

# *Aortic aneurysms*

## Treatment (suprarenal/endovascular)



iGuide refers to current C-arm geometry

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*Arterial aneurysms*

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## *Arterial aneurysms*

### **Competences**

1. To understand the **causes, frequency** and **location** of the most common arterial aneurysms.
2. To understand the **background to the pathophysiology** of aneurysms.
3. To **initially evaluate** patients with arterial aneurysm at different locations.
4. To **understand and interpret diagnostic imaging** methods.
5. To properly use **scores for grading** rupture risk and operative risk.
6. To set the **differential diagnosis** with other pathologies.
7. To understand the **main basis for treatment**: endovascular and open (indications and complications).

## *Arterial aneurysms*

### Topics

concept and classification  
etiology  
location  
pathophysiology  
symptoms  
diagnosis  
treatment: basic principles  
abdominal aortic aneurysms

★ ***personal work:***

- 1. peripheral aneurysms*
- 2. renal and visceral aneurysms*

## *Arterial aneurysms*

### References

- ★ Keisler B, Carter C. Abdominal aortic aneurysm. *Am Fam Physician*. 2015; 15;91(8):538-43
- ★ Croswell J, Chu K. Screening for abdominal aortic aneurysm. *Am Fam Physician*. 2015; 15;91(8):563-4.
- Verhoeven EL, Zeebregts CJ, Kapma MR, Tielliu IF, Prins TR, van den Dungen JJ. Fenestrated and branched endovascular techniques for thoraco-abdominal aneurysm repair. *J Cardiovasc Surg (Torino)*; 2005 Apr;46(2):131-40
- Joviliano EE, Ribeiro MS, Tenorio EJR. MicroRNAs and Current Concepts on the Pathogenesis of Abdominal Aortic Aneurysm. *Braz J Cardiovasc Surg*. 2017 ;32(3):215-224. doi: 10.21470/1678-9741-2016-0050
- Indrakusuma R, Jalalzadeh H, Planken RN, Marquering HA, Legemate DA, Koelemay MJ, Balm R. Biomechanical Imaging Markers as Predictors of Abdominal Aortic Aneurysm Growth or Rupture: A Systematic Review. *Eur J Vasc Endovasc Surg*. 2016 Oct;52(4):475-486.
- Patelis N1, Moris D, Schizas D, Damaskos C, Perrea D, Bakoyiannis C, Liakakos T, Georgopoulos S. Animal models in the research of abdominal aortic aneurysms development. *Physiol Res*. 2017 Dec 20;66(6):899-915. Epub 2017 Sep 22.

## *Arterial aneurysms*

### **Data sources (guidelines)**

#### **abdominal aorta**

★	ESVS	2011/2018
	ESC	2014
★	SVS	2009/2017
	ACC/AHA	2011/2016

#### **thoracic aorta**

	ESVS	2017
	ESC	2014
	SVS	2011 (Trauma)
	ACC/AHA	2010/2017

#### **screening**

US Preventive Task Force  
NHS

## *Arterial aneurysm*

### **Problem case**

A 52-year-old patient with a history of smoking, hypertension and type-II diabetes who had received a heart transplant and whose father had died from the rupture of an aortic aneurysm.

After aortic dilatation is identified in an MRI for back pain, infrarenal AAA is confirmed in CT Angio. Maximum diameter is 5 cm, proximal neck is 1.5 cm, and the iliac arteries are neither dilated nor tortuous.

## *Arterial aneurysms*

### **Topics**

concept and classification

etiology

location

pathophysiology

symptoms

diagnosis

treatment: basic principles

abdominal aortic aneurysms



## Arterial aneurysms

### Concept ★

**aneurysm** = dilatation (2x regular diameter)

**ectasia** = expansion (lower than this threshold)

### Classification

#### ☐ Shape ★

saccular

fusiform

#### ☐ Histology ★

true

false

#### ☐ Etiology

congenital

traumatic

infectious

degenerative

#### ☐ Topography

aortic

peripheral

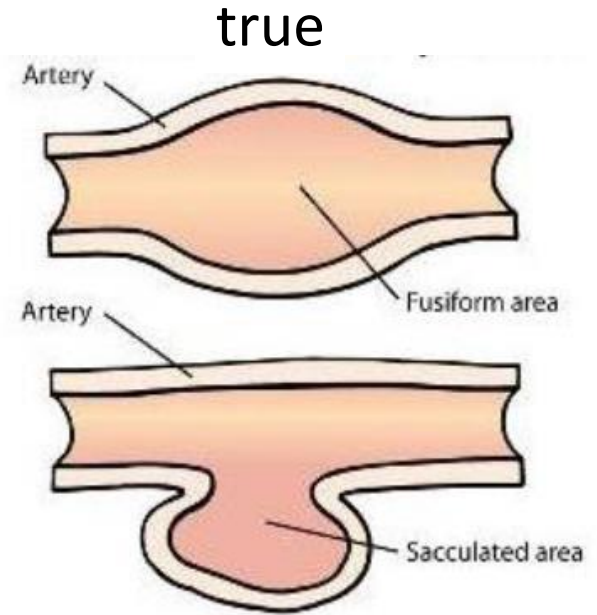
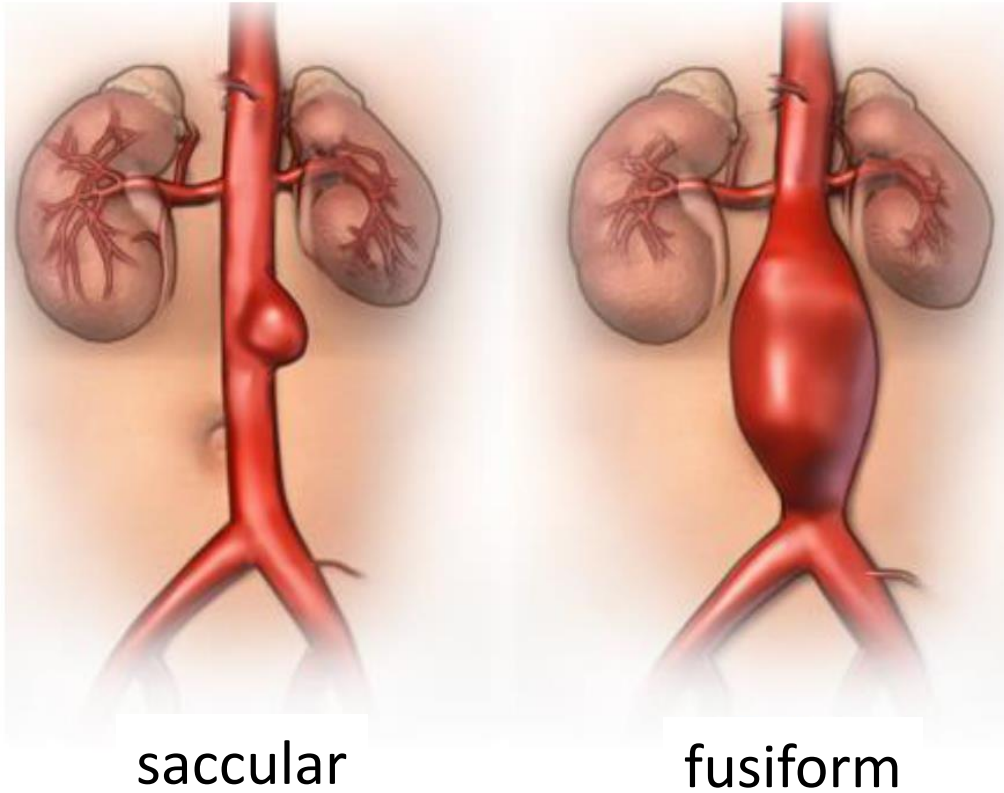
visceral

cerebral

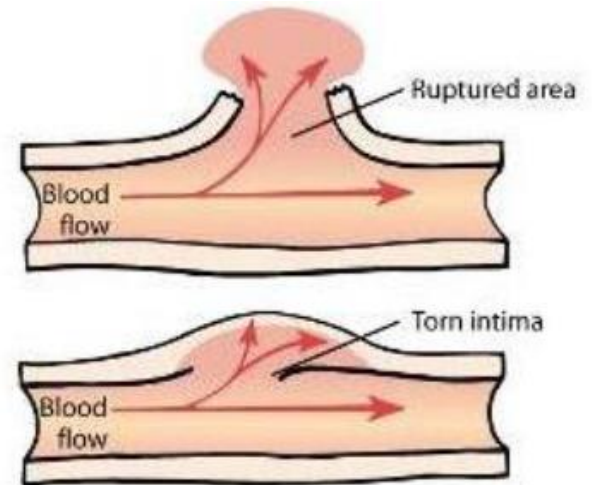
# Arterial Aneurysms

## Classification

## Morphology/histology ★



## false/pseudoaneurysm



## *Arterial aneurysms*

### **Topics**

concept and classification

etiology

**location**

pathophysiology

symptoms

diagnosis

treatment: basic principles

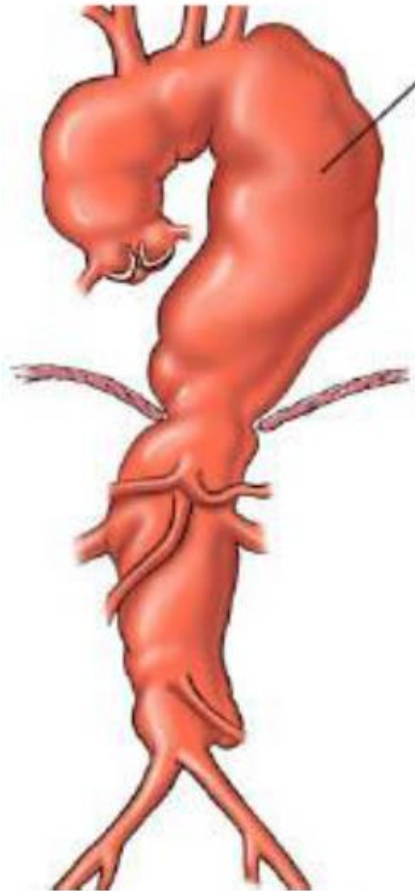
abdominal aortic aneurysms

# Arterial Aneurysms

## Arterial aneurysms

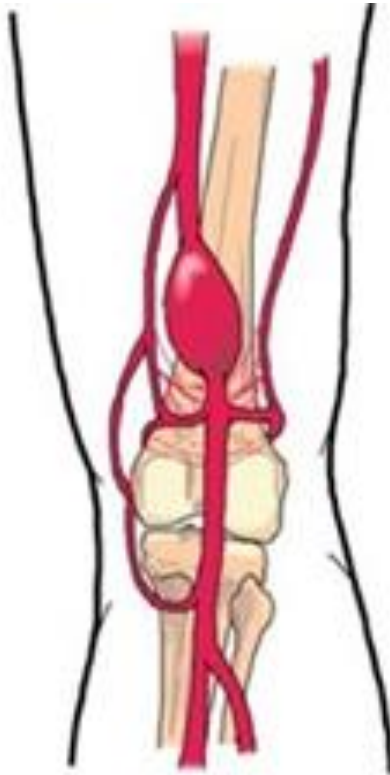
### Location

aortic



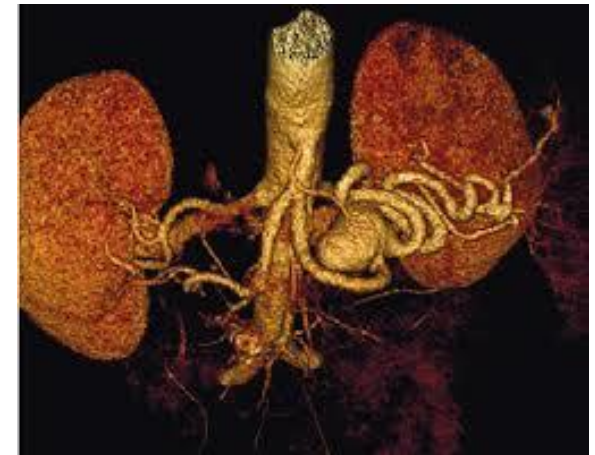
★ 4.2% (IC 95%: 2.3-6.9)

peripheral



2.7% (IC 95%: 1.2-5%).

renal/visceral



< 1% (0.01-0.2%)

# Arterial aneurysms

## Location

↗	Ascending	(10%)
↗	Aortic arch	(5%)
↗	Descending thoracic aorta	(7%)
★ ↗	<u>Abdominal aorta</u>	<u>(73%)</u>
↗	Thoracoabdominal aorta	(5%)



# Arterial aneurysms

## Location

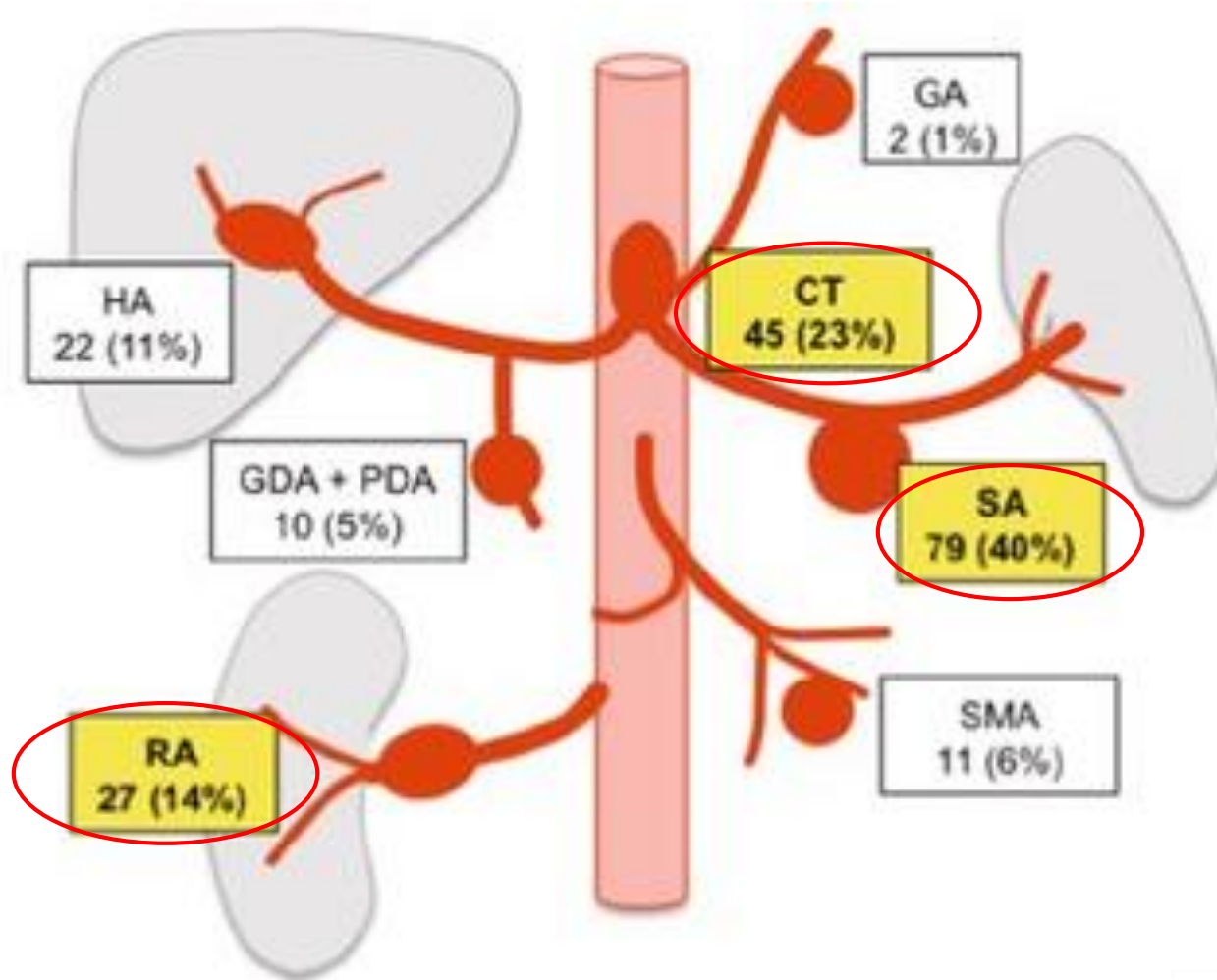
- ★ ↗ Popliteal (70%)
  - ↗ ( 60% are bilateral)
- ↗ Femoral (15%)
- ↗ Iliac (5%)
- ↗ Subclavian ( 5%)
- ↗ Visceral (2%)



