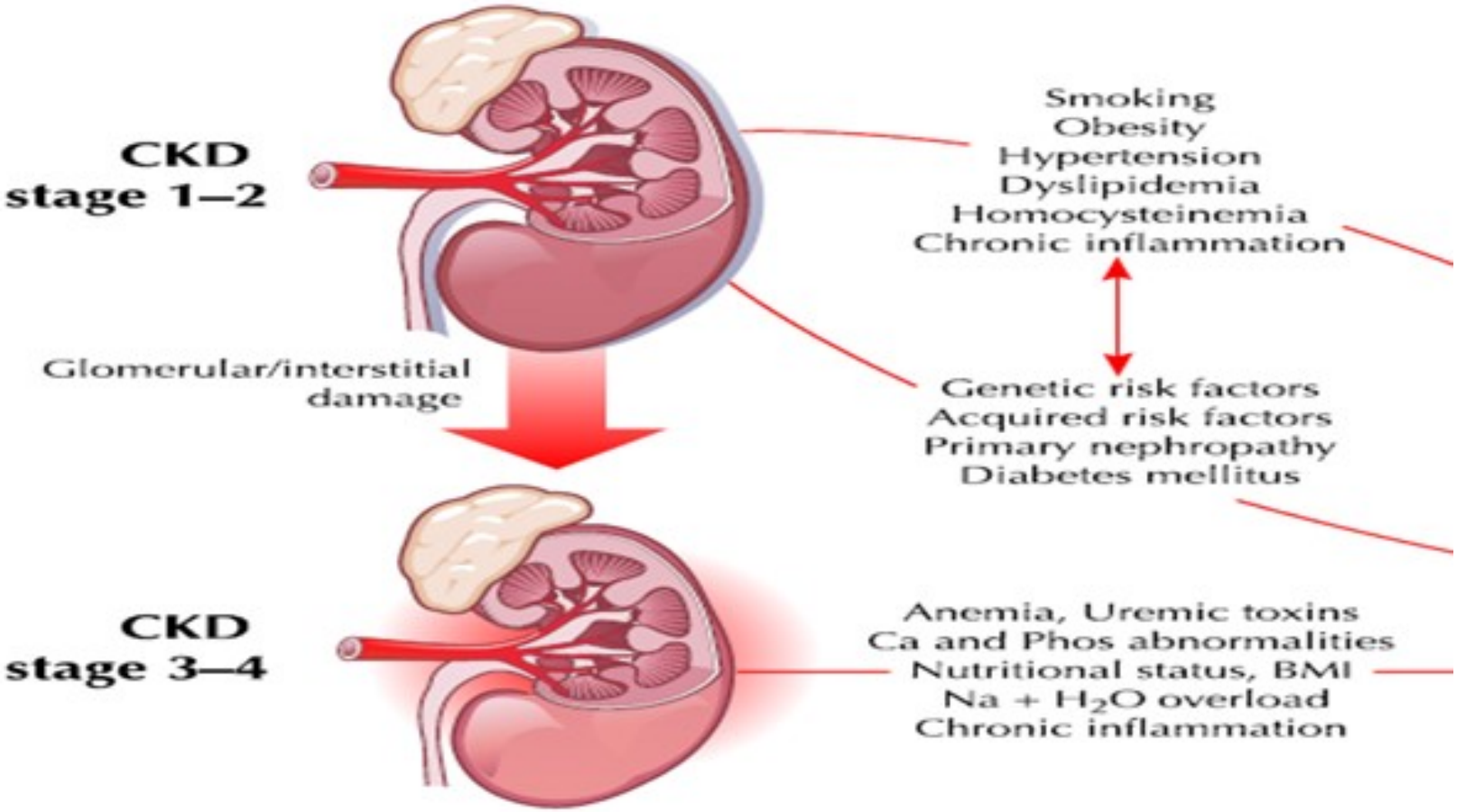
Ronco C, Contrib Nephrol. 2010;164:33-8

Cardiorenal Syndrome



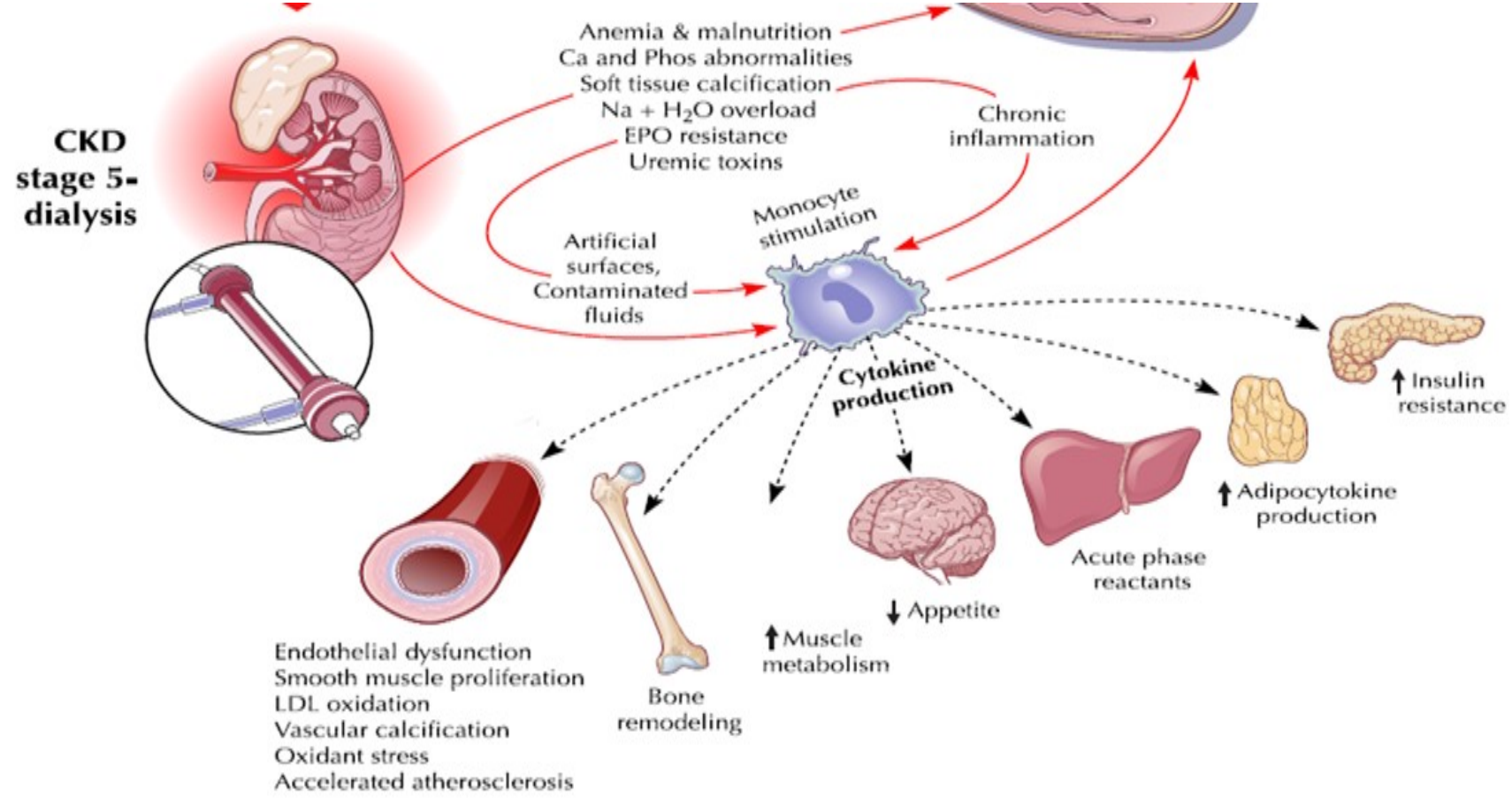
Ronco C et al: J Am Coll Cardiol 2008;52:1527–39

Cardiorenal Syndrome



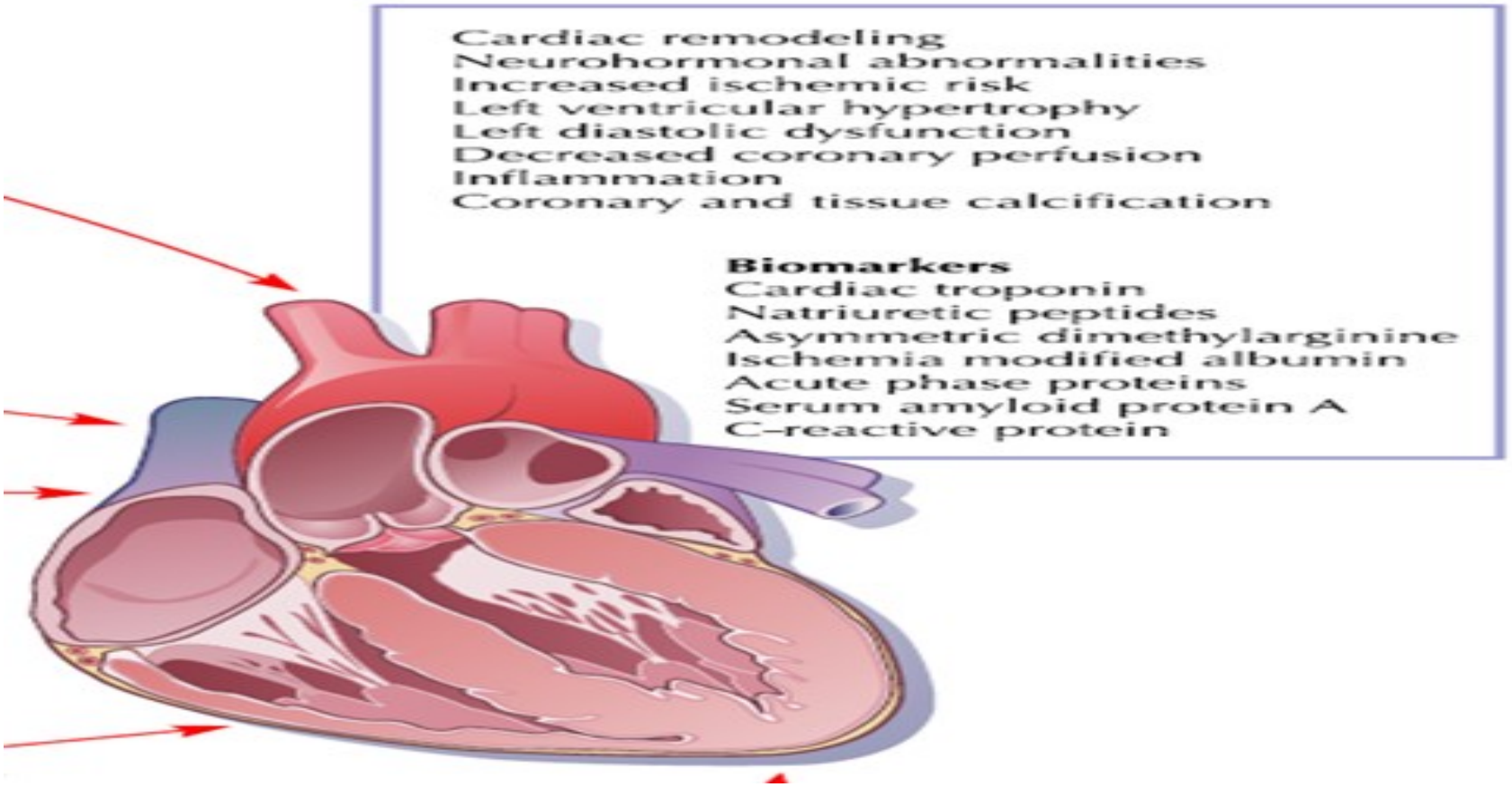
Ronco C et al: J Am Coll Cardiol 2008;52:1527–39

Cardiorenal Syndrome



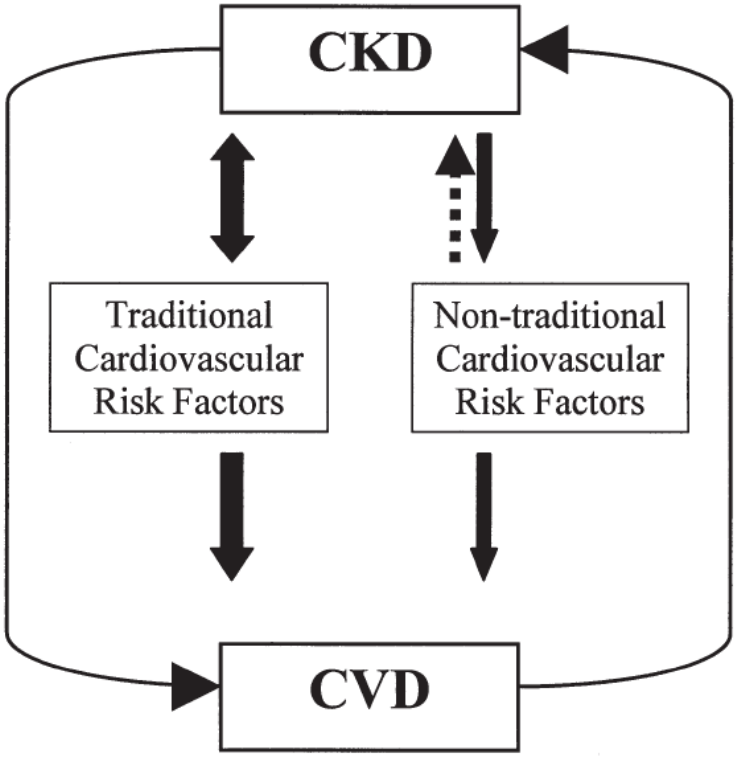
Ronco C et al: J Am Coll Cardiol 2008;52:1527–39

Cardiorenal Syndrome



Ronco C et al: J Am Coll Cardiol 2008;52:1527–39

Traditional and Nontraditional Risk Factors of CVD in CKD



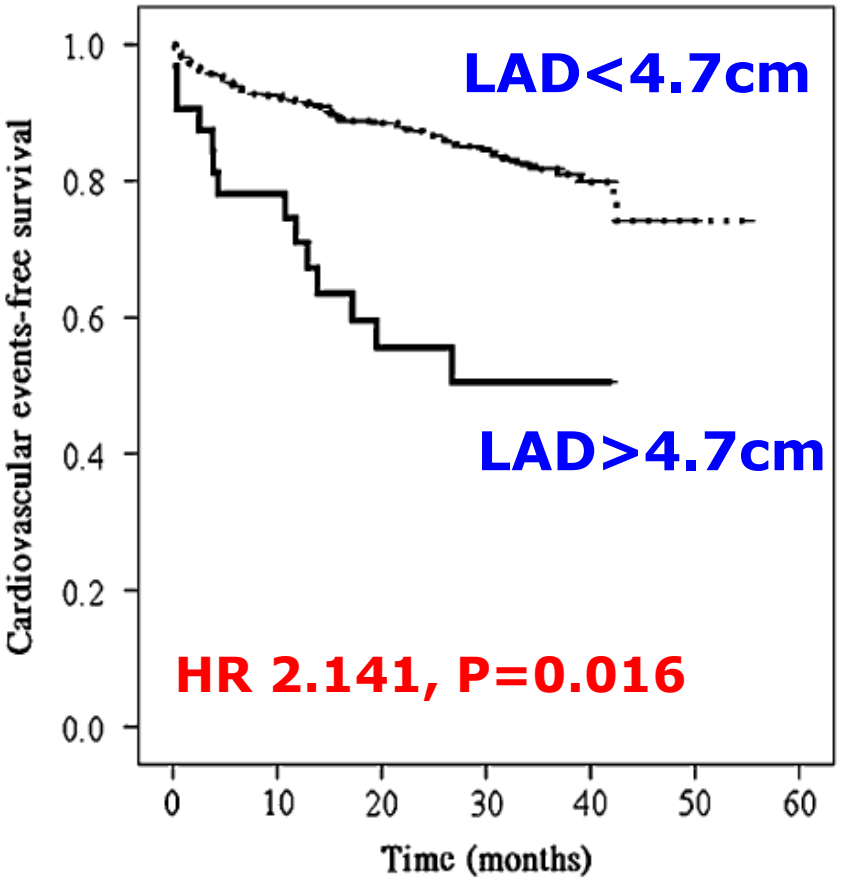
Traditional Risk Factors	Nontraditional Risk Factors
Older age	Albuminuria/proteinuria
Male sex	Homocysteine
Hypertension	Lipoprotein(a) and apolipoprotein(a) isoforms
Higher LDL cholesterol	Lipoprotein remnants
Low HDL cholesterol	Anemia
Diabetes	Abnormal calcium-phosphate metabolism
Smoking	Extracellular fluid overload
Physical inactivity	Oxidative stress
Menopause	Inflammation (C-reactive protein)
Family history of CVD	Malnutrition
Left ventricular hypertrophy	Thrombogenic factors
	Sleep disturbances
	Altered nitric oxide/endothelin balance

