Pourquoi suivre en imagerie les anévrismes intracrâniens ?

O. Naggara, MD, PhD – D. Trystram, MD – C. Rodriguez-Regent, MD, MSc – W. Ben Hassen, MD, MSc – G.Boulouis, MD, MSc – Myriam Edjlali, MD, MSc - J.-F. Meder, MD, PhD – C. Oppenheim MD, PhD.

43 ème congrès de la SFNR, Paris, France

FACULTÉ DE MÉDECINE PARIS DESCARTES

Centre hospitalier Sainte-Anne

Necker ENFANTS MALADES HÔPITAL UNIVERSITAIRE

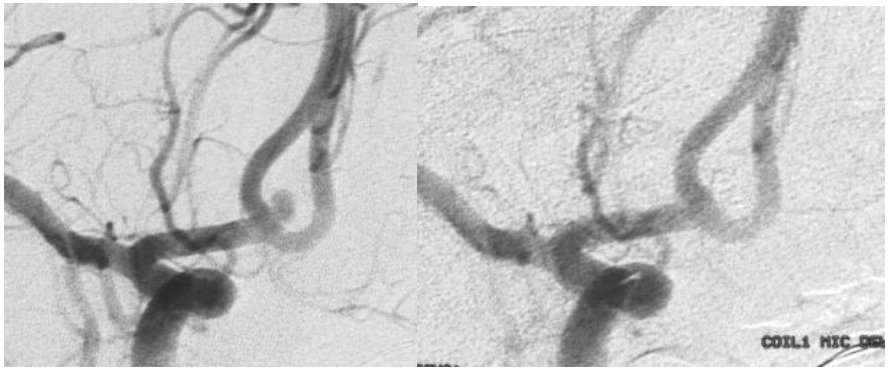
Conflits d’intérêt

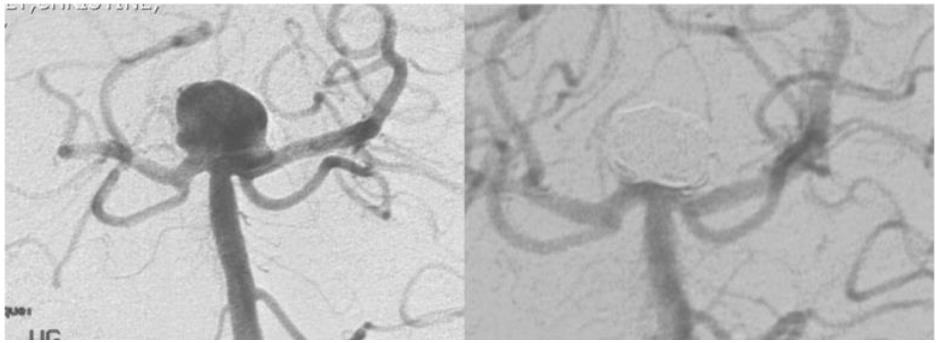
- Aucun

SFNR
SOCIETE FRANCAISE DE NEURORADIOLOGIE

Pourquoi suivre en imagerie les anévrismes intracrâniens ?

- Anévrismes traités
- Anévrismes non traités





Anévrismes traités

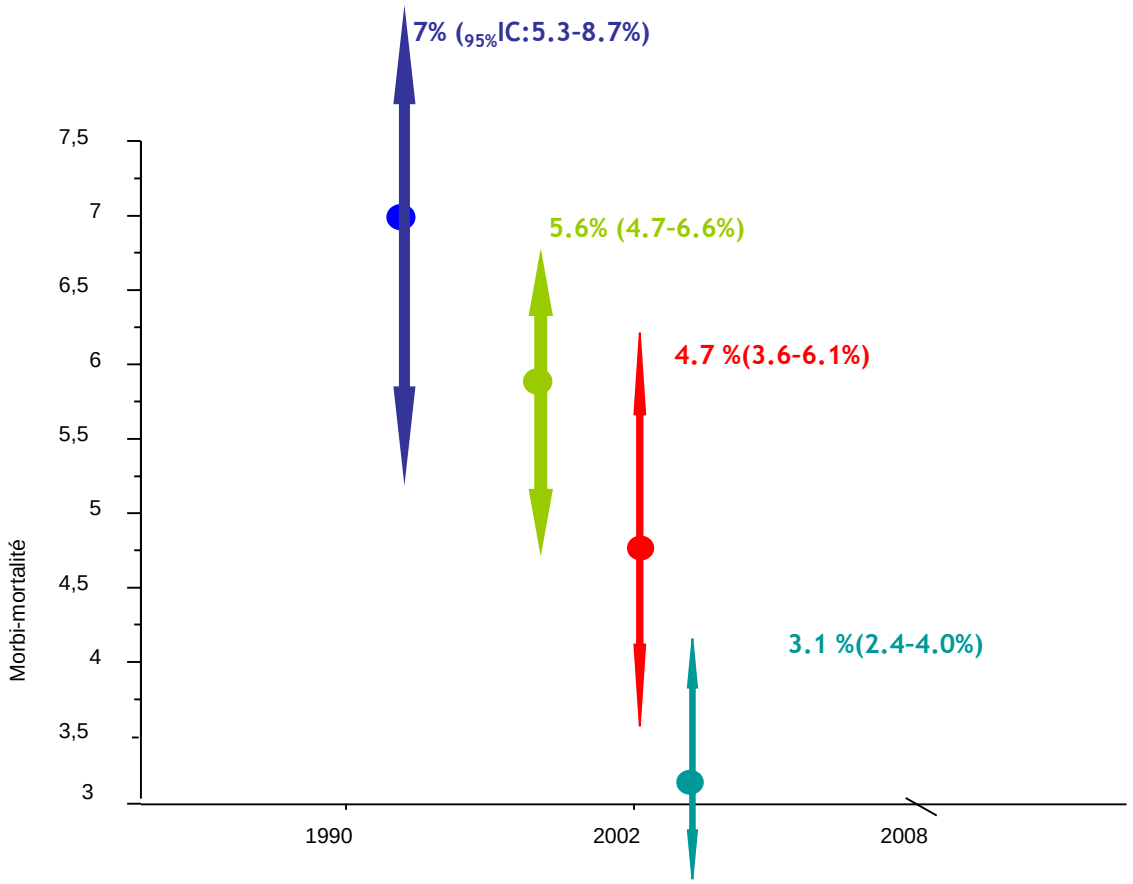
- Traitement endovasculaire : technique de référence
- Bénéfice clinique supérieur à celui de la chirurgie
- Faible morbi-mortalité 1-4% du traitement des non rompus