# Arterial Aneurysms

## Arterial aneurysms

### Location ★





## *Arterial aneurysms*

### **Topics**

concept and classification

etiology

location

**pathophysiology**

symptoms

diagnosis

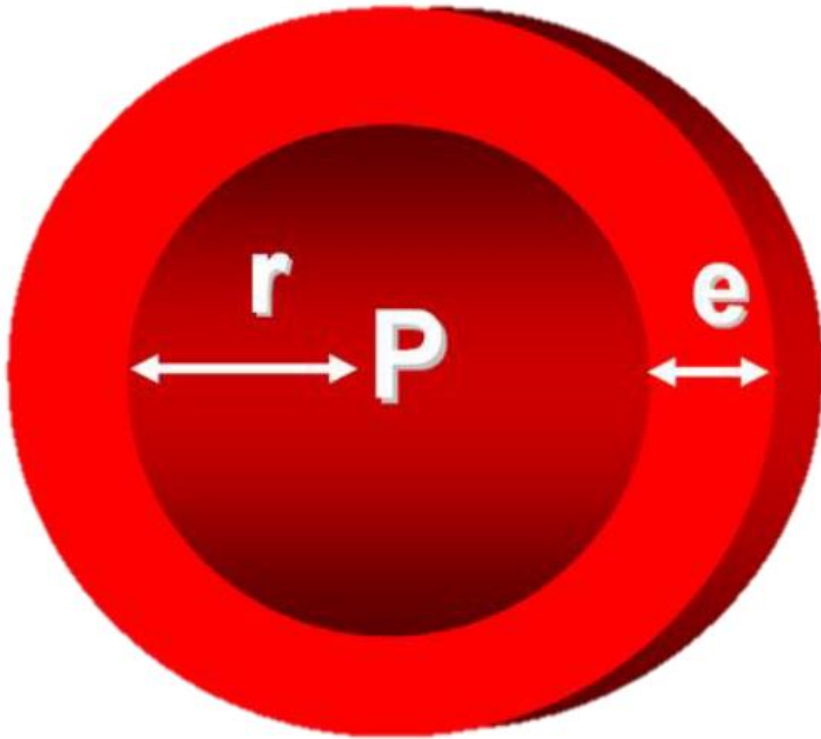
treatment: basic principles

abdominal aortic aneurysms



*Pathophysiology*

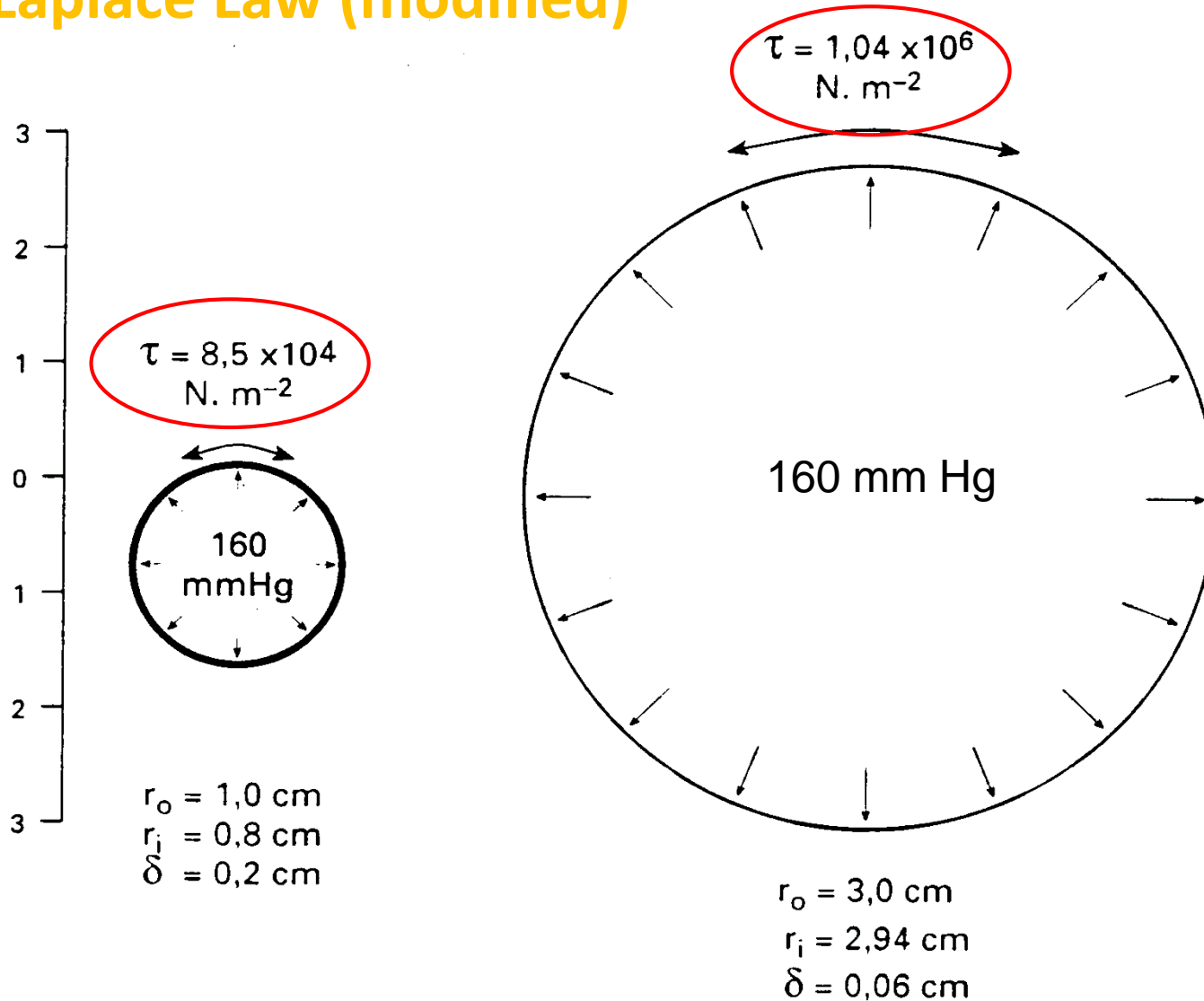
**Laplace Law (modified) ★**



$$\text{Wall stress} = \frac{P \times r}{2e}$$

## Pathophysiology

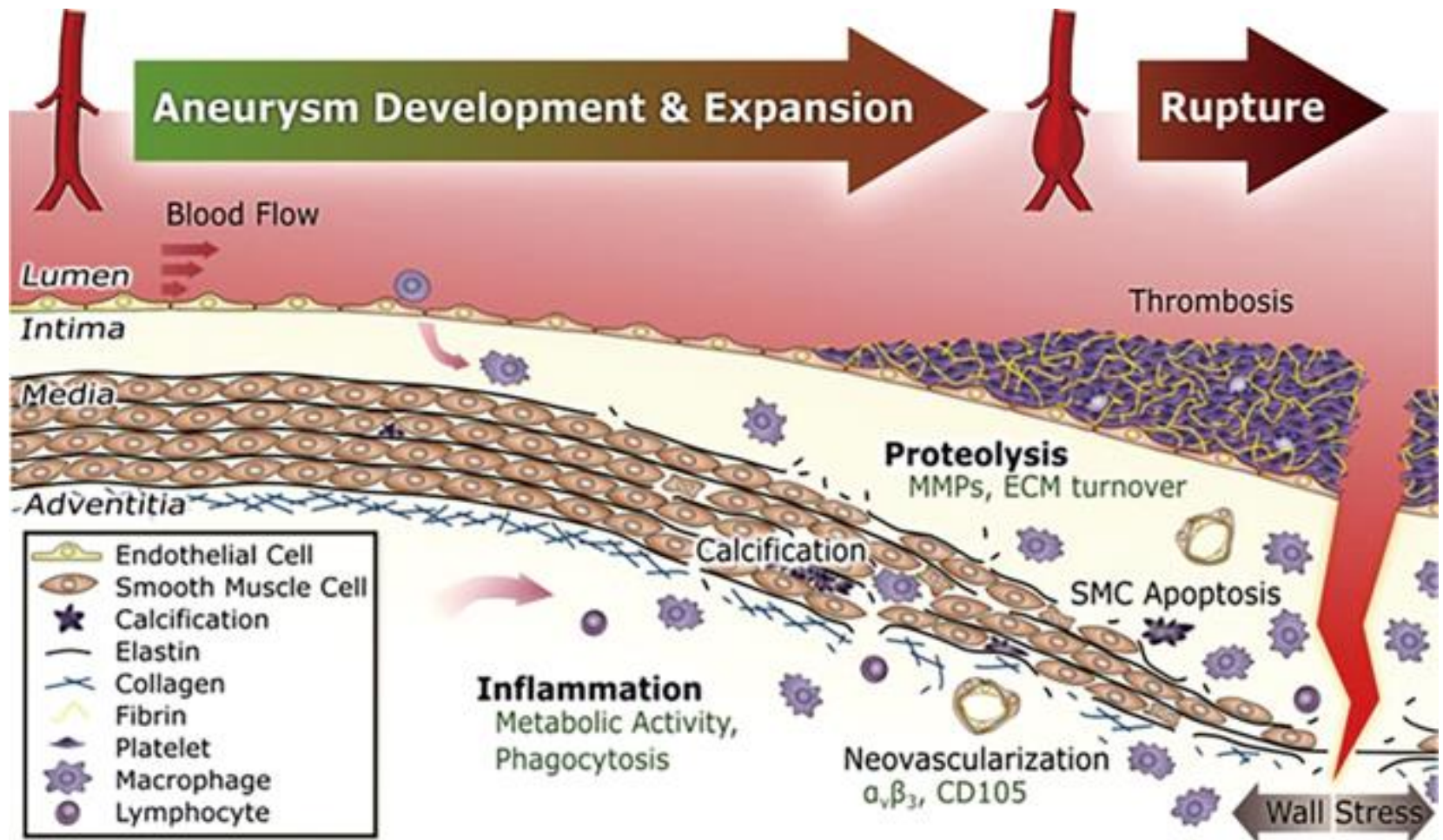
### Laplace Law (modified) ★



# Arterial Aneurysms

## Arterial aneurysms

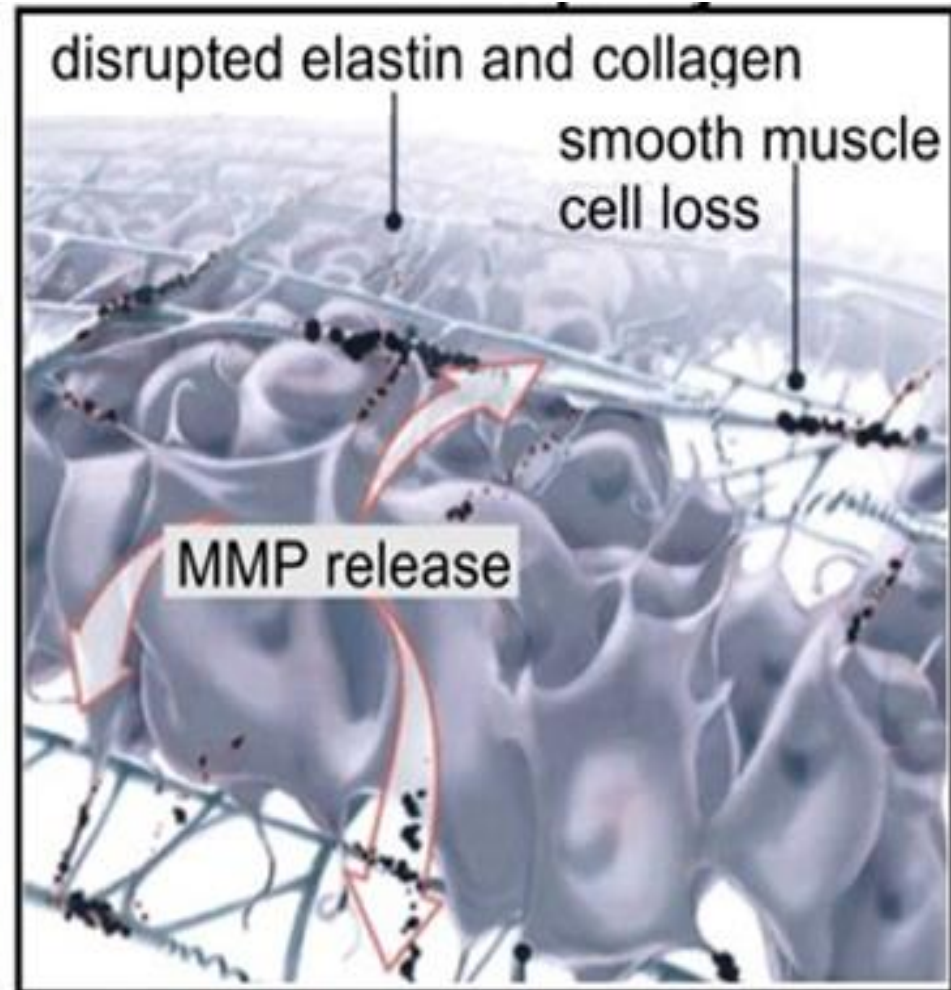
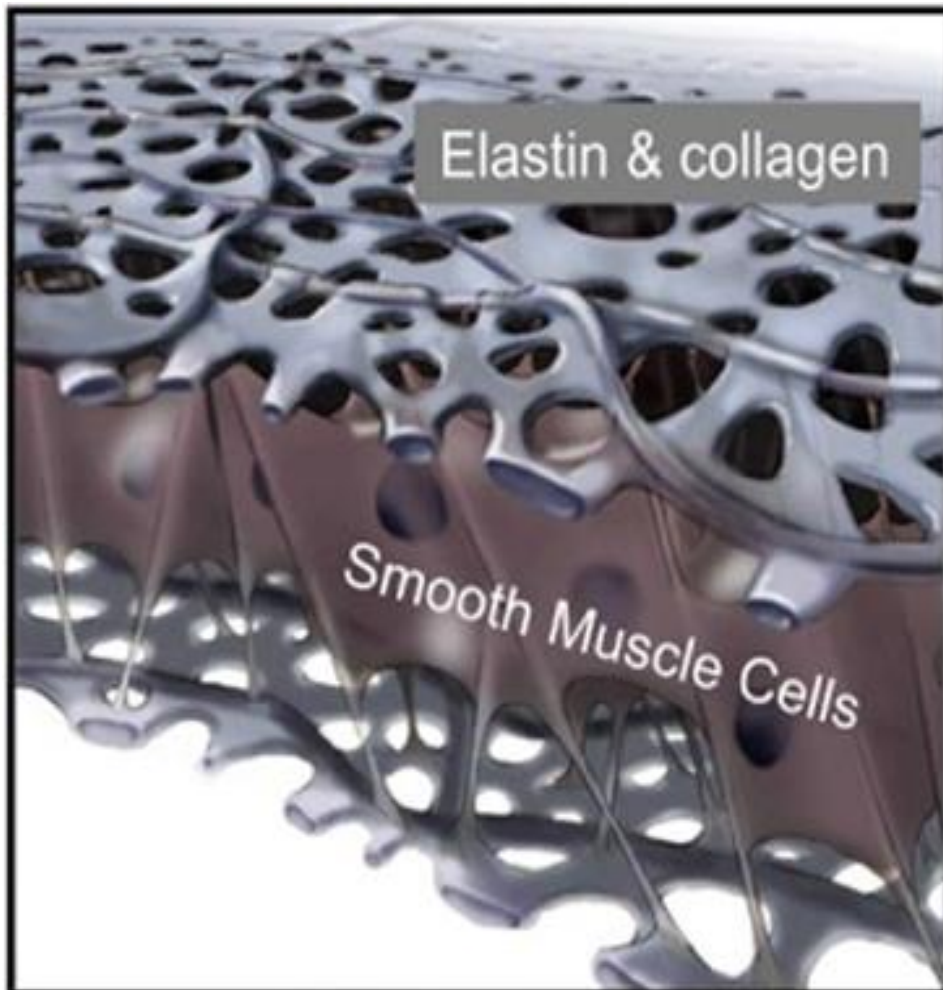
### Pathophysiology ★



# Arterial Aneurysms

## Arterial aneurysms

### Pathophysiology ★



## *Arterial aneurysms*

### **Topics**

concept and classification

etiology

location

pathophysiology

**symptoms**

diagnosis

treatment: basic principles

abdominal aortic aneurysms



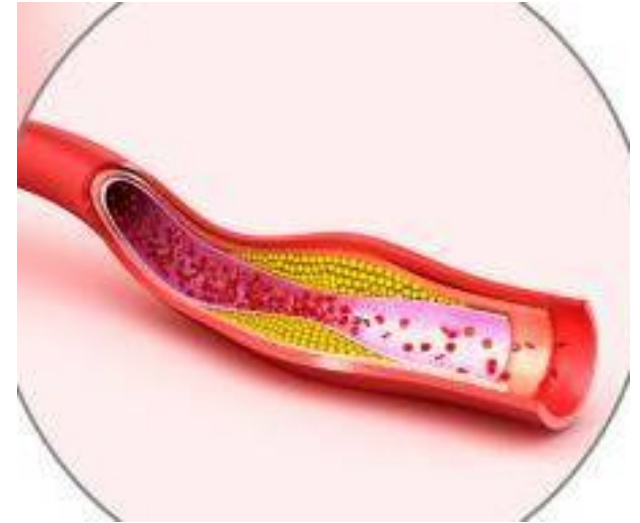
# Arterial Aneurysms

## Arterial aneurysms

### Symptoms ★



rupture



thrombosis



embolization

## *Arterial aneurysms*

### **Topics**

concept and classification

etiology

location

pathophysiology

symptoms

**diagnosis**

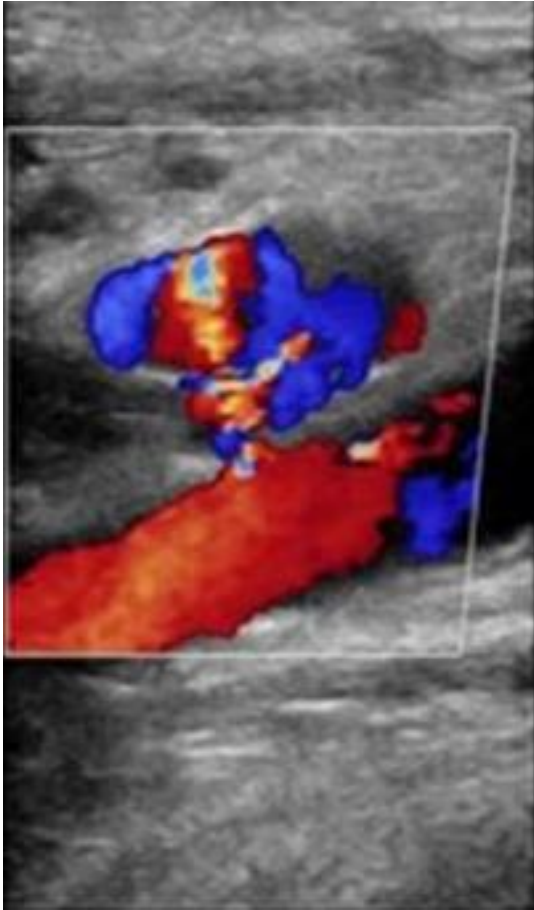
treatment: basic principles

abdominal aortic aneurysms

# Arterial Aneurysms

## Arterial aneurysms

### Diagnosis



Duplex scanning



MR Angio

CT Angio





## Arterial aneurysms

### Diagnosis by image

#### Spatial resolution imaging techniques

Parameter	DSA	Multi-Detector Row			US	Intravascular US
		CT Angiography	MR Angiography			
Matrix size	1024	512	~512*	...	...	
Frequency (MHz)	...	...	...	2.5-10	20-40	
Section thickness (mm)	...	0.5-1.0	≥1.0*	...	...	
Spatial resolution (mm)	<0.5†	~0.5†	>0.5†	0.15-0.6‡	<0.1‡	

*Arterial aneurysms*

**Diagnosis by image**

Spatial resolution imaging techniques

	<b>Angio</b>	<b>Angio TC</b>	<b>Angio RM</b>	<b>Eco</b>	<b>IVUS</b>
<b>Spatial resolution</b>	<0.5mm	~0.5	>0.5	0.15-0.6	<0.1

## *Arterial aneurysms*

### **Topics**

concept and classification

etiology

location

pathophysiology

symptoms

diagnosis

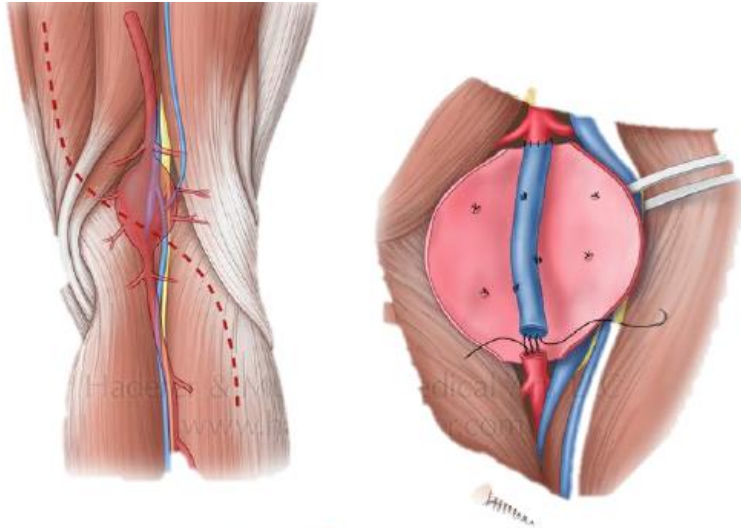
**treatment: basic principles**

abdominal aortic aneurysms

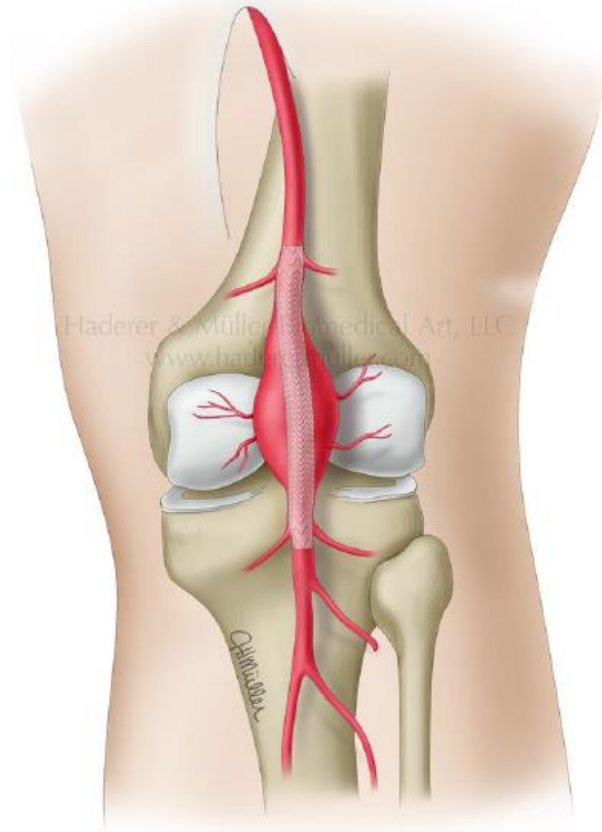
# Arterial Aneurysms

## Arterial aneurysms

### Treatment ★



vascular graft (open)

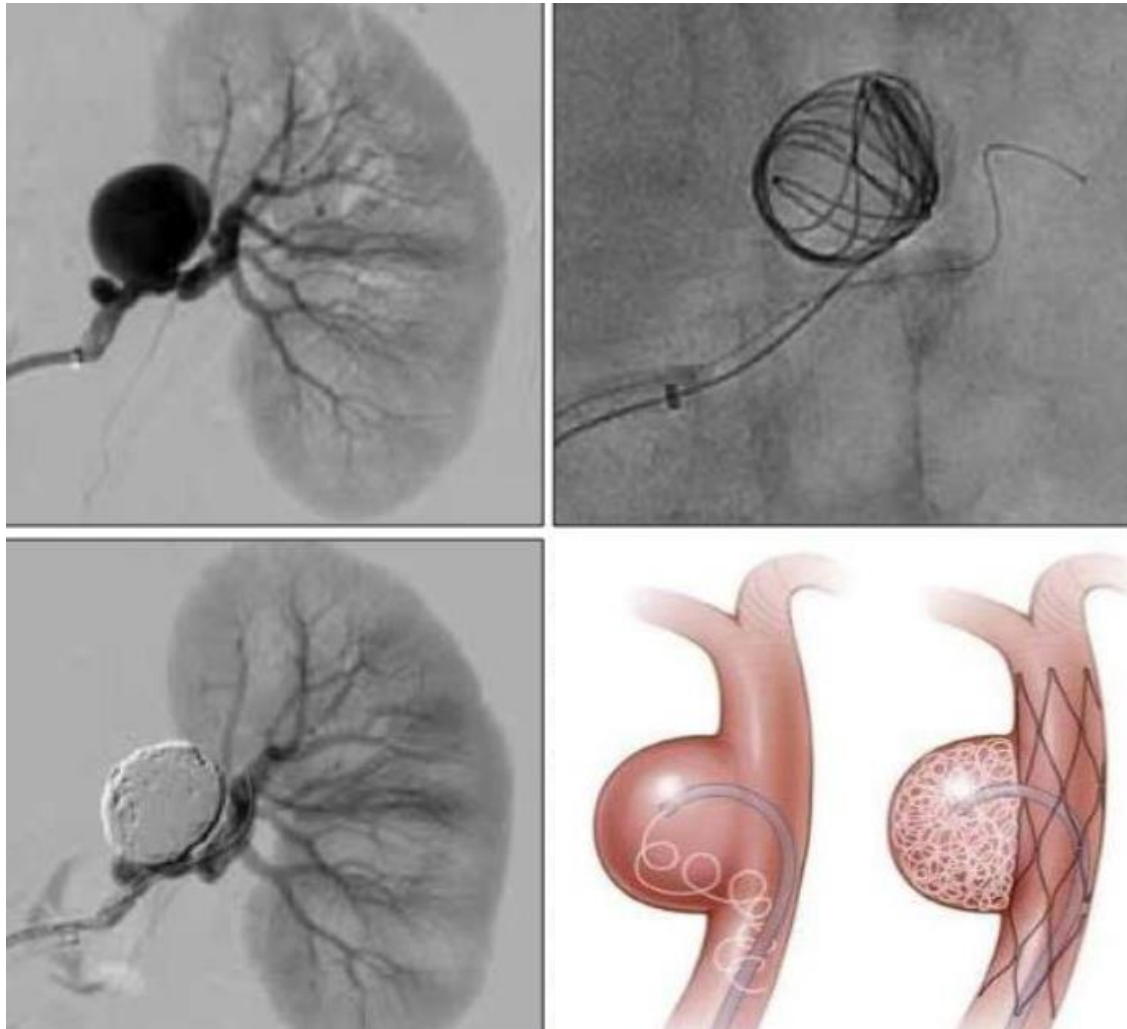


endovascular repair

# Arterial Aneurysms

## Arterial aneurysms

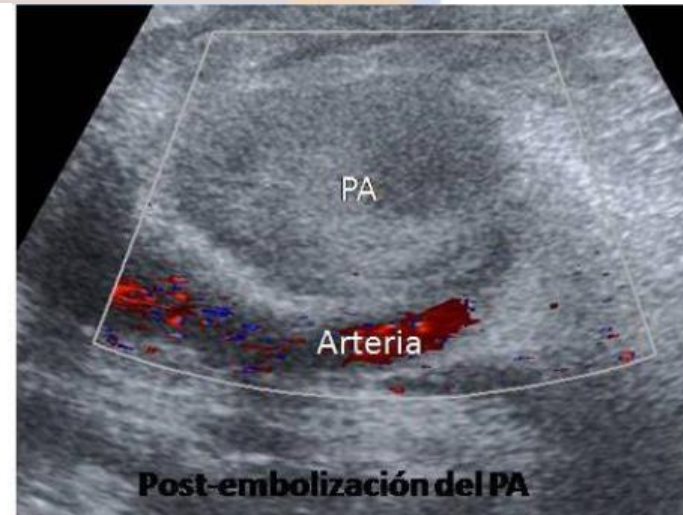
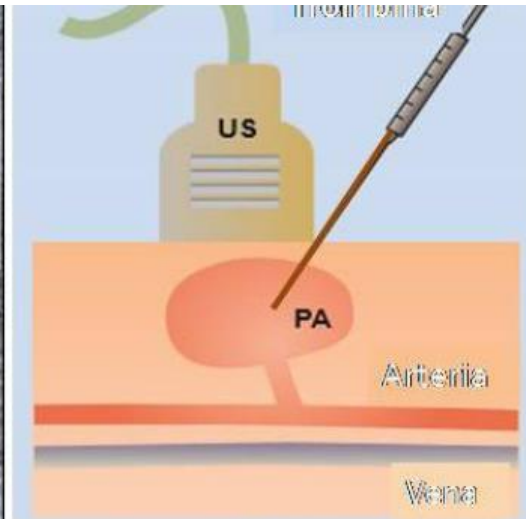
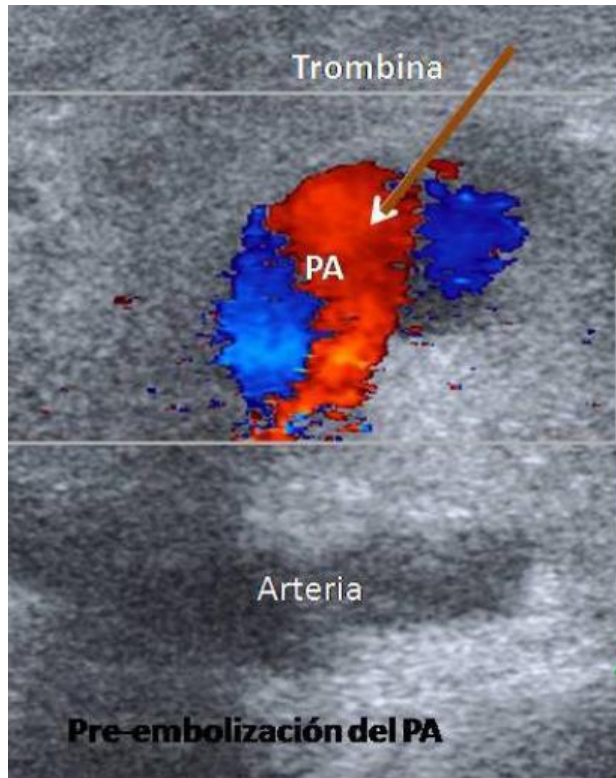
### Treatment



endovascular (stents + coils renal artery)

# Arterial aneurysms

## Treatment



echo-guided thrombin (pseudoaneurysms)

## *Arterial aneurysms*

### Topics

concept and classification

etiology

location

pathophysiology

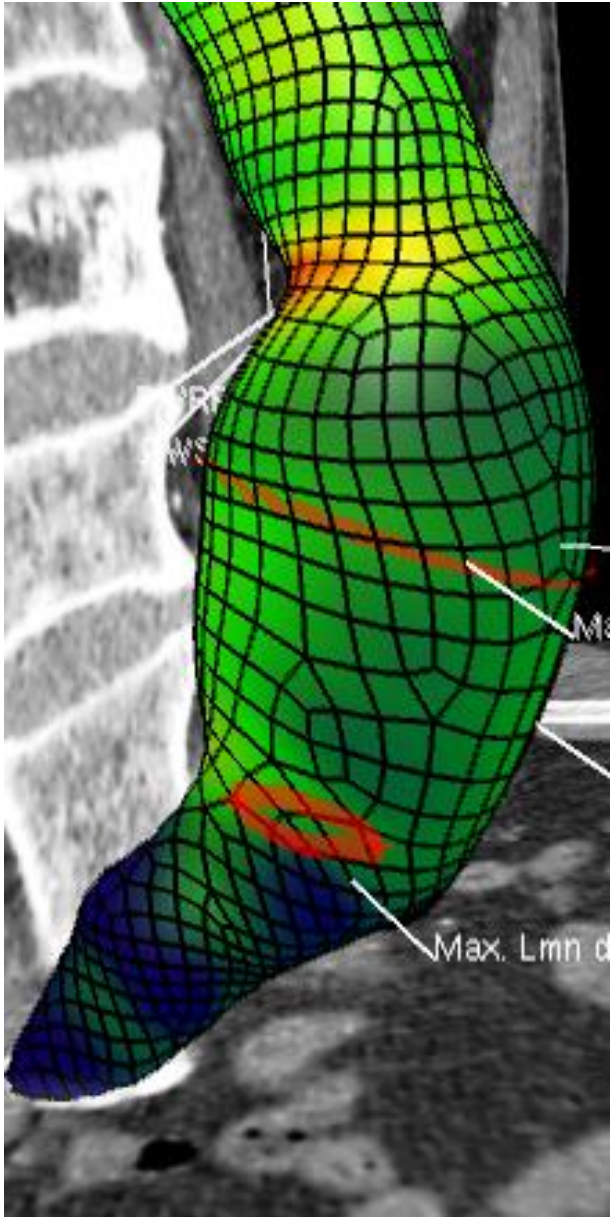
symptoms

diagnosis

treatment: basic principles

**abdominal aortic aneurysms**





# Open and endovascular repair of aortic aneurysms: state of the art

Manuel Miralles

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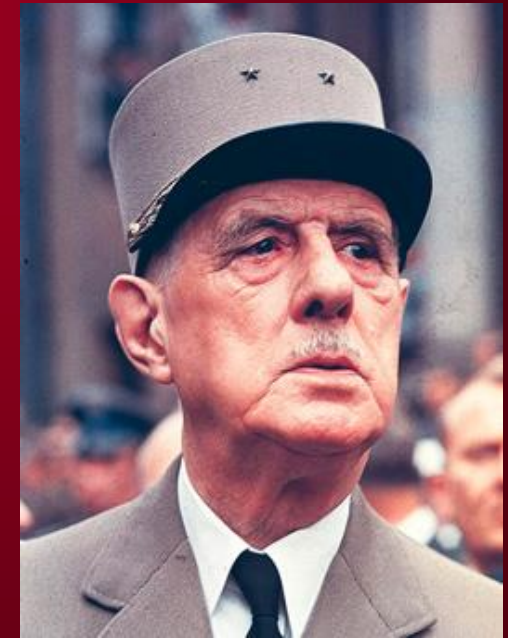
# Famous people and aortic aneurysm



*George II*



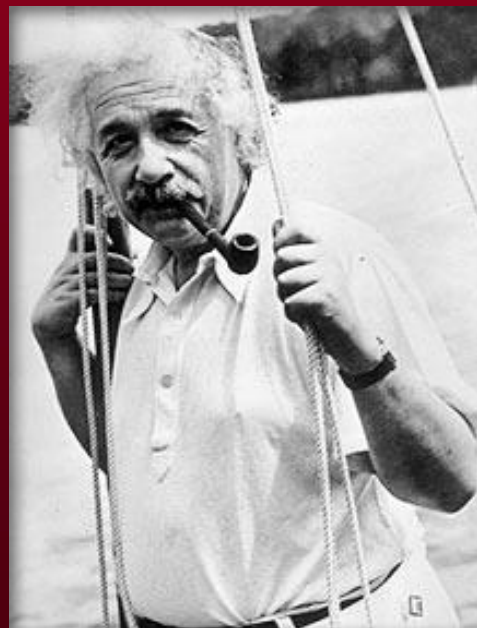
*George C. Scott*



*Charles de Gaulle*

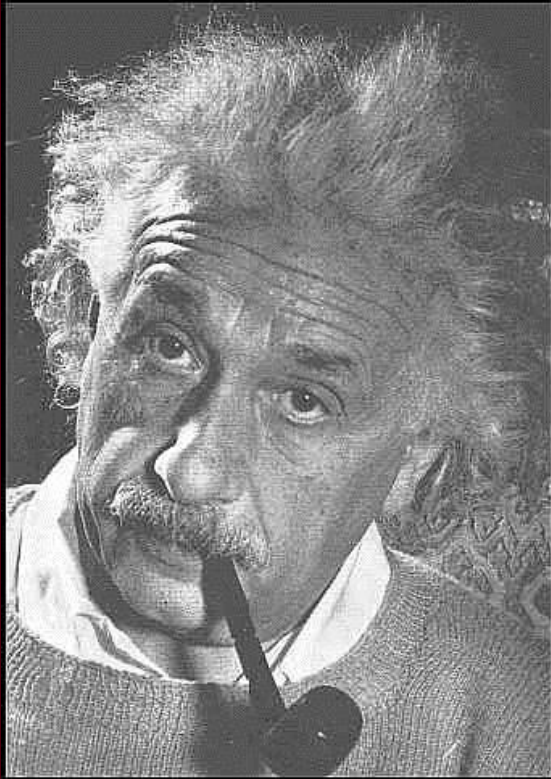


*Thomas Mann*



*Albert Einstein*

## VASCULAR PATHOLOGY AND HISTORY



*Albert Einstein*  
(1879-1955)

### **1948**

December: is diagnosed with aortic aneurysm and intervened at Brooklyn Jewish Hospital (Nissen): cellophane coating.

### **1952**

November: rejects the presidency of the state of Israel.

### **1955**

April 12: suffers from abdominal pain.

April 15: is admitted to Princeton Hospital.

April 16: F. Glenn proposes resection + homograft but Einstein refuses surgery.

**April 18** (1:15 am): **dies.**

April 18: **Autopsy** and cremation except brain:

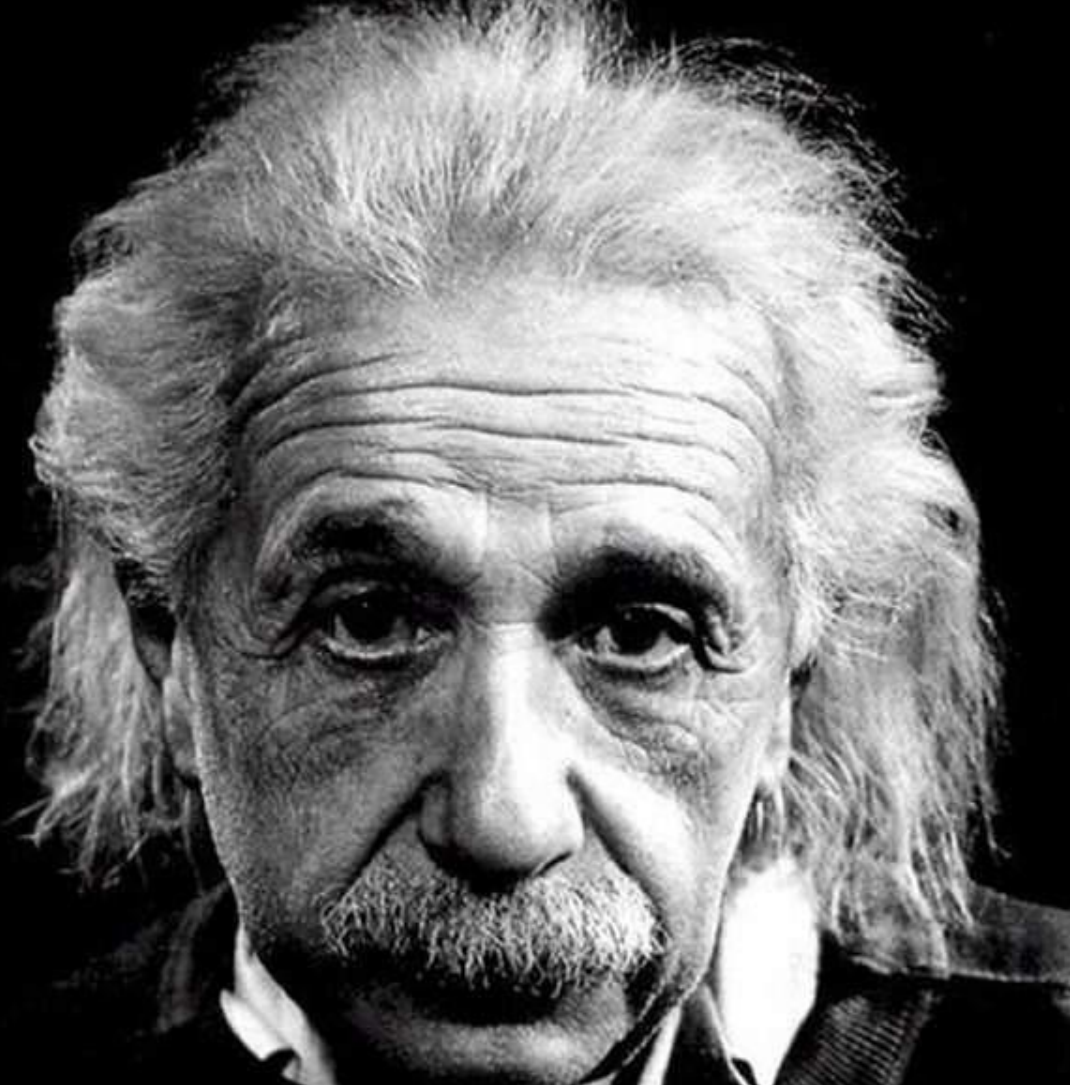
Ruptured aortic aneurysm 2.

