

# SEDUTA MULTIDISCIPLINARE

Sabato 1 dicembre 2012

Aula Magna Nuovo Arcispedale S. Anna  
Cona, Ferrara



**La Radiologia Interventistica nel rene ischemico e nell'ipertensione nefrovascolare: passato, presente e futuro? *R Galeotti, E Salviato***

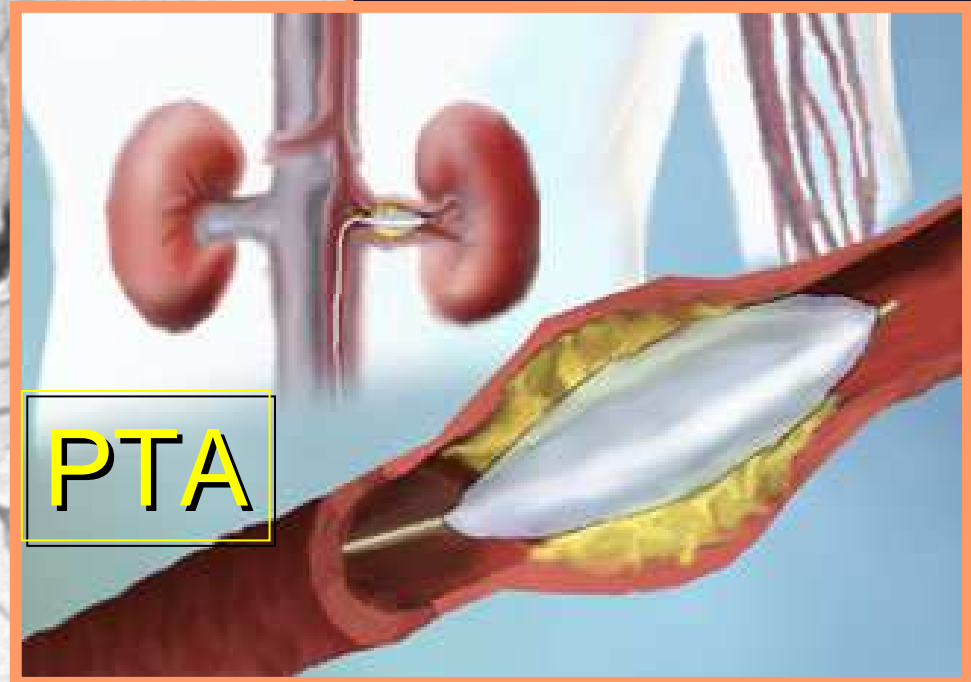
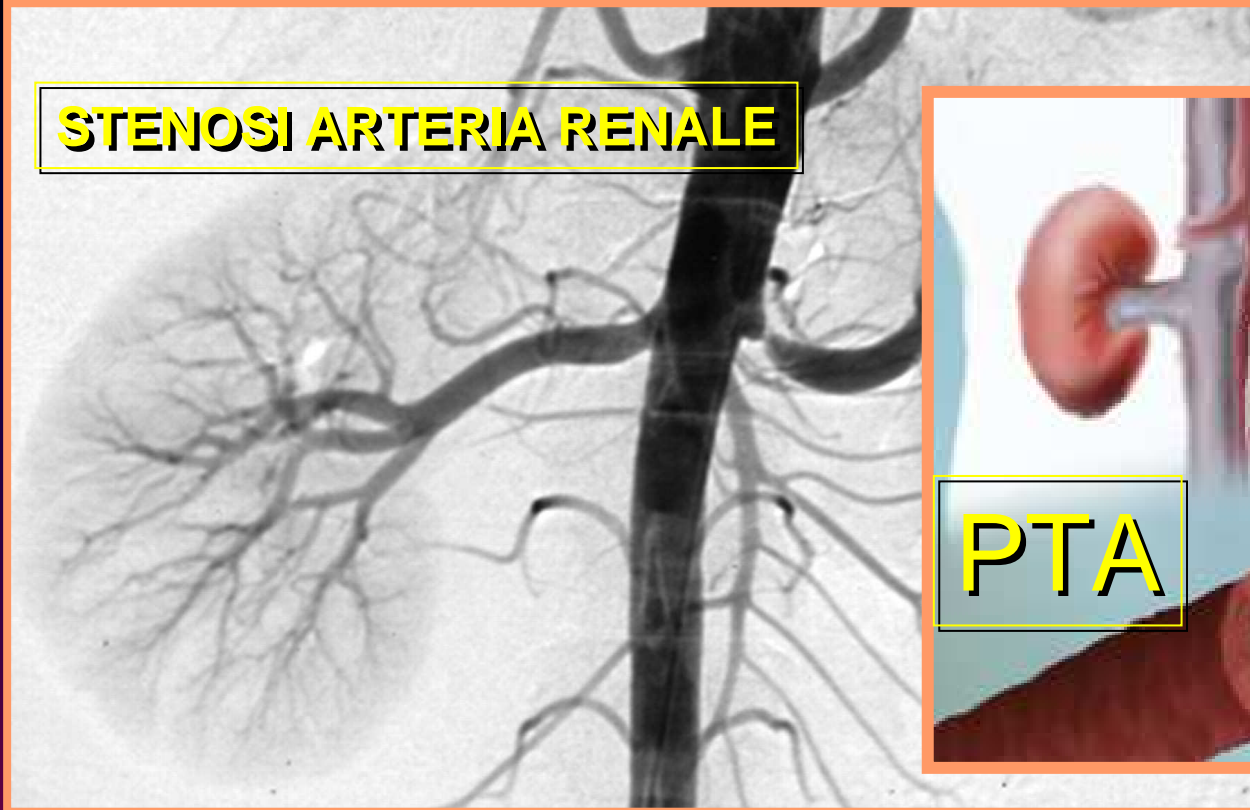


Dipartimento di Diagnostica per Immagini e Medicina di Laboratorio / Arcispedale S. Anna di Ferrara  
**Unità Operativa Semplice di Radiologia Vascolare e d Interventistica**

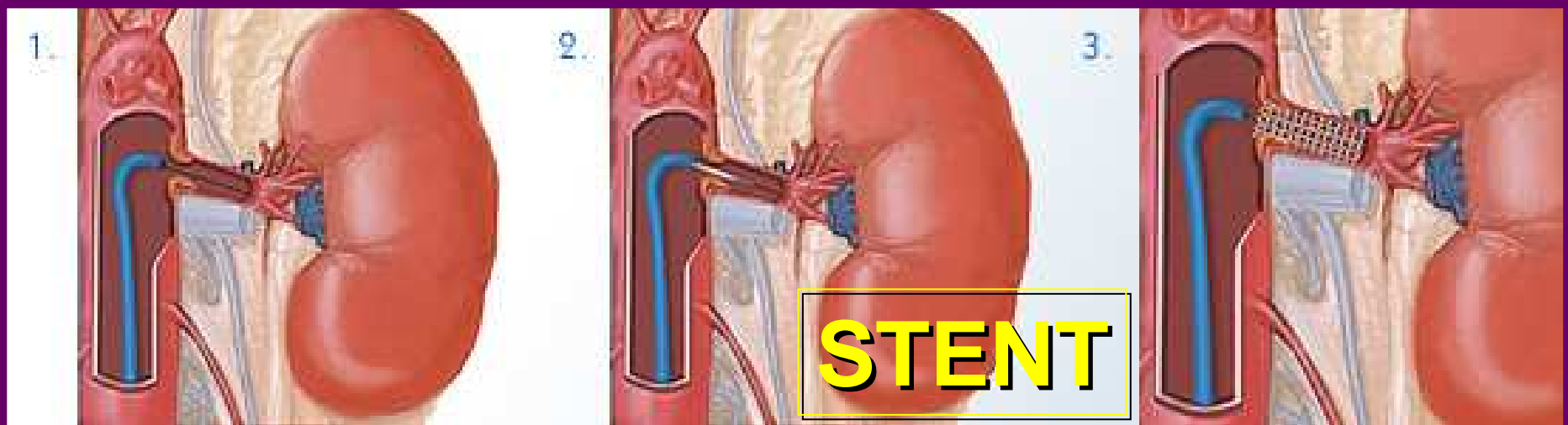


# IPERTENSIONE NEFROVASCOLARE E RENE ISCHEMICO

**STENOSI ARTERIA RENALE**



**PTA**



**STENT**

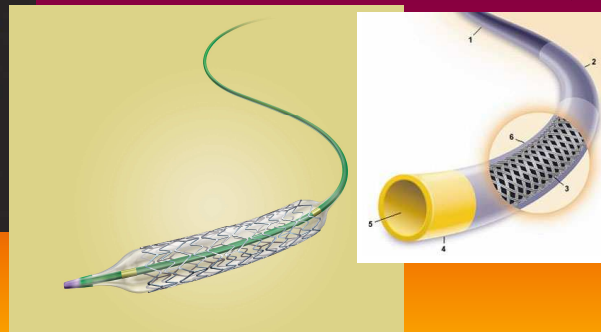
# PROCEDURE ENDOVASCOLARI

Miglioramenti nell'imaging diagnostico e terapeutico

Anni '80

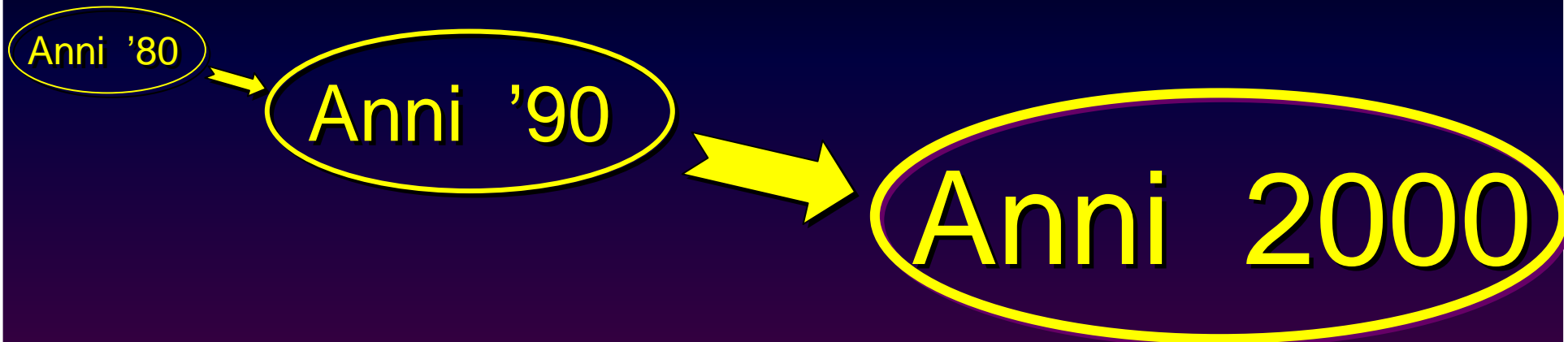
Anni '90

Perfezionamento dei materiali



Anni 2000

## PROCEDURE ENDOVASCOLARI



Atherosclerotic renal disease is detected in patients >50 year of age .  
The prevalence and impact of these lesions appear to be increasing,  
in part because of the aging population and improved survival from  
other vascular disease, including stroke and myocardial infarction

Renal artery stenosis resulting from atherosclerotic disease is  
common in individuals undergoing coronary angiography (18% to  
20%) and in those undergoing peripheral vascular angiography for  
occlusive disease of the aorta and legs (35% to 50%).