ATENA

Revues systématiques

1. *Molyneux A, et al. Lancet. 2002*
2. *Pierot L, et al Stroke. 2008*
3. *Naggara ON, et al Radiology. 2010.*
4. *Molyneux AJ, et al. The Lancet Neurology. 2009*

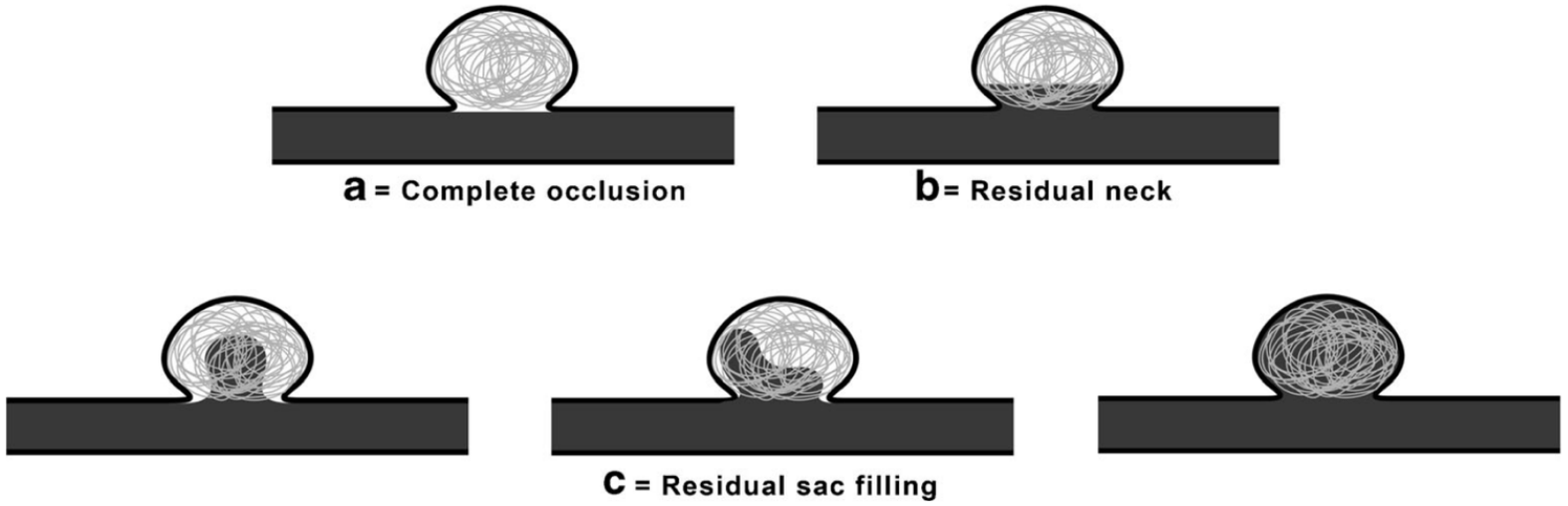
Une morbidité de plus en plus faible



1. *Lanterna LA, et al. Neurosurgery. 2004;55*
2. *Pierot L, et al Stroke. 2008*
3. *Naggara O, et al Radiology 2010*
4. *Naggara O, et al Radiology 2012*

Pourquoi suivre en imagerie les anévrismes intracrâniens traités ?

- Évaluation de l'efficacité du traitement



Classification de Montréal Stroke 2003

Traitement endovasculaire des anévrismes

- Quelle efficacité à court terme ? (fin de procédure)

Naggara O, et al Radiology. 2010.