2. Normal encephalic mass

3. Increased glial cells

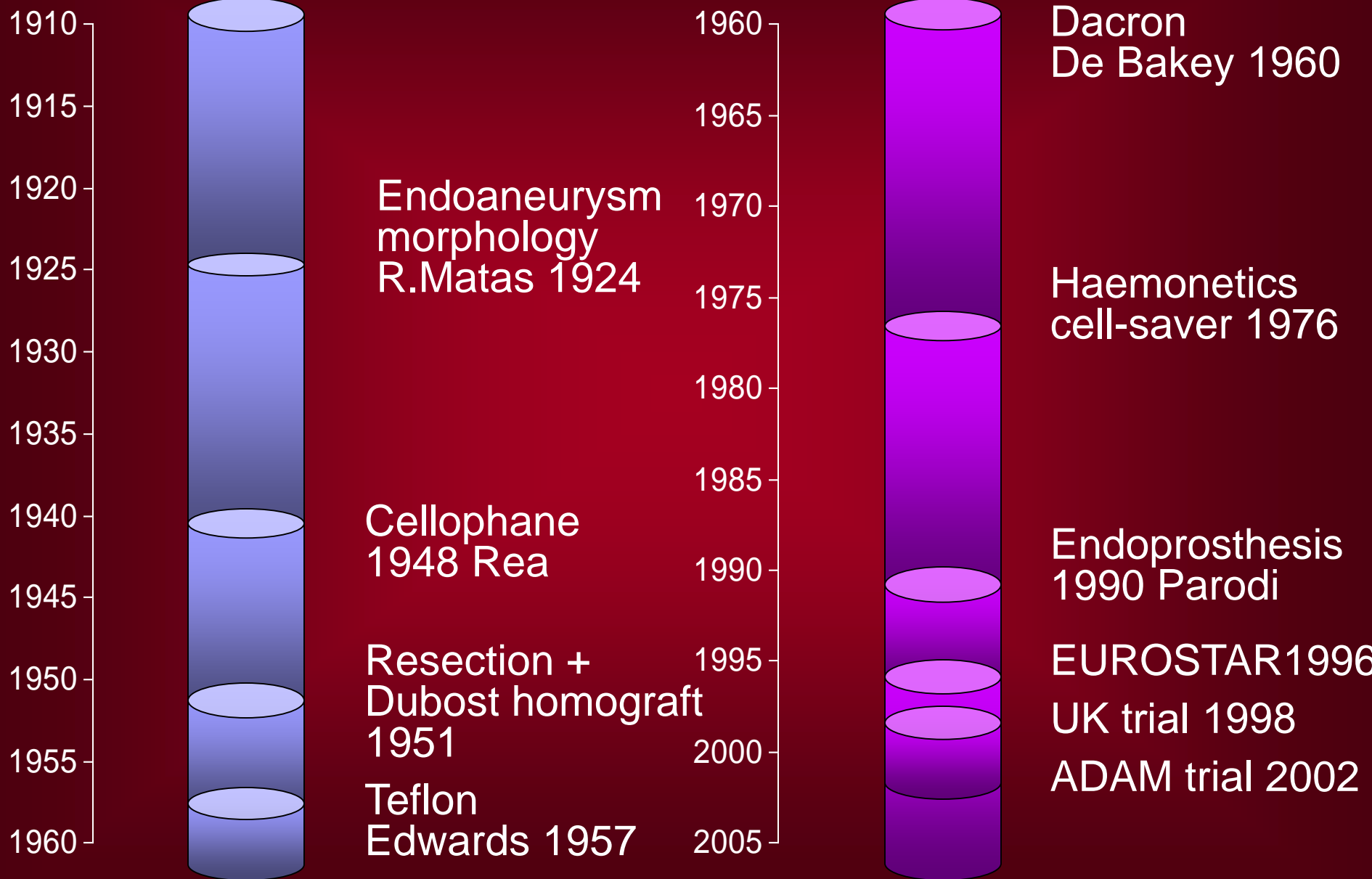
*(Wade N. Science 1981; 213:521)*

*(Cohen J; Surg Gynecol Obst. 2000;170:455-8)*



*"I want to leave when I decide. It is useless to prolong life artificially. I have done my part and the time has come. I will do it elegantly"*

# Aortic aneurysm (1900-2000)





## *Aortic aneurysms*

### Topics

etiology/epidemiology\*  
screening  
diagnostic technology  
pharmacological treatment  
surgical treatment\*  
endovascular treatment  
ruptured aneurysm



## Aortic aneurysms

### Etiology/physiopathology ★

★ AE >90%

Brucella, Salmonella

TBC

Marfan, Ehlers-Danlos

Behçet, Takayasu

Smoking

COPD

Hypertension

Dyslipidemia

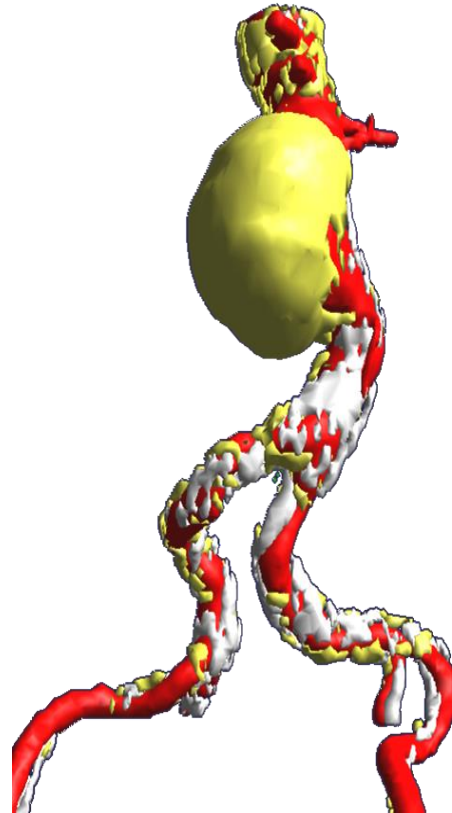
Family history

autosomic recessive

19q13

PAI-1 (4G/5G)

LRP3



★ cross-link elastic fibers

★ MMP-9, MMP-2  
TIMP-2, PAI 1

MCP-1

uPA, plasmin

Alpha-2 antiplasmin

*Wassef M, et al. J Vasc Surg 2001;34:730-8.*

*Rasmussen TE, et al. J Vasc Surg 2002;35:988-93.*

*van Vlijmen-van Keulen CJ, et al. Eur J Vasc Endovasc Surg  
2002;24:105-16.*

## *Aortic aneurysms*

### **Animal models**

rat aorta + elastase (Anidjar 1989)

increase in diameter 300-400% (7 days)

Histological findings

rupture of elastic fibers

inflammatory infiltrates (T cell and macrophages)

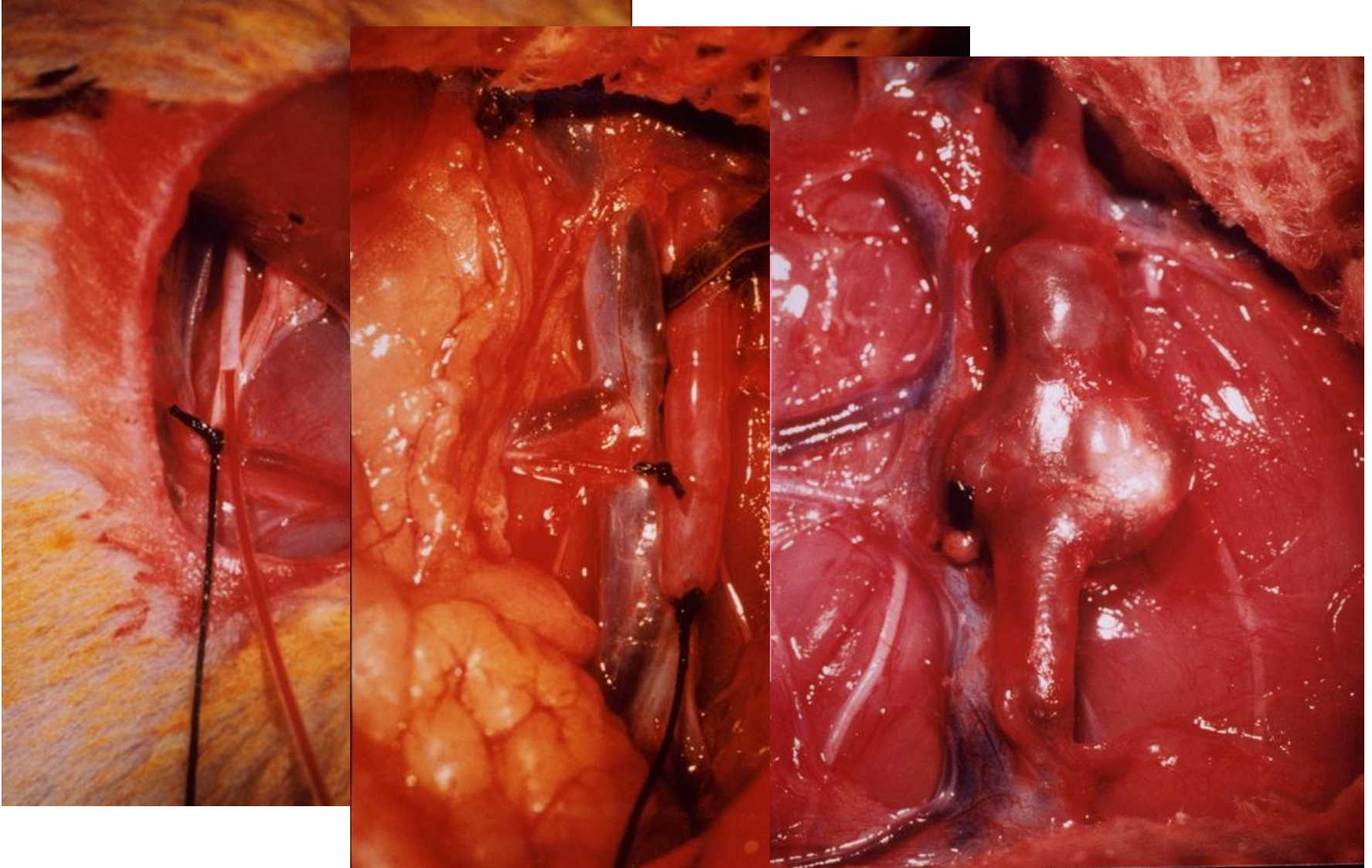
adventitia

media

# Arterial Aneurysms

## Aortic aneurysms

### Animal models



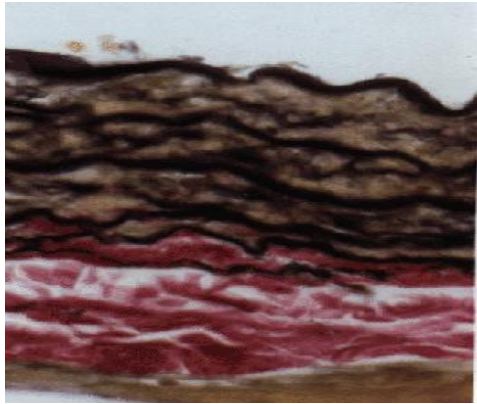


# Arterial Aneurysms

## Aortic aneurysms

### Animal models

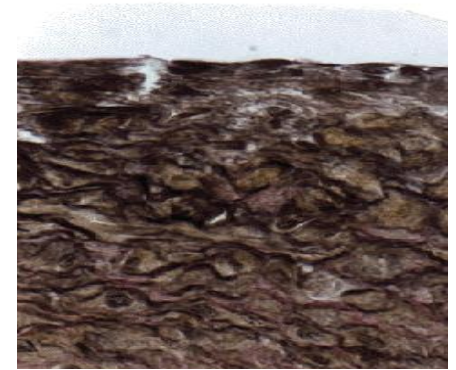
### histology (VVG)



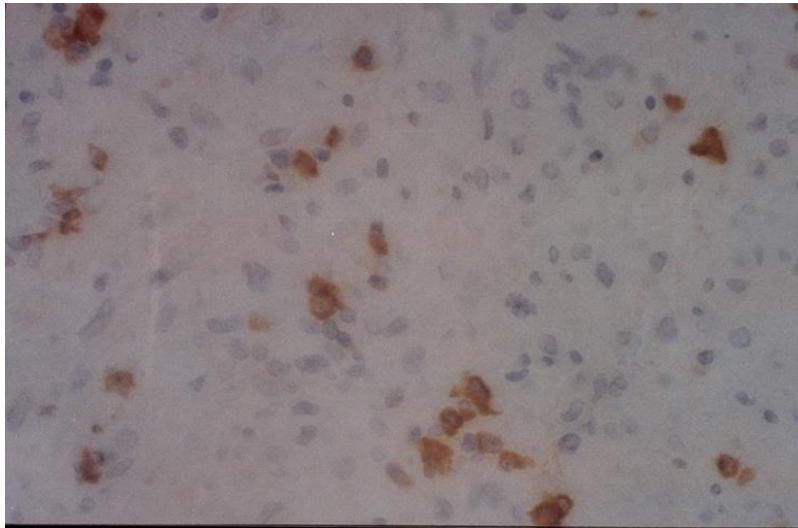
elastase (2 days)



elastase (4 days)



(elastase 14 days)



*Anti ED2 (400x)*

# Arterial Aneurysms

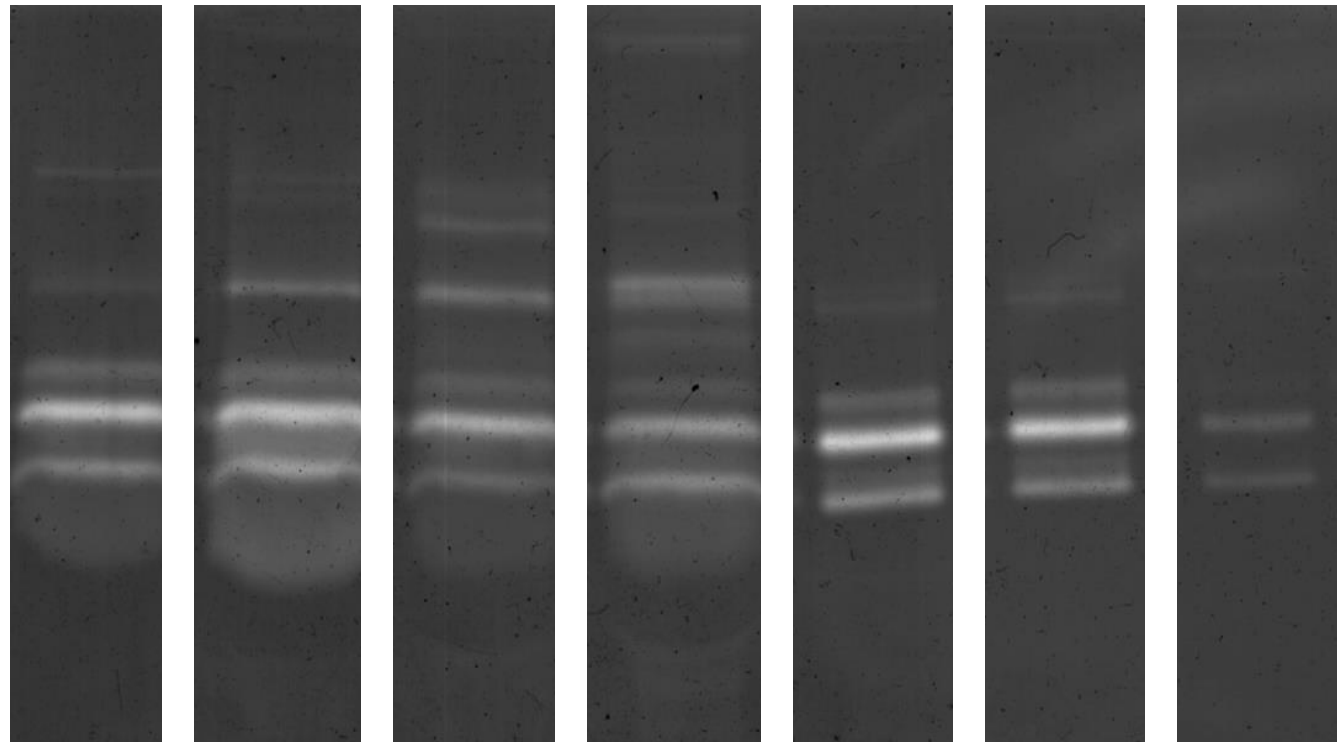
## Aortic aneurysms

### Animal models

zymography/gelatine

**MMP9**

**MMP2**



saline

elastase

elastase

elastase

elastase

elastase

elastase

indom.

indom.

indom.

## Aortic aneurysms

### Epidemiology (prevalence)

#### prevalence

necropsy 2%

★ > 60 years 5%

increases with age, tobacco and hypertension

#### incidence

15-37/100,000 h/y (increasing?)

#### etiology

★ arteriosclerosis 90%

medial cystic necrosis

infection (Salmonella)

#### location

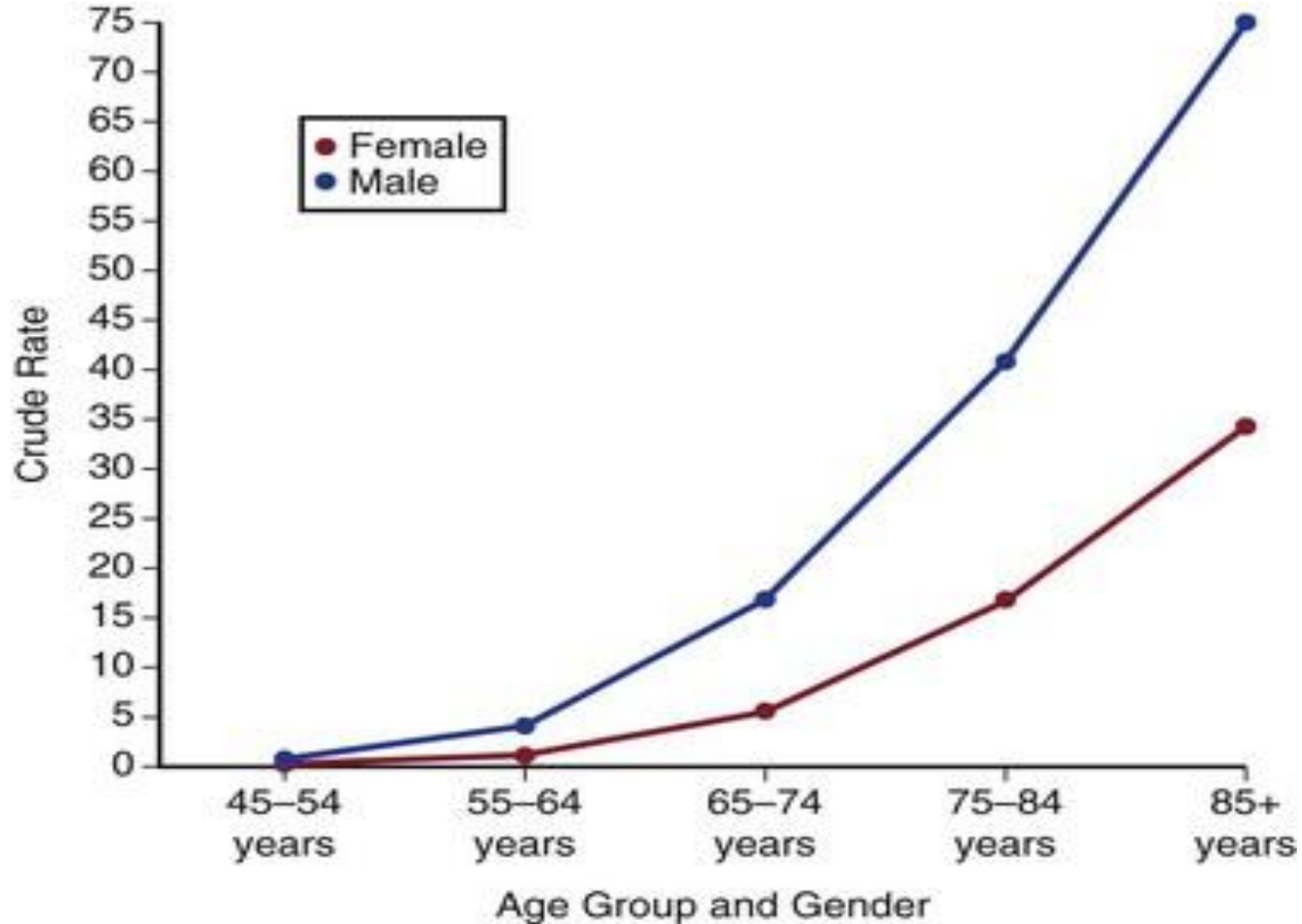
★ suprarenal 2%

iliac 70%

# Arterial Aneurysms

## Aortic aneurysms

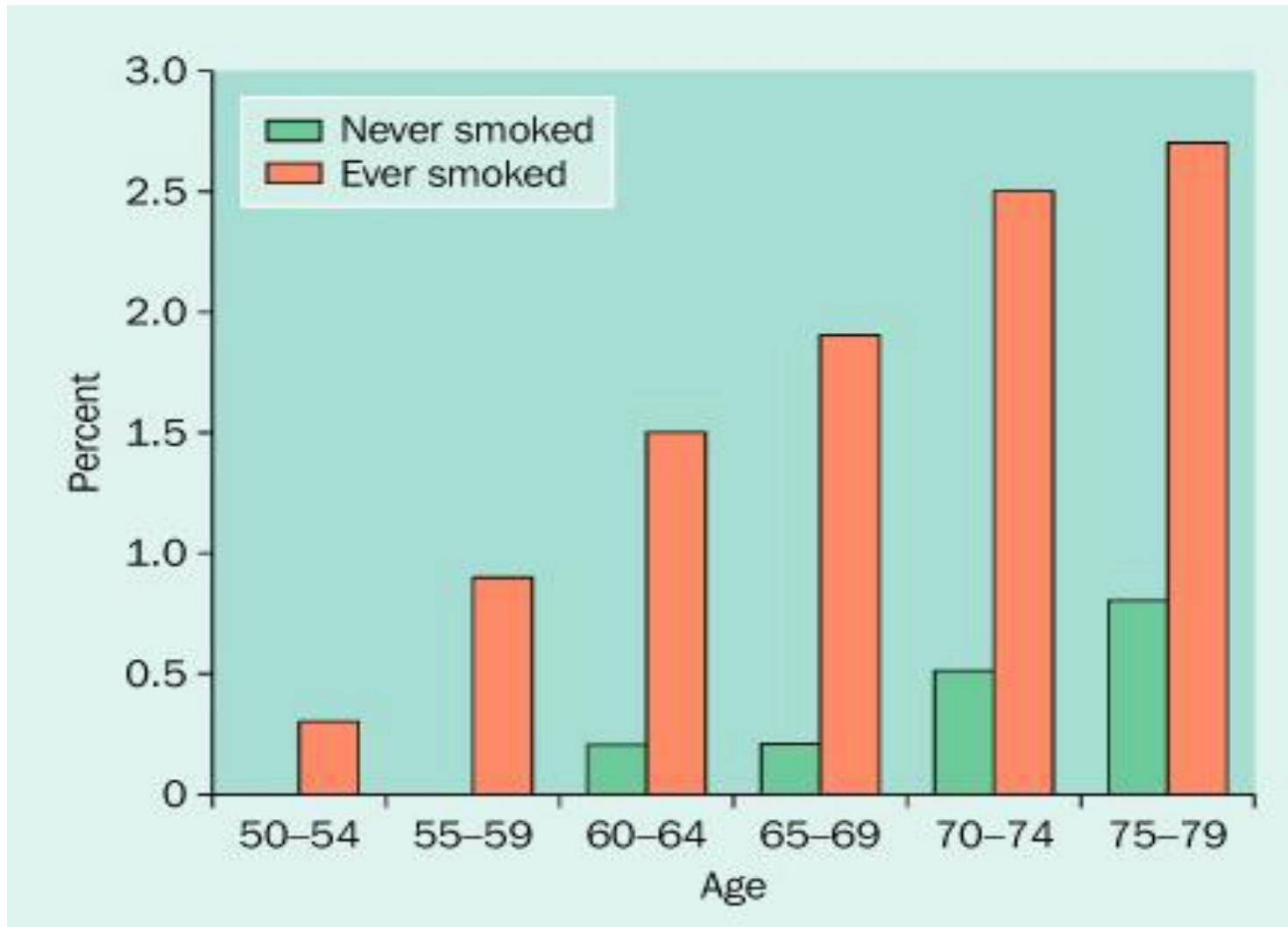
### Epidemiology (prevalence)



Centers for Disease Control and Prevention, National Center for Health Statistics: Compressed Mortality File 1999-2009.

