



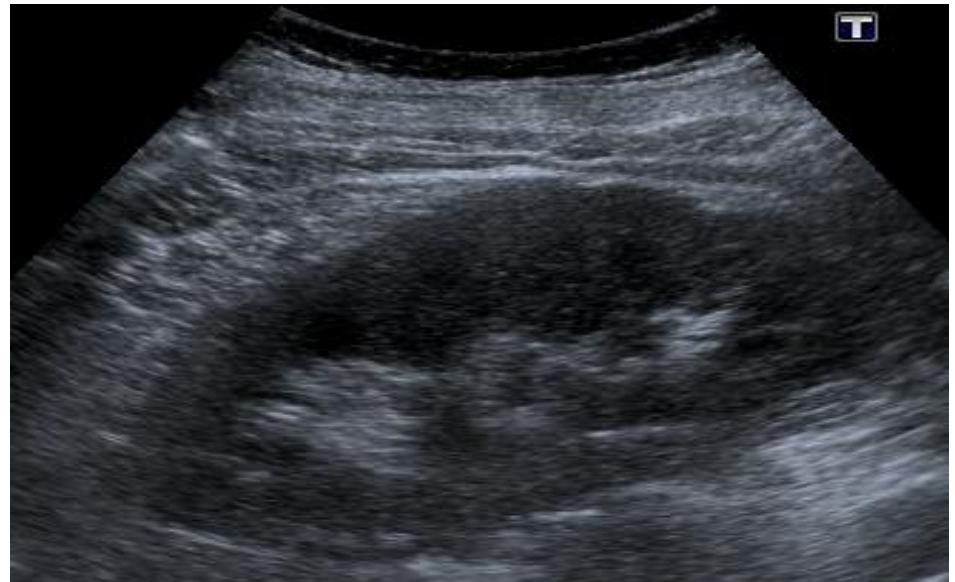
Echographie rénale et hypertension artérielle

Dr Belén Ponte
Cheffe de clinique scientifique
Service de néphrologie HUG



Introduction

- ❑ L'échographie rénale simple détecte certaines malformations ou anomalies rénales pouvant être associées à une hypertension
- ❑ Le doppler rénal permet de rechercher de sténose artérielle
- ❑ Des données suggèrent que les index de résistances mesurés peuvent avoir un rôle pronostic dans l'HTA

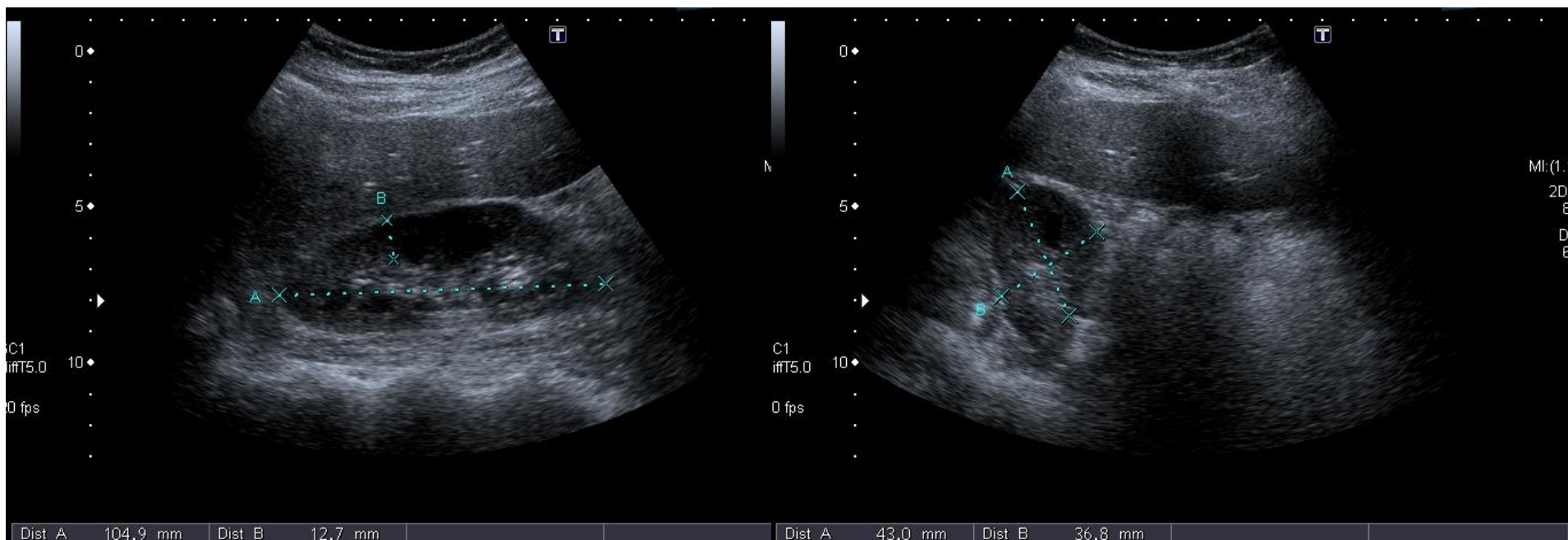


Emamian et al. AJR 1993; Kariyanna s et al DNT 2009; Akpinar et al J Clin US 2003
Chin HJ et al KI 2006; Mosharaf et al BJ Urol Int 2007

Méthode 2B



- A jeun
- Décubitus dorsal $\pm$ latéral
- Mesure de la taille des reins (longueur normale 9-12cm)

