Cause et management des anévrisme de l'aorte abdominal (AAA).

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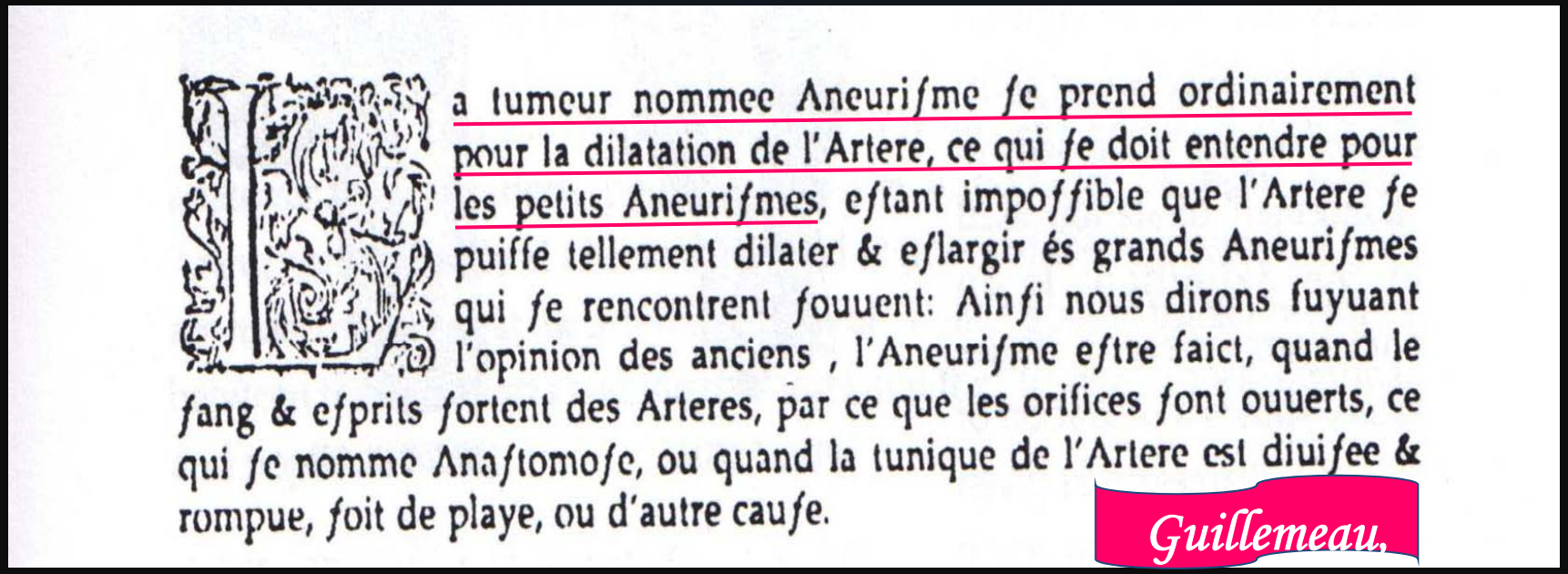
Abdominal Aortic Aneurysm

- 13th leading cause of death in the U.S.
- Most common in men >65 years
- AAA causes 1.3% of all deaths among men aged 65–85 years in developed countries
- Most abdominal aneurysms are asymptomatic until rupture

Kniemeyer HW, et al. *Eur J Vasc Endovasc Surg*. 2000;19:190-196;
Gillum RF. *J Clin Epidemiol*. 1995;48:1289-1298; Sakalihasan N, et al. *Lancet*. 2005;365:1577-1589.

Définition de l'AAA



La tumeur nommee Aneuriſme ſe prend ordinairement pour la dilatation de l'Artere, ce qui ſe doit entendre pour les petits Aneuriſmes, eſtant impoſſible que l'Artere ſe puiſſe tellement dilater & eſlargir és grands Aneuriſmes qui ſe rencontrent ſouuent: Ainſi nous dirons ſuyuant l'opinion des anciens, l'Aneuriſme eſtre faict, quand le ſang & eſprits ſortent des Arteres, par ce que les orifices ſont ouuerts, ce qui ſe nomme Anaſtomoſe, ou quand la tunique de l'Artere est diuiſee & rompue, ſoit de playe, ou d'autre cauſe.

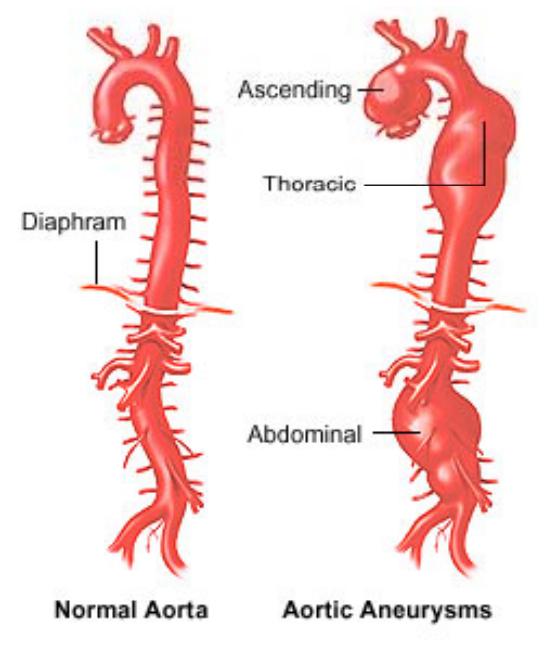
Guillemeau,

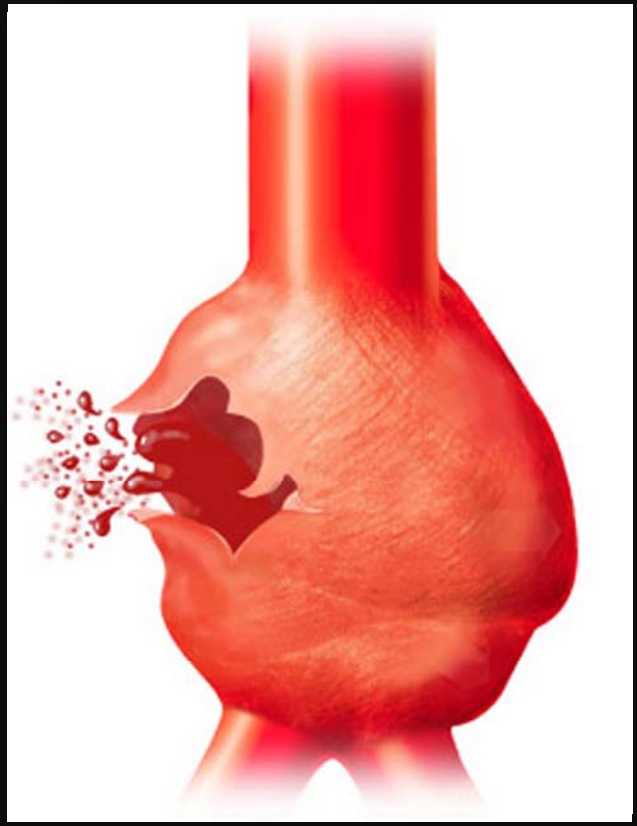
1632

diamètre aortique infrarénal ≥ 30 mm

Définition de l’ AAA

La dilatation irreversible d’un segment d’une artère

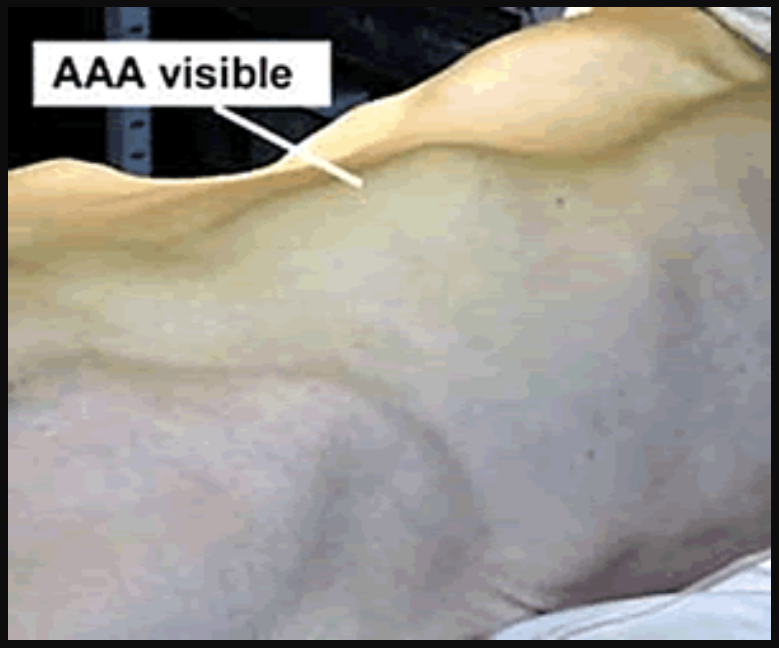




diamètre aortique infrarénal ≥ 30 mm

Abdominal Aortic Aneurysm
Diagnosis

- Usually asymptomatic
- Diagnosed incidentally during clinical exam



Sakalihasan N, et al. Lancet. 2005;365:1577-1589

Abdominal Aortic Aneurysm
Diagnosis

- Ultrasonography is the simplest and cheapest diagnostic procedure

Sakalihasan N, et al. Lancet. 2005;365:1577-1589

Abdominal Aortic Aneurysm
Diagnosis

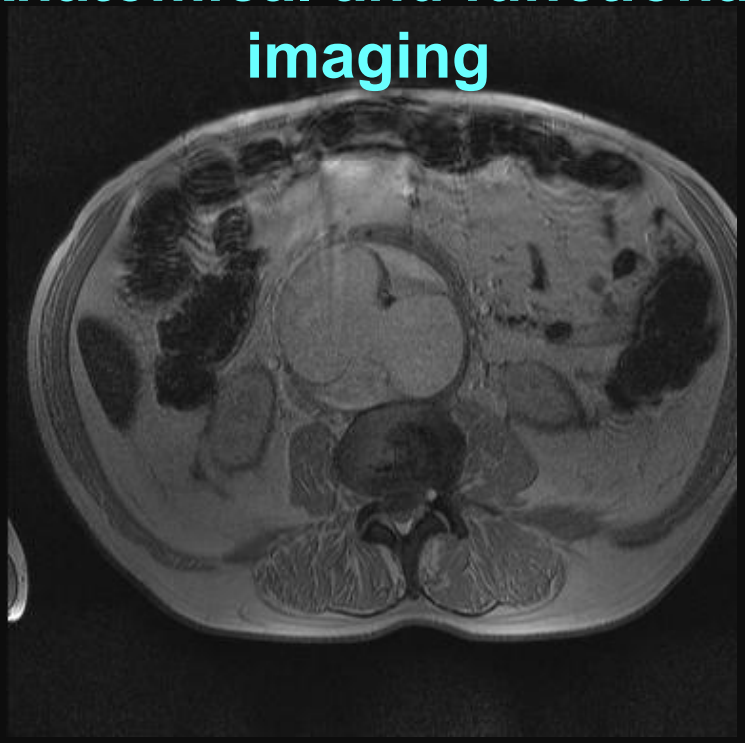
- CT scans helpful to determine surgical treatment - endovascular or open surgery

Sakalihasan N, et al. Lancet. 2005;365:1577-1589

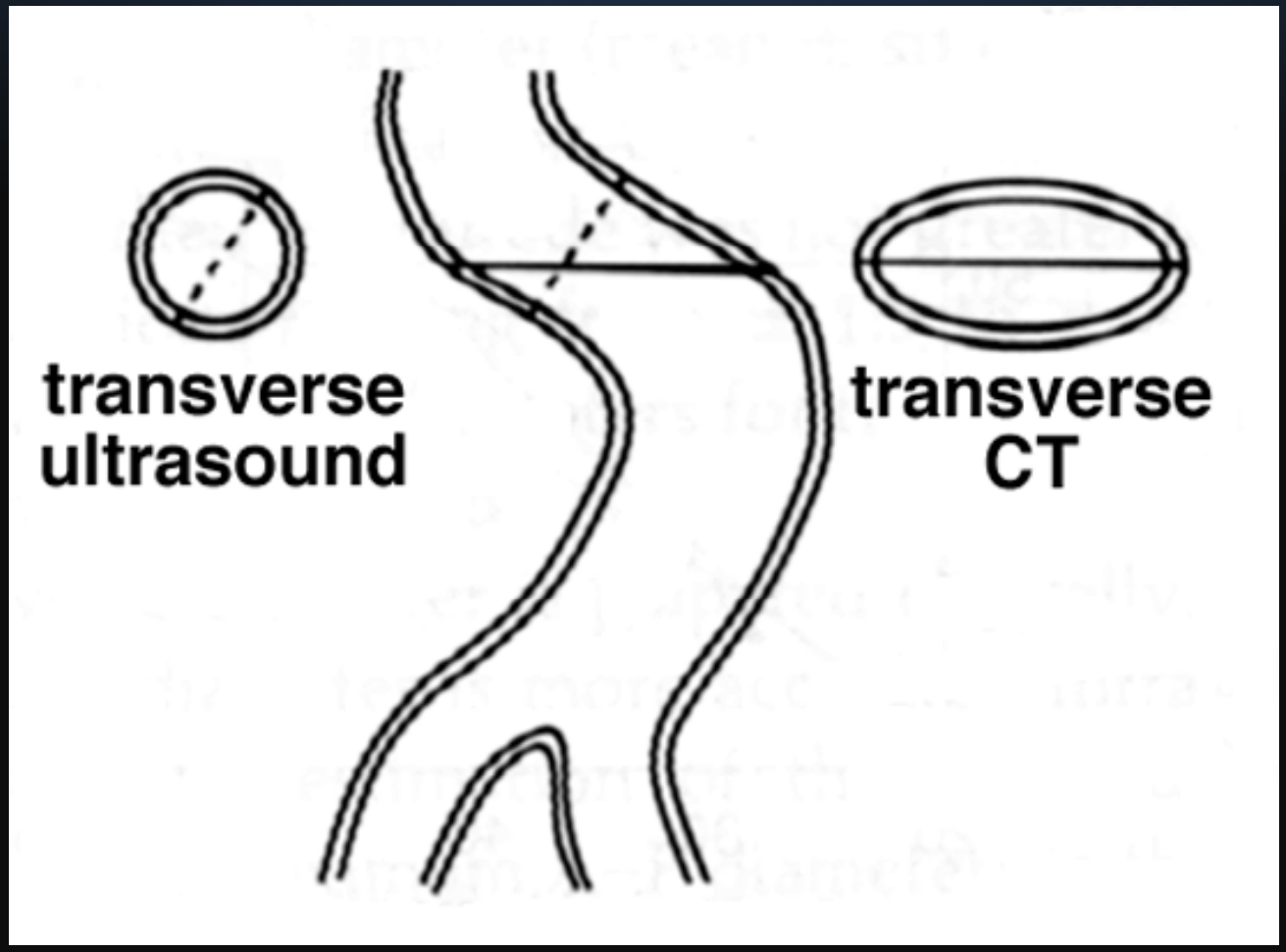
Abdominal Aortic Aneurysm
Diagnosis

- Magnetic Resonance Imaging

Anatomical and functional imaging

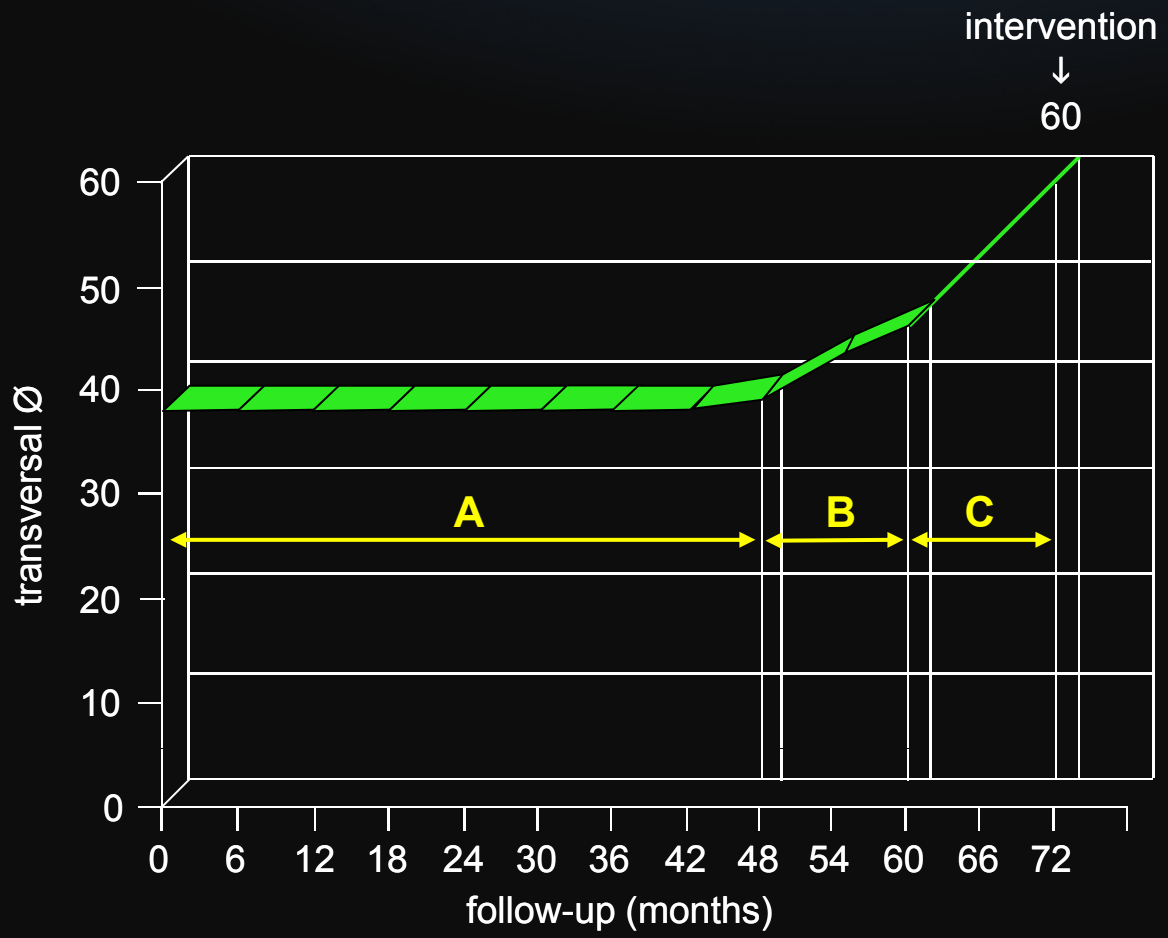


Nchimi A,….. Sakalihasan N, Radiology, 2010



The versatility of ultrasound.
from M Ellis et al : "The limitations of ultrasound in surveillance of small abdominal aortic aneuryms" ; edited by RM Greenhalgh & JA Mannick "The cause and management of aneurysms".

D.C. Fem. 74 years
INITIAL Ø : 38 mm - FINAL Ø : 60 mm



3 PHASES TYPES :

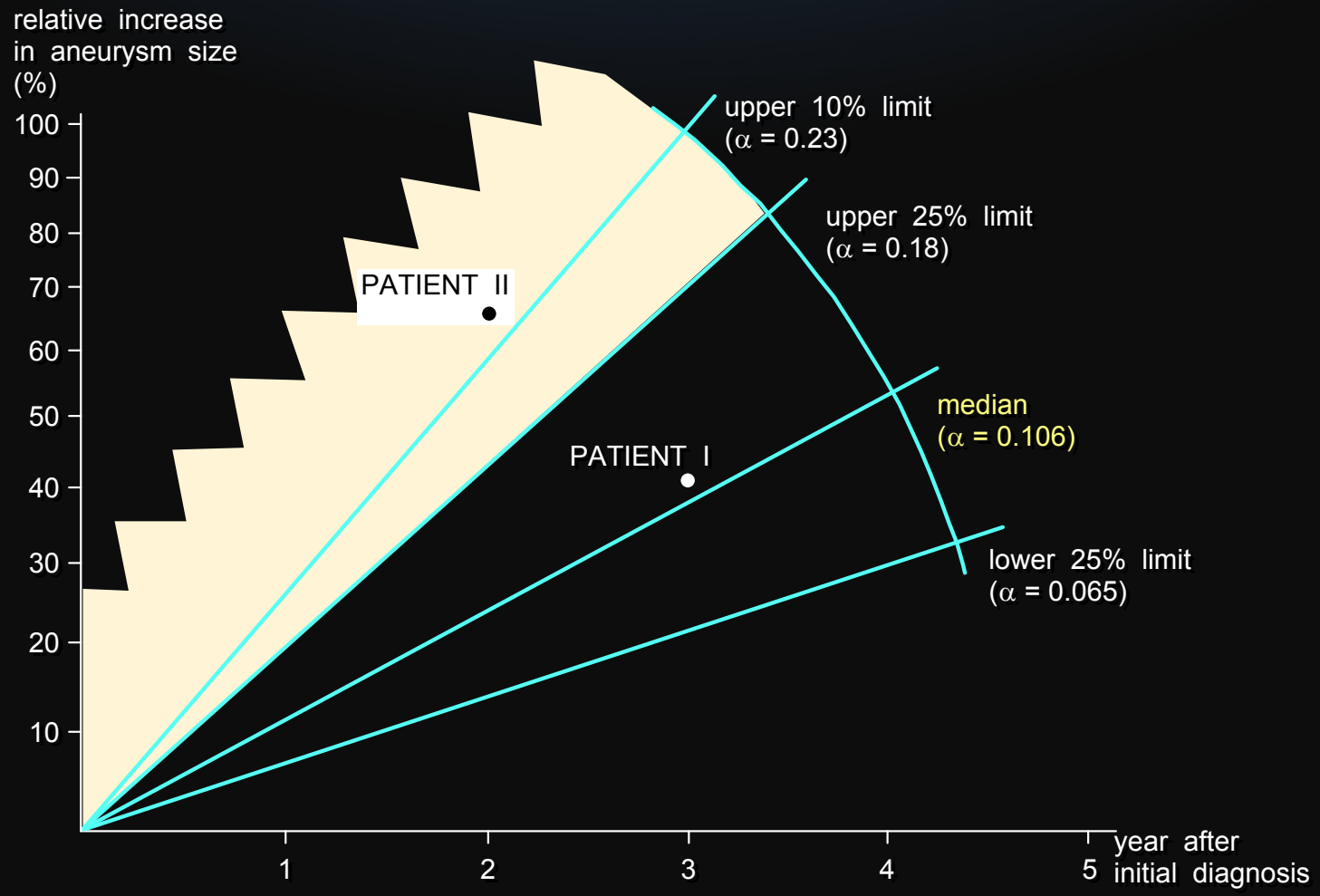
A. Stable Phase
(5 à 10 years)
Ø : 30 → 40

B. Critical Moment
(1 year)
Ø : 40 → 45

C. Accelaration Phase
?
Ø : 45 → +

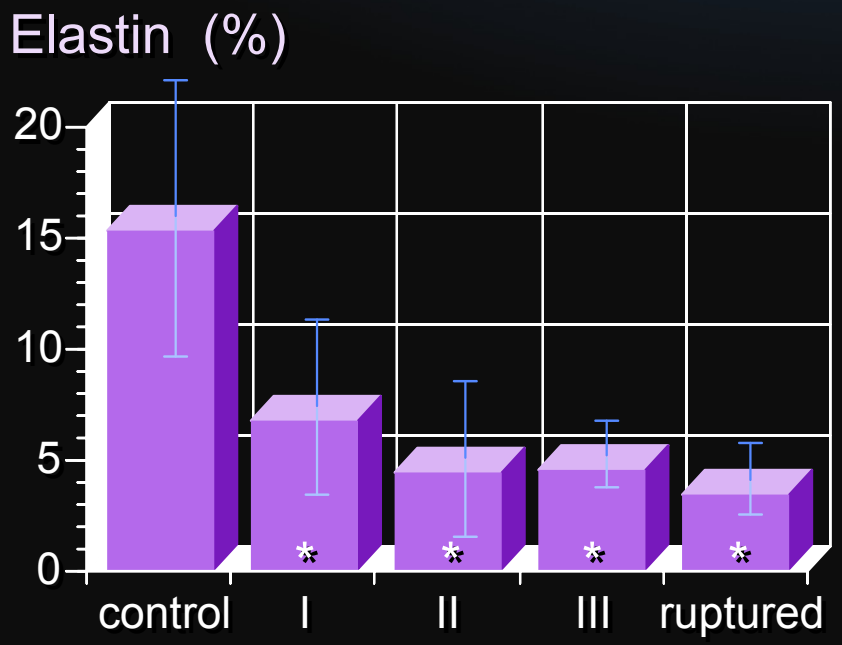
Determination of the expansion rate and incidence of rupture of abdominal aortic aneurysms.
R Limet, N Sakalihasan, A Albert, *J Vasc Surg 1991 ; 14 : 540-548*

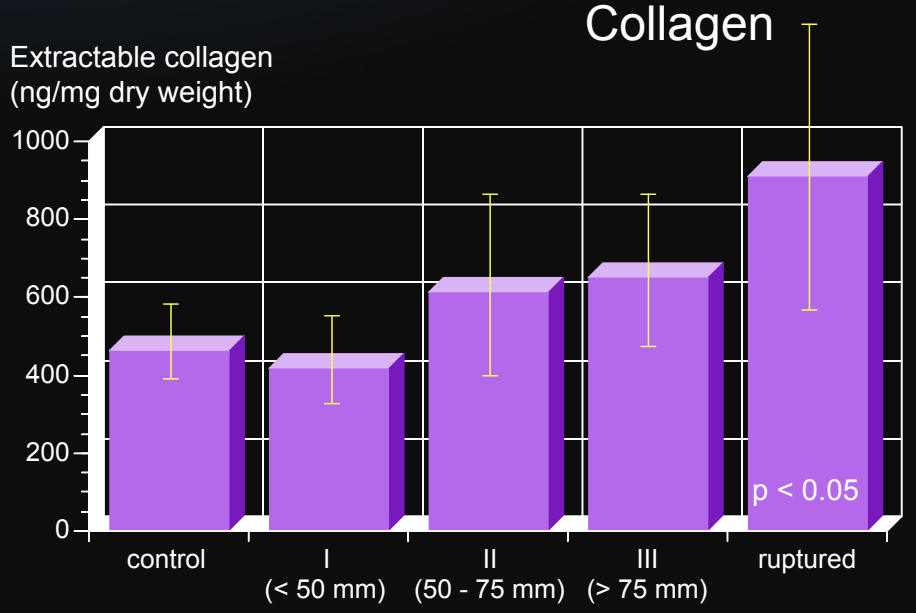
The risk of rupture is not exclusively determined by the size of the AAA but also by its growth rate

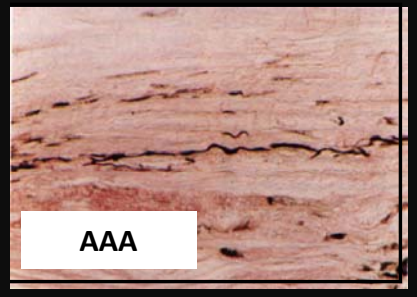


Determination of the expansion rate and incidence of rupture of abdominal aortic aneurysms.
R Limet, N Sakalihasan, A Albert, ***J Vasc Surg 1991;14:540-548***

MODIFICATIONS OF THE EXTRACELLULAR MATRIX OF ANEURYSMAL ABDOMINAL AORTAS AS A FUNCTION OF THEIR SIZE

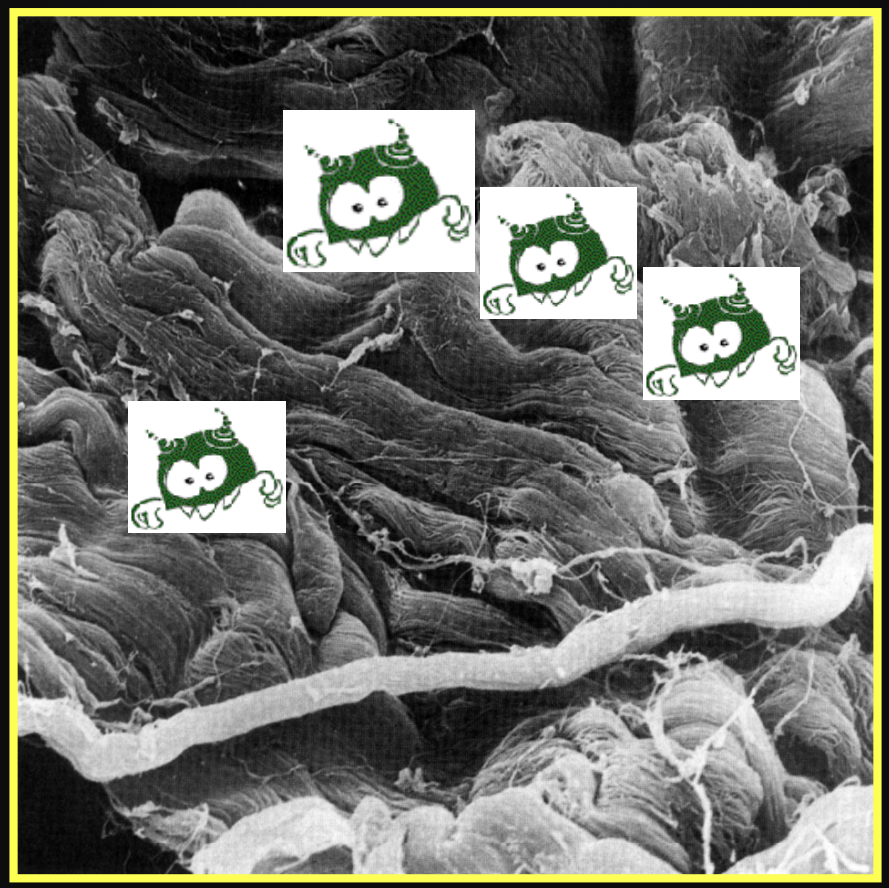




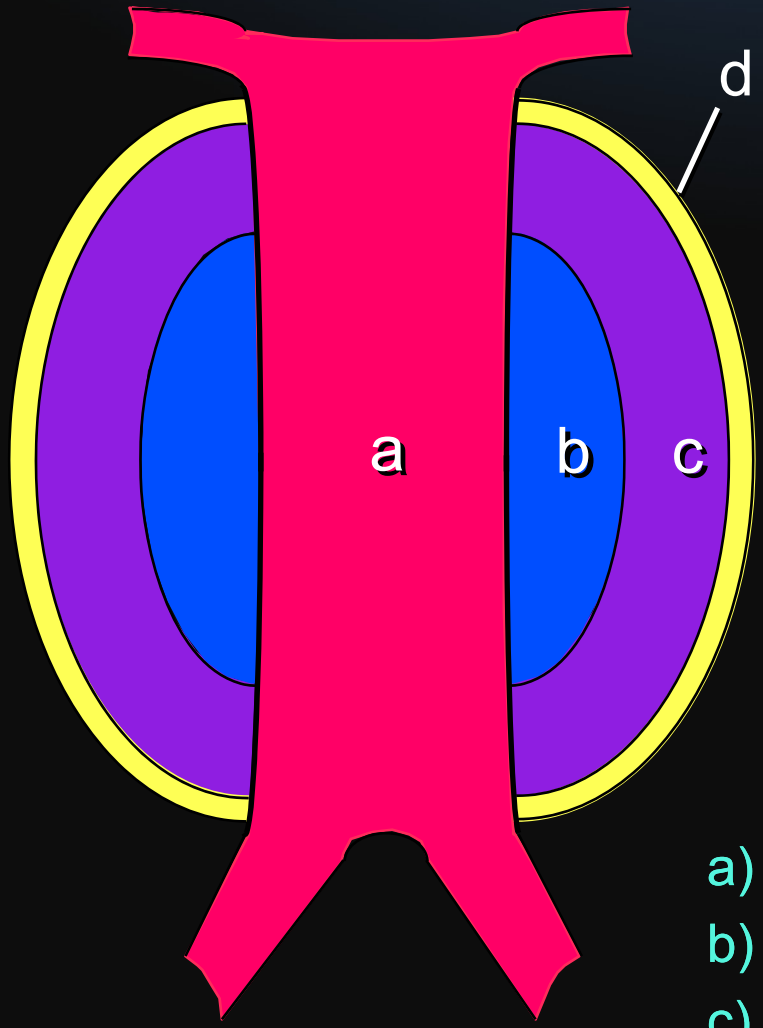


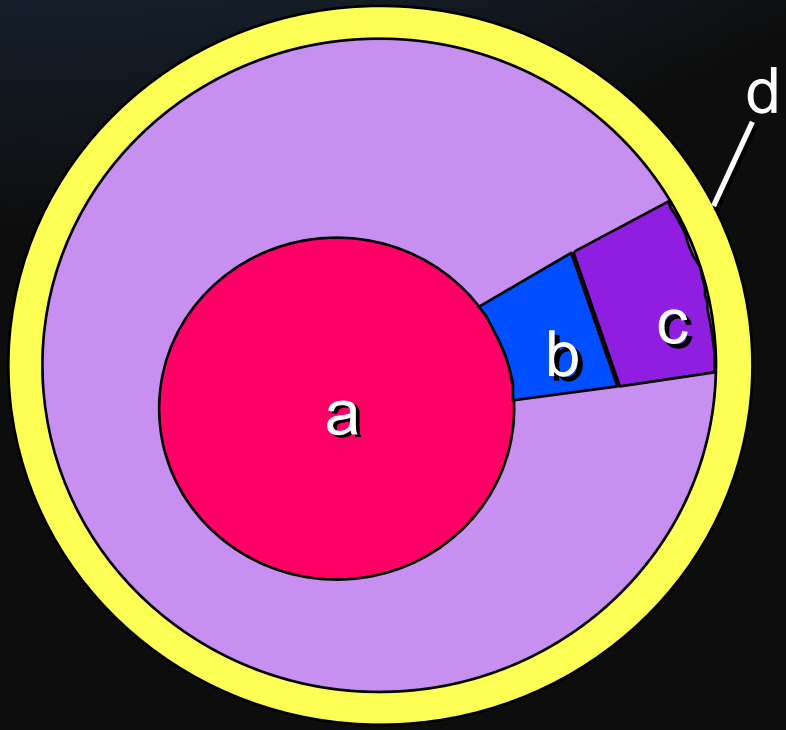
Sakalihasan et al, Eur J Vasc Surg 1993;7:633-637

Quel est le rôle des métallo-protéases dans le mécanisme de ces modifications ?