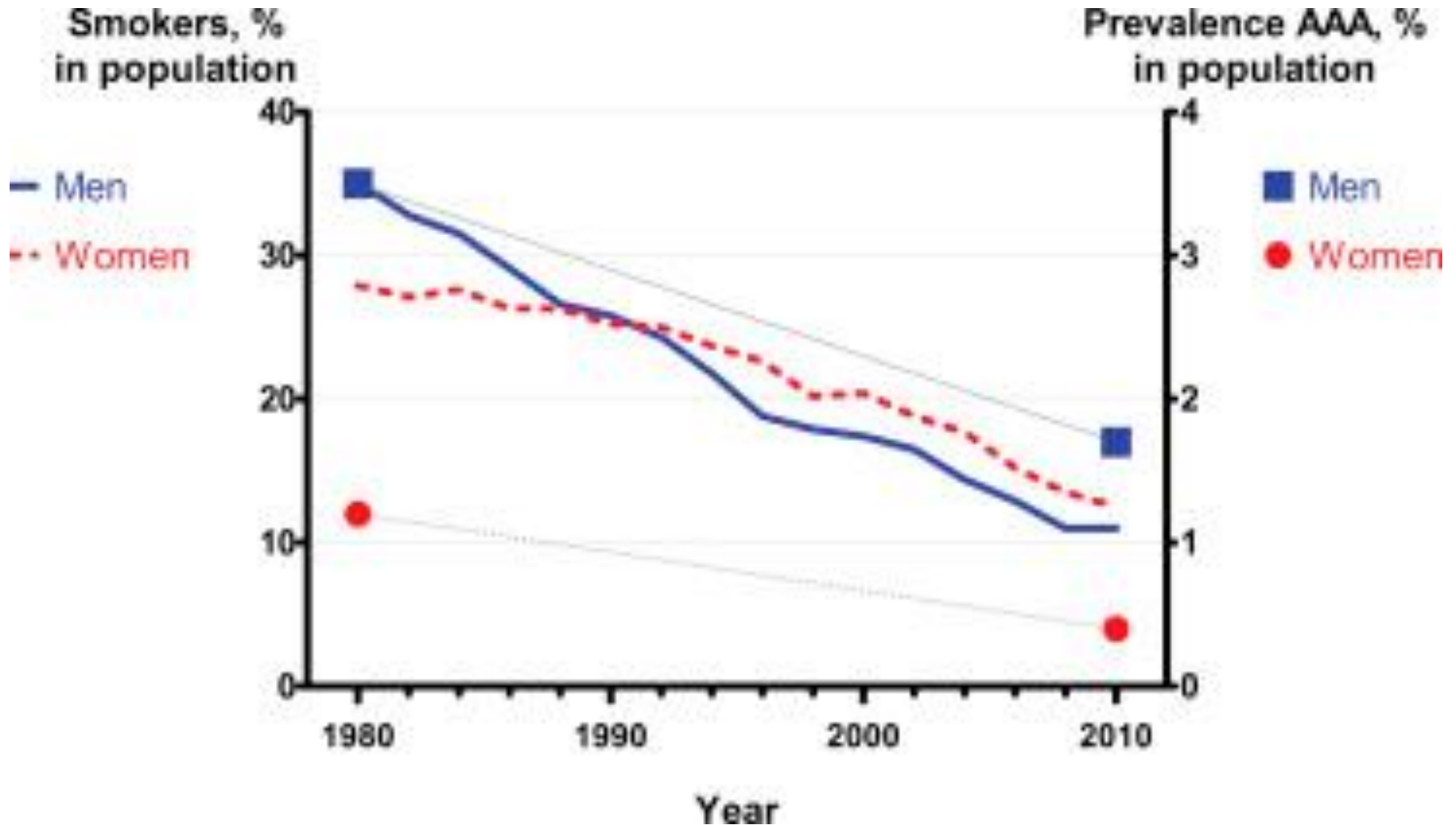
## Aortic aneurysms

### Epidemiology (prevalence)



# Aortic aneurysms

## Epidemiology (prevalence)



## Aortic aneurysms

### Screening

The **U.S. Preventive Services Task Force (USPSTF)** recommends one-time screening for abdominal aortic aneurysm (AAA) by ultrasonography in men aged 65 to 75 who have smoked.

Rating: [B Recommendation](#).

The USPSTF makes no recommendation for or against screening for men aged 65 to 75 who have never smoked.

Rating: [C Recommendation](#).

The USPSTF recommends against routine screening for AAA in women.

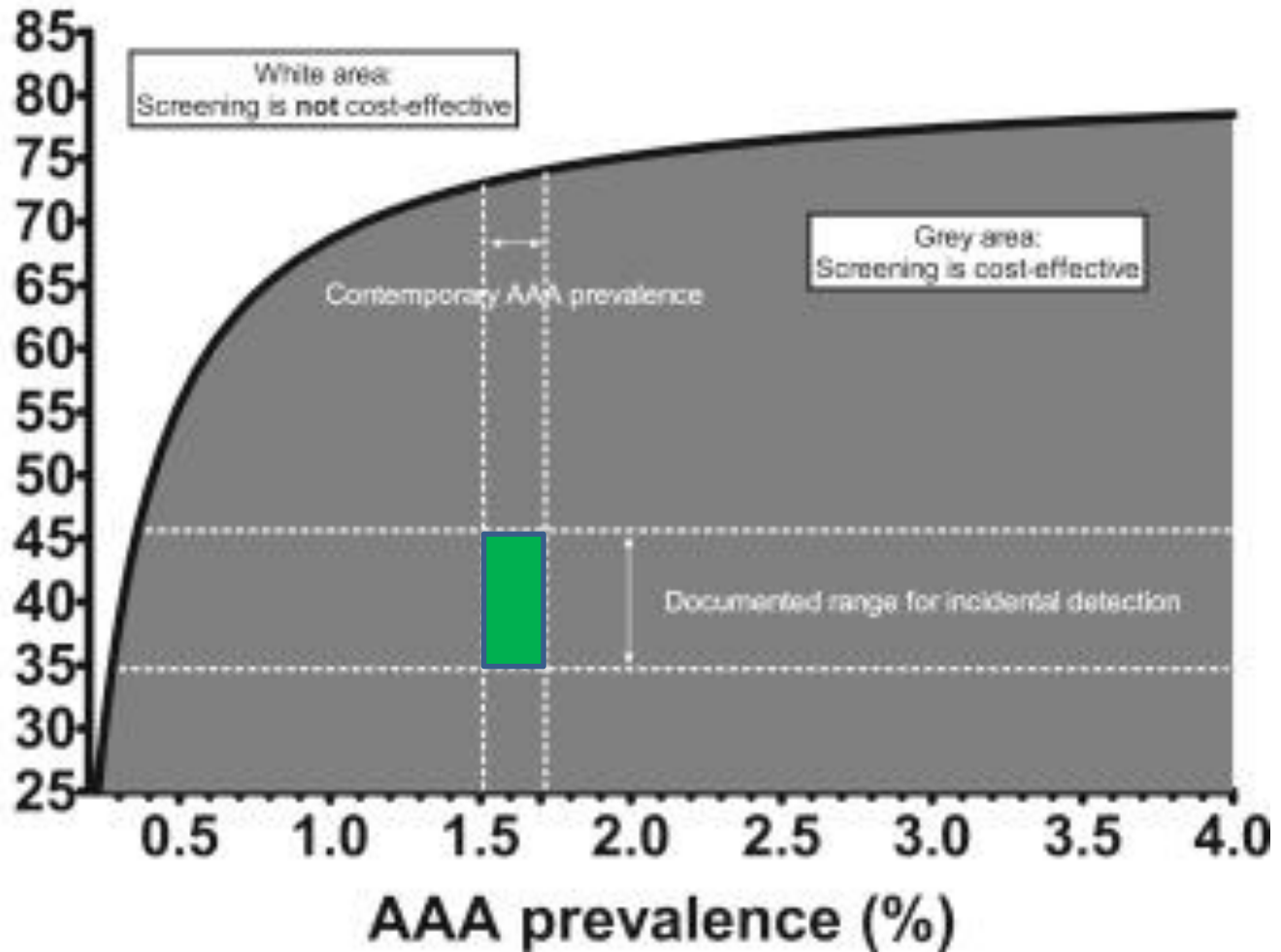
Rating: [D Recommendation](#).



## Aortic aneurysms

### Diagnosis (screening)

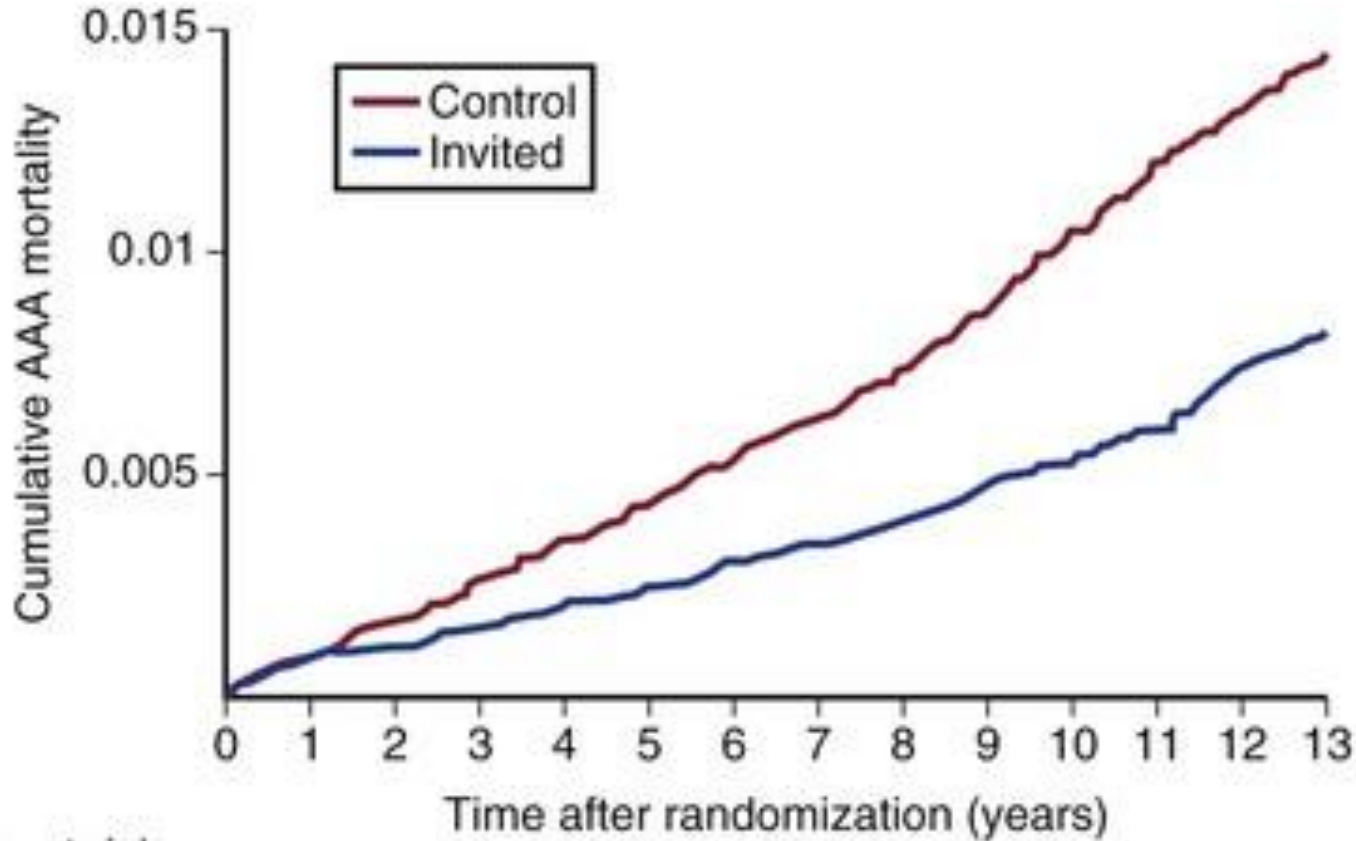
Degree of incidental detection of AAA in population (%)





# Aortic aneurysms

## Diagnosis (screening)



No. at risk

Control

33,987 33,049 32,102 31,055 29,995 28,872 27,674 26,347 25,030 23,841 22,664 21,405 20,185 11,015

Invited

33,983 33,020 32,080 31,127 30,108 29,012 27,873 26,627 25,406 24,155 22,907 21,676 20,497 11,161

Multicentre Aneurysm Screening Study (MASS)  
Thompson SG, et al. Br J Surg 2012 (99):1649-1656

## Aortic aneurysms

### Epidemiology (risk of rupture)

**Table 3. Absolute Risk of Rupture for Abdominal Aortic Aneurysm**

<i>Aneurysm diameter</i>	<i>Absolute lifetime risk of rupture</i>
5 cm	20%
6 cm	40%
7 cm	50%

*Information from references 1 and 2.*

## Aortic aneurysms

### Epidemiology (risk of rupture)

Size (cm)	Rupture risk (%/year)
< 4.0	0
4 - 5	0.5-5
5 - 6	3-15
6 - 7	10-20
7 - 8	20-40
> 8	30-50

## *Aortic aneurysms*

### **Epidemiology (risk of rupture)**

#### **increased risk:**

women

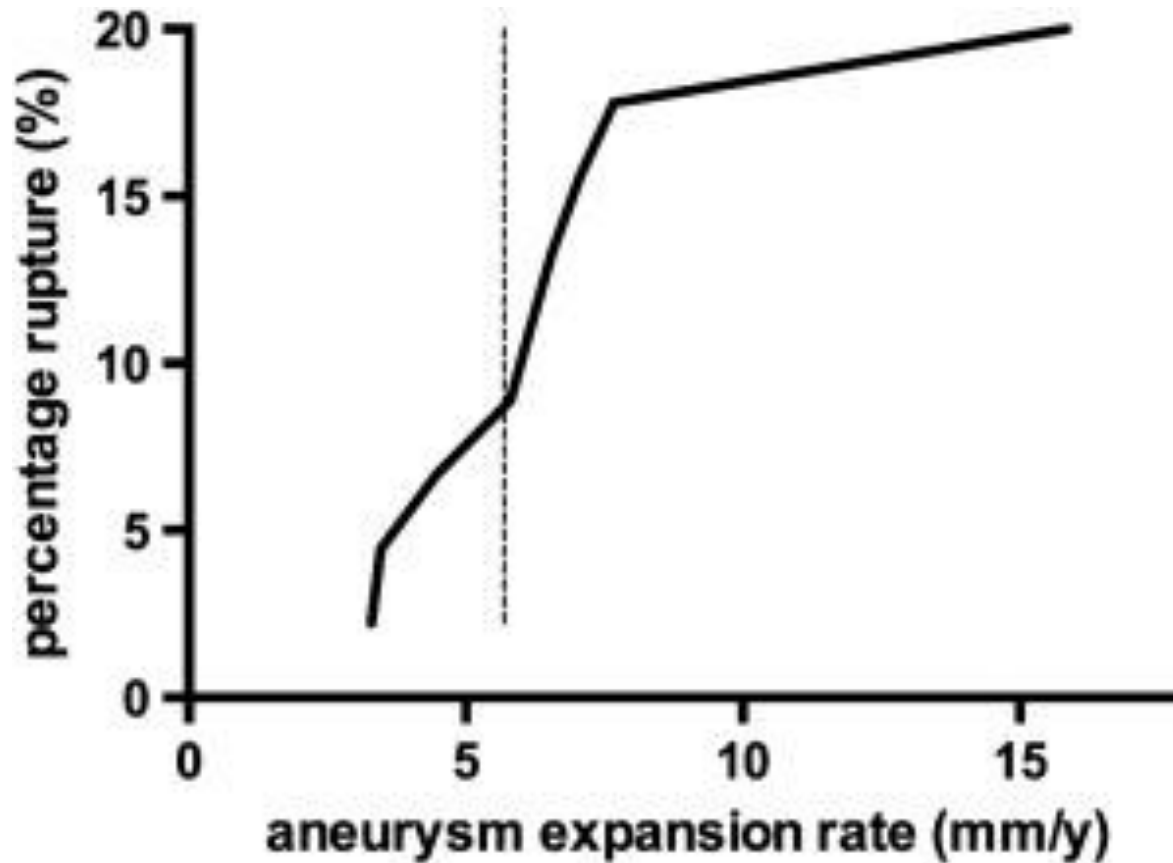
Marfan syndrome

COPD

kidney and heart transplant

## Aortic aneurysms

### Epidemiology (risk of rupture)



## Aortic aneurysms

### Symptoms

★	asymptomatic	75%
	abdominal pain	30%
★	COPD	25- 30%
	rupture	10-30%
	low back pain	6%
★	associated cancer	5%
	aorto-IVC fistula	1%
	aorto-enteric fistula	<1%
	hydronephrosis	
	embolism	

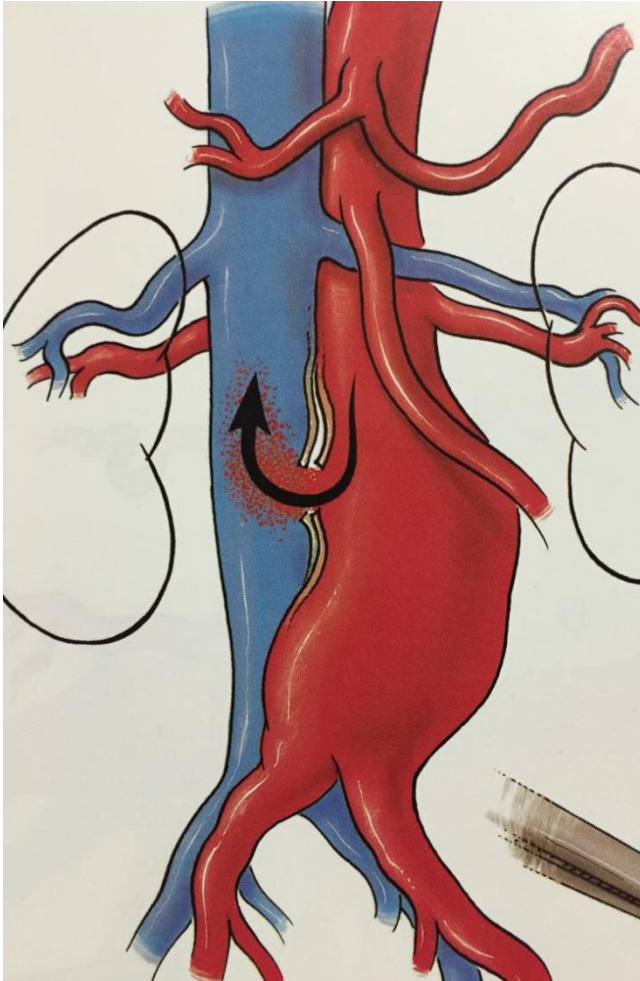


# Arterial Aneurysms

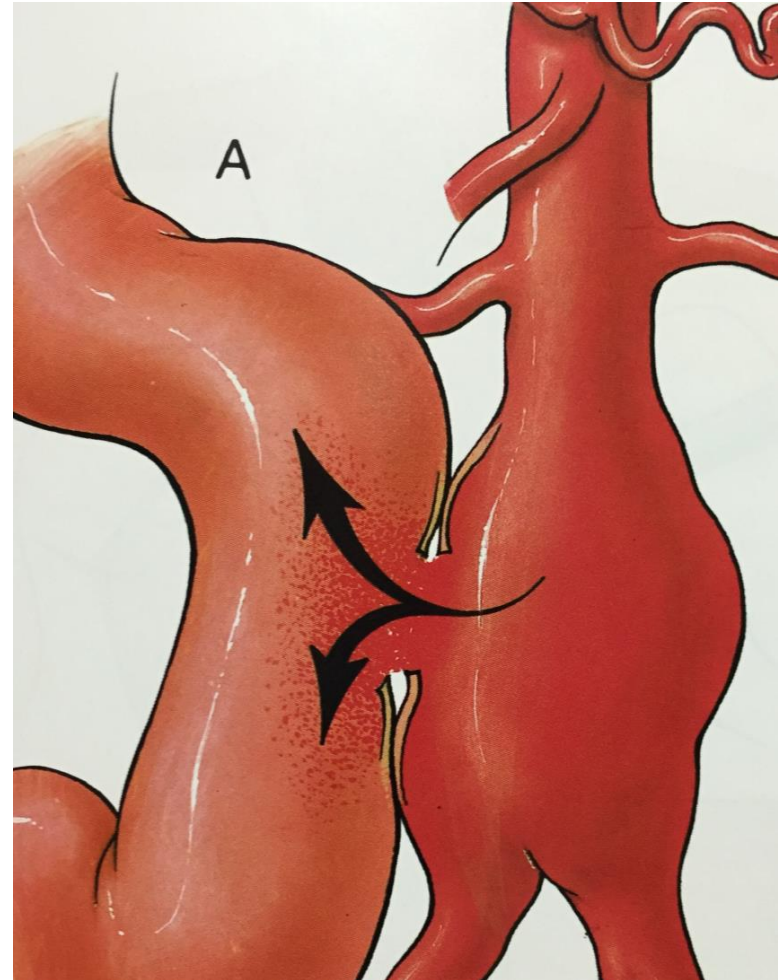
## Aortic aneurysms

### Complications (rupture)

★ aortocaval fistula



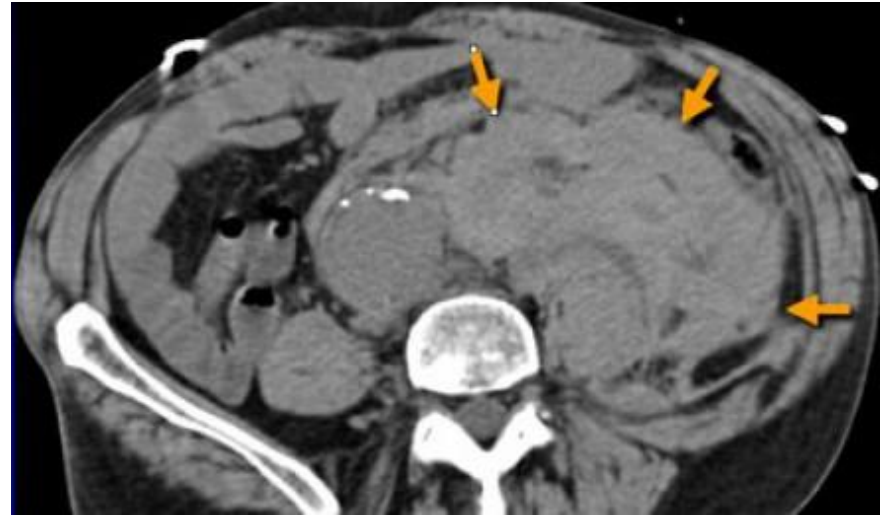
★ aortoenteric fistula



# Arterial Aneurysms

## Aortic aneurysms

### Complications (rupture)

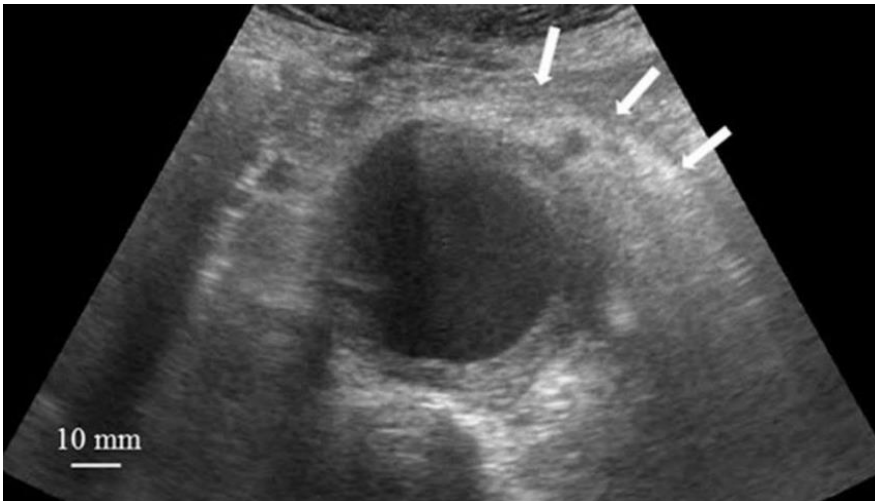
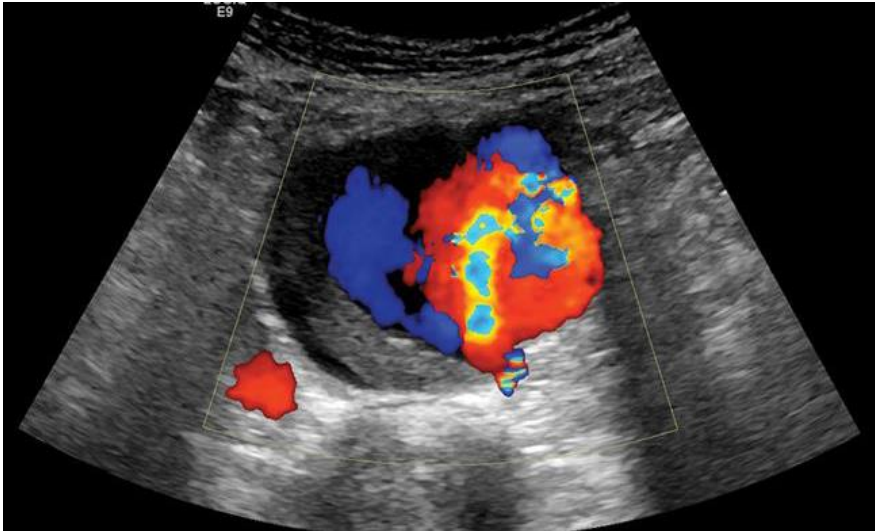




# Arterial Aneurysms

## Aortic aneurysms

### Diagnosis (clinic/X-ray/ultrasonography)



## *Arterial Aneurysms*

### *Aortic aneurysms*

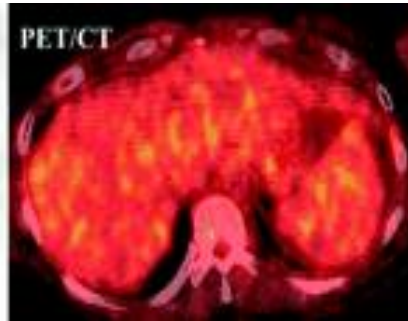
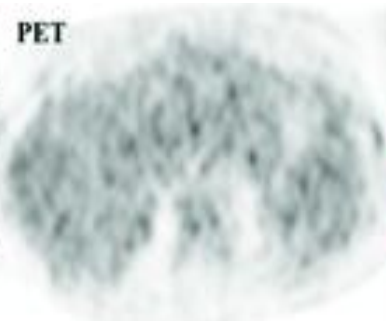
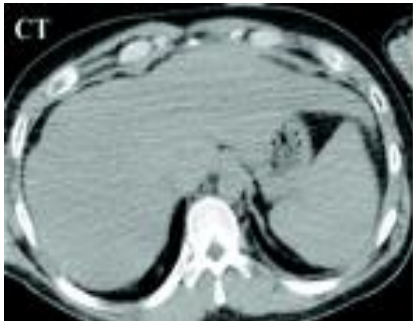
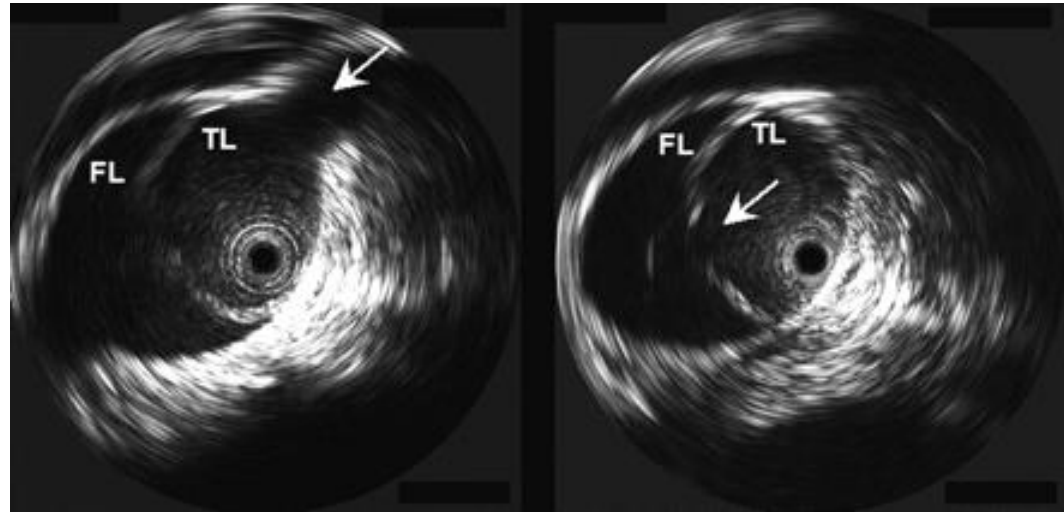
### **Diagnosis (clinic/X-ray/ultrasonography)**



## Aortic aneurysms

### Diagnosis ★

Duplex scanning  
CT/CT Angio  
MRI/MR Angio  
Gammagraphy??  
Angiography ??



IVUS\*  
PET/CT\*\*

\*White RA. *J Endovasc Surg.* 1997;4(1):45-55.