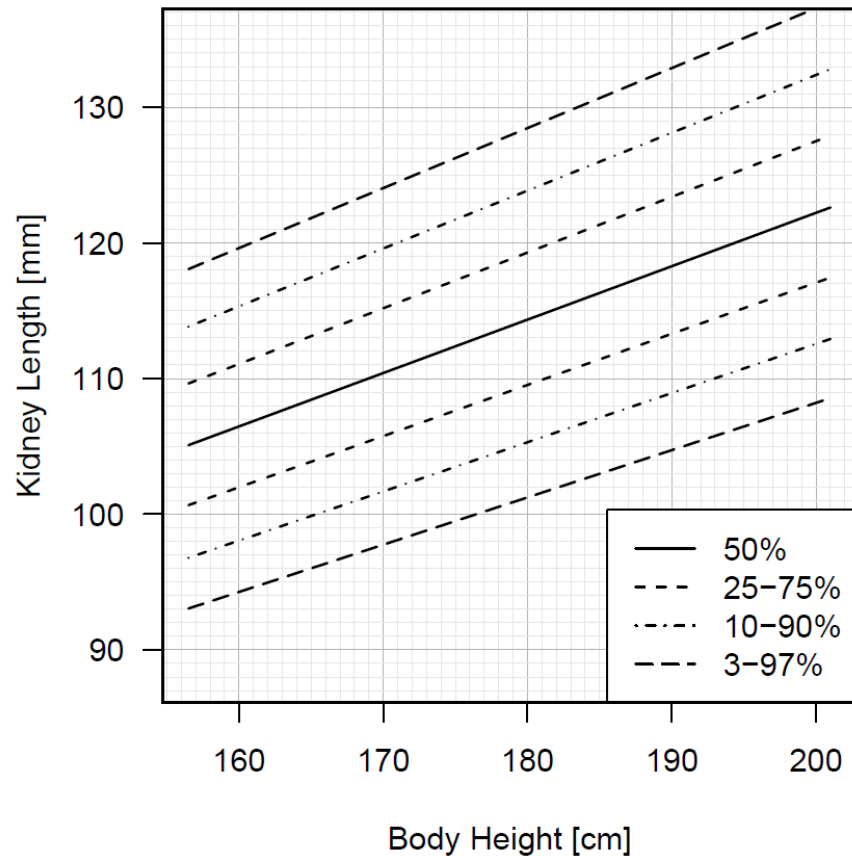


→ Volume rénal = longueur x profondeur x largeur x 0.523

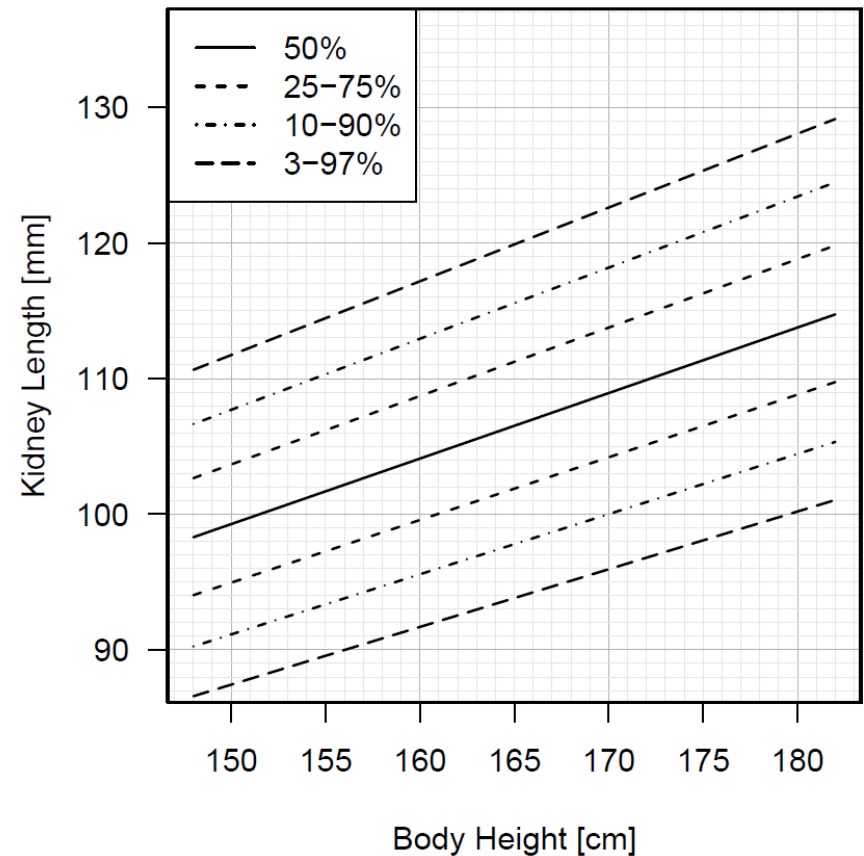
Taille des reins



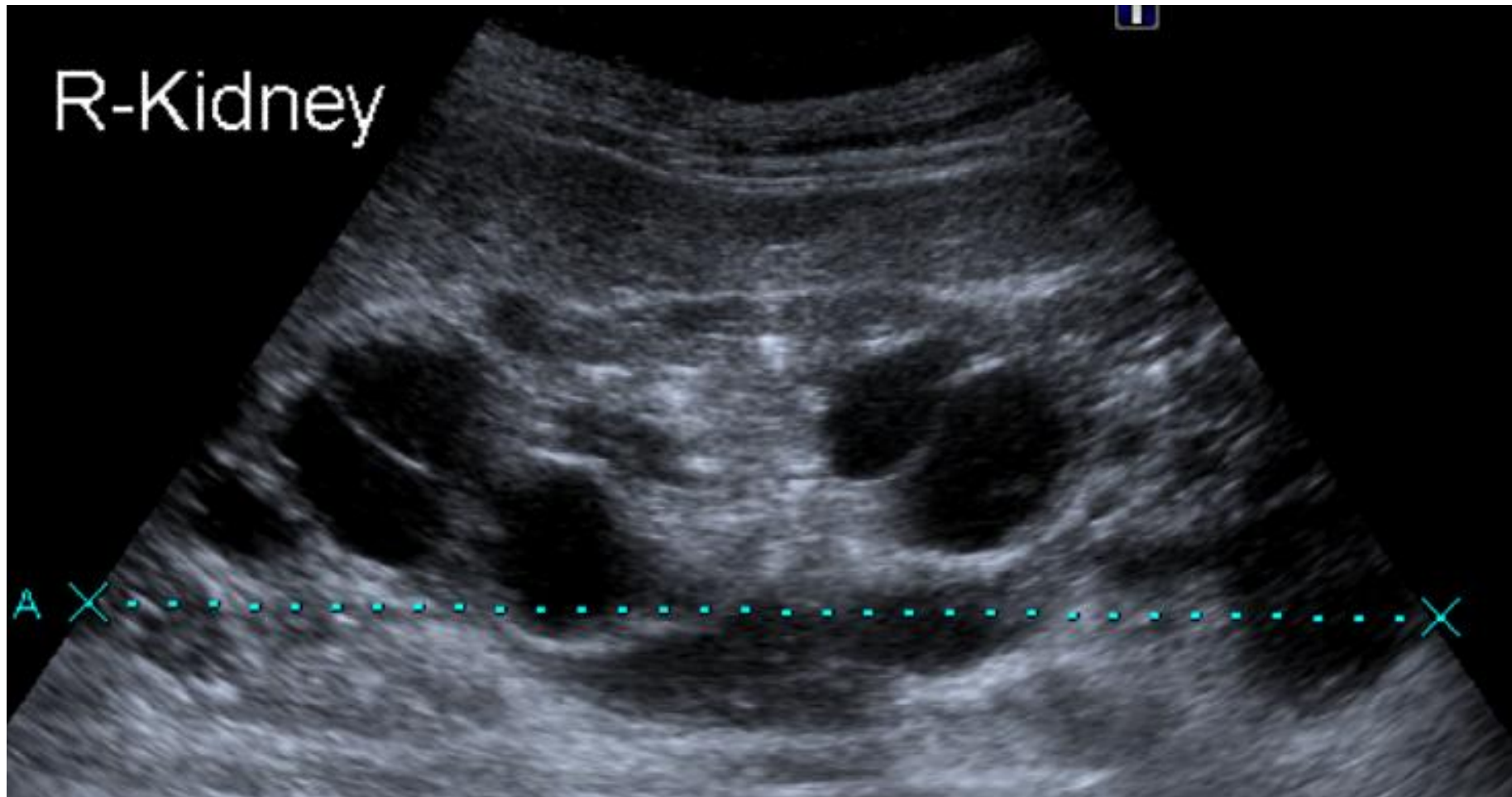
Men

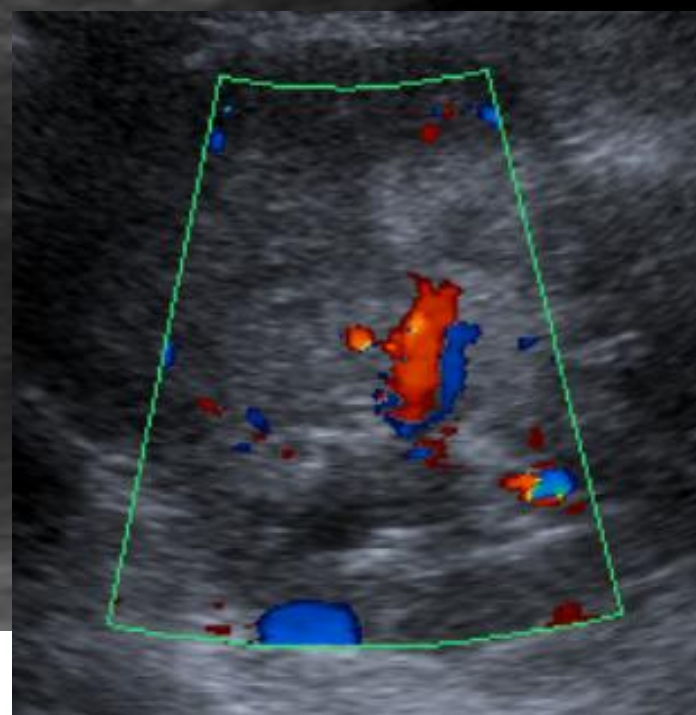
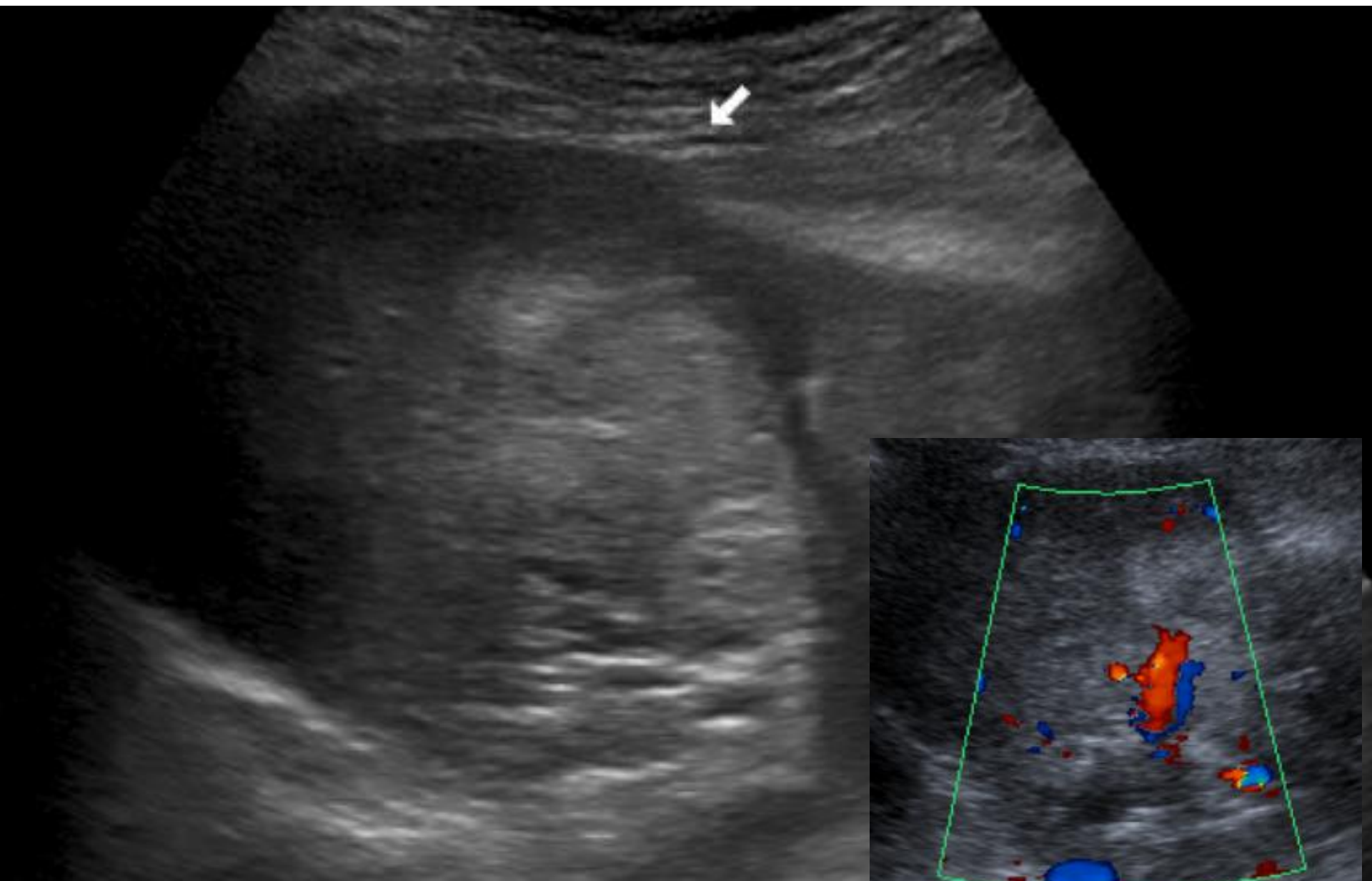


Women



Détection anomalies



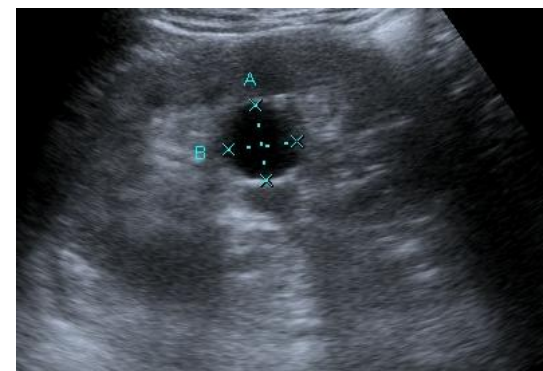


Anomalies rénales à l'us

Catégories d'âge	Anomalies rénales %	Kystes %	Lithiases %	Masse %
<30 ans	5.8	0	1.9	1.9
30-45 ans	8.5	5.0	3.7	1.7
45-60 ans	11.3	11.1	5.0	2.5
> 60 ans	35.2	21.3	11.5	4.2
Total	19.8	12.4	4.8	2.3

La découverte d'une pathologie rénale à l'échographie est fréquente et augmente avec l'âge, surtout après 60 ans.

Le kyste solitaire est la pathologie la plus fréquente au-delà de 30 ans.

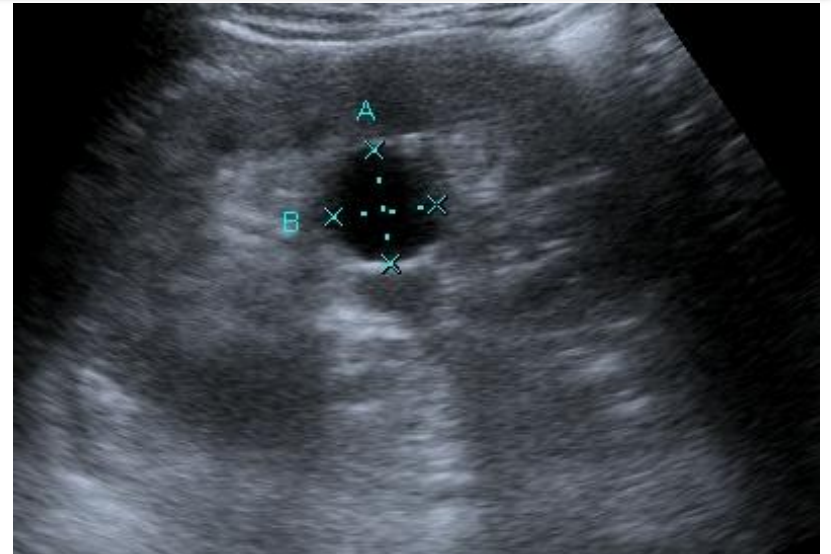


HTA: différences?



	Hypertension (n=180)	No Hypertension (n=897)	p
Age (years)	52 (18)	47 (17)	<0.01
Gender (% female)	48.3	54.2	0.15
Body Mass Index (kg/m ²)	25.7 (4.7)	25.0 (4.7)	0.044
Systolic Blood Pressure (mmHg)	145 (14)	114 (12)	<0.01
Diastolic Blood Pressure (mmHg)	88 (9)	73 (8)	<0.01
eGFR _{CKD-EPI} (ml/min/1.73m ²)	94.9 (17)	95.4 (17)	0.79
Kidney length (cm)	10.9 (1.0)	11.0 (0.9)	0.1
Nephrolithiasis (%)	4.40	6.90	0.22
Simple renal cyst (%)	15.60	11.40	0.12
Renal mass (%)	1.70	2.30	0.58
Hydronephrosis (%)	2.20	2.80	0.67
Kidney Abnormality (%)	21.70	20.20	0.65

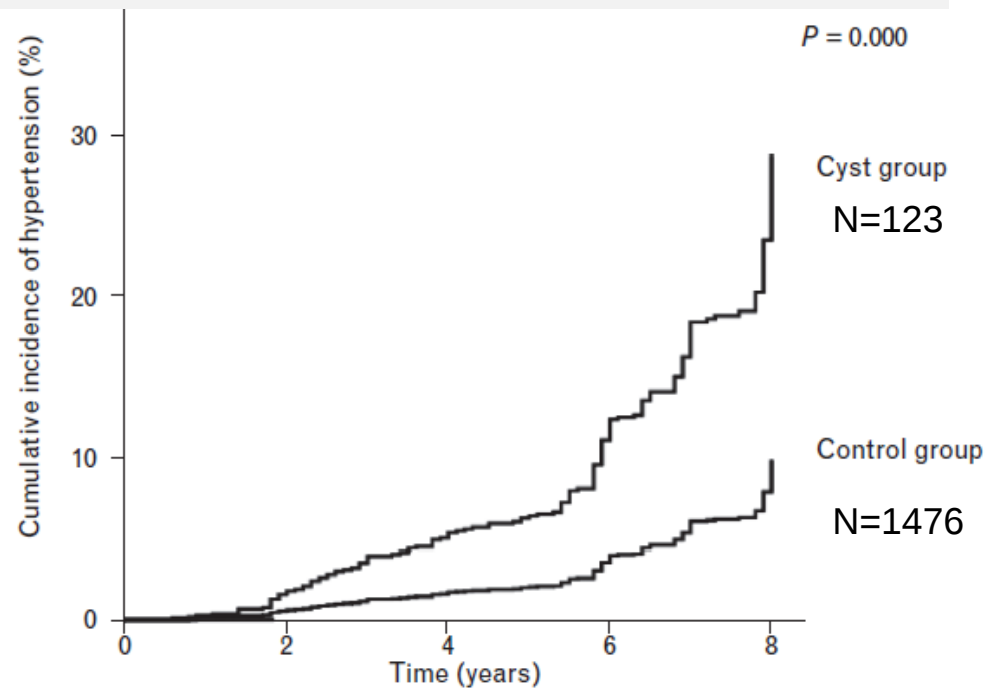
Kyste rénal simple et Hypertension artérielle