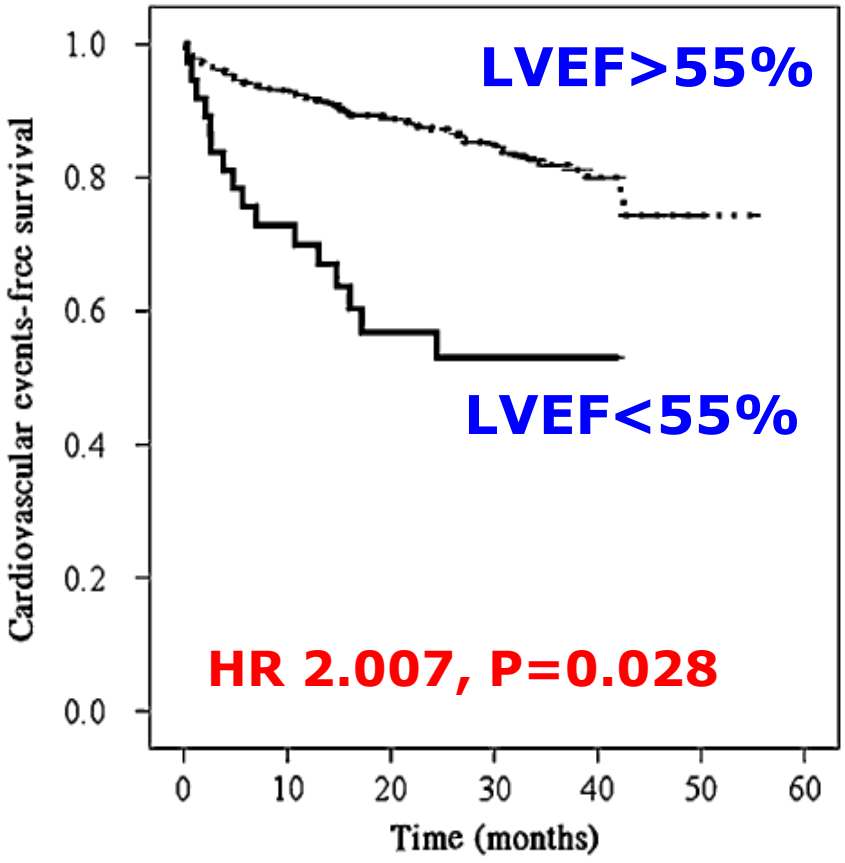
Menon V et al, AJKD 2005;45:223-32

Our Findings of Some Traditional and Nontraditional CV Risk Factors in CKD

- Cardiac structural changes – Heeart Echo Parameters, Surface ECG P wave
- bPEP/bET (brachial pre-ejection period/ejection time)
- Ankle-Brachial Index
- Arterial stiffness – baPWV (Pulse wave velocity)
- Heart rate variability
- Four limb BP
- Anemia
- Volume status & Lipid profile

Increased LA Diameter & Decreased LVEF are Associated with Increased CV Events in CKD





N=505, Stage 3-5

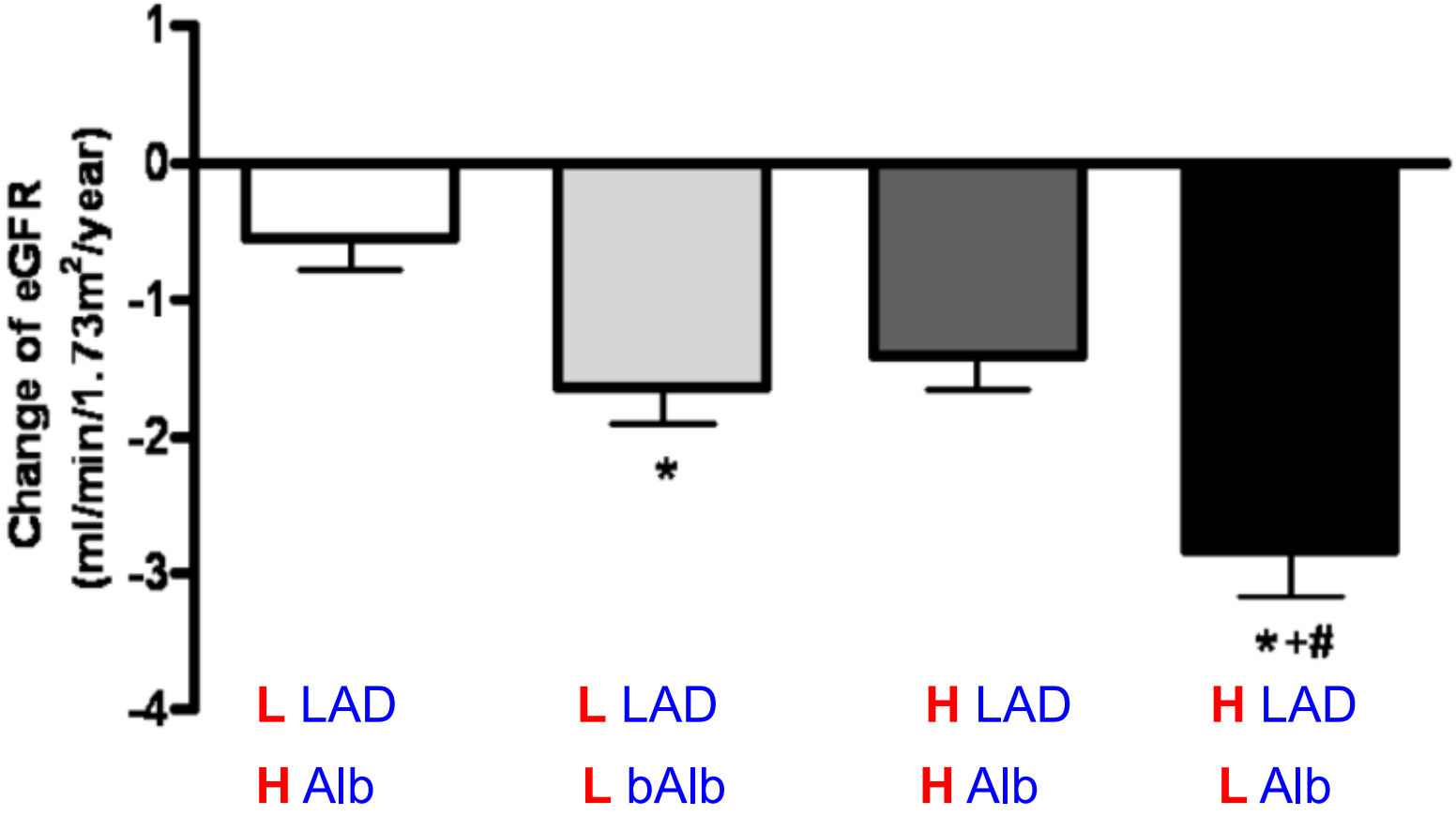
Chen & Chen, NDT 2012;27:1064-70

Increased LAD & Decreased LVEF are Associated with Rapid Renal Function Decline

Echocardiographic data				
aortic root diameter (cm)	0.05 (−0.59, 0.68)	0.88	—	—
LA diameter (cm)	−0.97 (−1.38, −0.56)	<0.01	−0.5 (−0.89, −0.11)	0.01
LV relative wall thickness	1.36 (−0.71, 3.43)	0.20	—	—
LV geometry				
non-LVH	Reference		Reference	
concentric LVH	−1.03 (−1.70, −0.35)	0.03	—	—
eccentric LVH	−1.02 (−1.64, −0.4)	0.01	—	—
observed/predicted LVM (%)	−0.01 (−0.01, 0)	0.02	—	—
inappropriate LVM	−0.53 (−1.13, 0.07)	0.08	—	—
LVEF (%)	0.09 (0.07, 0.11)	<0.01	0.06 (0.03, 0.08)	<0.01
mwFS (%)	0.14 (0.06, 0.22)	0.01	—	—
E/A <1	−0.09 (−0.76, 0.59)	0.80	—	—

N=415, Stage 3-5, Follow 27.3m Chen & Chen, CJASN 2011;6:2750-8

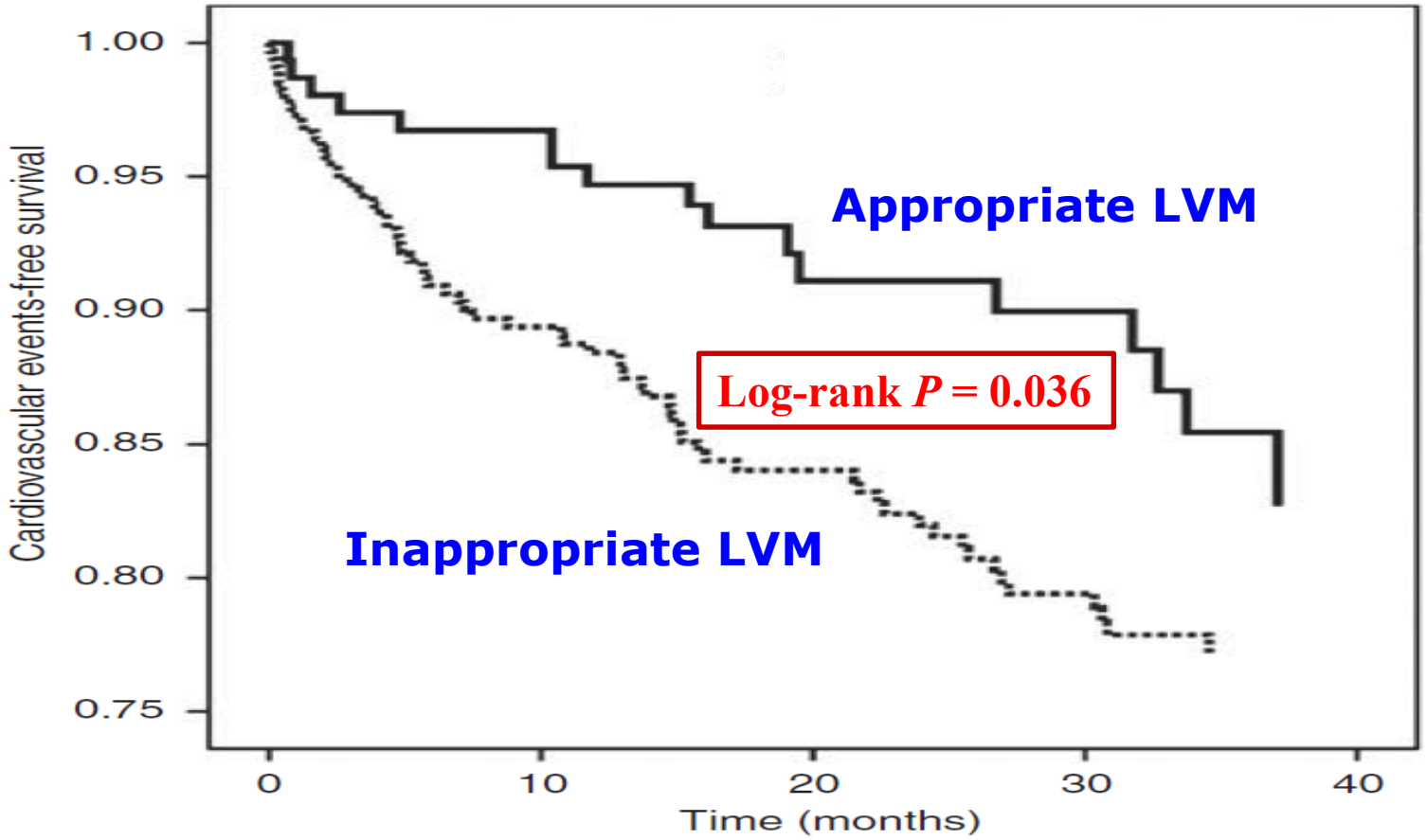
Combination of High LAD & Low Albumin is Associated with Renal Function Decline and Dialysis



N=395, Stage 3-5

Chen & Chen, Int J Med Sci 2013;10:575-84

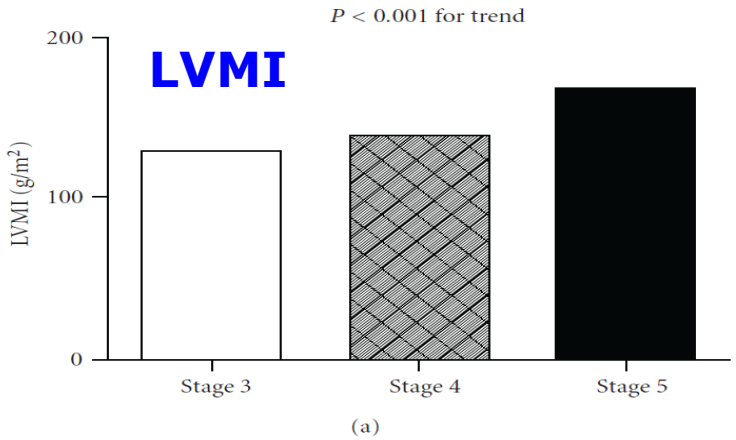
Inappropriate LVM is Associated with Increased CV Events in CKD