Traitement endovasculaire des anévrismes

- Ne pas juger en fin de procédure mais à 6 mois

1035 anévrismes < 10 mm

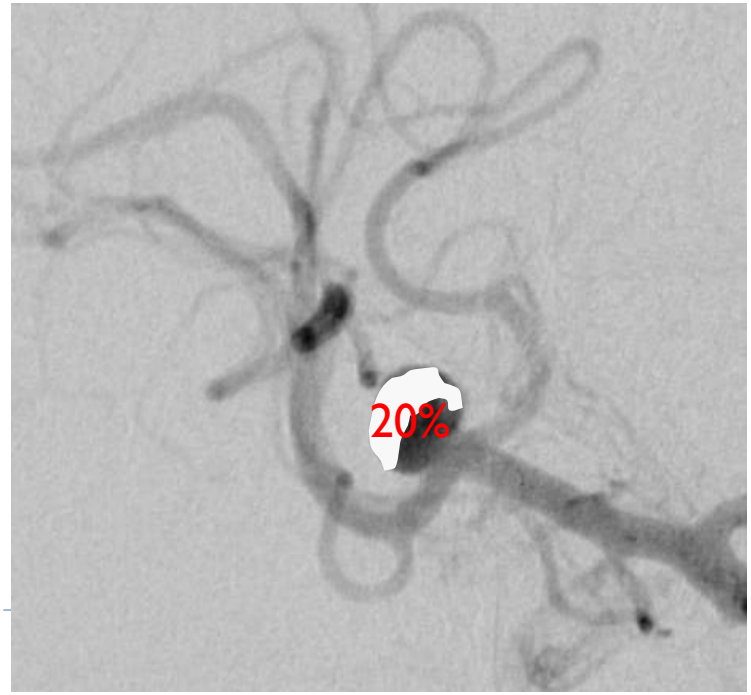
210 avec opacification résiduelle du sac en fin de procédure (≃20%)

186/210 (89%) occlusion complète à 6 mois

Soit 2-3% de grade 3

→ Collet <4 mm

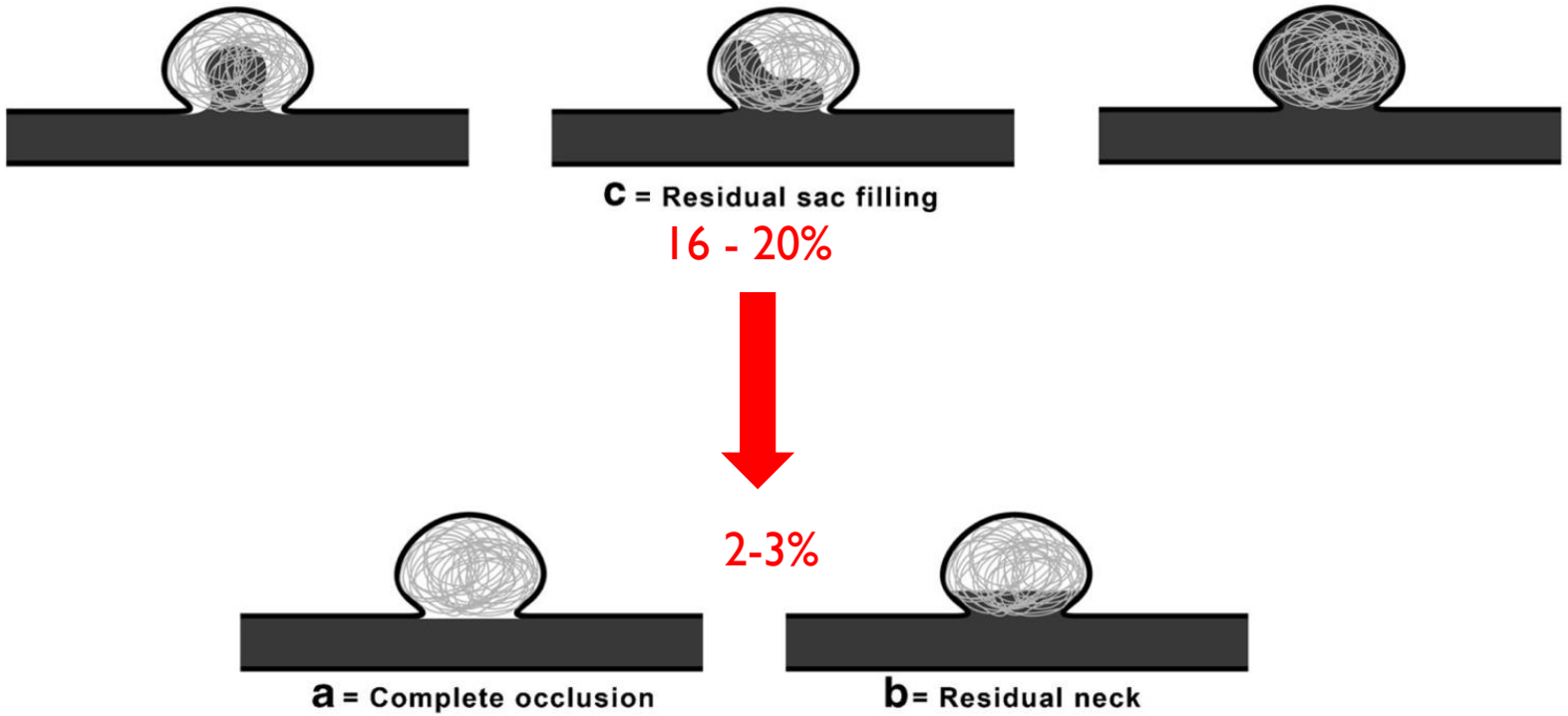
→ Packing density >30%



Cho YD et al. Neuroradiology. 2015

Traitement endovasculaire des anévrismes

- Quelle efficacité à court terme ? (6 mois)



Le suivi >6 mois est il utile ?