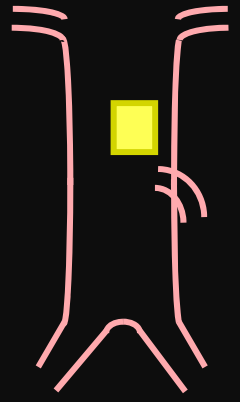


SOURCE OF THE POTENTIAL COLLAGENESES





a) Serum
b) Luminal thrombus
c) Parietal thrombus
d) Aortic wall



Activité des gélatinases dans l'aorte normale et anévrysmale évaluée par "soluble assay"

	sérum		échantillons tissulaires			
	contrôle	AAA	AAA			normal
			thrombus			
			luminal	pariétal	paroi aortique	paroi aortique
	n = 6	n = 10	n = 10	n = 10	n = 10	n = 6
72 kDa	1.6 ± 0.4	1.6 ± 0.3	8.0 ± 6.7	3.2 ± 1.7	3.6 ± 1.1	3.6 ± 0.3
72 kDa Act.	0	0	0	1.2 ± 1.0	1.9 ± 0.7	0.7 ± 0.2
92kDa	1.3 ± 0.4	1.1 ± 0.3	39.9 ± 6.7	8.0 ± 2.1	4.5 ± 1.2	1.6 ± 0.4
92kDa Act.	0	**0.1 ± 0.2**	0	**0.8 ± 0.9**	1.2 ± 0.9*	0

Les résultats sont exprimés par unités µl de sérum ou par mg de tissu frais.
Une unité correspond à l'activité de l'enzyme qui dégrade 1µg de gélatine en 16H à 37° C.

* $p < 0.05$

Sakalihasan et al, J.Vasc.Surg 1996

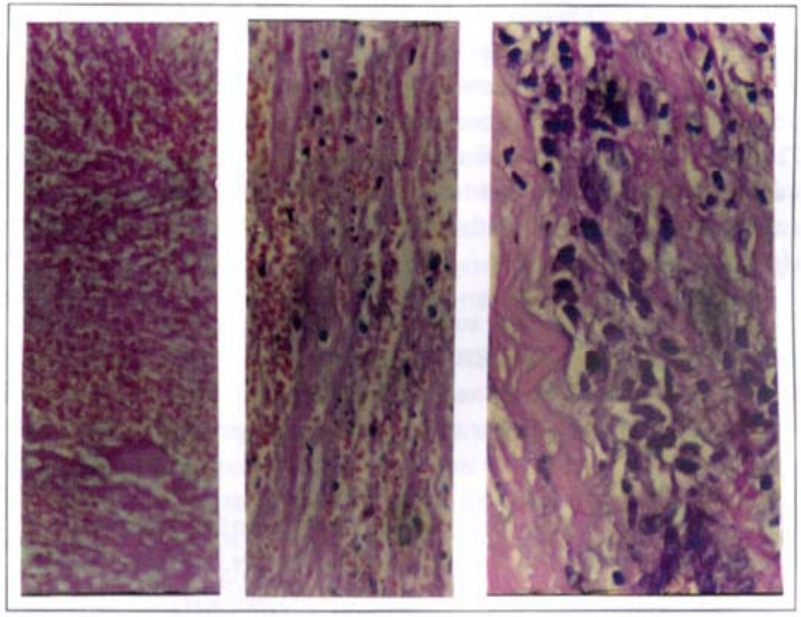


Figure V-2. Hematoxylin and eosin stained sections of internal thrombus (A), adherent thrombus (B) and aortic wall (C). The thrombi consisted essentially of a fibrinous material infiltrated by degenerated red cells and rare leucocytes (A and B). The aortic wall specimen showed a medial and intimal fibrosis associated with a mononuclear cell infiltrate predominating in the adventita and media (C).

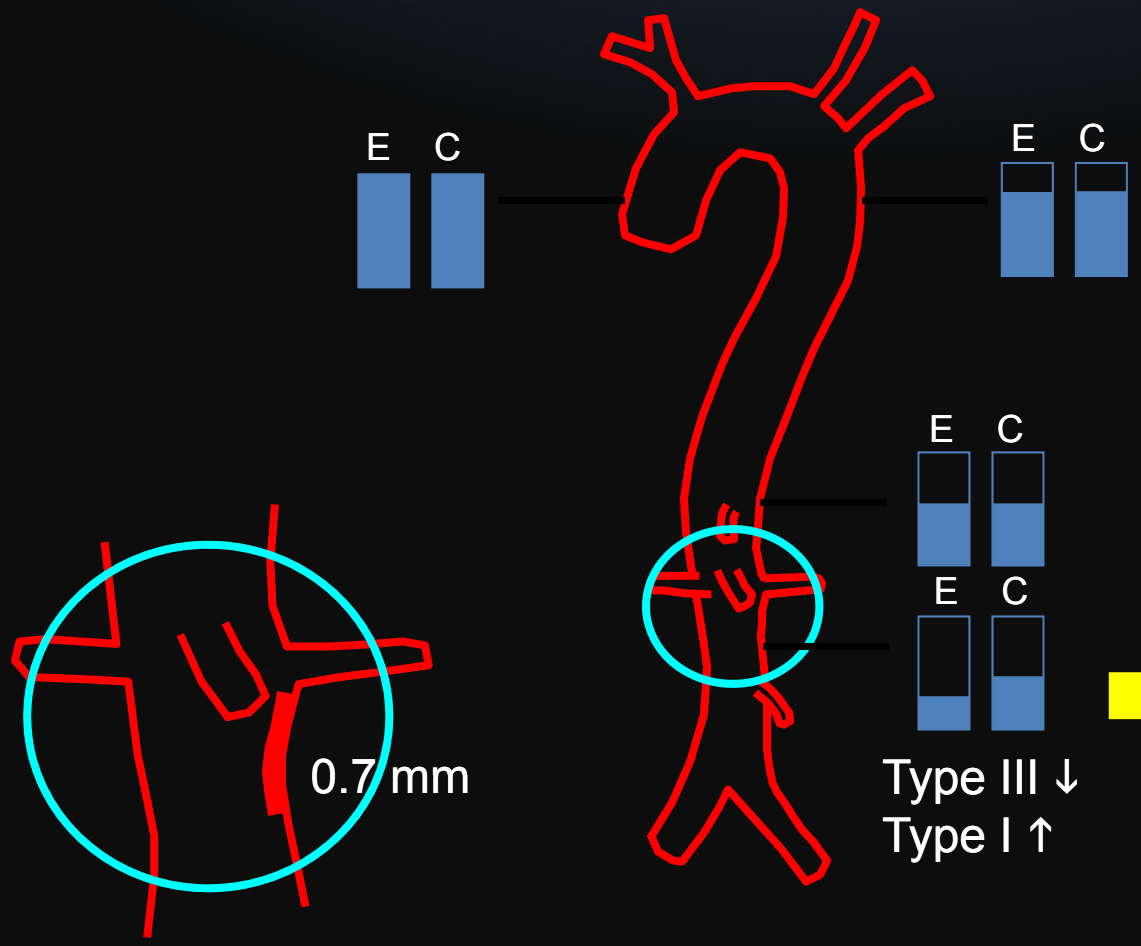
Table V-V. Relationship between inflammatory cell infiltrate and activation of 72 kDa gelatinase.

		72 kDa active form (cpm/mg)	
Score	*n*	*Mean*	*Min – Max*
3	2	264	135 – 393
5	5	404	175 – 785
6	2	657	334 – 981

Positive linear correlation between the inflammatory cell infiltrate and the individual values of 72 kDa gelatinase active forms.
($y = 117 + 129x$ – $r = 0.46$).

"Involvement of MMP2 and MMP9 in the developement of abdominal aortic aneurysms".
N SAKALIHASAN, P DELVENNE, B NUSGENS, R LIMET, CH LAPIERE.
Cell Biol Intern, 1995, 19 : 250-251

AAA

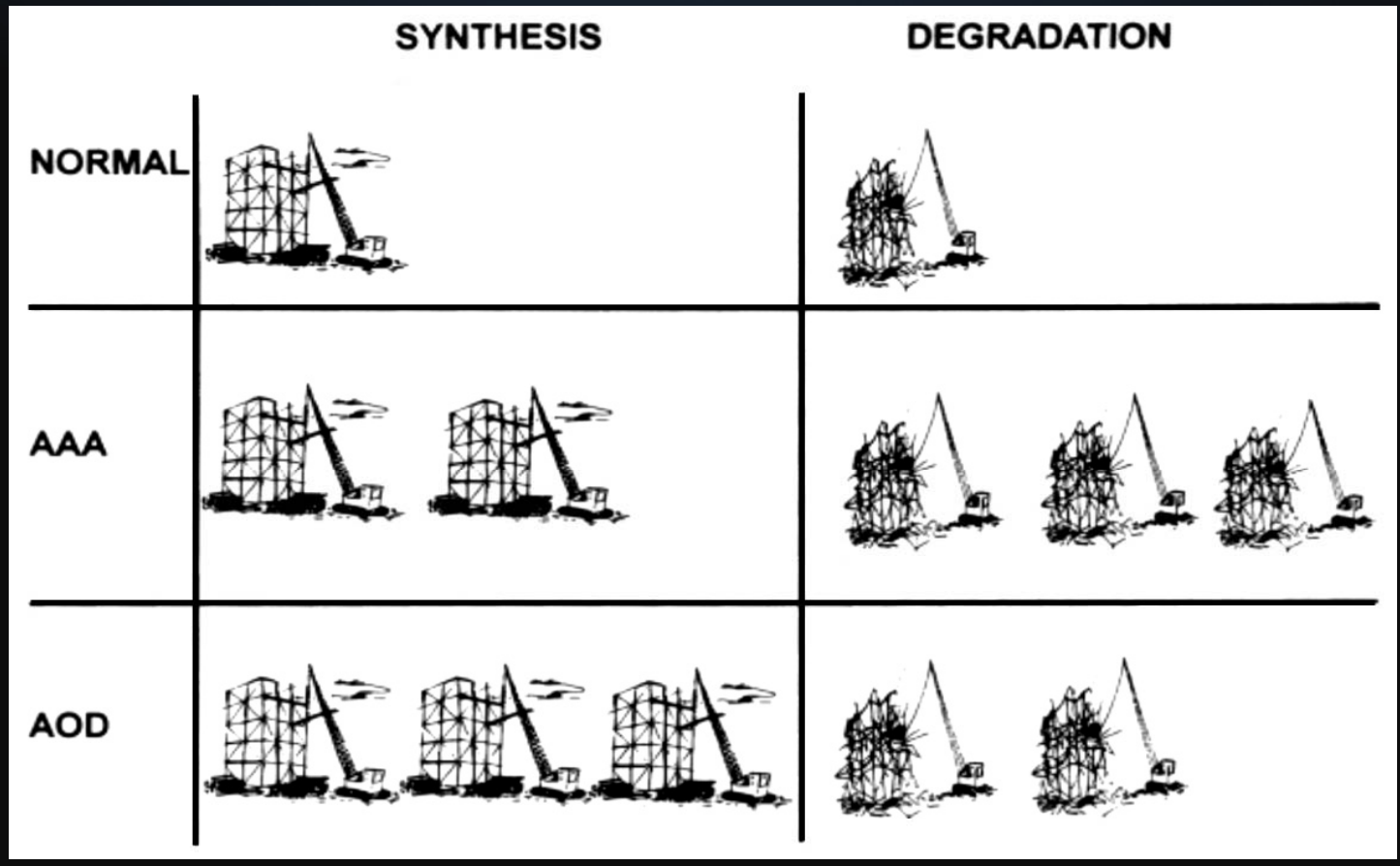


in mammalian : 40 layers
human aorta : 29 layers

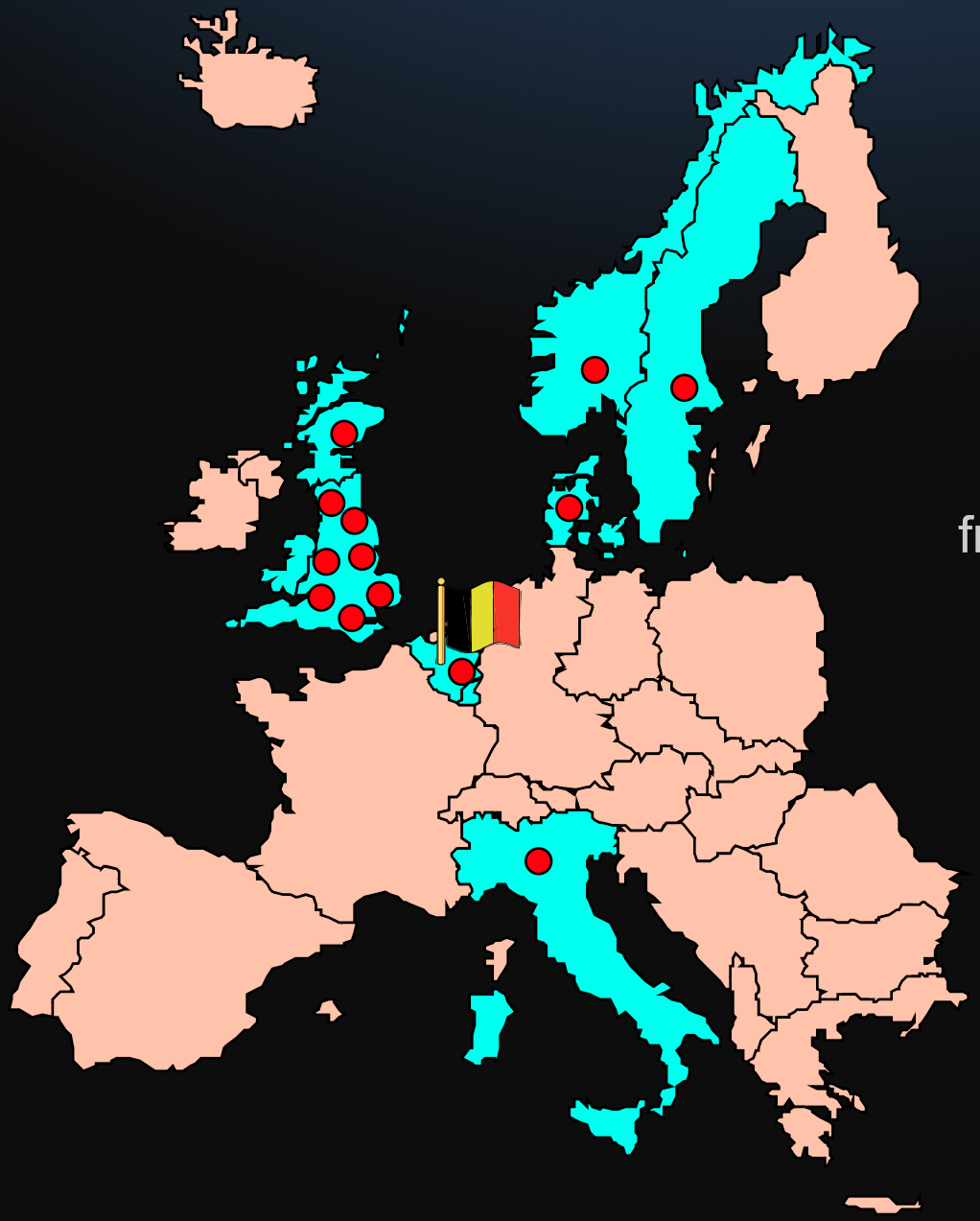
Type III ↓
Type I ↑

Bernouilli's phenomenon
Laplace law

weakening of wall
↓
↑ tangential tension
↓
AAA development



The dynamics of the aortic wall matrix. Synthesis and degradation are balanced in the normal aorta. Metabolic activity increases in the diseased aorta, favoring either protein accumulation (AOD) or matrix degeneration (AAA).

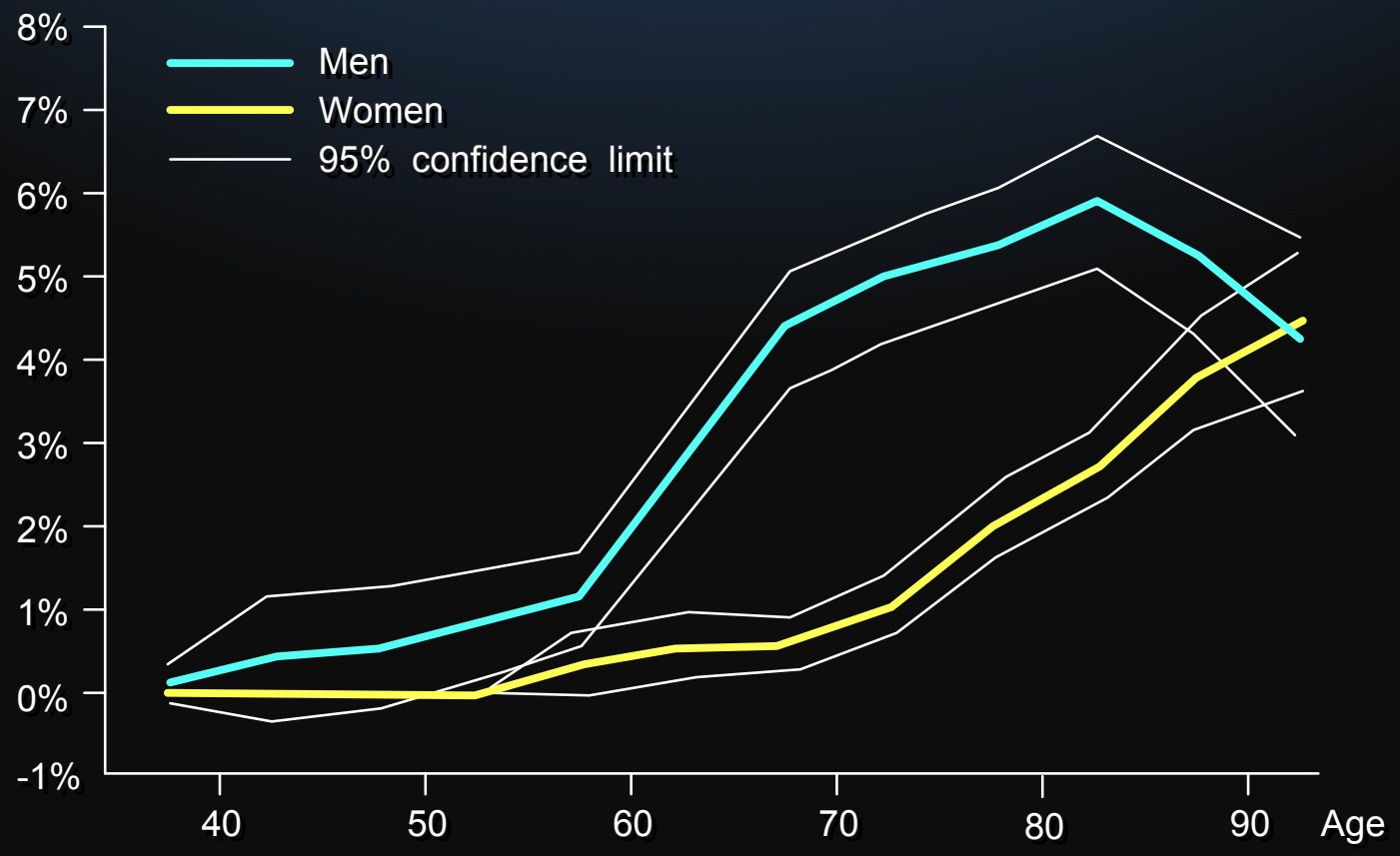


frequency of AAA in population-based screening studies ranging 2.4% →3.9% (AAA ≥ 30 mm ∅)

Abdominal Aortic Aneurysm – Epidemiology

- Incidence has increased in the past two decades
  - Smoking
  - Aging population
  - Introduction of screening programs
  - Improved diagnostic tools
- Prevalence in men > women
  - Men between 1.3%–8.9%
  - Women between 1.0%–2.2%

Lederle FA, et al. *Arch Intern Med*. 2000;160:1425-1430; Lindholt JS, et al. *Euro J Vasc Endovasc Surg*. 2000;20:369-373; Lederle FA, et al *J Vasc Surg*. 2001;34:122-126; Singh K, et al. *Am J Epidemiol*. 2001;154:236-244; Vardulaki KA, et al. *Br J Surg*. 2000;87:195-200; Sakalihasan N, et al. *Lancet*. 2005;365:1577-1589.



Autopsy-based age specific rate (95% confidence limit)
of abdominal aortic aneurysms in Malmö, Sweden.
from D Berqvist et al : "Associated atherosclerotic manifestations" ; edited by RM Greenhalgh & JA Mannick "The cause and management of aneurysms".

Factors promoting the aortic rupture
gender

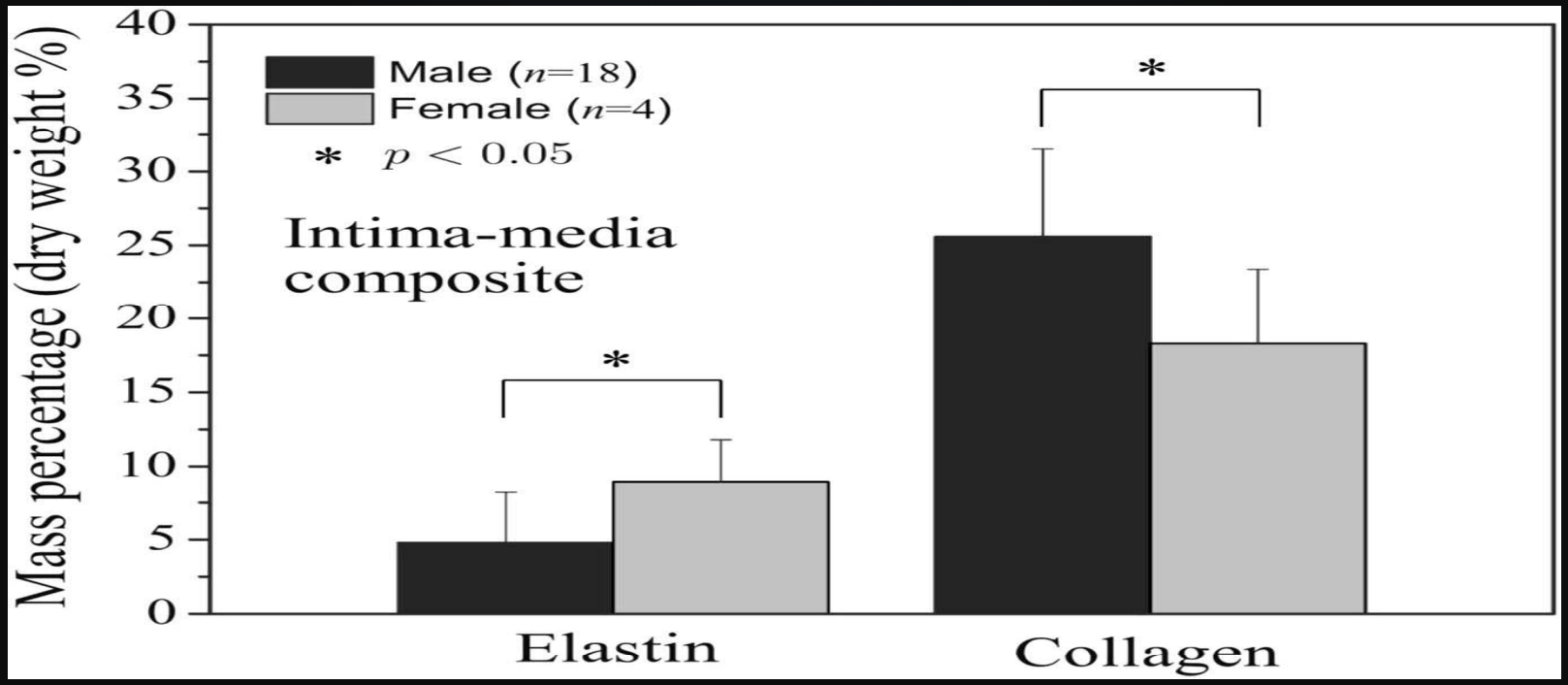


Figure 6 Mass fractions of elastin and collagen within the thrombus-covered intima-media composite for male and female patients. Significant differences are noted for the dry weight percentages of both elastin and collagen between male and female.

J. Tong , A.J. Schriefl , T. Cohnert , G.A. Holzapfel

Gender Differences in Biomechanical Properties, Thrombus Age, Mass Fraction and Clinical Factors of Abdominal Aortic Aneurysms

European Journal of Vascular and Endovascular Surgery Volume 45, Issue 4 2013 364 - 372
http://dx.doi.org/10.1016/j.ejvs.2013.01.003

PREVALENCE and RISK FACTORS OF AAA (POPULATION BASED STUDY in LIEGE)

âge	n	%
65	18	3,9
75	10	3,8

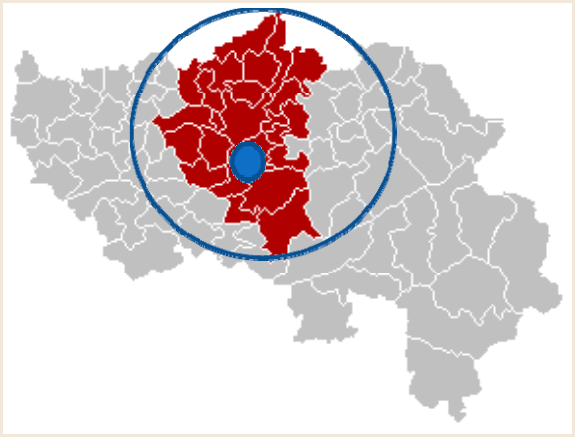
	sans AAA		avec AAA		
	n	%	n	%	p
dyslipidemia	172	24,92	13	35,13	NS
diabetes	78	11,30	7	18,91	NS
hypertension	**188**	**27,24**	**17**	**45,94**	**< 0,05**
smoking	**156**	**21,73**	**13**	**35,13**	**< 0,06**

Vasquez C, Sakalihasan N, Harcour JB, Limet R, Ann Vasc Surg 1998

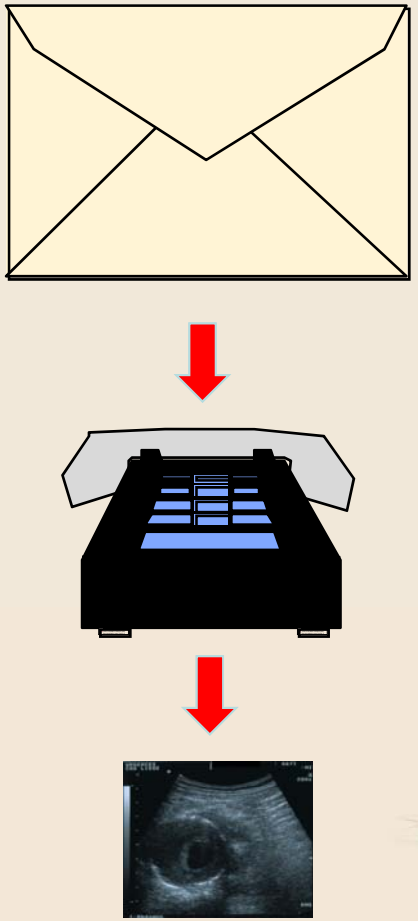
Extending abdominal aortic aneurysm detection to older age groups (65-85 years): preliminary results from the Liège screening program.

Georgios Makrygiannis, Philippe Labalue, Marie Erpicum, Martin Schlitz, Laurence Seidel, Mounia El Hachemi, Marjorie Gangolf, Adelin Albert, Jean-Olivier Defraigne, Jes S. Lindholt, and Natzi Sakalihasan

Annals of Vascular Surgery; in press



Arrondissement	01-07-2003	01-07-2004	01-07-2005	01-07-2006	01-01-2010
Huy	102 423	102 900	103 597	104 262	107 832
Liège	585 930	587 531	589 203	591 906	604 062
Verviers	268 886	269 982	272 039	274 148	280 203
Waremme	70 102	70 858	71 749	72 524	75 588
Province de Liège	**1 027 341**	**1 031 271**	**1 036 588**	**1 042 840**	**1 067 685**



U.S. Preventive Services TASK FORCE

Abdominal Aortic Aneurysm: Screening

Release Date: June 2014

Recommendation Summary

Population	Recommendation	Grade (Wi... Thi...)
Men Ages 65 to 75 Years who Have Ever Smoked	The USPSTF recommends one-time screening for abdominal aortic aneurysm (AAA) with ultrasonography in men ages 65 to 75 years who have ever smoked.	B
Men Ages 65 to 75 Years who Have Never Smoked	The USPSTF recommends that clinicians selectively offer screening for AAA in men ages 65 to 75 years who have never smoked rather than routinely screening all men in this group.	C
Women Ages 65 to 75 Years who Have Ever Smoked	The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of screening for AAA in women ages 65 to 75 years who have ever smoked.	I
Women Who Have Never Smoked	The USPSTF recommends against routine screening for AAA in women who have never smoked.	D

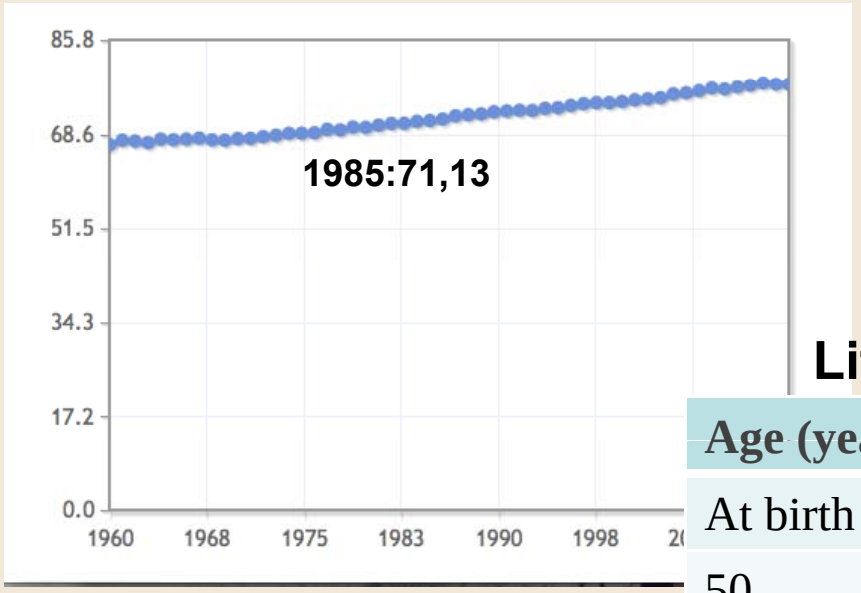
Current guidelines on AAA screening propose either 1-time screening in men at the age of 65 or 1-time screening in men ever smokers aged 65 to 75.

index mundi

Home > Countries > Belgium > Health > Mortality

Belgium - Life expectancy at birth

Life expectancy at birth, male (years)



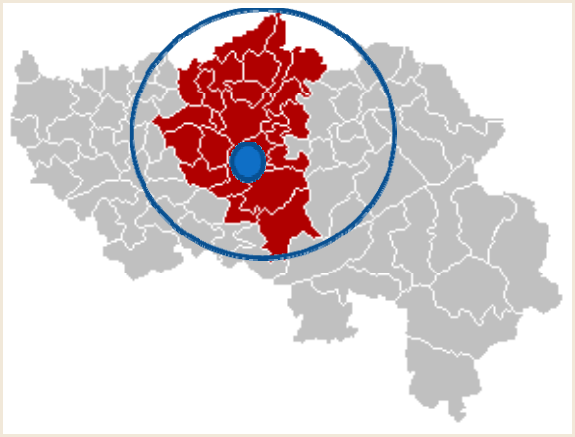
Life expectancy in Belgium, 2013

Age (years)	Men	Women	Total
At birth	77,93	82,91	80,46
50	29,99	34,27	32,20
65	17,61	21,07	19,46
70	14,01	16,97	15,64
75	10,72	13,08	12,08
80	7,79	9,51	8,84

Extending abdominal aortic aneurysm detection to older age groups (65-85 years): preliminary results from the Liège screening program.