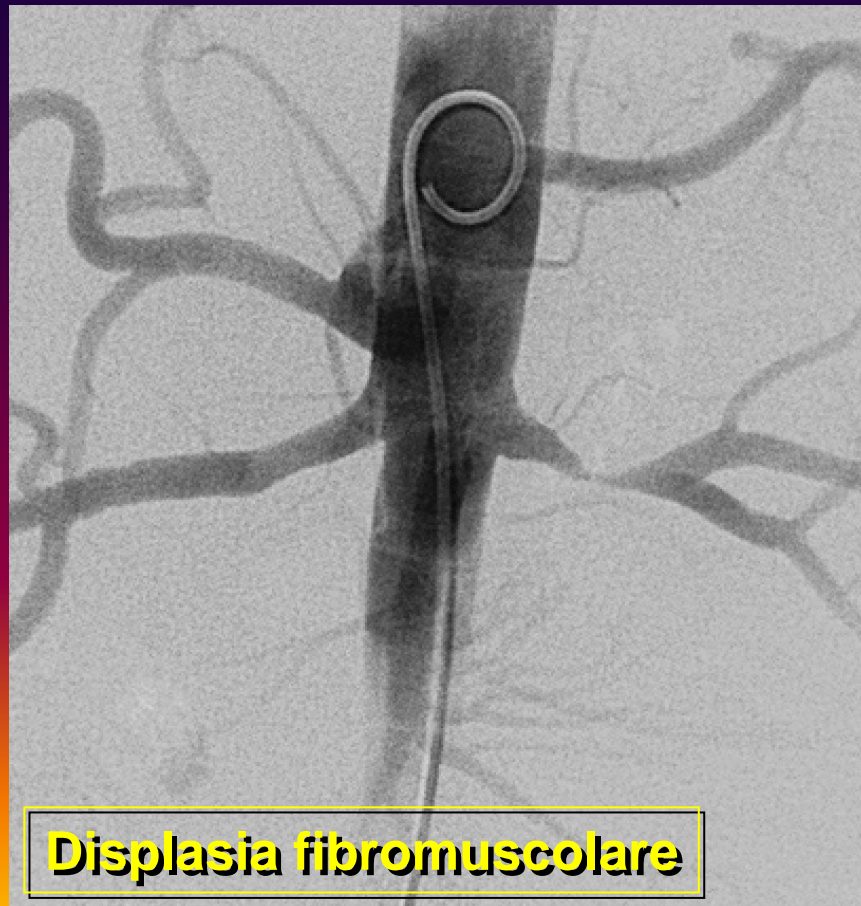
# PROCEDURE ENDOVASCOLARI

Anni '80



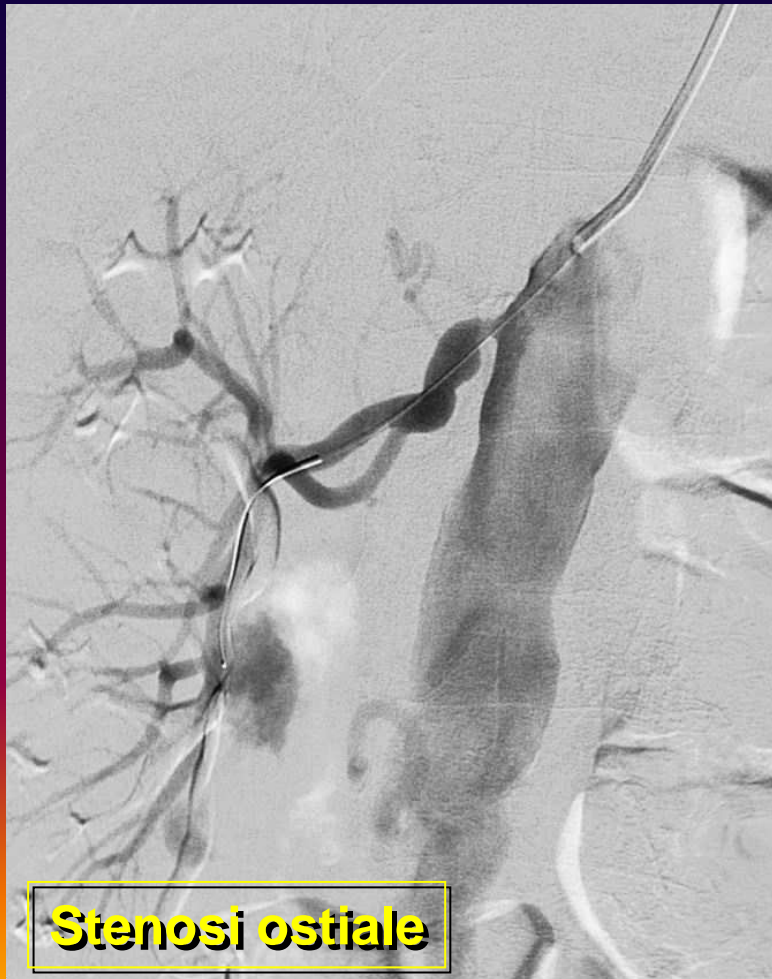
## **PROCEDURE ENDOVASCOLARI**

# **Anni 2000**



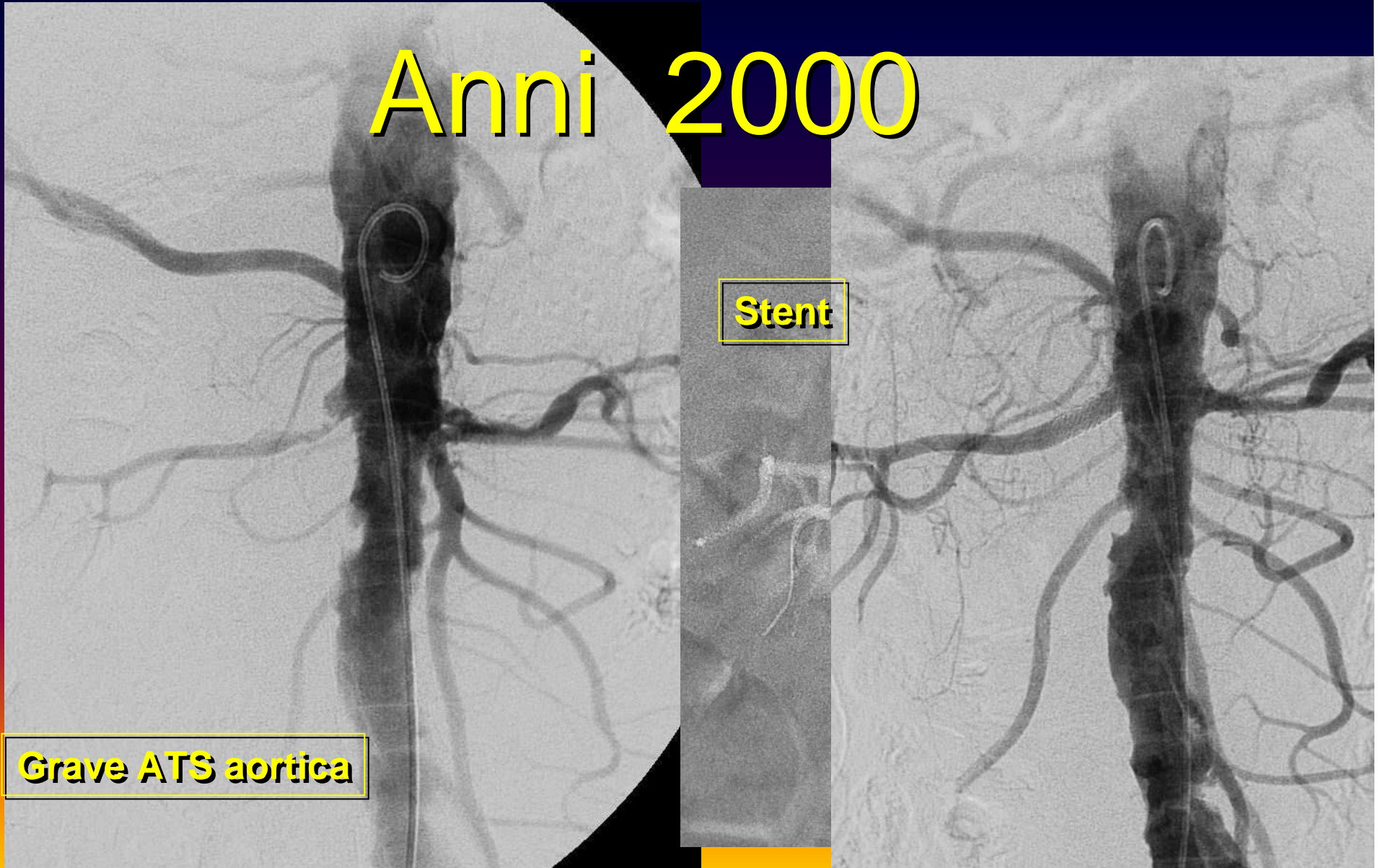
PROCEDURE ENDOVASCOLARI

Anni 2000



**PROCEDURE ENDOVASCOLARI**

**Anni 2000**



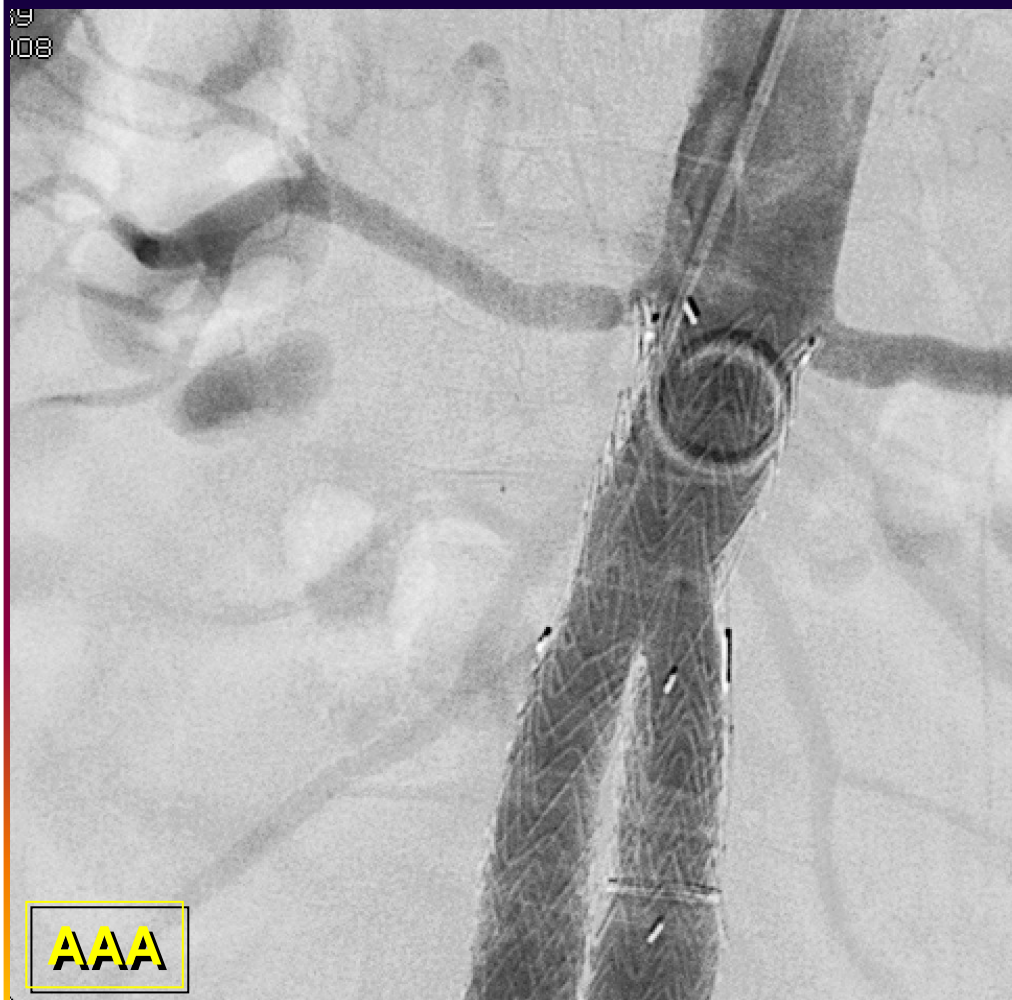
**Grave ATS aortica**

**Stent**

PROCEDURE ENDOVASCOLARI

Anni 2000

19  
108



Stent

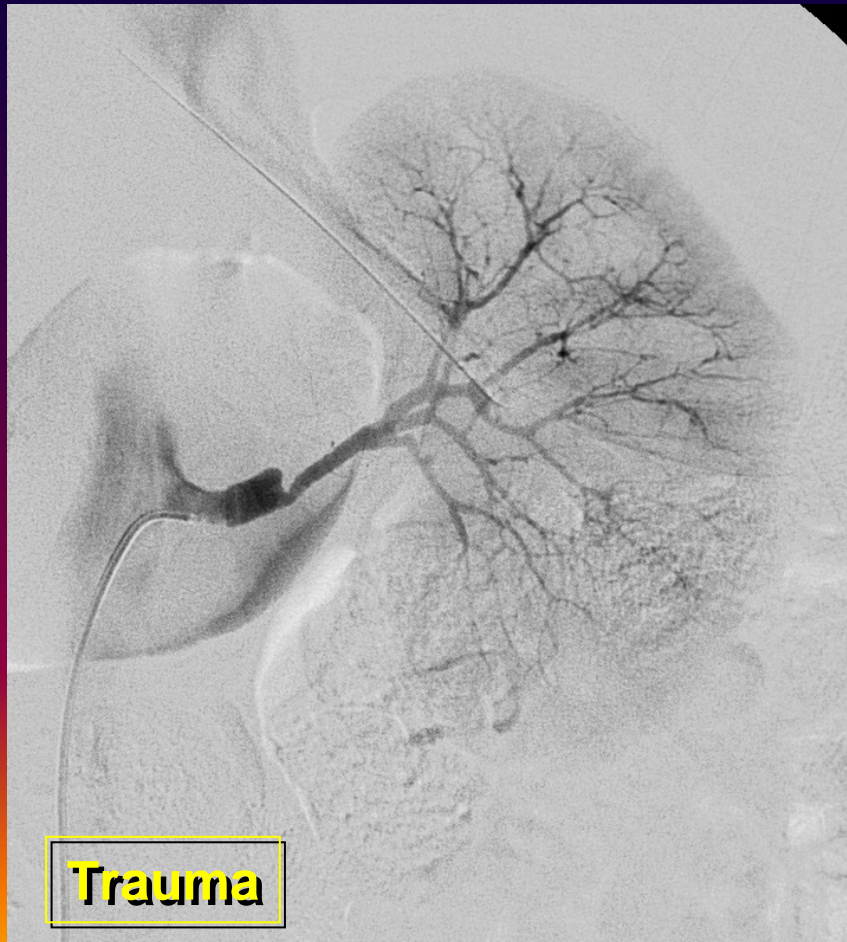


AAA

MRSI

**PROCEDURE ENDOVASCOLARI**

**Anni 2000**



**Trauma**



**Stent**

**PROCEDURE ENDOVASCOLARI**

**Anni 2000**



**Prime metanalisi**



# IPERTENSIONE NEFROVASCOLARE E RENE ISCHEMICO

## Renal Artery Stenting

### Technical Success

Study series	No. of Arteries	Ostial Lesion(%)	Success (%)
Rodriguez-Lopez	125	66	98
Henry	104	77	99
Rocha-Singh	180	43	98
Tuttle	148	100	98
Dorros	202		99

## Renal Artery Stenting

### Restenosis

Study	RA evaluated (% original total a.)	F/U (mo)	Restenosis (%)
van de Ven	52 (95%)	6	21
Rocha-Singh	158 (88%)	13	12
Rundback	28 (52%)	12	26
Tuttle	49 (33%)	8	14
White	80 (60%)	9	19