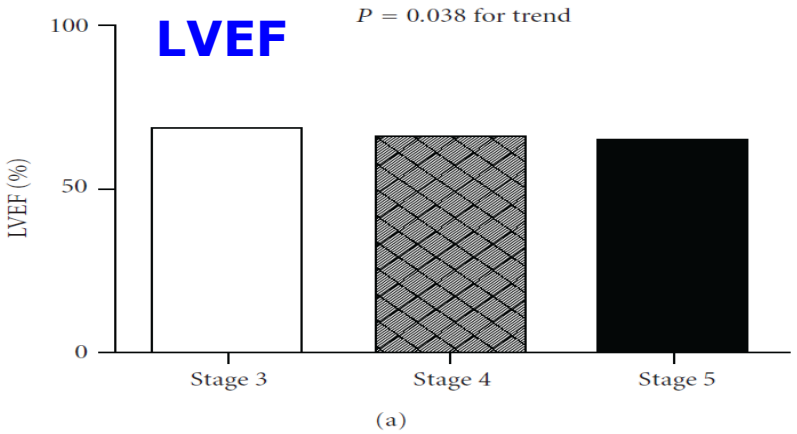


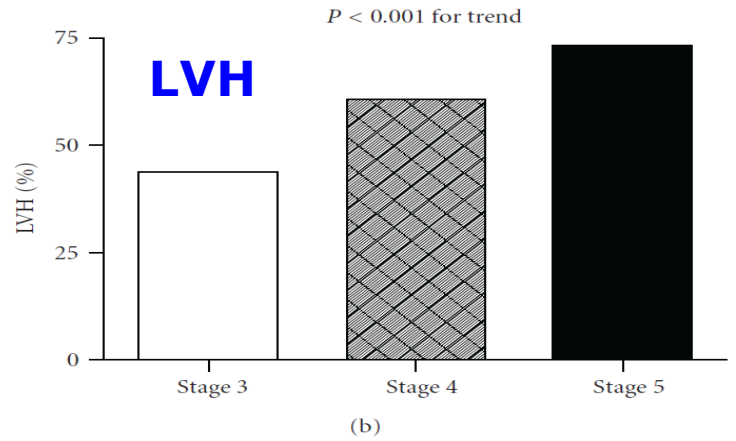
N=485, Stage 3-5

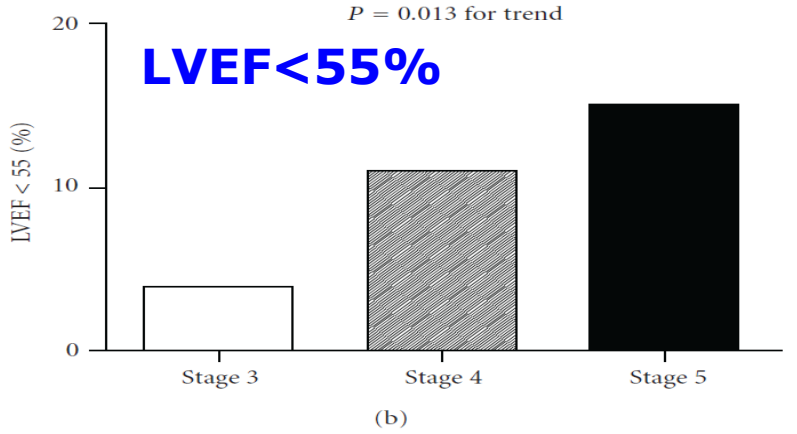
Chen & Chen, Hypertens Res. 2012;35:832-8

Increased LVMI & Decreased LVEF Correspond with CKD Stages in DM









N=285, DM Stage 3-5

Chen & Chen, Exp Diabetes Res 2012;2012:789325

High UA & LVMI are Associated with Rapid Renal Progression & Dialysis

Parameters	commencement of dialysis: Hazard ratio (95% CI)	commencement of dialysis: P	rapid renal progression: Odds ratio (95% CI)	rapid renal progression: P	change of eGFR: Unstandardized coefficient β (95% CI)	change of eGFR: P
Lower UA and LVMI	1	P = 0.23 (df = 3)	1	P = 0.20 (df = 3)	–0.080 (–0.512, 0.351)	0.72
Higher UA and lower LVMI	1.180 (0.531, 2.624)	0.68	1.799 (0.793, 4.081)	0.16	–1.651 (–2.190, –1.111)	< 0.001
Lower UA and higher LVMI	1.027 (0.499, 2.111)	0.94	2.032 (0.919, 4.493)	0.08	–1.414 (–1.959, –0.870)	< 0.001
Higher UA and LVMI	1.830 (1.007, 3.326)	0.048	2.231 (1.058, 4.705)	0.04	–2.363 (–2.795, –1.931)	< 0.001

Multivariate model: adjusted for age, diabetes mellitus, hypertension, coronary artery disease, cerebrovascular disease, 4 study groups, mean arterial pressure, albumin, log triglyceride, total cholesterol, baseline eGFR, proteinuria (negative, 1+, and > 1+), LVEF < 50%, and medications including ACEIs and/or ARBs, diuretics, and hypouricemic agents. The study patients were stratified into 4 groups according to sex-specific median values of UA (male: 7.9; female: 7.45 mg/dL) and LVMI (male: 134.7; female: 132.5 g/m^2). Abbreviations are the same as in Table 1.

N=540, Stage 3-5, Follow 33.4m, Rapid progressor: eGFR >-3/y

Chen & Chen, Am J Hypertens 2013;26:243-9

Combination of Lower BMI & Higher LVMI is Associated with CV Events in CKD

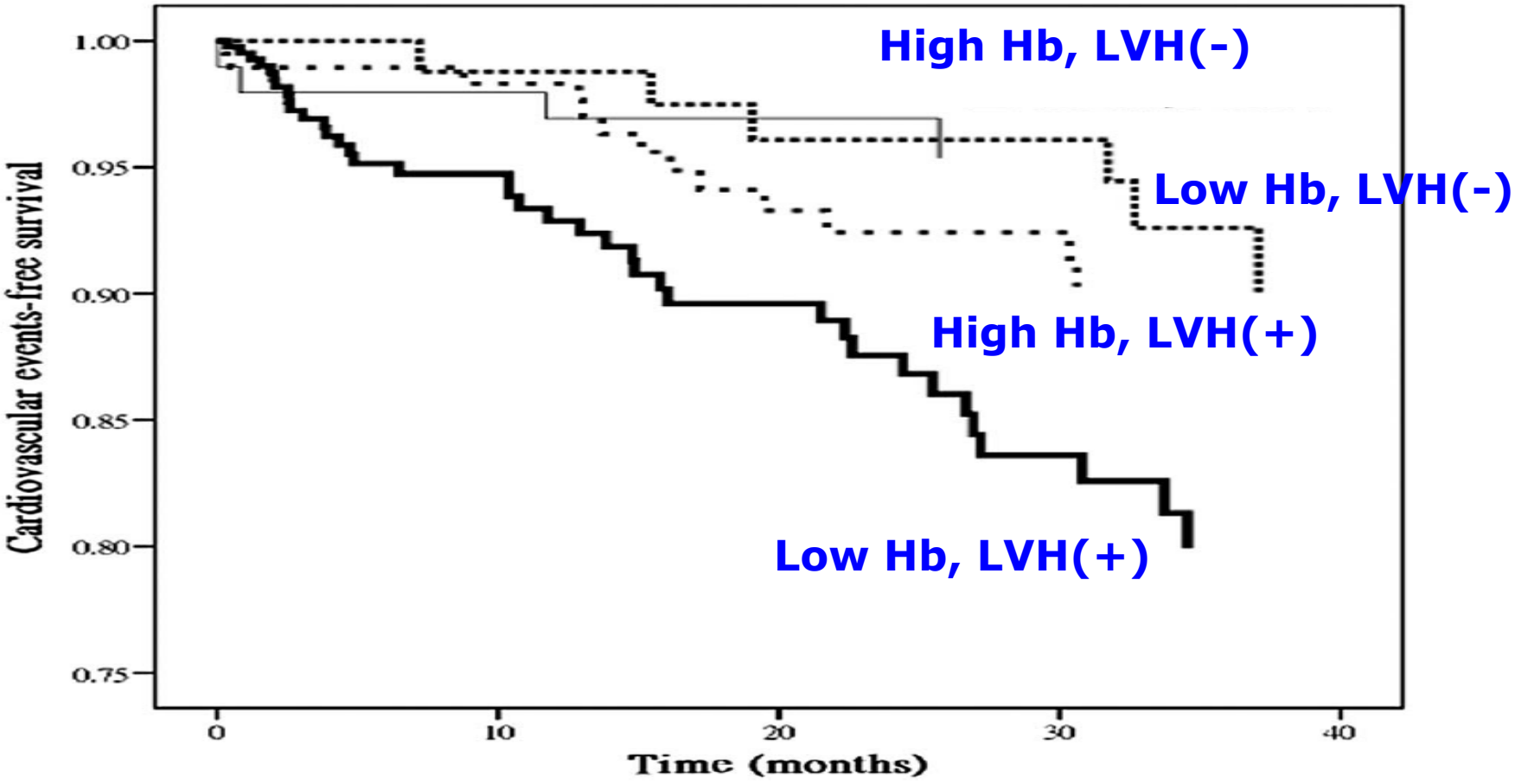
Parameters	Unadjusted		Multivariate adjusted (1)		Multivariate adjusted (2)	
	hazard ratio (95% CI)	*p*	hazard ratio (95% CI)	*p*	hazard ratio (95% CI)	*p*
Higher BMI and lower LVMI	1		1		1	
Lower BMI and LVMI	1.060 (0.490-2.293)	0.882	1.465 (0.646-3.322)	0.361	2.006 (0.768-5.240)	0.155
Higher BMI and LVMI	2.146 (1.094-4.206)	0.026	1.965 (0.973-3.966)	0.060	2.058 (0.900-4.710)	0.087
Lower BMI and higher LVMI	3.178 (1.645-6.140)	0.001	3.511 (1.744-7.072)	< 0.001	3.553 (1.494-8.450)	0.004

Multivariate model (1): adjusted for age, diabetes mellitus, hypertension, coronary artery disease, atrial fibrillation, systolic blood pressure, and pulse pressure.
Multivariate model (2): model (1) + albumin, fasting glucose, log triglyceride, total cholesterol, hemoglobin, eGFR, proteinuria, and ACEI and/or ARB use.

N=523, Stage 3-5

Chen & Chen, Am J Med Sci. 2016 351:91-6

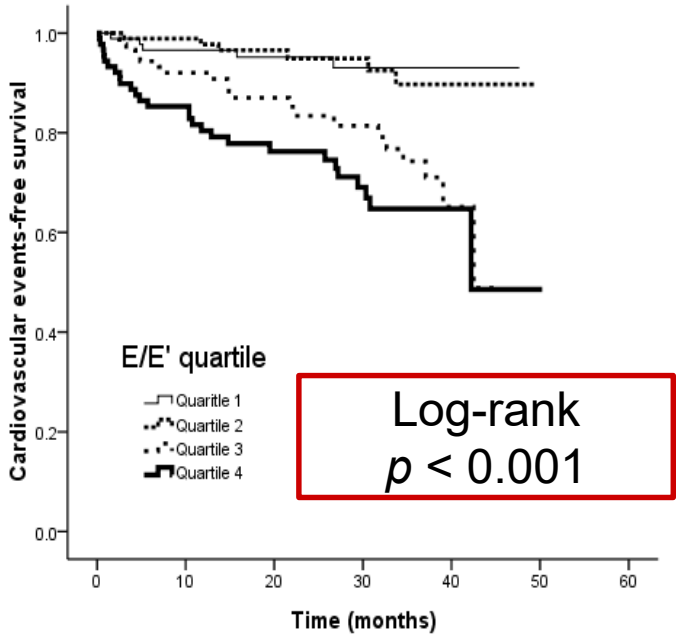
Anemia & LVH are Associated with Renal Function Decline & CV Events

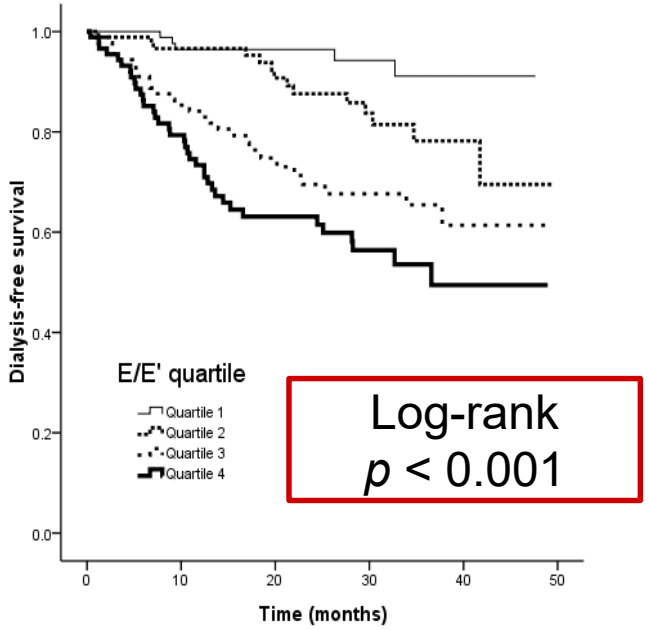


N=415, Stage 3-5

Chang & Chen, Am J Med Sci 2014; 347:183-9

High E/Ea is Associated with CV Events and Dialysis in CKD



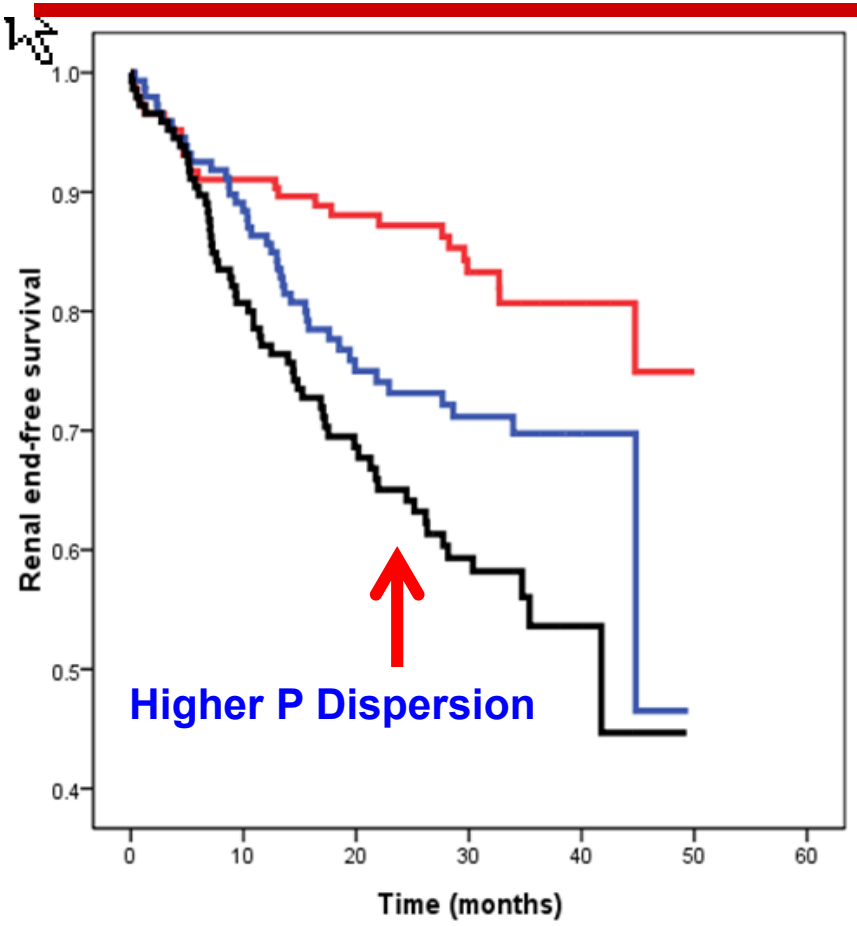


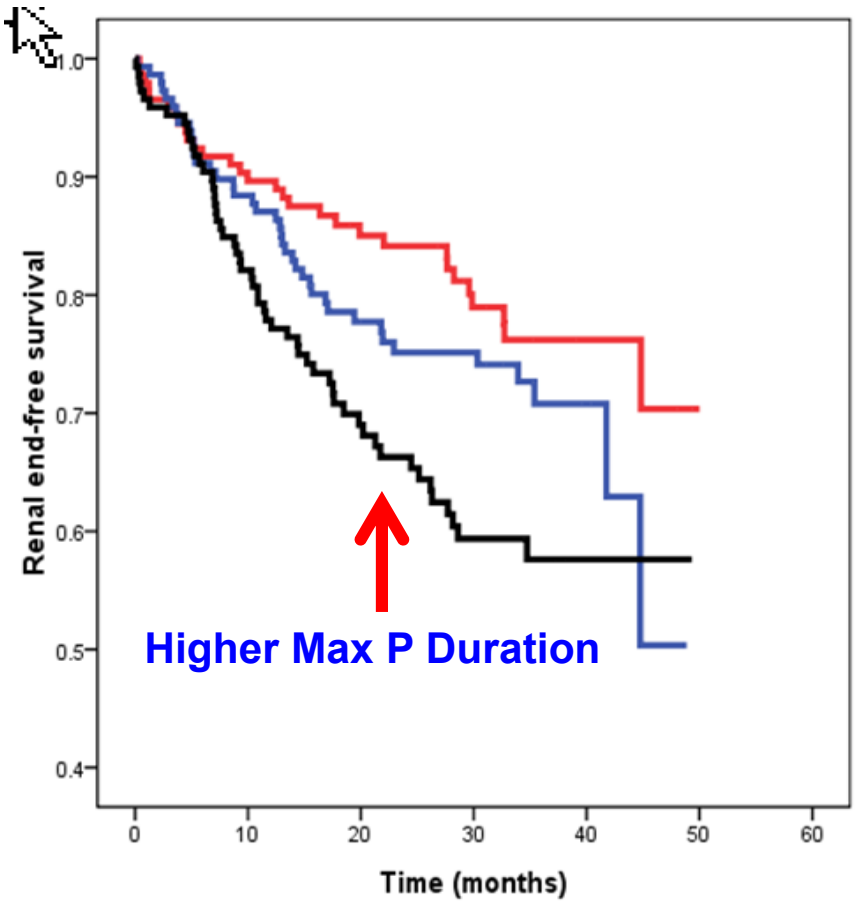
Transmitral E-wave velocity (E)/ Early diastole mitral annulus velocity (Ea): LV diastolic function, the higher the worse.