Georgios Makrygiannis, Philippe Labalue, Marie Erpicum, Martin Schlitz, Laurence Seidel, Mounia El Hachemi, Marjorie Gangolf, Adelin Albert, Jean-Olivier Defraigne, Jes S. Lindholt, and Natzi Sakalihasan

Annals of Vascular Surgery; in press



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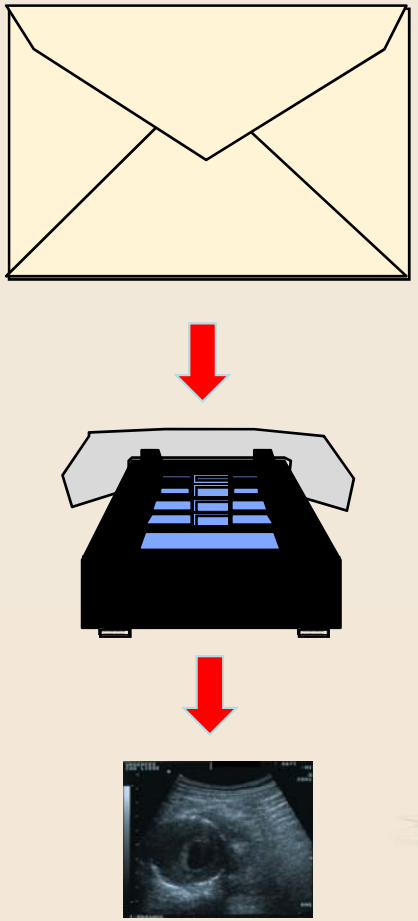
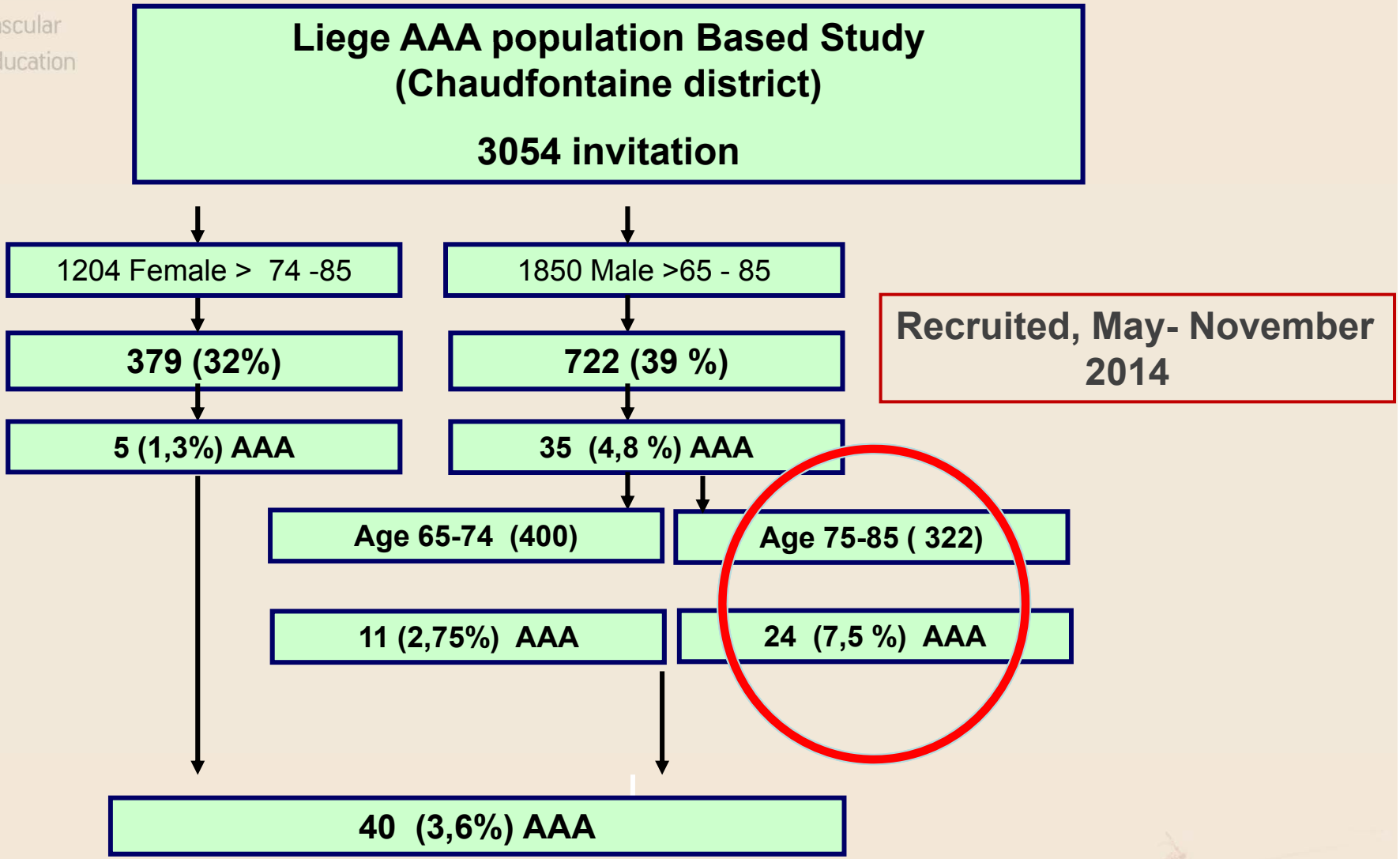
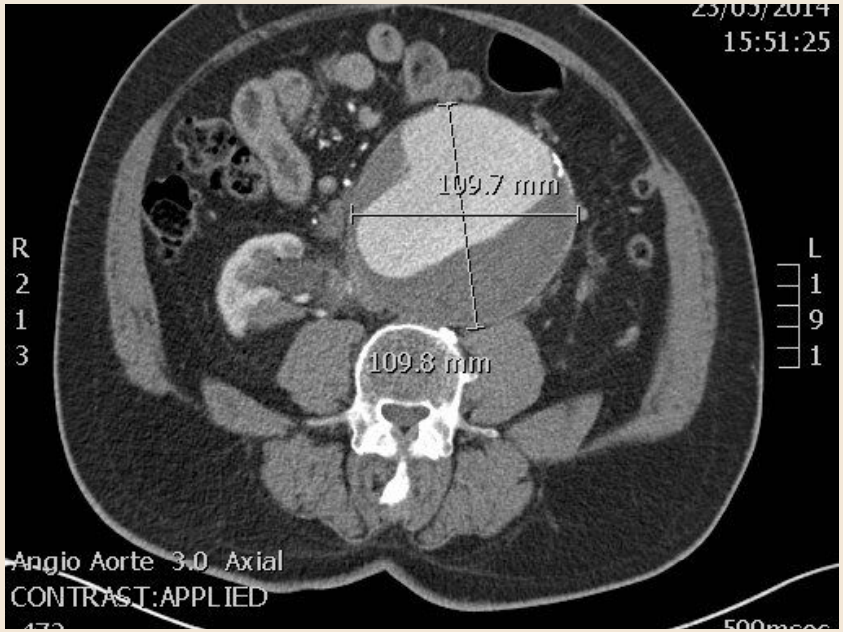




!!! 12 deaths. (1 AAA related)


Frq 4.0 MHz
Gn 64
E/A 1/1
D 17.0 cm
DR 72
FR 30 Hz
AO 100 %
XBeam On
Gauche
% de sténose
Volume
Angle
Volume rénal
Emergency Medicir
Ratio A/B
Diam.Ao
Longueur Rénale
F.d.travail
1 L 10.44 cm
2 L 10.72 cm
d 9.24 cm
L 0.00 cm
Menu


15:51:25
109.7 mm
109.8 mm
R
2
1
3
L
1
9
1
Angio Aorte 3.0 Axial
CONTRAST:APPLIED

Prevalence of AAA in Belgium

Prevalence programme	65-74	75-84	65-84
Belgium (10.839.905)*	430.178	284.590	714.768
Prevalence %	2,8 %	7,5 %	
Total New AAA	12.044	21.344	33.388

* Inhabitants in Belgium for the year 2010

Prevalence of AAA in men reported screening studies in the population with hypertension, coronary artery disease and peripheral vascular disease

Year	Author (ref)	Selection basis (patients)	Sex & age group		Aneurysm definition	Prevalence of AAA (%)
1984	Twoomey [199]	hypertension	M	> 50 y	≥ 30 mm	M = 7%
1985	Lindholm [121]	hypertension	M + F	> 50 y	infrarenal Ao > suprarenal Ao	M + F = 0.4%
1987	Allen [2]	hypertension	M + F	65 - 85 y	5 mm > suprarenal Ao	M = 7.4% / F = 2.8%
1986	Thurmond [193]	general cardiologist	M + F	mean = 67.5 y	≥ 40 mm	M + F = 5%
1991	Nevelstein [139]	CAD	M + F	34 - 79 y	≥ 40 mm	M + F = 6%
1991	Piotrowski [153]	cardiac transplantation (IHD)	M	mean = 58 y	> 25 mm	M + F = 10.5%
1980	Shapira [178]	PVD	M + F	31 - 83 y	≥ 30 mm – 5 mm > suprarenal Ao	M + F = 5.9%
1983	Cabellon [33]	PVD	M + F	43 - 79 y	not reffered	M + F = 10%
1988	Bengtsson [12]	carotid surgery	M + F	41 - 88 y	localized dilatation	M = 12% / F = 9%
1988	Allardice [1]	PVD	M + F	74 - 90 y	localized dilatation	M = 14% / F = 4%
1989	Bengtsson [11]	claudication	M + F	43 - 82 y	localized dilatation	M = 16.3% / F = 2.8%
1991	Galland [81]	PVD	M + F	38 - 95 y	≥ 35 mm IRD > SRD	M + F = 14%
1994	*Sakalihasan*	PVD + CAD	M + F	55 - 75 y	≥ 30 mm 2 times suprarenal Ao Ø	M = 8.9% / F = 3.2%

PVD : Peripheral Vascular Disease ; CAD : Coronary Artery Disease ; IHD : Ischemic Heart Disease.

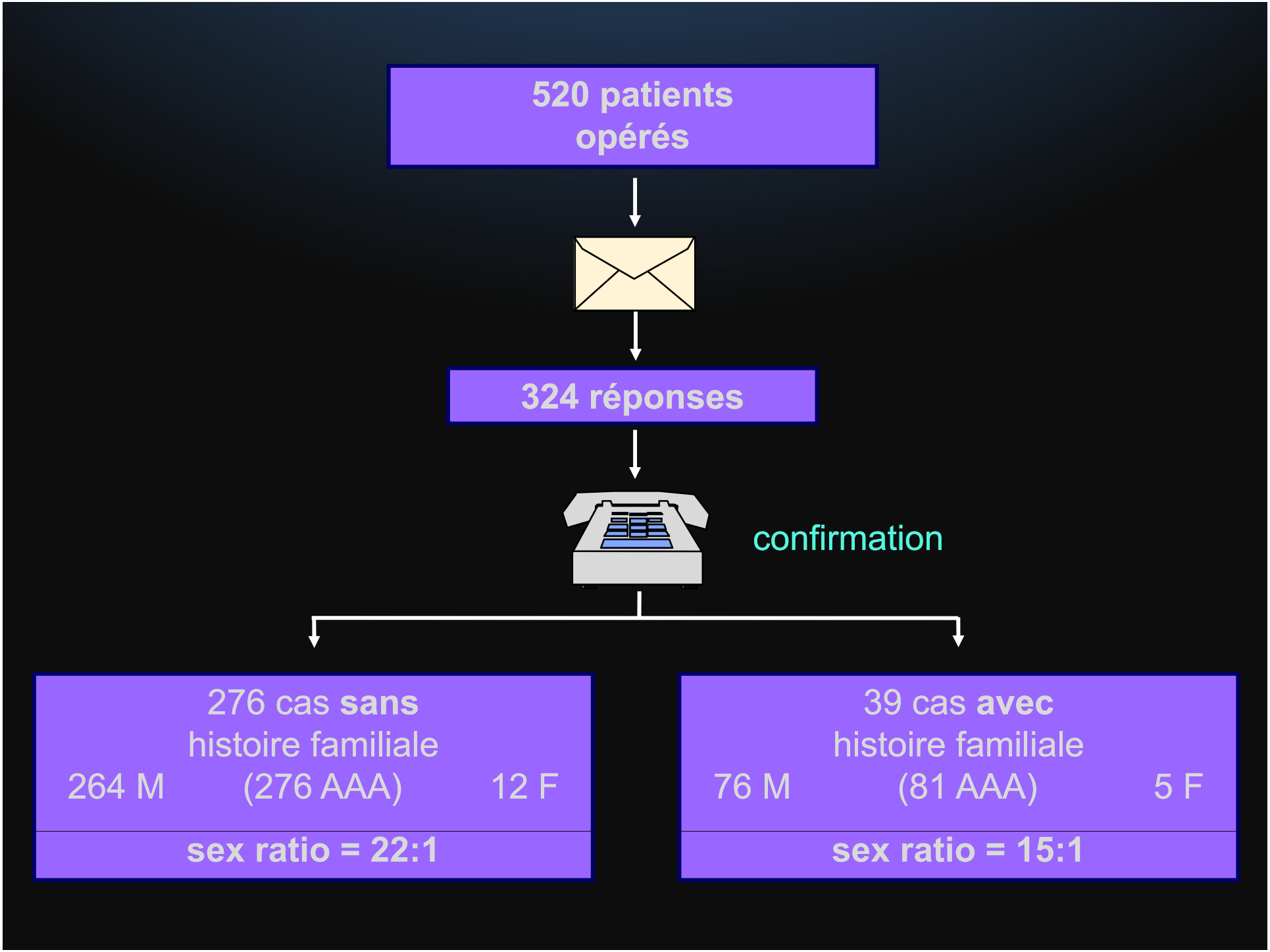
PREVALENCE OF AAA TO CORONARY OR PERIPHERAL DISEASES IN PATIENTS ≥ 60 YEARS

	coronary artery			peripheral vascular		
	n	AAA	%	n	AAA	%
male	40	6	15.0	25	1	4.0
female	17	1	5.9	7	0	0.0
total	57	7	12.3	32	1	3.1

Prevalence of AAA according to the coronary profile and age in male patients

Coronary profile	Overall AAA, % (n)	< 65 years AAA, % (n/N)	≥ 65 years AAA, % (n/N)
normal	2.5% (4/158)	1% (1/105)	5.7% (3/53)
1-vessel disease	4.3% (11/255)	2.9% (4/139)	6.0%(7/116)
2-vessel disease	5.7% (10/175)	3.5% (3/85)	7.8% (7/90)
3-vessel disease	14.4% (16/111)	11.4% (5/44)	16.4% (11/67)

Durieux R, et al; Submitted ***Eur J Vasc Endovasc Surg*** *in revision (2013)*


520 patients opérés
324 réponses
confirmation
276 cas sans histoire familiale
264 M (276 AAA) 12 F
sex ratio = 22:1
39 cas avec histoire familiale
76 M (81 AAA) 5 F
sex ratio = 15:1

Aneurysms of the abdominal aorta: familial and genetic aspects in three hundred thirteen pedigrees

A. Verloes, N. Sakalihasan, L. Koulischer, and **R. Limet,** *Liège, Belgium*

Purpose: Familial clustering of abdominal aortic aneurysm was first noticed in 1977.
Methods: Through questionnaire and phone inquiry, familial data on 324 probands with abdominal aortic aneurysms allowed the establishment of 313 multigenerational pedigrees including 39 with multiple affected patients.
Results: There were 276 sporadic cases (264 men, 12 women); 81 cases belonged to multiplex pedigrees (76 men; 5 women). We compared familial and sporadic male cases; the ages at diagnosis were 64.1 ± 7.9 years and 66.0 ± 7.3 years ($p < 0.05$), respectively, the ages at rupture were 65.4 ± 6.6 years and 75.2 ± 8.6 years ($p < 0.001$), and the rupture rate was 32.4% and 8.7% ($p < 0.001$). Survival curves were computed. Relative risk for male siblings of a male patient was 18. We performed a segregation analysis with the mixed model, the most likely explanation for occurrence of abdominal aortic aneurysm in our families was a single gene effect showing dominant inheritance. The frequency of the morbid allele was 1:250, and its age-related penetrance was not higher than 0.4.
Conclusion: This analysis indicates the preeminence of genetic factors on multifactorial/environmental effects of the pathogenesis of abdominal aortic aneurysm. (J VASC SURG 1995;21:646-55.)

Familial Abdominal Aortic Aneurysm

Summary on studies investigating the role of family history of AAA using an interview method

Study	Country	Patients (*n*)[a]		Familial prevalence (%)
		Studied	Positive history	
Norrgård et al. 1984[7]	Sweden	87	16	18
Johansen and Koepsell 1986[19]	USA	250	48	19
Powell and Greenhalgh 1987[29]	UK	56	20	36
Johnston and Scobie 1988[20]	Canada	666	41	6.1
Cole et al. 1989[30]	Canada	305	34	11
Darling et al. 1989[31]	USA	542	82	15
Majumder et al. 1991[32]	USA	91	13	14
Verloes et al. 1995[27]	Belgium	313	39	13
Lederle et al. 1997[21]	USA	985	91	9.2
Lawrence et al. 1998[33]	USA	86	19	22
Salkowski et al. 1999[34]	USA	72	19	26
Rossaak et al. 2001[35]	New Zealand	248	48	19
Sakalihasan et al. 2013 (present study)	Belgium	618	62	10
Combined		4,312	532	12

AAA, abdominal aortic aneurysm.

[a]Family history information was collected by interviewing the patients with AAA or sending a family history questionnaire via mail. Information was updated from our previously published table.[36]

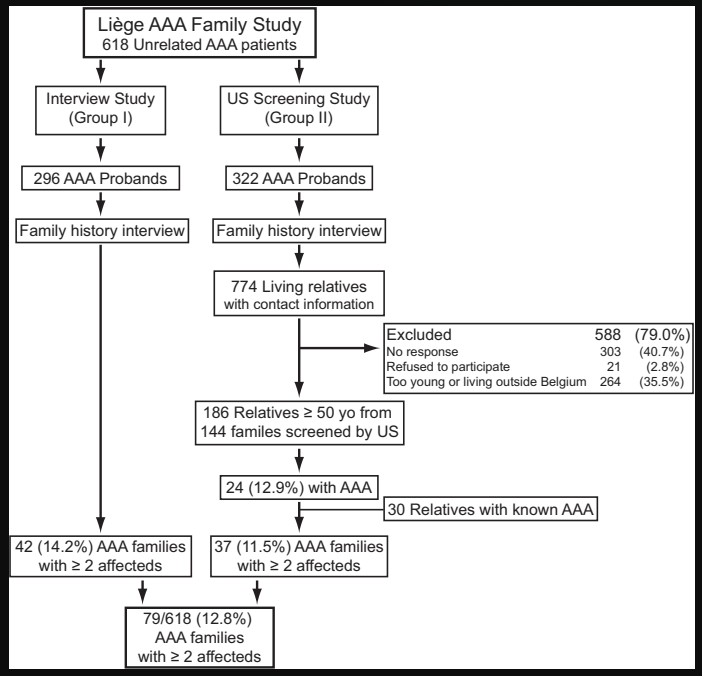
Sakalihasan N et al; **Annals of Vascular Surgery (2014), doi: 10.1016/j.avsg.2013.11.005.**

CALCULATION OF RELATIVE RISK OF AAA AMONG BROTHERS

	mean
relative risk	17.9
(95% confidence interval)	(12.8 - 22.9)

Family Members of Patients with Abdominal Aortic Aneurysms are at Increased Risk for Aneurysms: Analysis of 618 Probands and their Families from the Liège AAA Family Study

Natzi Sakalihasan, Jean-Olivier Defraigne, Marie-Ange Kerstenne, Jean-Paul Cheramy-Bien, Diane T. Smelser, Gerard Tromp, Helena Kuivaniemi



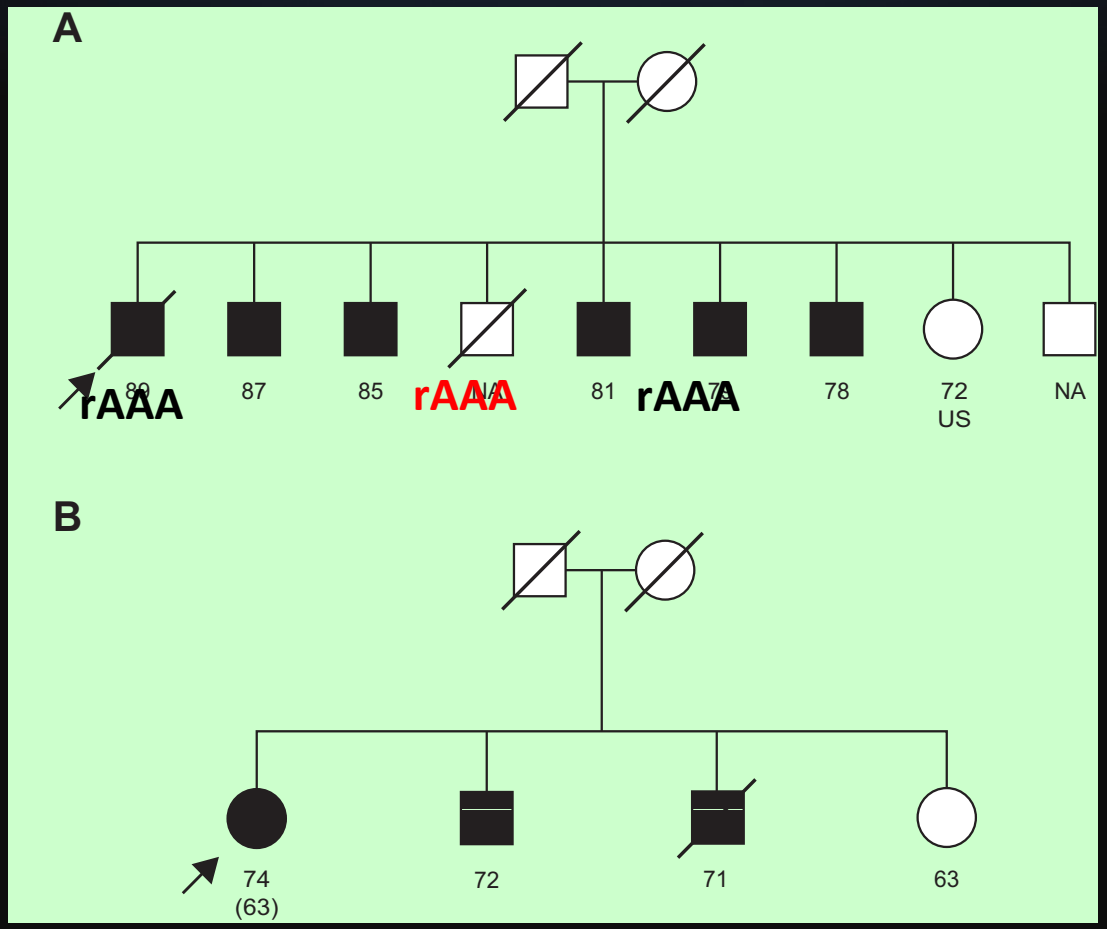
Sakalihasan N et al; Annals of Vascular Surgery (2014), doi: 10.1016/j.avsg.2013.11.005.

Factors promoting the aortic rupture
gender and familial cases

Authors	Country	Brothers	Sisters	Total
Bengtsson et al.1989	Sweden	30%	5%	15 %
Webster et al. 1991	USA	25%	7%	8,9%
Adamson et aL 1992	UK	25%	11%	15%
Bengtsson et al 1992	Sweden			15%
Van der Graaf et al.1998	Holland	12%		12%
Rossaak et al. 2001	N. Zelland			8,2%
Ogata et al. 2005	Canada	11%	2,7%	5,4%
Sakalihasan et al. 2014	Belgium	24 %	3,2 %	9,5 %

Sakalihasan N et al; Annals of Vascular Surgery (2014), doi: 10.1016/j.avsg.2013.11.005.

Examples of Pedigrees from the Liège AAA Family Study



AAA is a Genetic Disease ????

•Aneurysms of the abdominal aorta. Familial and genetic aspects in three hundred thirteen pedigrees. VERLOES A, SAKALIHASAN N, KOULISCHER L, LIMET R. **J Vasc Surg, 21 (4) (1995), 646-655**.

•Genetic aspects of abdominal aortic aneurysms. VERLOES A, SAKALIHASAN N, LIMET R, KOULISCHER L**. Ann NY Acad Sci, 18 (1996), 44-55.**

• Analysis of coding sequences for tissue inhibitor of metalloproteinases 1 (TIMP1) and 2 (TIMP2) in patients with aneurysms. WANG X, TROMP G, COLE CW, VERLOES A, SAKALIHASAN N, YOON S, KUIVANIEMI H**. Matrix Biol, 18 (1999), 121-124.**

•Familial abdominal aortic aneurysms : collection of 233 multiplex families. KUIVANIEMI H, SHIBAMURA H, ARTHUR C, BERGUER R, COLE W, JUVONEN T, KLINE R, LIMET R, McKEAN G, NORRGARD O, PALS G, POWELL J, RAINIO P, SAKALIHASAN N, VAN WIJMEN-VAN KEULEN C, VERLOES A, TROMP G. **J Vasc Surg, 37(2) (2003), 340-345.**

• Genome scan for familial abdominal aortic aneurysm using sex and family history as covariates suggests genetic heterogeneity and identifies linkage chromosome. SHIBAMURA H, OLSON JM, VAN VLIJMEN-VAN KEULEN C, BUXBAUM SG, DUDEK DM, TROMP G, OGATA T, SKUNCA M, SAKALIHASAN N, PALS G, LIMET R, MACKEAN GL, DEFAWE O, VERLOES A, ARTHUR C, LOSSING AG, BURNETT M, SUEDA T, KUIVANIEMI H. **Circulation, 109 (17) (2004), 2103-8.**

• Genetic analysis of polymorphisms in biologically relevant candidate genes in patients with abdominal aortic aneurysms OGATA T, SHIBAMURA H, TROMP G, SINHA M, STAT M, GODDARD K, SAKALIHASAN N, LIMET R, McKEAN G, ARTHUR C, SUEDA T, LAND S, KUIVANIEMI H **. J Vasc Surg, 41 (6) (2005), 1036-42.**

• HLA-DQA is associated with abdominal aortic aneurysms in the Belgian population. TROMP G, OGATA T, GREGOIRE L, GODDARD K, SKUNCA M, LANCASTER W, PARRADO A, LU Q, SHIBAMURA H, SAKALIHASAN N, LIMET R, MACKEAN G, ARTHUR C, SUEDA T, KUIVANIEMI H**. Ann NY Acad Sci, 1085 (2006), 392-5.**

•Evidence for association between the HLA-DQA locus and abdominal aortic aneurysms in the Belgian population: a case control study. OGATA T, GREGOIRE L, GODDARD K, SKUNCA M, TROMP G, LANCASTER W, PARRADO A, SHIBAMURA L, SAKALIHASAN N, LIMET R, MacKEAN G, ARTHUR C, SUEDA T, KUIVANIEMI H. **BMC Med Genet 7 (2006), 67.**

•The same sequent variant on 9p21 associates with myocardial infarction, abdominal aortic aneurysm and ntracranial aneurysm. HELGADOTTIR A, THORLEIFSSON G, MAGNUSSON KP, GRÉTARSDOTTIR S, STEINTHORSDOTTIR V, MANOLESCU A, JONES GT, RINKEL GJ, BLANKENSTEIJN JD, RONKAINEN A, JÄÄSKELÄINEN JE, KYO Y, LENK GM, SAKALIHASAN N et al. **Nat Genet, 40 (2008), 217-24.**

•Genome wide association study identifies sequence variants within the DAB2IP gene conferring susceptibility to abdominal aortic aneurysm. GRETARSDOTTIR S, BAAS AF, THORLEIFSSON G, HOLM H, DEN HEIJER M, DE VRIES...MASSON G, SULEM P, SAEMUNDSDOTTIR J, MOUY M, MAGNUSSON KP, TROMP G, ELMORE JR, SAKALIHASAN N, LIMET R, DEFRAIGNE JO, et al. **Nat Genet, 42(8) (2010), 692-7.**

• Analysis of positional candidate genes in the AAA1 susceptibility locus for abdominal aortic aneurysms on chromosome 19. LILLVIS JH, KYO Y, TROMP G, LENK GM, LI M, LU Q, IGO RP, SAKALIHASAN N, FERRELL RE, SCHWORER CM, GATALICA Z, LAND S, KUIVANIEMI H. **BMC Med Gen, 19;12 (2011), 14.**

•Family Members of Patients with Abdominal Aortic Aneurysms are at Increased Risk for Aneurysms: Analysis of 618 Probands and their Families from the Liege AAA Family Study. SAKALIHASAN N, DEFRAIGNE JO, KERSTENNE MA, CHERAMY-BIEN JP, TROMP G, KUIVANIEMI H. **Ann Vasc Surg. Dec 20 2013), doi: 10.1016/j.avsg.2013.11.005..**

ANEURYSM OF THE ABDOMINAL AORTA.

By WILLIAM OSLER, M.D., F.R.S.,
REGIUS PROFESSOR OF MEDICINE AT THE UNIVERSITY OF OXFORD.

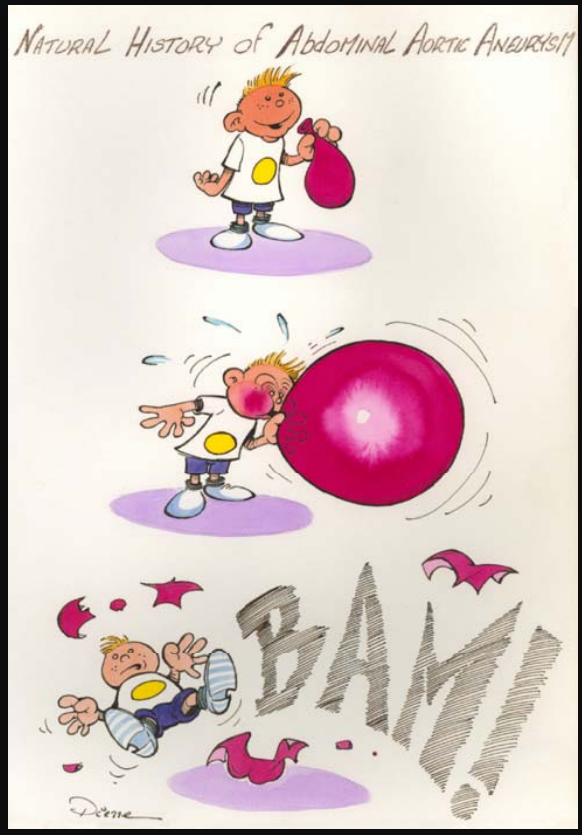
[Oct. 14, 1905. The Lancet,]

There is no disease more conducive to clinical humility than aneurysm of the aorta.

« Il n'y a pas de maladie plus favorable à l'humilité clinique que l'anévrisme de l'aorte. »

Abdominal Aortic Aneurysm
Rupture

- Mortality rate for patients with ruptured AAA is 65%–85%
- Approximately half of deaths attributed to rupture occur before the patient reaches the surgical room



Lederle FA, et al. N Engl J Med. 2002;346:1437-1444 ; Sakalihasan N, et al. Lancet. 2005;365:1577-1589

Factors promoting the aortic rupture

Aneurysm rupture occurs when the mechanical stress acting on the wall exceeds the strength of the wall

INFLAMMATION

GENETICS & FAMILIAL

SMOKING

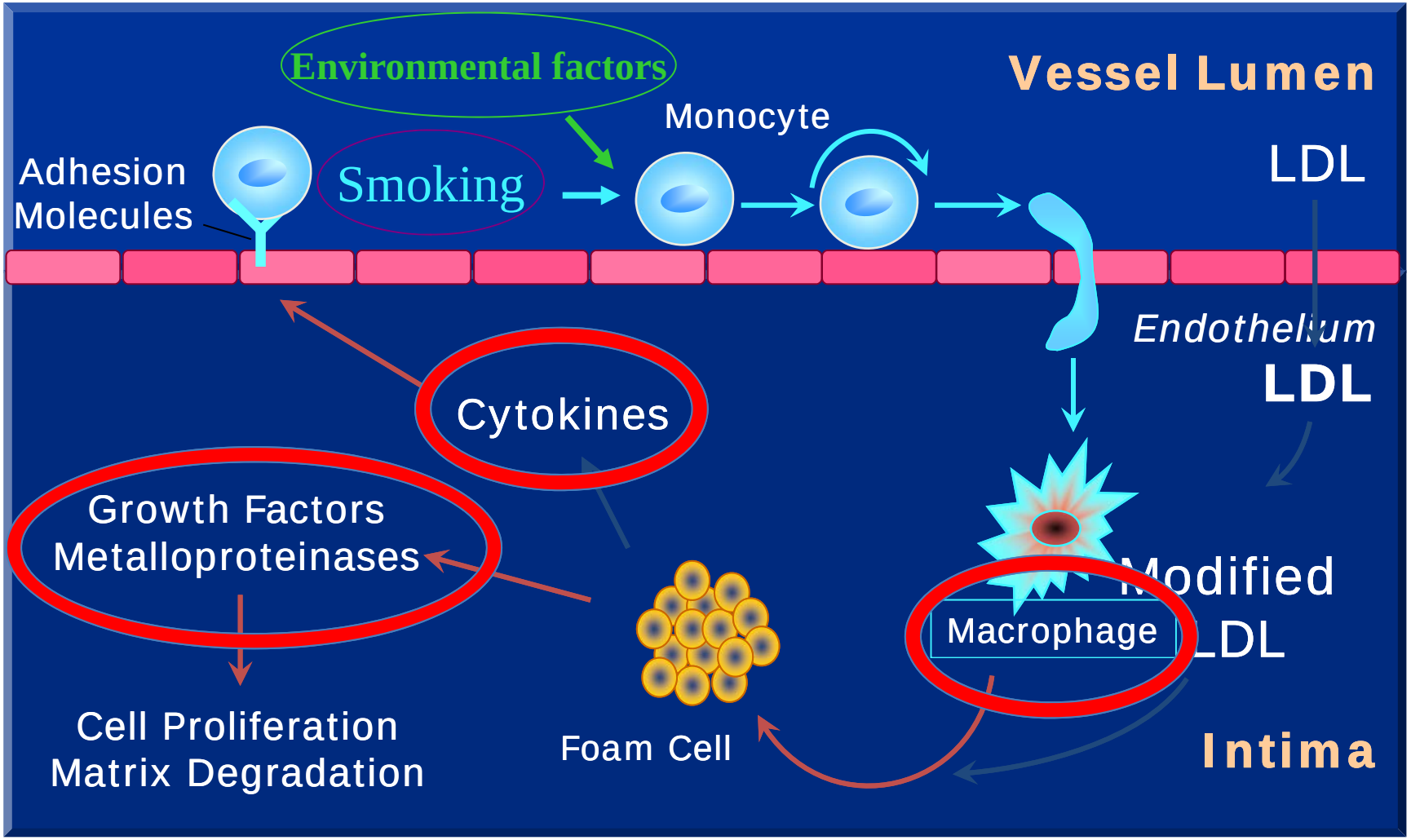
GENDER

Factors promoting the aortic rupture

Aneurysm rupture occurs when the mechanical stress acting on the wall exceeds the strength of the wall

INFLAMMATION

Vascular wall injury and Inflammatory Processes

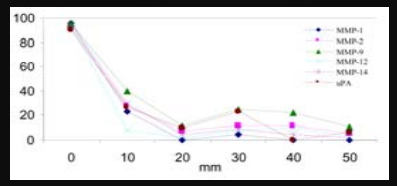


Adapted from Ross R. *N Engl J Med* 1999;340:115-126.

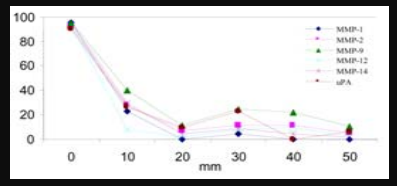
Gradient of proteolytic enzymes, their inhibitors and matrix proteins expression in a ruptured abdominal aortic aneurysm

O. D. Defawe, A. Colige, C. A. Lambert, P. Delvenne, Ch. M. Lapière, R. Limet, B. V. Nusgens and N. Sakalihasan
University of Liège, Liège, Belgium

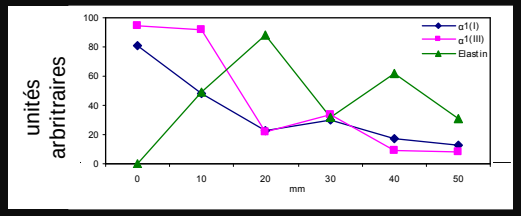
Eur J Clin Invest 2004; 34 (7): 513–514



PROTEASES

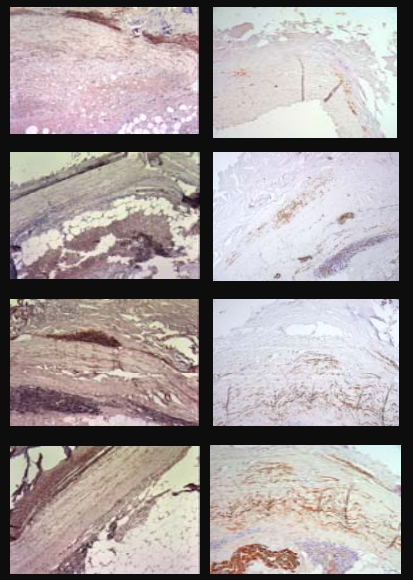


INHIBITORS



EXTRACELLULAR MATRIX PROTEINS

ORCEINE **α-SM actine**



The **rupture** of an AAA occurs at a **hot spot** characterized by an altered expression of a panel of connective tissues genes.