Country year reference	Cyst type	Study method	Number of cyst/total	Result/comments
Japan 2000 [40]	Include all (+ADPKD) unless query malignant	Population health screen, BP, U/S, blood	45/17 914	Higher mean SBP with (123 mmHg ^a) than without (118 mmHg) cysts
Turkey 2010 [50]	'SRC', excluded >3 cm or ADPKD	BP, blood, U/S, urinalysis in newly diagnosed hypertensive cohort	92/190	Higher mean ambulatory BP with (134 mmHg ^a) than without (128 mmHg) cysts multivariate analysis: 'SRC' associated nocturnal non-dipping of BP
South Korea 2006 [25]	'SRC', excluded congenital cystic kidney disease/agenesis, single kidney	Cohort of population health screen with U/S ± CT, correlated clinical features	5674/29 523	Higher mean BP ± SD with (121 ± 15/76 ± 9 mmHg) than without (118 ± 15/75 ± 9 mmHg) cysts. Not standard definition of hypertension
South Korea 2003–4 [47]	'SRC', excluded congenital cystic kidney disease	Cohort of population health screen with SRC on U/S, correlated clinical features	436/6603	Higher mean BP ± SD with (125 ± 16/80 ± 11 mmHg) than without (122 ± 15/77 ± 10 mmHg) cysts. BP associated with more cysts. Confounding factors (male gender, age)
USA 2000–8 [11]	Cystic + solid renal lesions	Cohort of potential kidney donors with CT, BP, blood	629/1948	'SRC' >10 mm associated with OR 1.4 of hypertension. Confounding factors (albuminuria, hyperfiltration)
China 2013 [1]	'SRC', excluded ADPKD, VHL, TS, medullary sponge kidney, duplex kidney, renal tumour, pregnancy	Cohort of population health screen with SRC on U/S, BP, blood, correlated clinical features	1694/14 995	Pre-hypertension and hypertension associated with 'SRC' <2 cm

4516 travailleurs masculin en Corée. Exclusion HTA.
123 (2.7%) ont des kystes principalement solitaires (90.2%)

Etude rétrospective 2003-2004
Follow-up median: 7.4 ans
1.6/100 pers-an HTA
29.9% dans groupe kyste
15.4% dans groupe contrôle



Analyse multivariée

Exp (B)

95% CI

Lower

Upper

Age (years)	1.08	1.05	1.10
BMI (kg/m ²)	1.11	1.03	1.18
Diabetes mellitus	1.23	0.45	3.36
Family history of HTN	2.50	1.73	3.62
MAP (mmHg)	1.11	1.08	1.14
eGFR (ml/min per 1.73 m ² BSA)	1.00	0.99	1.02
Uric acid (mg/dl)	0.97	0.86	1.10
Cholesterol (mg/dl)	1.00	1.00	1.01
Smoking (current or previous)	1.29	0.90	1.85
Renal cyst	3.28	2.24	4.80

Etude prospective check-up santé à Taiwan, n=14'995

	Normotension (n = 8850)	Prehypertension (n = 4278)	Hypertension (n = 1867)	P-value
Age (years)	45.2 ± 11.4	50.9 ± 12.8	58.2 ± 11.9	<0.001
Male gender	4595 (51.9)	3119 (72.9)	1237 (66.3)	<0.001
Body weight (kg)	63.2 ± 11.6	69.9 ± 12.4	68.5 ± 12.8	<0.001
Body height (cm)	163.7 ± 8.2	165.5 ± 8.8	162.9 ± 8.7	<0.001
Body mass index (kg/m ²)	23.5 ± 3.3	25.4 ± 3.5	25.7 ± 3.6	<0.001
Body mass index status				<0.001
≥ 25	2614 (29.5)	2219 (51.9)	1049 (56.2)	
23–24.9	2083 (23.5)	1052 (24.6)	4400 (21.4)	
< 23	4153 (47.0)	1007 (23.5)	418 (22.4)	
Systolic blood pressure (mm Hg)	107.1 ± 8.0	127.7 ± 5.7	152.2 ± 16.8	<0.001
Diastolic blood pressure (mm Hg)	63.9 ± 6.8	75.7 ± 6.7	86.7 ± 9.6	<0.001
Fasting plasma glucose (mg/dl)	90.1 ± 19.9	98.3 ± 29.2	107.5 ± 36.8	<0.001
Total cholesterol (mg/dl)	193.0 ± 36.7	201.3 ± 37.3	201.7 ± 38.3	<0.001
Triglyceride (mg/dl)	98.0 (71.0, 140.0)	122.0 (88.0, 175.0)	131.0 (92.0, 188.0)	<0.001
HDL-cholesterol (mg/dl)	50.5 ± 14.0	46.8 ± 13.0	46.5 ± 13.1	<0.001
Creatinine (mg/dl)	0.8 ± 0.3	0.9 ± 0.4	1.0 ± 0.7	<0.001
eGFR (ml/min per 1.73 m ²)	95.1 ± 17.8	90.7 ± 17.7	86.5 ± 21.0	<0.001
Diabetes mellitus	571 (6.6)	624 (15.2)	516 (30.3)	<0.001
Family history of hypertension	2168 (24.5)	1026 (24.0)	402 (21.5)	0.024
Regular exercise	692 (7.8)	334 (7.8)	112 (6.0)	0.017
Smoking	1005 (11.4)	507 (11.9)	259 (13.9)	0.009
Simple renal cyst				<0.001
No	8114 (91.7)	3699 (86.5)	1488 (79.7)	
Yes	736 (8.3)	579 (13.5)	379 (20.3)	
Number				<0.001
≥ 2	131 (1.5)	160 (3.7)	146 (7.8)	
< 2	605 (6.8)	419 (9.8)	233 (12.5)	
Size				<0.001
≥ 2 cm	209 (2.4)	207 (4.8)	132 (7.1)	
< 2 cm	527 (5.9)	372 (8.7)	247 (13.2)	
Number and size				<0.001
Number ≥ 2 and size ≥ 2 cm	53 (0.6)	60 (1.4)	56 (3.0)	
Number ≥ 2 and size < 2 cm	78 (0.9)	100 (2.3)	90 (4.8)	
Number < 2 and size ≥ 2 cm	156 (1.7)	147 (3.4)	76 (4.1)	
Number < 2 and size < 2 cm	449 (5.1)	272 (6.4)	157 (8.4)	

Facteurs associés à pré-hypertension et HTA en dehors de facteurs classiques:

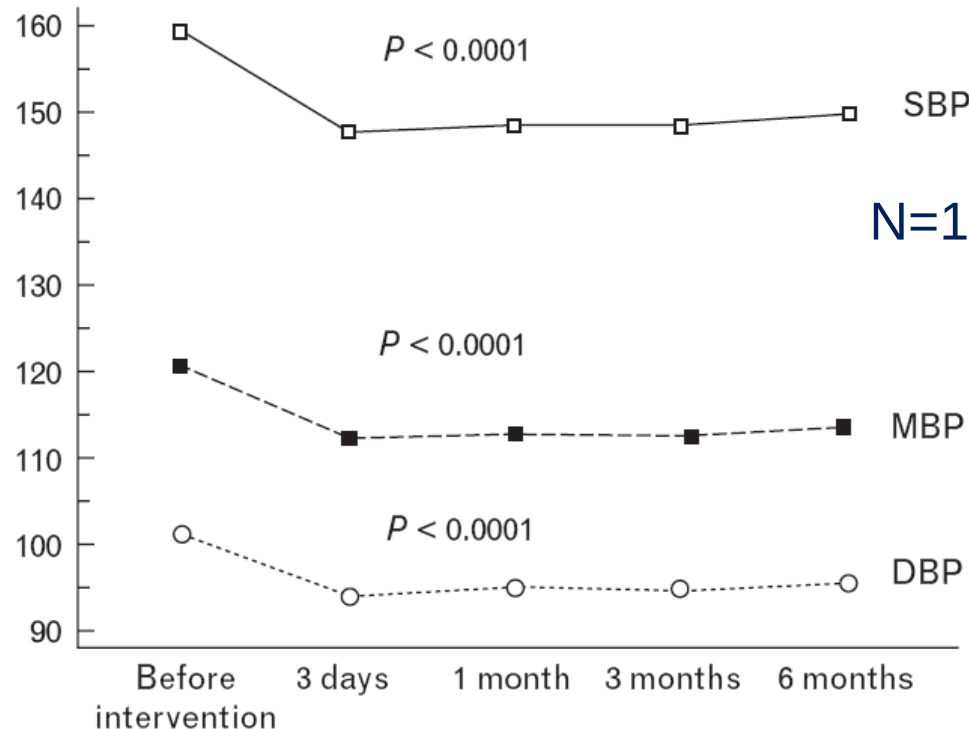
Présence de kyste, nombre et taille kystes

Variables	Model 1		Model 2		Model 3	
	Prehypertension vs. normotension OR (95% CI)	Hypertension vs. normotension OR (95% CI)	Prehypertension vs. normotension OR (95% CI)	Hypertension vs. normotension OR (95% CI)	Prehypertension vs. normotension OR (95% CI)	Hypertension vs. normotension OR (95% CI)
Age ≥ 65 years vs. < 40 years	3.90*** (3.30-4.61)	19.57*** (15.14-25.31)	3.87*** (3.270-4.57)	19.25*** (14.89-24.90)	3.89*** (3.29-4.59)	19.62*** (15.17-25.37)
40-64 years vs. < 40 years	1.4*** (1.31-1.60)	3.86*** (3.11-4.78)	1.44*** (1.31-1.59)	3.85*** (3.11-4.78)	1.44*** (1.31-1.60)	3.86*** (3.11-4.78)
Male vs. female	2.17*** (1.98-2.37)	1.76*** (1.55-2.00)	2.16*** (1.97-2.37)	1.74*** (1.53-1.98)	2.17*** (1.98-2.37)	1.76*** (1.55-2.00)
Simple renal cyst, yes vs. no	1.20* (1.06-1.36)	1.54*** (1.32-1.80)	—	—	—	—
<i>Simple renal cyst number</i>						
≥ 2 vs. no	—	—	1.56** (1.21-2.00)	2.69*** (2.05-3.54)	—	—
< 2 vs. no	—	—	1.12 (0.97-1.28)	1.25* (1.04-1.49)	—	—
<i>Simple renal cyst size</i>						
≥ 2 cm vs. no	—	—	—	—	1.28* (1.04-1.58)	1.46** (1.13-1.88)
< 2 cm vs. no	—	—	—	—	1.16 (1.00-1.34)	1.59*** (1.32-1.90)
<i>Body mass index status</i>						
$\geq 25 \text{ kg/m}^2$ vs. $< 23 \text{ kg/m}^2$	2.59*** (2.35-2.86)	2.78*** (2.41-3.21)	2.59*** (2.35-2.86)	2.77*** (2.40-3.19)	2.59*** (2.35-2.86)	2.78*** (2.41-3.21)
23-24.9 kg/m^2 vs. $< 23 \text{ kg/m}^2$	1.61*** (1.45-1.80)	1.43*** (1.21-1.69)	1.61*** (1.45-1.80)	1.44*** (1.22-1.69)	1.61*** (1.45-1.80)	1.43*** (1.21-1.69)
Family history of hypertension, yes vs. no	1.16* (1.06-1.27)	1.29** (1.13-1.47)	1.16* (1.06-1.27)	1.29*** (1.13-1.47)	1.16** (1.06-1.27)	1.29*** (1.13-1.47)
Regular exercise, yes vs. no	1.10 (0.95-1.27)	1.34* (1.07-1.67)	1.10 (0.95-1.27)	1.33* (1.07-1.66)	1.10 (0.95-1.27)	1.34* (1.07-1.67)
Smoking, yes vs. no	1.22** (1.08-1.38)	1.50*** (1.23-1.82)	1.22** (1.08-1.38)	1.49*** (1.22-1.81)	1.22** (1.08-1.38)	1.49*** (1.23-1.82)
eGFR $\times 10$, ml/min per 1.73 m^2	0.99 (0.97-1.02)	0.95** (0.92-0.98)	0.99 (0.97-1.02)	0.95** (0.92-0.98)	0.99 (0.97-1.02)	0.95** (0.92-0.98)
Diabetes mellitus, yes vs. no	1.82*** (1.61-2.07)	3.56*** (3.08-4.12)	1.82*** (1.60-2.07)	3.57*** (3.08-4.12)	1.82*** (1.60-2.07)	3.56*** (3.08-4.12)
Total cholesterol						
$\geq 200 \text{ mg/dl}$ vs. $< 200 \text{ mg/dl}$	1.29*** (1.19-1.40)	1.28*** (1.14-1.43)	1.29*** (1.19-1.40)	1.29*** (1.15-1.44)	1.29*** (1.19-1.40)	1.28*** (1.14-1.43)
Low HDL-cholesterol [†] , yes vs. no	1.04 (0.96-1.13)	1.12 (1.00-1.27)	1.04 (0.96-1.13)	1.13* (1.01-1.27)	1.04 (0.96-1.13)	1.12 (1.00-1.27)



Rôle système rénine-angiotensine-aldostérone ?