N=356, Stage 3-5, Follow 24m

Chen & Chen, Nephron Clin Pract 2013;11;123:52-60

High ECG P Wave Dispersion & Maximum P Wave Duration are Associated with Progression to Dialysis & Death in CKD

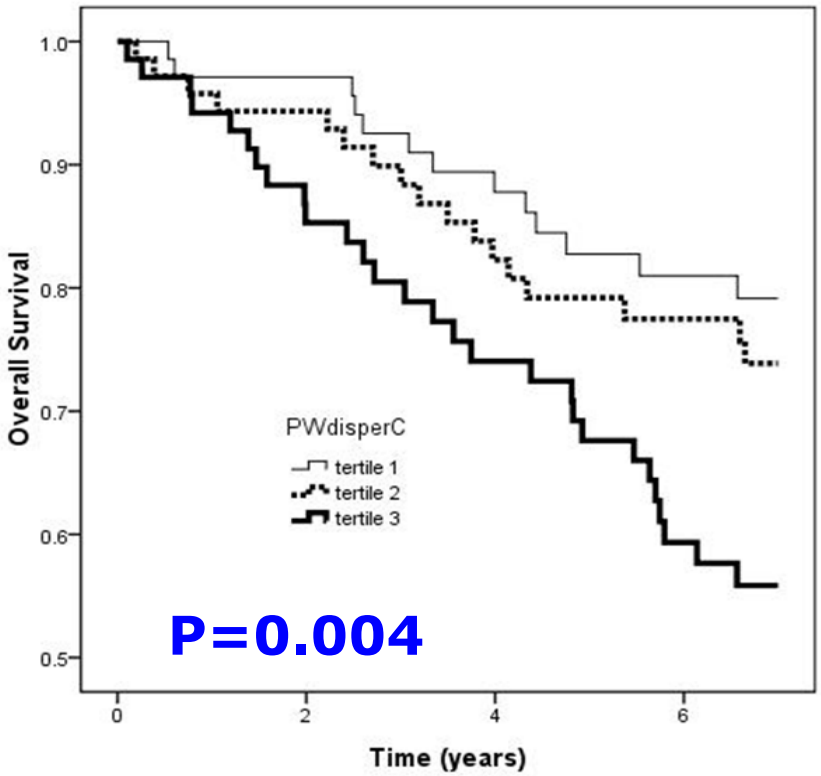


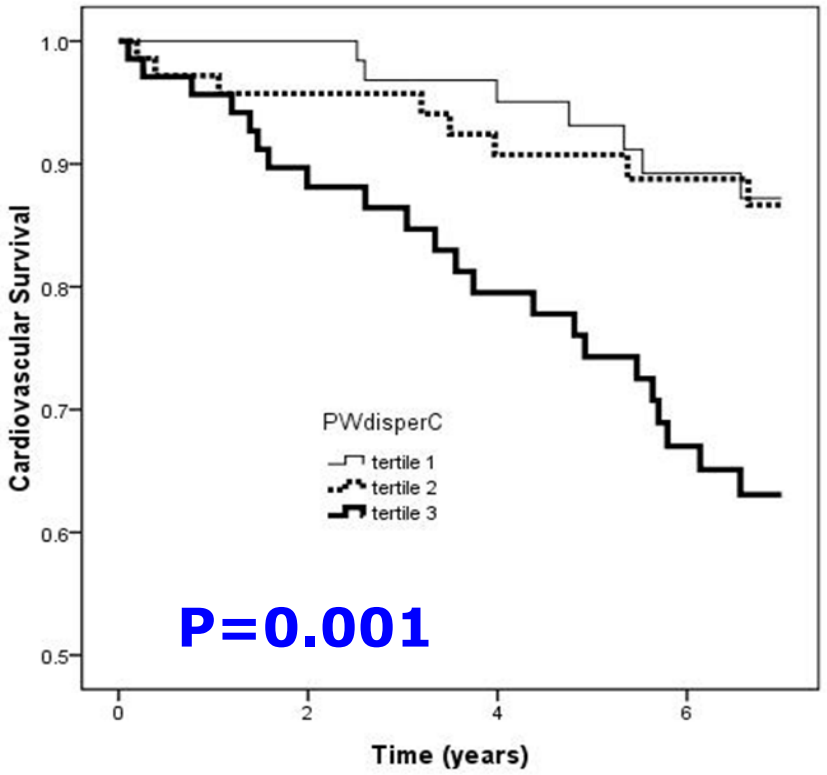


N=439, Stage 3-5

Chen & Chen, PLoS One. 2014;9:e101962

High P wave Dispersion is Associated with Overall and CV Mortality in HD





Overall Survival

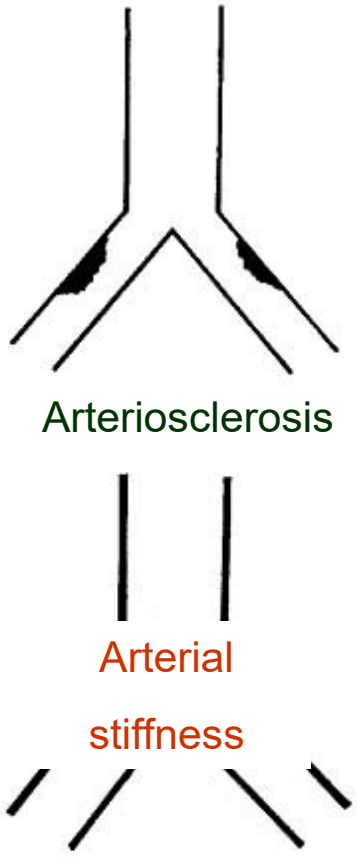
CV Survival

N=209 HD, Follow 5.4yrs

Chen & Chen, Am J Nephrol 2015;42:198-205

Colin VP System

VP1000 - ABI, baPWV, bPEP/bET

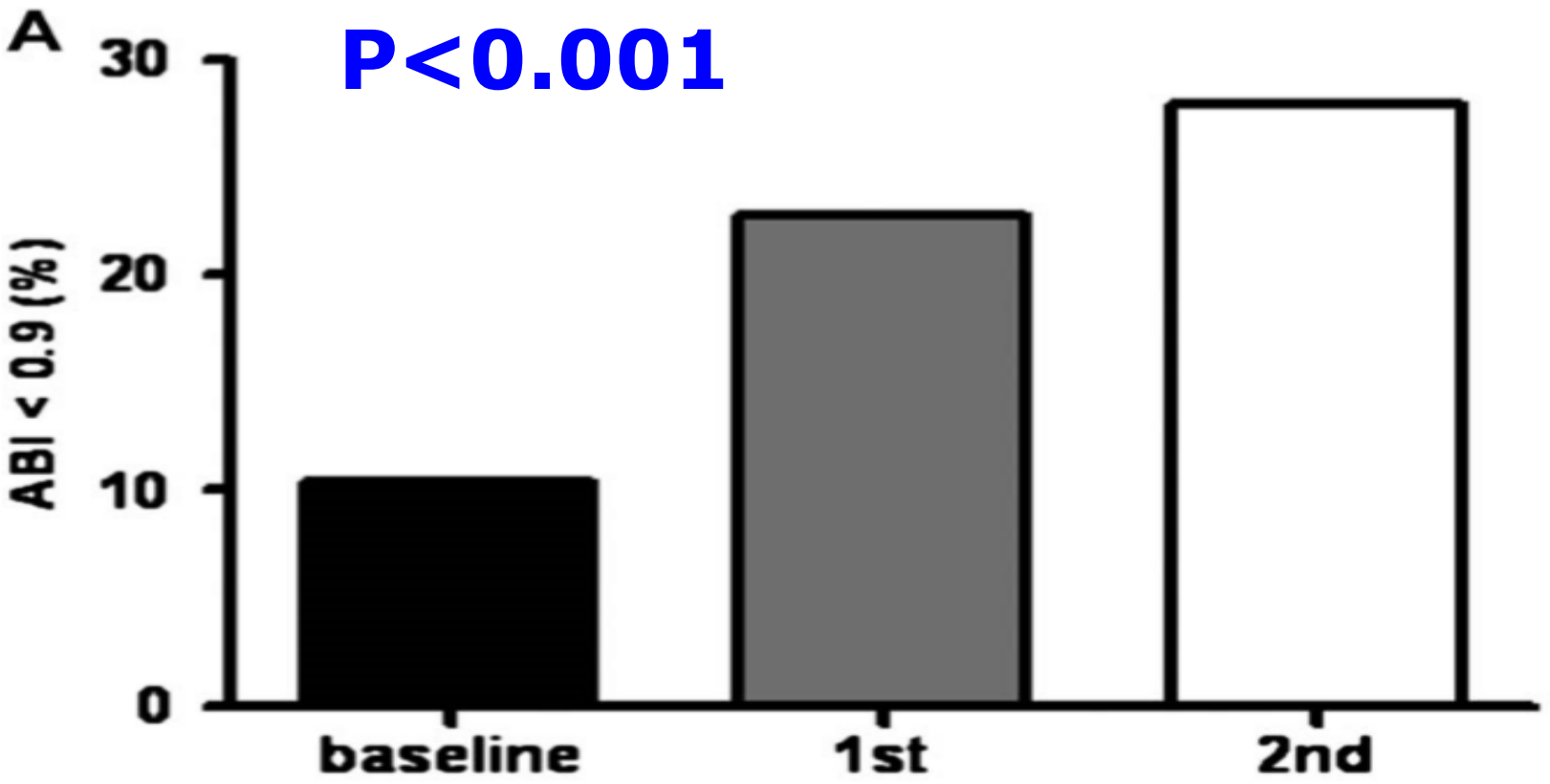


1.ABI/API
(Ankle Brachial Pressure Index)—
Lower extremity artery stenosis

2. baPWV
(Brachial-Ankle Pulse Wave Velocity)
Artery stiffness

3. bPEP/bET(brachial pre-ejection period/brachilal ejection time)
Systolic time interval (STI)

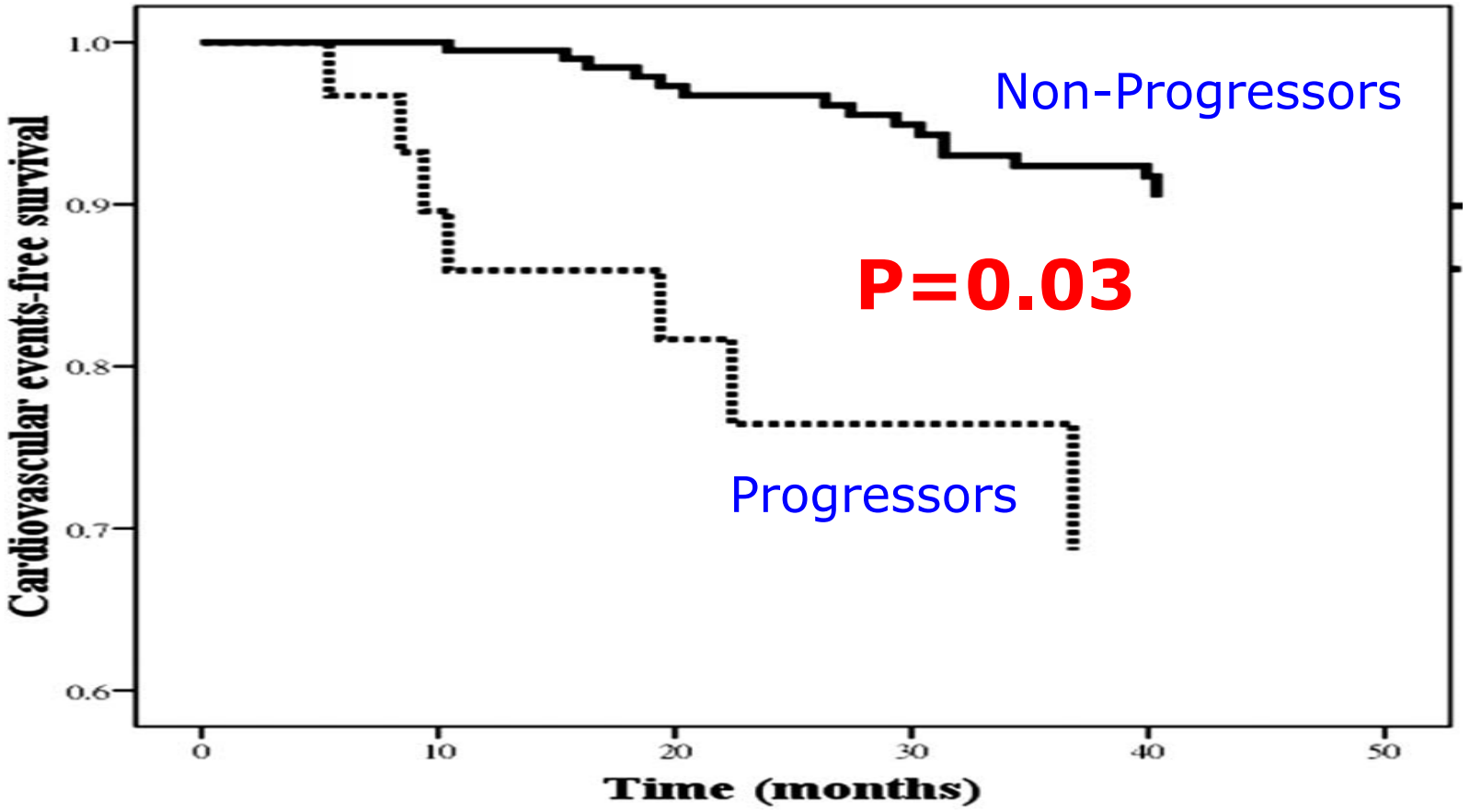
Increasing Prevalence of Peripheral Arterial Occlusive Disease (ABI<0.9) after Initiating HD