\*\*Sakalihasan N, et al. *Semin Vasc Surg.* 2004;17(2):144-53

## *Aortic aneurysms*

### **Diagnosis (MR Angio)**

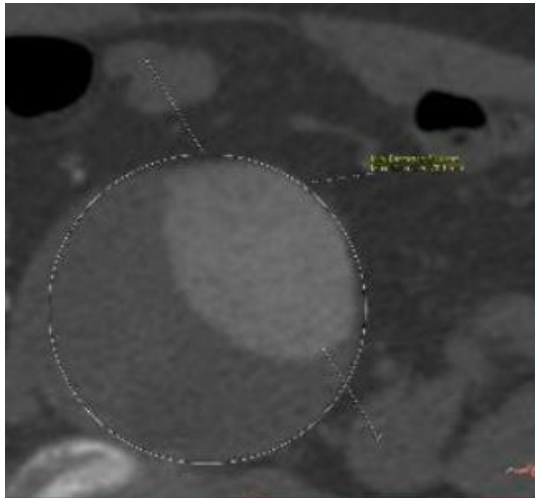




# Arterial Aneurysms

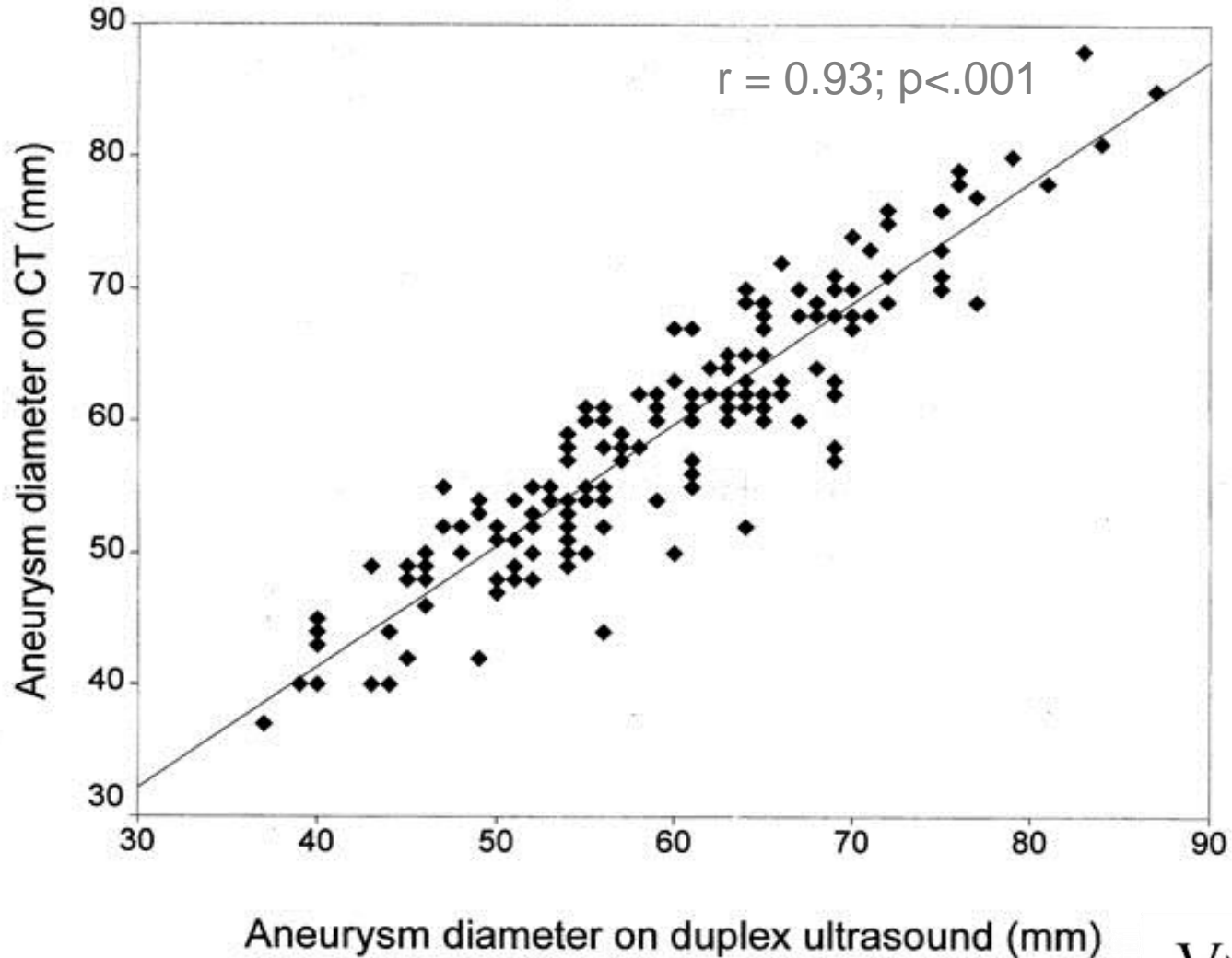
## Aortic aneurysms

### Diagnosis (CT Angio)



# Aortic aneurysms

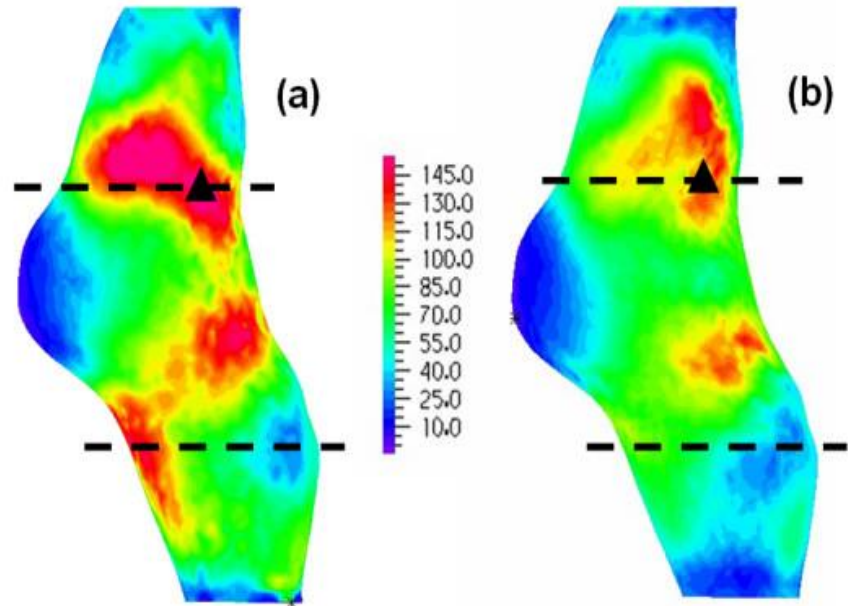
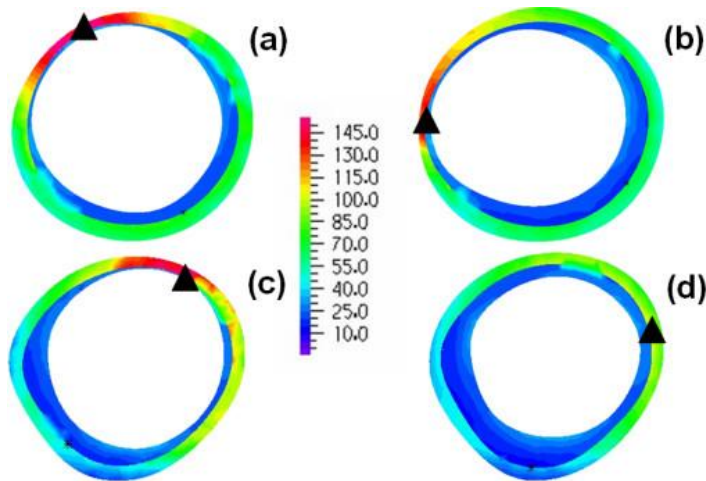
## Diagnosis (ultrasonography vs CT) ★



## Aortic aneurysms

### Diagnosis (new technologies)

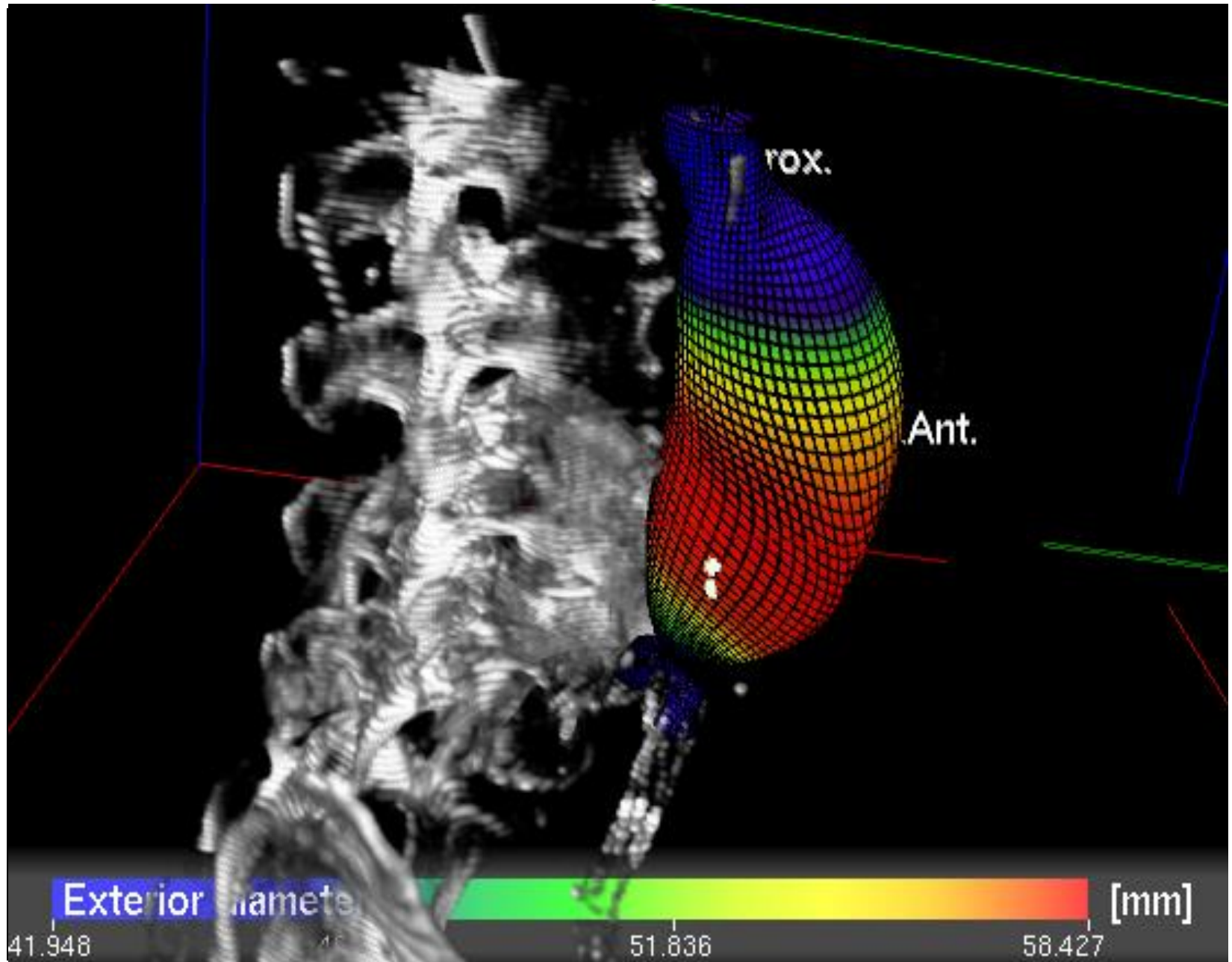
computerized simulation  
models  
wall stress levels



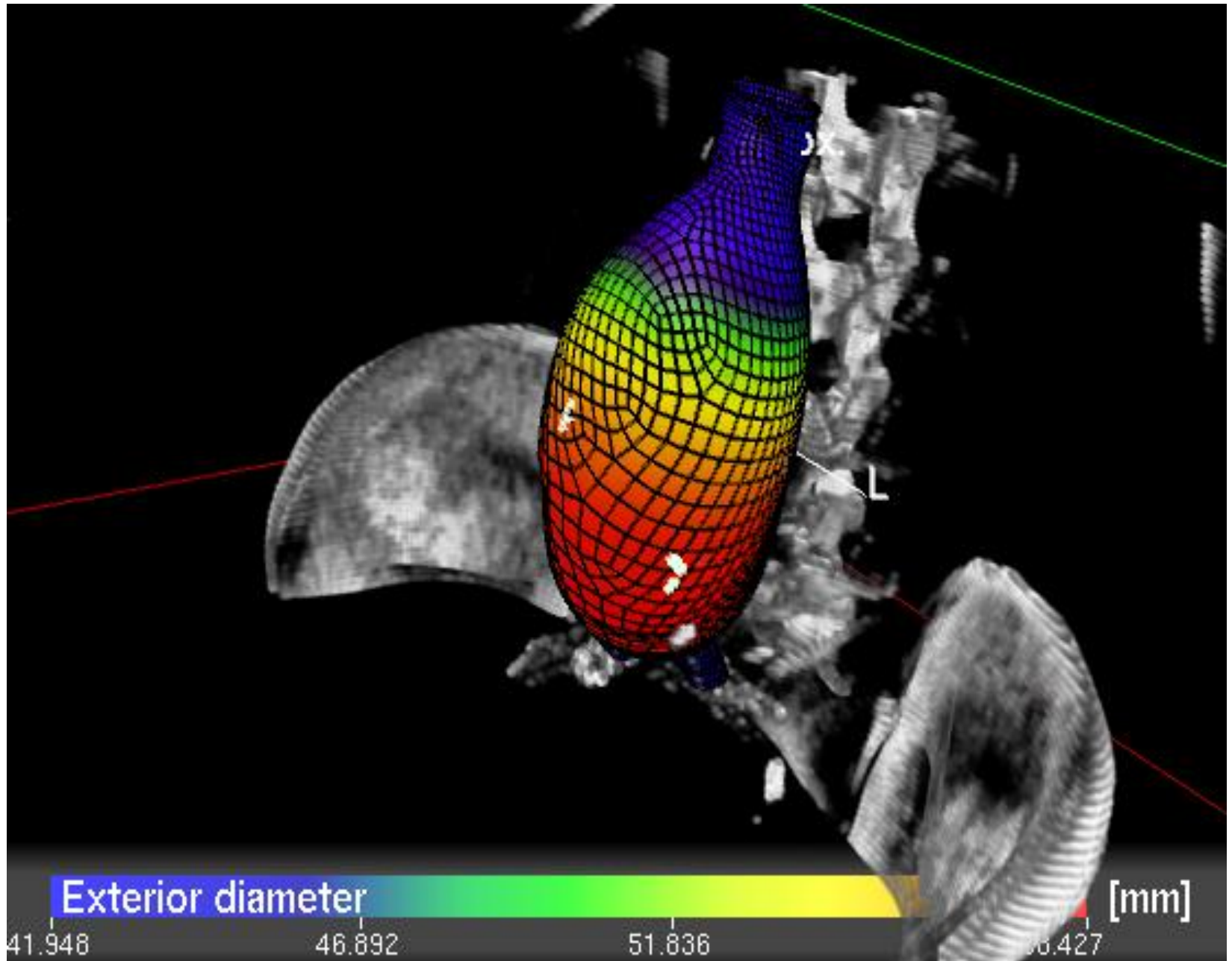
Raghavan ML, et al. *J Vasc Surg.* 2000 ;31(4):760-9  
Fillinger MF, et al. *J Vasc Surg.* 2002 ;36(3):589-97



# Arterial Aneurysms



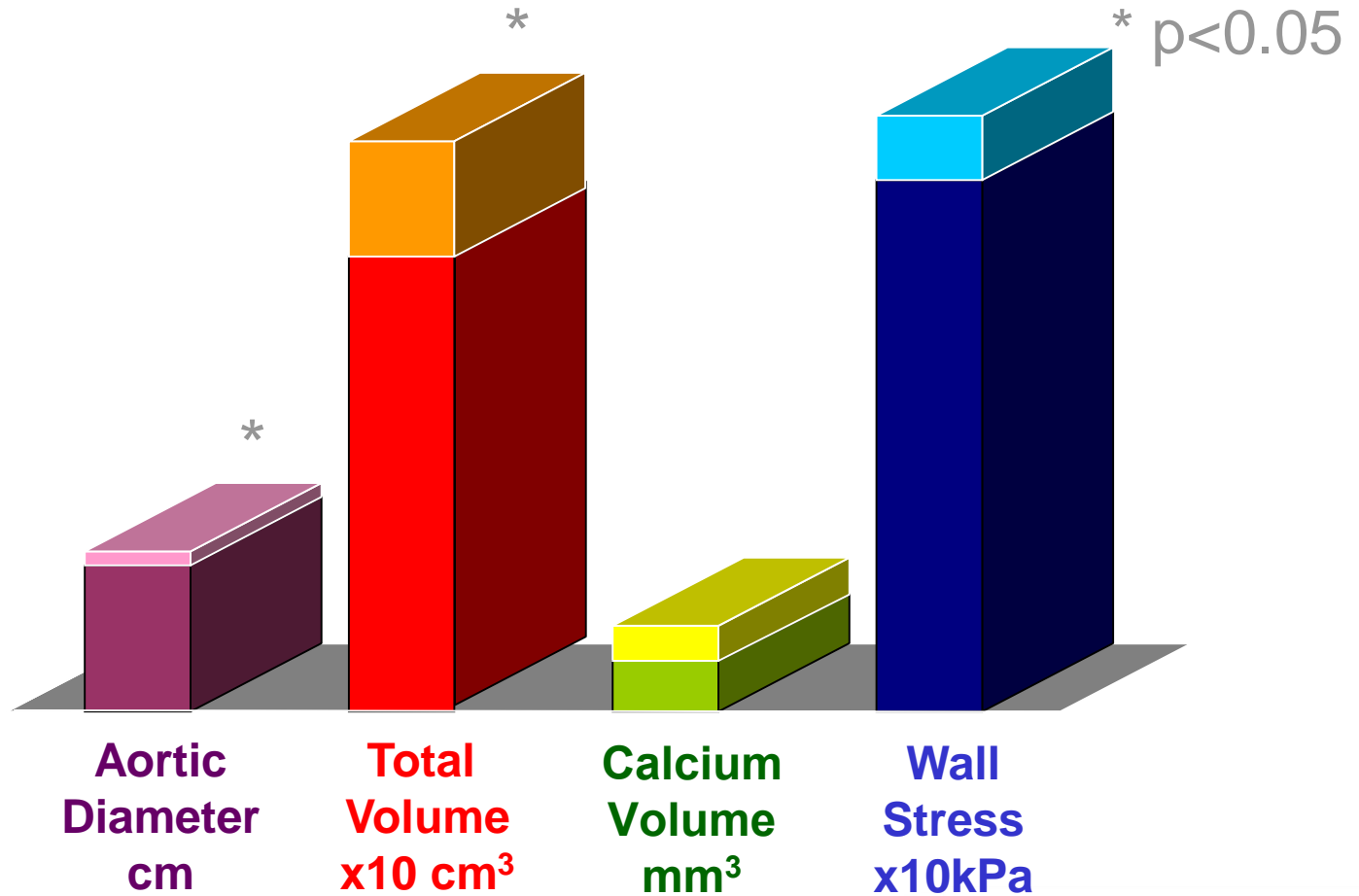
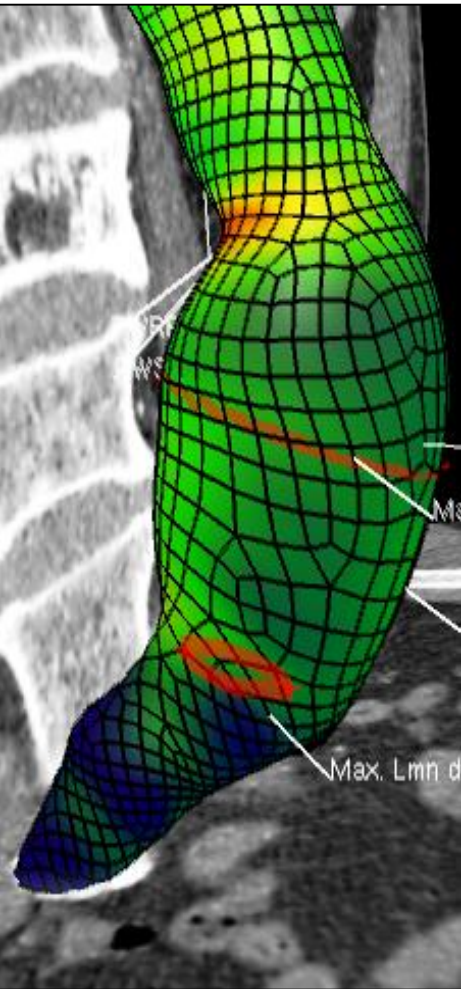
# Arterial Aneurysms



# Aortic aneurysms

## Diagnosis (computational analysis)

results (n=22; follow up = 15+/-8 m)



## Aortic aneurysm

### Pharmacological treatment

#### **MMP inhibitors**

- ★ Doxycycline/Roxithromycin
- Batimastat (BB-94)
- Indomethacin

#### **PGE2 inhibitors**

#### **ACE inhibitors**

#### **Beta blockers**

Propranolol ??

#### ★ **Statins**

Cerivastatin?

#### ★ **Gene therapy (antiproteases) ??**

Vammen S, et al. *Br J Surg*. 2001 Aug;88(8):1066-72

Bergoeing MP, et al. *Expert Opin Ther Targets*. 2006 ;10:547-59

Colledge J, et al. *Arterioscler Thromb Vasc Biol*. 2006;26:2605-13

Dawson J, et al. *Curr Vasc Pharmacol*. 2006 Apr;4:129-49

## Aortic aneurysms

### Treatment (guidelines)

#### **Abdominal aorta**

★	ESVS	2011/2018
	ESC	2014
★	SVS	2009/2017
	ACC/AHA	2011/2016

#### **Thoracic aorta**

★	ESVS	2017
	ESC	2014
	SVS	2011 (Trauma)
	ACC/AHA	2010/2017

#### **Screening**

- ★ US Preventive Task Force
- NHS
- Kaiser Permanente

## Aortic aneurysms

### Treatment (guidelines)

★ **Abdominal aorta** (risk of rupture > 6cm: 10%/year)\*  
diameter > 55 mm (50 mm women and Marfan S.)  
growth > 8-10 mm/year  
symptomatic

**Thoracic aorta (AAT/ATA)** (risk of rupture > 6cm: 7%/year)\*\*  
diameter > 60 mm (55mm women; 50mm Marfan S)  
growth > 3-10 mm/year  
symptomatic

★ **Screening**  
man > 65 years and smoker > 100 cigarettes



## Aortic aneurysm

### Treatment (open surgery)

- ★ resection + aortoaortic graft
  - aortoiliac graft
  - aortobifemoral graft

### ★ *operative mortality*

elective surgery	2-5%
rupture	55%
rupture + shock	90%

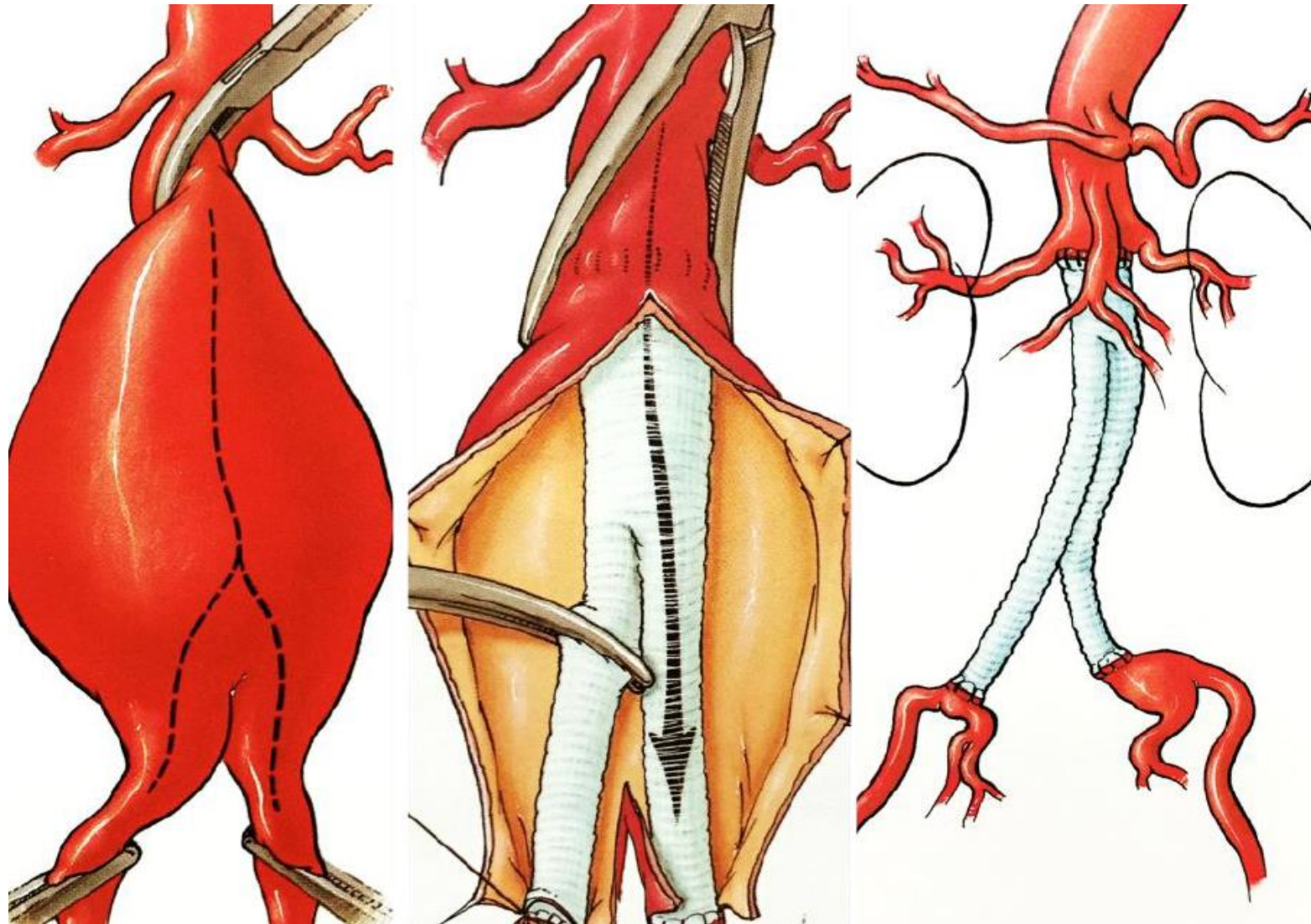
### *long-term mortality*

5 years	30%
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# Arterial Aneurysms