Factors promoting the aortic rupture
Inflammation and MMPs

Proteolysis of the Abdominal Aortic Aneurysm Wall and the Association with Rupture.

Peterson E et al. Eur J Vasc Endovasc Surg,2002;23,153-157

Gradient of proteolytic enzymes, their inhibitors and matrix proteins expression in a ruptured abdominal aortic aneurysm.

Defawe OD,.., Sakalihasan N. Eur J Clin Invest. 2004 Jul;34(7):513-4.

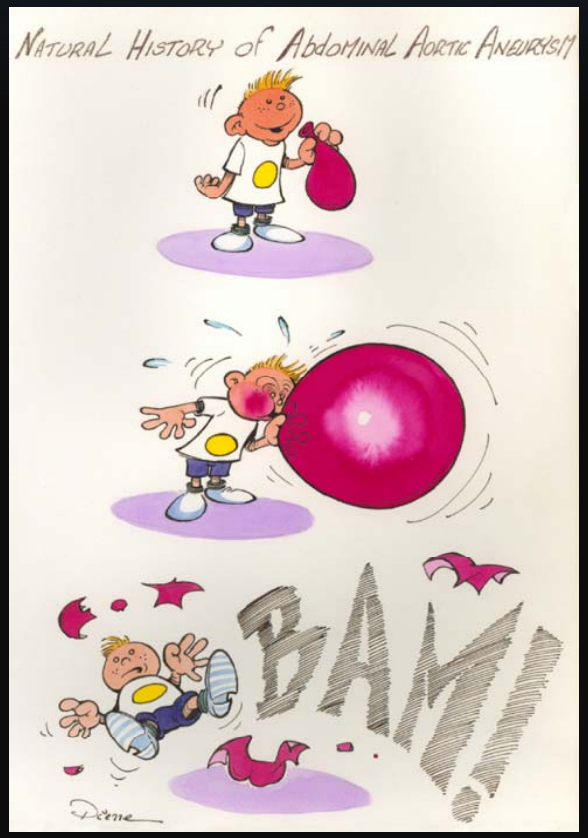
Matrix Metalloproteinase-8 and -9 Are Increased at the Site of Abdominal Aortic Aneurysm Rupture.

Wilson W R W et al. Circulation 2006;113:438-445

Elevated Plasma MMP1 and MMP9 are Associated with Abdominal Aortic Aneurysm Rupture.

Wilson W R W et al. Eur J Vasc Endovasc Surg,2008;35.580-584

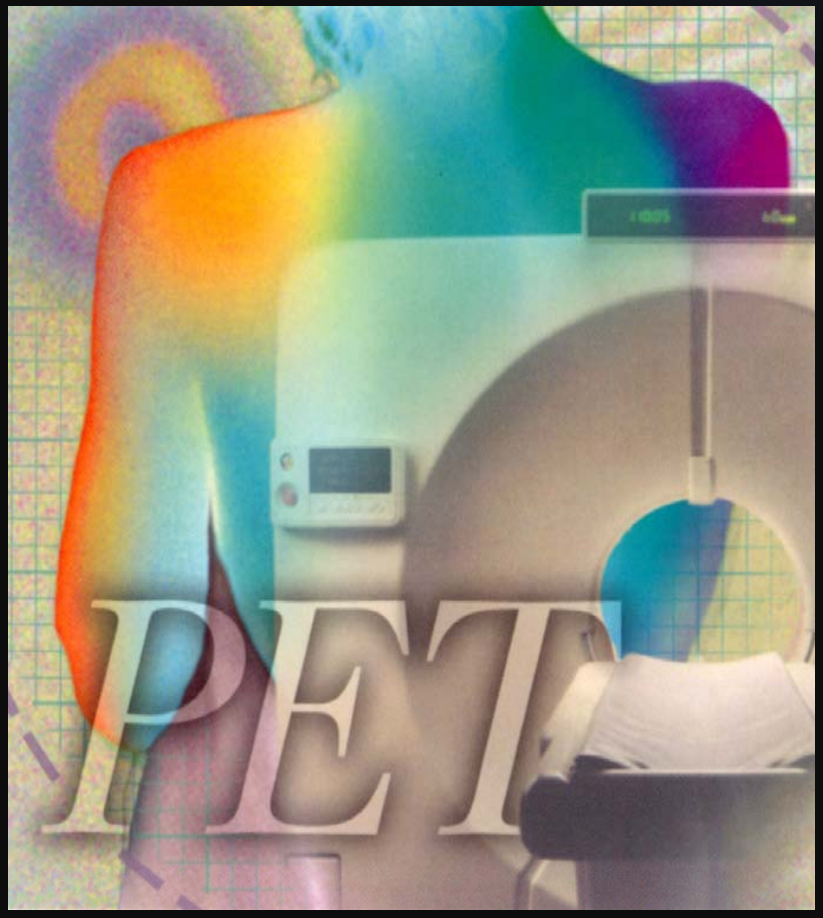
Preliminary events leading to rupture are undoubtedly linked with an increased metabolism of the wall cells.

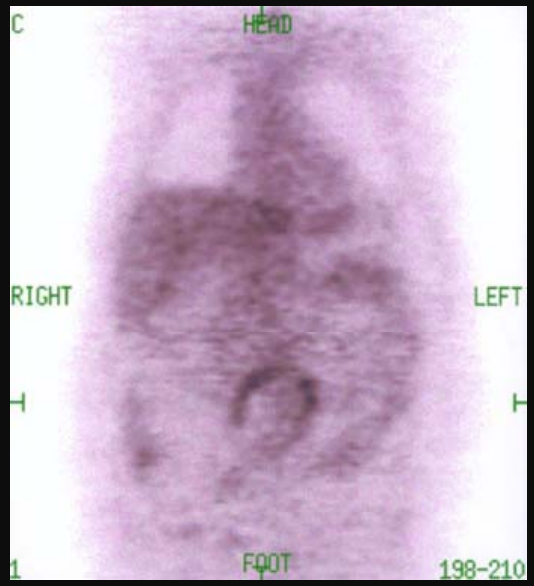


Question :

Is the metabolic increase of an expanding AAA and/or threatening rupture identifiable by the PET-scan?

Positron Emission Tomography (PET) with 18-Flurodeoxyglucose (FDG)





PET-CT & 18F-FDG (fluoro-deoxy-glucose)

Analogue of glucose labeled with the isotope fluorine visible with the PET-scan :

1) allows the evaluation of the regional glucose metabolism

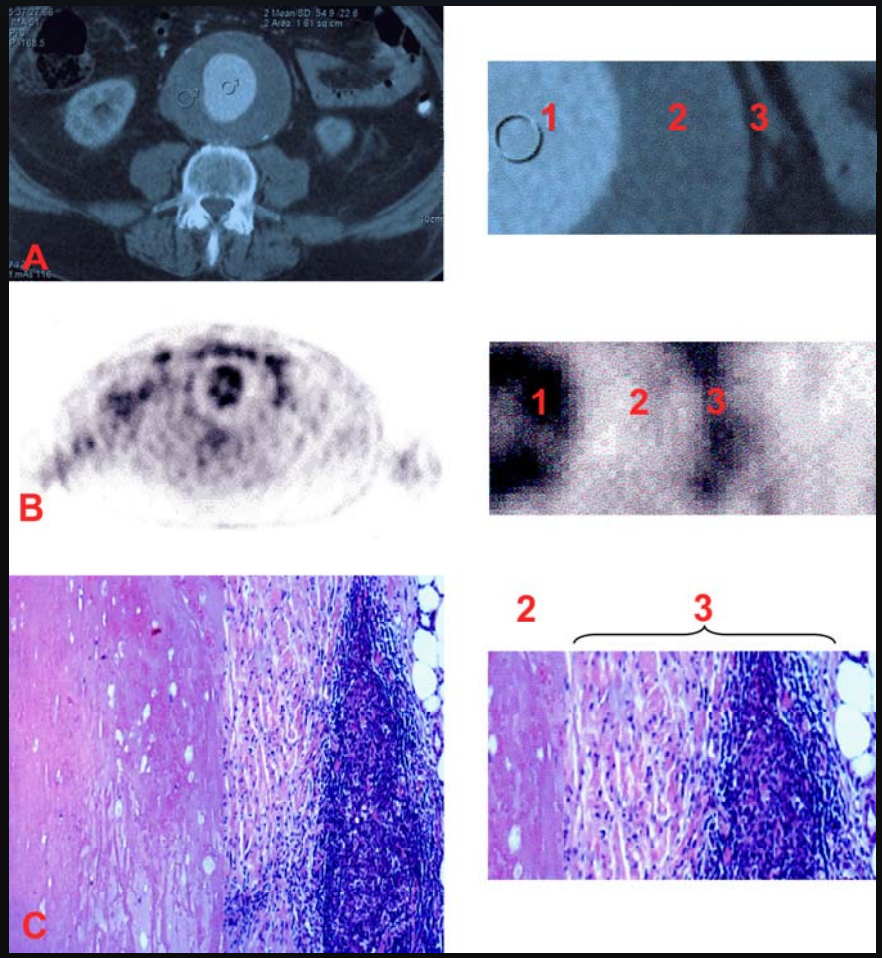
2) shows the presence of an inflammatory reaction at the level of atherosclerotic tissue infiltrated by the macrophages

Patient Characteristics With Positive FDG Uptake

patients			last ∅ during PET-Scan	delay between diagnosis and surgery	remarks
n°	sex	age			
1	M	79	70	96 months	Rapid expansion
2	M	82	60	6 months	Rapid expansion
3	M	73	64	6 months	Leaking AAA
4	M	77	70	24 months	Ruptured AAA
5	M	70	77	36 months	Painfull IAAA
6	M	60	76	< 2 months	Painful IAAA
7	F	64	71	< 1 month	Painful AAA
8	M	74	70	< 1 month	Painful AAA
9	M	69	70	2 days	Painful AAA
10	M	84	50	unoperated	Painful&Lung CA

Sakalihasan N et al, Eur J Vasc Endovasc Surg 2002

Functional imaging and inflammatory cells

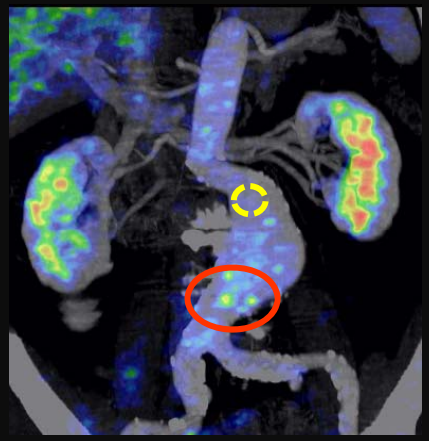


Defawe OD,.. Sakalihasan N. Clin Nucl Med 2005 May;30(5):340-1

Journal of Nuclear Medicine, published on September 5, 2013 as doi:10.2967/jnumed.112.115873

^{18}F-FDG Uptake Assessed by PET/CT in Abdominal Aortic Aneurysms Is Associated with Cellular and Molecular Alterations Prefacing Wall Deterioration and Rupture

Audrey Courtois[1], Betty V. Nusgens[1], Roland Hustinx[2], Gauthier Namur[2], Pierre Gomez[3], Joan Somja[4], Jean- Olivier Defraigne[5], Philippe Delvenne[4], Jean-Baptiste Michel[6], Alain C. Colige*[1], and Natzi Sakalihasan*[5]



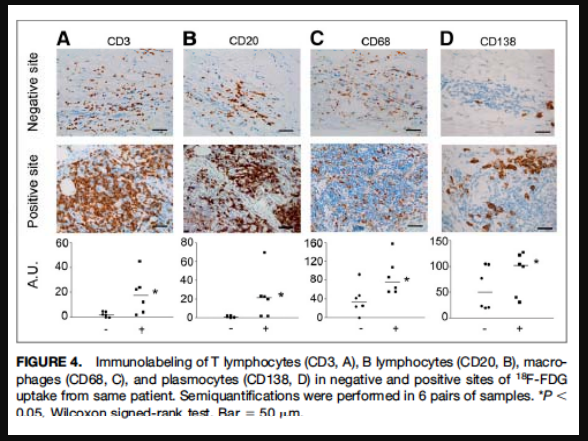


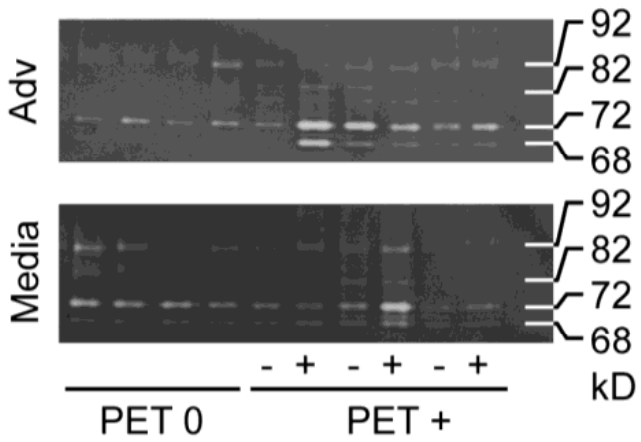
FIGURE 4. Immunolabeling of T lymphocytes (CD3, A), B lymphocytes (CD20, B), macrophages (CD68, C), and plasmocytes (CD138, D) in negative and positive sites of ^{18}F-FDG uptake from same patient. Semiquantifications were performed in 6 pairs of samples. *$P <$ 0.05, Wilcoxon signed-rank test. Bar = 50 μm.

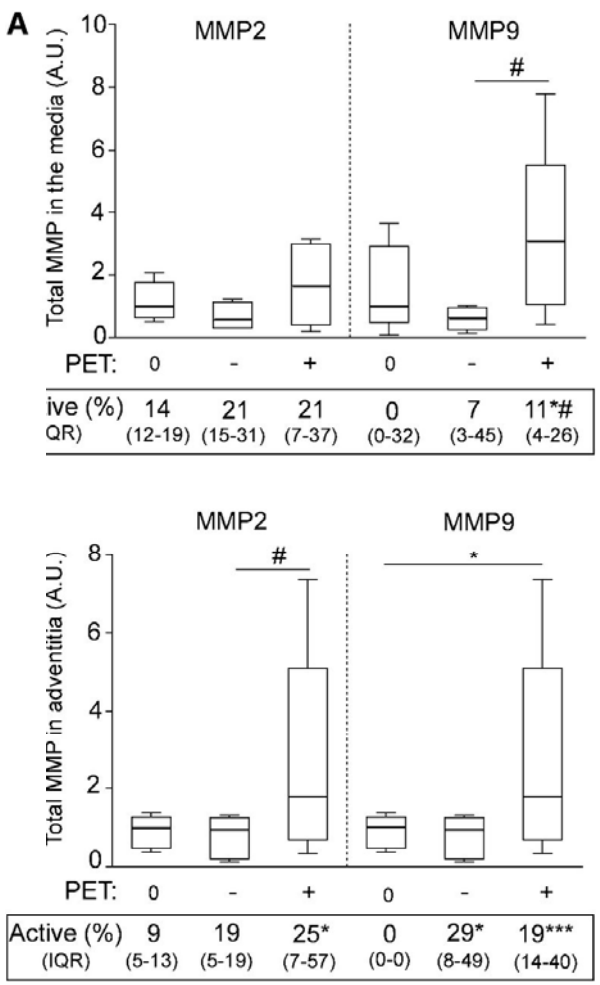
Modulated Genes at Positive Site Relative to Negative Site of PET+ Patients

Media		Adventitia	
Gene	Fold change	Gene	Fold change
ELN	0.3*	EMMPRIN	0.7*
TIMP2	0.7*	VEGF	0.7*
EMMPRIN	0.8*	TIMP2	0.9*
TGFβ	0.8*	MMP14	1.6*
TIMP1	1.8*	TSP1	1.9*
MMP1	1.8*	uPA	2.2*
MMP12	1.8*	COL1A1	5.5*
COL1A1	2.2*	MMP13	9.1†
MMP13	3.9*	MMP1	12.9

*$P < 0.05$, Wilcoxon signed rank test.
†MMP13 was not detected in negative sites of PET+ adventitia; median value in positive site was calculated using lowest value as 1.
Results are expressed as median of fold changes relative to values measured in negative site of PET+ samples.

Conclusion: High 18F-FDG Uptake in aneurysmal wall is associated with cellular and molecular alterations and rupture.





	ADVENTITIA		
	PET 0	PET +	
		- site	+ site
MMP1	1	3 §	8*
MMP2	1		
MMP3	1	3	
MMP9	1		
MMP12	nd	nd	nd
MMP13	nd	1	8 * #
MMP14	1		2 ** #
MMP15	1		
TIMP1	1		
TIMP2	1		
RECK	1		
PAI1	1	2	2 *
TIMP3	1		
uPA	1	2	2.6 * #
EMMPRI			
N	1		0.8 #
COL1A1	1		5 ** #
ELN	1		
MCP1	1		
IL1α	1		0.8 #
IL6	1	4	2
IL8	1	4	
COX2	1		
TNFα	1	0.6*	0.5 *
TGFα	1	0.8 *	0.7 *
HIF1α	1	2	2 *
CD31	1		0.7 *
VEGF	1		0.6* #
TSP1	1		
αSMA	1		

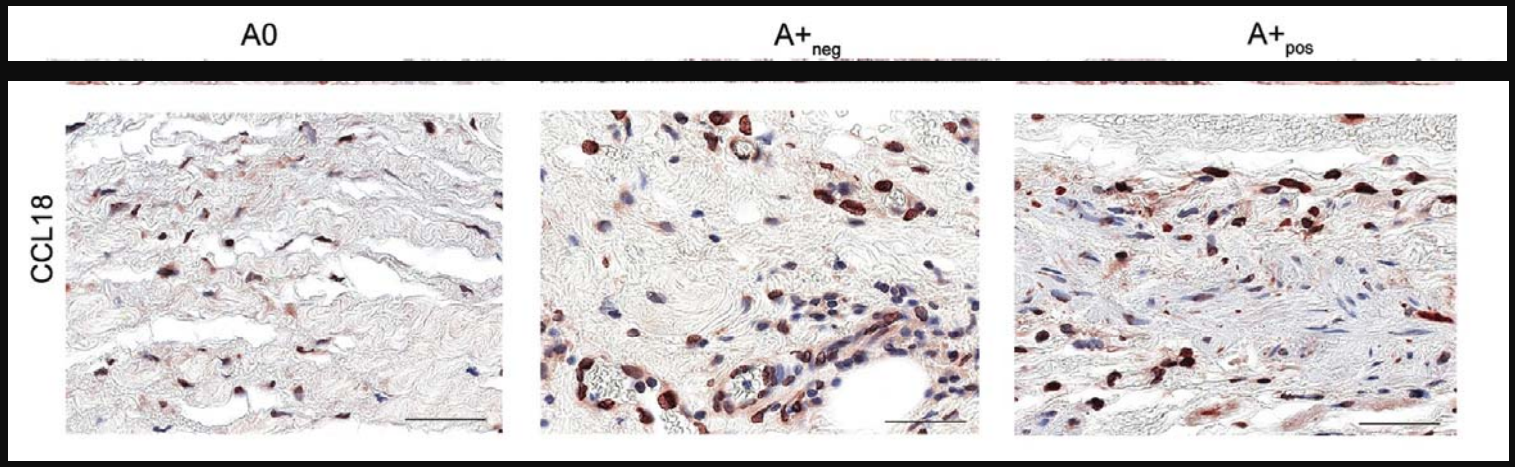
JNM The Journal of NUCLEAR MEDICINE

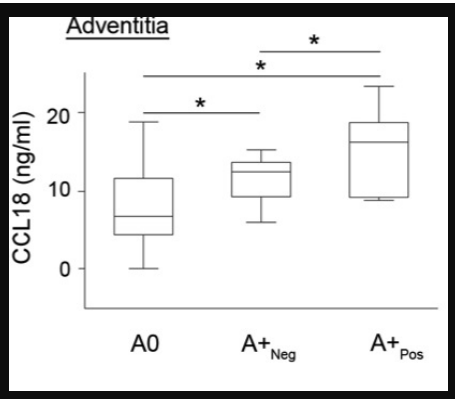
Audrey Courtois et al. J Nucl Med 2013;54:1740-1747

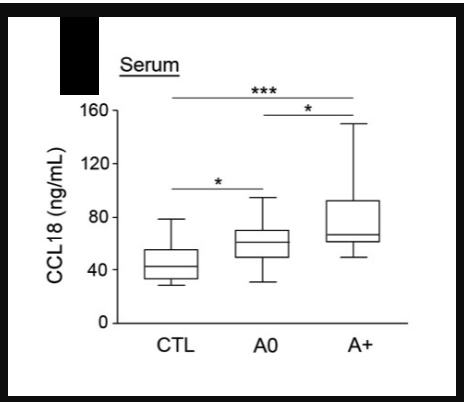
Molecular Medicine

Gene Expression Study in Positron Emission Tomography–Positive Abdominal Aortic Aneurysms Identifies CCL18 as a Potential Biomarker for Rupture Risk

Audrey Courtois,[1,2,3] Betty V Nusgens,[2] Roland Hustinx,[4] Gauthier Namur,[4,5] Pierre Gomez,[5] Helena Kuivaniemi,[6,7] Jean-Olivier Defraigne,[3] Alain C Colige,[2] and Natzi Sakalihasan[1,4*]*



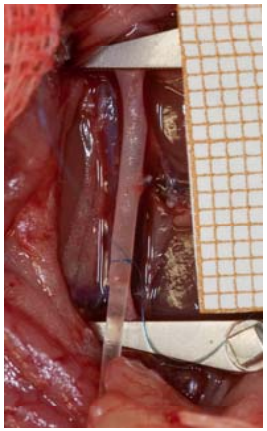


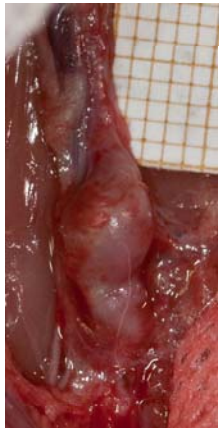


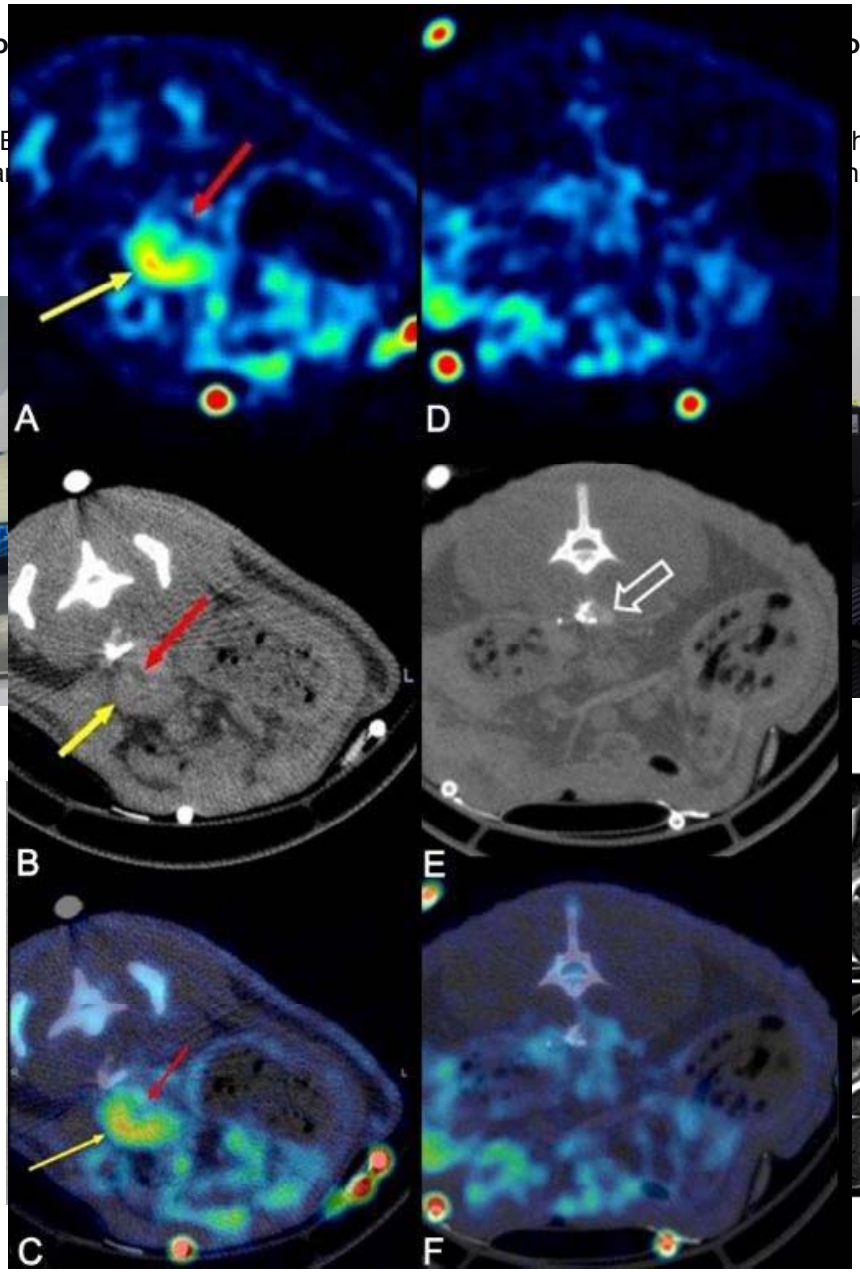
Eur Radiol. 2015 Sep 22.

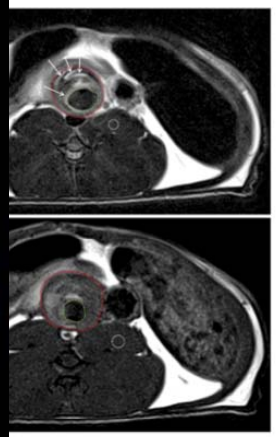
Multimodality imaging assessment o **of abdominal aortic aneurysm in a rat model**

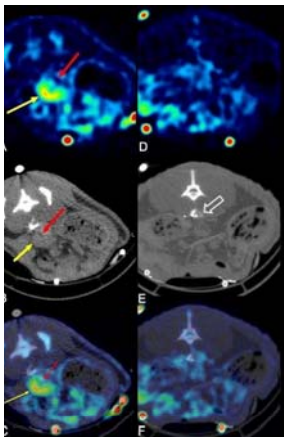
Alain Nchimi, Audrey Courtois, Mounia B hamed-Ali Bahri, Jean-Michel Dogné, Jean-Paul Cheramy-Bien, Laurent Schoysman hevaux, Natzi Sakalihasan











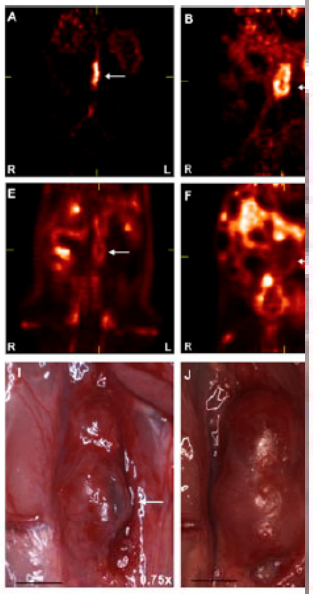
CT MRI PET-CT

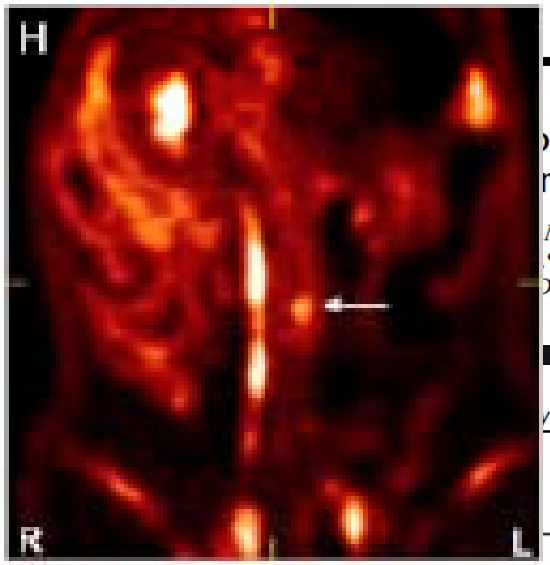
Increased ^{18}F-FD
Rat Abdo

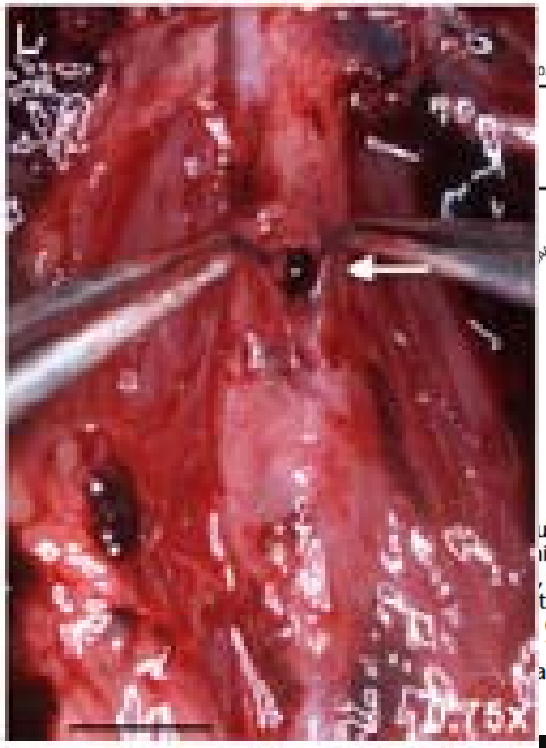
ture in a Novel
re Model

Sean J. English, MD, Moran*
Louis G. D'Alecy, PhD,§
Tessa Watt, BA, Gang Su,*

*MD,‡ Abhijit Ghosh, PhD,**
*¶ Elise P. DeRoo, BA,**
D, Gorav Ailawadi, MD,¶*







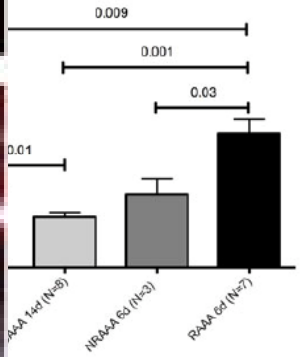


FIGURE 1. Micro-PET SUV_{max} map
rupture. Early phase represents the
scan. (A–D) Coronal cuts for early
cuts for late phase images: (E) CAA
left anterolateral AAA wall, and (H)
respective animals imaged in A–H,
6d on harvest, rupture site correlate
SUV_{max} values for left anterolateral

uptake at the site of ultimate AAA
inutes, of a 90-minute micro-PET
, and (D) RAAA 6d. (E–H) Coronal
take, with decreased uptake in the
(I–L) Harvest photographs for the
14d, (K) NRAAA 6d, and (L) RAAA
arrows identify the left kidney. (M)

566 PET-CT / 301 patients (273 male)

(2008 - 2012)

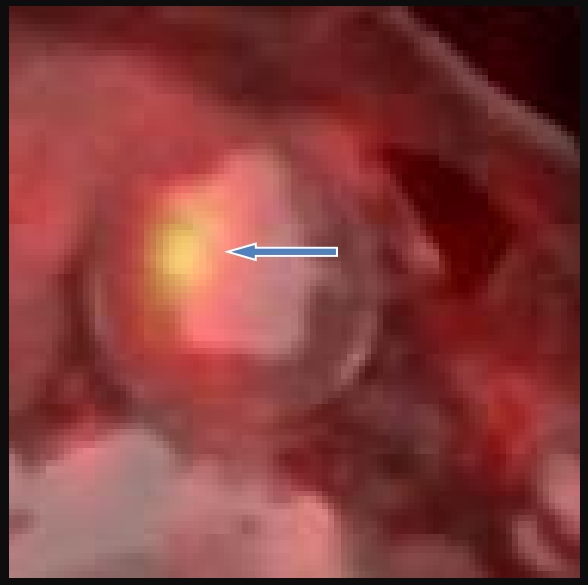
*** All patients with (+) PET (3 AAA < 55 mm)**

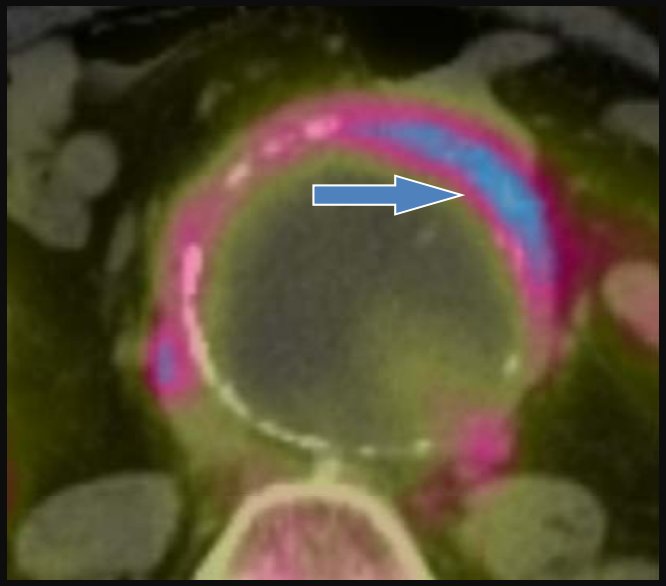
Distribution of FDG uptake according to initial Ø