N=237 HD, Follow 2yrs

Chen & Chen, AJMS 2012 ;343:440-5

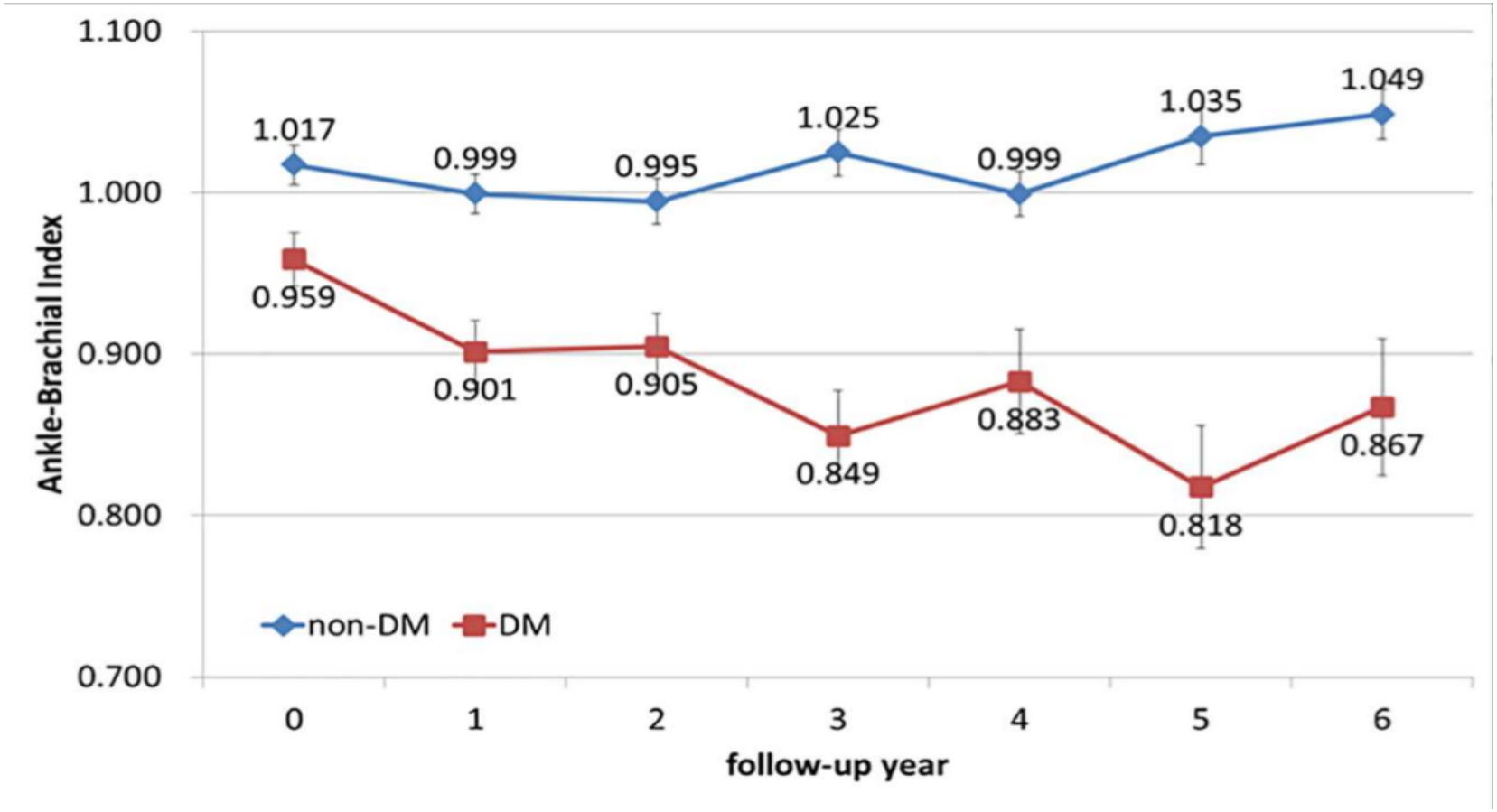
Faster Decrease in ABI over time is Associated with Higher CV Mortality



N=234 HD, Follow 37.8m

Chen & Chen, AJMS 2012 ;344:457-61

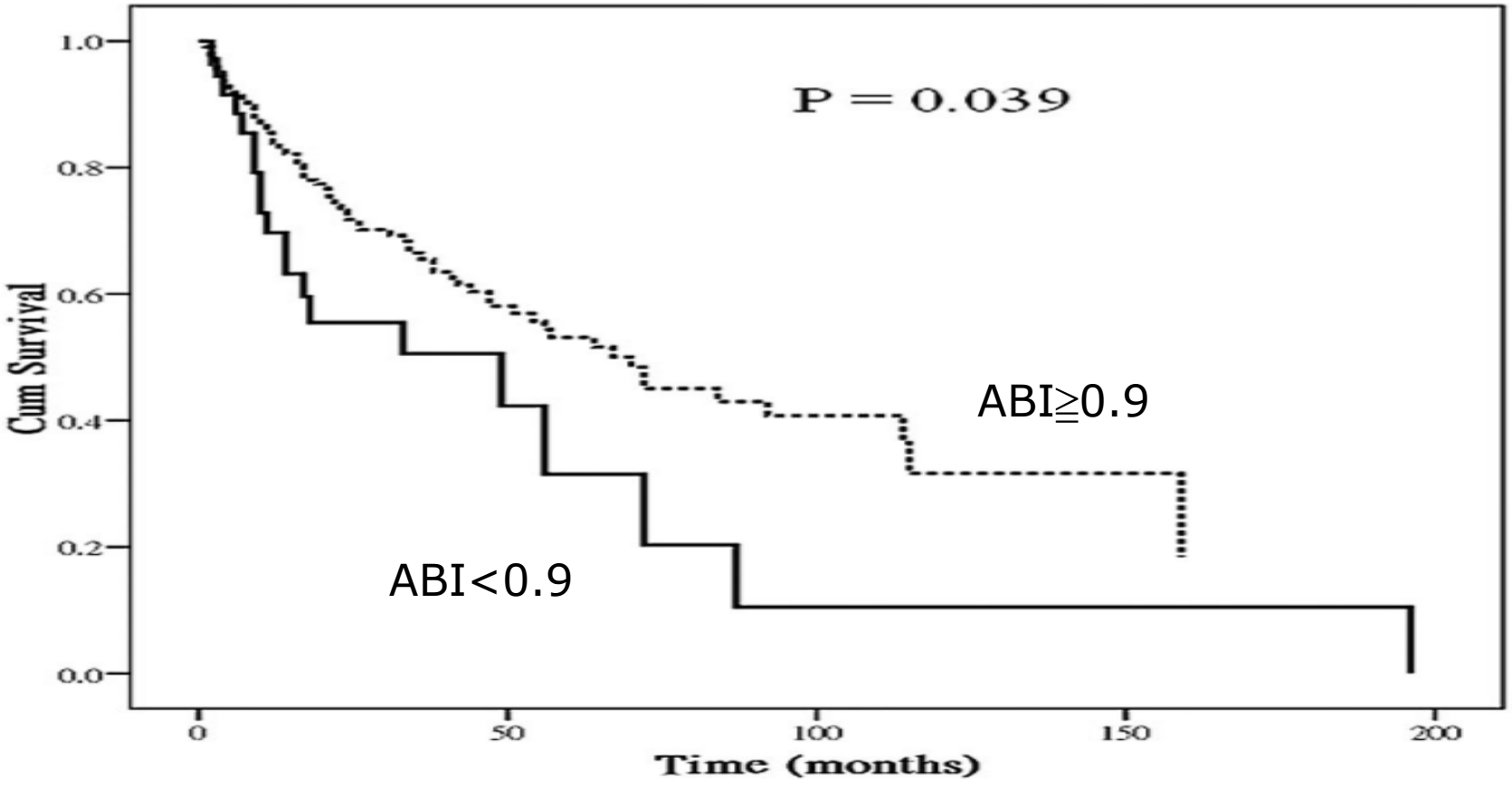
DM is Associated with Faster Decline in ABI



N=296 HD, Follow 6yrs

Chen & Chen, Plos One 2017
https://doi.org/10.1371/journal.pone.0175363

ABI <0.9 is Significantly Correlated with Increased Vascular Access Failure



N=222 HD, Follow 42.2m

Chen & Chen, CJASN 2009 ;4:128-34

Either ABI<0.9 or ≧1.3 is Associated with LVH in CKD

Characteristics	Normal (n = 244)	Concentric remodeling (n = 58)	Eccentric LVH (n = 284)	Concentric LVH (n = 98)	*P*
ABI					
≥0.9 to<1.3 (%)	87.7	87.7	80.4*	74.2*	0.001
<0.9 in either leg (%)	5.8	10.8	9.6	10.4	0.041
≥1.3 in either leg (%)	6.5	1.5	10.0	15.3	0.018

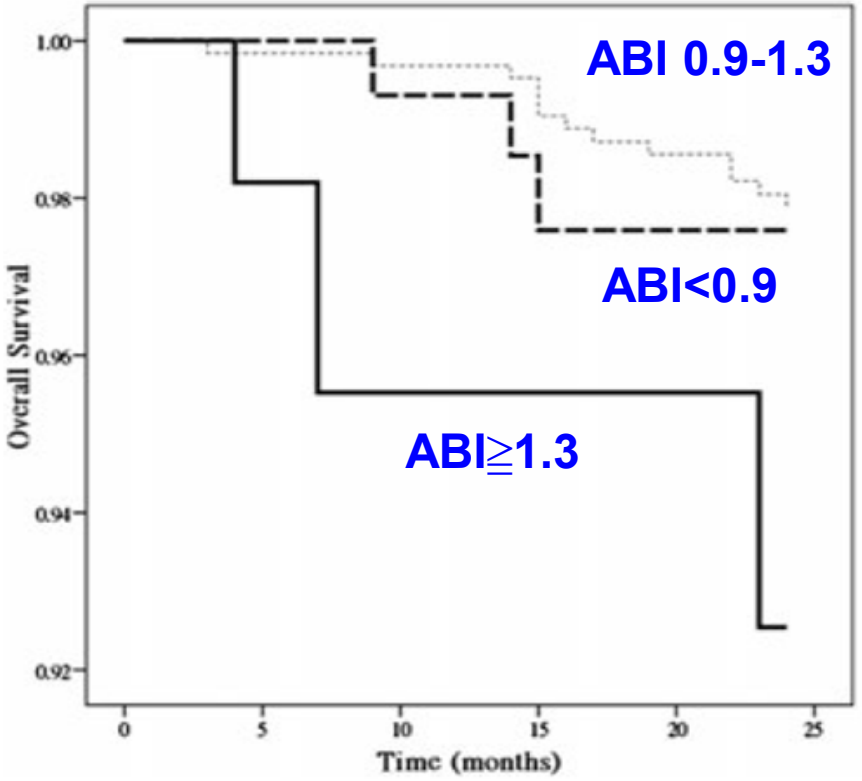
Table 4. Determinants of LVMI in study patients.

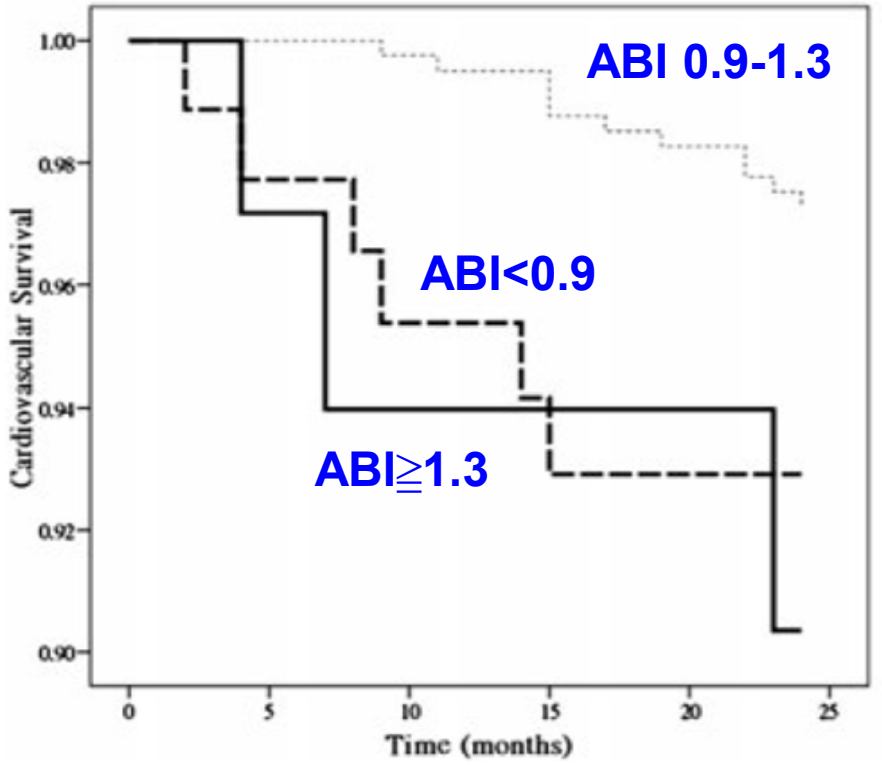
Parameter	Univariate		Multivariate (Forward)	
	Standardized coefficient β	*P*	Standardized coefficient β	*P*
ABI (*versus* ≥0.9 to <1.3)	Reference		Reference	
<0.9 in either leg	0.123	0.001	0.099	0.004
≥1.3 in either leg	0.154	<0.001	0.143	<0.001