~20%

## Renal Artery Stenting

### Effect on Hypertension

Study series	No.	Cure (%)	Improved (%)	Benefits (%)
Tegtmeyer	65	23	71	94
Klinge	134	10	68	78
Martin	94	22	46	68
Lossino	153	12	51	63
Rodriguez-Perez	37	0	81	81
Blum	74	16	62	78
<b>Pooled Result</b>	586	14	63	~77%

## Renal Artery Stenting

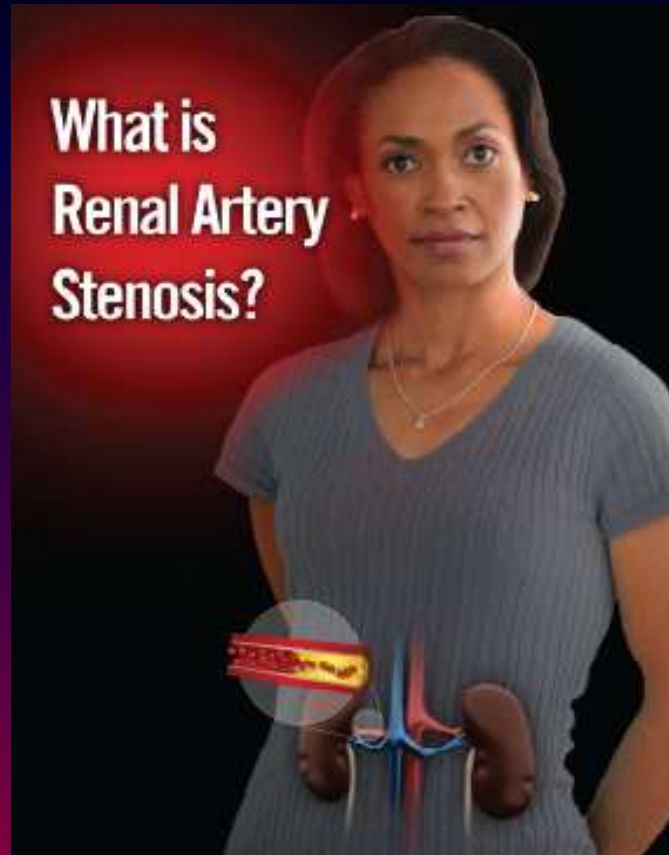
### Effect on Renal Function

Study	No	Improved (%)	Stable (%)	Deteriorated (%)
Van de Ven	42	12	62	26
Rocha-Singh	150	22	70	8
Tuttle	129	15	81	4
Dorros	163	18	48	34
Rundback	45	20	47	33
Harden	32	34	38	28
<b>TOTAL</b>	561	19%	62%	19%

## PROCEDURE ENDOVASCOLARI

....patients with abnormal renal function who undergo renal artery stent placement, roughly one quarter will have improved renal function, one quarter will have decreased renal function, and one half will remain unchanged....

# PROCEDURE ENDOVASCOLARI



**HeartHealthIndiana.com**

T.P. Murphy

Renal artery stenosis and the ischemic kidney. What is a significant stenosis?

*CIRSE Lisbon september 2009*

## **PROCEDURE ENDOVASCOLARI**

### ***Hemodynamic significance:***

70%, with a translesional pressure gradient of  $> 20$  mm Hg  
(measured with 0.014 guidewire)

### ***Clinical significance:***

which causes a clinical syndrome that is improved if reversed

T.P. Murphy

Renal artery stenosis and the ischemic kidney. What is a significant stenosis?

# PROCEDURE ENDOVASCOLARI

Analisi ragionata dei risultati

....patients with abnormal renal function who undergo renal artery stent placement, roughly one quarter will have improved renal function, one quarter will have decreased renal function, and one half will remain unchanged....

# PROCEDURE ENDOVASCOLARI

Analisi ragionata dei risultati

Renal artery stenosis (RAS)

Fibromuscular dysplasia (FMD)

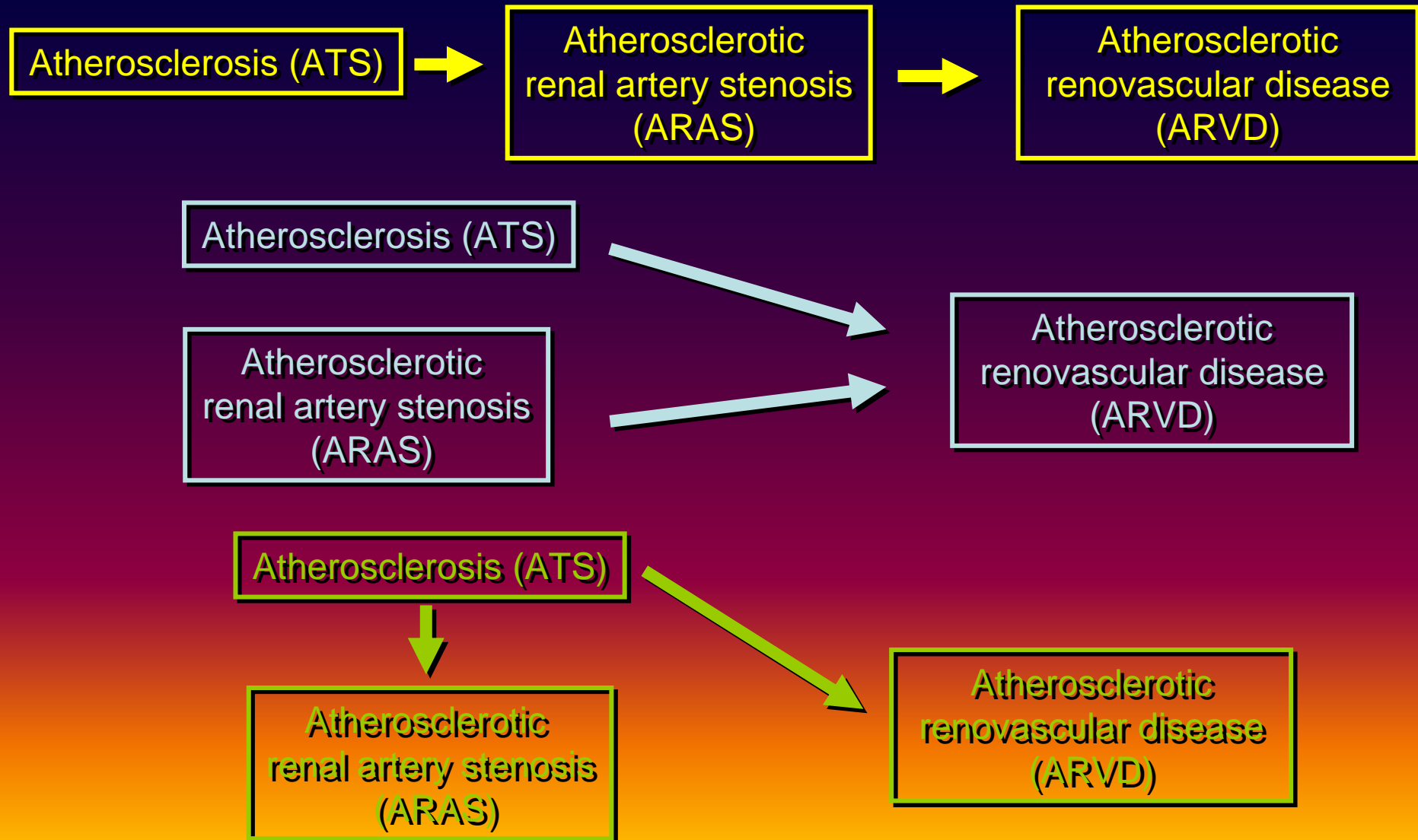
Atherosclerotic renal artery stenosis (ARAS)

Atherosclerosis (ATS)

Atherosclerotic renovascular disease (ARVD)

# PROCEDURE ENDOVASCOLARI

Analisi ragionata dei risultati



## PROCEDURE ENDOVASCOLARI

Analisi ragionata dei risultati

....., in ARAS the narrowing of the renal artery is not an isolated phenomenon, but part of a progressive process of generalized atherosclerosis...

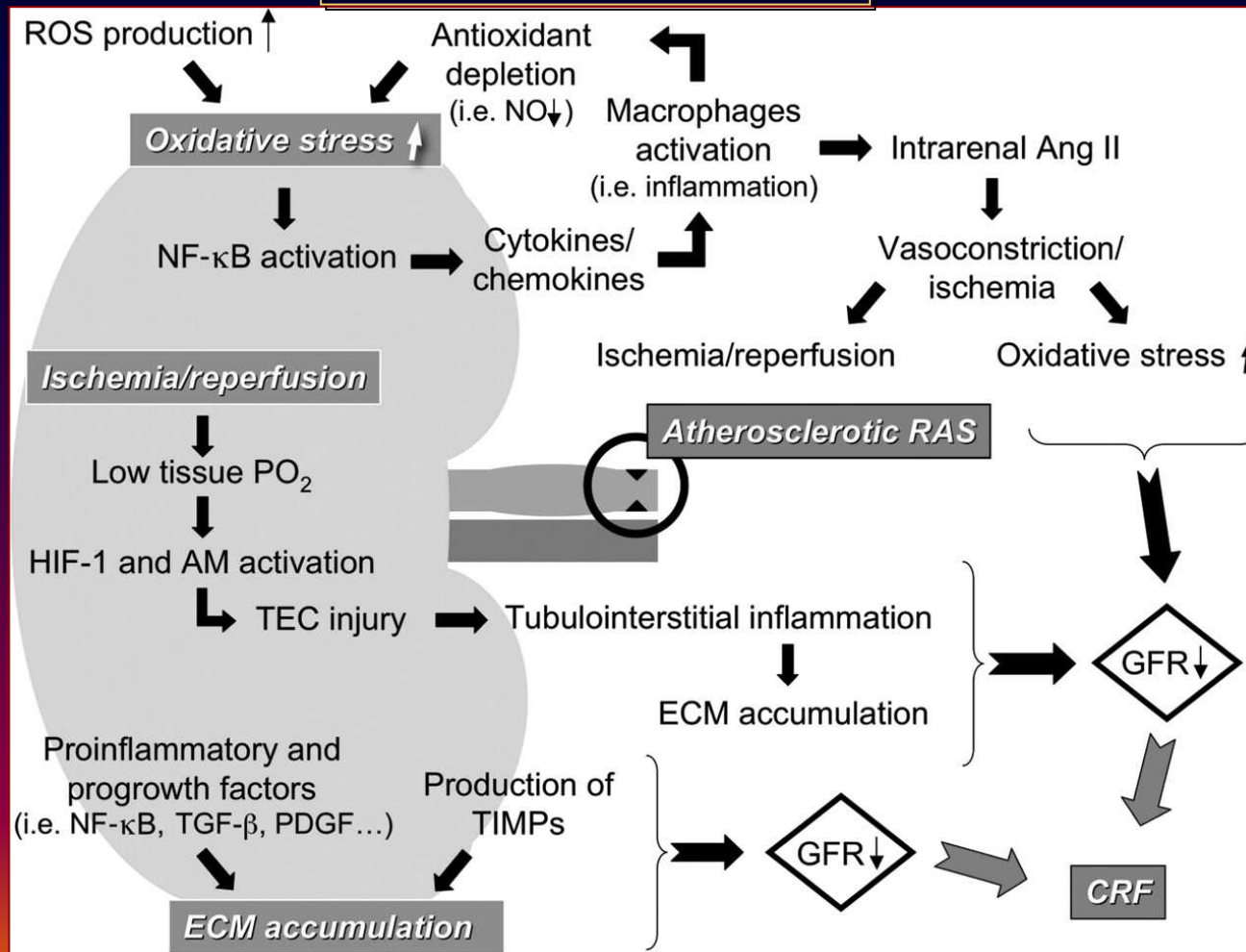
*Kwok-Wai Lui, MD, Arend-Jan Weittiez, MD, PhD, and Gerjan Navis, MD, PhD*

Atherosclerotic Renovascular Disease and Renal Impairment: Can We Predict the Effect of Intervention

**Current Hypertension Reports 2007, 9:140–147**

# PROCEDURE ENDOVASCOLARI

## Analisi ragionata dei risultati

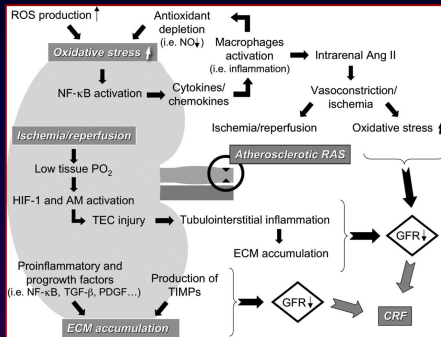


Pascal Meier, Jérôme Rossert, Pierre-François Plouin and Michel Burnier

Atherosclerotic renovascular disease: beyond the renal artery stenosis  
Nephrology Dialysis Transplantation (2007)

# PROCEDURE ENDOVASCOLARI

Analisi ragionata dei risultati



..arteriolar thickening, tubular and glomerular atrophy, and glomerulosclerosis....

.....renal interstitial fibrosis and scarring by increasing the production of fibrogenic factors that stimulate the synthesis of ECM proteins.....

.... risk factors such as dyslipidaemia, smoking and diabetes, which also increase the risk of renal artery disease progression in patients with ARVD.....