## Aortic aneurysms

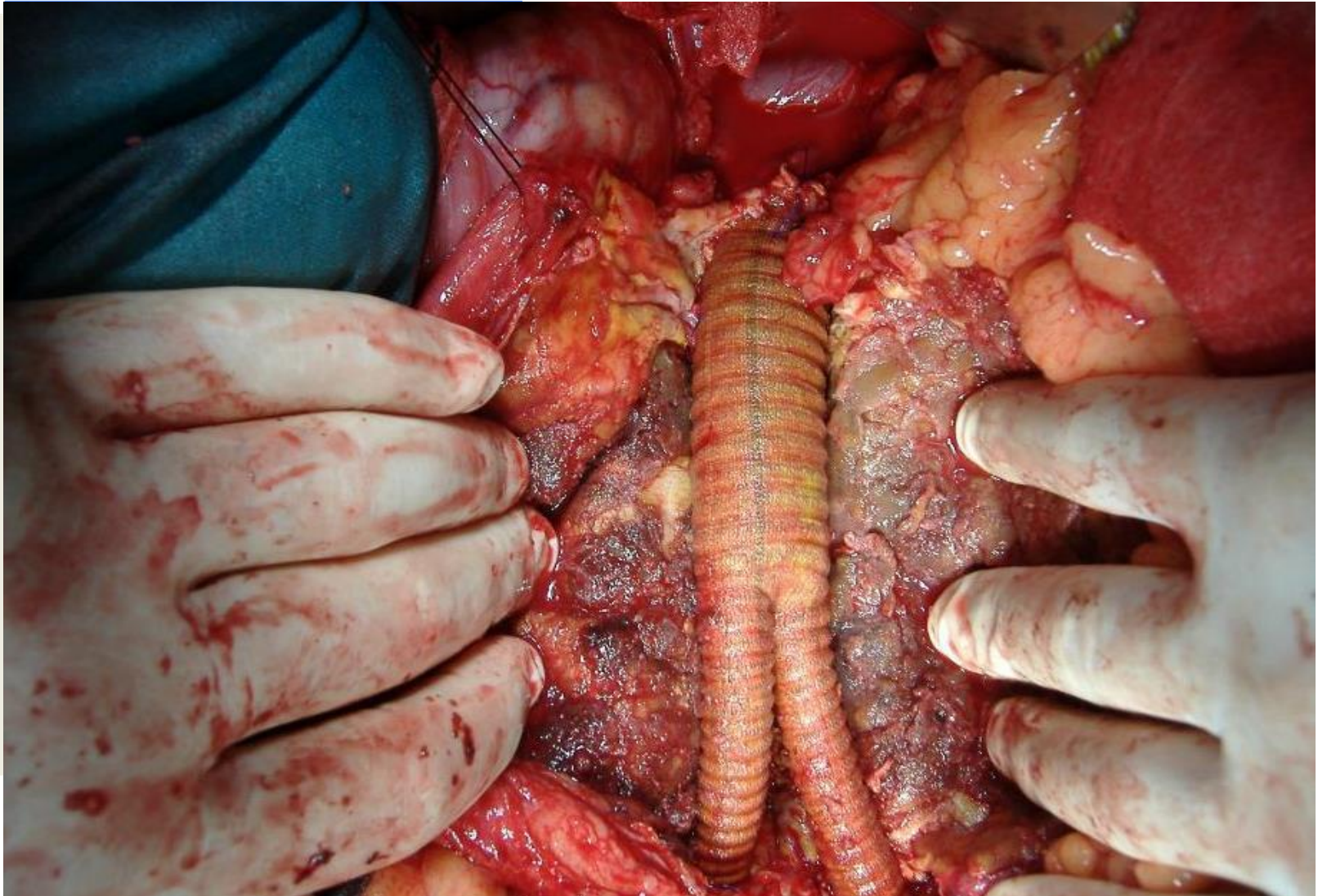
### Treatment (open surgery)



# *Arterial Aneurysms*

## *Aortic aneurysms*

### **Treatment (open surgery)**

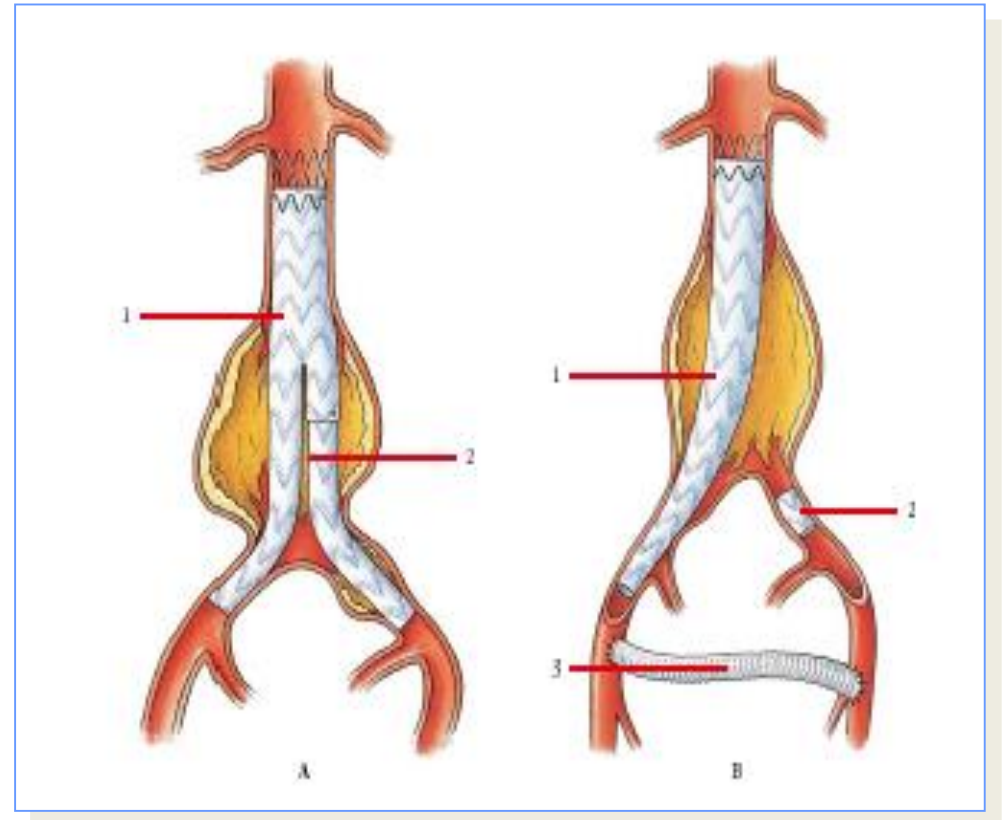
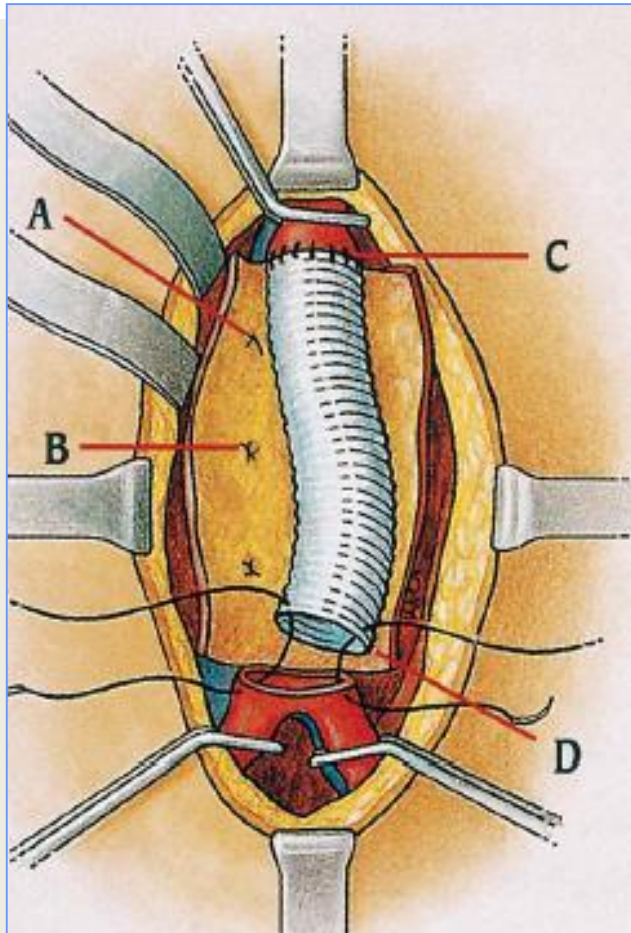




# Arterial Aneurysms

## Aortic aneurysms

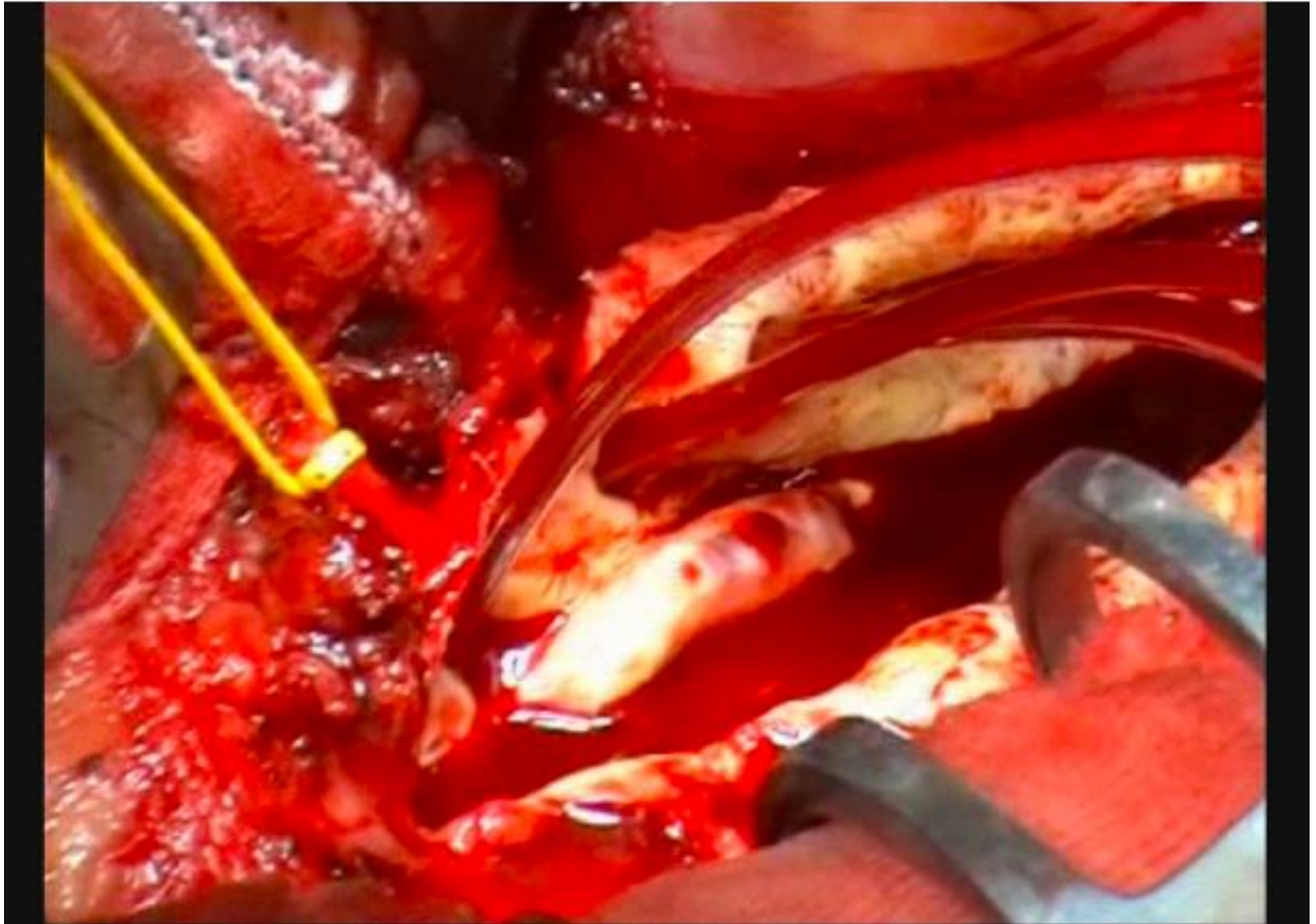
### Treatment (open surgery)



*Arterial Aneurysms*

***Aortic aneurysms***

**Treatment (a. juxtarenal/open surgery)**



## Aortic aneurysms

### Treatment (open surgery/high risk)

#### ★ High risk

- > 85 years
- angor (III-IV)
- LEVF < 30%
- VEMS < 25%
- stress-test Ta +
- pO<sub>2</sub> < 50 mmHg
- ascites
- fibrosis retroperitoneal

***operative mortality***

8-10%

## Aortic aneurysms

### Treatment (open surgery/complications)

**mortality :** 2-5 %

★ **morbidity :**

cardiac (MI, CHF)

15 %

renal failure

12 % (dialysis 1-5%)

respiratory failure

8-12 %

bleeding

2-5 %

lower limb ischemia

1 %

mesenteric ischemia

1 %

ischemic colitis

1 %



*Aortic aneurysms*

**Treatment (endovascular repair)**



# Arterial Aneurysms

## Aortic aneurysms

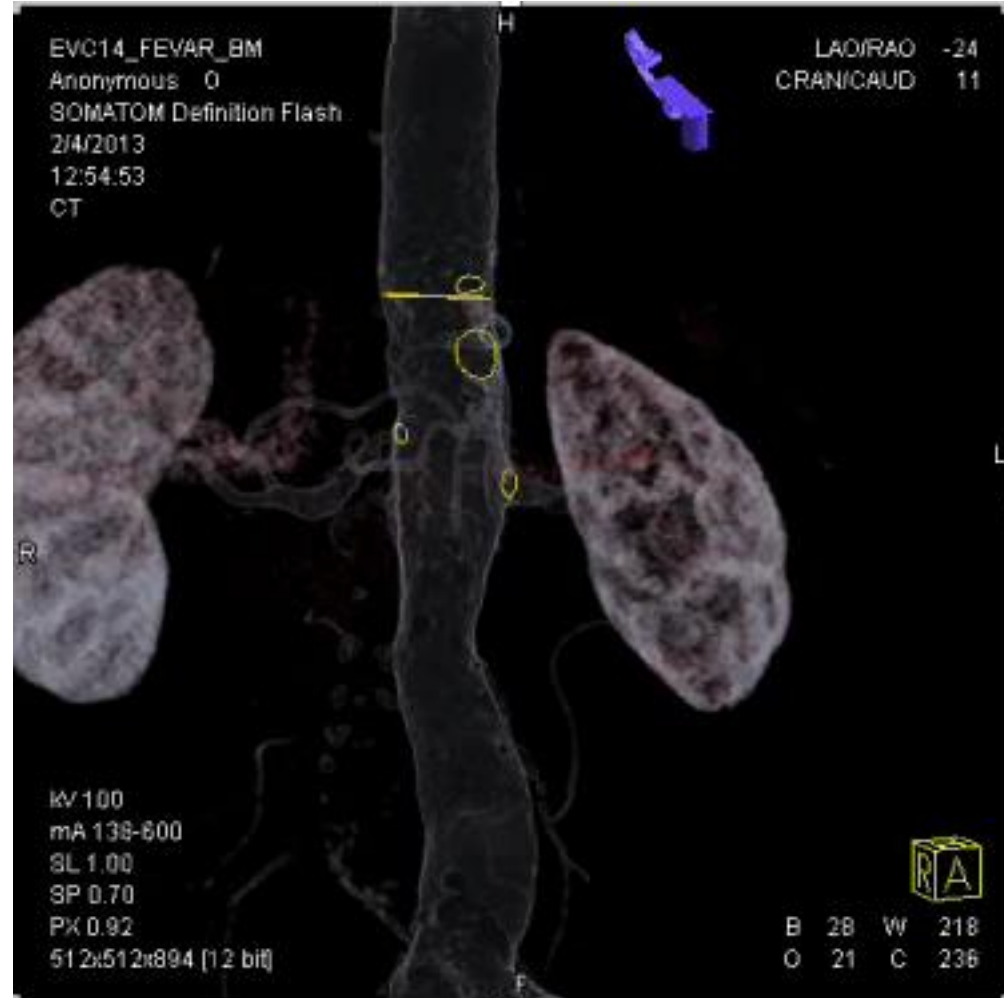
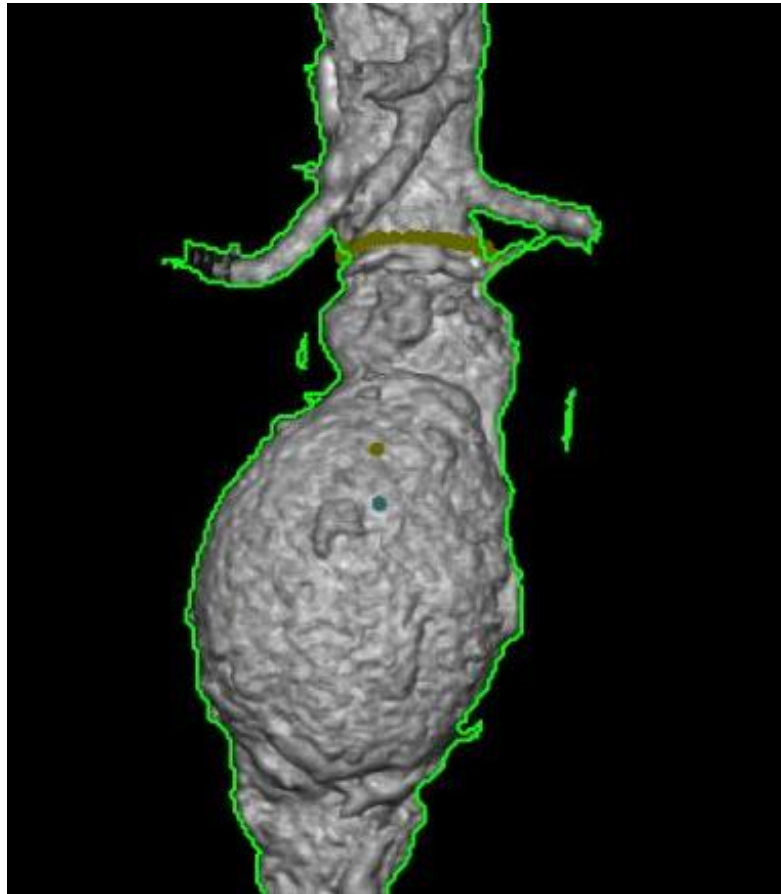
### Treatment (hybrid rooms)



# Arterial Aneurysms

## Aortic aneurysms

### Treatment (endovascular repair)



*Aortic aneurysms*

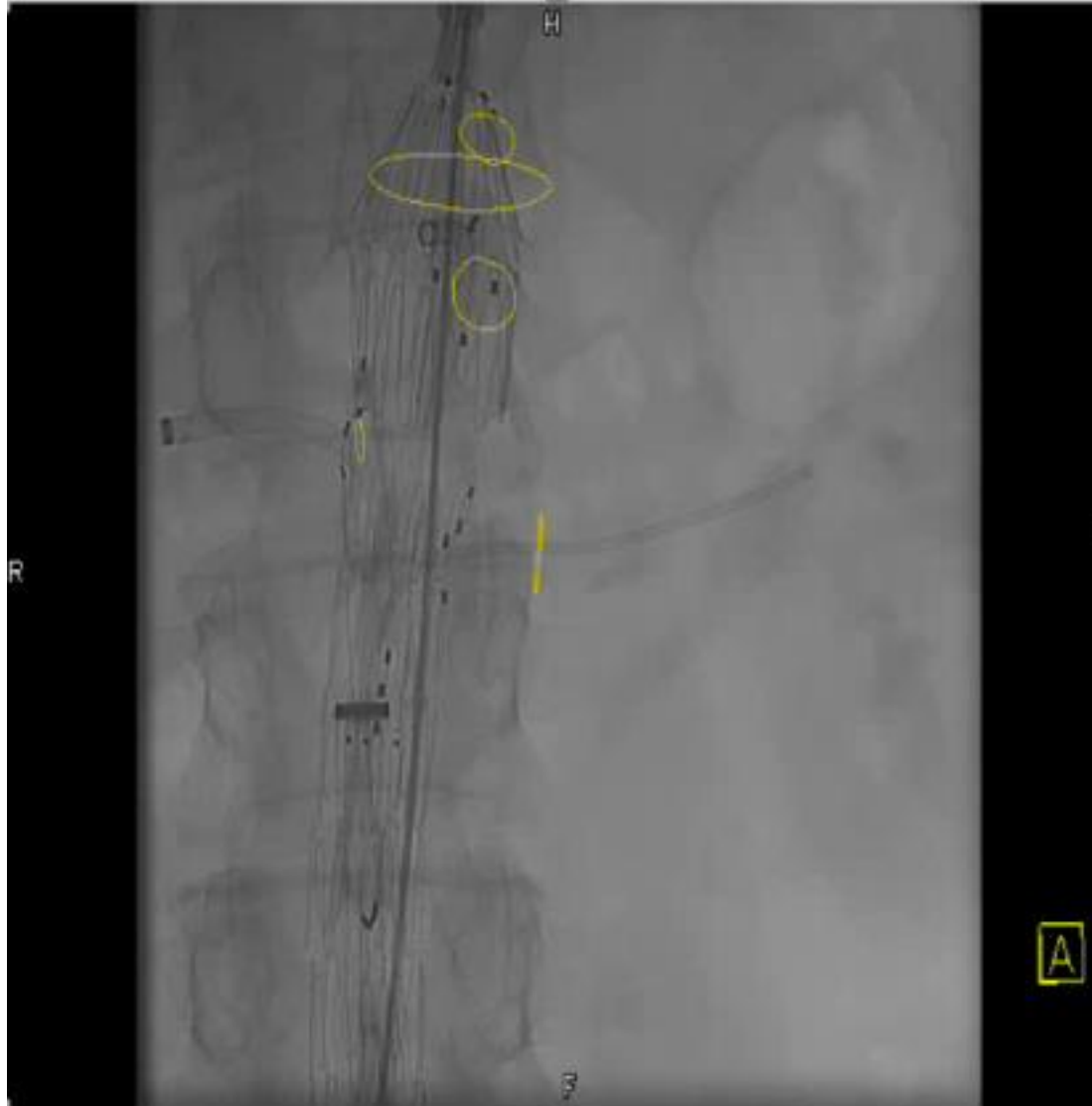
**Treatment (endovascular repair)**





*Aortic aneurysms*

**Treatment (endovascular repair)**

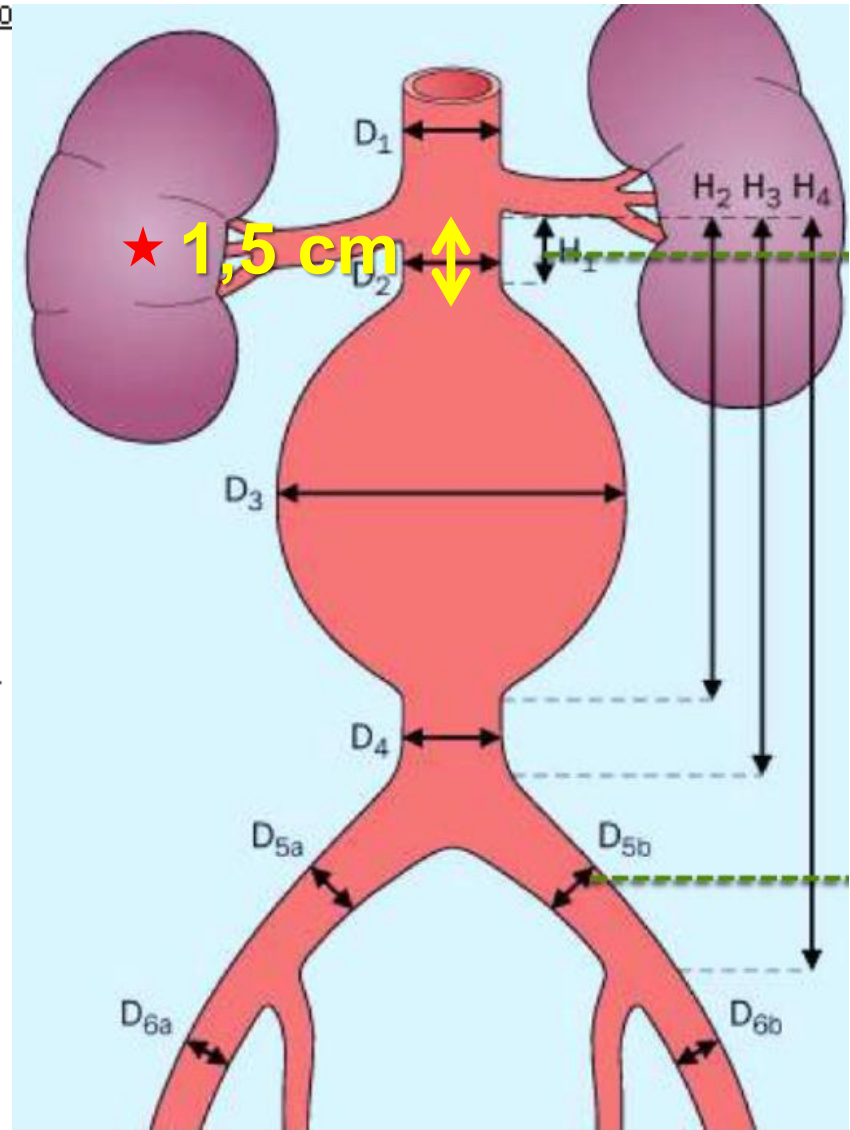


# Aortic aneurysms

## Treatment (endovascular repair) measurements

Measurements (mm) : measurements in bold are mandatory

D1 (suprarenal)	<b>H1 (infrarenal neck)</b>	_____
D2a (directly infrarenal)	H2 (left renal to distal end of aneurysm)	_____
D2b (mid portion of infrarenal)	H3 (left renal to bifurcation)	_____
D2c (junction of infrarenal neck and aneurysm)	H4L (left renal to distal right CIA)	_____
D3 (widest transverse)	H4R (left renal to distal left CIA)	_____
D3A (patent lumen diam.)	H5 (linear length from infrarenal to CIA)	_____
D3AP (widest AP diam.)		_____
D4 (distal neck)		_____
D5R (right CIA diam.)		_____
D5L (left CIA diam.)		_____