- Exemple monocentrique
- 458 anévrismes

→traités entre 1996 et 2010

→ grade 1 à 6 mois

→ suivis 2.5 ans

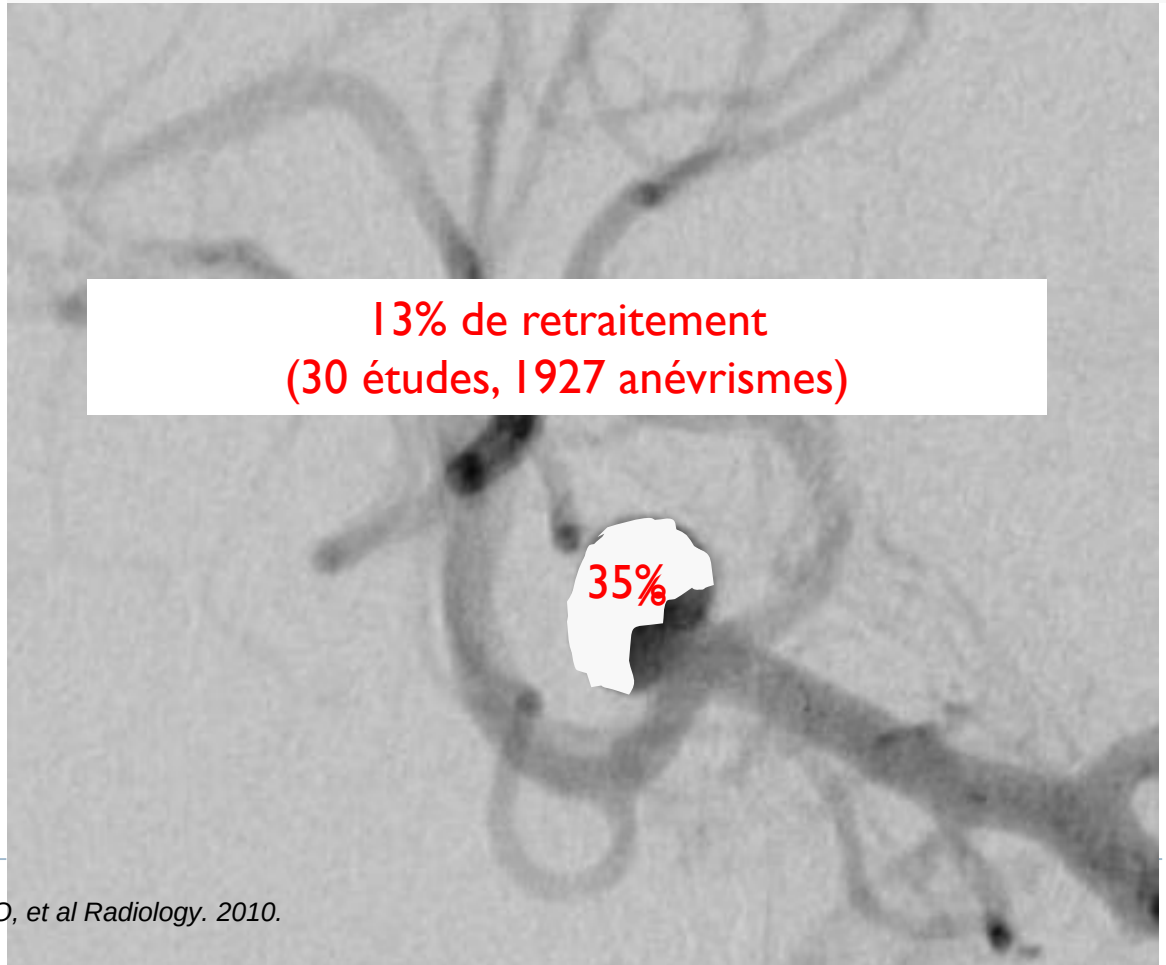
- Retraitements → 1%
- Mais…

Mortimer AM et al. JNS 2015
Naggara O et al. Radiology 2012

Traitement endovasculaire des anévrismes

- Quelle efficacité à moyen terme ? (3 ans)