Pascal Meier, Jérôme Rossert, Pierre-François Plouin and Michel Burnier

Atherosclerotic renovascular disease: beyond the renal artery stenosis

Nephrology Dialysis Transplantation (2007)

## PROCEDURE ENDOVASCOLARI

Analisi ragionata dei risultati

....patients with abnormal renal function who undergo renal artery stent placement, roughly one quarter will have improved renal function, one quarter will have decreased renal function, and one half will remain unchanged....

The two most likely reasons for deterioration of renal function after intervention are

contrast-induced nephropathy and atheroembolization...

# PROCEDURE ENDOVASCOLARI

Analisi ragionata dei risultati

**SELEZIONE DEI PAZIENTI**

(circa il 70% non migliora !!! )

**PREVENZIONE E TRATTAMENTO COMPLICANZE**

(circa il 20% peggiora !!! )

## **PROCEDURE ENDOVASCOLARI**

**SELEZIONE DEI PAZIENTI**



**TRIALS**



**REVIEW  
LETTERATURA**

# PROCEDURE ENDOVASCOLARI TRIALS

**ASTRAL**—Angioplasty and Stent for Renal Artery Lesions;

**CORAL**—Cardiovascular Outcomes in Renal Atherosclerotic Lesions;

**DRASTIC**—Dutch Renal Artery Stenosis Intervention Cooperative;

**EMMA**—Essai Multicentrique Medicaments vs Angioplastie;

**NITER**— Nephropathy Ischemic Therapy;

**SNRASCG**—Scottish and Newcastle Renal Artery Stenosis Collaborative Group;

**STAR**—Benefit of Stent Placement and Blood Pressure and Lipid-lowering for the Prevention of Progression of Renal Dysfunction Caused by Atherosclerotic Ostial Stenosis of the Renal Artery.

# PROCEDURE ENDOVASCOLARI TRIALS

## STAR

**Intervention:** Stent placement and medical treatment (64 patients) or medical treatment only (76 patients)

**Measurements:** The **primary end point** was a 20% or greater decrease in creatinine clearance. **Secondary end points** included safety and cardiovascular morbidity and mortality.

**Conclusion:** **Stent placement** with medical treatment had **no clear effect** on progression of impaired renal function but led to a small number of significant procedure-related complications. The **study findings favor a conservative approach** to patients with ARAS, focused on cardiovascular risk factor management and avoiding stenting.

Liesbeth Bax,; Arend-Jan J. Weittiez,; Hans J. Kouwenberg, Willem P.T.M. Mali, Erik Buskens, Frederik J.A. Beek,; Branko Braam,; PhD; Frans T.M. Huysmans,; Leo J. Schultze Kool,; Matthieu J.C.M. Rutten, Cornelius J. Doorenbos,; Johannes C.N.M. Aarts, Ten J. Rabelink,; Pierre-François Plouin, Alain Raynaud,; Gert A. van Montfrans,; Jim A. Reekers,; Anton H. van den Meiracker, Peter W.T. Pattynama, Peter J.S. van de Ven,; Damnis Vroegindewelt,; Abraham A. Kroon, Michiel W.de Haan, Cornelis T. Postema, and Jaap J. Bouter,

**Stent Placement in Patients With Atherosclerotic Renal Artery Stenosis and Impaired Renal Function**

*Ann Intern Med.* 2009;150:340-348.

## PROCEDURE ENDOVASCOLARI TRIALS

# ASTRAL

**Intervention:** Stent placement and medical treatment or medical treatment only (Total : 806 patients)

The procedure was successful in 88% of patients .

At one year, there was **no difference** in the change in serum creatinine ,in the rates of myocardial infarction, cerebrovascular events between the two groups

**Conclusions** :Results from the ASTRAL trial demonstrate that **catheter-based interventions** for renal artery stenosis are **not associated with improvements in kidney function, blood pressure control, or rates of major cardiovascular illness** compared to treatment with medical therapy alone

# PROCEDURE ENDOVASCOLARI TRIALS

## CORAL

**1080 hypertensive patients** (systolic blood pressure 155 mm Hg)  
with severe atherosclerotic renal artery lesions (>60% diameter stenosis with 20 mm Hg gradient or > 80%)

**Treatment** : optimum medical therapy **with or without renal artery stent** implantation  
with emboli protection (if possible)

**5-year follow-up** period

**Composite cardiovascular and renal end points** : death, cerebrovascular accident,  
myocardial infarction, kidney failure, uncontrolled hypertension , hospitalization for  
congestive heart failure..

# PROCEDURE ENDOVASCOLARI

## REVIEW

## LETTERATURA



# IPERTENSIONE NEFROVASCOLARE E RENE ISCHEMICO

## REVIEW LETTERATURA

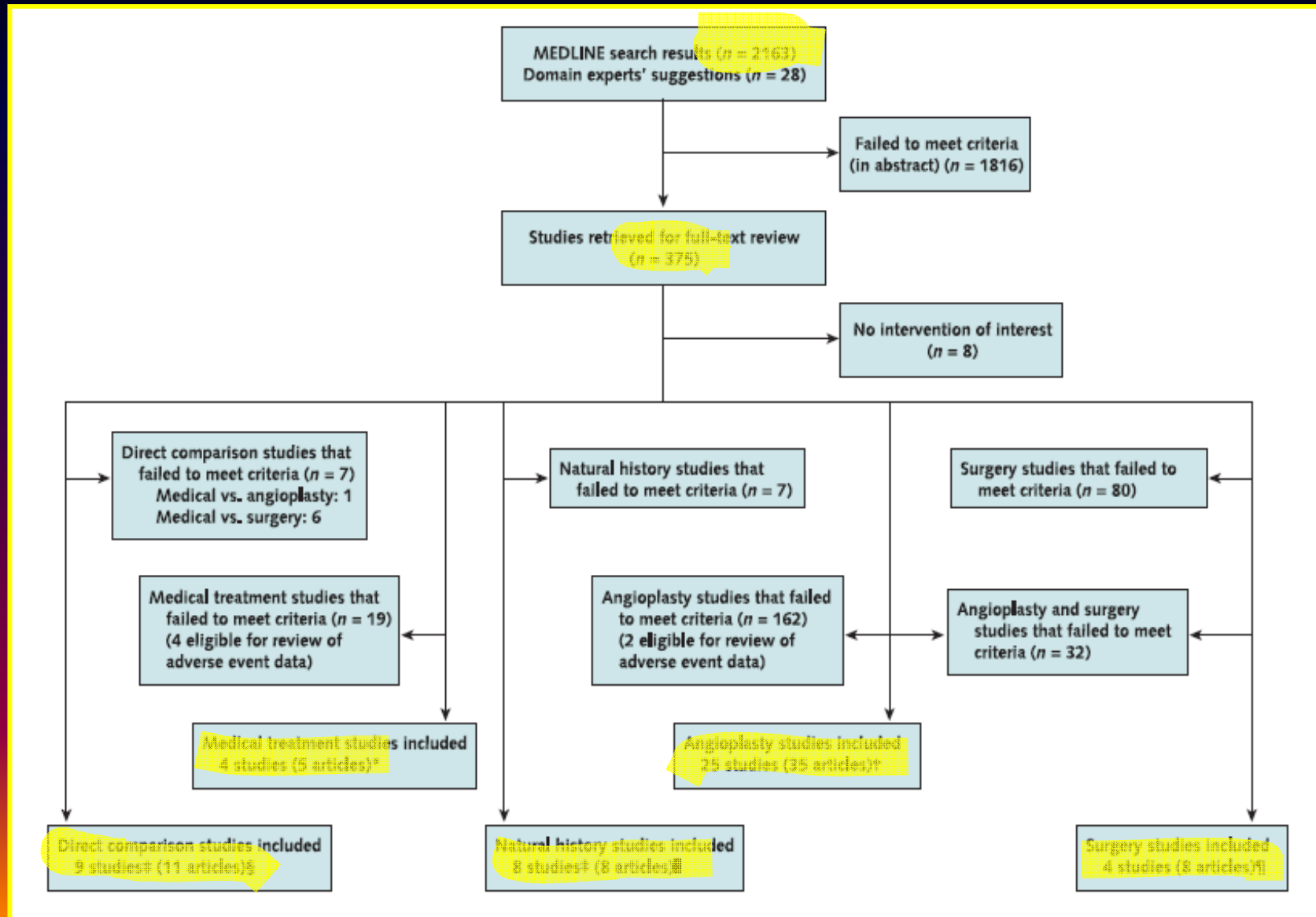


Ethan Balk, Gowri Raman, ; Mei Chung, ; Stanley Ip, Athina Tatsioni, Alvaro Alonso, Priscilla Chew, Scott J. Gilbert, ; and Joseph Lau,  
**Effectiveness of Management Strategies for Renal Artery Stenosis: A Systematic Review**

*Ann Intern Med.* 2006;145:901-912.

# IPERTENSIONE NEFROVASCOLARE E RENE ISCHEMICO

## REVIEW LETTERATURA



Ethan Balk, Gowri Raman, Mei Chung, Stanley Ip, Athina Tatsioni, Alvaro Alonso, Priscilla Chew, Scott J. Gilbert, and Joseph Lau,  
**Effectiveness of Management Strategies for Renal Artery Stenosis: A Systematic Review**  
*Ann Intern Med.* 2005;145:901-912.

## REVIEW LETTERATURA

**Table 2. Effects of Renal Artery Revascularization versus Medical Treatment Alone on Clinical Outcomes**

Outcomes	Strength of Evidence	Studies (Participants), <i>n</i>			Conclusions
		Randomized Trials	Other Comparative Studies	Cohort Studies	
Death	Weak	1 (55)	4 (381)	30 (4646)	No large difference in mortality up to about 5 years between revascularization and medical treatment
Kidney function	Acceptable	2 (103)	7 (428)	34 (4916)	No substantial difference in kidney function; Improvements in kidney function were reported in cohort studies only among patients receiving revascularization
Blood pressure	Acceptable	2 (103)	8 (597)	34 (4275)	Some evidence that blood pressure may be lower and more after angioplasty than with medical treatment alone, particularly among patients with bilateral disease (range, no difference to 26/10 mm Hg lower after angioplasty); cure of hypertension was reported in cohort studies only among patients receiving revascularization
Cardiovascular events	Weak	1 (55)	1 (52)	3 (560)	No large differences found in comparative studies up to about 4 years
Adverse events	Weak	2 (103)	4 (323)	31 (4906)	Evidence does not support meaningful conclusions about relative adverse events or complications from angioplasty compared with medical treatment

Ethan Balk, Gowri Raman, Mei Chung, Stanley Ip, Athina Tatsioni, Alvaro Alonso, Priscilla Chew, Scott J. Gilbert, and Joseph Lau, Effectiveness of Management Strategies for Renal Artery Stenosis: A Systematic Review

*Ann Intern Med.* 2005;145:901-912.

# PROCEDURE ENDOVASCOLARI

## REVIEW LETTERATURA

### Predictors of kidney salvageability

Kidney size >9.0 cm

Resistive index <0.80 (Doppler)

Recent increase in serum creatinine

Decrease in GFR during ACE inhibition or ARB therapy

Absence of glomerular or interstitial fibrosis on kidney biopsy

# **PROCEDURE ENDOVASCOLARI**

## **REVIEW LETTERATURA**

### **Predictors of poor renal function outcome after revascularization**

Kidney size < 8 cm

Resistive index >0.80

Albuminuria (> 1g/day)

# PROCEDURE ENDOVASCOLARI

## REVIEW LETTERATURA

### Factors favoring medical therapy and **revascularization** for renal artery stenosis

Progressive decline in GFR during treatment of systemic hypertension

Failure to achieve adequate blood pressure control with optimal medical therapy (medical failure)

Rapid or recurrent decline in the GFR in association with a reduction in systemic pressure

Decline in the GFR during therapy with ACE inhibitors or ARBs

Recurrent congestive heart failure in a patient in whom the adequacy of left ventricular function does not explain a cause

### Factors favoring medical therapy and **surveillance** of renal artery disease

Controlled blood pressure with stable renal function (eg, stable renal insufficiency)

Stable renal artery stenosis without progression on surveillance studies (eg, serial duplex ultrasound)

Very advanced age and/or limited life expectancy

Extensive comorbidities that make revascularization too risky

High risk for or previous experience with atheroembolic disease

Other concomitant renal parenchymal diseases that cause progressive renal dysfunction (eg, interstitial nephritis, diabetic nephropathy)

Krishna J. Rocha-Singh, Chair; Andrew C. Eisenhauer; Stephen C. Textor, FAHA;  
Christopher J. Cooper, FAHA; Walter A. Tan, MD; Alan H. Matsumoto; Kenneth Rosenfield

**Atherosclerotic Peripheral Vascular Disease Symposium II Intervention for Renal Artery Disease**  
*Circulation. 2008;118:2873-2878*

# **PROCEDURE ENDOVASCOLARI**

## **REVIEW LETTERATURA**

### **Indications for Renal Revascularization**

#### **- Resistant hypertension**

Failure of medical therapy despite full doses of 3 drugs, including diuretic

Compelling need for ACE inhibition/angiotensin blockade with angiotensin-dependent GFR

#### **- Progressive renal insufficiency**

Salvageable kidneys

Recent rise in serum creatinine

Loss of GFR during antihypertensive therapy, eg, with ACE inhibition/ARB therapy

Evidence of preserved diastolic blood flow (low resistive index)