N=684, Stage 3-5

Su & Chen, PLoS One 2012;7(9):e44732

Both ABI<0.9 & ≧1.3 are Associated with Overall and CV Mortality in HD and CKD



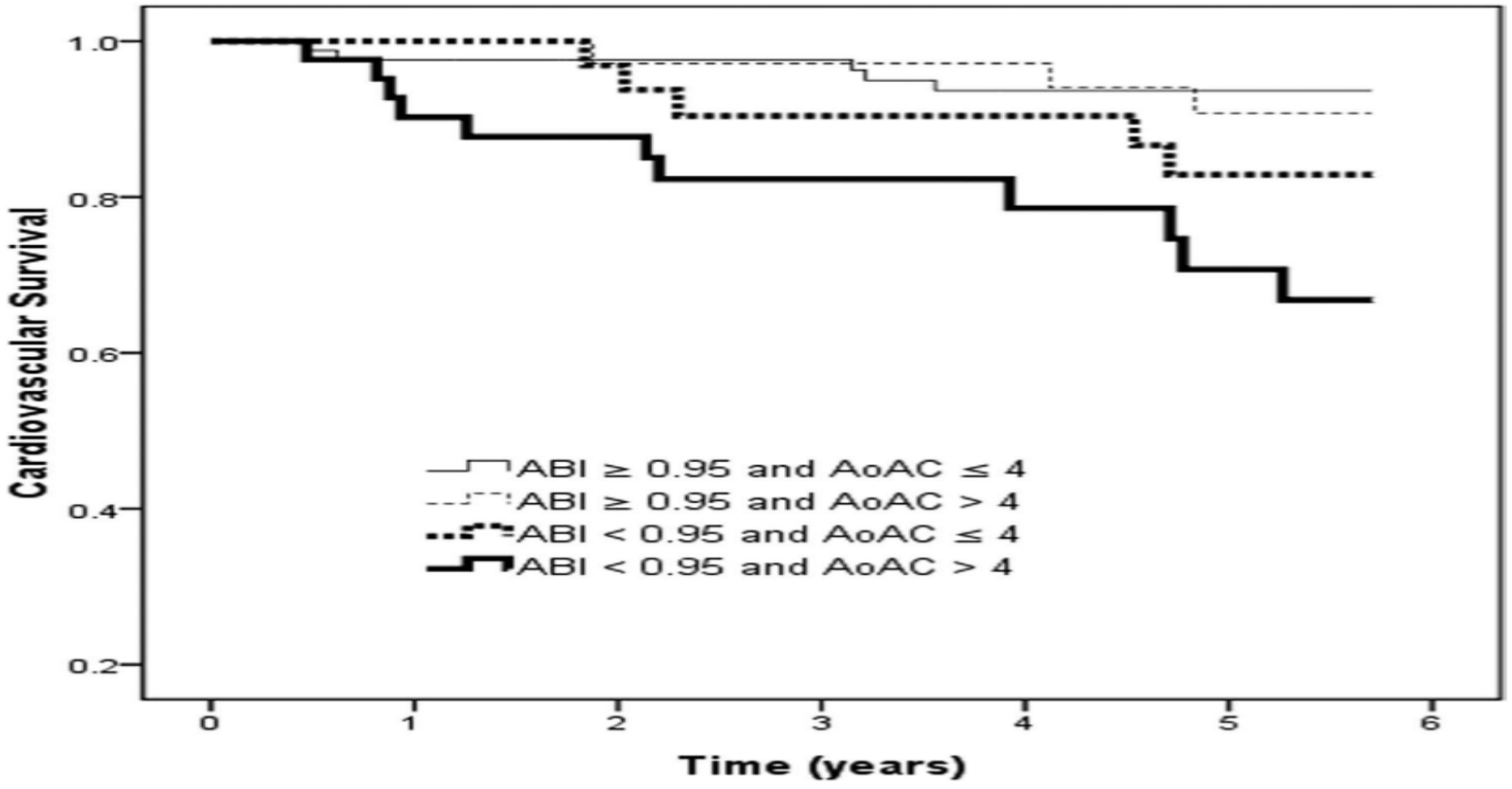


Overall Survival

Cardiovascular Survival

N=69, Stage 3-5, HDN=231 Chen & Chen, Nephrology 2010;15:294-9

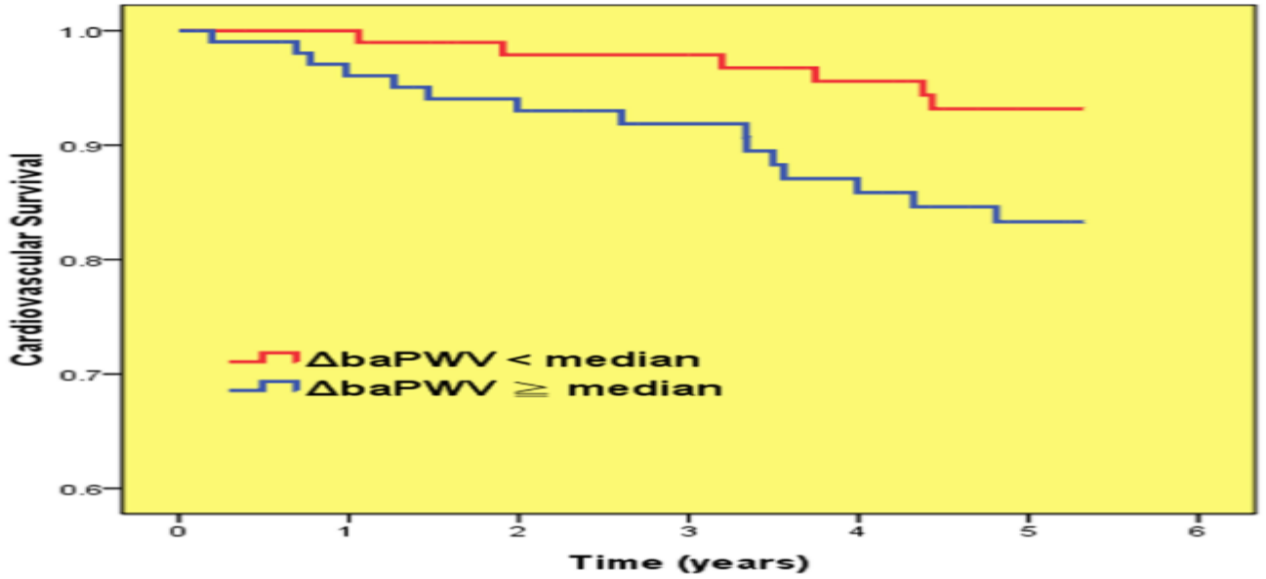
Ankle-Brachial Index and Aortic Arch Calcification Predict CV Mortality



N=197 HD, Follow 5.7yrs

Chen & Chen, Sci Rep 2016 ; DOI: 10.1038/srep33164

Unequal baPWV is Associated with Higher CV Mortality

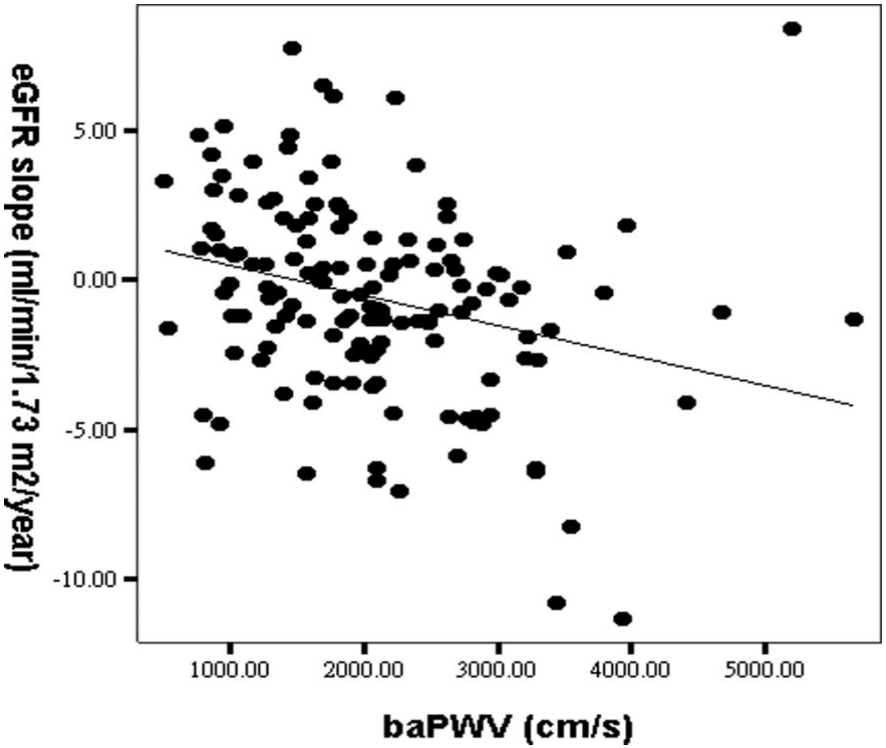


ΔbaPWV < median	101	101	99	99	97	95
ΔbaPWV ≥ median	104	100	97	96	91	89

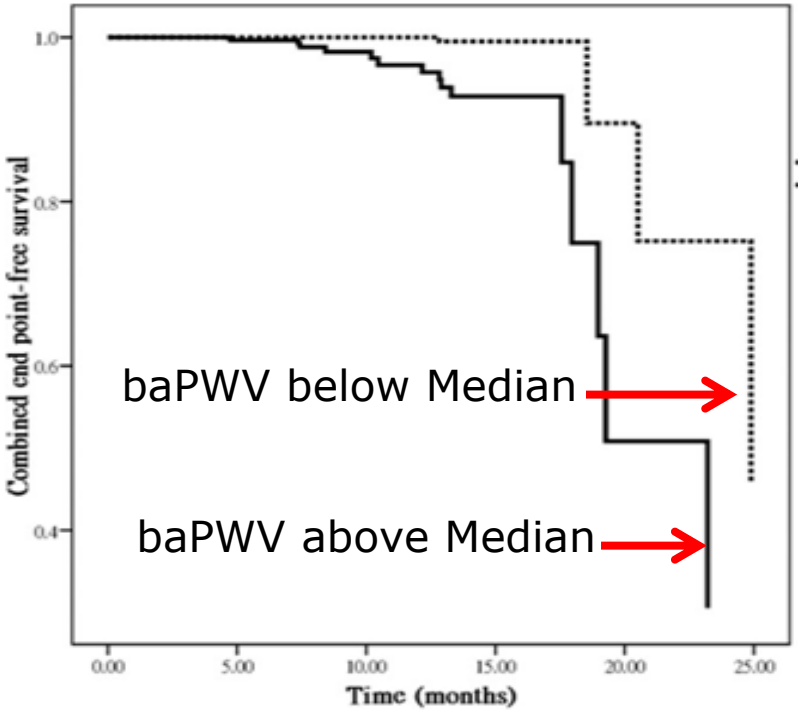
baPWV: Arterial stiffness

N=205 HD, Follow 4.4yrs Wei & Chen, AJMS 2016 ;351:187-93

High baPWV is Associated with Rapid Renal Function Decline and Progression to Dialysis and Death in CKD



eGFR Slope



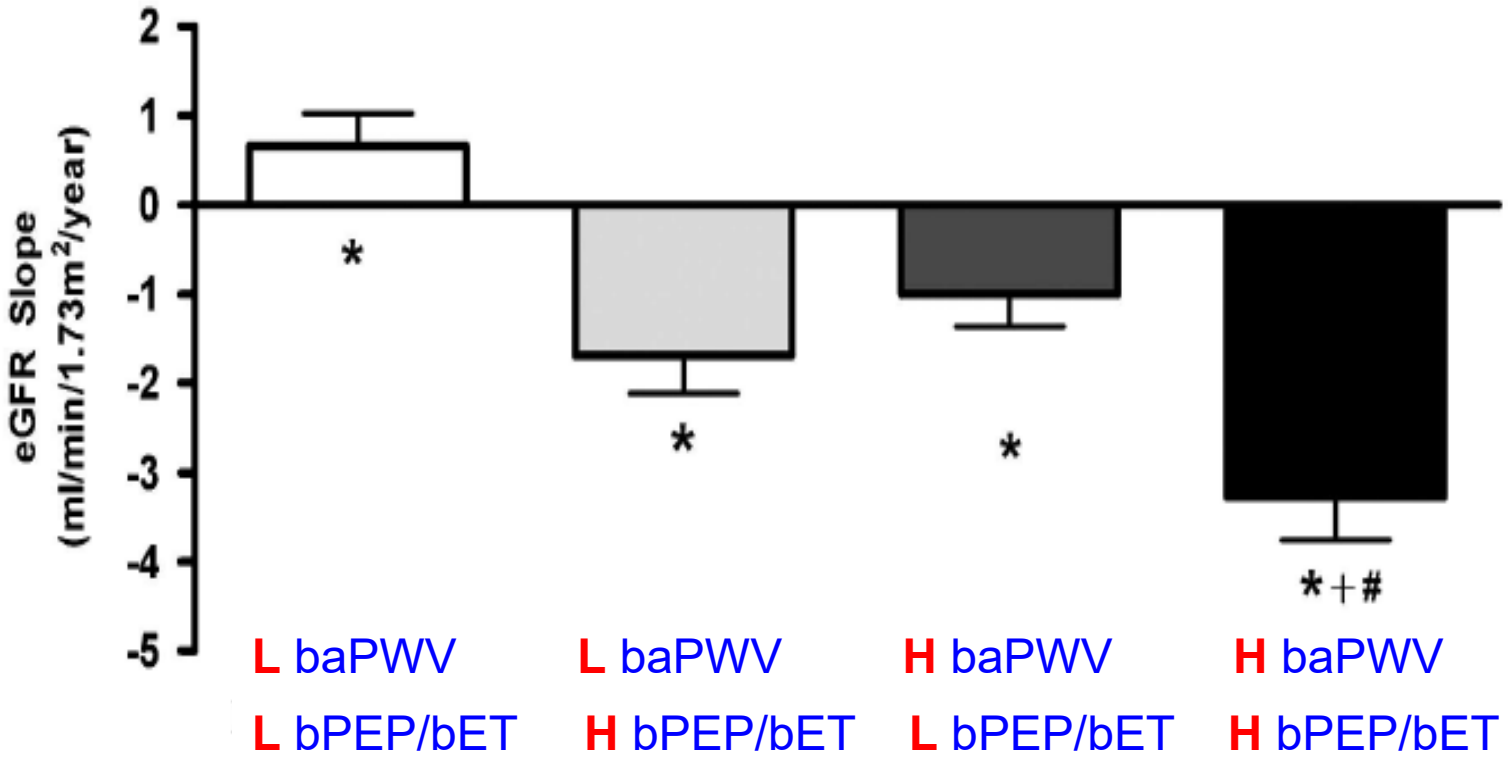
Combined end point-free Survival

baPWV: brachial artery Pulse Wave Velocity (Arterial stiffness)

N=145, Stage 3-5, Follow 14m

Chen & Chen, CJASN 2011;6:724-32

High baPWV and High bPEP/bET are Associated with Rapid Renal Function Decline and Progression to Dialysis in CKD



N=243, Stage 3-5

Chen & Chen, Hypertens Res 2012;35:1159-63

bPEP/bET is associated with Overall and CV Mortality in HD

Parameter	Univariate Hazard ratios (95% CI)	P	Multivariate Hazard ratios (95% CI)	P
Age (per 1 year)	1.025 (0.992–1.060)	0.144	0.997 (0.949–1.048)	0.919
Male *vs.* female	1.035 (0.447–2.395)	0.936	1.573 (0.528–4.686)	0.416
Duration of dialysis (per 1 month)	0.987 (0.974–0.999)	0.041	0.987 (0.771–1.003)	0.107
Uric acid (per 1 mg per 100 ml)	0.864 (0.648–1.151)	0.318	—	—
PTH (per 1 pg ml^{-1})	0.999 (0.997–1.000)	0.061	—	—
hsCRP (per 1 mg l^{-1})	1.124 (0.961–1.314)	0.144	—	—
Kt/V (per 1.0)	0.868 (0.153–4.931)	0.873	—	—
Cardiothoracic ratio >50%	1.268 (0.550–2.925)	0.577	—	—
Medications				
Aspirin use	2.863 (1.120–7.319)	0.028	1.375 (0.349–5.427)	0.649
ACEI and/or ARB use	2.529 (1.061–6.029)	0.036	2.087 (0.741–5.879)	0.164
Statins use	0.376 (0.111–1.269)	0.115	—	—