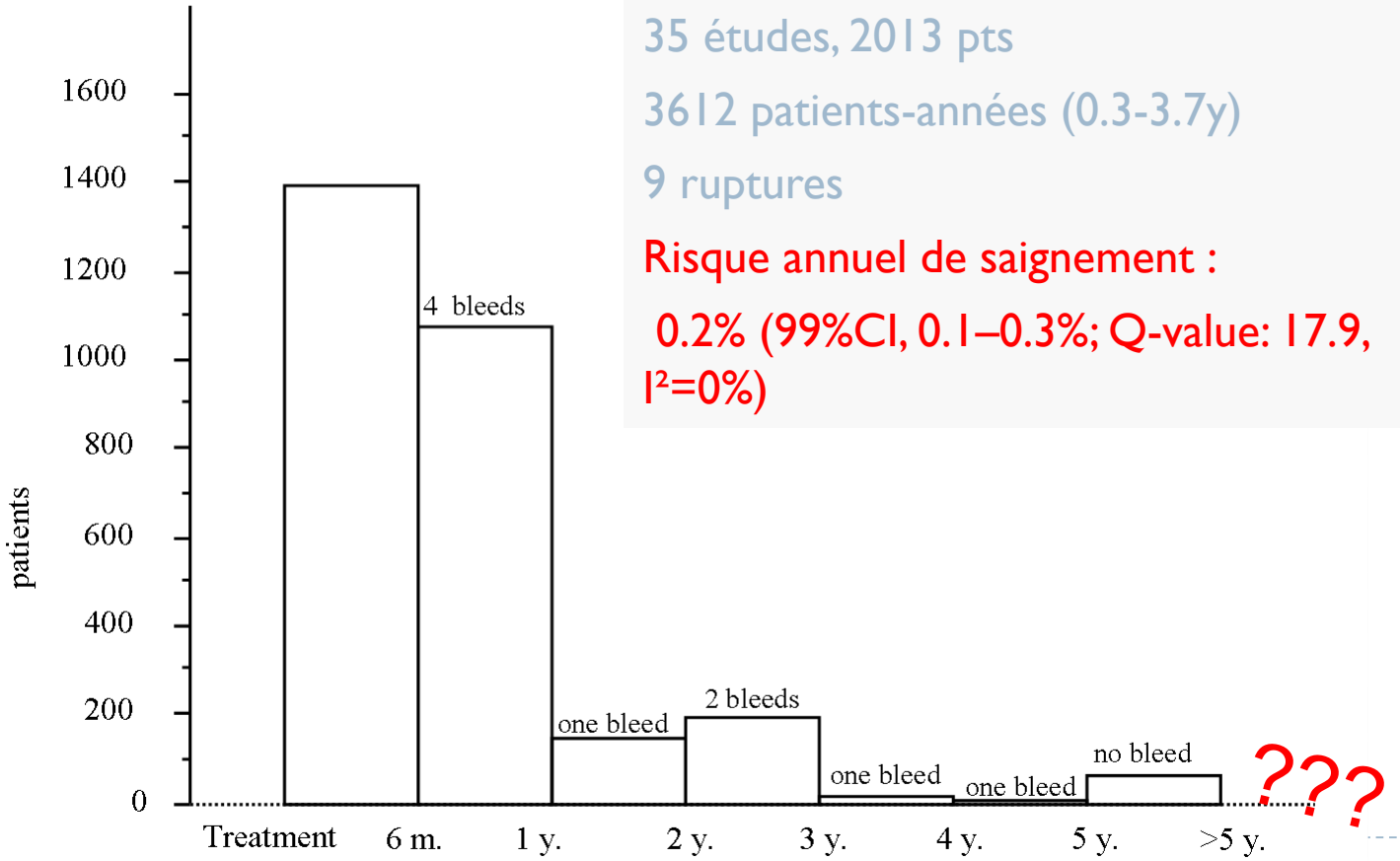
22 études, 1737 UAs, 1964 patients années (0.4-3.2y)



Naggara O, et al Radiology. 2010.

Traitement endovasculaire des anévrismes

- Quelle efficacité clinique à moyen terme ? (3 ans)



35 études, 2013 pts

3612 patients-années (0.3-3.7y)

9 ruptures

Risque annuel de saignement :

0.2% (99%CI, 0.1–0.3%; Q-value: 17.9, I^2=0%)

SFNR SOCIETE FRANCAISE DE NEURORADIOLOGIE

Traitement endovasculaire des anévrismes

- Risque annuel de saignement : 0.2%

→ un suivi plus tardif est il utile ?

- Absence de données fiables de suivi à long terme

- Peu de séries dédiées avec suivi > 5 ans

Molyneux A. Lancet 2002
Pyysalo LM. Interventional neuroradiology 2010
Lindvall P. Vascular and endovascular surgery 2012
Campi A. Stroke 2007
Schaafsma JD. Stroke 2010
Ramgren B. Neuroradiology 2008