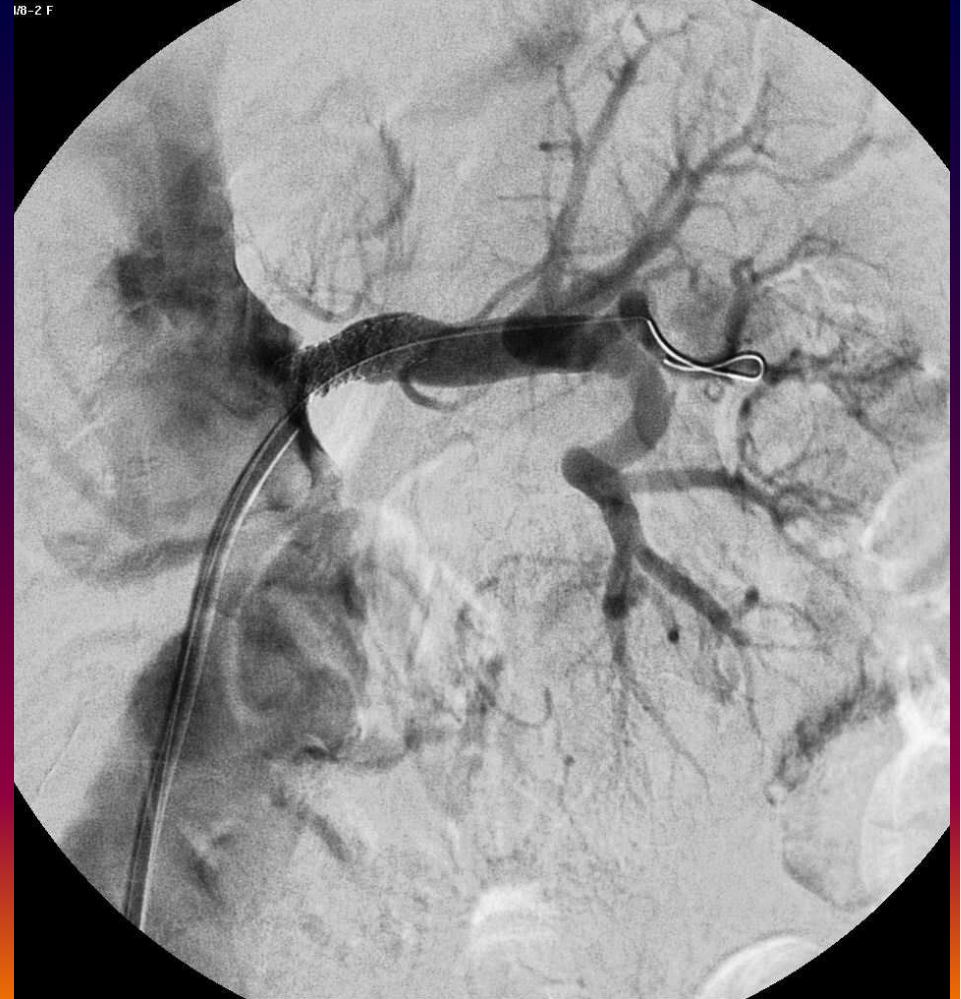
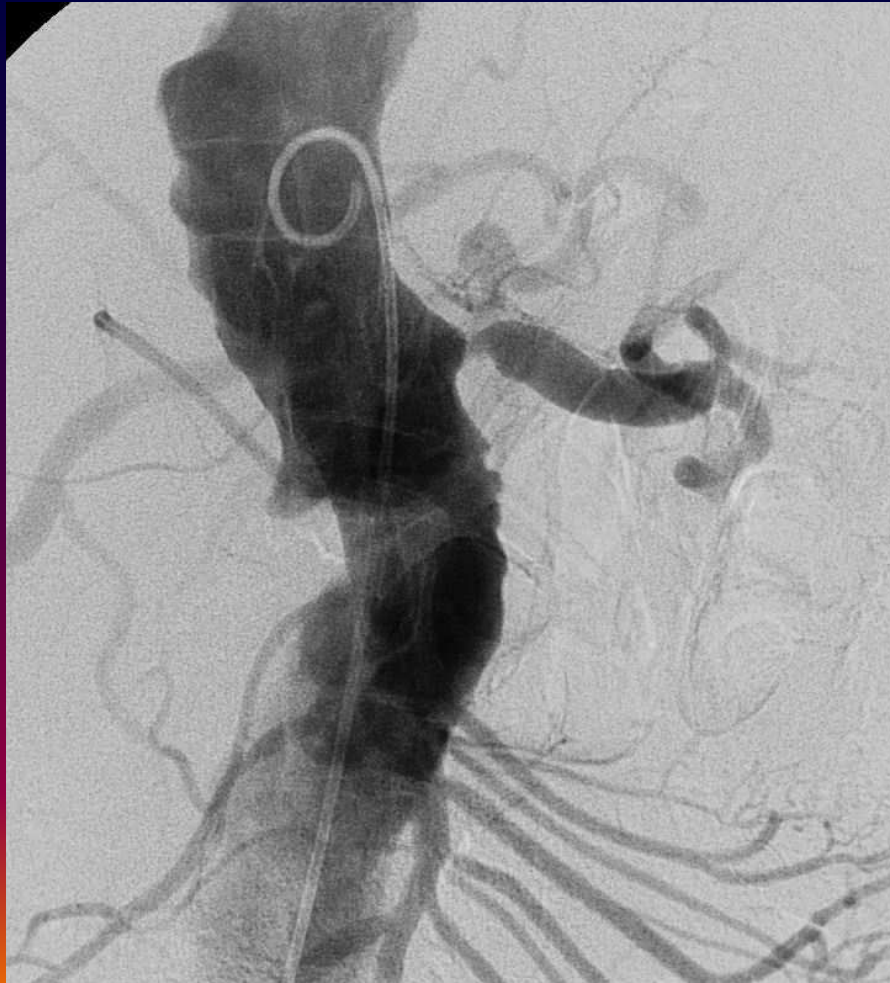
#### **- Circulatory congestion, recurrent "flash" pulmonary edema**

#### **- Refractory congestive heart failure with bilateral renal arterial stenosis**

# IPERTENSIONE NEFROVASCOLARE E RENE ISCHEMICO



# IPERTENSIONE NEFROVASCOLARE E RENE ISCHEMICO



## **PROCEDURE ENDOVASCOLARI**

### **PREVENZIONE E TRATTAMENTO COMPLICANZE**

**Incidenza variabile dal 5% al 65%....!**

## **PROCEDURE ENDOVASCOLARI**

### **PREVENZIONE E TRATTAMENTO COMPLICANZE**

**Embolizzazione**

**Trombosi stent**

**Restenosi intra stent**

**Rottura arteria renale**

**Perforazione renale**

**CIN (contrast induced nephropaty)**

## PROCEDURE ENDOVASCOLARI

### Embolizzazione

Macro (ateromasica) ,Micro (colesterolica)

emboli may occur during the diagnostic angiogram, as a consequence of manipulation of catheters and guidewires within the abdominal aorta, or during an attempt to selectively catheterize the renal artery (Type I embolization).

may also be caused by direct manipulation within the main renal artery during balloon dilation and/or stenting, resulting from "active" disruption of the atherosclerotic plaque (Type II embolization).

Krishna J. Rocha-Singh, Chair; Andrew C. Eisenhauer; Stephen C. Textor, FAHA;  
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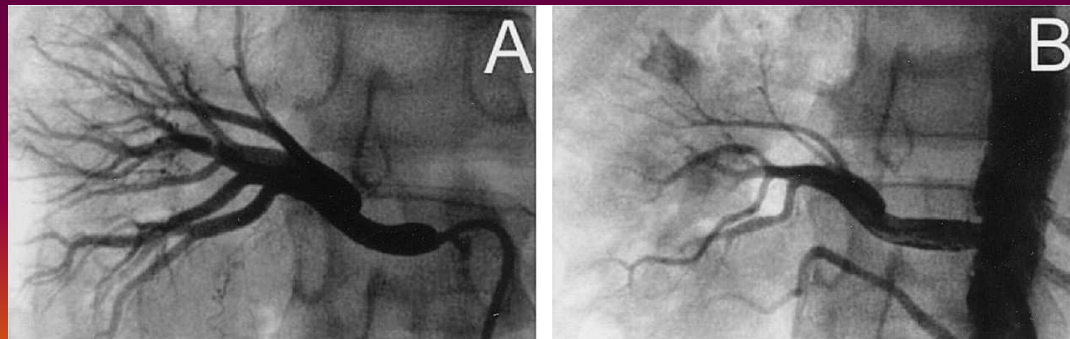
## PROCEDURE ENDOVASCOLARI

### Embolizzazione

Macro (ateromasica) ,Micro (colesterolica)

The diagnosis is suspected when subacute renal failure or peripheral evidence of embolization, such as *blue toes* and livedo reticularis, is evident

0% to 10% in published series



Krishna J. Rocha-Singh, Chair; Andrew C. Eisenhauer; Stephen C. Textor, FAHA;  
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## **PROCEDURE ENDOVASCOLARI**

### **Embolizzazione**

Macro (ateromastica) ,Micro (colesterolica)

### **PREVENZIONE**

**Valutare attentamente gli esami preprocedurali non invasivi**

**Evitare guide e cateteri rigidi**

**Evitare ripetuti passaggi**

**Minimizzare i contatti con le pareti aortiche**

**Usare materiale low-profile**

**Usare il filtro (non provato)**

## PROCEDURE ENDOVASCOLARI

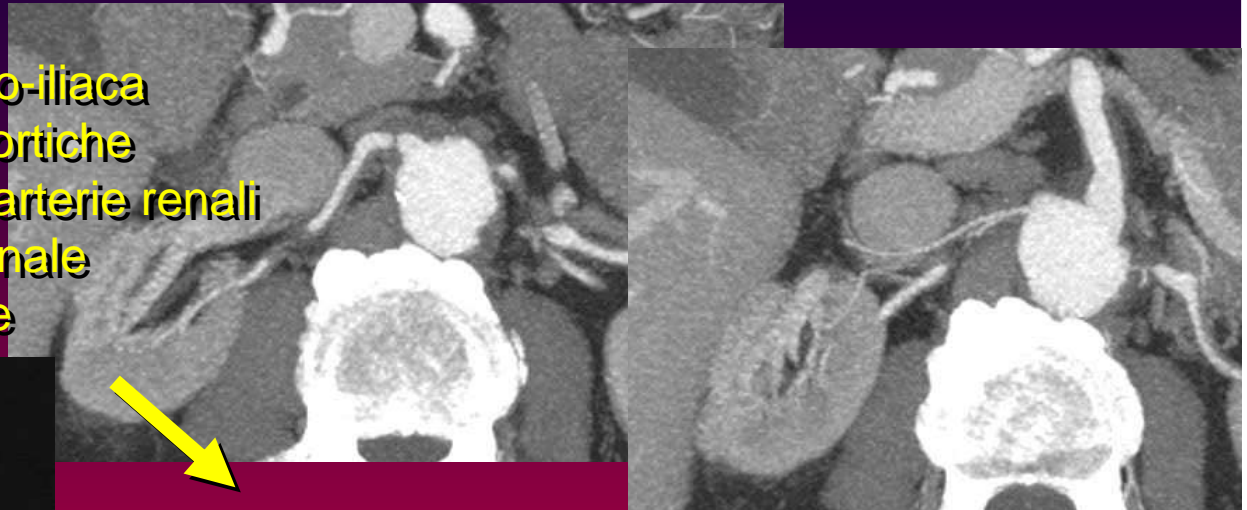
### Embolizzazione

Macro (ateromastica) ,Micro (colesterolica)

### PREVENZIONE

**Valutare attentamente gli esami preprocedurali non invasivi con riguardo a :**

- diametro e tortuosità aorto-iliaca
- calcificazioni e placche aortiche
- numero e diametro delle arterie renali
- orientamento dell'ostio renale
- decorso dell'arteria renale



**Selezione di un adeguato:**

- accesso (brachiale)
- angolo dell'amplificatore di brillantezza
- morfologia del catetere-guida
- diametro del pallone/stent

# PROCEDURE ENDOVASCOLARI

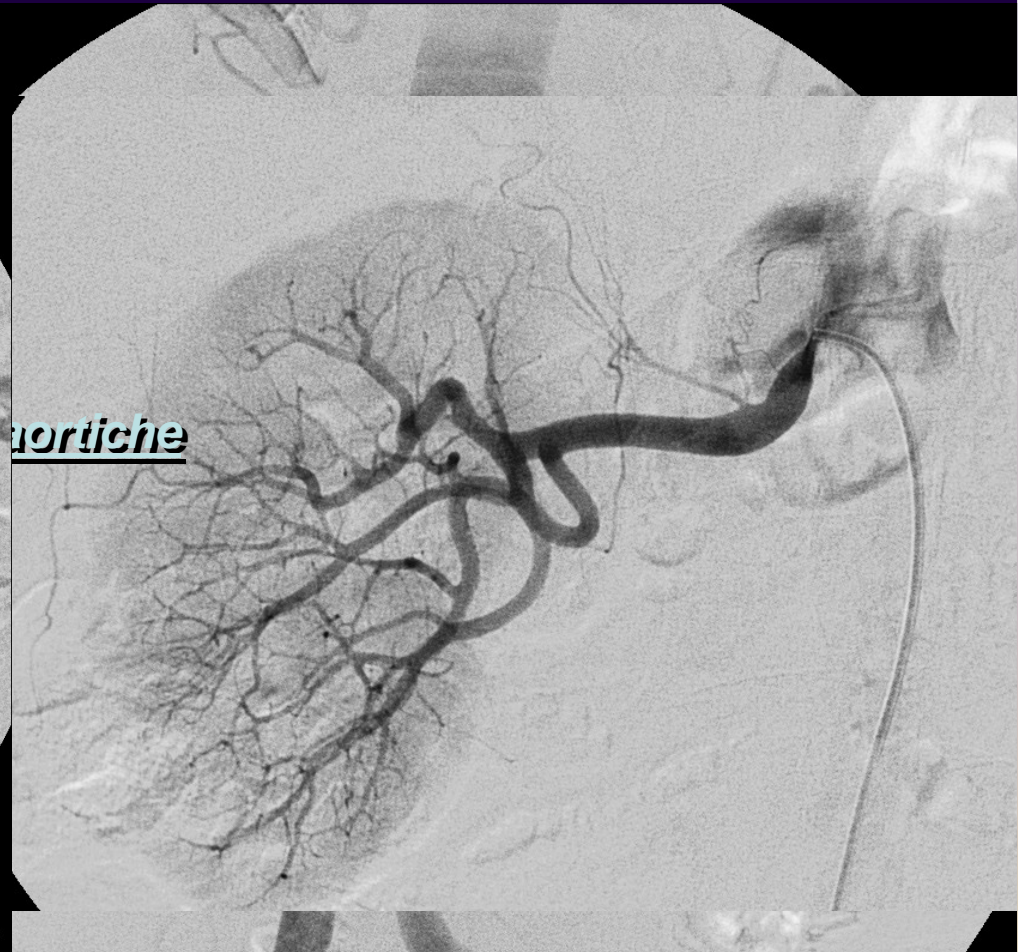
## Embolizzazione

Macro (ateromastica) ,Micro (colesterolica)