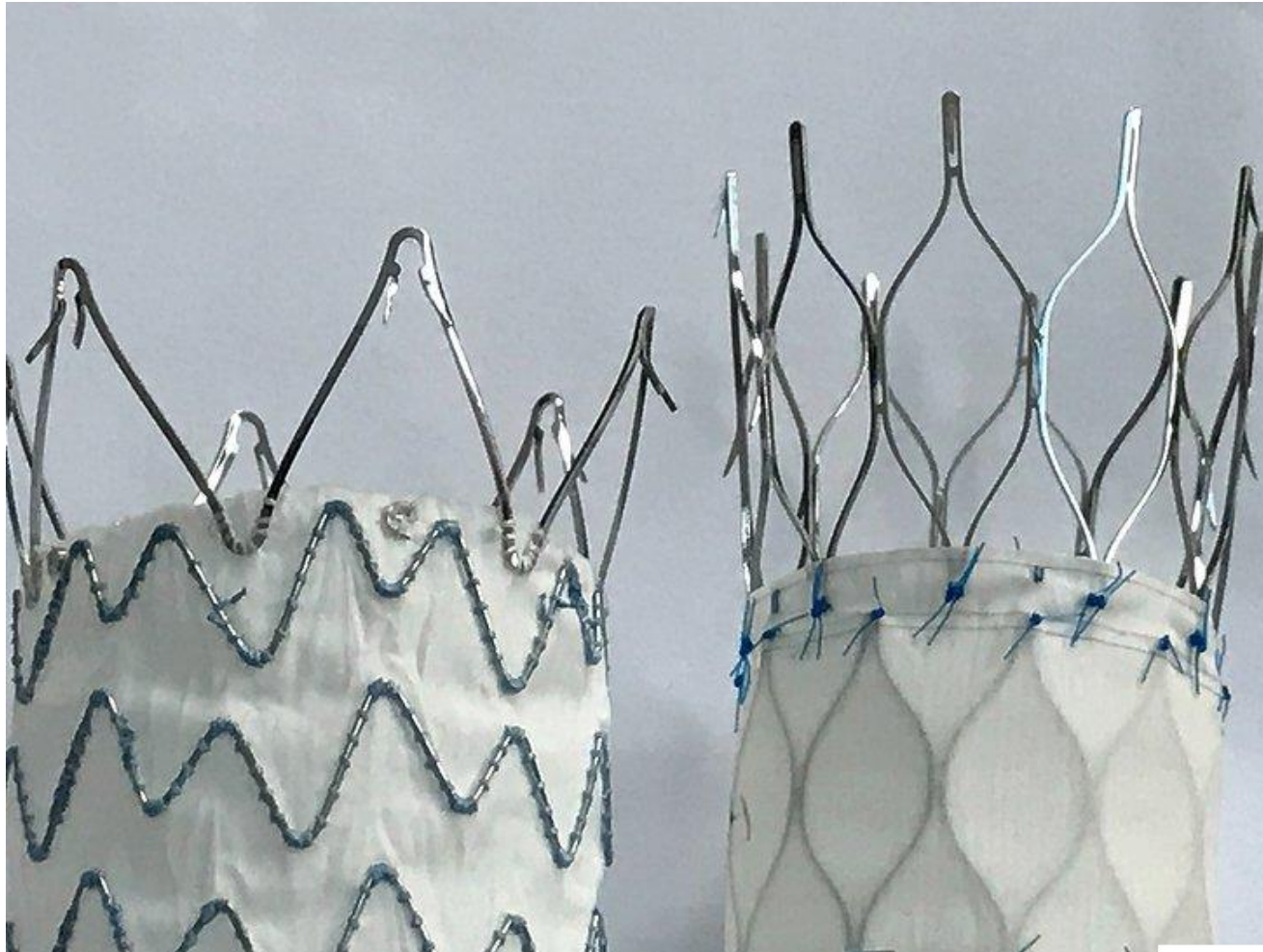
*Aortic aneurysms*

**Treatment (endovascular repair)**



*Aortic aneurysms*

**Treatment (endovascular repair)/suprarenal fixation**

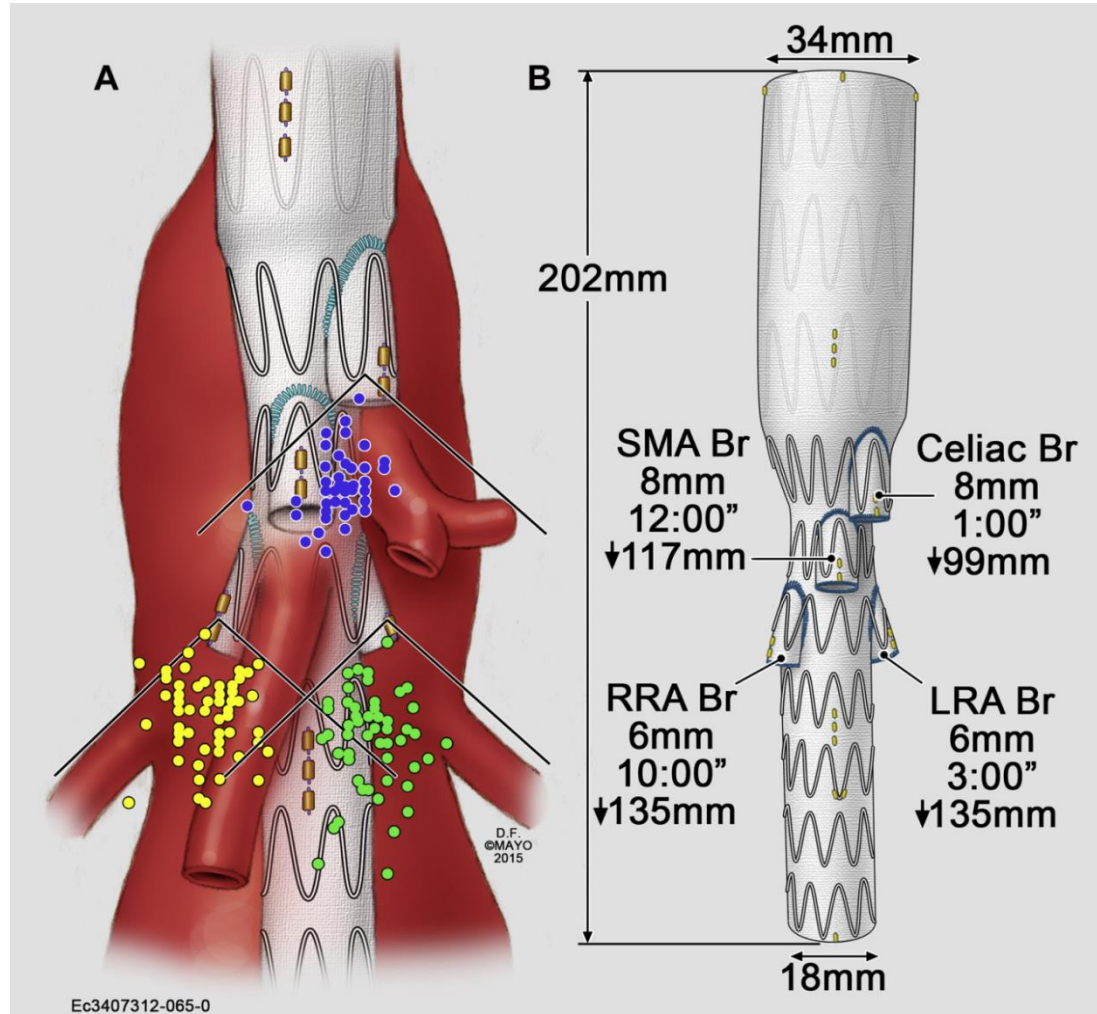


Endurant (Medtronic)

# Arterial Aneurysms

## Aortic aneurysms

### Treatment (endovascular repair)/suprarenal

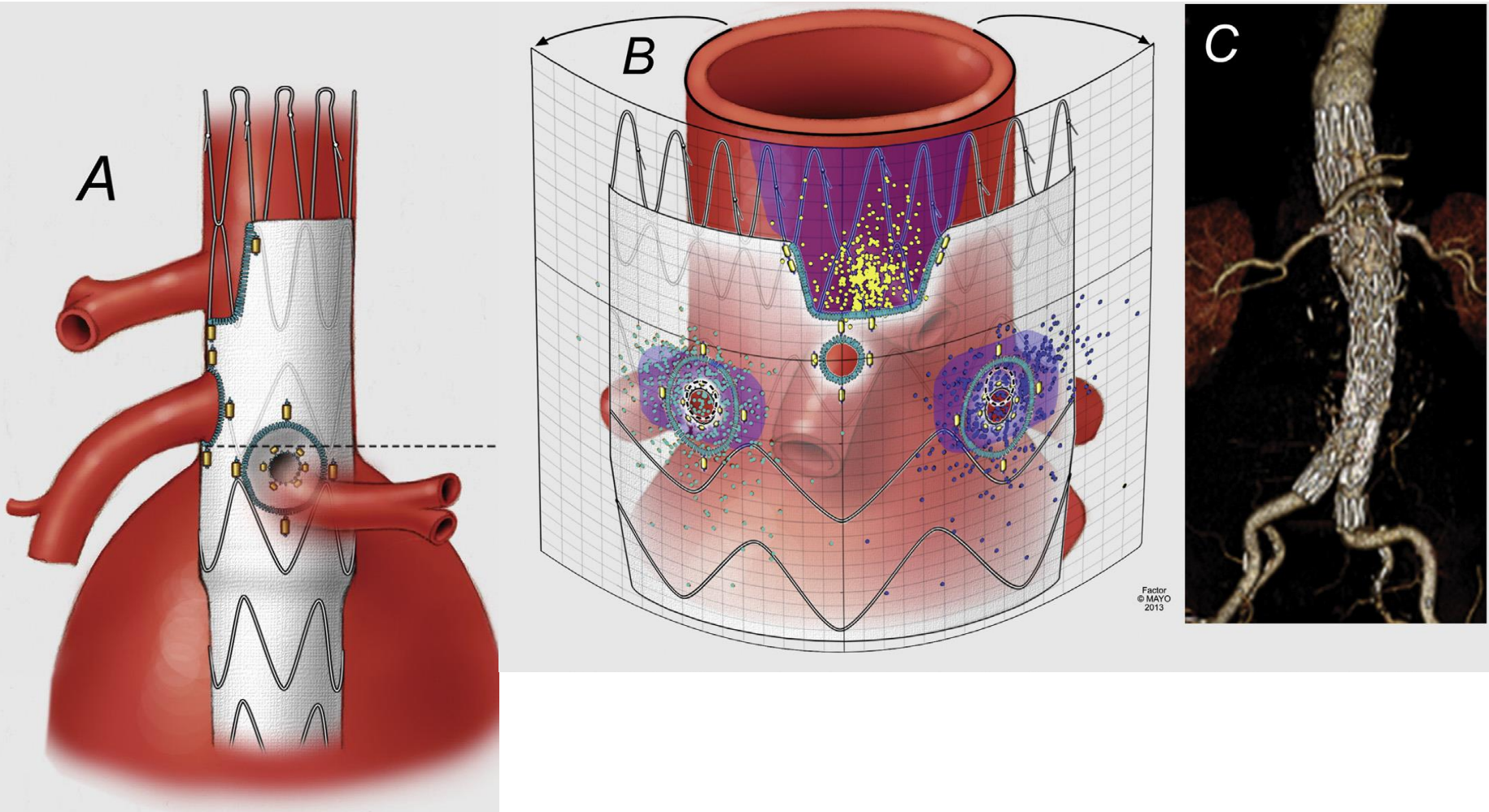




# Arterial Aneurysms

## Aortic aneurysms

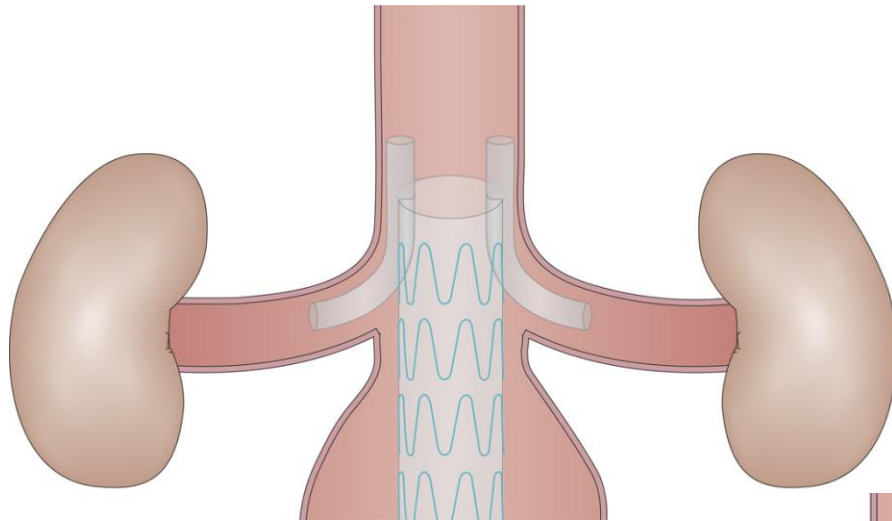
### Treatment (endovascular repair)/suprarenal



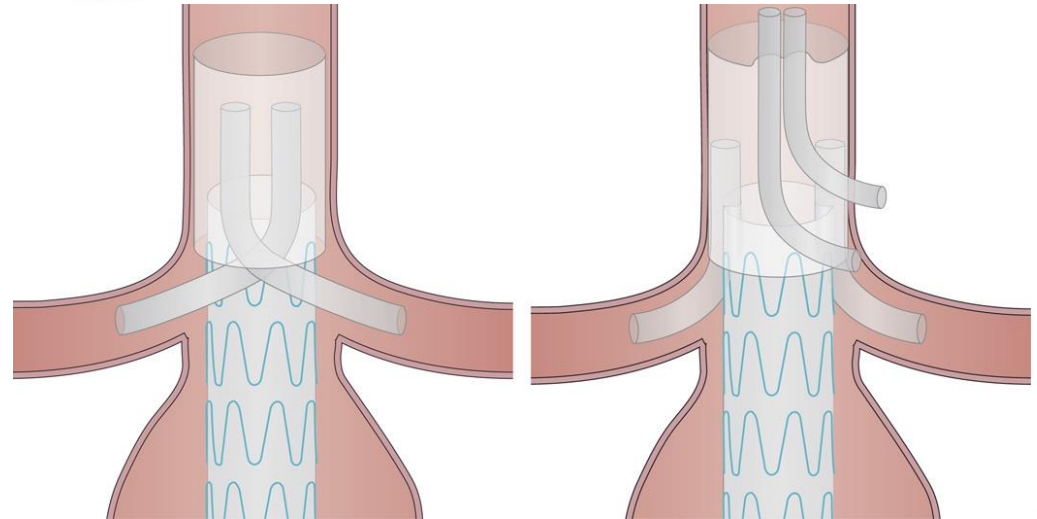
Arterial Aneurysms

Aortic aneurysms

Treatment (endovascular repair)/suprarenal



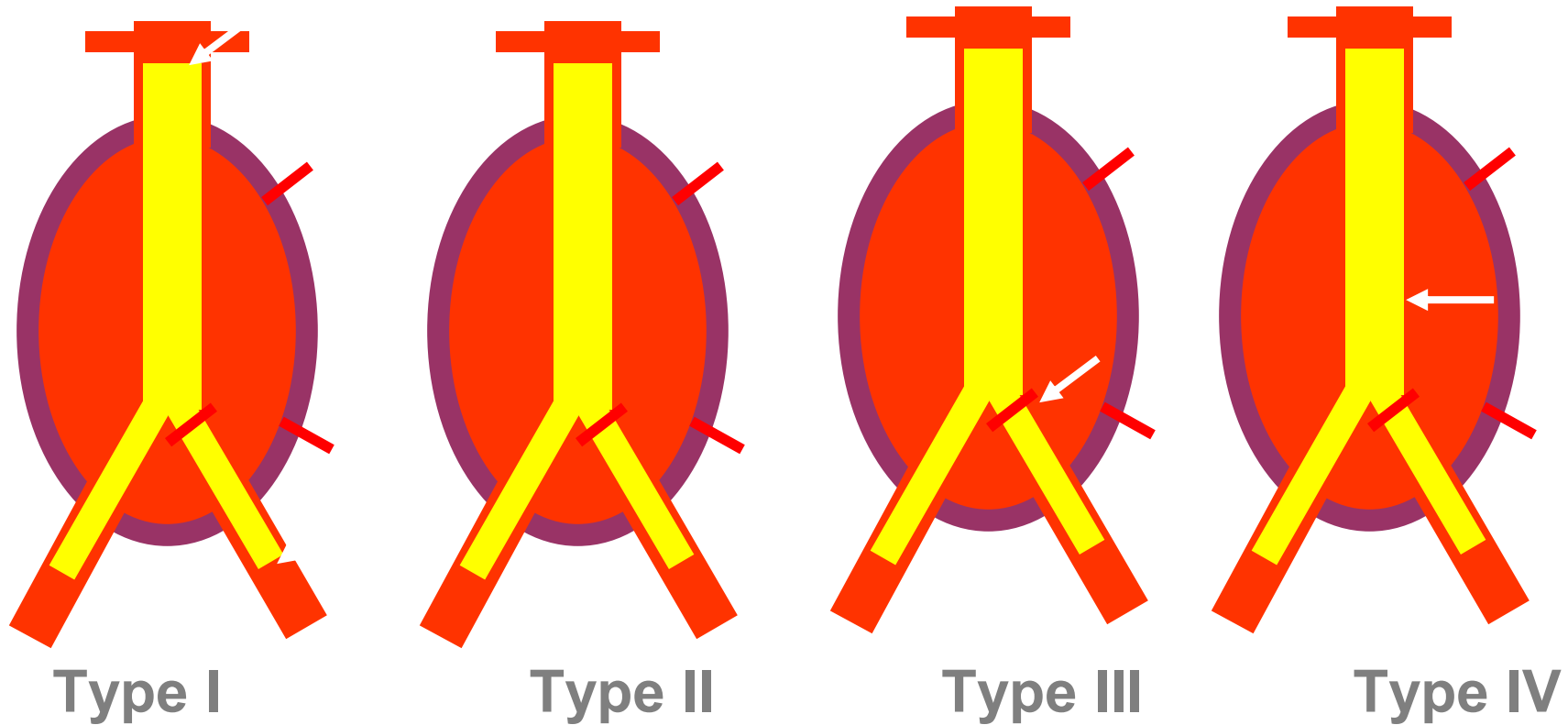
*chimneys*



*sandwich*

*Aortic aneurysms*

Endovascular treatment (endoleaks) ★



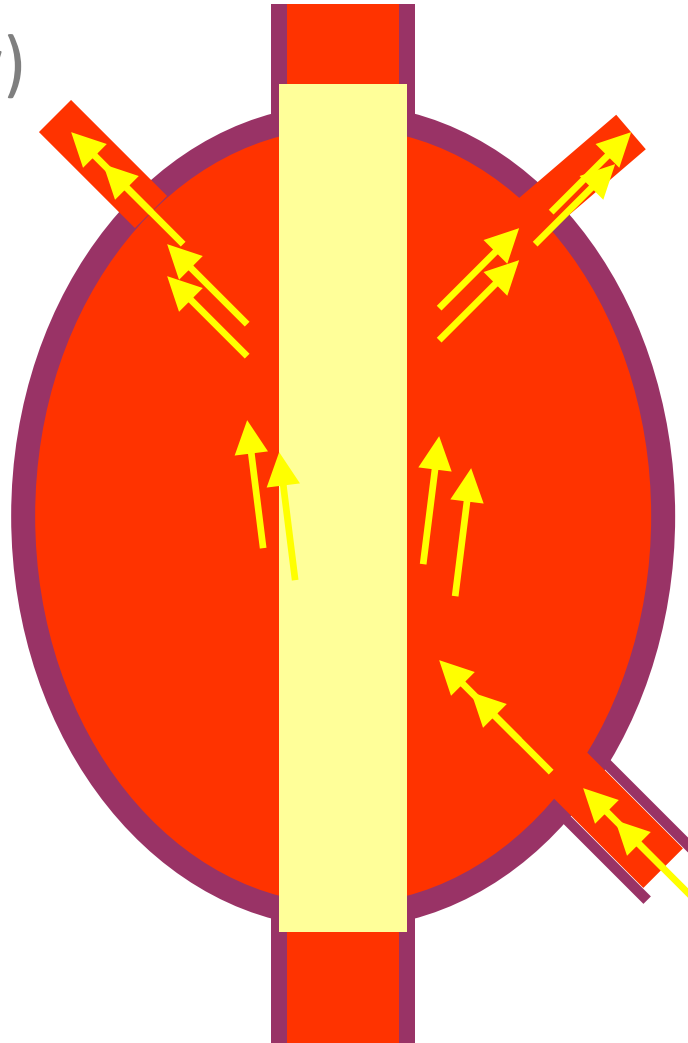


*Aortic aneurysms*

**Endovascular treatment (endoleaks)**

---

Leak (high flow)

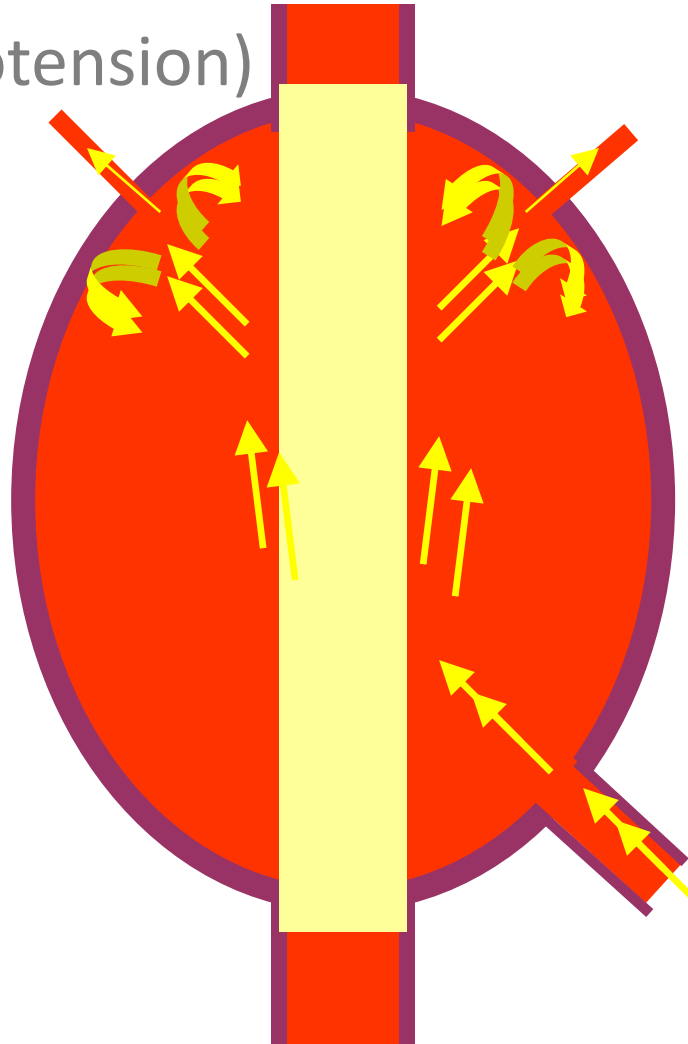


# Arterial Aneurysms

## Aortic aneurysms

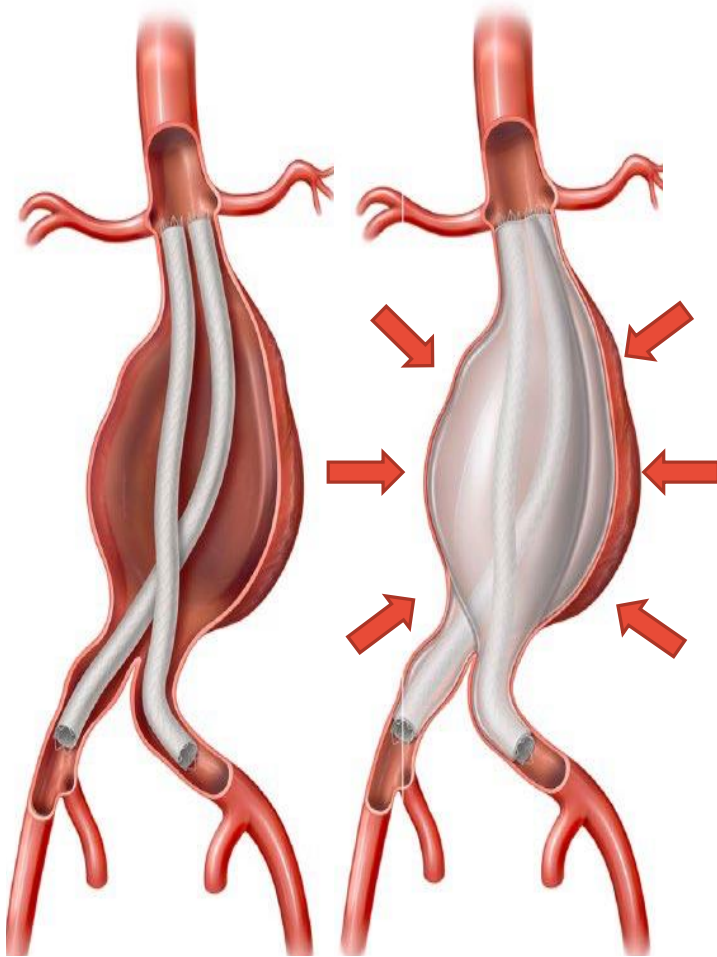
### Endovascular treatment (endoleaks)

virtual leak (endotension)



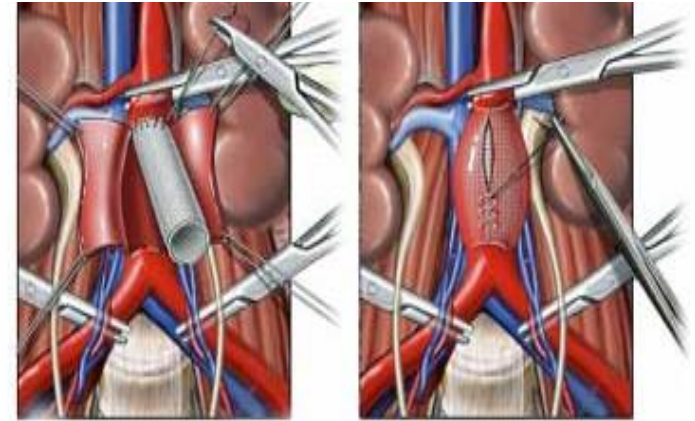
## Aortic aneurysms

### Endovascular treatment (endovascular sealing)



### Active aneurysm sac management

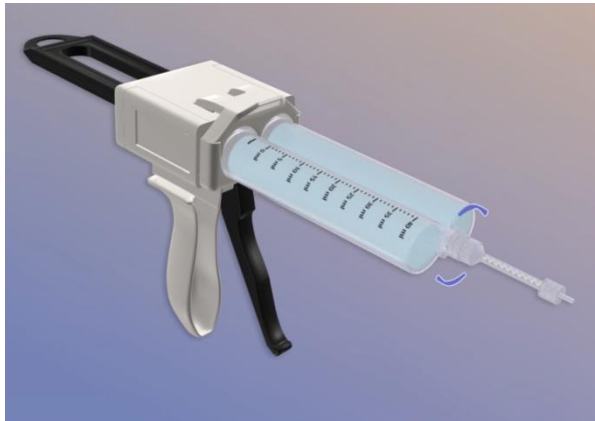
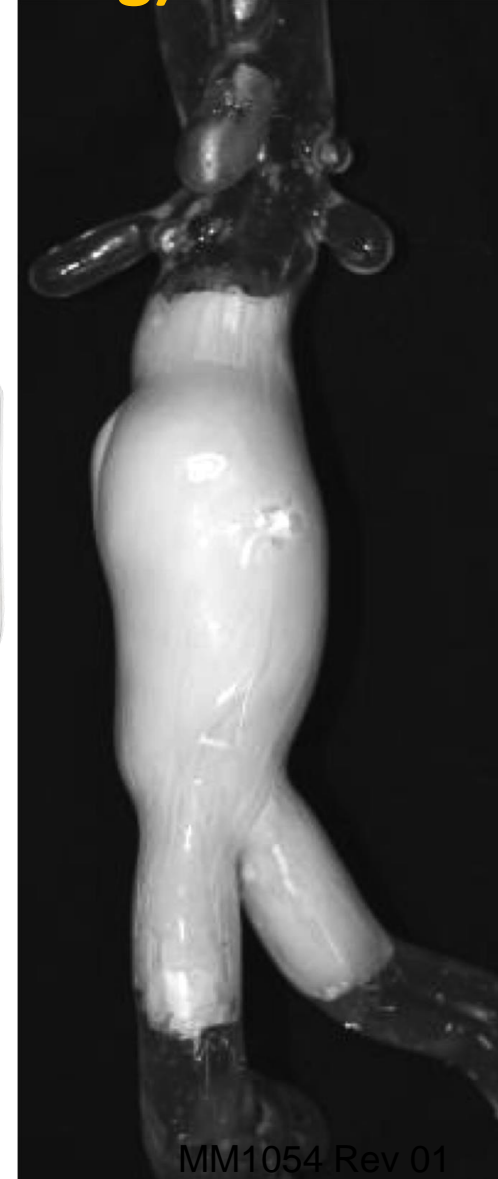
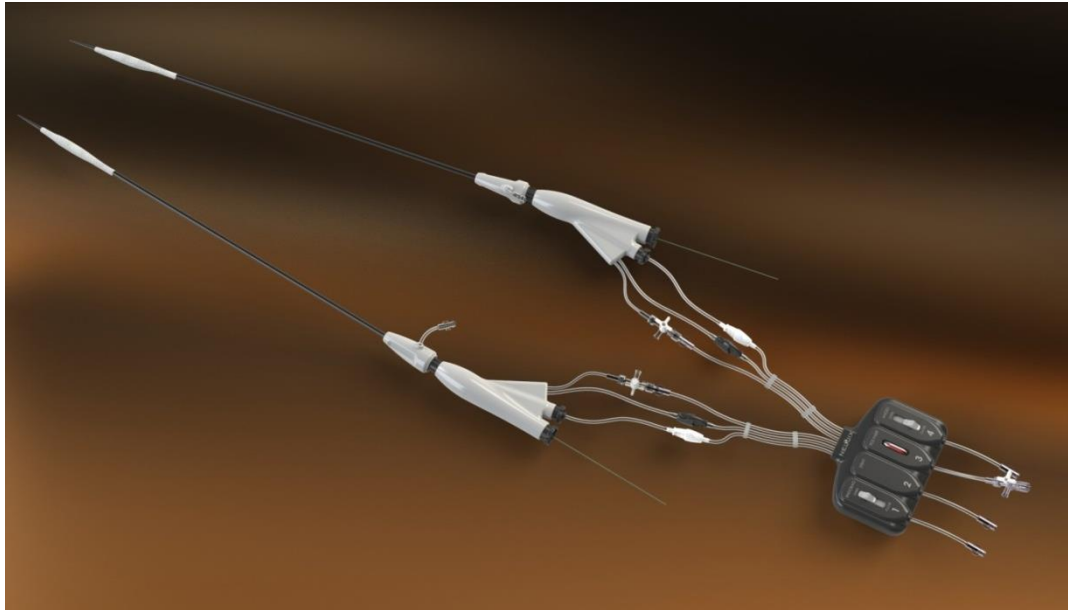
- Designed to mitigate all types of endoleaks