Ablation kyste = traitement HTA ?



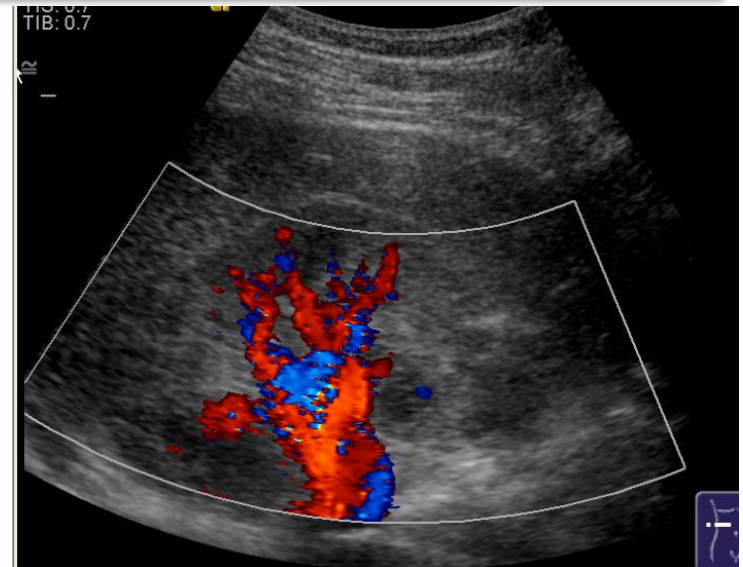
Zerem .J Hypertension 2009

Treatment of symptomatic simple renal cysts by percutaneous aspiration and ethanol sclerotherapy

TAREK MOHSEN and MOHAMED A. GOMHA*

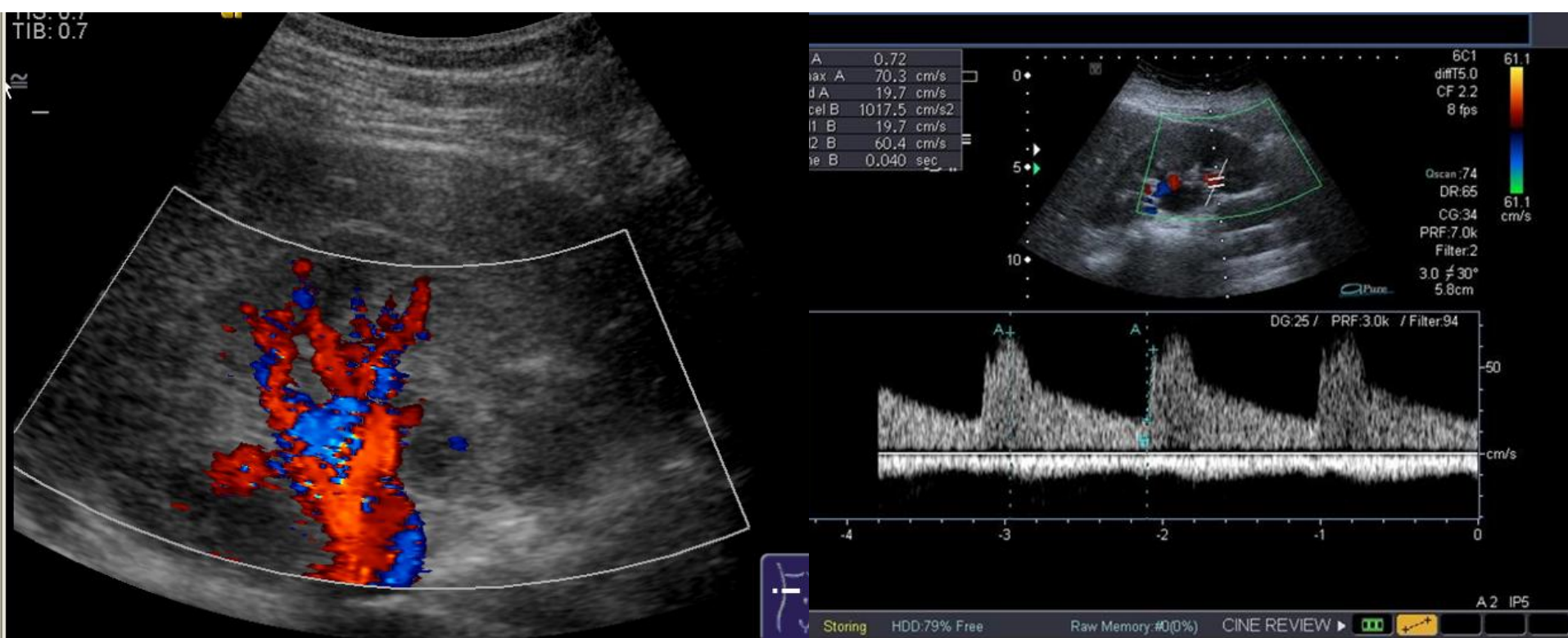
Departments of Radiology and *Urology, Mansoura Urology and Nephrology Center, Mansoura University, Egypt

Doppler rénal et Hypertension artérielle

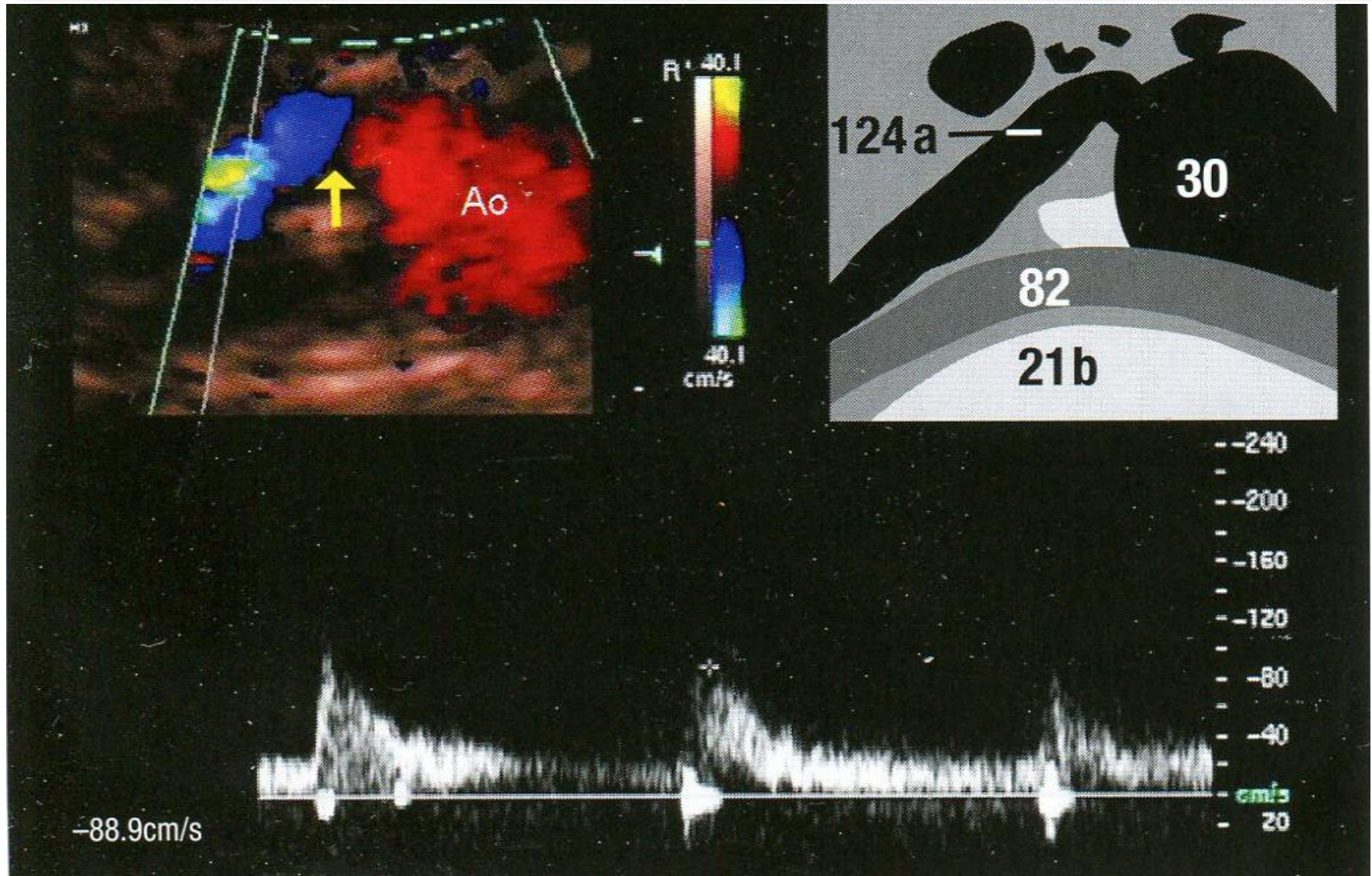


Doppler rénal

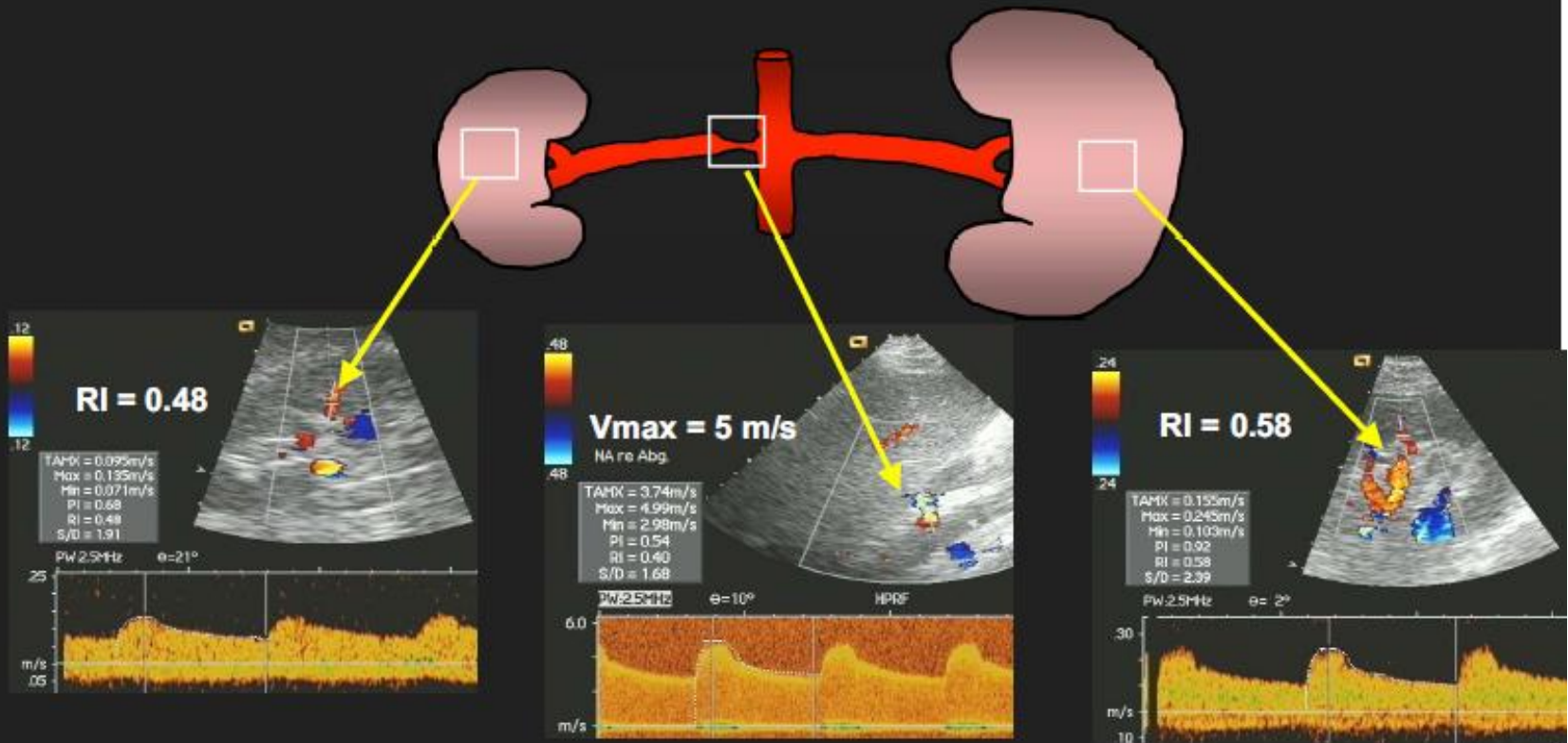
1. Recherche sténose des artères rénales
2. Mesure des index de résistance