## PREVENZIONE

3/5-2 F

5/10-5 F



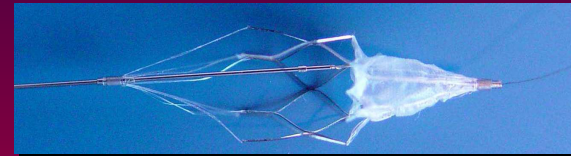
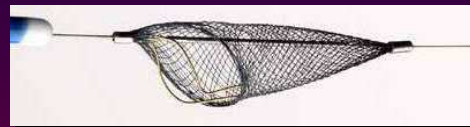
## PROCEDURE ENDOVASCOLARI

### Embolizzazione

Macro (ateromastica) ,Micro (colesterolica)

### PREVENZIONE

## Uso del filtro (non provato)



## PROCEDURE ENDOVASCOLARI

### Embolizzazione

Macro (ateromastica) ,Micro (colesterolica)

### PREVENZIONE

## Uso del filtro (non provato)

Henry et al.

- 2001 J Endovasc Ther
- 2003 Catheter Cardiovasc Interv
- 2005 Expert Rev Cardiovasc Ther

- 56 pts. – 65 renal arteries
- Visible debris >80%
- Size 98.1 $\mu$ m
- No deterioration of renal function
- Atheroembolism prevented
- Incidence of end-organ complications prevented



## PROCEDURE ENDOVASCOLARI

### Embolizzazione

Macro (ateromastica) ,Micro (colesterolica)

### PREVENZIONE

## Uso del filtro (non provato)

Although these initial results are encouraging, the devices used in these renal applications initially were designed for use in coronary saphenous vein grafts or carotid stenting, and their utility in the kidneys has not been determined.



Krishna J. Rocha-Singh, Chair; Andrew C. Eisenhauer; Stephen C. Textor, FAHA;  
Christopher J. Cooper, FAHA; Walter A. Tan, MD; Alan H. Matsumoto; Kenneth Rosenfield

Atherosclerotic Peripheral Vascular Disease Symposium II Intervention for Renal Artery Disease  
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## PROCEDURE ENDOVASCOLARI

### Embolizzazione

Macro (ateromastica) ,Micro (colesterolica)

### TRATTAMENTO

Antiaggreganti

Corticosteroidi

Statine

Cholesterol and atheroembolic debris lodged in the terminal vessels (arterials and capillaries) can cause **local inflammation**, scarring, and disruption of the local vascular architecture. **Statins** may have a protective effect on the inflammatory reaction of vessels to atheroemboli

Scolari F, Ravani P, Pola A, Guerini S, Zubani R, Movilli E, Savoldi S, Malberti F, Maiorca R.  
Predictors of renal and patient outcomes in atheroembolic renal disease: a prospective study.

*J Am Soc Nephrol.* 2003; 14: 1534–1590

## **PROCEDURE ENDOVASCOLARI**

### **CIN (contrast induced nephropathy)**

#### **PREVENZIONE**

- Individuazione fattori di rischio
- Idratazione paziente
- Anti-ossidanti (?)
- Vasodilatatori (?)
- Scelta del mdc
- Quantità del mdc
- Rimozione del mdc

Richard Solomon

**Contrast media nephropathy—how to diagnose and how to prevent?**

Nephrology Dialysis Transplantation 2007 22(7):1812-1815

**PROCEDURE ENDOVASCOLARI**  
**CIN (contrast induced nephropathy)**

**PREVENZIONE**

**Individuazione fattori di rischio**

- Insufficienza renale cronica (eGFR <60ml/min/1,73m<sup>2</sup>)
- Ridotta frazione di eiezione ventricolare sinistra (<40%)
- Diabete
- Ipotensione
- Uso di farmaci antinfiammatori non-steroidi
- Necessità di elevate quantità di mdc

Richard Solomon

**Contrast media nephropathy—how to diagnose and how to prevent?**

Nephrology Dialysis Transplantation 2007 22(7):1312-1315

PROCEDURE ENDOVASCOLARI  
CIN (contrast induced nephropathy)

PREVENZIONE

Idratazione paziente

Orale o Endovenosa

3 ml/Kg/h 1 ora prima  
1 ml/Kg/h 6 ore dopo

- Soluzione fisiologica isotonica meglio di quella ipotonica
- Bicarbonato di sodio isotonico meglio della soluzione fisiologica isotonica
- Non associare furosemide

Richard Solomon

Contrast media nephropathy—how to diagnose and how to prevent?

Nephrology Dialysis Transplantation 2007 22(7):1312-1315

# PROCEDURE ENDOVASCOLARI

## CIN (contrast induced nephropathy)

### PREVENZIONE

### Anti-ossidanti

Martin Tepel, M.D., Marcus van der Giet, M.D., Carola Schwarzfeld, Ulf Laufer, M.D., Dieter Liermann, M.D.,

**Prevention of Radiographic-Contrast-Agent–Induced Reductions in Renal Function by Acetylcysteine**

The New England Journal of Medicine, Volume 343:180-184, 3, 2000

Ute Hoffmann\*, Michael Fischereder\*, Bernd Krüger\*, Wolfgang Drobnik and Bernhard K. Kramer

**The Value of N-Acetylcysteine in the Prevention of Radiocontrast Agent-Induced Nephropathy Seems Questionable**

J Am Soc Nephrol 15:407-410, 2004

Zagler A, Azadpour M, Mercado C, Hennekens GH.

**N-acetylcysteine and contrast-induced nephropathy: a metaanalysis of 13 randomized trials.**

Am Heart J (2006) 151:140–145

*“....use of NAC in patients receiving intra-arterial CM found mixed results and a number of meta-analyses could not uniformly support the use of this agent .”*

PROCEDURE ENDOVASCOLARI  
CIN (contrast induced nephropathy)

PREVENZIONE

Vasodilatatori

L'uso per via sistemica di Fenoldopam ha dato risultati negativi (rischio di ipotensione)

In studio l'uso diretto in arteria renale



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# PROCEDURE ENDOVASCOLARI

## CIN (contrast induced nephropathy)

### PREVENZIONE

## Scelta del mdc

### Classificazione dei mezzi di contrasto

#### Ionici monomerici (ionici ad alta osmolarità)

Diatrizoato (Gastrografin)

Iothalamato (Conray)

#### Ionici dimerici (ionici a bassa osmolarità)

Ioxaglato (Hexabrix)

#### Non ionici monomerici (non ionici a bassa osmolarità)

Iopamidolo (Iopamiro)

Iomeprolo (Iomeron)

Iohexolo (Omnipaque)

Ioversolo (Optiray)

Iopromide (Ultravist)

Iobitridolo (Xenetix)

#### Non ionici dimerici (non ionici isosmolari)

Iodixanolo (Visipaque)

PROCEDURE ENDOVASCOLARI  
CIN (contrast induced nephropathy)

PREVENZIONE

Scelta del mdc

Concetto di “ **OSMOTOSSICITA'** “ :

Nei pazienti a rischio

- mdc iperosmolare è più nefrotossico del mdc ipoosmolare
- mdc isoosmolare è meno nefrotossico del mdc ipoosmolare

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PROCEDURE ENDOVASCOLARI  
CIN (contrast induced nephropathy)

PREVENZIONE

Quantità del mdc

*The lower the dose of contrast, the lower the risk of CIN*

- the risk of CIN is clearly dose dependent
- possible guideline regarding the upper limit of contrast volume administration:

**Weight (Kg) x 5 / serum creatinine (mg/dl)**

Cigarroa et al.

Dosing of contrast material to prevent contrast nephropathy in patients with renal disease.

Am J Med 1989;86:649

PROCEDURE ENDOVASCOLARI  
CIN (contrast induced nephropathy)

PREVENZIONE

Rimozione del mdc

...Unfortunately, trials with dialysis concurrent and following CM administration have failed to find any benefit with regard to CIN . Dialysis is not able to remove CM quickly enough to prevent the renal injury

PROCEDURE ENDOVASCOLARI  
CIN (contrast induced nephropathy)

PREVENZIONE

Rimozione del mdc

...In patients with severely impaired renal function (eGFR < 30 ml/min), haemofiltration prior to CM administration is reported to offer protection against both CIN and adverse cardiovascular events

Marenzi G, Marana I, Lauri G, et al.

The prevention of radiocontrast-agent-induced nephropathy by hemofiltration.

N Engl J Med (2003) 349:1333–1340

**IPERTENSIONE NEFROVASCOLARE E RENE ISCHEMICO**

# PROCEDURE ENDOVASCOLARI

**Passato**



**Presente**



# PROCEDURE ENDOVASCOLARI

**Futuro ?**

## **STATE-OF-THE-ART PAPER**

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# **Renal Denervation for Hypertension**