Exemple multicentrique français

- Période de traitement 1998 – 2003, 5 centres

- 110/ 1036 contrôles > 10 ans

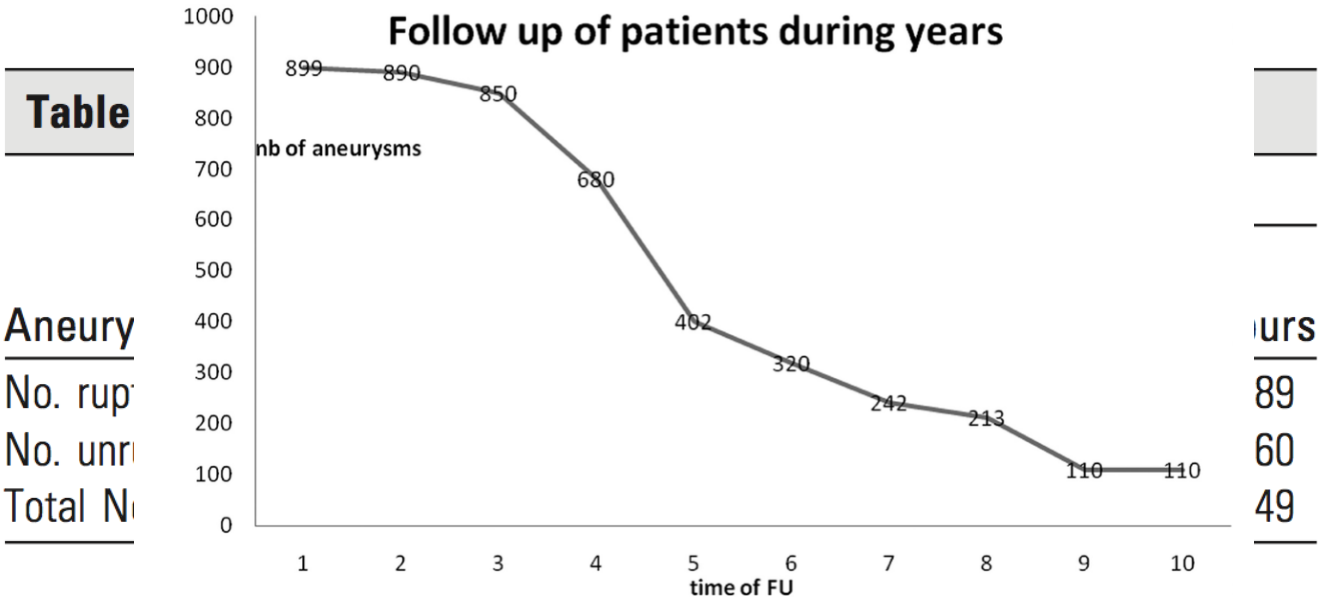


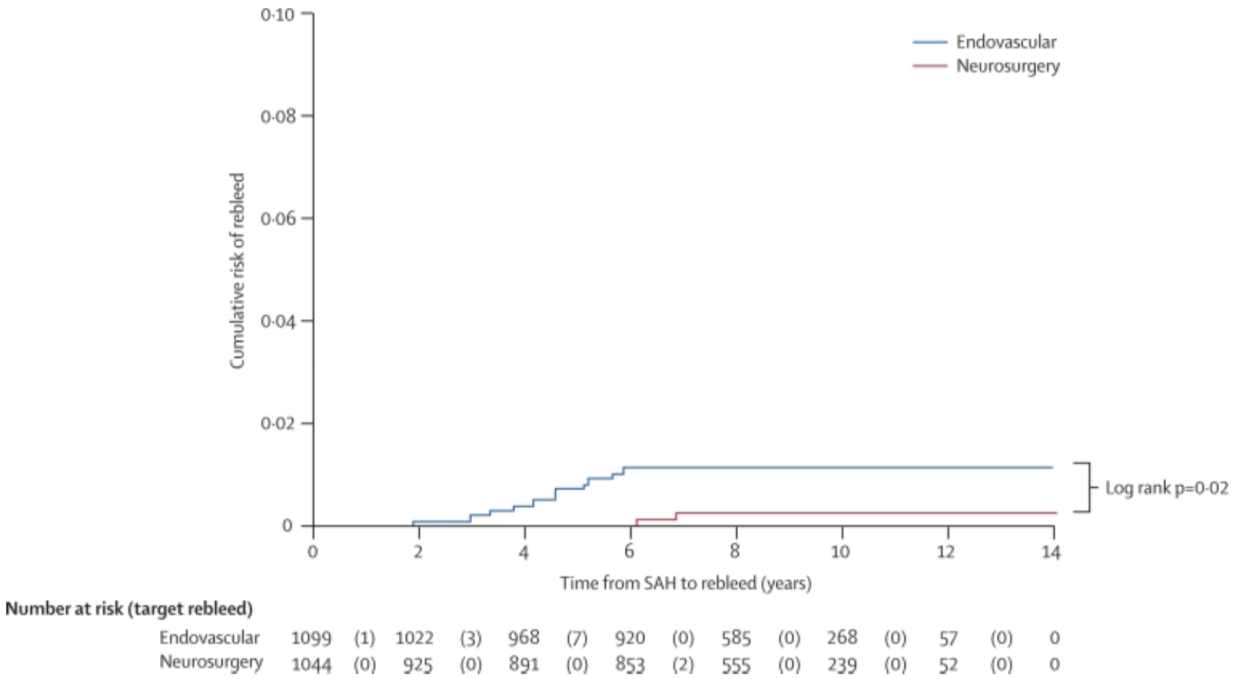
Fig 2. Graph shows follow-up (FU) of patients for 10 years.