1. Sténose de l'artère rénale



Critères de sténose



1. Nierenarterie

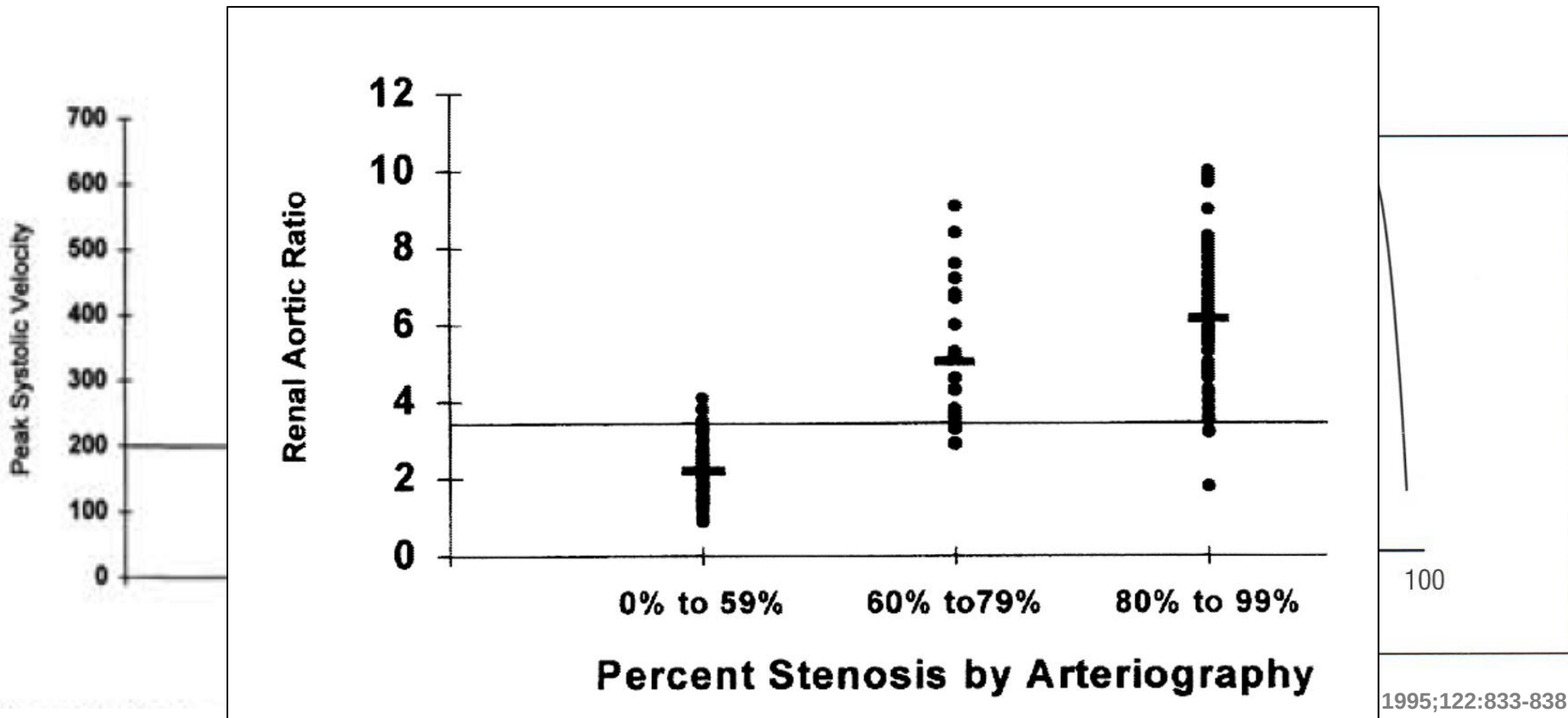
- Vmax > 2m/s
- Renal-Aortic Ratio > 3.5

2. Intrarenal

- Seitendifferenz RI > 0.05
- Accelerationszeit > 70 ms
- parvus-tardus Flow

Critères de sténose: directs

1. $V_{\max} > 200 \text{ cm/sec}$ dans a rénale $\rightarrow$ sténose $> 60\%$
2. Gradient $V_{\max} \text{ Ao} / V_{\max} \text{ a rénale} > 3.5 \rightarrow$ sténose $> 60\%$



Critères de sténose: indirects

Tardus parvus, Time to peak > 0.07 , Différence IR D-G > 0.05

Subjective evidence

Tardus-parvus waveform

Objective evidence

Acceleration* $< 5 \text{ m/sec}^2$

Time-to-peak $> 70 \text{ msec}$

Low RI (value depends on vessel)

Upstream
stenosis

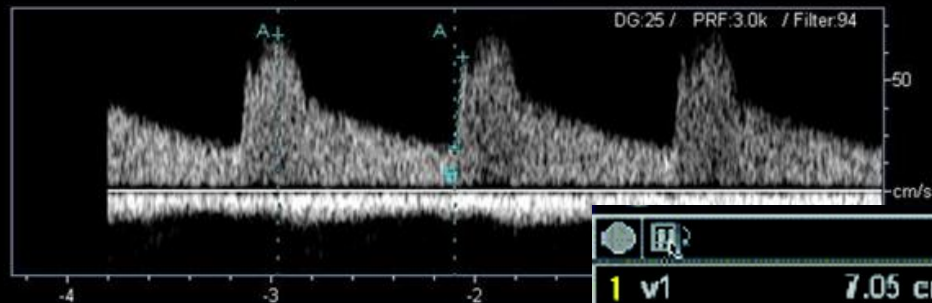


Normal



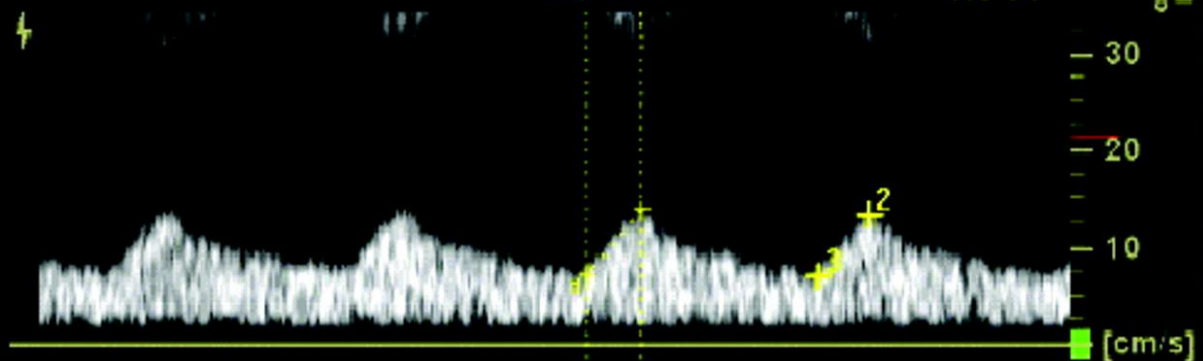
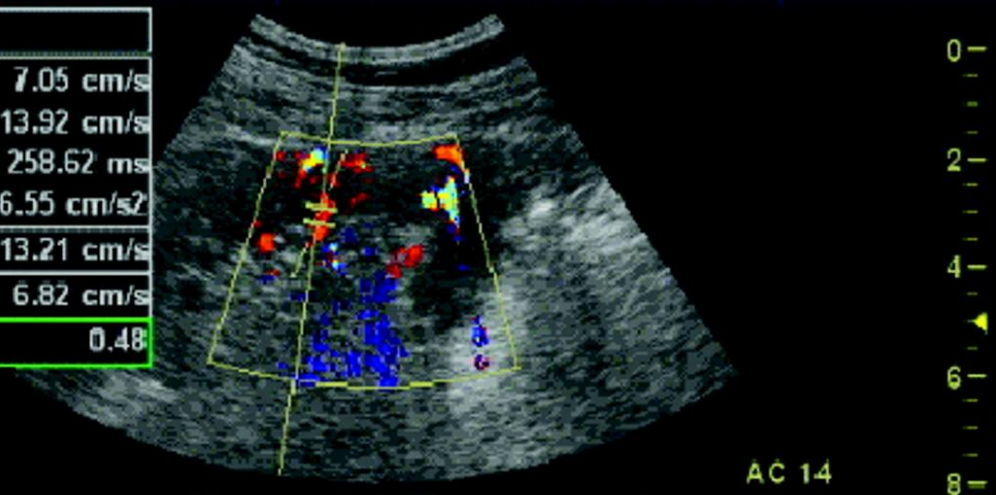
*Acceleration = PSV / TTP

RI A	0.72
Vmax A	70.3 cm/s
Ved A	19.7 cm/s
Accel B	1017.5 cm/s ²
Vel1 B	19.7 cm/s
Vel2 B	60.4 cm/s
Time B	0.040 sec



1	v1	7.05 cm/s
	v2	13.92 cm/s
	Time	258.62 ms
	acc	26.55 cm/s ²
2	Prox Ao PS	13.21 cm/s
3	Prox Ao ED	6.82 cm/s
	Prox Ao RI	0.48