Stefan C. Bertog, MD,\*† Paul A. Sobotka, MD,‡§ Horst Sievert, MD\*

*Frankfurt, Germany; Minneapolis, Minnesota; and Columbus, Ohio*

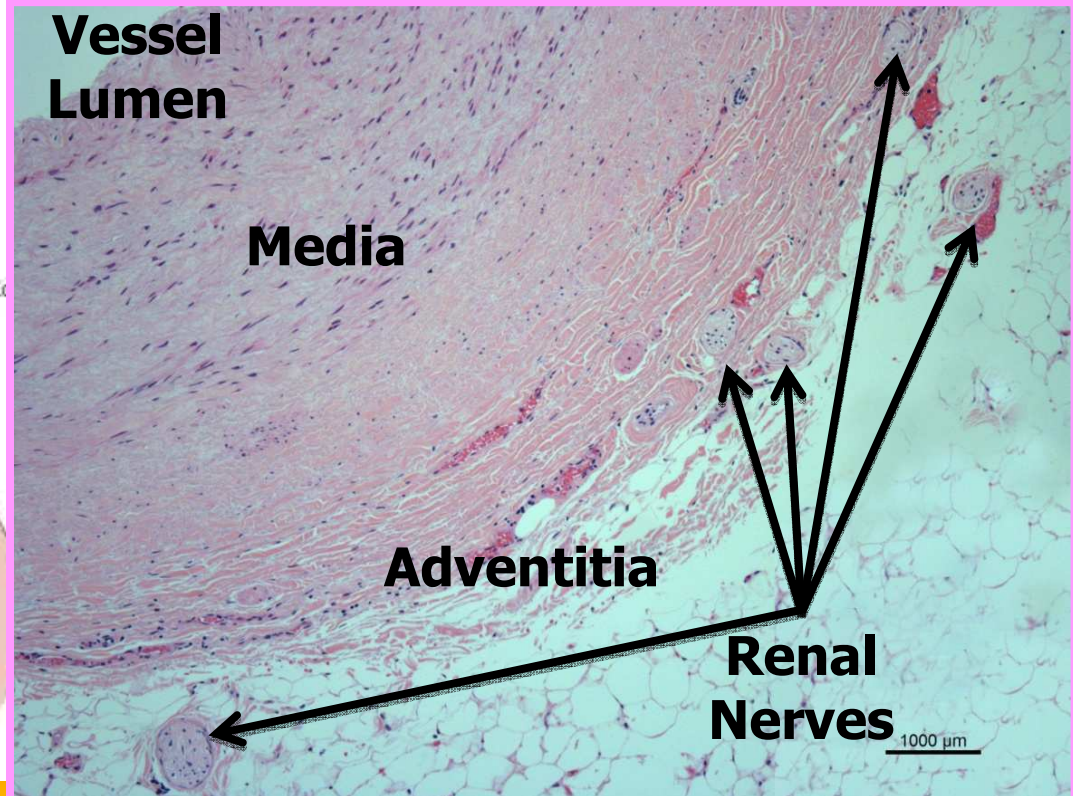
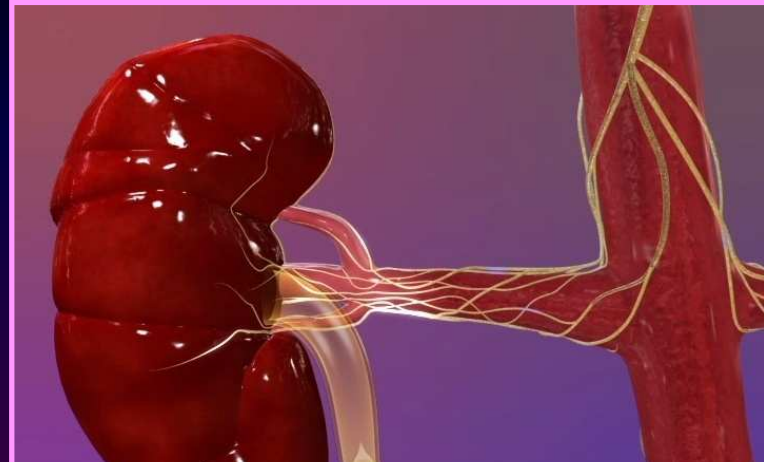
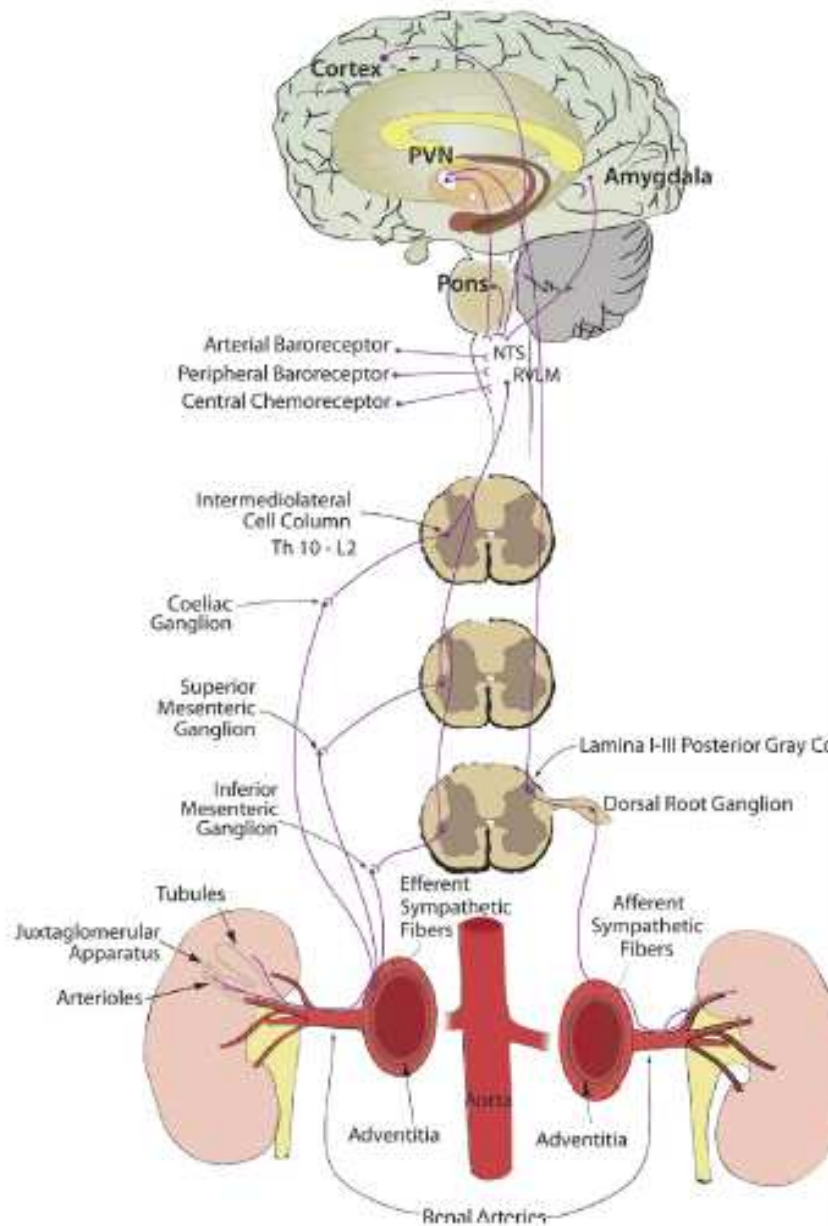
**JACC: CARDIOVASCULAR INTERVENTIONS, VOL. 5, NO. 3, 2012**

# Renal Denervation

Renal sympathetic nerves help regulate volume and blood pressure as they innervate the renal tubules, blood vessels, and juxtaglomerular apparatus. They carry both afferent and efferent signals between the central nervous system and the kidneys.

Surgical sympathectomy was done in the 1950s for malignant hypertension. It had lasting antihypertensive results but also caused severe procedure-related morbidity. A new percutaneous procedure for selective renal denervation offers the advantage of causing few major procedure-related adverse effects.

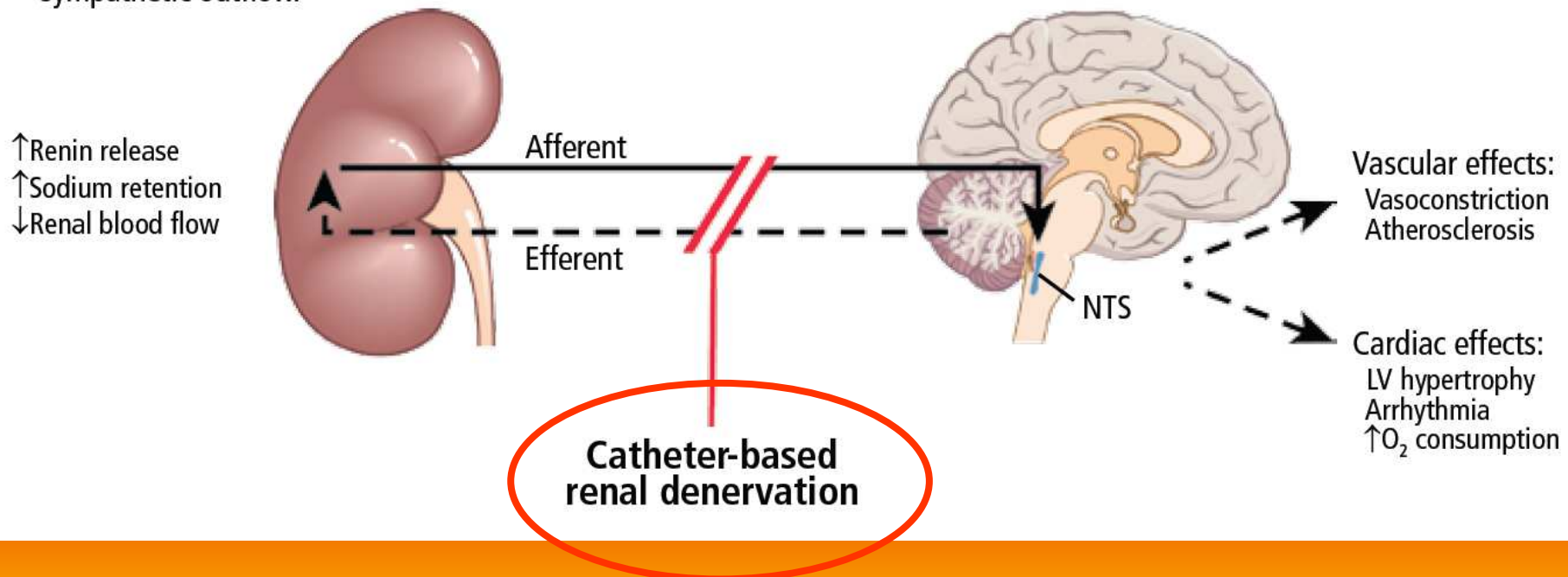
# Renal Denervation



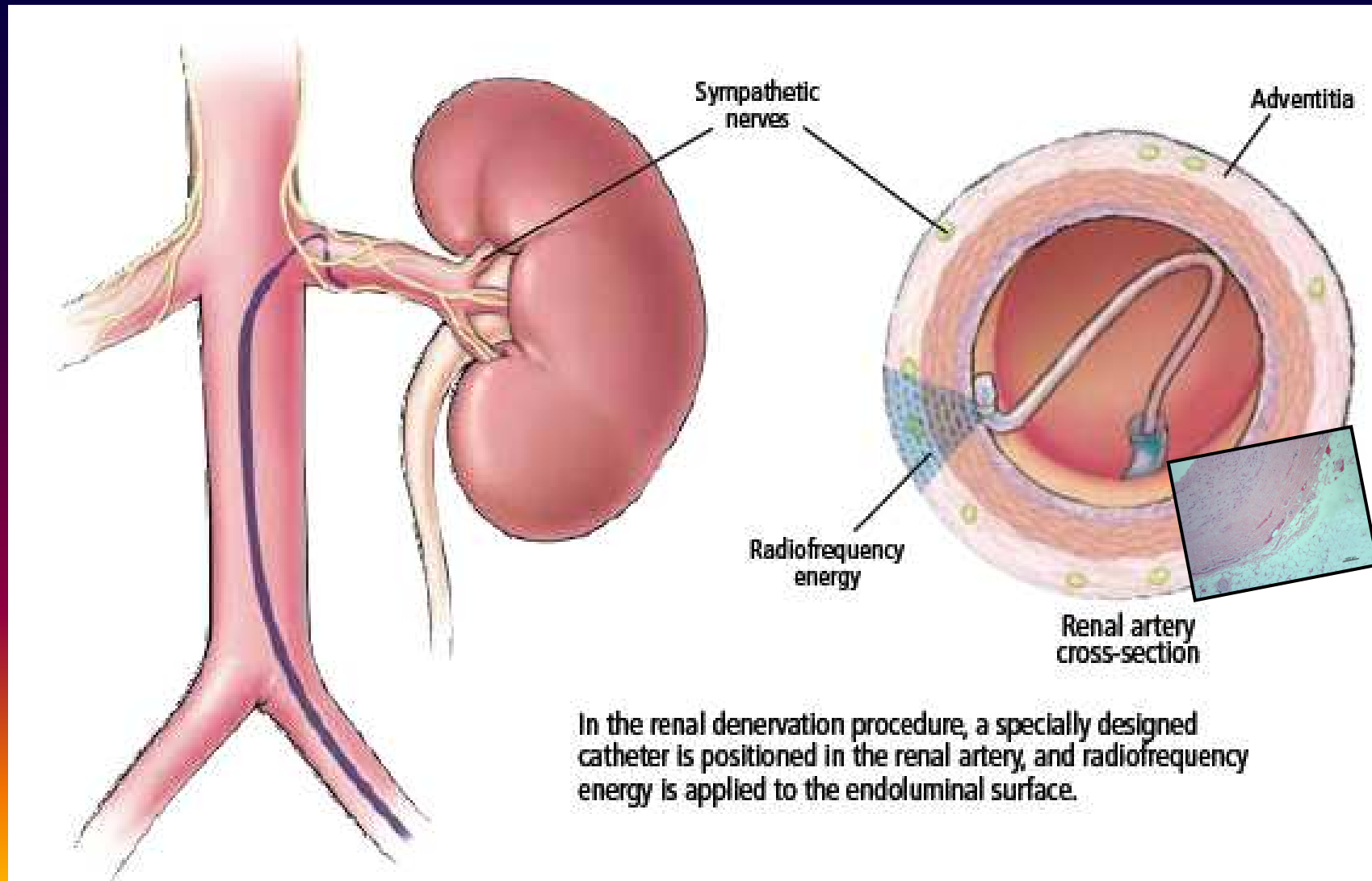
# Renal Denervation

Kidneys, in response to ischemia, send afferent sympathetic signals to the brain that disinhibit the nuclei tractus solitarii (NTS), increasing sympathetic outflow.

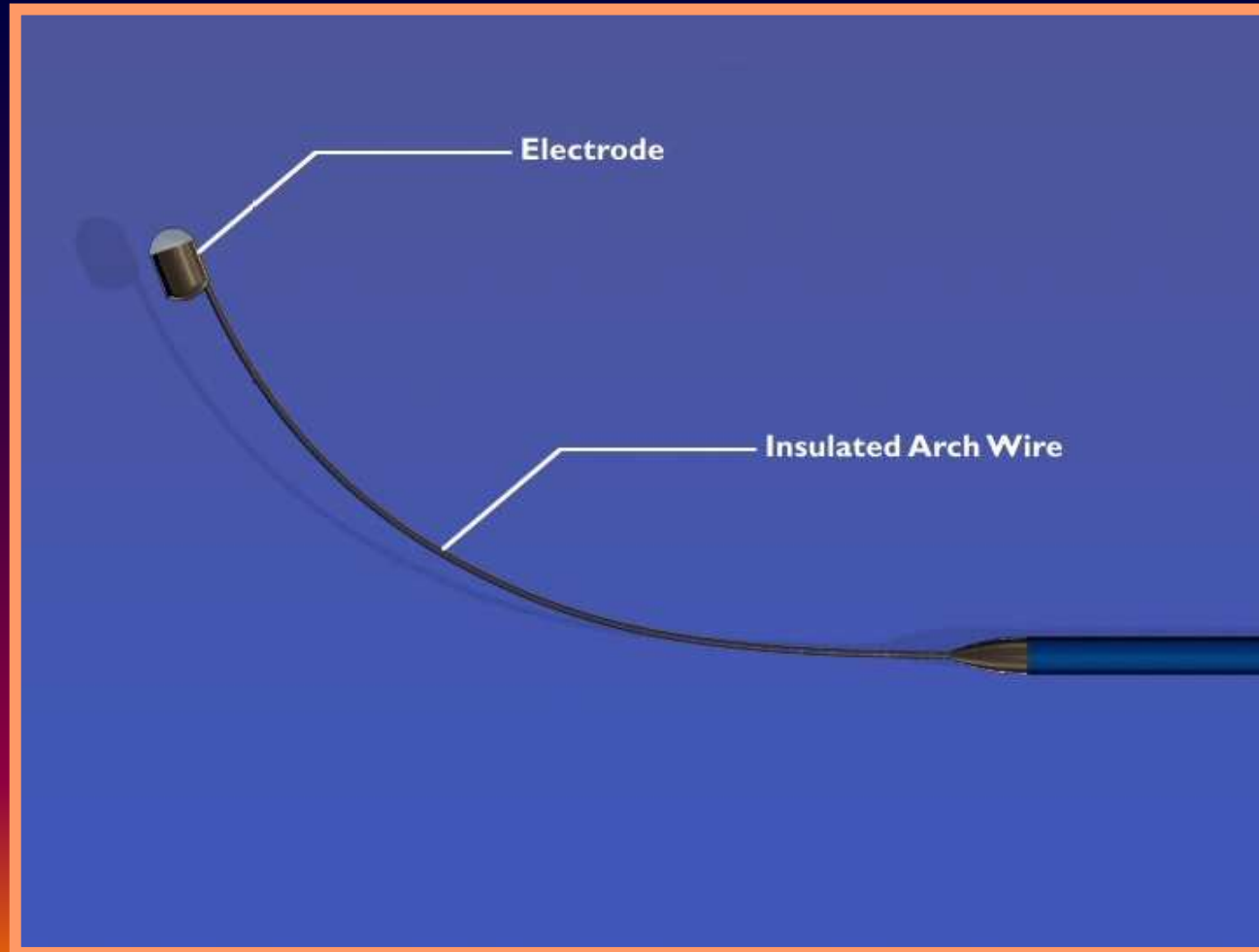
The NTS in the brainstem control efferent sympathetic signals from the brain to various organs of the body. Sympathetic signals raise blood pressure by increasing the heart rate, constricting arteries, and, in the kidney, increasing renin release and sodium and fluid retention.