# Arterial Aneurysms

## Aortic aneurysms

### Endovascular treatment (endovascular sealing)



## Aortic aneurysms

### Endovascular treatment (endovascular sealing)

ADVANCE 17Fr  
CATHETERS



Evacuate endobags  
and visualize  
anatomy

ALIGN AND  
EXPAND STENTS



Establish  
stent flow  
lumens

PREFILL TO  
180MMHG



Angiographically  
confirm seal; aspirate

POLYMER FILL TO  
180MMHG



Angiographically  
confirm seal;  
remove delivery

## Arterial Aneurysms

### Aortic aneurysm

### Results (open surgery vs endovascular repair)

Follow-up (5 years)	endovascular	Open surg.	Odds ratio	p
Myocardial infarction	6,8	9,2	0,73	<0.001
Renal failure	5,3	10,4	1,05	0.9
Ictus	2,4	1,9	1,28	0.36
Reinterventions	28,9	25.5	2,08	0.003
Aneurysm rupture	2.0	0.3	5,94	<0.001



# Aortic aneurysms

## Arterial Aneurysms

### Treatment (endovascular)

#### infrarenal aorta results (studies)

	★	<b>EUROSTAR</b>	<b>LIFELINE</b>	<b>DREAM</b>	<b>EVAR</b>	<b>OVER</b>
study type		Registry	Registry	EPA	EPA	EPA
number of patients		1,190	2,664	351	1,252	881
aneurysm size		>4 cm	>4.5 cm	>5 cm	>5.5 cm	>5 cm
recruitment		1996- 1999	1998- 2003	2000- 2003	1999- 2004	2002- 2008
mean follow-up		3 years	3 years	4 years	6 years	1.8 years

# Aortic aneurysms *Arterial Aneurysms*

## Treatment (endovascular)

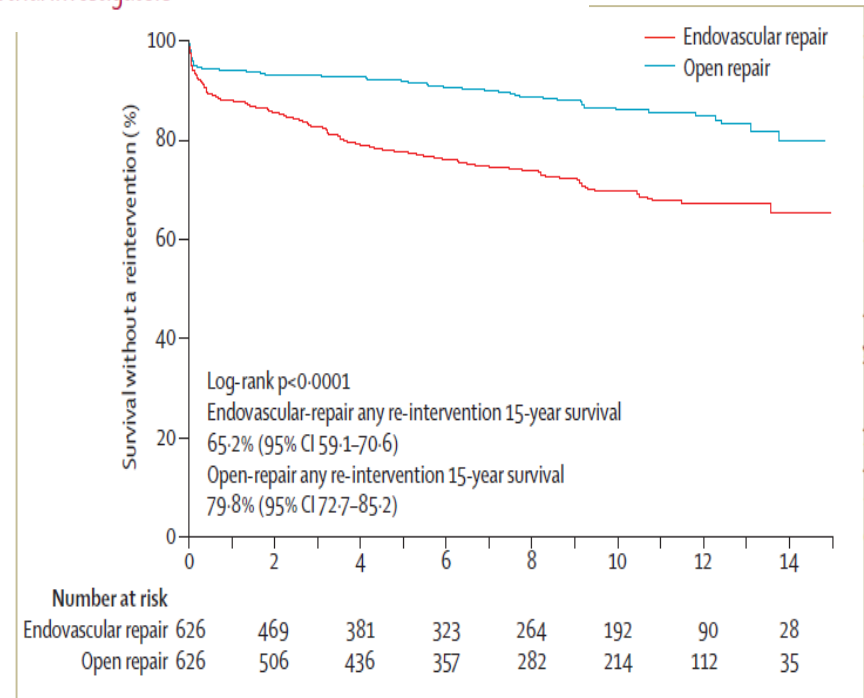
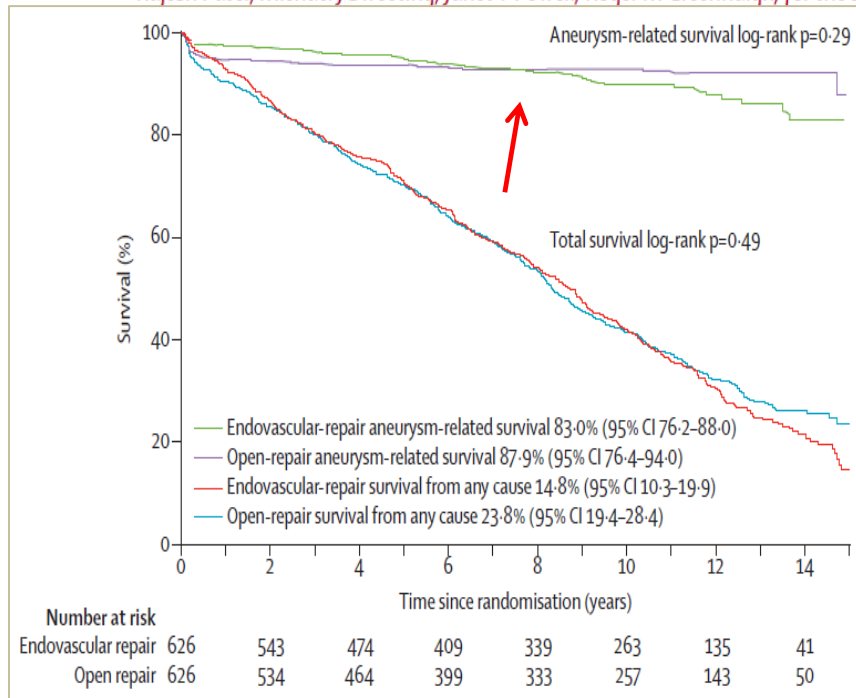
### infrarenal aorta results (studies)

	★	EUROSTAR	DREAM	EVAR		OVER	
		EVAR open	EVAR	open	EVAR	open	EVAR
mortality (30 days) (%)	2.9	4.6	1.2	6	2.3	3	0.5
aneurysm-related late mortality (%)	3	5.7	2.1	1.2	1	3	1.4
systemic complications (%)	12.9	10.9	3.5	NA	NA	4.6	4.1
aneurysm-related complications (%)	28	8.6	16.4	2.5	12.6	11.7	13.1
reintervention rate (%)	14	5	13	1.7	5.1	12.5	13.7

### Treatment (endovascular)

★ Endovascular versus open repair of abdominal aortic aneurysm in 15-years' follow-up of the UK endovascular aneurysm repair trial 1 (EVAR trial 1): a randomised controlled trial

Rajesh Patel, Michael J Sweeting, Janet T Powell, Roger M Greenhalgh, for the EVAR trial investigators\*



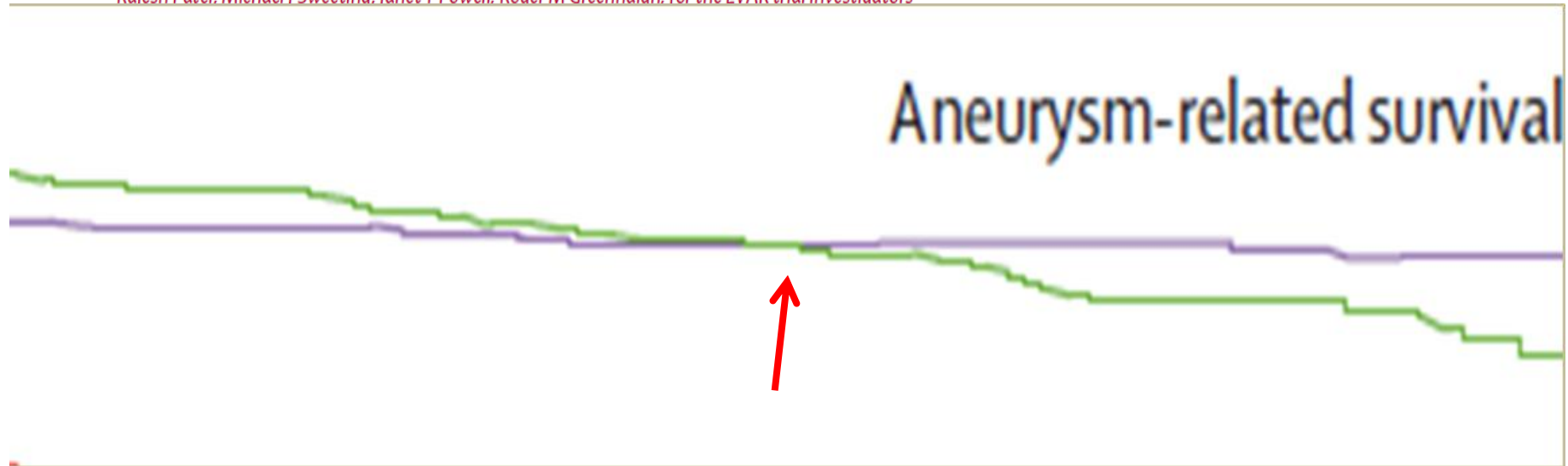
# Aortic aneurysms

## Arterial Aneurysms

### Treatment (endovascular)

- ★ Endovascular versus open repair of abdominal aortic aneurysm in 15-years' follow-up of the UK endovascular aneurysm repair trial 1 (EVAR trial 1): a randomised controlled trial

Raiesh Patel, Michael I Sweetina, Janet T Powell, Roaer M Greenhalah, for the EVAR trial investigators\*



***“EVAR has an early survival benefit but an inferior late survival compared with open repair, which needs to be addressed by lifelong surveillance of EVAR and prompt re-intervention if necessary.”***

## Aortic aneurysms (endovascular treatment)

- hybrid rooms
- endoprosthesis
- infrarenal aneurysms
- juxtarenal and suprarenal aneurysms
- indications
- complications
- results
- ruptured aneurysm



## Aortic aneurysms

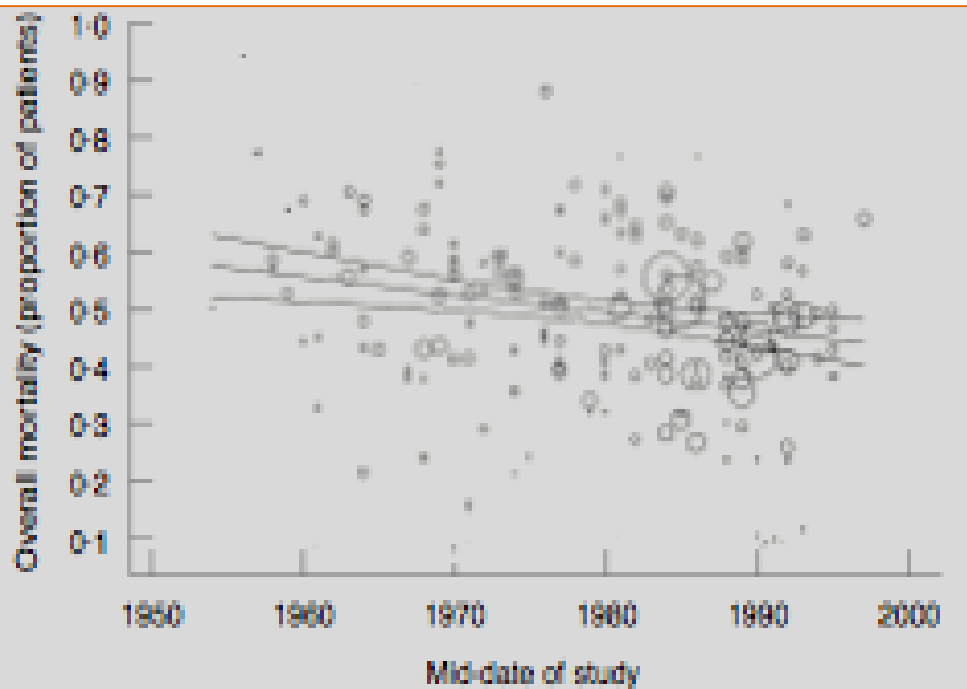
### Ruptured aneurysms (open surgery)

Vascular Surgical Society

## A meta-analysis of 50 years of ruptured abdominal aortic aneurysm repair

M. J. Bown, A. J. Sutton\*, P. R. F. Bell and R. D. Sayers

Departments of Surgery and \*Epidemiology and Public Health, University of Leicester, Leicester, UK



meta-analysis of 171 papers  
21,523 patients, 1955-1988  
decrease in operative  
mortality  
3.5%/decade

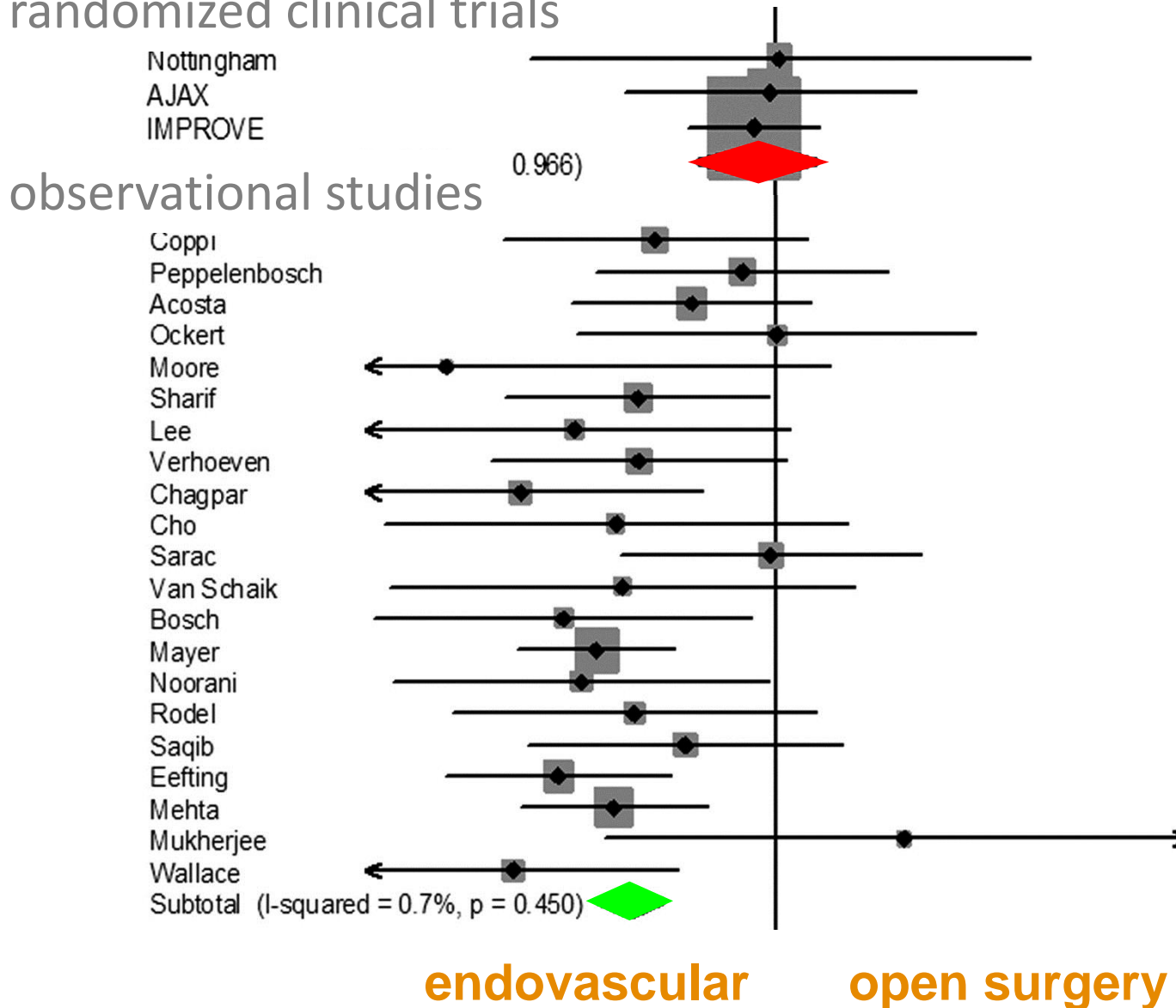
**operative mortality 48%**

*Brown MJ, J Surg. 2002; 89:714-30*



# Aortic aneurysms *Arterial Aneurysms*

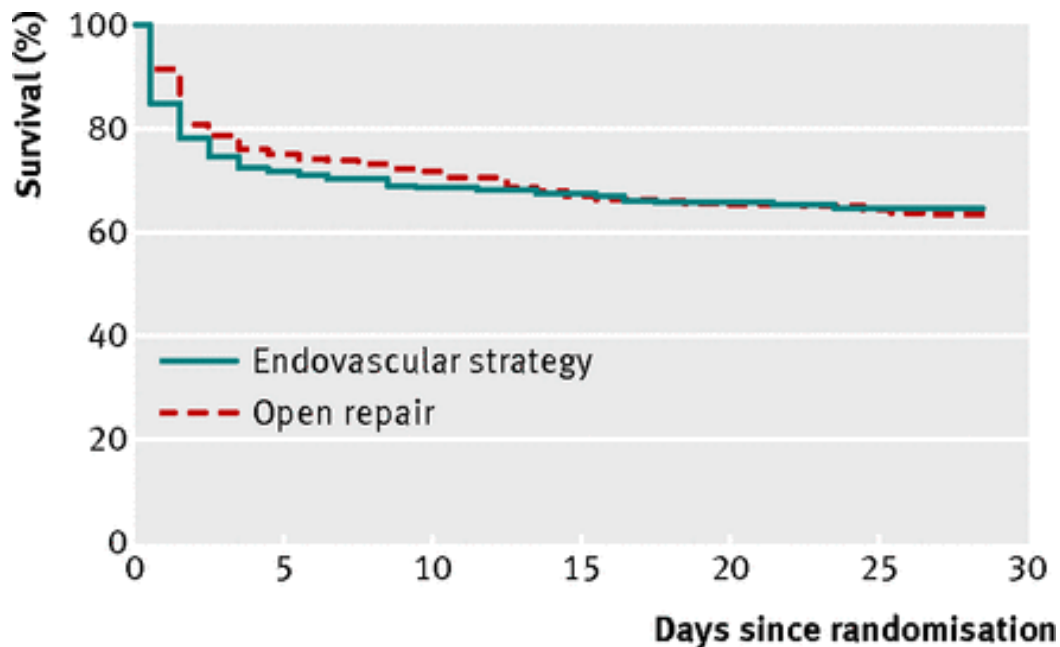
## Ruptured aneurysms (open vs endovascular surgery) randomized clinical trials



# Aortic aneurysms

## Ruptured aneurysms (open vs endovascular surgery)

Endovascular or open repair strategy for ruptured abdominal aortic aneurysm: 30 day outcomes from IMPROVE randomised trial



**No at risk**

Endovascular strategy

316    227    217    213    207    205    204

Open repair

297    223    214    199    194    191    188

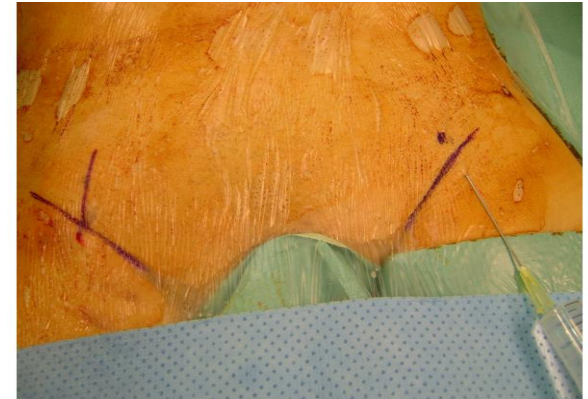
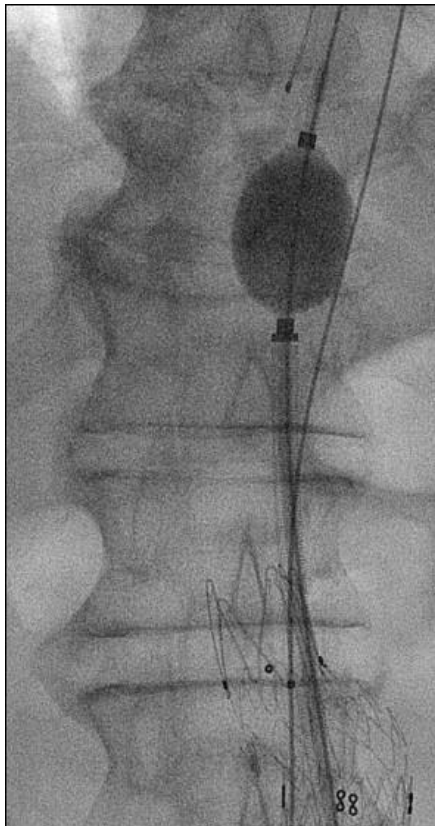
IMPROVE col. BMJ 2014; 348:f7661

# Aortic aneurysms

## Ruptured aneurysms (open vs endovascular surgery)★

permissive hypotension

aortic balloon



local anesthesia

abdominal decompression

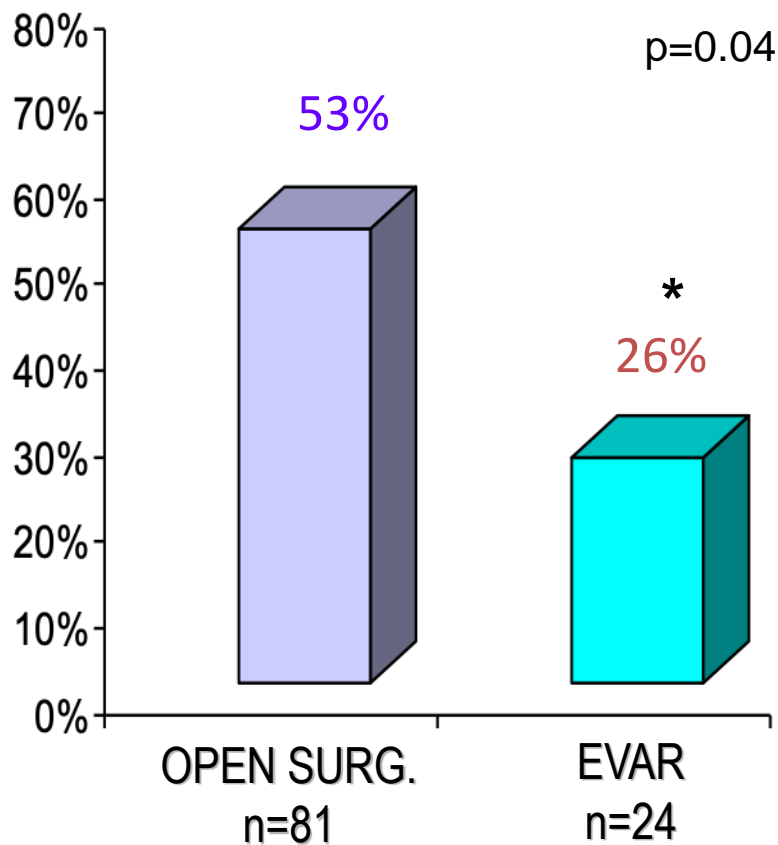


# Aortic aneurysms

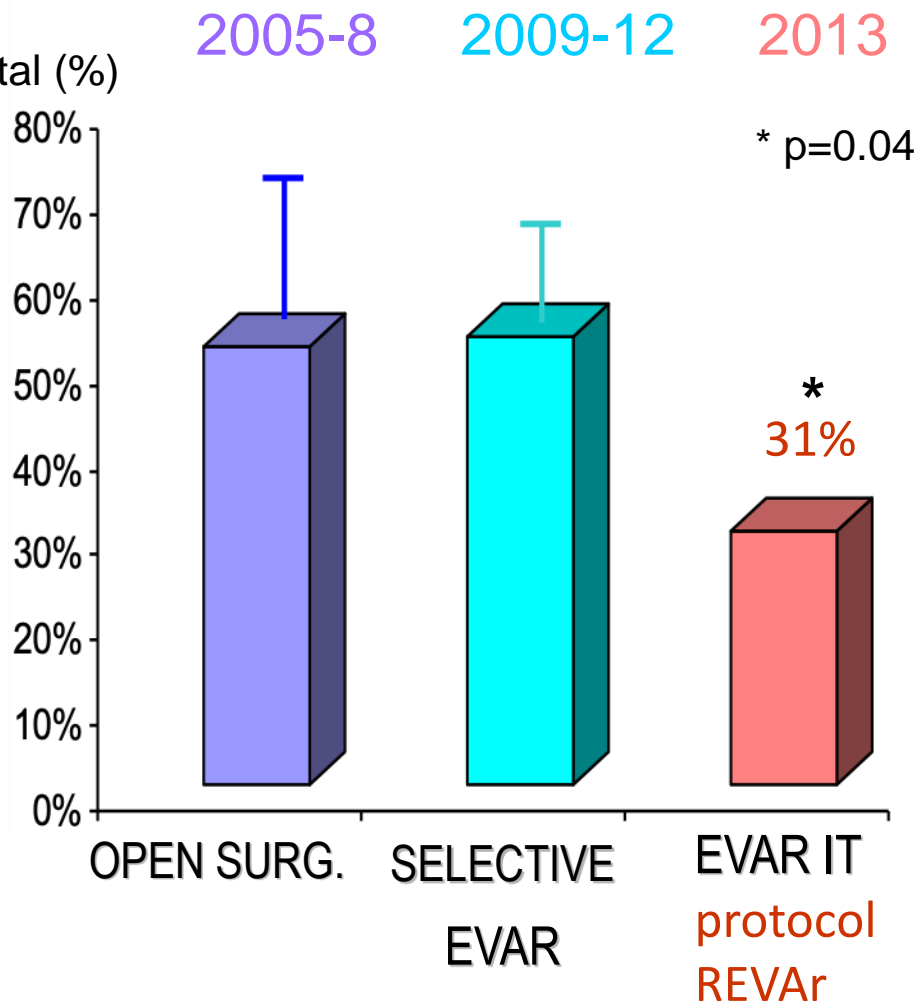
## Ruptured aneurysms (open vs endovascular surgery)

evolution rAAA 2006-20013 (n=105)

mortal (%)



mortal (%)



*Arterial aneurysm*

**problem case**

A 52-year-old patient with a history of smoking, hypertension and type-II diabetes who had received a heart transplant and whose father had died from the rupture of an aortic aneurysm.

After aortic dilatation is identified in an MRI for back pain, infrarenal AAA is confirmed in CT Angio. Maximum diameter is 5 cm, proximal neck is 1.5 cm, and the iliac arteries are neither dilated nor tortuous.

## *Arterial aneurysm*

### **Problem case**

All past-history data for this patient have been linked to the formation or growth of abdominal aortic aneurysms, **EXCEPT** for:

- a) Smoking
- b) Hypertension
- c) Heart transplantation
- d) Diabetes mellitus
- e) Family history



## *Arterial aneurysm*

### **Problem case**

Which therapeutic option would you advise for this patient?

- a) Annual monitoring with ultrasonography
- b) Endovascular repair
- c) Open repair
- d) Annual follow-up with CT Angio
- e) None of the above