-10
cm/s

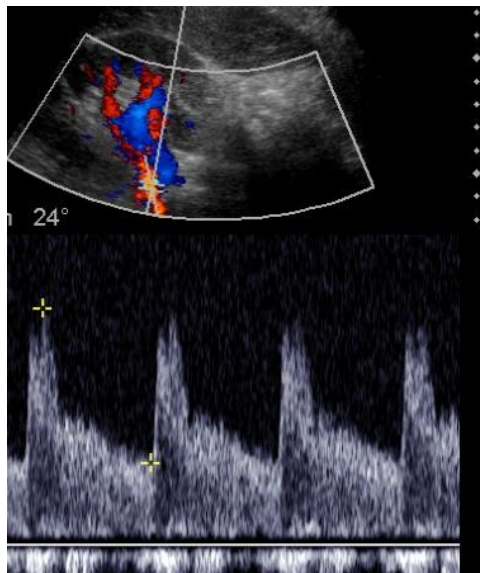


2. Index de résistance rénal

IR a rénale ~ 0.65

Vmax 94cm/s

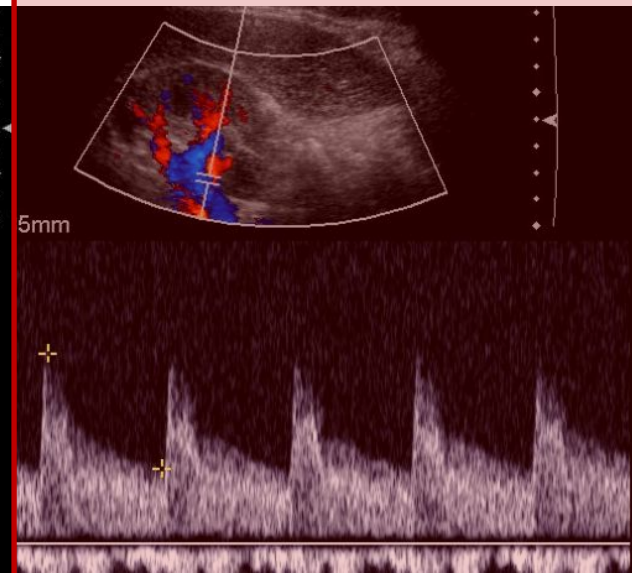
V min 33 cm/s



IR a segmentaire ~ 0.60

V max 57 cm/s

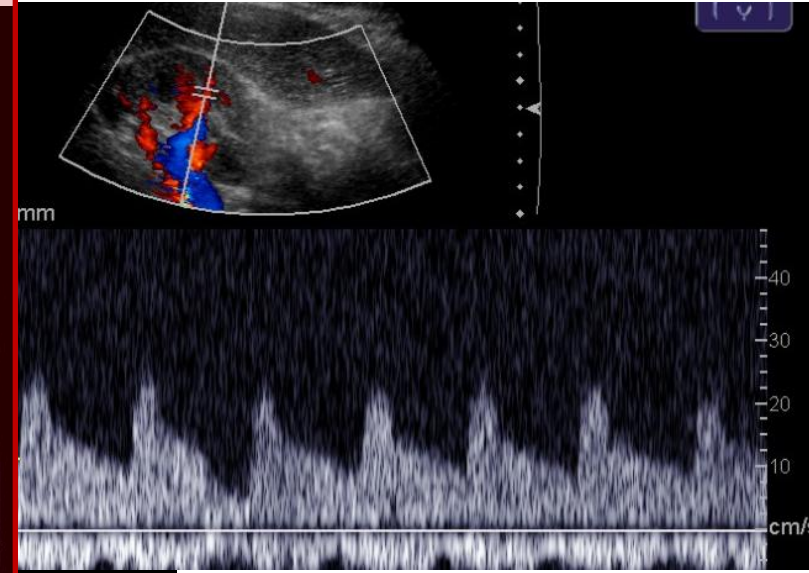
Vmin 23 cm/s



IR a interlobaire ~ 0.55

Vmax 26 cm/s

Vmin 12 cm/s



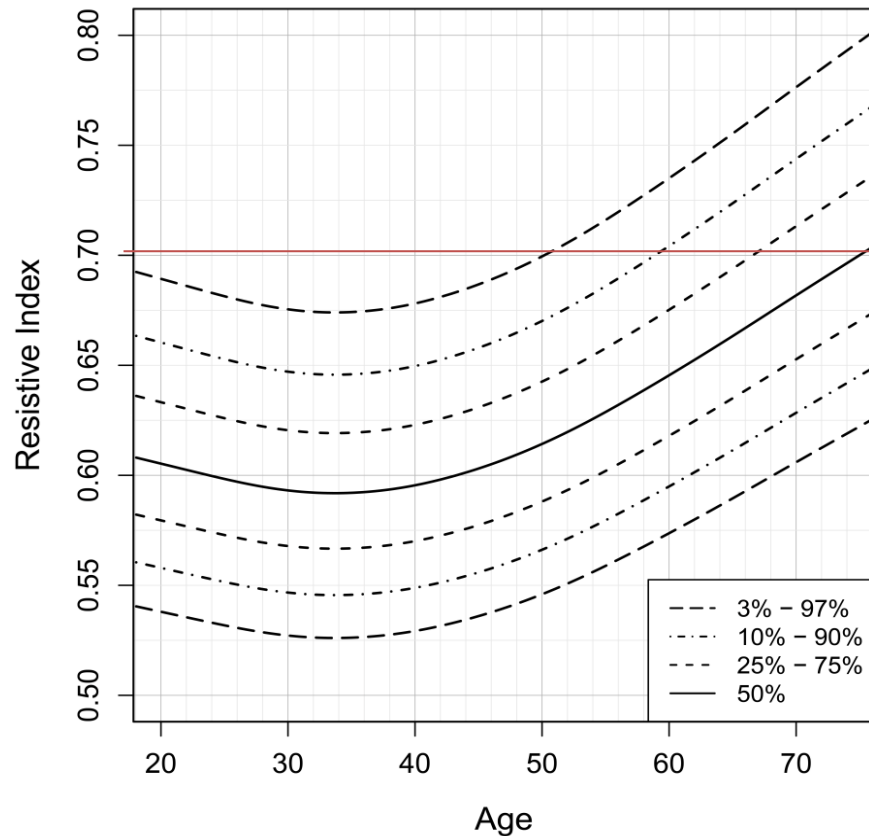
Index de résistance (IR) =

$$(\text{Peak Systolic Velocity} - \text{Peak Diastolic Velocity}) / \text{Peak Systolic Velocity}$$

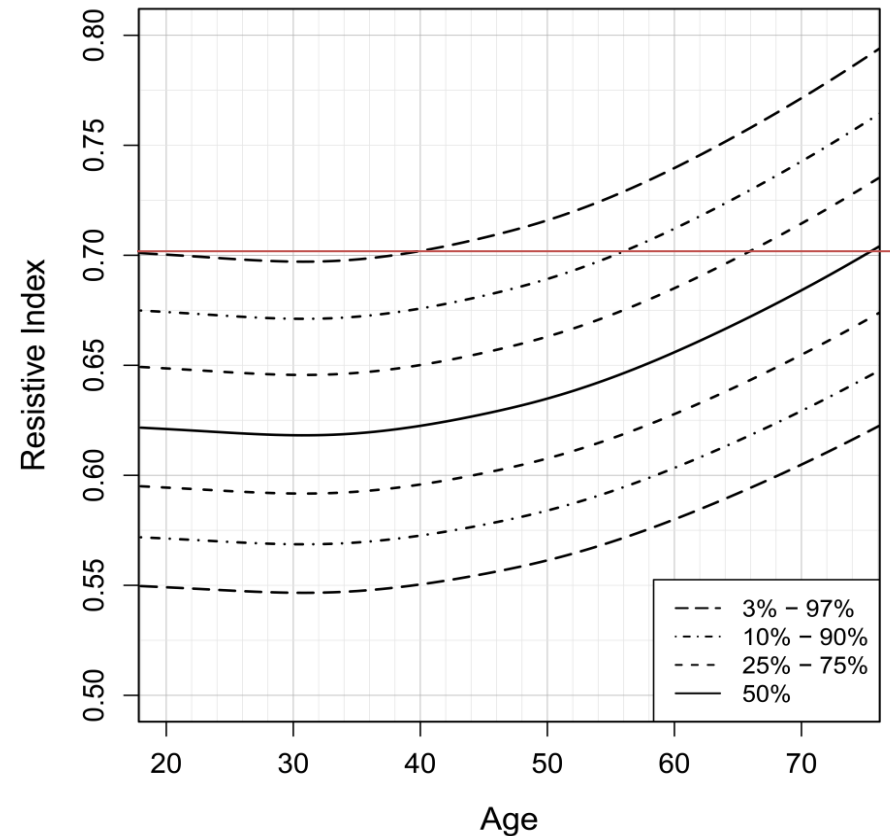
Normes IR pour l'âge



All men (N=326)



All women (N=400)



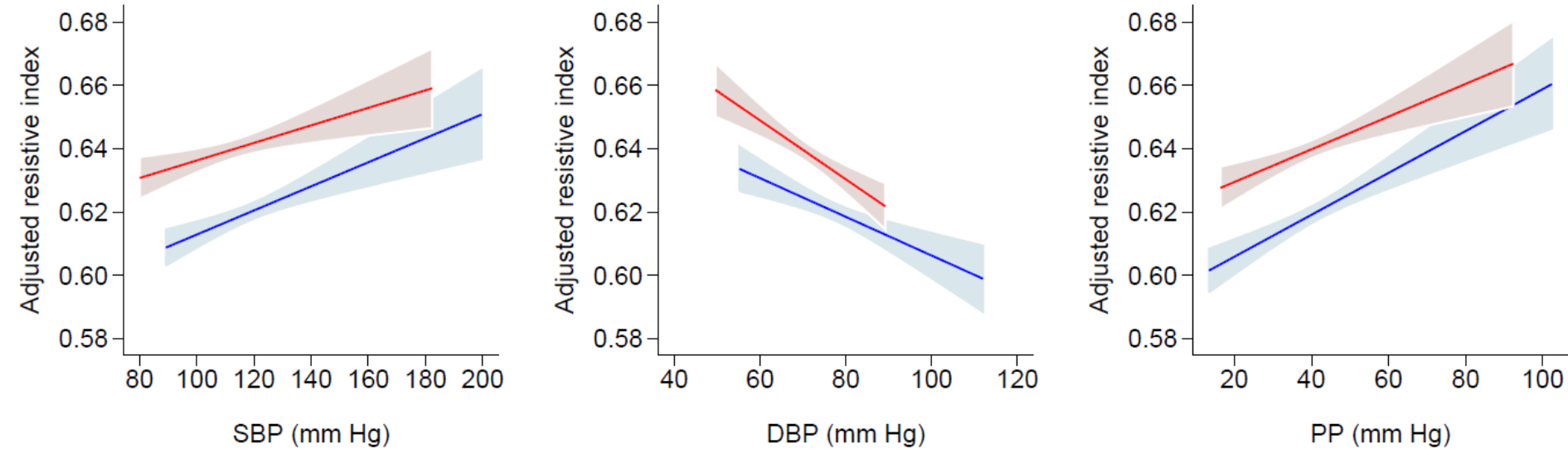
***Index de résistance** (tous / H / F)

0.64 ± 0.06

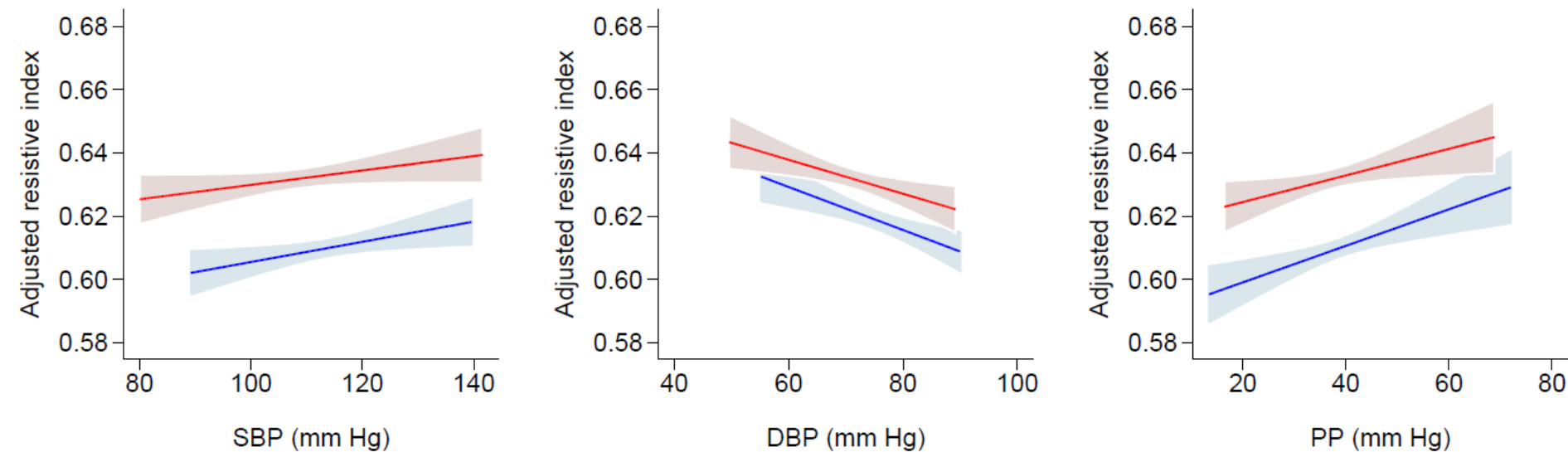
0.63 ± 0.06

0.65 ± 0.05

A All (n=726)

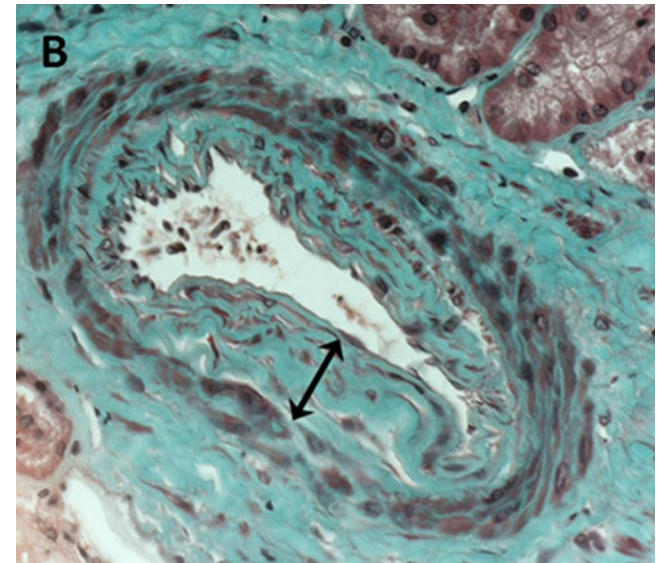


B Healthy (n=572)