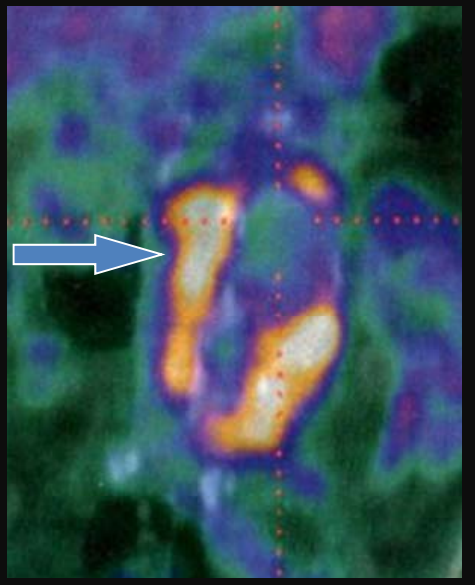
(preliminary reports)

Initial Diameter at PET-CT	FDG Uptake (+)	FDG Uptake (-)	Non - Operated	Ruptured
< 55 mm (n:201)	66	135	99	3
≥ 55 mm (n:100)	39	61	11	4
Total	105	196	110	7

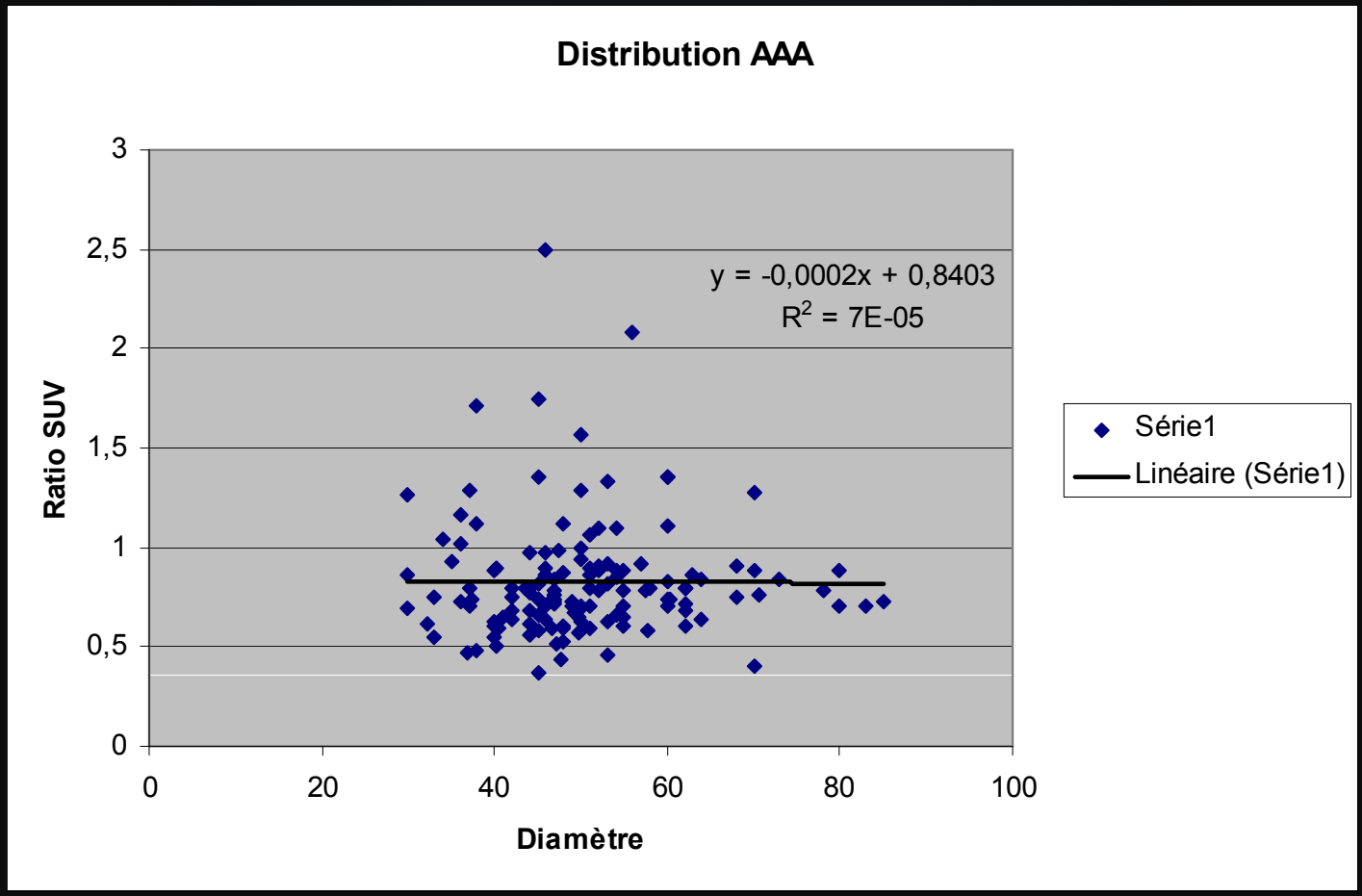
FDG uptake at the different level of the AAA wall



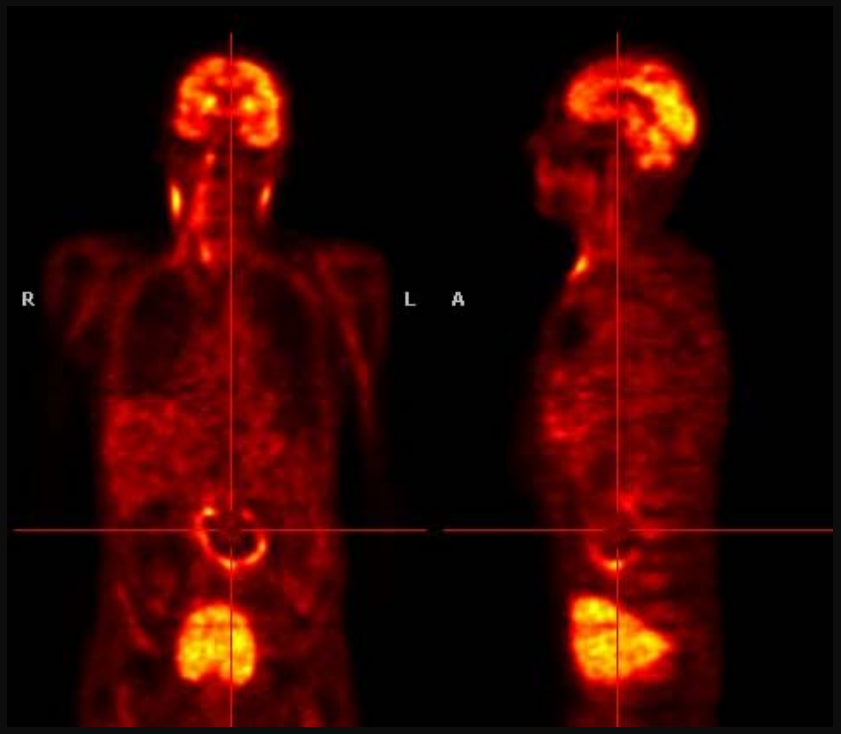


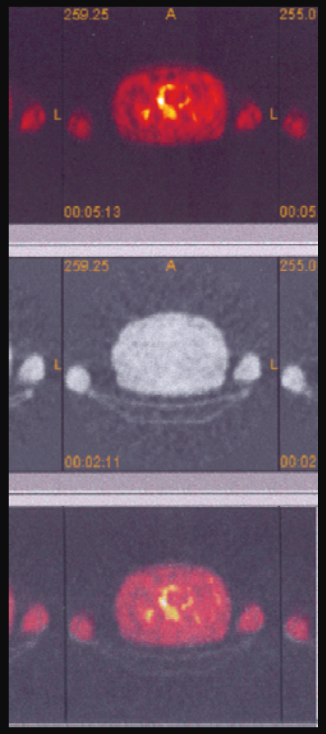


Distribution of FDG uptake according to initial Ø (preliminary reports)

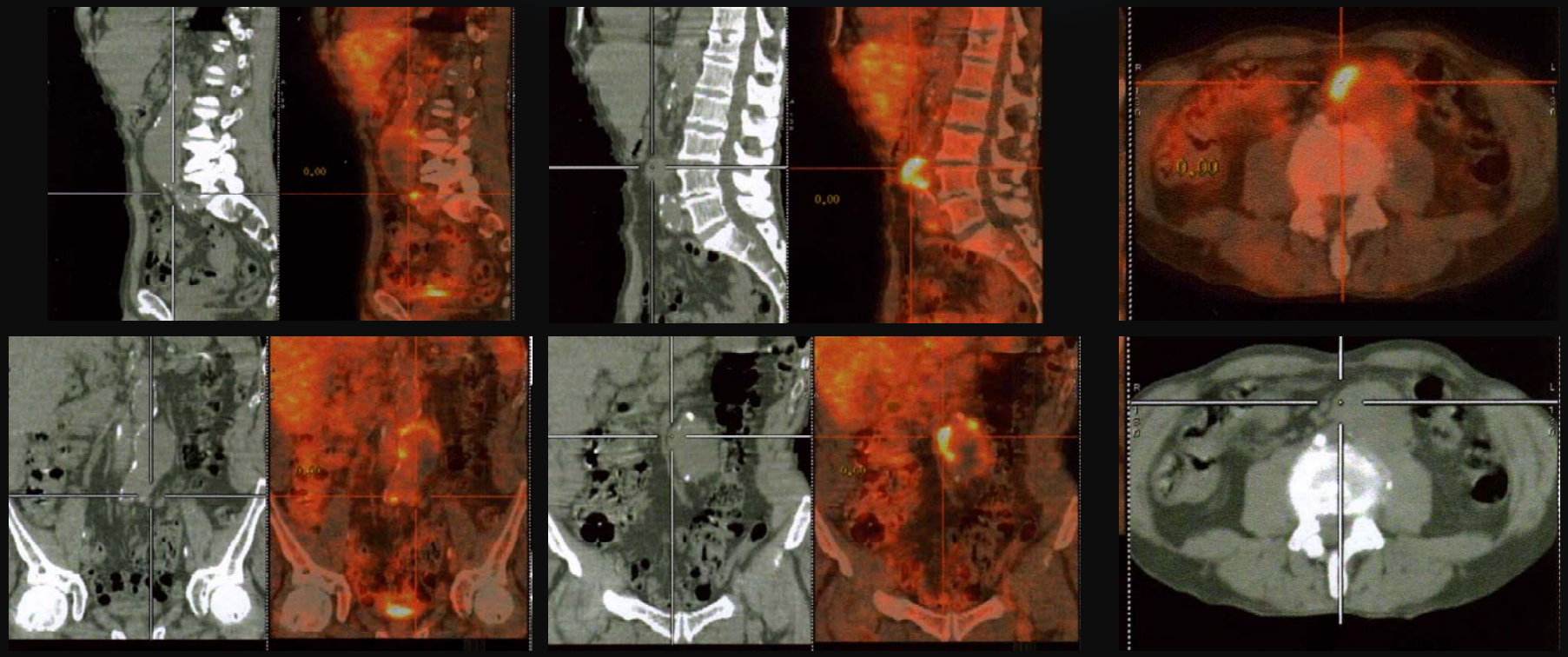


Site of abdominal aortic aneurysm rupture and High 18F-FDG uptake

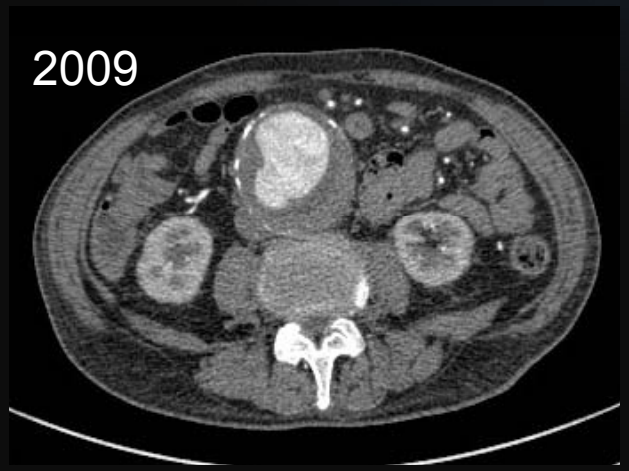


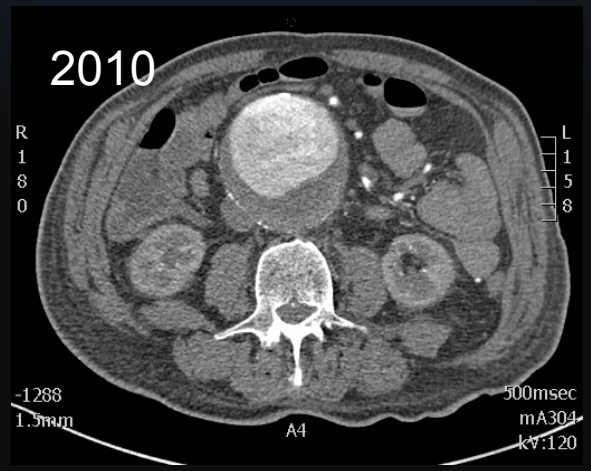


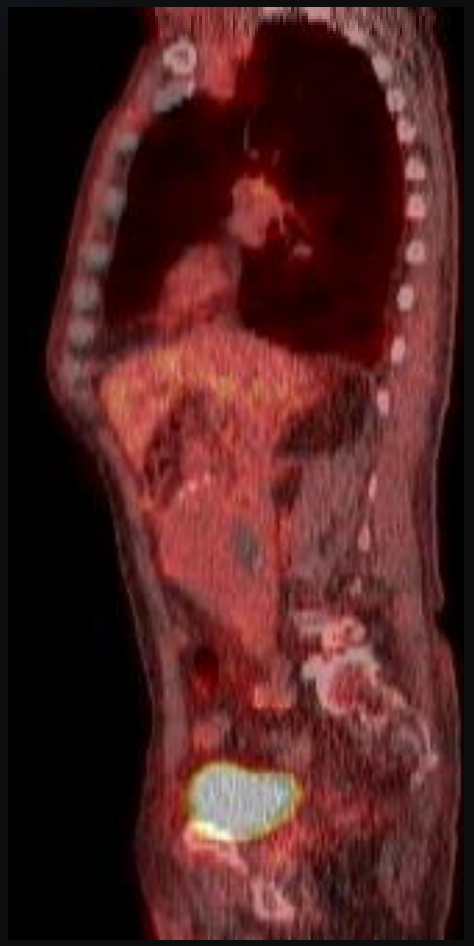
Rapid Growth and High FDG Uptake with symptomatic small AAA

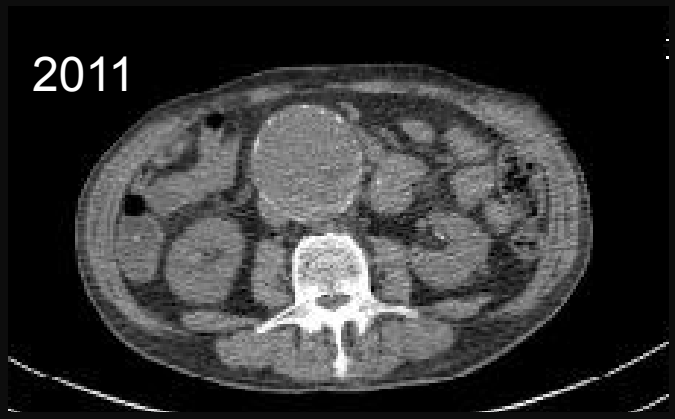


Outcome of the patient with large AAA (-) FDG uptake



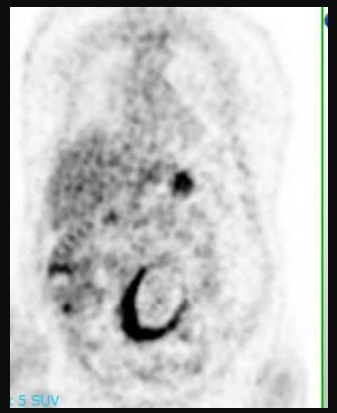


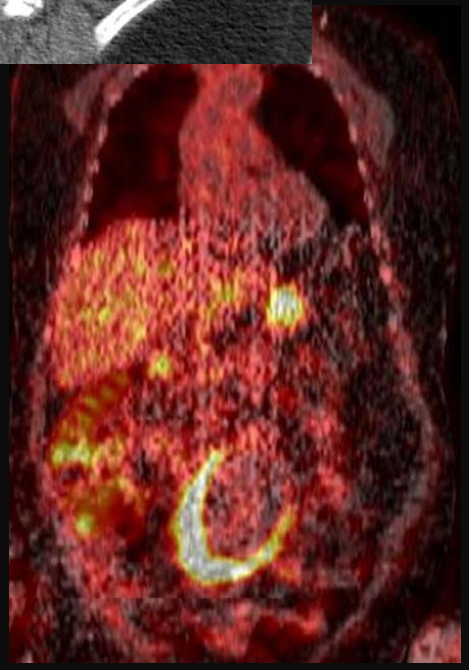


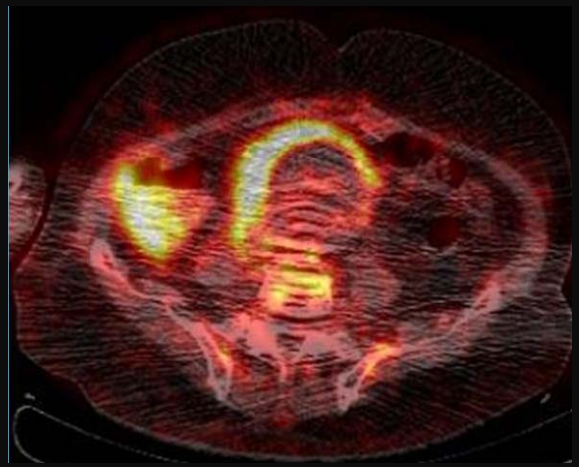


Male,74 years old

Outcome of the patient with symptomatic AAA With (+) FDG uptake







Male, 83 years

Site of abdominal aortic aneurysm rupture and High 18F-FDG uptake

Factors promoting the aortic rupture

Aneurysm rupture occurs when the mechanical stress acting on the wall exceeds the strength of the wall

INFLAMMATION

GENETICS & FAMILIAL

Aneurysms of the abdominal aorta: familial and genetic aspects in three hundred thirteen pedigrees

A. Verloes, N. Sakalihasan, L. Koulischer, and **R. Limet,** *Liège, Belgium*

Purpose: Familial clustering of abdominal aortic aneurysm was first noticed in 1977.
Methods: Through questionnaire and phone inquiry, familial data on 324 probands with abdominal aortic aneurysms allowed the establishment of 313 multigenerational pedigrees including 39 with multiple affected patients.
Results: There were 276 sporadic cases (264 men, 12 women); 81 cases belonged to multiplex pedigrees (76 men; 5 women). We compared familial and sporadic male cases; the ages at diagnosis were 64.1 ± 7.9 years and 66.0 ± 7.3 years ($p < 0.05$), respectively, the ages at rupture were 65.4 ± 6.6 years and 75.2 ± 8.6 years ($p < 0.001$), and the rupture rate was 32.4% and 8.7% ($p < 0.001$). Survival curves were computed. Relative risk for male siblings of a male patient was 18. We performed a segregation analysis with the mixed model, the most likely explanation for occurrence of abdominal aortic aneurysm in our families was a single gene effect showing dominant inheritance. The frequency of the morbid allele was 1:250, and its age-related penetrance was not higher than 0.4.
Conclusion: This analysis indicates the preeminence of genetic factors on multifactorial/environmental effects of the pathogenesis of abdominal aortic aneurysm. (J VASC SURG 1995;21:646-55.)

Descriptive statistics of 315 nuclear families with respect to their family history, sex, and position

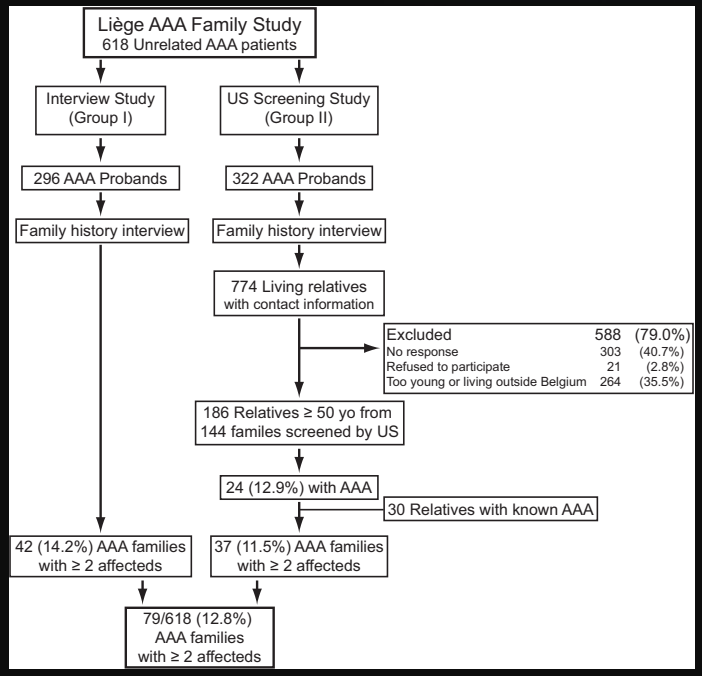
	n	AAA	Mean age of patients with AAA ± SD (yr)	Mean age of unaffected patients ± SD (yr)	Rupture (%)	Age at rupture ± SD (yr)
Total	1597	357	66.4 ± 7.8	68.1 ± 13.4	52 (14.6)	-
Familial subgroup						
Fathers	39	8	73.3 ± 7.6	71.6 ± 14.0	[illegible]	[illegible]
Mothers	39	5	73.0 ± 7.7	71.4 ± 12.7	3 (60.0)	70.8 ± 8.0
Brothers	104	68	**64.1 ± 7.9***	64.8 ± 11.5	**22 (32.4) †**	**65.4 ± 6.6‡**
Sisters	44	0	-	66.4 ± 10.6	-	-
Sporadic subgroup						
Fathers	276	0	-	69.9 ± 14.2	-	-
Mothers	276	0	-	74.4 ± 12.7	-	-
Brothers	546	264	**66.0 ± 7.3***	63.8 ± 11.5	**23 (8.7) †**	**75.2 ± 8.6‡**
Sisters	273	12	68.0 ± 12.5	66.4 ± 12.2	0 (0.0)	-

** p < 0.013*
† p < 0.001
‡ p < 0.001Age statistics are given based on censoring age or age at death for the unaffected subjects and age at diagnosis for patients with AAA.

Verloes P, Sakalihasan N, Koulischer L, Limet R. J Vasc Surg 1995

Family Members of Patients with Abdominal Aortic Aneurysms are at Increased Risk for Aneurysms: Analysis of 618 Probands and their Families from the Liège AAA Family Study

Natzi Sakalihasan, Jean-Olivier Defraigne, Marie-Ange Kerstenne, Jean-Paul Cheramy-Bien, Diane T. Smelser, Gerard Tromp, Helena Kuivaniemi



Sakalihasan N et al; Annals of Vascular Surgery (2014), doi: 10.1016/j.avsg.2013.11.005.

Factors promoting the aortic rupture (Single center (CHU) experiences)

	total	familial	sporadic	
incidence of rupture (313 probands,1995)	**14,6%**	**32%**	**8.7%**	**p < 0.0001***
incidence of rupture (618 probands,2014)	**5,9%**	**8%**	**2.4%**	**p < 0.0001****

** Verloes P, Sakalihasan N, Koulischer L, Limet R. J Vasc Surg 1995*

*** Sakalihasan N et al;* Annals of Vascular Surgery (2014), doi: 10.1016/j.avsg.2013.11.005.

Incidence of rupture in Familial and Non-Familial AAA Groups

Group	n Probands	n AAA	N rupture (%)
FAAA Group	79	188	15 (8%) *
Sporadic Group	539	539	13 (2,4%)
Total	618	727	28 (5,9%)

* P <0.0001

Sakalihasan N et al; Annals of Vascular Surgery (2014), doi: 10.1016/j.avsg.2013.11.005.

Circulation
Cardiovascular Imaging

American Heart Association®

Multifactorial Relationship Between ^{18}F-Fluoro-Deoxy-Glucose Positron Emission Tomography Signaling and Biomechanical Properties in Unruptured Aortic Aneurysms

Alain Nchimi, Jean-Paul Cheramy-Bien, T. Christian Gasser, Gauthier Namur, Pierre Gomez, Laurence Seidel, Adelin Albert, Jean-Olivier Defraigne, Nicos Labropoulos and Natzi Sakalihasan

Background—The relationship between biomechanical properties and biological activities in aortic aneurysms was investigated with finite element simulations and ^{18}F-fluoro-deoxy-glucose (^{18}F-FDG) positron emission tomography.

Methods and Results—The study included 53 patients (45 men) with aortic aneurysms, 47 infrarenal (abdominal aortic) and 6 thoracic (thoracic aortic), who had ≥1 ^{18}F-FDG positron emission tomography/computed tomography. During a 30-month period, more clinical events occurred in patients with increased ^{18}F-FDG uptake on their last examination than in those without (5 of 18 [28%] versus 2 of 35 [6%]; P=0.03). Wall stress and stress/strength index computed by finite element simulations and ^{18}F-FDG uptake were evaluated in a total of 68 examinations. Twenty-five (38%) examinations demonstrated ≥1 aneurysm wall area of increased ^{18}F-FDG uptake. The mean number of these areas per examination was 1.6 (18 of 11) in thoracic aortic aneurysms versus 0.25 (14 of 57) in abdominal aortic aneurysms, whereas the mean number of increased uptake areas colocalizing with highest wall stress and stress/strength index areas was 0.55 (6 of 11) and 0.02 (1 of 57), respectively. Quantitatively, ^{18}F-FDG positron emission tomographic uptake correlated positively with both wall stress and stress/strength index (P<0.05). ^{18}F-FDG uptake was particularly high in subjects with personal history of angina pectoris and familial aneurysm.

Conclusions—Increased ^{18}F-FDG positron emission tomographic uptake in aortic aneurysms is strongly related to aneurysm location, wall stress as derived by finite element simulations, and patient risk factors such as acquired and inherited susceptibilities. (***Circ Cardiovasc Imaging*. 2014;7:82-91.**)

Factors promoting the aortic rupture

Aneurysm rupture occurs when the mechanical stress acting on the wall exceeds the strength of the wall

INFLAMMATION

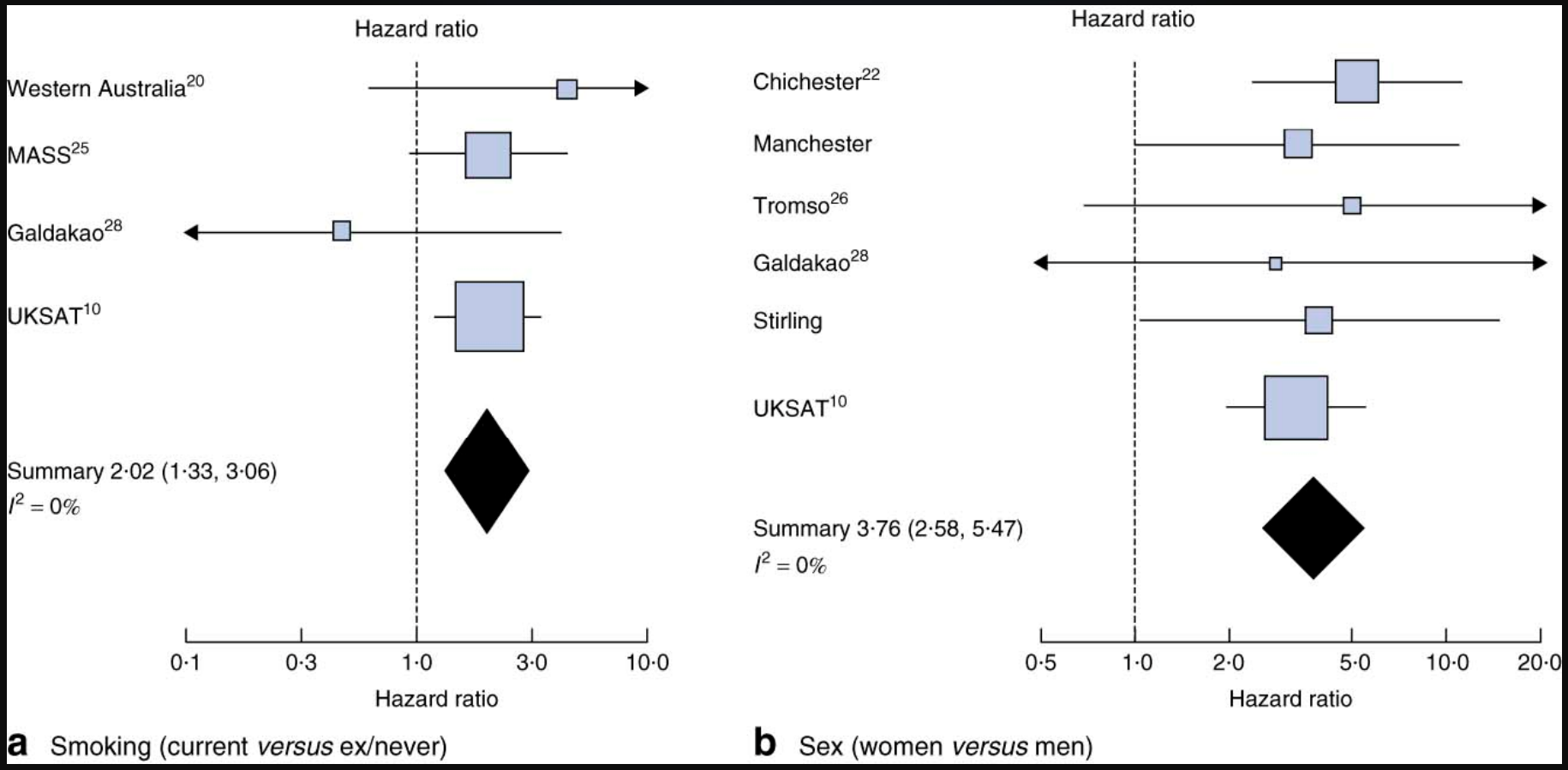
GENETICS & FAMILIAL

GENDER

SMOKING

Factors promoting the aortic rupture
gender & smoking

Meta-analysis of individual patient data to examine factors affecting growth and rupture of small abdominal aortic aneurysms



Sweeting MJ, Thompson SG, Brown LC, Powell J;RESCAN collaborators

British Journal of Surgery;Volume 99, Issue 5, pages 655-665, 5 MAR 2012 DOI: 10.1002/bjs.8707

Factors promoting the aortic rupture
gender

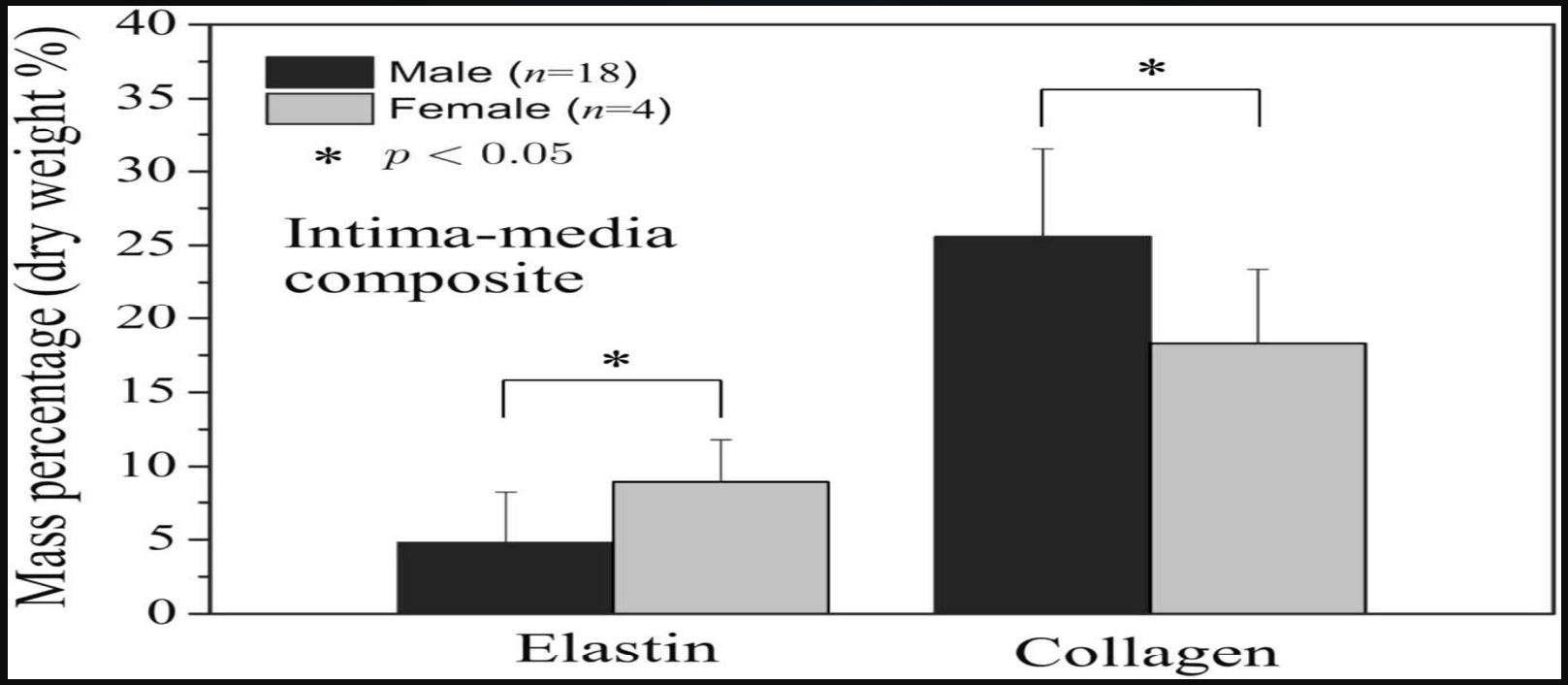


Figure 6 Mass fractions of elastin and collagen within the thrombus-covered intima-media composite for male and female patients. Significant differences are noted for the dry weight percentages of both elastin and collagen between male and female.