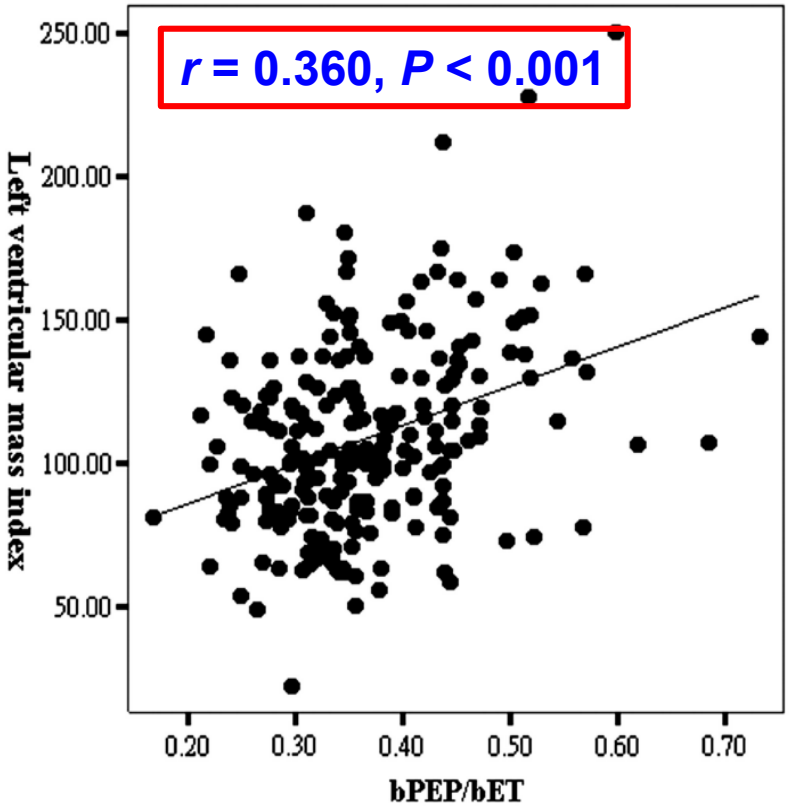
Parameter	Univariate Hazard ratios (95% CI)	P	Multivariate Hazard ratios (95% CI)	P
Age (per 1 year)	1.021 (0.981–1.063)	0.303	0.988 (0.927–1.053)	0.712
Male *vs.* female	1.086 (0.394–2.996)	0.873	2.067 (0.519–8.238)	0.303
Duration of dialysis (per 1 month)	0.989 (0.974–1.003)	0.129	—	—
Uric acid (per 1 mg per 100 ml)	0.882 (0.625–1.246)	0.476	—	—
PTH (per 1 pg ml^{-1})	0.998 (0.996–1.000)	0.071	—	—
hsCRP (per 1 mg l^{-1})	1.119 (0.922–1.358)	0.256	—	—
Kt/V (per 1.0)	0.336 (0.040–2.836)	0.317	—	—
Cardiothoracic ratio > 50%	1.108 (0.402–3.056)	0.843	—	—
Medications				
Aspirin use	1.887 (0.532–6.688)	0.326	—	—
ACEI and/or ARB use	2.949 (1.050–8.287)	0.040	2.361 (0.626–8.898)	0.204
Statins use	0.368 (0.083–1.633)	0.189	—	—

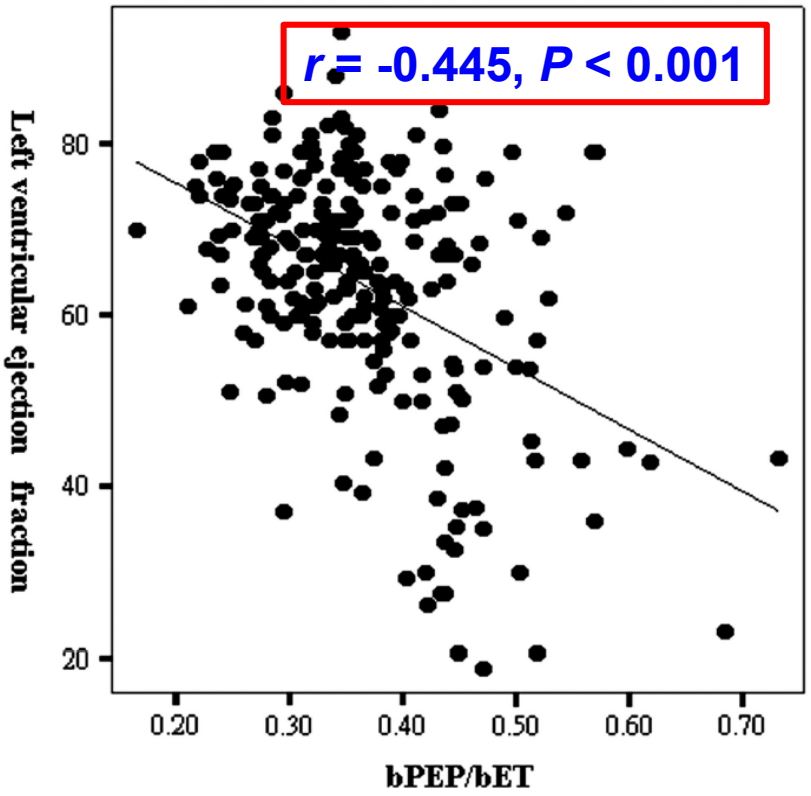
Overall mortality	Univariate		Multivariate	
Parameter	Hazard ratios(95% CI)	P	Hazard ratios(95% CI)	P
bPEP/bET(per 0.01)	1.051(1.005-1.100)	0.030	1.055(1.001-1.112)	0.047
CV mortality	Univariate		Multivariate	
Parameter	Hazard ratios(95% CI)	P	Hazard ratios(95% CI)	P
bPEP/bET(per 0.01)	1.073(1.020-1.128)	0.006	1.080(1.014-1.150)	0.017

N=212 HD, Follow 28.3m

Chen & Chen, Hypertens Res 2010;33:492-8

Higher bPEP/bET is Associated with Higher LVMI and Lower LVEF in CKD





bPEP/bET(brachial pre-ejection period/brachilal ejection time): STI

N=243, Stage 3-5

Chen & Su, NDT 2011;26:1895-902

bPEP/bET is Associated with Increassed CV Events in CKD

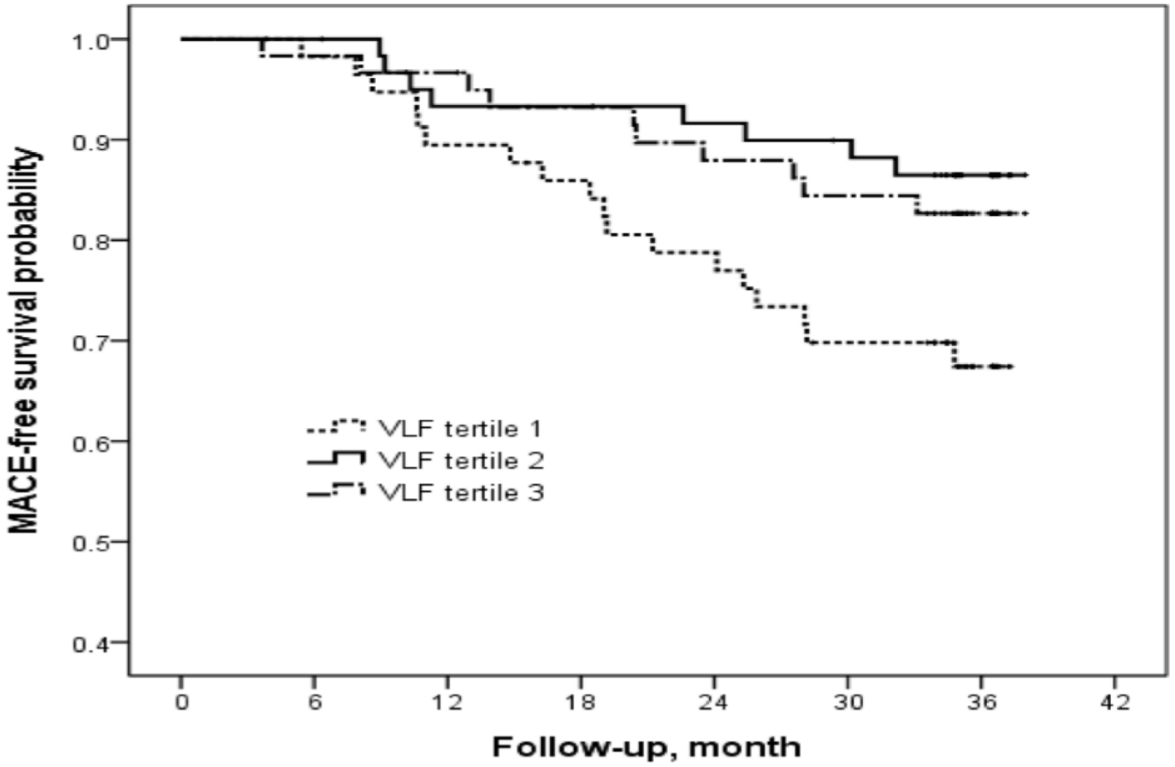
Table 1. Comparison of Baseline Characteristics Between Patients With and Without Cardiovascular Events

Characteristics	Patients without events (n=214)	Patients with events (n=28)	All patients (n=242)
Age (years)	64.5±12.8	64.5±13.4	64.5±12.8
Male gender (%)	64.5	53.6	63.2
ABI	1.11±0.13	1.12±0.09	1.11±0.13
baPWV (cm/s)	1986.9±522.5	2043.7±436.9	1993.4±512.8
bPEP (ms)	100.3±17.9	107.4±23.9	101.1±18.8
bET (ms)	284.9±32.3	269.0±31.1*	283.1±32.5
bPEP/bET	0.36±0.08	0.41±0.11*	0.36±0.09

N=242, Stage 3-5

Chen & Chen, Circ J 2010 ;24;74:2206-10

Heart Rate Variability Predicts Major Adverse CV Events



VLF tertile 1	58	57	52	50	46	41	40	40	(Number at risk)
VLF tertile 2	61	61	57	57	56	55	53	53	
VLF tertile 3	60	59	58	56	53	51	50	50	

N=179 HD, Follow 33.3m Chen & Chen, KBPR 2017;42:76-88

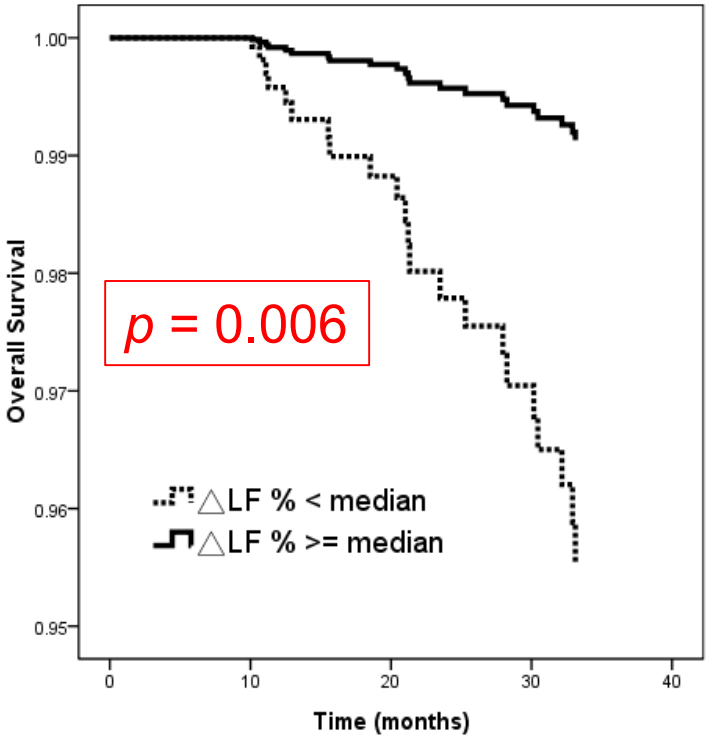
Diminished Heart Rate Variability Changes in Patients with Peripheral Artery Disease

HRV parameters (frequency domain)	Without PAD		With PAD	
	Before HD	After HD	Before HD	After HD
LF (ms^2)	2.5 ± 0.4	2.9 ± 0.5	1.6 ± 0.6	2.7 ± 0.6
HF (ms^2)	2.3 ± 0.4	2.7 ± 0.4*	1.6 ± 0.7	2.5 ± 0.7
LF% (nu)	42.2 ± 2.2	47.0 ± 2.0*	35.3 ± 3.	40.4 ± 3.4
HF% (nu)	33.0 ± 1.6	30.3 ± 1.3	33.2 ± 1.9	30.2 ± 1.9
LF/HF	0.22± 0.12	0.46 ± 0.10*	-0.07 ± 0.17	0.16 ± 0.16

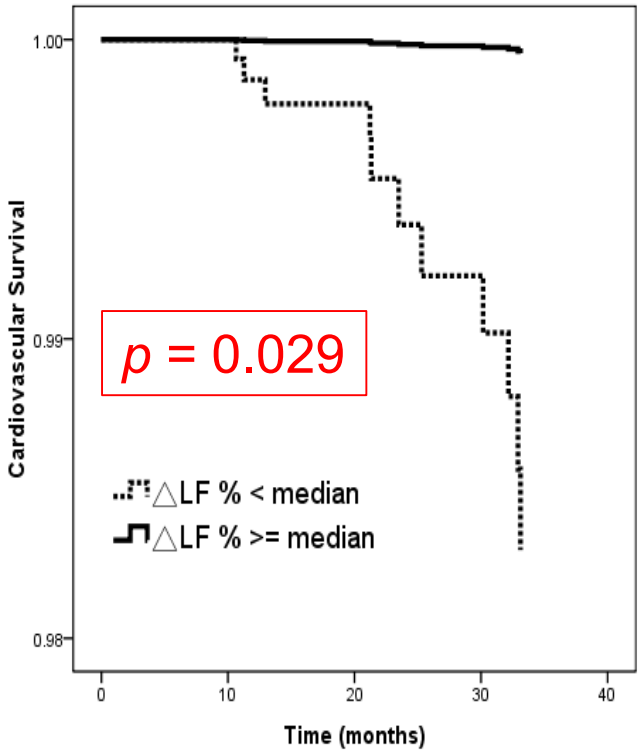
N=161 HD

Chen & Chen, PLoS One 2015;10:e0120459

Less Change in Heart Rate Variability after Single HD is Associated with Higher CV Mortality