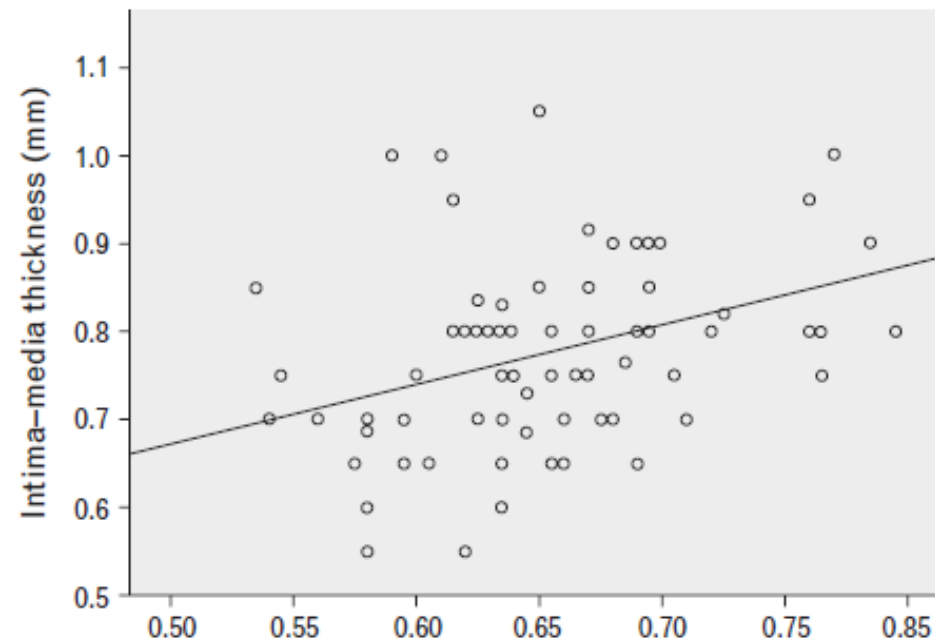
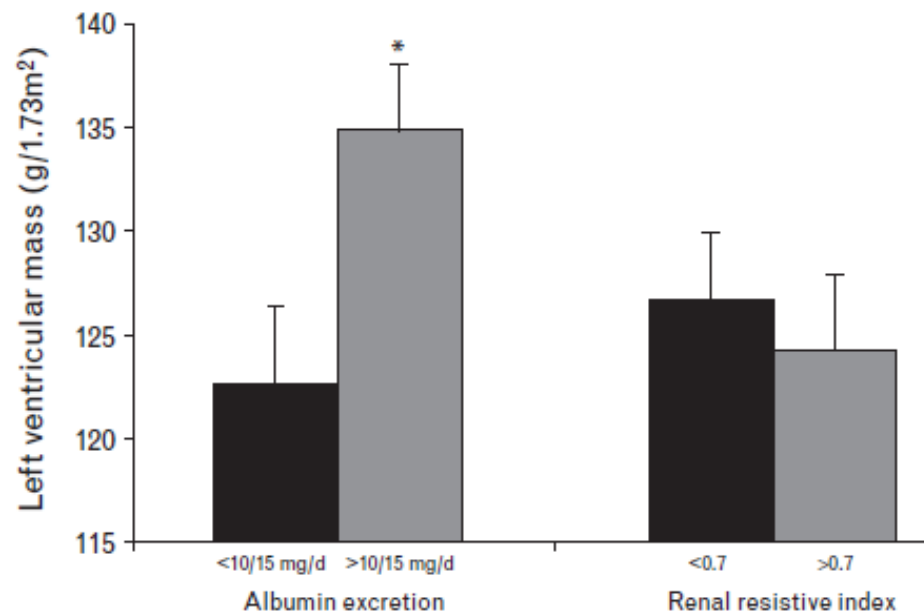
***IR plus élevés chez femmes, hypertendus et diabétiques**

Index de résistance et Hypertension artérielle: atteinte d'organe et pronostic?



	RRI ≤ 0.7 (n = 65)	RRI > 0.7 (n = 15)	P value
Pulse wave velocity (m/s)	9.8 $\pm$ 2.2	11.6 $\pm$ 3.7	0.02*
Augmentation index (%)	27.6 $\pm$ 9.8	27.2 $\pm$ 8.6	0.89
Pulse pressure (mmHg)	56.4 $\pm$ 17.7	59.9 $\pm$ 23.3	0.63
Mean arterial pressure (mmHg)	113 $\pm$ 13.7	116 $\pm$ 18.1	0.51
Intima-media thickness (mm)	0.76 $\pm$ 0.1	0.85 $\pm$ 0.09	0.007*
Agatston score	129 $\pm$ 256	640 $\pm$ 915	0.05
Left ventricular mass (g)	127 $\pm$ 24.5	124 $\pm$ 14.0	0.72
Ejection fraction (%)	71.2 $\pm$ 8.0	72.6 $\pm$ 10.1	0.64

HTA résistante (n=85): association IR avec PWV et IMT



HTA essentielle (n=288): association avec IMT, HVG et albuminurie

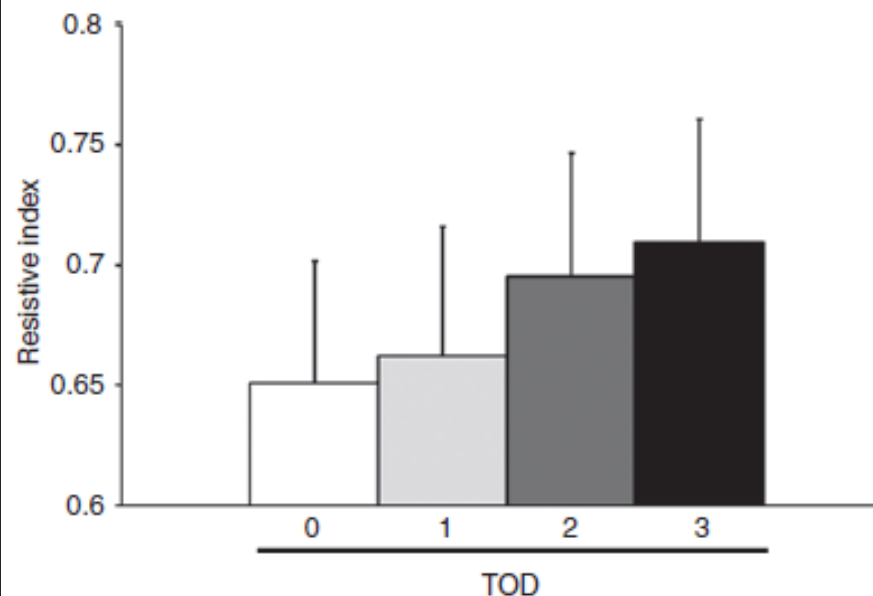
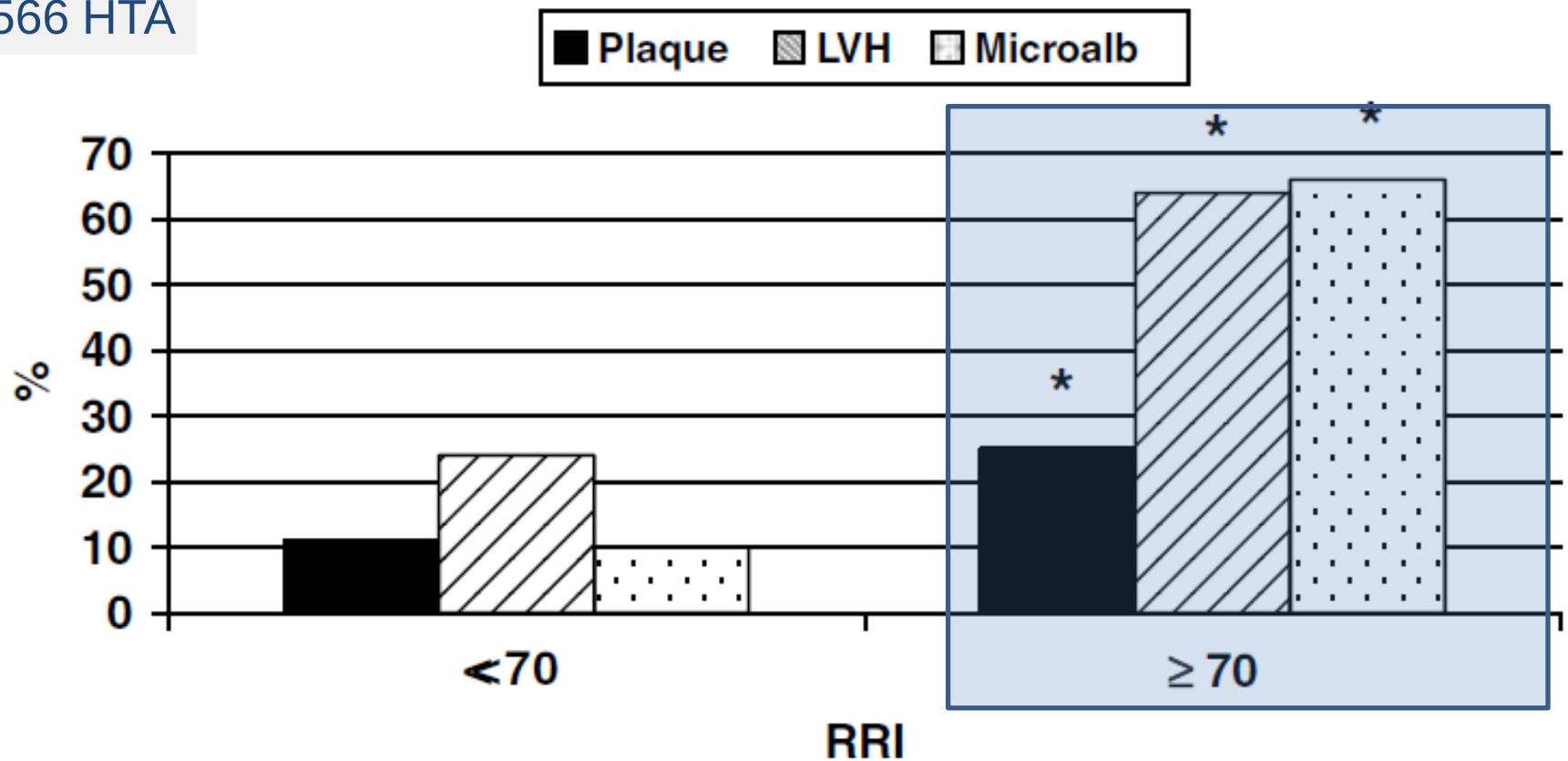


Table 4 | Results of multiple logistic regression analysis relating renal resistive index to at least two TOD

Variables	Unit of increase	Odds ratio	95% CI	P
Age	13.8 for male and 11.2 years for female (1 s.d.)	1.42	0.94–2.21	0.13
Sex	Male	1.48	0.78–2.84	0.10
Duration of hypertension	11.7 for male and 11.3 years for female (1 s.d.)	1.30	0.95–1.77	0.10
Diabetes	Yes	2.42	1.03–6.10	<0.05
Dyslipidemia	Yes	0.90	0.45–1.79	0.77
Smoking status	Former or current smoker	2.28	1.09–4.76	<0.05
Body mass index	3.97 for male and 4.40 kg/m ² for female (1 s.d.)	1.07	0.76–1.79	0.40
Pulse pressure	13 for male and 10 mm Hg for female (1 s.d.)	1.42	1.17–1.76	<0.01
Heart rate	8 for male and 7 bpm for female (1 s.d.)	1.12	0.93–1.29	0.41
eGFR	16 for male and 17 ml/min/1.73 m ² for female (1 s.d.)	0.94	0.52–1.25	0.73
Antihypertensive drug use	Yes	1.76	0.62–3.22	0.20
Antihyperlipidemic drug use	Yes	1.52	0.68–3.40	0.30
RI	0.08 for male and 0.07 for female (1 s.d.)	1.89	1.28–2.89	<0.01