J. Tong , A.J. Schriefl , T. Cohnert , G.A. Holzapfel

Gender Differences in Biomechanical Properties, Thrombus Age, Mass Fraction and Clinical Factors of Abdominal Aortic Aneurysms

European Journal of Vascular and Endovascular Surgery Volume 45, Issue 4 2013 364 - 372
http://dx.doi.org/10.1016/j.ejvs.2013.01.003

Factors promoting the aortic rupture

gender

The risk of rupture in untreated aneurysms: The impact of size, gender, and expansion rate

Peter M. Brown, MD, David T. Zelt, MD, and Boris Sobolev, PhD, Kingston, Ontario, Canada

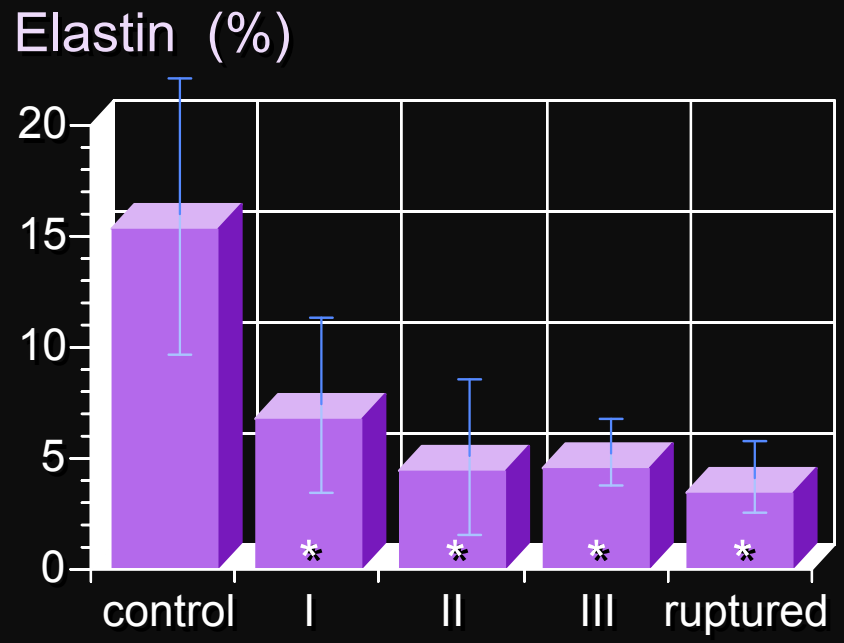
Objective: The purpose of this study was to establish the risk of rupture as related to size of abdominal aortic aneurysm (AAA), gender, and expansion of the aneurysm.

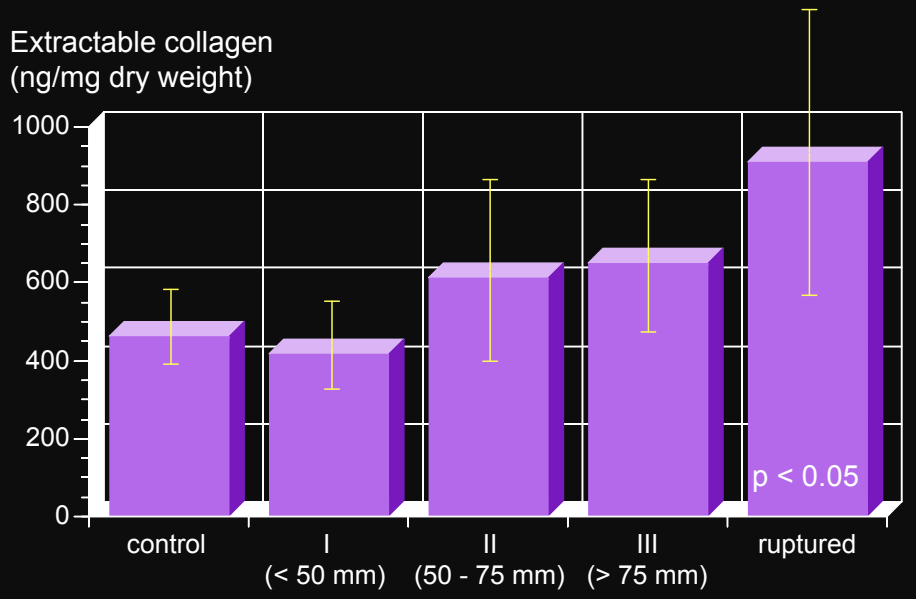
Methods: Between 1976 and 2001, 476 patients with conditions considered unfit for surgery with AAA 5.0 cm or more were followed with computed tomographic scans every 6 months until rupture, surgery, death, or deletion from follow-up. Surgery was performed for rupture (n 22), improved medical condition (n 37), increase in size (n 95), symptoms (n 17), and other reasons (n 24).

Results: Fifty ruptures occurred during the follow-up period. The average risk of rupture (and standard error) in male patients with 5.0-cm to 5.9-cm AAA was 1.0% (0.01%) per year, in female patients with 5.0-cm to 5.9-cm AAA was 3.9% (0.15%) per year, in male patients with 6.0-cm or greater AAA was 14.1% (0.18%) per year, and in female patients with 6.0-cm or greater AAA was 22.3% (0.95%) per year.

Conclusion: **The risk of rupture in male patients with AAA 5.0 to 5.9 cm is low. The four-time higher risk of rupture in female patients with AAA 5.0 to 5.9 cm suggests a lower threshold for surgery be considered in fit women.** The data regarding risk of rupture in patients with AAA 6.0 cm or more may allow more appropriate decision analysis for surgery in patients with unfit conditions with large AAA. (J Vasc Surg 2003;37:280-4.)

MODIFICATIONS OF THE EXTRACELLULAR MATRIX OF ANEURYSMAL ABDOMINAL AORTAS AS A FUNCTION OF THEIR SIZE

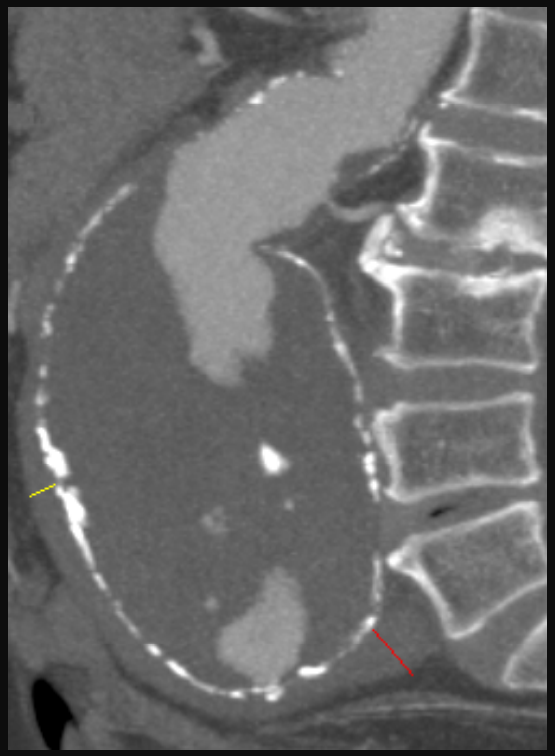


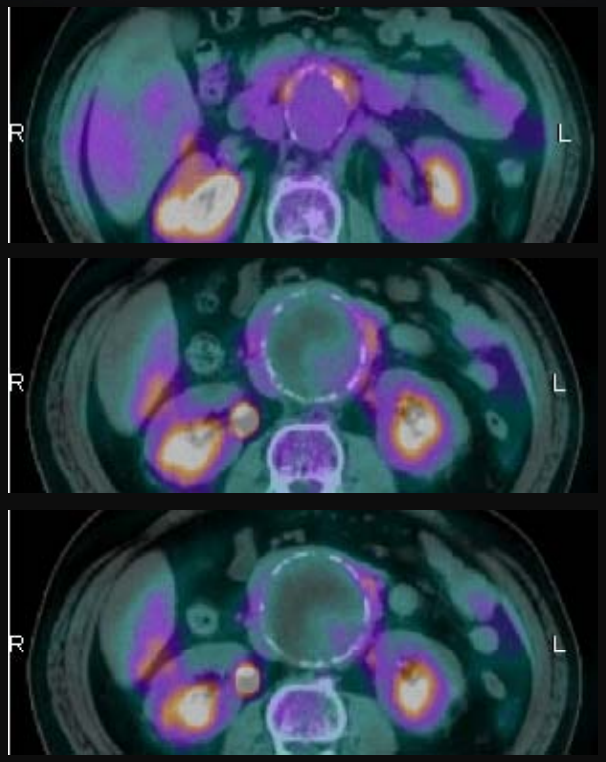


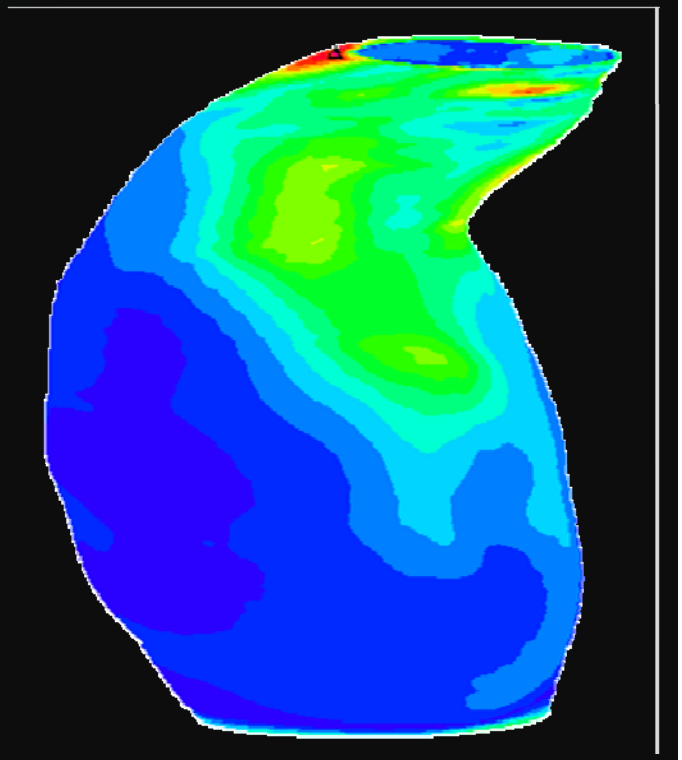
Sakalihasan et al, Eur J Vasc Surg 1993;7:633-637

RUPTURE INDICATOR STUDY

(CHU Liège & Imperial College London)





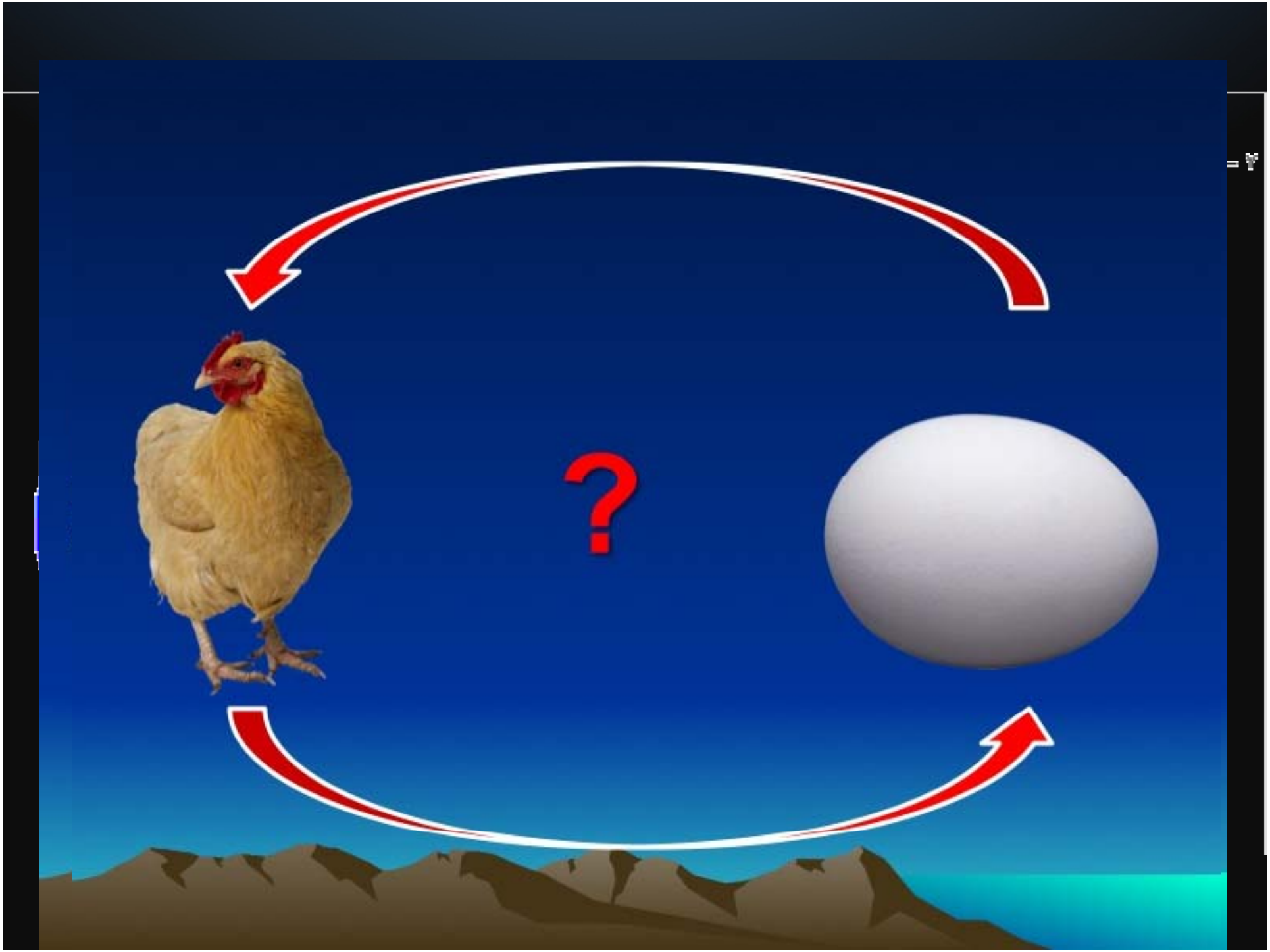


Sakalihasan N et al, Eur J Vasc Endovasc Surg 2002

Sakalihasan N et al, Sem Vasc Surg 2004

Defawe OD,.. Sakalihasan N, Clin Nucl Med 2005

Xu Y,. Sakalihasan N Eur J Vasc Endovasc Surg 2010.



Hypothetical Mechanism of AAA Stabilisation

Environmental Factors

Hemodynamic Stress

Humoral Factors

Inhibition

vascular cells

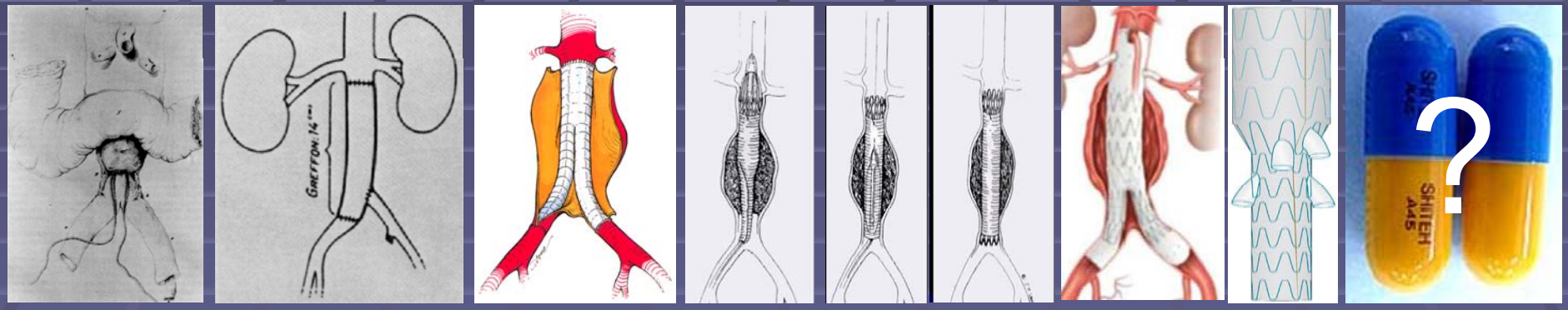
Signaling Pathway

MMPs

Destruction of Extracellular Mattrix

Progression of AAA

Past and future of Endovascular aneurysm repair
&
(the role of PET/CT)



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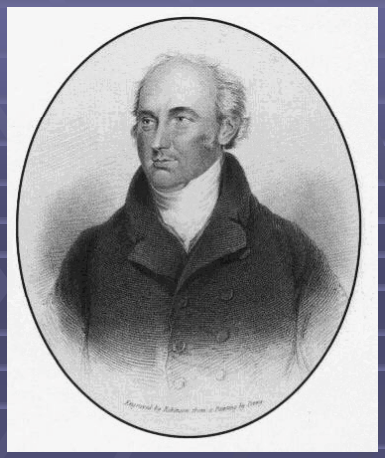
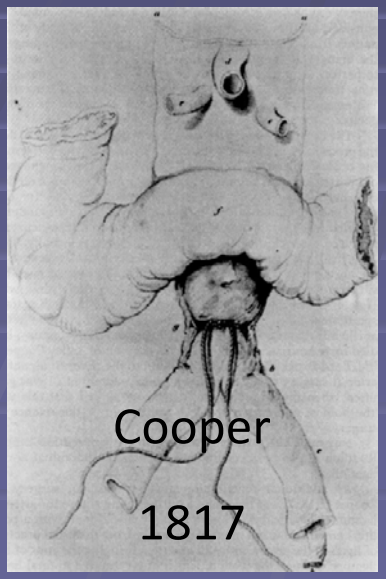
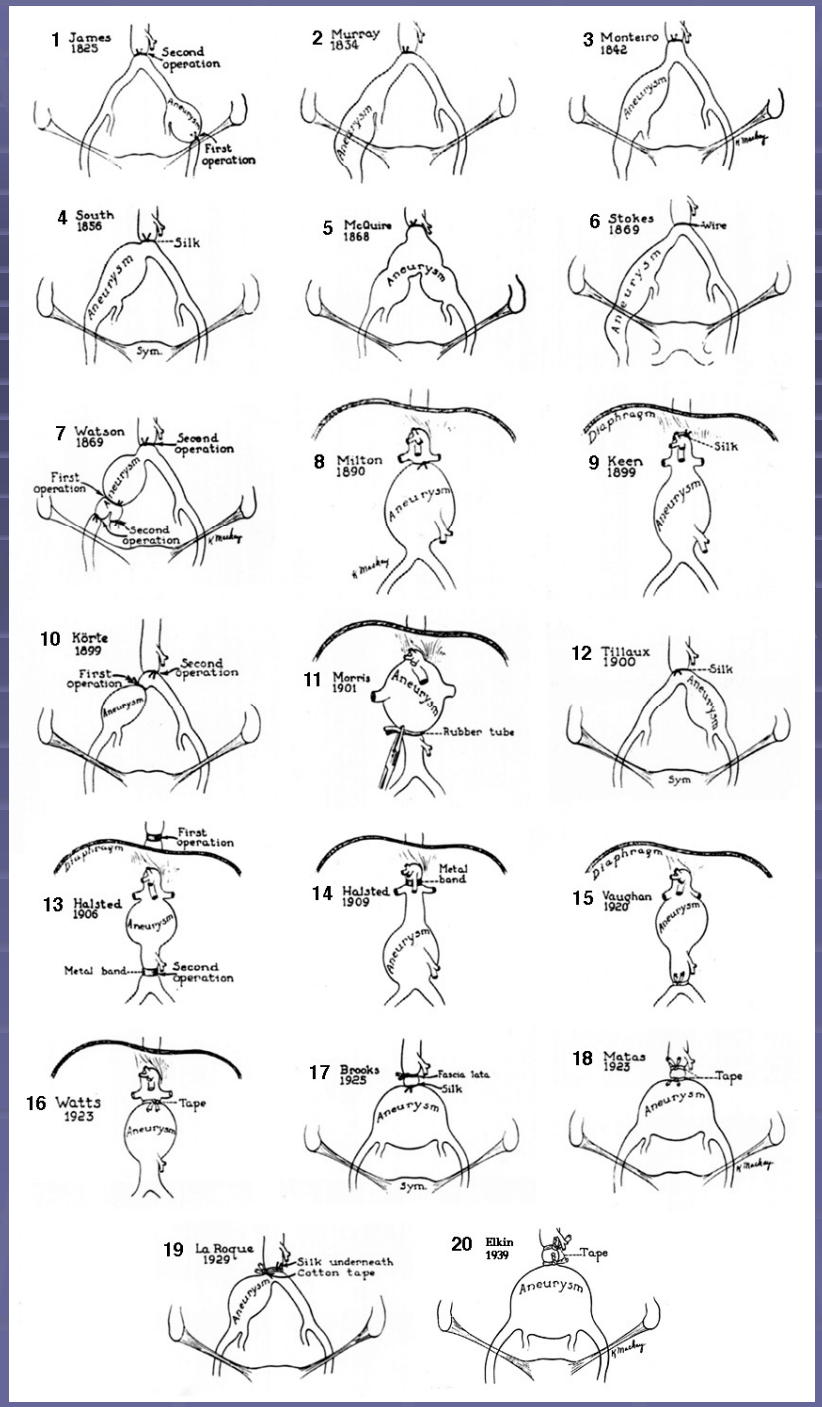
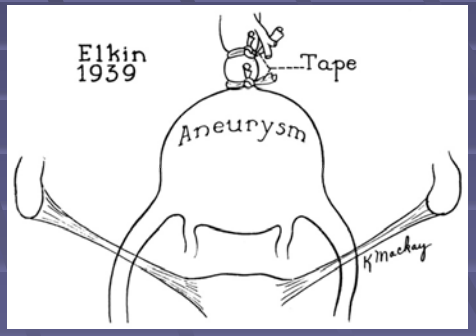
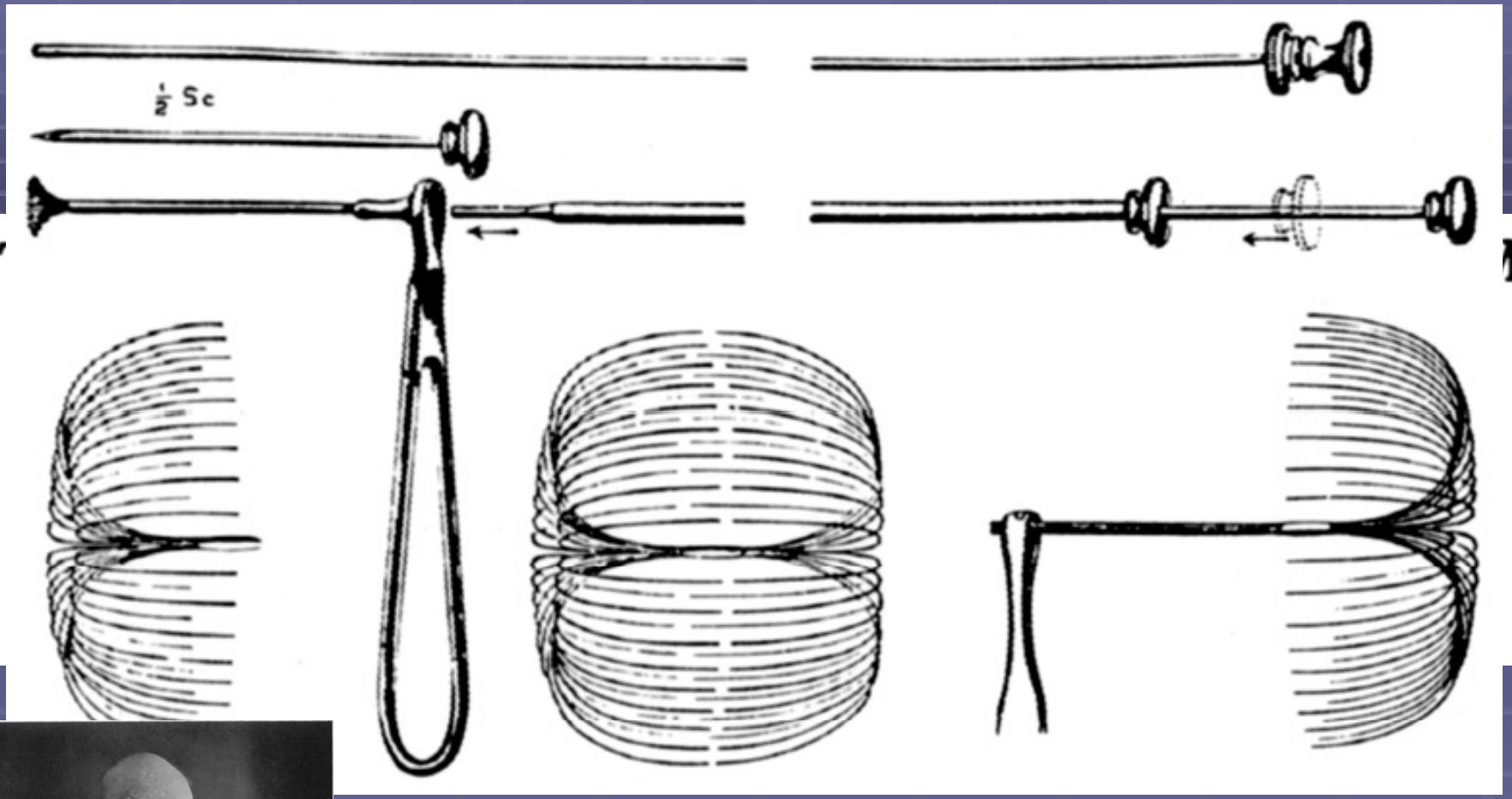
Liège, BELGIUM

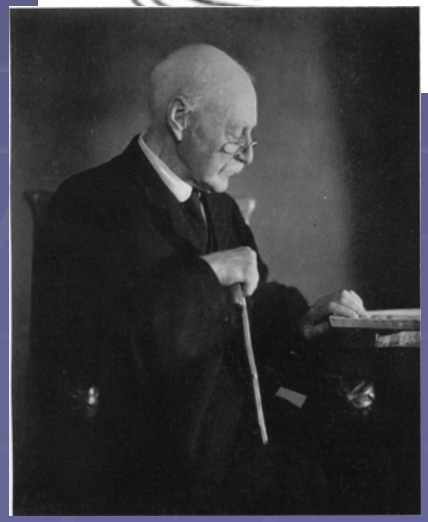


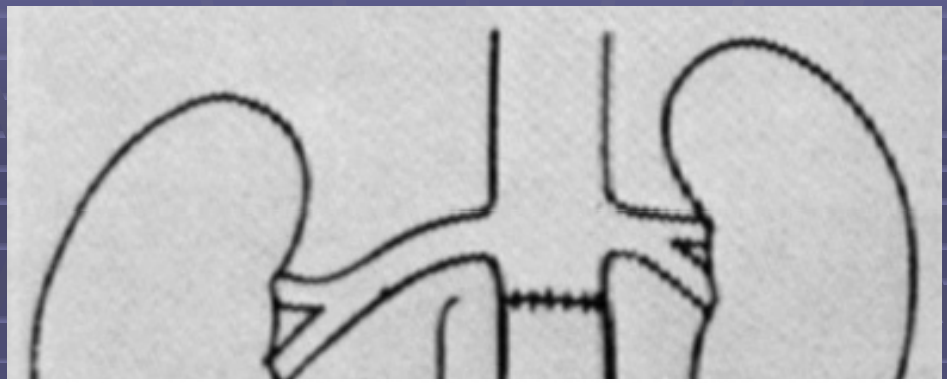

Cooper
1817

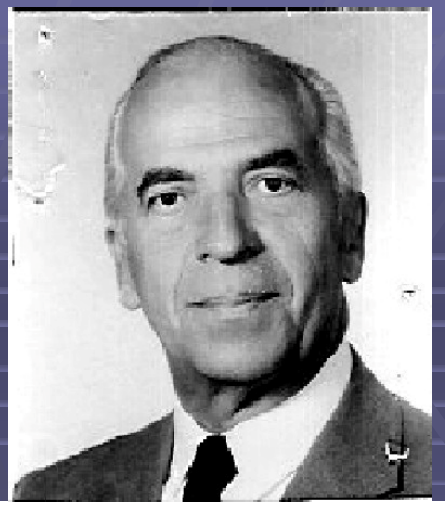

1 James 1825
Second operation
First operation
Aneurysm
2 Murray 1834
Aneurysm
3 Monteiro 1842
Aneurysm
4 South 1856
Silk
Aneurysm
Sym.
5 McGuire 1868
Aneurysm
6 Stokes 1869
Wire
Aneurysm
7 Watson 1869
Second operation
First operation
Aneurysm
Second operation
8 Milton 1890
Aneurysm
9 Keen 1899
Diaphragm
Silk
Aneurysm
10 Körte 1899
First operation
Second operation
Aneurysm
11 Morris 1901
Aneurysm
Rubber tube
12 Tillaux 1900
Silk
Aneurysm
Sym
13 Halsted 1906
First operation
Diaphragm
Aneurysm
Metal band
Second operation
14 Halsted 1909
Metal band
Aneurysm
15 Vaughan 1920
Diaphragm
Aneurysm
16 Watts 1923
Tape
Aneurysm
17 Brooks 1925
Fascia lata
Silk
Aneurysm
Sym.
18 Matas 1925
Tape
Aneurysm
19 La Roque 1929
Silk underneath
Cotton tape
Aneurysm
20 Elkin 1939
Tape
Aneurysm


Elkin
1939
Tape
Aneurysm


½ Sc







RESECTION OF AN ANEURYSM OF THE ABDOMINAL AORTA

Reestablishment of the Continuity by a Preserved Human Arterial Graft, with Result After Five Months

CHARLES DUBOST, M.D.

MICHEL ALLARY, M.D.

AND

NICOLAS OECONOMOS, M.D.

PARIS, FRANCE

Arch Mal Coeur Vaiss. 1951 Sep;44(9):848-51.