All Cause Mortality

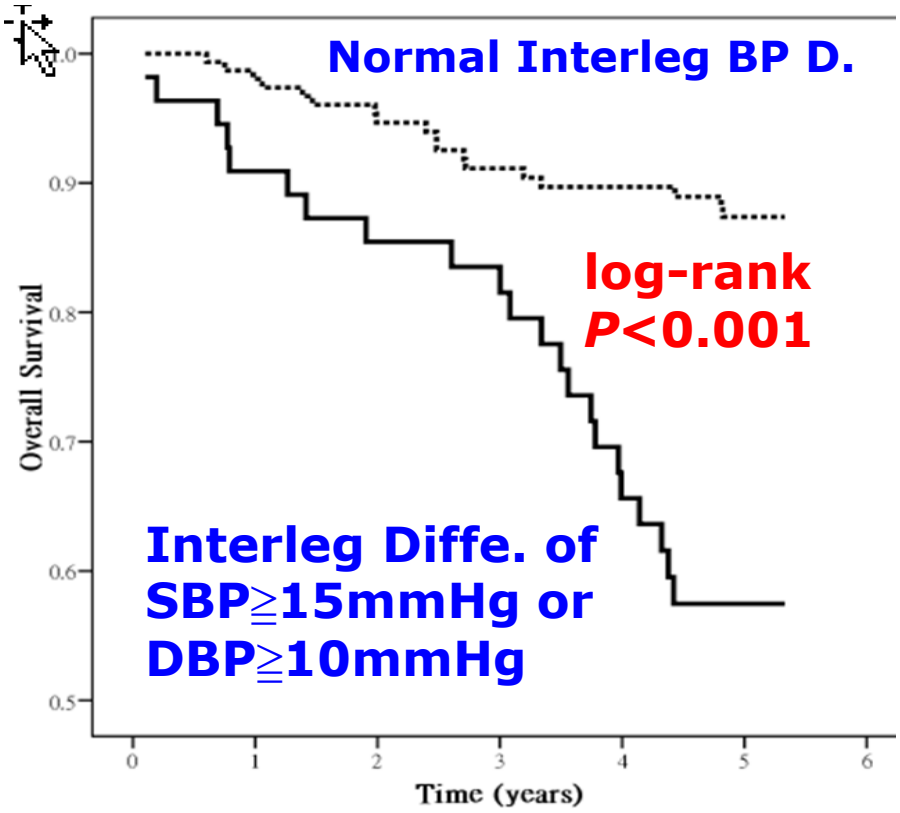


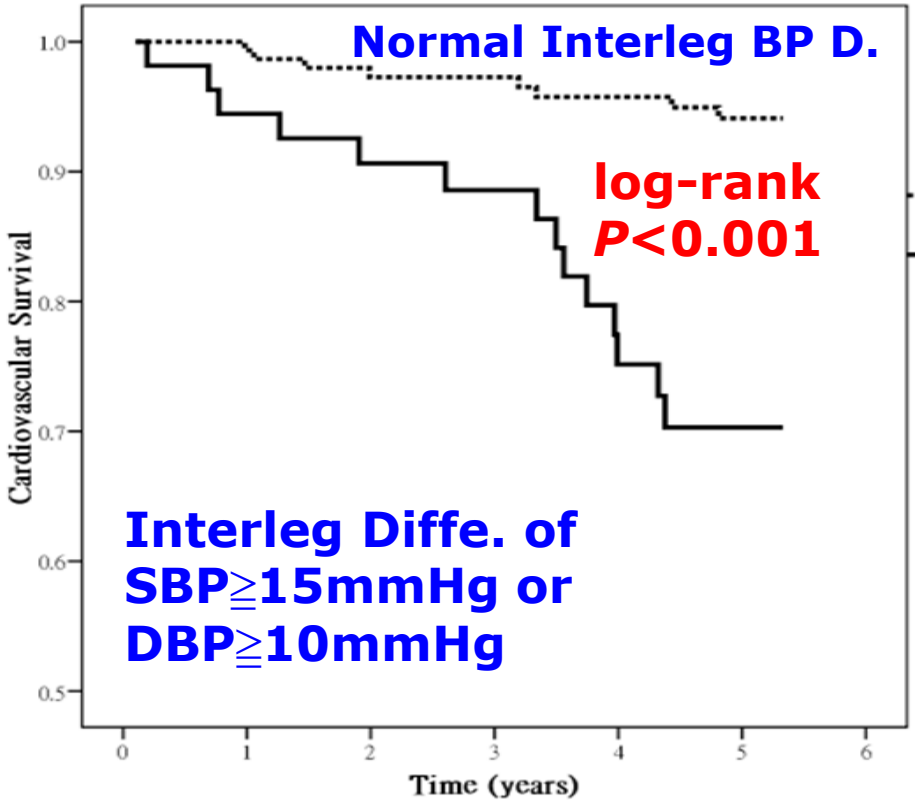
CV Mortality

N=182 HD, Follow 35.2m

Chen & Chen, Sci Rep 2016;6:20597

Interleg BP Difference Predicts Overall and CV Mortality in HD





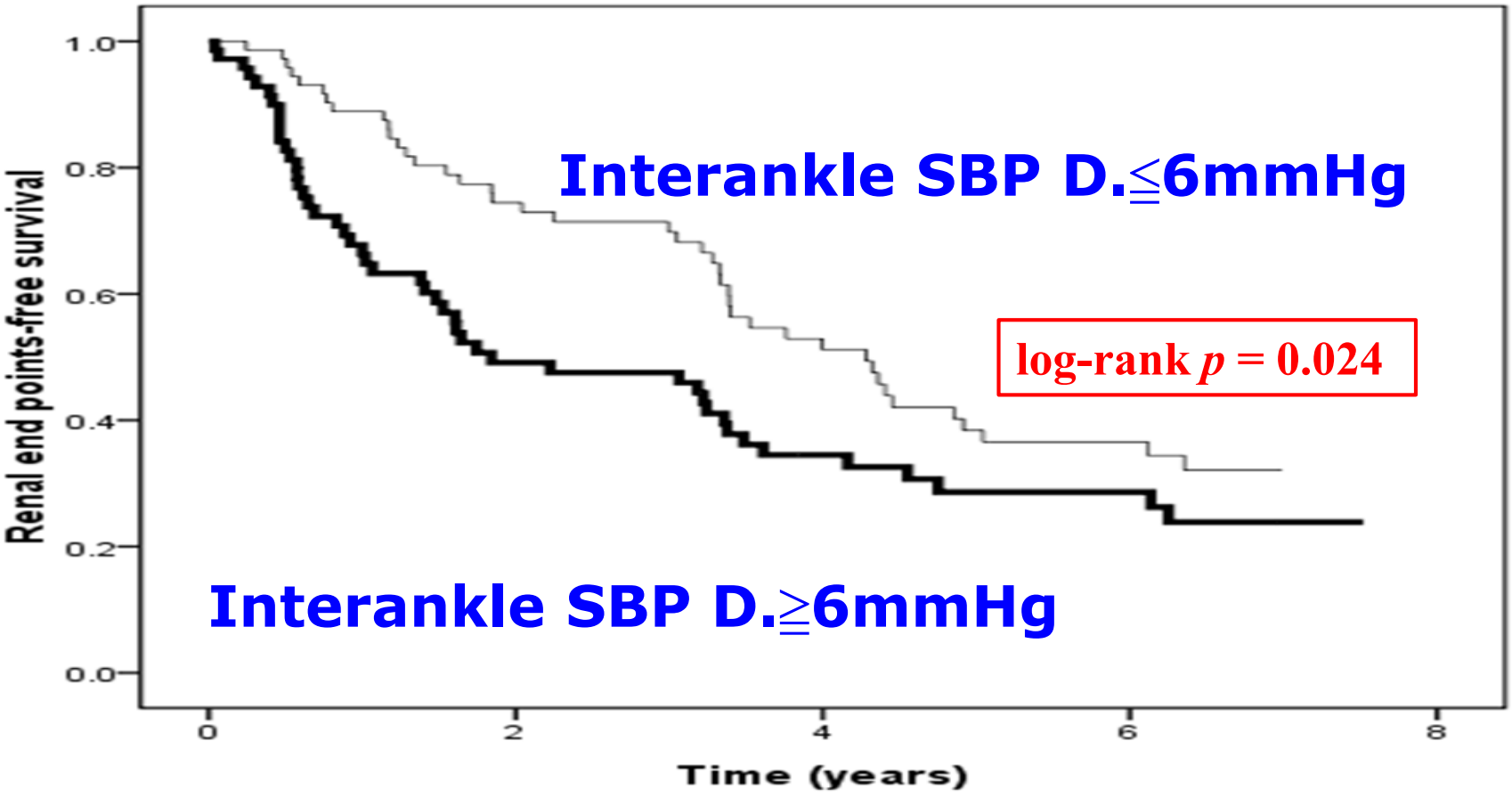
Overall Survival

Cardiovascular Survival

N=110, Follow up 4.4±1.5y

Chen & Chen, CJASN 2012;7:1646-53

Interankle SBP Difference is Associated with a ≧25% Decline in eGFR



N=1445, Stage 3-5, Follow 3.1y

Chen & Chen, Nephrology 2016;21:379-86

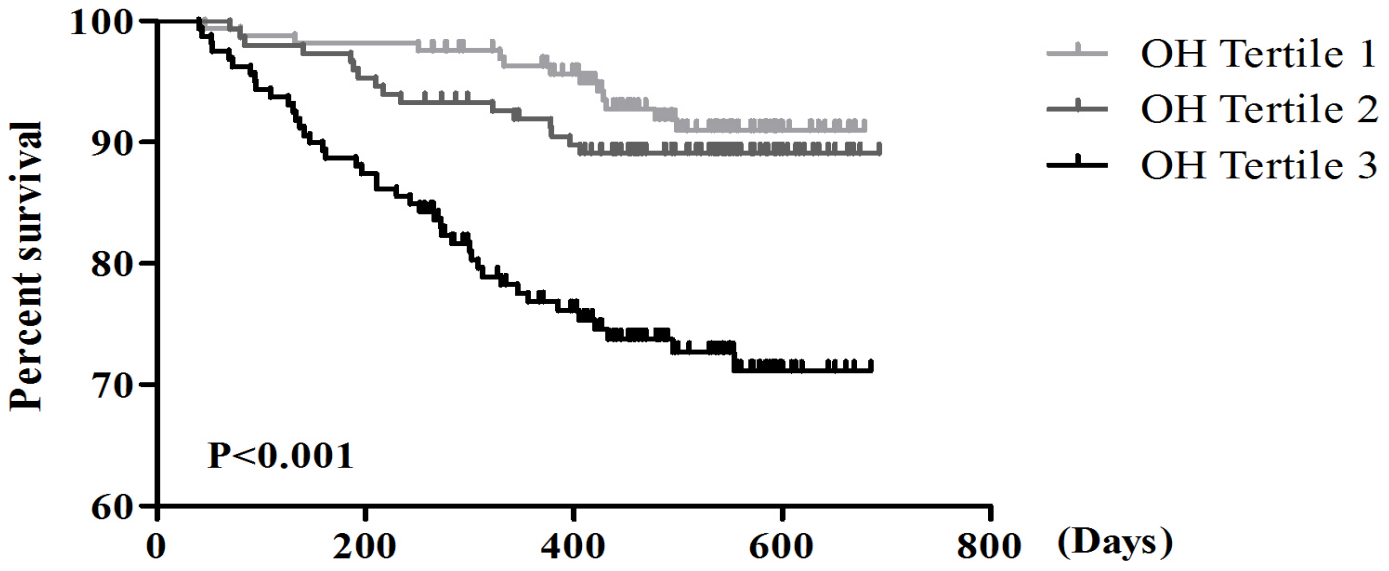
Associations of Hb (6 months after 1ST HD) with Cardiovascular Mortality in Incident HD Patients

	Categorical Hb, g/dL						Continuous Hb
	<8	8-9	9-10	10-11	11-12	>12	per 1 g/dL
Event, n(%)	38 (23.0%)	92 (20.9%)	202 (22.6%)	106 (15.9%)	38 (10.9%)	9 (9.3%)	–
Incidence rate, per 1000 patient years	47.4	36.9	41.9	32.3	28.9	22.2	–
Adjusted HR (95% CI)	1.57* (1.04-2.35)	1.16 (0.86-1.56)	1.22 (0.96-1.57)	1	0.92 (0.63-1.33)	0.81 0.42-1.55)	

N=485, Follow up 15yrs

Hung & Chen, KMUH

Overhydration is Associated with Progression to RRT in CKD



OH Tertile 1	164	161	157	151	(No. Patients at Risk)
OH Tertile 2	149	142	134	133	
OH Tertile 3	159	139	122	117	

N=472, Stage 4-5, Follow 17.3m Tsai & Chen, AJKD 2014;63:68-75

Overhydration is Associated with Overall and CV Mortality in CKD

	Entire Cohort N=478	△HS<7% N=239	△HS≧7% N=239	P-value
Patient-year of follow-up	763.5	434.4	329.1	<0.001
Combined outcomes per 100 patient-year (95%CI)	8.6 (6.7-11.0)	4.4(26.4-68.4)	14.3(10.5-19.0)	<0.001
Cardiovascular morbidity per 100 patient-year (95%CI)	6.7(5.0-8.8)	3.0(1.6-5.1)	11.5(8.2-15.9)	<0.001
Death per 100 patient-year (95%CI)	3.3(2.1-4.8)	1.4(0.5-3.0)	5.8(3.5-9.0)	0.008

Data are expressed as number (percentage) for categorical variables and median (25^{th}, 75^{th} percentile) for continuous variables, as appropriate.
Abbreviations: △HS, relative hydration status
P-value was measured by comparisons between participants with △HS≧7% and those with △HS<7%.

N=478, Stage 4-5, Follow 23.2m Tsai & Chen, CJASN 2015;10:39-46

Cholesterol is Associated with Renal Outcomes in CKD

	Renal replacement therapy		Rapid renal progression	
	Unadjusted	Adjusted	Unadjusted	Adjusted
Total cholesterol	HR (95% CI)	HR (95% CI)	OR (95% CI)	OR (95% CI)
Quintile 1	1.33 (1.10, 1.61)*	1.23 (1.01, 1.49)*	1.12 (0.86, 1.46)	1.06 (0.79, 1.42)
Quintile 2	1	1	1	1
Quintile 3	0.90 (0.74, 1.10)	1.08 (0.88, 1.33)	1.05 (0.81, 1.38)	1.17 (0.87, 1.57)
Quintile 4	1.15 (0.95, 1.39)	1.25 (1.02, 1.52)*	1.18 (0.90, 1.54)	1.20 (0.89, 1.61)
Quintile 5	1.36 (1.13, 1.64)*	1.35 (1.11, 1.65)*	1.98 (1.53, 2.55)*	1.36 (1.01, 1.83)*

*$p < 0.05$; **$p < 0.001$ compared to quintile 2

N=3,303, Stage 3-5, Follow 2.8y Chen & Chen, PLoS One 2013;8:e55643

Proteinuria Modify the Relationship Between Lipid Profile and Mortality in CKD

All-cause mortality	Proteinuria < 1 g/day		Proteinuria ≥ 1 g/day		*P*
	Unadjusted	Adjusted	Unadjusted	Adjusted	
	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)	
Total cholesterol					0.045
Quartile 1	1	1	1	1	
Quartile 2	0.75 (0.50-1.13)	1.21 (0.79-1.86)	0.71 (0.54-0.94)	0.94 (0.70-1.25)	
Quartile 3	0.78 (0.52-1.18)	1.65 (1.06-2.57)	0.60 (0.45-0.80)	0.81 (0.60-1.08)	
Quartile 4	0.93 (0.61-1.41)	2.00 (1.27-3.16)	0.57 (0.43-0.76)	0.82 (0.60-1.10)	
TC/HDL					0.029
Quartile 1	1	1	1	1	
Quartile 2	0.71 (0.45-1.11)	1.06 (0.66-1.70)	0.69 (0.52-0.93)	0.78 (0.58-1.05)	
Quartile 3	1.22 (0.81-1.82)	1.73 (1.12-2.68)	0.68 (0.51-0.91)	0.75 (0.56-1.01)	
Quartile 4	1.64 (1.09-2.48)	1.67 (1.08-2.58)	0.70 (0.53-0.92)	0.71 (0.53-0.94)	

↑TC & TC/HDL--↑Overall mortality if UPr<1g/D

↑TC/HDL--↓Overall mortality if UPr≧1g/D

N=3,303, Stage 3-5, Follow 2.8y Chen & Chen, CJASN 2013 ;8:1915-26

Summary

- Cardiovascular diseases are common in CKD, and CKD has been recognized as a major risk factor for CVD.
- Many nontraditional risk factors also contribute to CVD and should not be missed.
- We should recognize patients at risk and provide early prevention and treatment.

2nd International Congress of Chinese Nephrologists

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