Gallas S et al. AJNR 2009

Exemple multicentrique international

- Période de traitement 1994 – 2002, 43 centres

- 57/ 1063 contrôles > 10 ans



Molyneux AJ, et al. Lancet Neurology 2009

Pas de complexe…
Exemple de la chirurgie des anévrismes

Safety and occlusion rates of surgical treatment of unruptured intracranial aneurysms: a systematic review and meta-analysis of the literature from 1990 to 2011

Marc Kotowski,[1,2] Olivier Naggara,[3] Tim E Darsaut,[1,4,5] Suzanne Nolet,[5] Guylaine Gevry,[5] Evgueni Kouznetsov,[1] Jean Raymond[1,5]

Table 1 Publication characteristics

	Studies	%
Quality score		
6–12 (poor)	51	85
13–18 (average)	8	13
19–26 (good)	1	2
Median (±SD)	8 (±2.9)	
Range	6–22	
Patient enrolment		
Prospective	11	18
Retrospective	49	82
Consecutive	9	15
Non-consecutive	51	85
Study design		
Multicentre	11	18
Single centre	49	82
Type of study		
Randomised controlled trial	1	1.7
Observational studies	59	98
Outcome assessment		
Independent clinical outcome assessment	3	5
Modified Rankin Scale	9	15
Glasgow Outcome Scale	33	55
EGFP	20	33
Loss of follow-up reported	11	18
Time of outcome assessment		
Short term ('discharge' to 1 month)	11	18
Mid term (>1 month to 1 year postop)	23	38
Long term (>1 year postop)	3	5
Patient years' follow-up	11	18
No information on time of outcome measurement	12	20

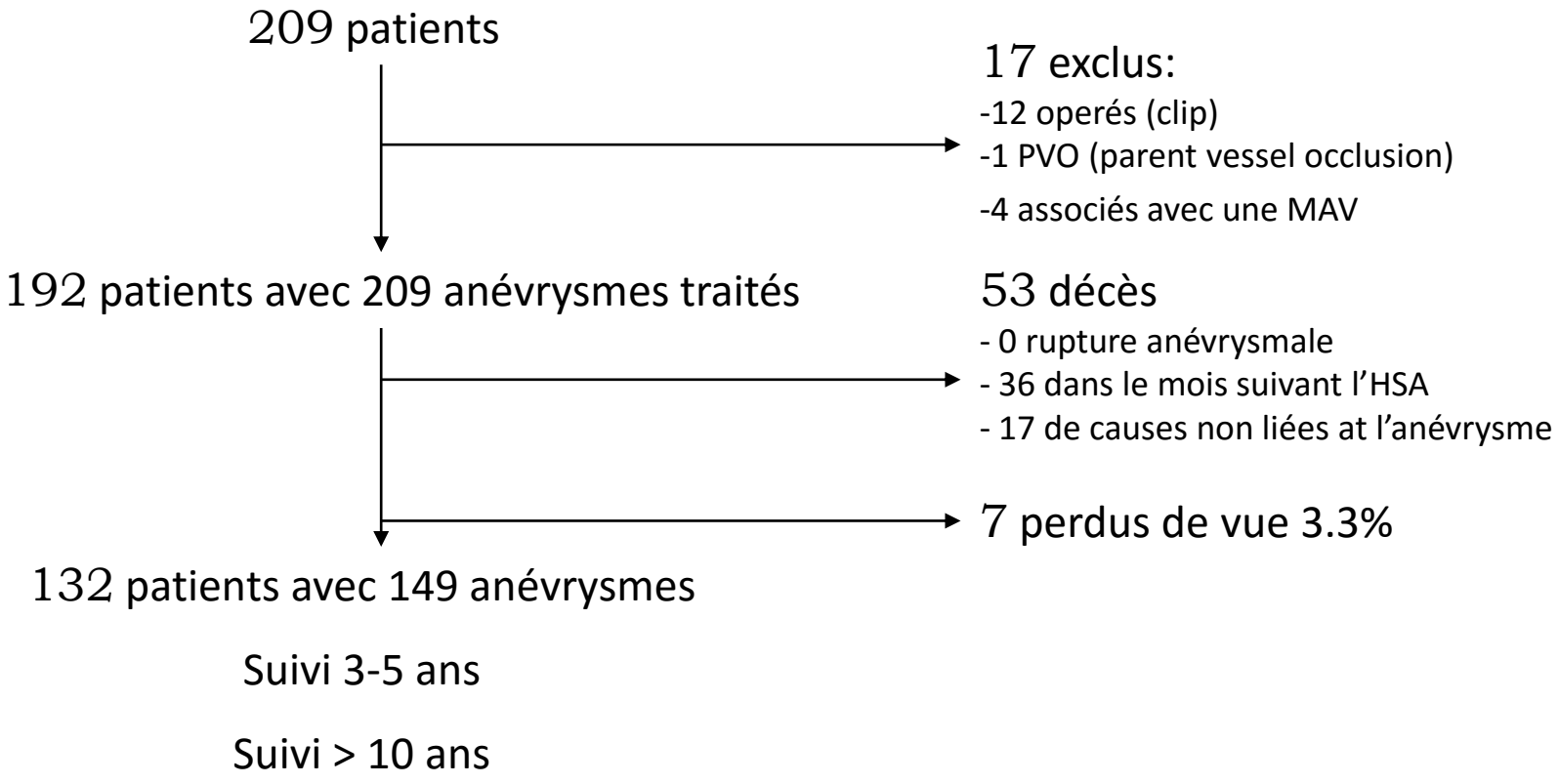
EGFP, Excellent, Good, Fair, Poor.