SURGERY

GYNECOL STETRICS

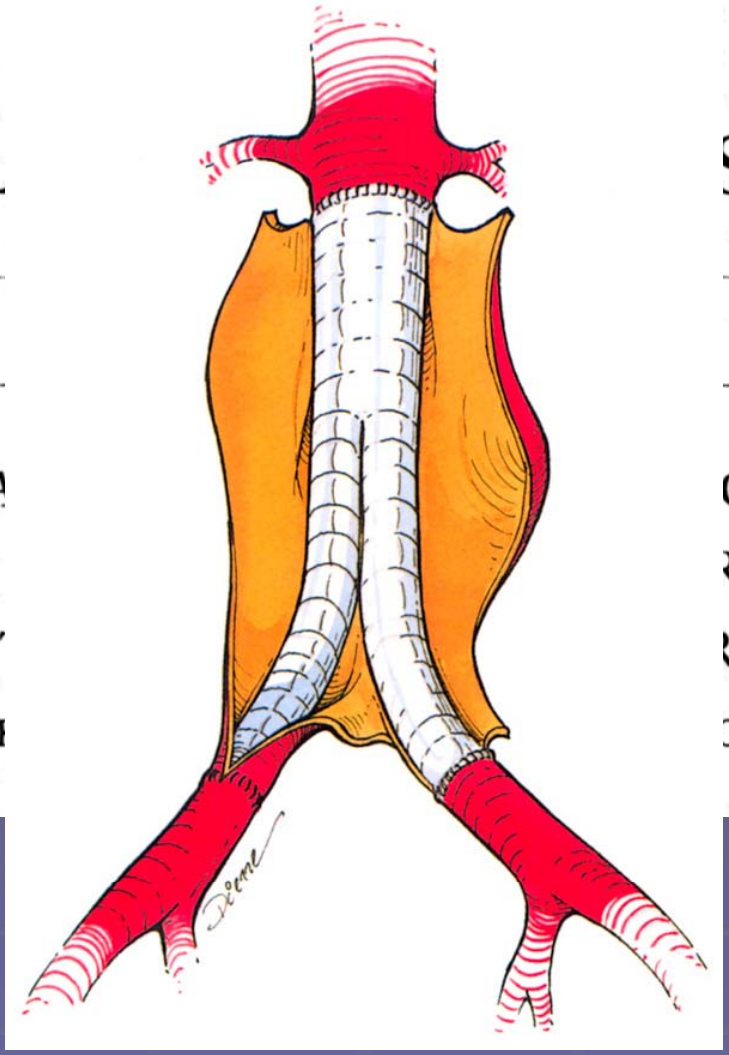
VOLUME 97 NUMBER 3

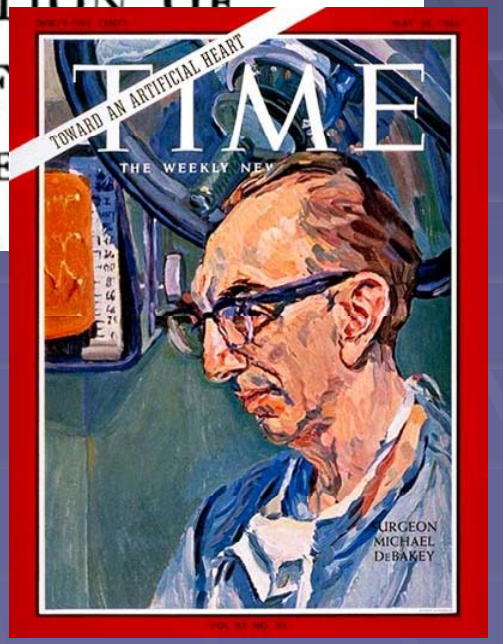
SURGICAL TREA OF ABDOMINAL

AORTA BY RATION OF

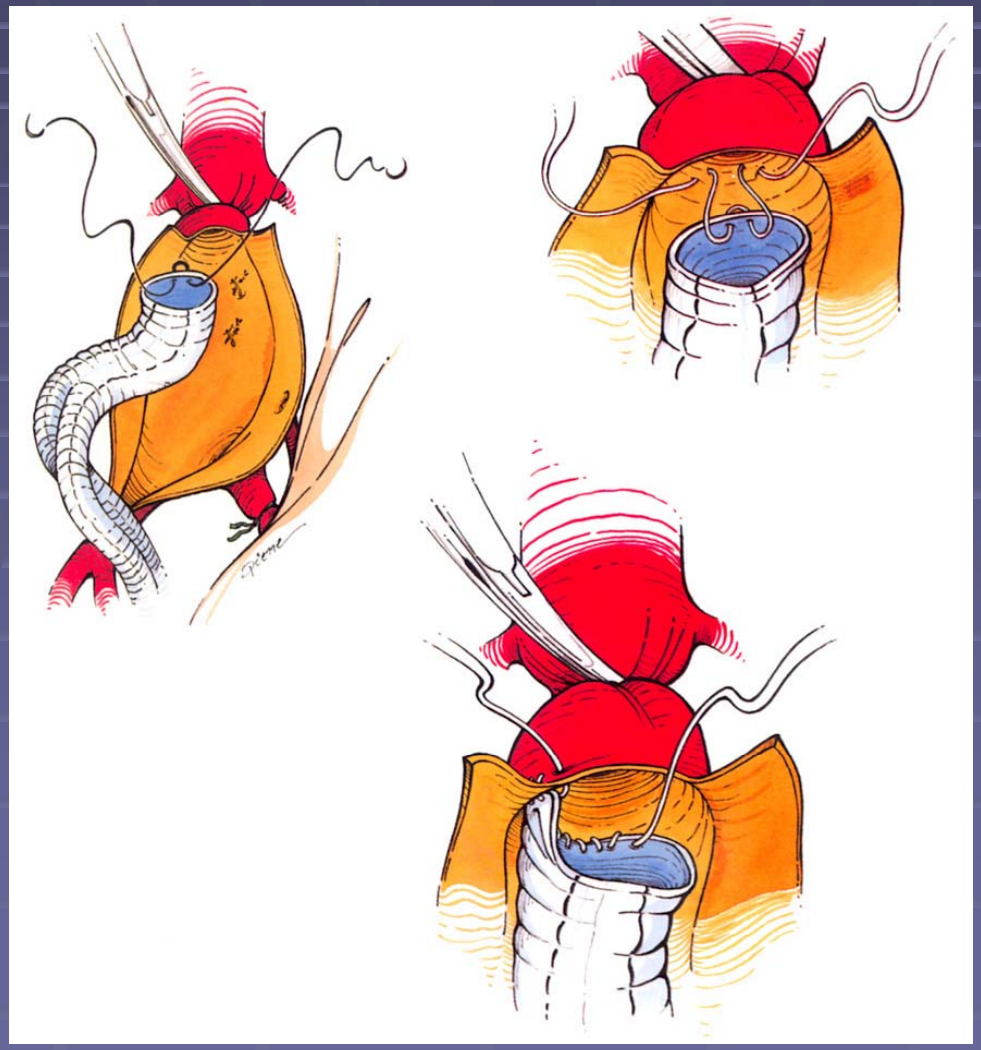
CON RAF

MICHAEL E. DE BA OLE

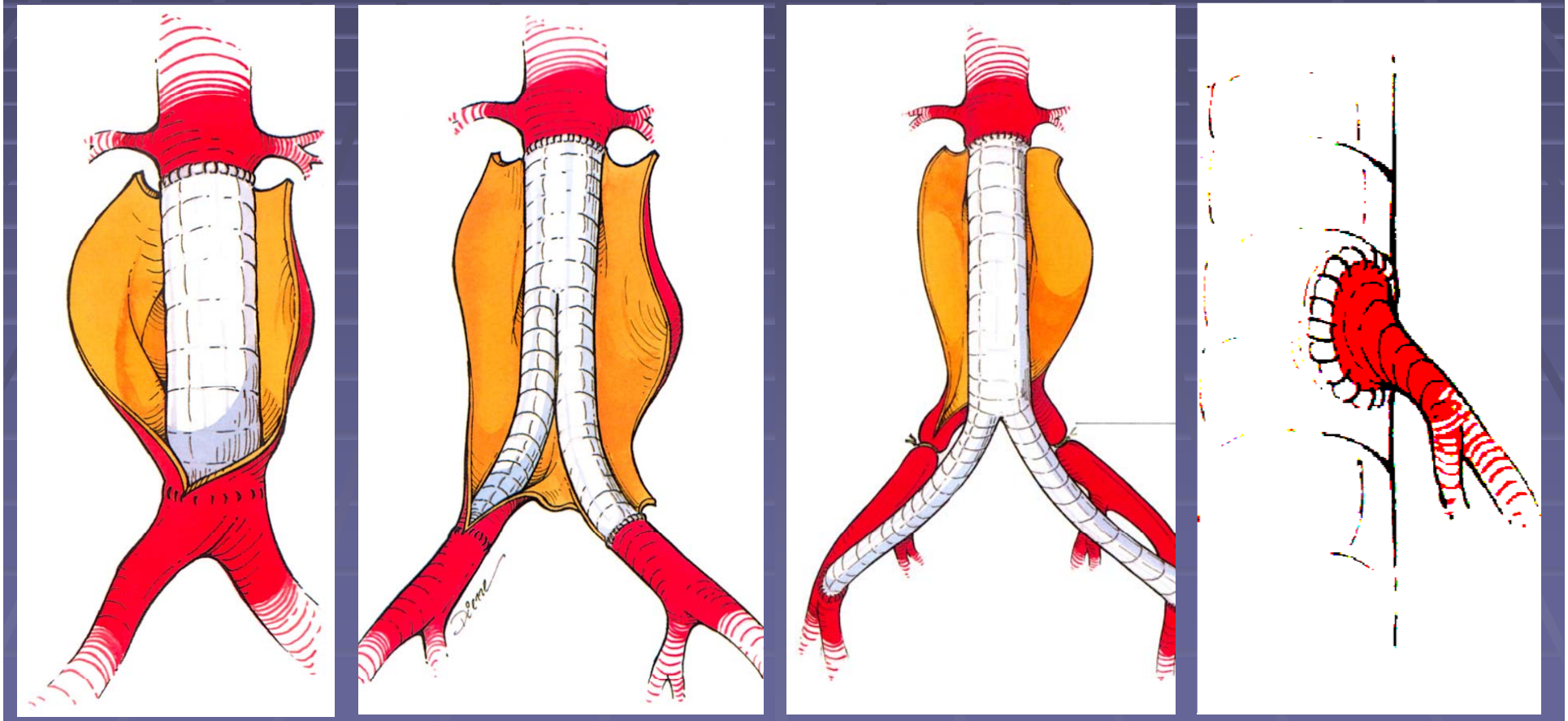




SURGICAL TREATMENT OF AAA



SURGICAL TREATMENT OF AAA



Dr. Nicholay Volodos.

☐ 1: Vestn Khir Im I I Grek. 1986 Nov;137(11):123-5.

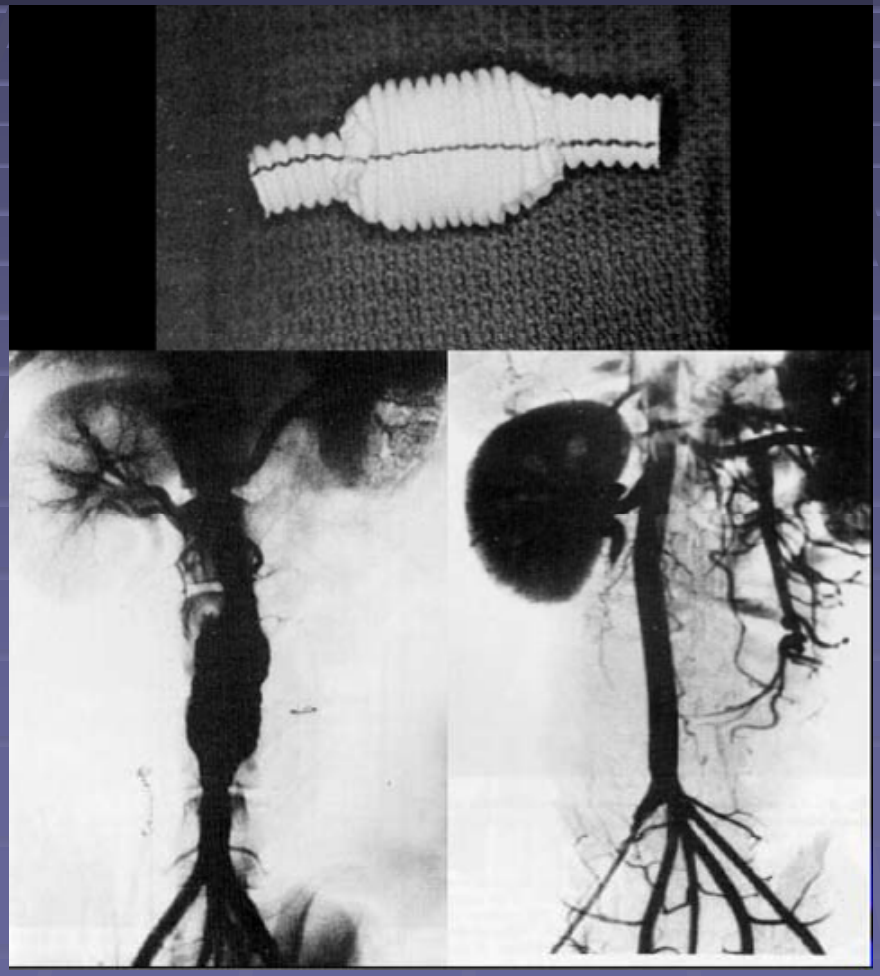
[A self-fixing synthetic blood vessel endoprosthesis]

[Article in Russian]

Volodos' NL, Shekhanin VE, Karpovich IP, Troian VI, Gur'ev IuA.

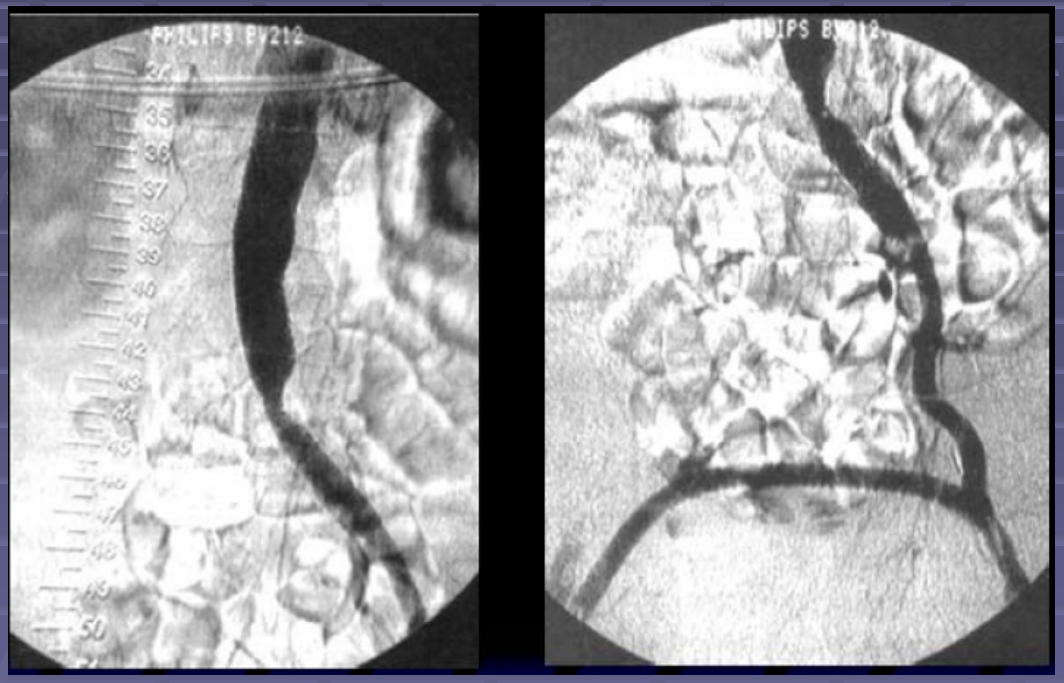
- Second Prototype (1988)

Palmaz stent and Dacron or EPTFE



Parodi Palmaz 1989

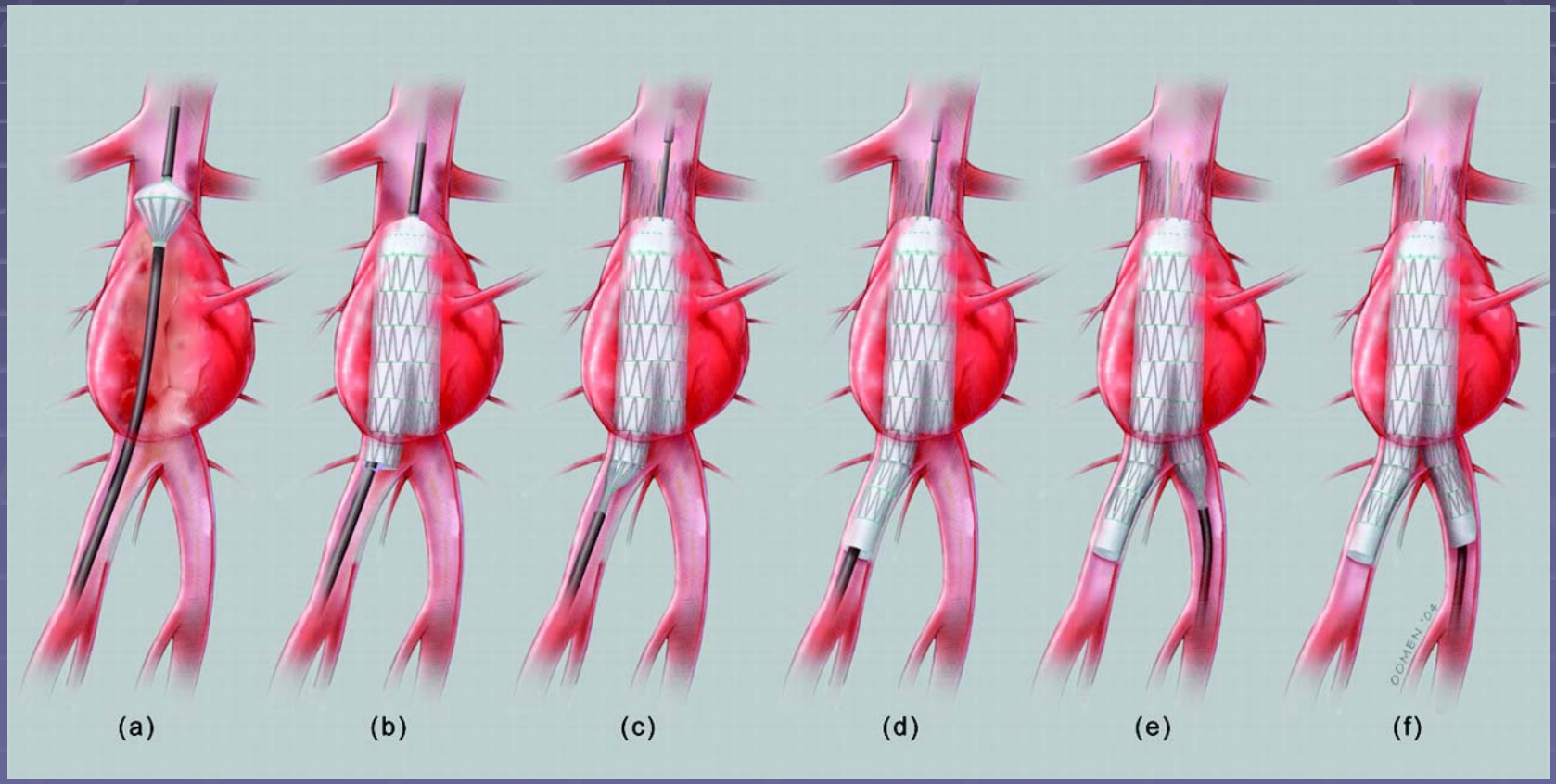
Aorto-Uni-Iliac EVAR 1991



"Transfemoral Intraluminal Graft Implantation for Abdominal Aortic Aneurysms"

Parodi JC, Palmaz JC, Barone HD
Ann Vasc Surg 5:491-499, 1991

EVAR of AAA



Stent graft families

APTUS, INC.
- Aptus[a]

COOK MEDICAL
- Zenith
- Zenith Flex
- Zenith LP[a]

CORDIS CORPORATION
- Incraft[a]

ENDOLOGIX
- Powerlink
- Nellix[a]

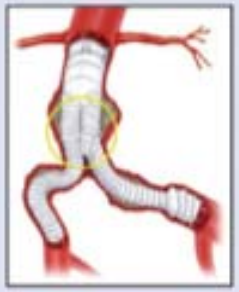
GORE & ASSOCIATES
- Excluder

LOMBARD
- Aorfix[a]

MEDTRONIC, INC.
- AneuRx
- Talent
- Endurant

TRIVASCULAR
- Ovation[a]

VASCUTEK
- Anaconda[a]



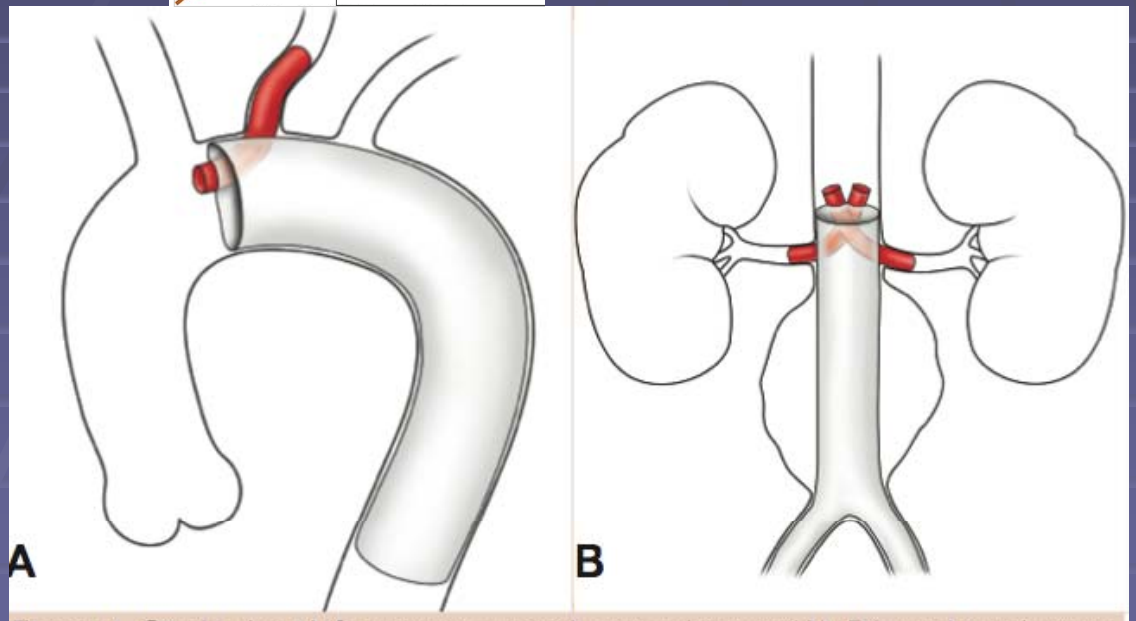


Figure 1. Single short left common carotid artery chimney (A). Bilateral renal artery chimneys (B).

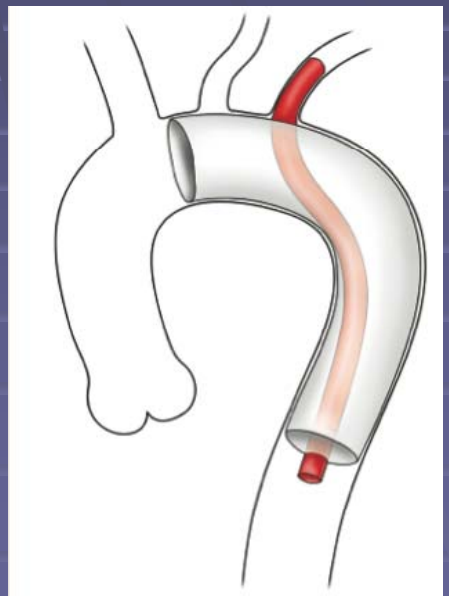
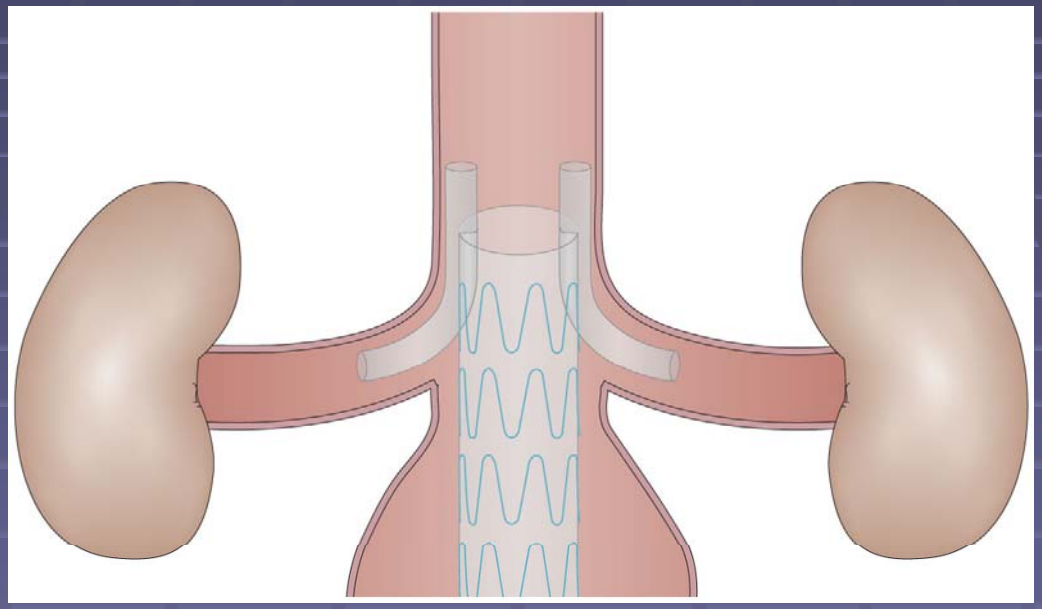


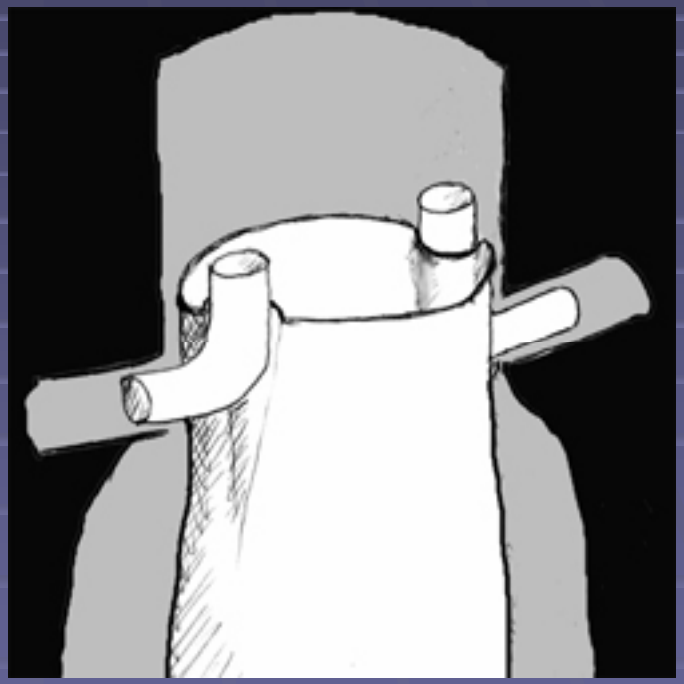
Figure 2. Long periscope graft for the left subclavian artery.

A chimney graft

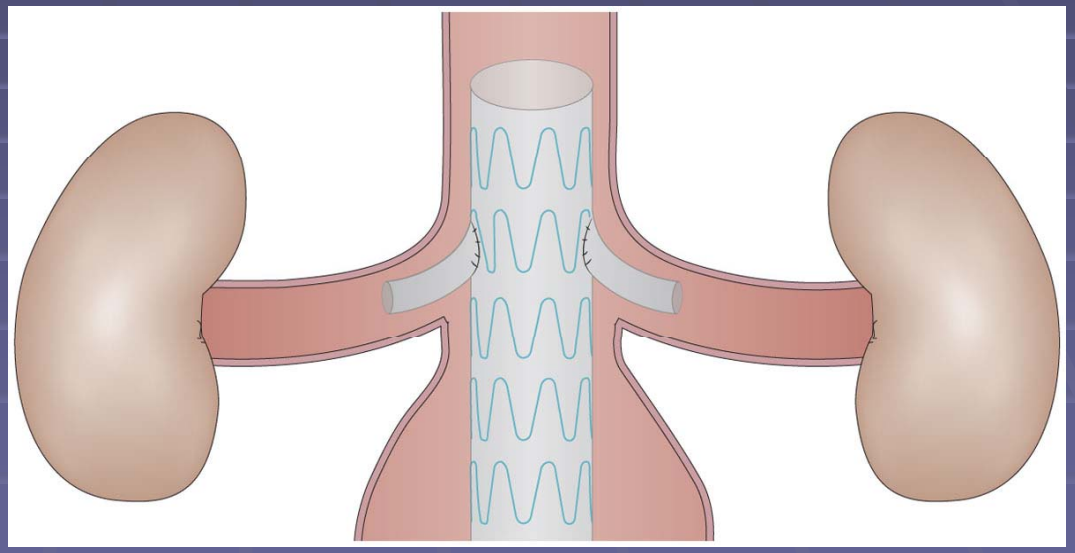


Buck, D. B. *et al.* (2013) Endovascular treatment of abdominal aortic aneurysms
Nat. Rev. Cardiol. doi:10.1038/nrcardio.2013.196

nature REVIEWS CARDIOLOGY

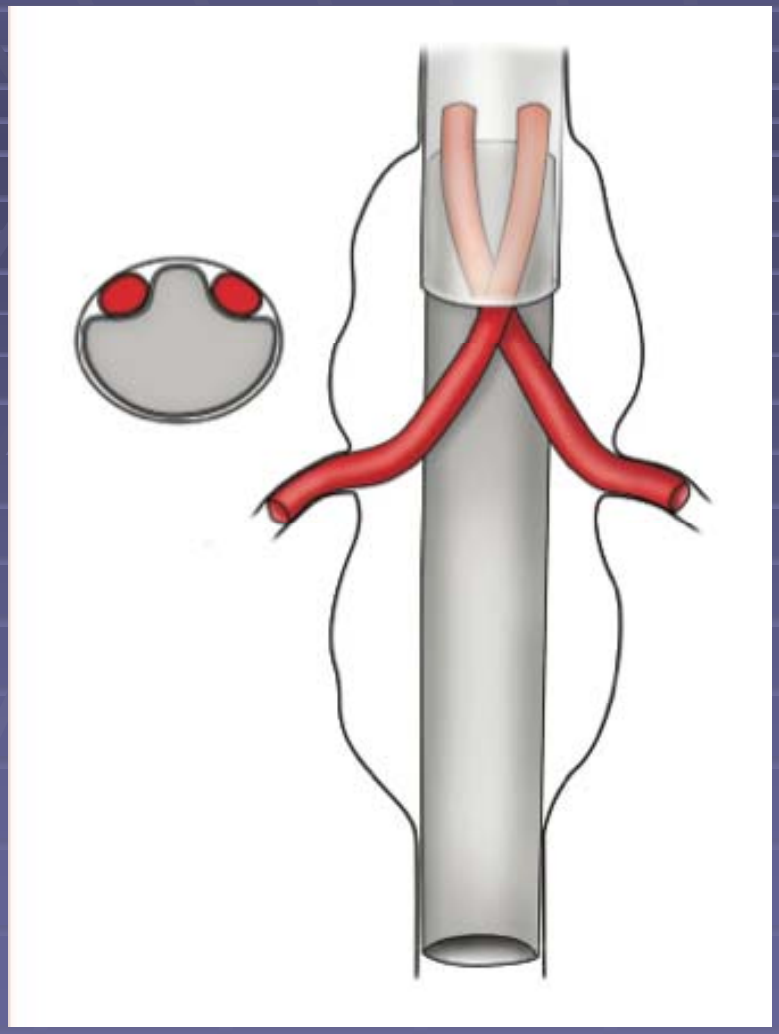


A fenestrated stent graft

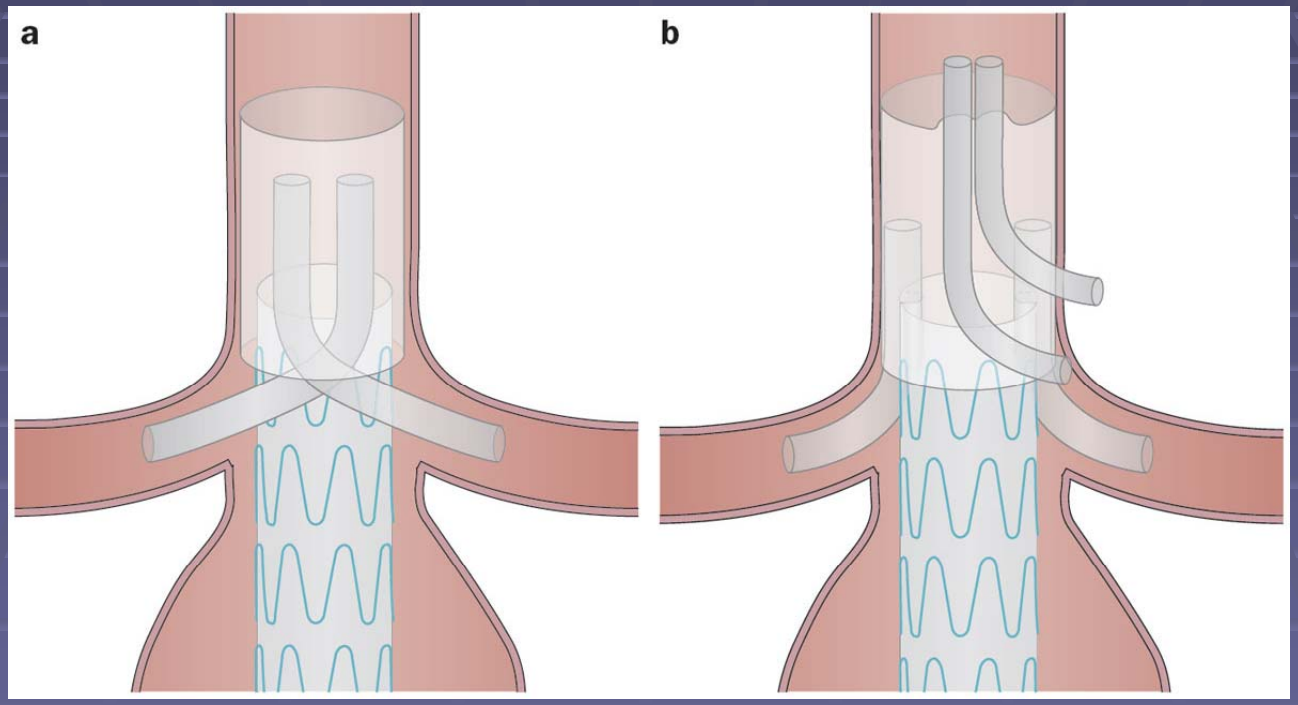


Buck, D. B. *et al.* (2013) Endovascular treatment of abdominal aortic aneurysms
Nat. Rev. Cardiol. doi:10.1038/nrcardio.2013.196

nature REVIEWS CARDIOLOGY



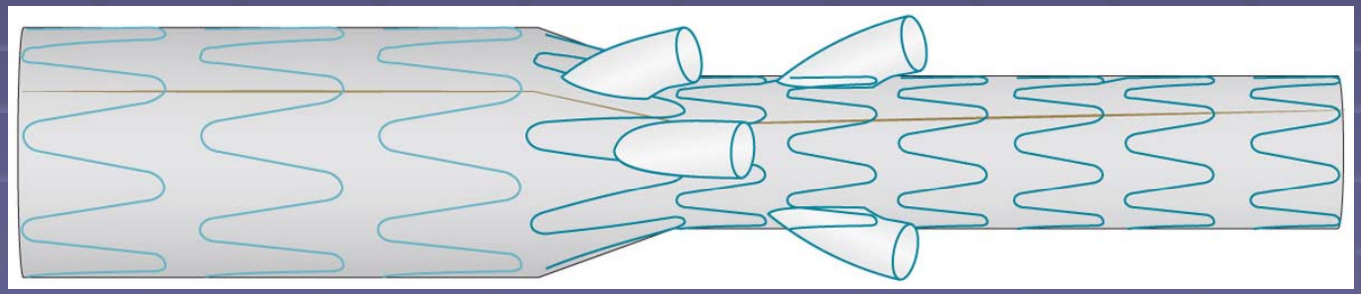
Endovascular aneurysm repair strategies that enable the revascularization of up to four aortic side branches