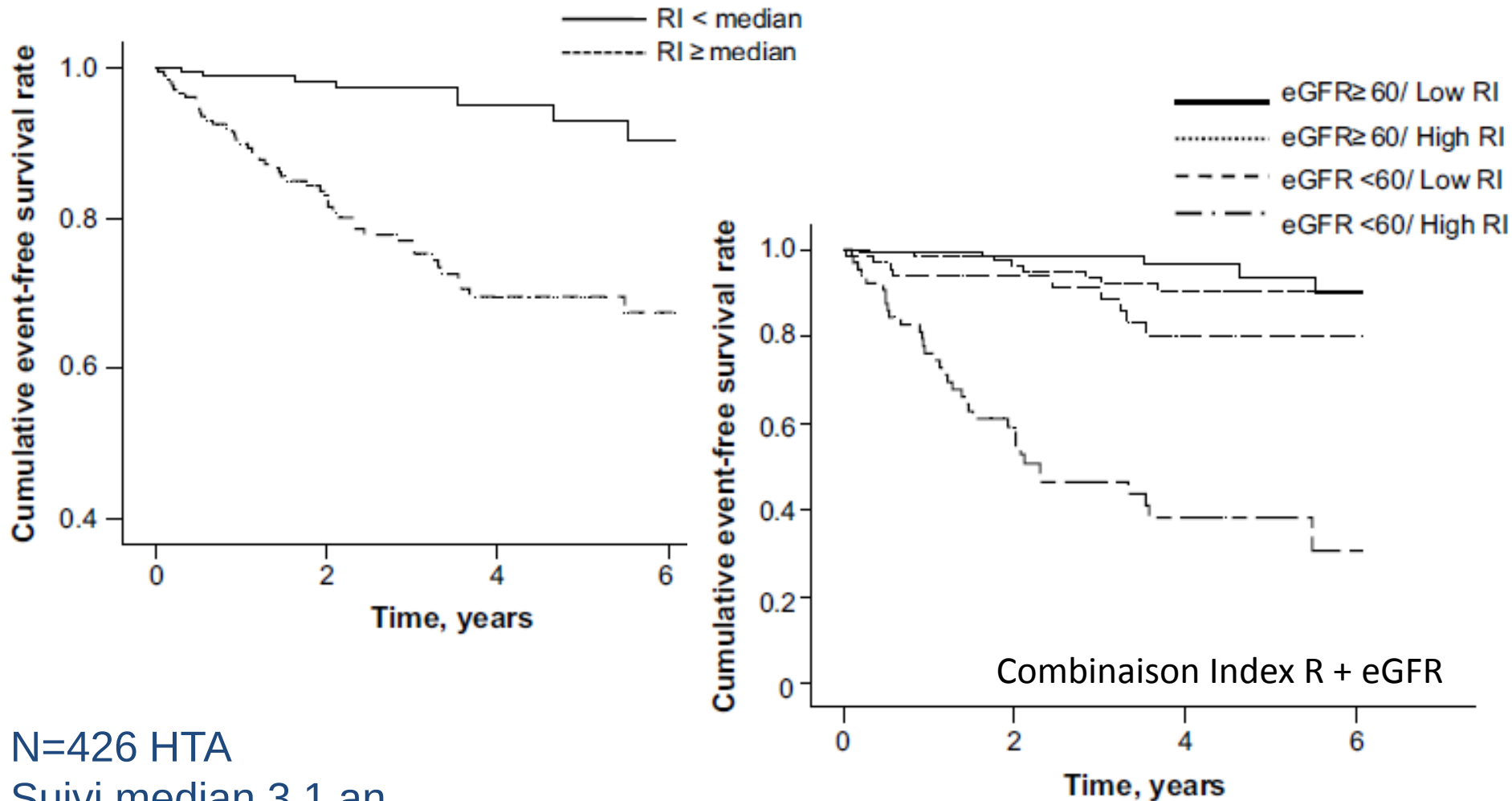
bpm, beats per minute; CI, confidence interval; eGFR, estimated glomerular filtration rate; RI: resistive index; TOD, target organ damage.

N=566 HTA



	β -coefficient	Standard error (β)	t-value	P
Age	0.002435	0.000326	7.4806	<0.0001
Pulse pressure	0.00181	0.000404	4.4809	<0.0001
Carotid IMT	0.051606	0.015938	3.238	0.0013
LVMI	0.000273	0.000111	2.4525	0.0145

Outcome CV et rénal

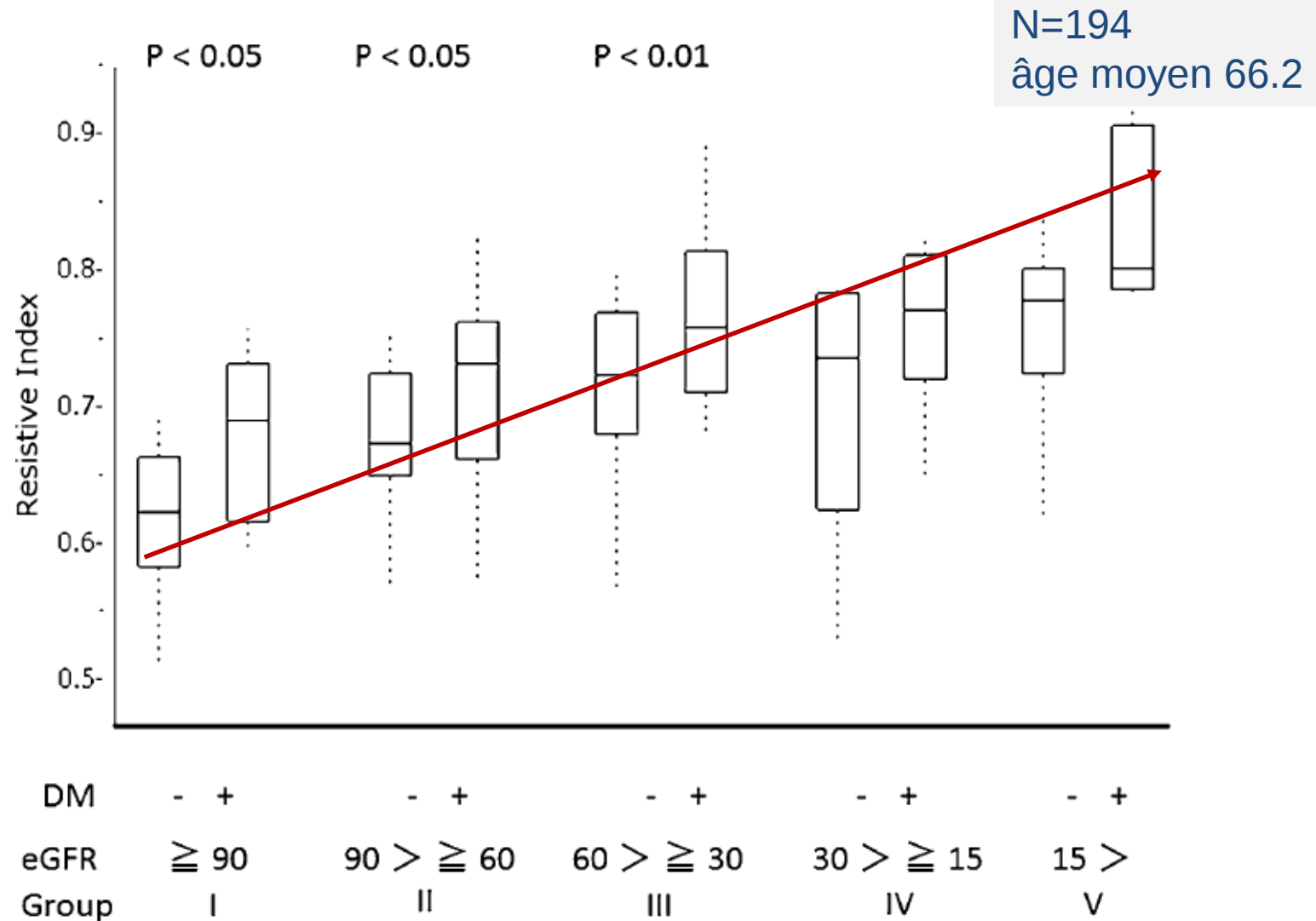


N=426 HTA

Suivi median 3.1 an

Outcome I composite: mortalité, événement CV ou dialyse

Index R corrèle avec stade IRC

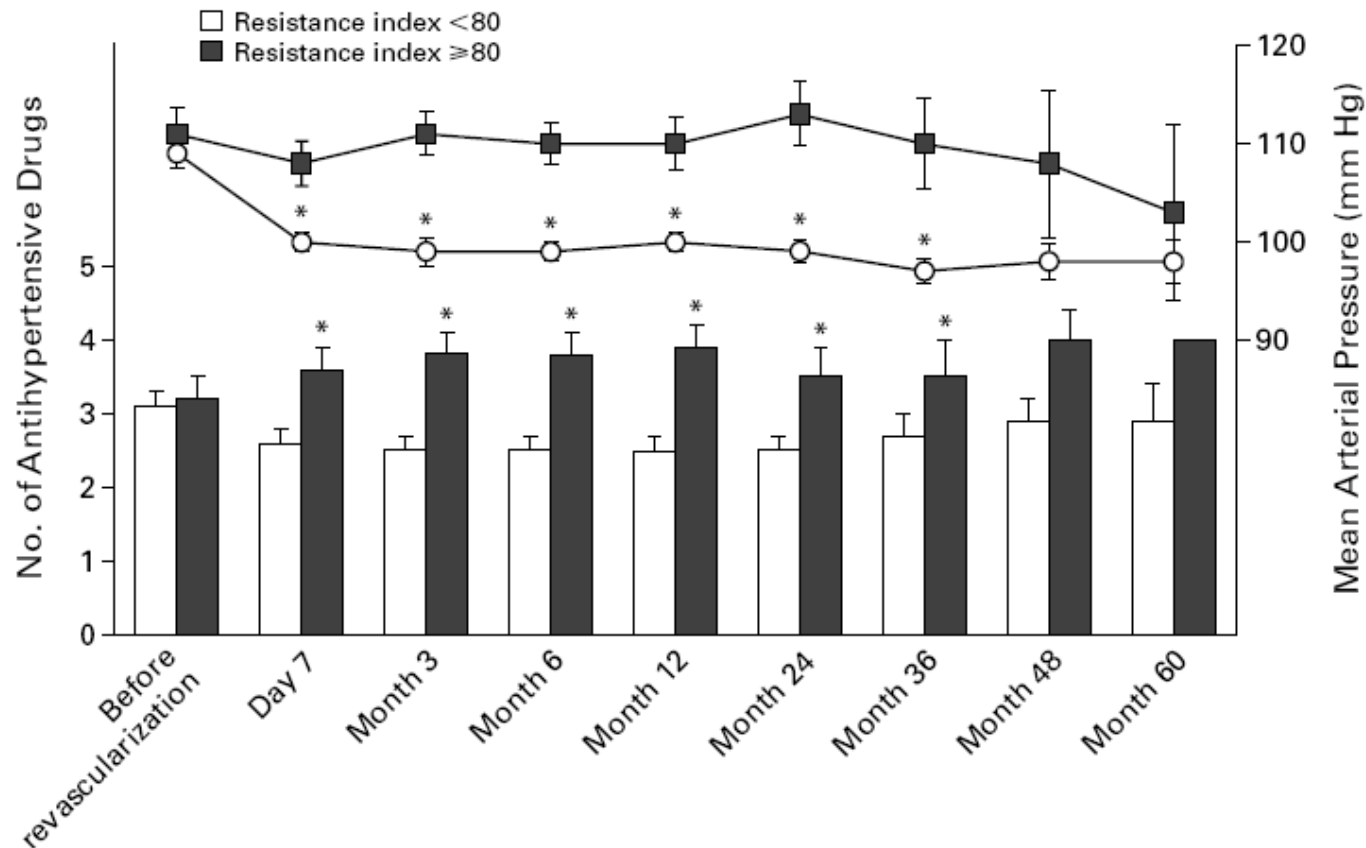


Progression maladie rénale

Characteristic	≥80	<80	P
Number	25	137	...
Age	66±10	47±16	<0.0001
Body mass index, kg/m ²	27.6±4.2	25.7±4.5	0.04
Documented atherosclerosis, n (%)	15 (60)	25 (18)	<0.0001
Coronary disease, n (%)	13 (52)	18 (13)	<0.0001
Peripheral arterial disease, n (%)	10 (40)	9 (7)	<0.0001
Diabetes mellitus, n (%)	10 (40)	11 (8)	<0.0001
Cigarettes total pack, y	34±12	20±12	0.005
ABPM 24-h systolic pressure, mm Hg	160±23	144±22	<0.001
ABPM pulse pressure, mm Hg	75±23	56±15	<0.0001
Hypertension duration, y	15±11	7±10	0.001
Antihypertensive drug classes	3.3±1.7	1.8±1.6	<0.0001
Heart rate, bpm	69±11	68±11	0.52
Uric acid, mg/dL	7.1±2.3	5.8±1.8	0.003
Creatinine clearance, mL/min/1.73 m ²	24±16	91±31	<0.0001
Protein excretion, g/d	2.6±2.2	0.5±1.1	<0.0001
Erythrocyte sedimentation rate, mm/1 st h	42±22	13±12	<0.0001

IRC
Suivi 3±1.4 ans
Outcome:
✓↓eGFR 50%
✓Dialyse
✓Décès

Pronostic post stent a rénale



NO. WITH FOLLOW-UP DATA

Resistance index <80	96	96	95	83	73	59	43	34	21
Resistance index ≥80	35	35	33	31	26	21	16	8	5

Conclusion

- L'ultrason renal de base permet de détecter certaines maladies rénales associées à l'HTA
- Le Doppler aide pour le screening d'une sténose de l'a rénale significative
- Les index de résistance ont une valeur ajoutée dans l'HTA:
 - Atteinte d'organe
 - Pronostic CV et renal
 - Gradation maladie rénale
 - Potentiel de recuperation post stent des a rénales



THANK YOU FOR YOUR ATTENTION