# Renal Denervation



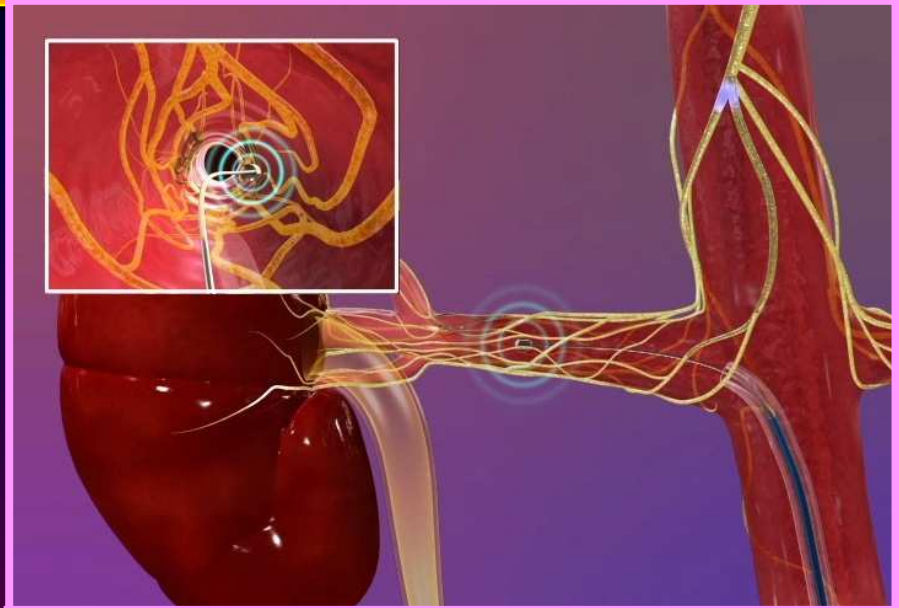
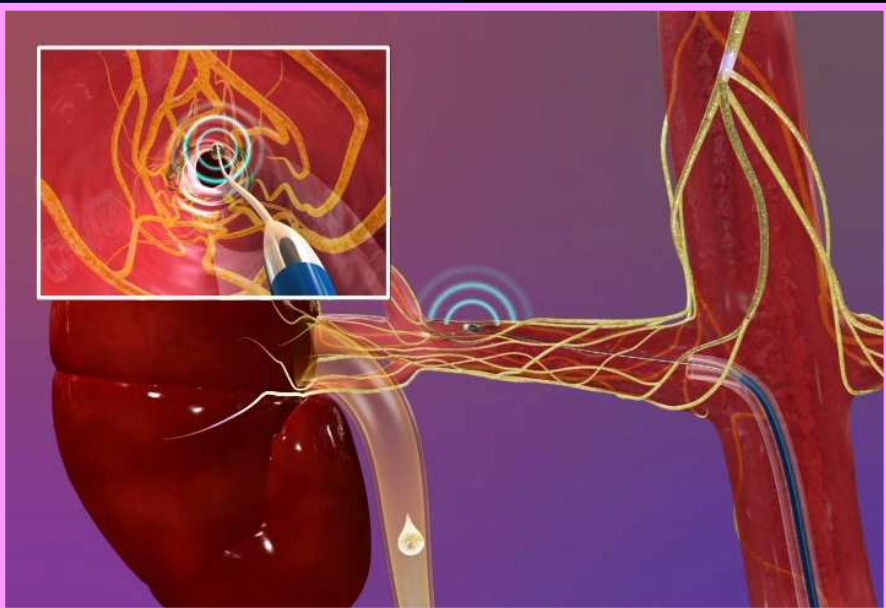
# Renal Denervation



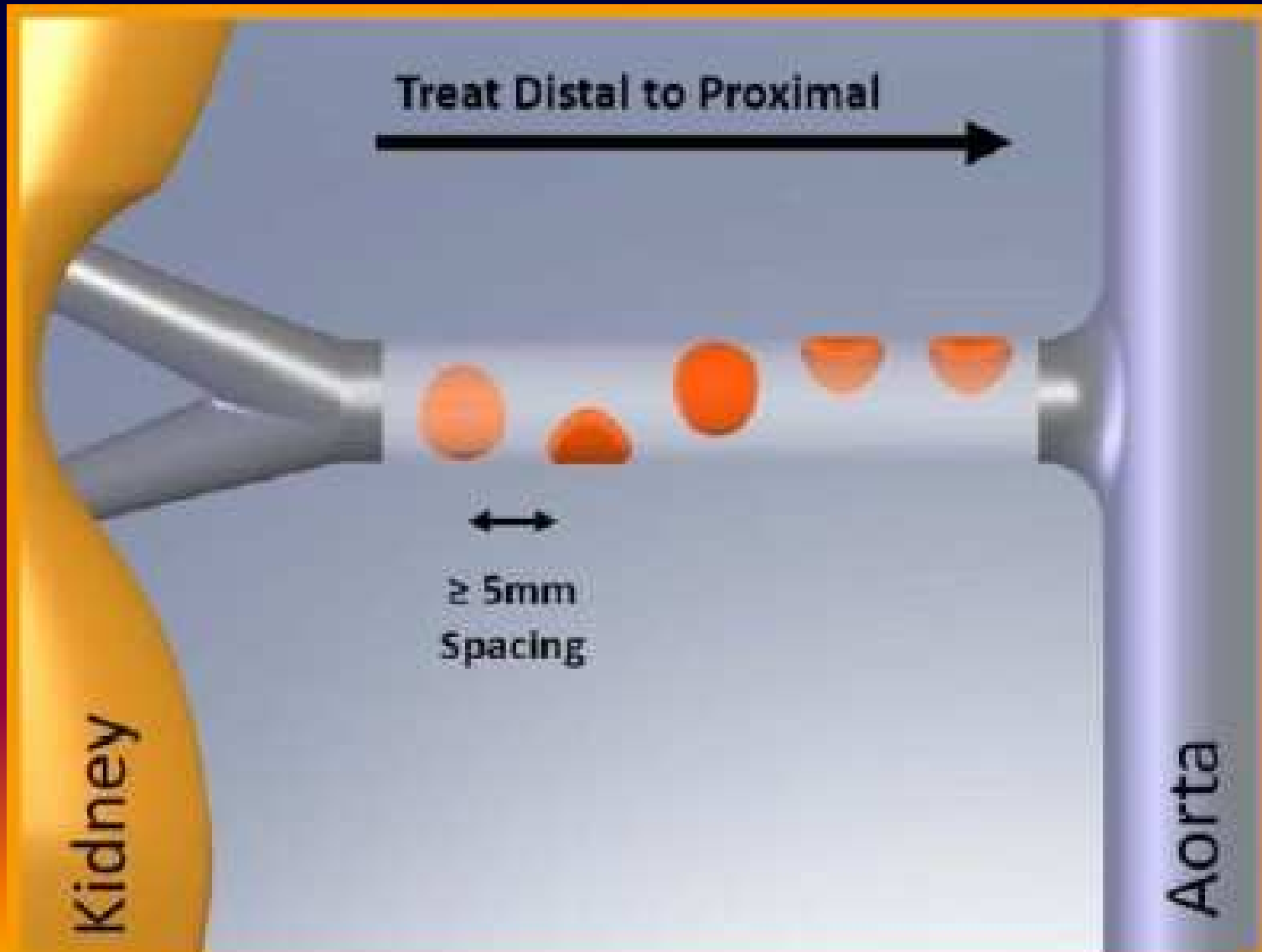
# Renal Denervation



# Renal Denervation



# Renal Denervation



# Renal Denervation



- 40-minute catheter-based procedure
- Selectively disable the renal sympathetic afferent and efferent nerves without impairing sympathetic signaling to other organs
- Ramped low power radiofrequency energy delivery (5-8W)
- Blood flow minimizes surface/endothelial injury
- Focal ablations spaced along vessel allows for rapid healing

# Renal Denervation



# Renal Denervation



TABLE 1

**The Symplicity HTN-1 and HTN-2 trials: Patients and methods**

	SYMPPLICITY HTN-1 <sup>14</sup>	SYMPPLICITY HTN-2 <sup>15</sup>	
Study design	Proof-of-principle; nonrandomized	Randomized, controlled; unblinded to treatment	
Study sites	Five centers in Australia and Europe	24 centers in Australia, Europe, New Zealand	
Number of patients	45 <sup>a</sup>	106 (52 renal denervation, 54 controls)	
		<u>Renal denervation group</u>	<u>Control group</u>
Mean age (years)	58 ± 9	58 ± 12	58 ± 12
Race	96% white	98% white	96% white
Female	44%	35%	50%
Type 2 diabetes	31%	40%	28%
Baseline blood pressure (mm Hg)	177/101 (20/15)	178/97 (18/16)	178/98 (16/17)
No. of antihypertensive drugs	4.7 (1.5)	5.2 (1.5)	5.3 (1.8)
Estimated glomerular filtration rate (eGFR) (mL/min/1.73 m <sup>2</sup> )	81 (23)	77 (19)	86 (20)
<b>Inclusion criteria</b>	Office systolic blood pressure (SBP) ≥ 160 mm Hg on at least three antihypertensive drugs including one diuretic, or confirmed intolerance to medications	Office SBP ≥ 160 mm Hg (≥ 150 mm Hg in patients with diabetes) on at least three antihypertensive drugs	
Main exclusion criteria	Known cause of secondary hypertension Type 1 diabetes Pregnancy eGFR < 45 mL/min/1.73 m <sup>2</sup> Hemodynamically significant valvular heart disease Existing permanent pacemaker or implantable cardioverter-defibrillator Use of clonidine, moxonidine, rilmenidine, or warfarin <sup>b</sup> Renovascular abnormalities	Type 1 diabetes Pregnancy eGFR < 45 mL/min/1.73 m <sup>2</sup> Substantial stenotic valvular heart disease Existing permanent pacemaker or implantable cardioverter-defibrillator Renovascular abnormality Contraindication to magnetic resonance imaging Myocardial infarction, unstable angina, or cerebrovascular accident in previous 6 months	
Primary end points	Office blood pressure and procedural safety data before and at 1, 3, 6, 9, and 12 months after procedure <sup>c</sup>	Between-group change in seated office SBP from baseline to 6 months after procedure <sup>d</sup>	

# Renal Denervation



TABLE 2

## The Symplicity HTN-1 and HTN-2 trials: Results

Primary efficacy outcomes <sup>a</sup>	SYMPPLICITY HTN-1 <sup>14</sup>			SYMPPLICITY HTN-2 <sup>15</sup>			
	Period	Number of patients	Change in office systolic blood pressure (SBP), mm Hg (mean, 95% CI)	Renal denervation group	Control group	Period	Change in office SBP, mm Hg (mean, SD), n = 51 <sup>b</sup>
	1 mo	41 of 45	-14/-10 (4/3)	1 mo	-20/-7	1 mo	0/0
	3 mo	39 of 45	-21/-10 (7/4)	3 mo	-24/-8	3 mo	-4/-2
	6 mo	26 of 45	-22/-11 (10/5)	6 mo	-32/-12 (23/11)	6 mo	1/0 (21/10)
	9 mo	20 of 45	-24/-11 (9/5)				
	12 mo	9 of 45	-27/-17 (16/11)				
Short-term safety outcomes	Renal artery dissection related to catheter placement before energy delivery (n = 1) Femoral artery pseudoaneurysm at access site (n = 3) (In initial and expanded cohorts)			Intraprocedural bradycardia requiring atropine (7/52 patients) Postprocedural drop in blood pressure (n = 1) Femoral artery pseudoaneurysm at access site (n = 1)			
Long-term safety outcomes	No renal vascular complications noted with postprocedure imaging studies on follow-up			No renal vascular complications noted with post-procedure imaging studies on follow-up			



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