Buck, D. B. *et al.* (2013) Endovascular treatment of abdominal aortic aneurysms
Nat. Rev. Cardiol. doi:10.1038/nrcardio.2013.196

nature REVIEWS CARDIOLOGY

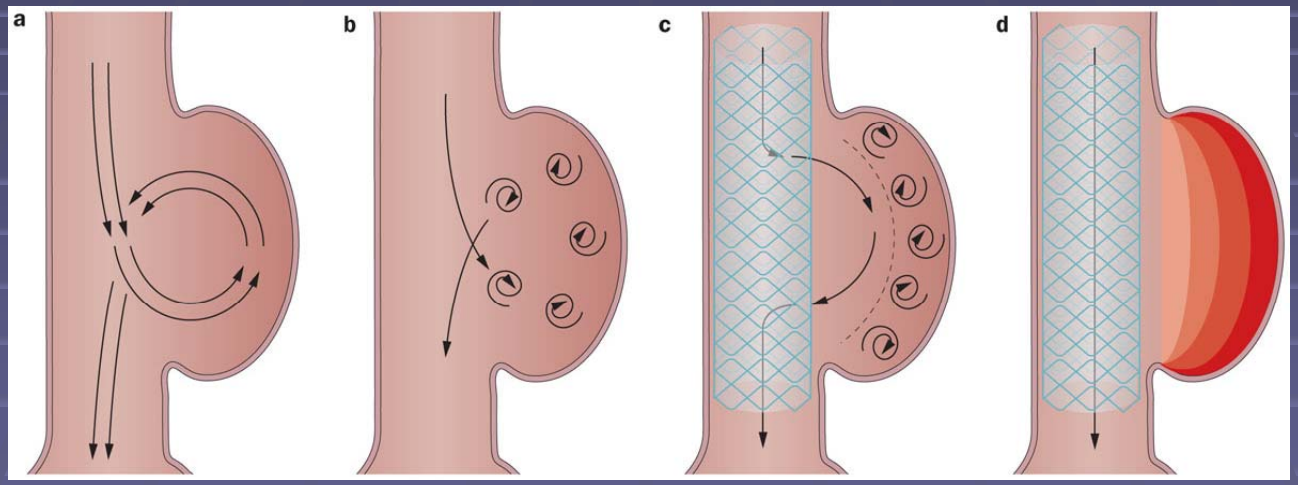
An off-the-shelf branched stent graft



Buck, D. B. *et al.* (2013) Endovascular treatment of abdominal aortic aneurysms
Nat. Rev. Cardiol. doi:10.1038/nrcardio.2013.196

nature REVIEWS CARDIOLOGY

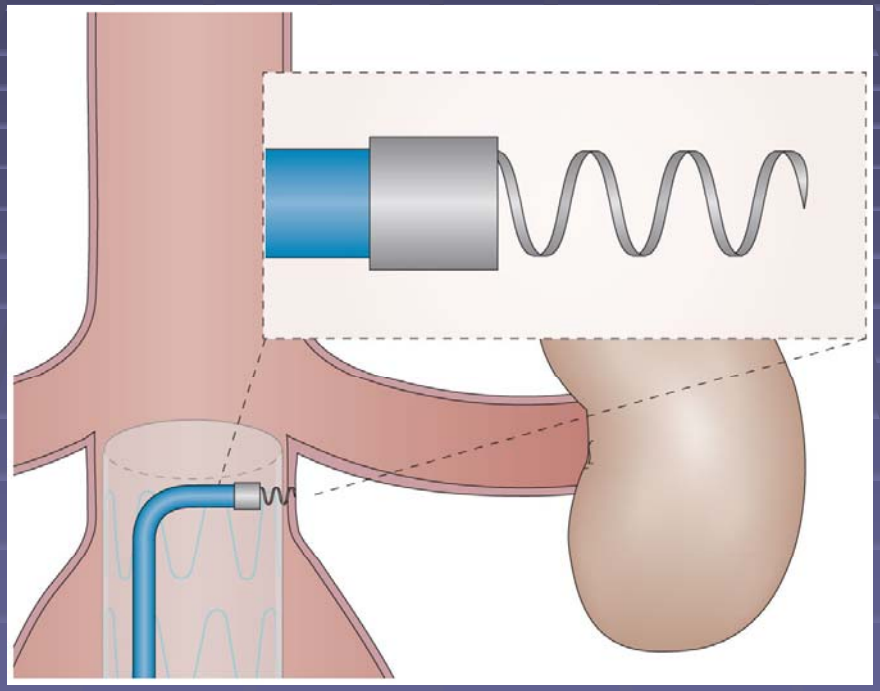
The multilayer stent graft



Buck, D. B. *et al.* (2013) Endovascular treatment of abdominal aortic aneurysms
Nat. Rev. Cardiol. doi:10.1038/nrcardio.2013.196

nature REVIEWS CARDIOLOGY

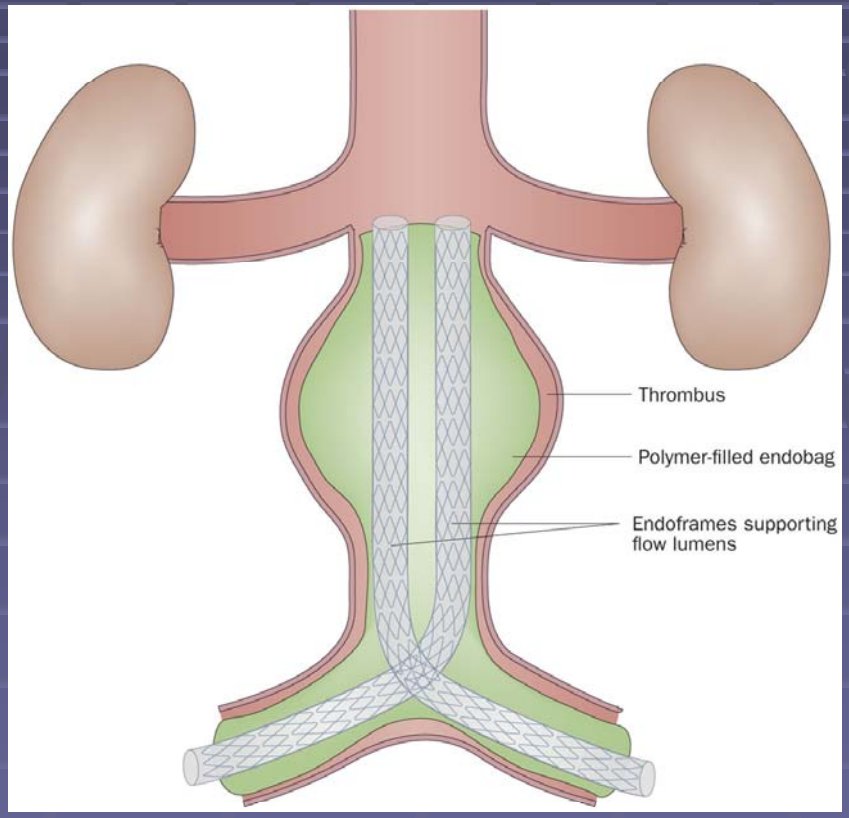
The endoanchor system, which can be used for transmural fixation of an aortic stent graft to the aortic wall at its landing zones



Buck, D. B. *et al.* (2013) Endovascular treatment of abdominal aortic aneurysms
Nat. Rev. Cardiol. doi:10.1038/nrcardio.2013.196

nature REVIEWS CARDIOLOGY

The sac-anchoring system, consisting of two femorally inserted stent grafts with polymer-filled endobags on the outside of the stent



Buck, D. B. *et al.* (2013) Endovascular treatment of abdominal aortic aneurysms
Nat. Rev. Cardiol. doi:10.1038/nrcardio.2013.196

nature REVIEWS CARDIOLOGY

First Indications

- **High Risk Patients: ASA III, IV**
- **Hostile Abdomen**

EVAR for ruptured AAA

Emergency endovascular repair of leaking aortic aneurysm

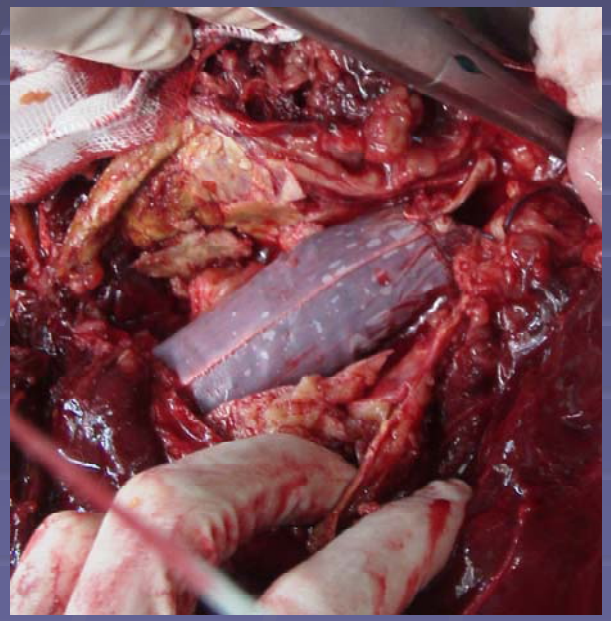
S.W. Yusuf et al; Lancet 1994;344:1645

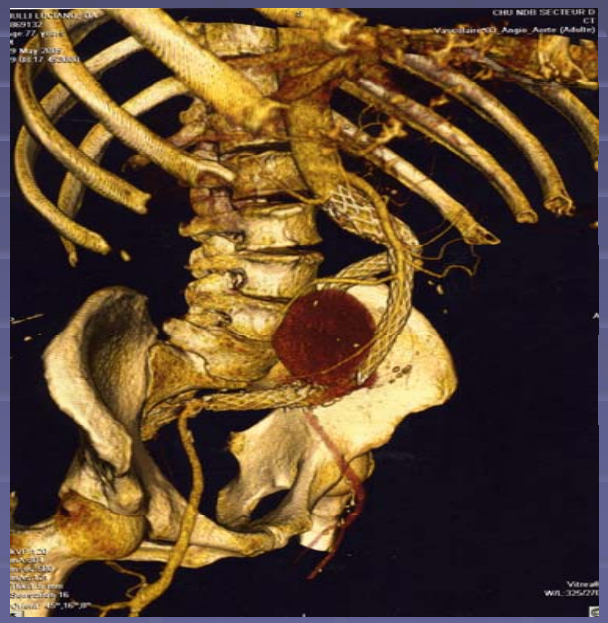
Endovascular graft repair of ruptured aortoiliac aneurysms.

Ohki, FJ Veith et al; J Am Coll Surg 1999;189:102

Outcome of AAA after EVAR

Despite decreasing parietal pressure, rupture occures in some AAA after EVAR. Which one?





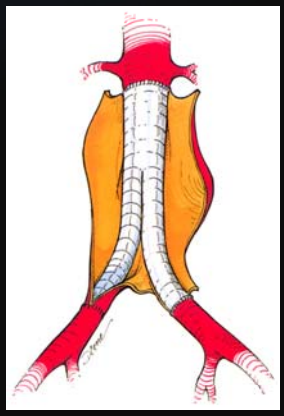
Potential issues of endovascular aneurysm repair

Sakalihasan N, Limet R, Defawe O. Abdominal aortic aneurysms, Lancet 2005

CURRENT TREATMENT OF AAA

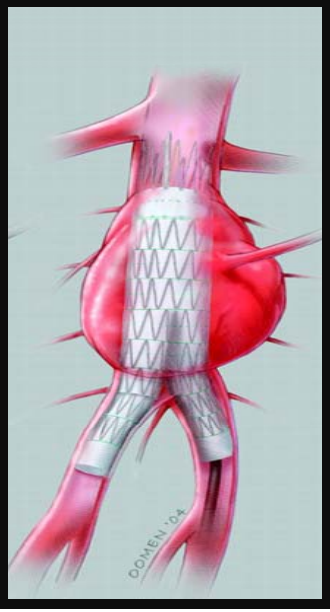
1) Open Surgery ; Since 1952
   Dubost ; Schaffer

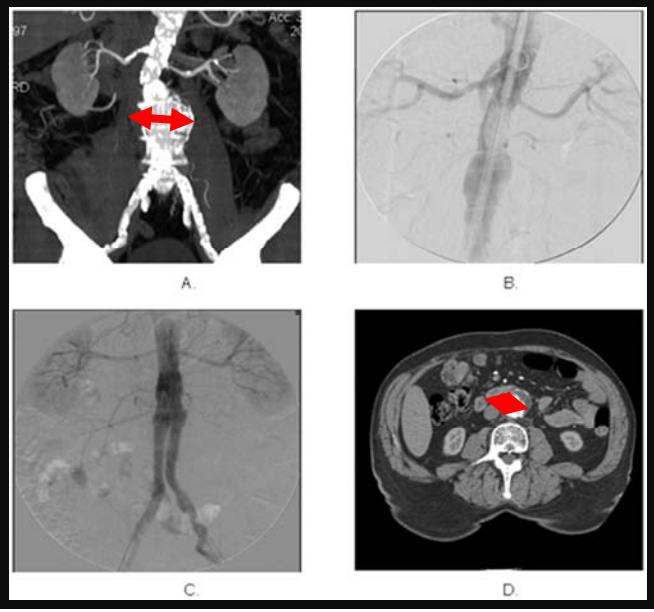
Goal : To prevention of AAA rupture



2) Endovascular repair ; since 1991
   Volodov & Parodi

Goal : To prevention of rupture by regression of AAA





EVAR & AAA

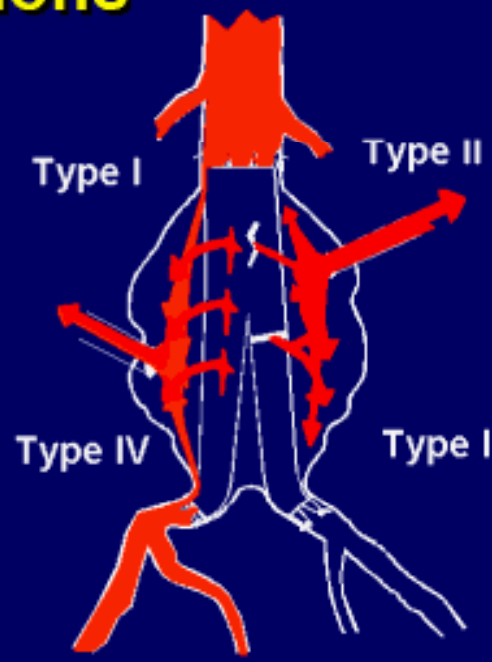
Perigraft Flow/Endoleak: Definitions*

Type I
Attachment Leak

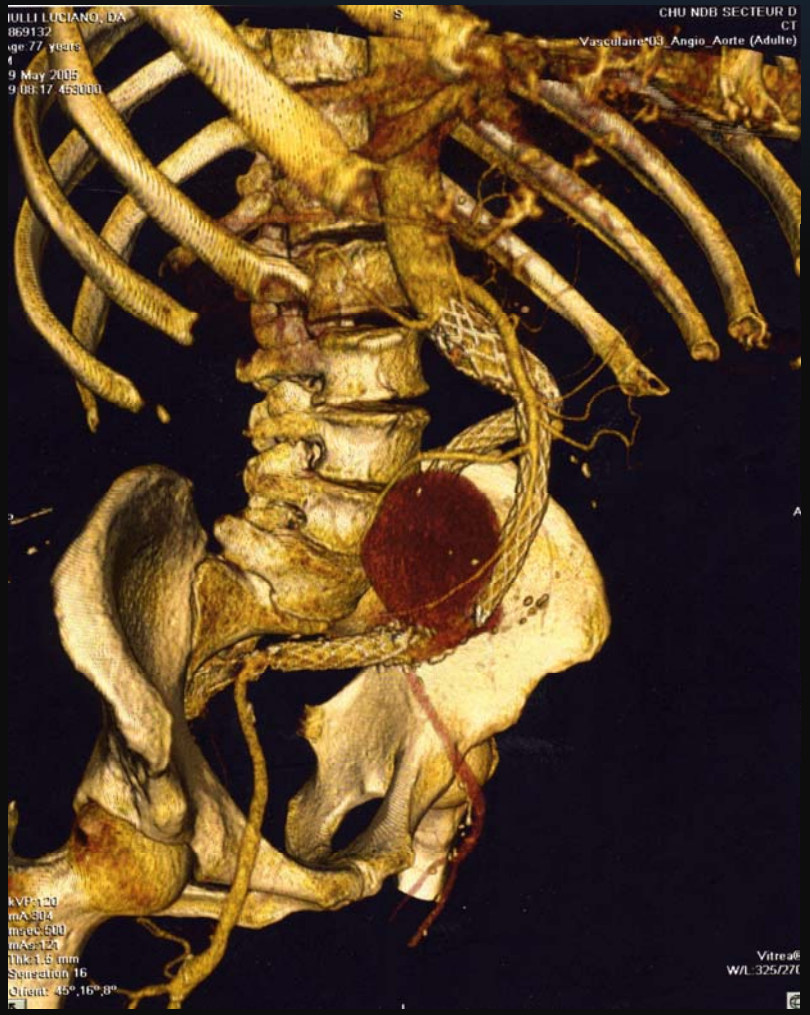
Type II
Branch Flow

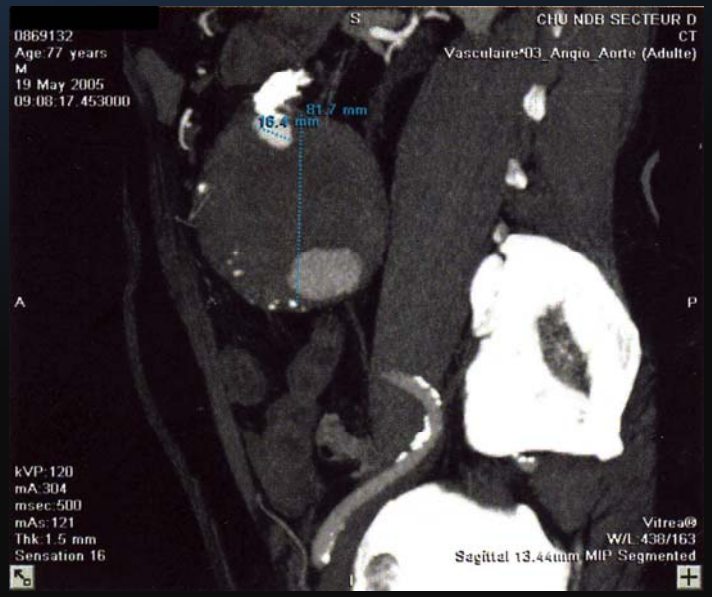
Type III
Defect in graft or
Modular disconnection

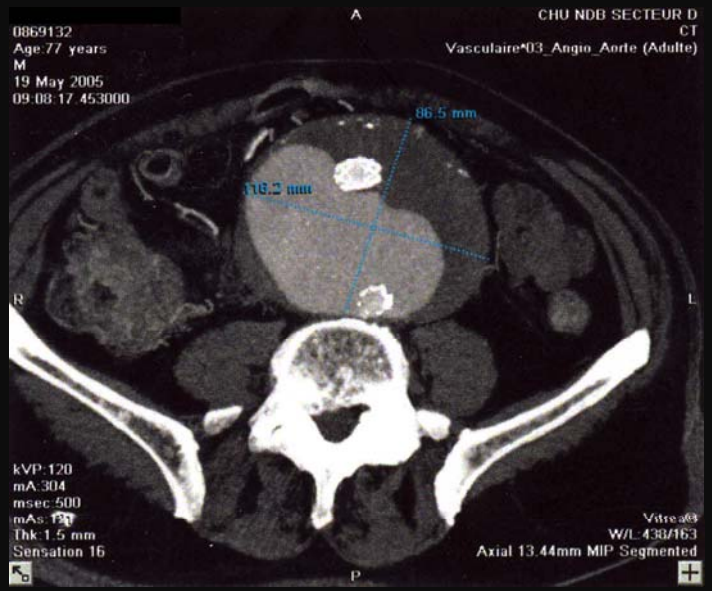
Type IV
Fabric porosity



* White et.al., Endoleak Classification, Journal of Endovascular Surgery, 1998;5:305-309


CHU NDB SECTEUR D
CT
Vasculaire*03_Angio_Aorte (Adulte)


S
CHU NDB SECTEUR D
0869132
Age:77 years
M
19 May 2005
09:08:17.453000
CT
Vasculaire*03_Angio_Aorte (Adulte)
81.7 mm
16.4 mm
A
P
kVP:120
mA:304
msec:500
mAs:121
Thk:1.5 mm
Sensation 16
W/L:438/163
Sagittal 13.44mm MIP Segmented


A
CHU NDB SECTEUR D
0869132
Age:77 years
M
19 May 2005
09:08:17.453000
CT
Vasculaire*03_Angio_Aorte (Adulte)
86.5 mm
116.2 mm
R
L
P
kVP:120
mA:304
msec:500
Thk:1.5 mm
Sensation 16
W/L:438/163
Axial 13.44mm MIP Segmented

Surgical Treatment of Abdominal Aortic Aneurysm

Is endovascular repair preferable to open repair?

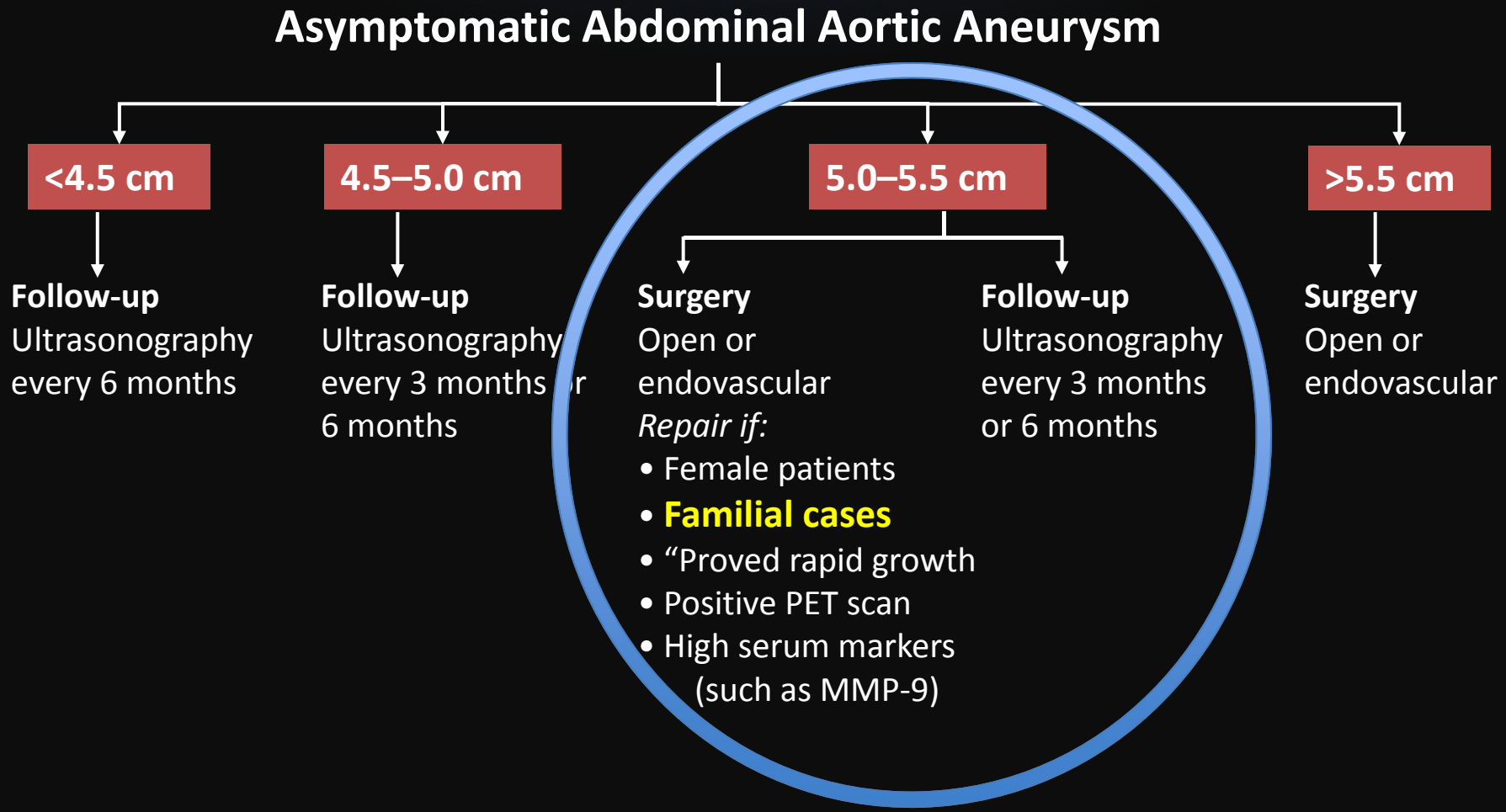
Open Surgical Treatment vs **Endovascular Repair**

- Advantages
  - Used for >50 yrs
  - Rate of failure ~0.3%
- Disadvantages
  - High rate of complications
  - Long recovery

- Advantages
  - Reduced rates of operative morbidity and mortality
  - Shorter initial hospital stay
  - Shorter recovery time
- Disadvantages
  - Rupture of AAA
  - Late complications?
  - Cost

Lederle FA. *N Engl J Med*. 2004;351:1677-1679; Sakalihasan N, et al. *Lancet*. 2005;365:1577-1589.

Proposed Management of an Asymptomatic Abdominal Aortic Aneurysm

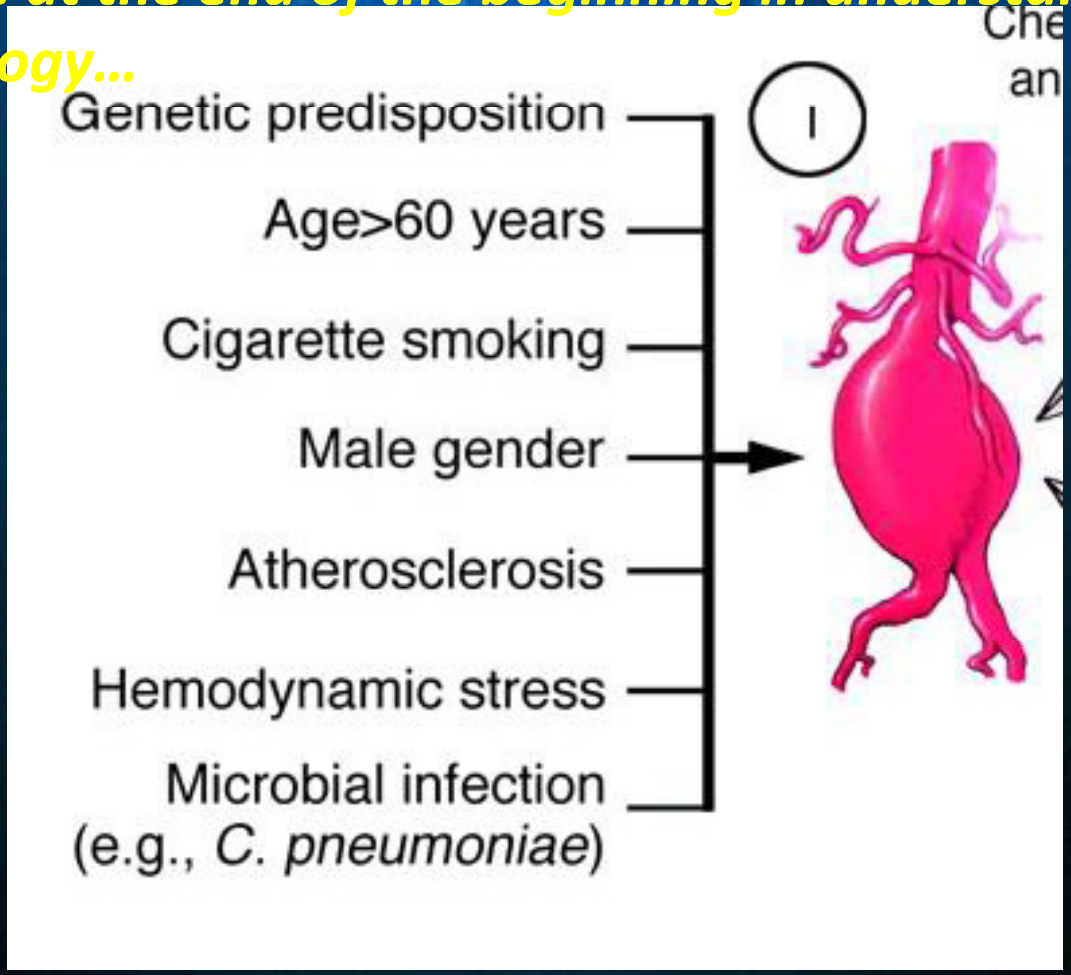


Sakalihasan N, et al. *Lancet*. 2005;365:1577-1589.

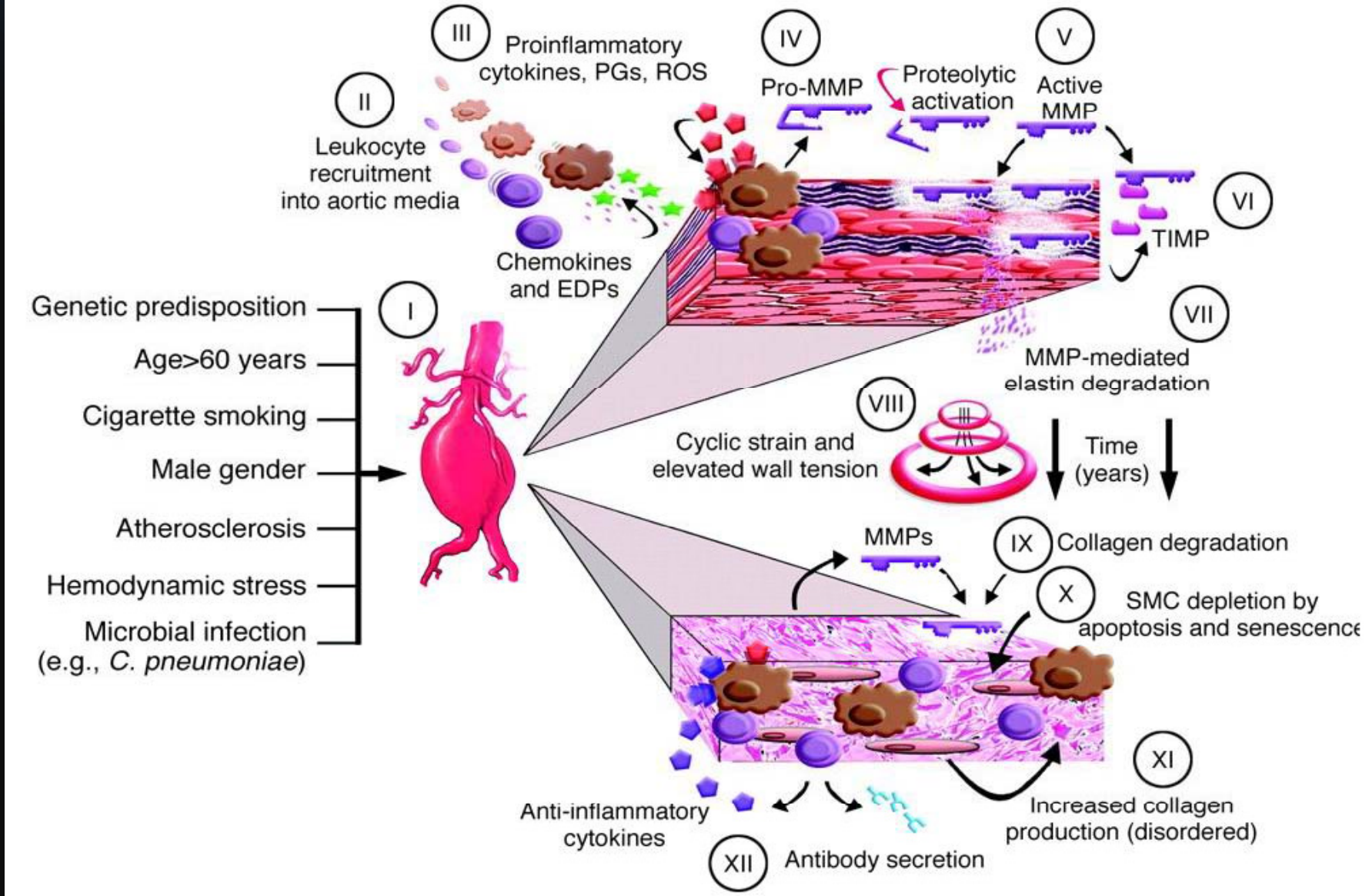
What are we knowing about abdominal aortic aneurysm (AAA) ?

Known part of AAA

We are at the end of the beginning in understanding AAA physio-pathology…

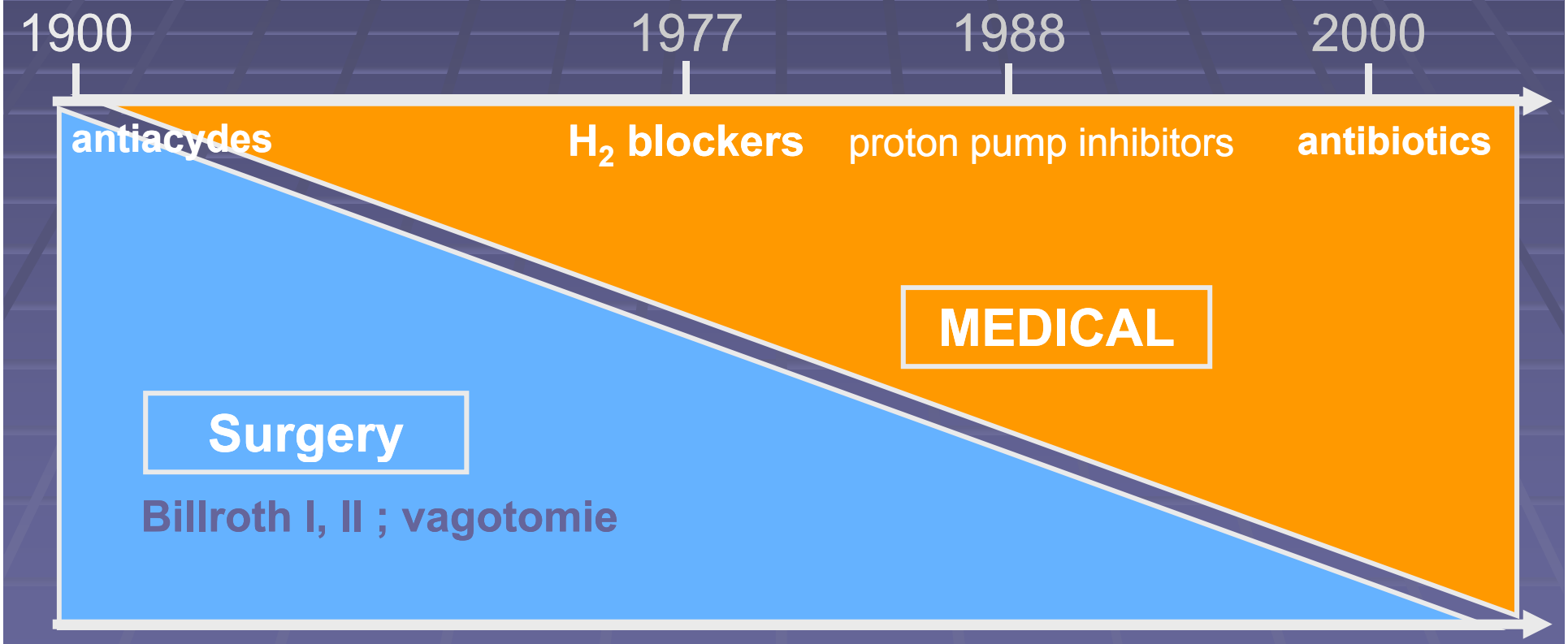


Unknown part of AAA


III
Proinflammatory cytokines, PGs, ROS
IV
Pro-MMP
Proteolytic activation
V
Active MMP
II
Leukocyte recruitment into aortic media
Chemokines and EDPs
VI
TIMP
Genetic predisposition
Age>60 years
Cigarette smoking
Male gender
Atherosclerosis
Hemodynamic stress
Microbial infection (e.g., C. pneumoniae)
I
VII
MMP-mediated elastin degradation
VIII
Cyclic strain and elevated wall tension
Time (years)
MMPs
IX
Collagen degradation
X
SMC depletion by apoptosis and senescence
XI
Increased collagen production (disordered)
Anti-inflammatory cytokines
XII
Antibody secretion
= Macrophages
= Lymphocytes
= SMCs
= Fibroblasts

Treatment of Gastric Ulcus

Paradigm for treatment of AAA ?



Programme de dépistage régional

0 %

Rupture de l'Aneurysme de l'Aorte Abdominale

Conclusion:

AAA est un tueur caché et silencieux

félicitations et je vous souhaite la bienvenue parmi nous.

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