J Neurol Neurosurg Psychiatry 2012;**0**:1–7. doi:10.1136/jnnp-2011-302068

Exemple monocentrique > 10 ans

- **Patients et IRM**
  - Cohorte active consécutive de patients
  - Traités entre août 1996 et août 2002
  - Suivis “classiquement” 3 à 5 ans
  - Reconvoqués > 10 ans pour consultation et IRM 3T

Exemple monocentrique > 10 ans



A Lecler, et al. Radiology 2015

Exemple monocentrique > 10 ans

132 patients avec 149 anévrysmes

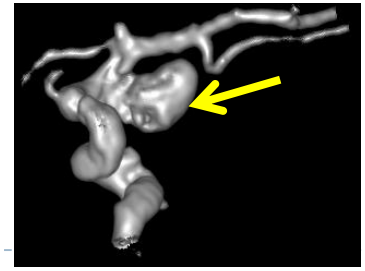
Suivi 3-5 ans vs. Suivi >10 ans

1 resaignement

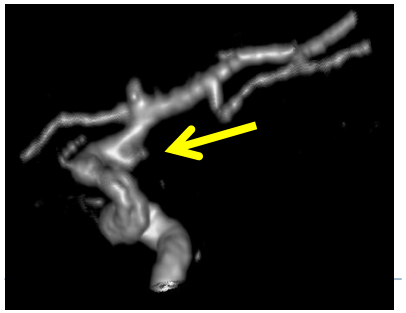
% annuel de resaignement 0.085%

9.1% d'anévrisme de novo

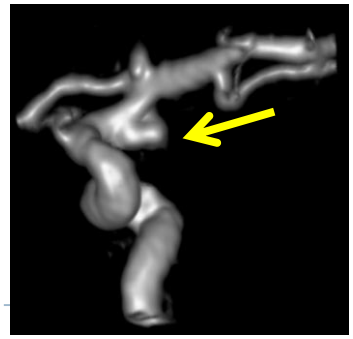
12.4% de recanalisation grade 3 >10 ans



Pretreatment

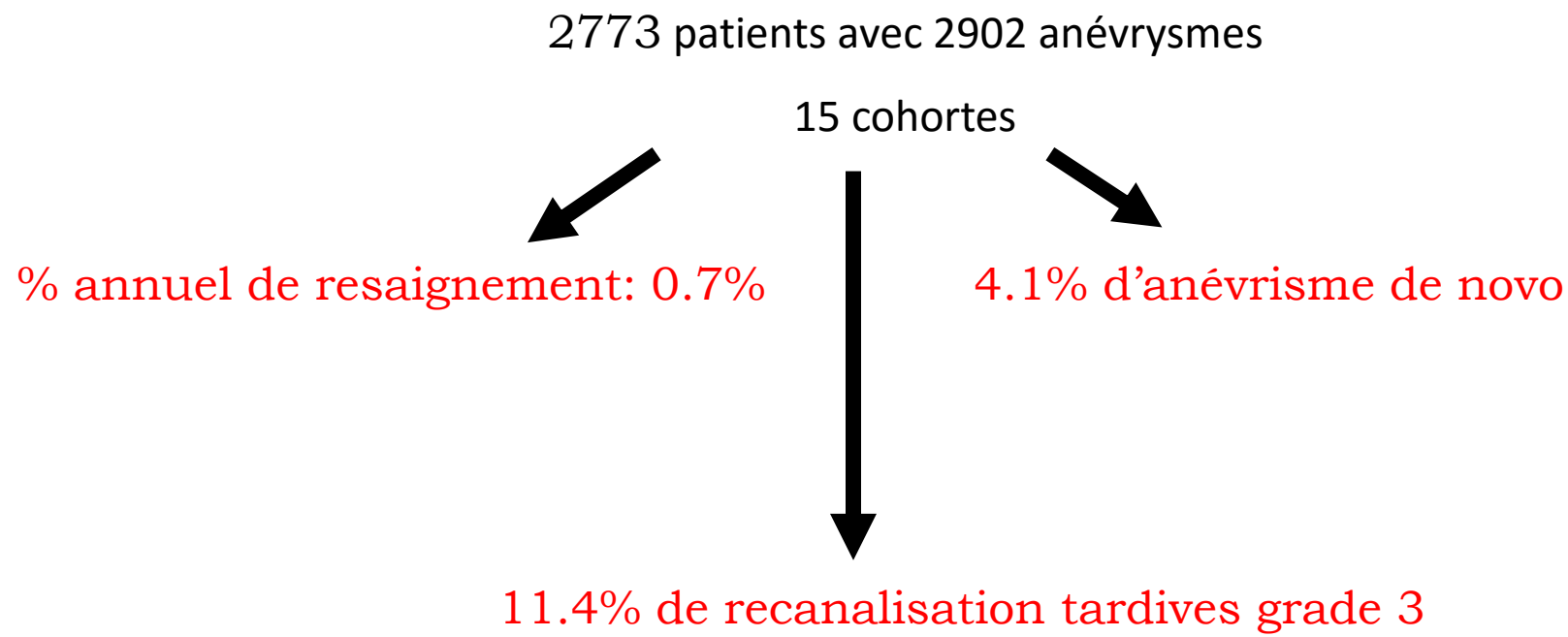


Midterm: grade 2



Longterm: grade 3

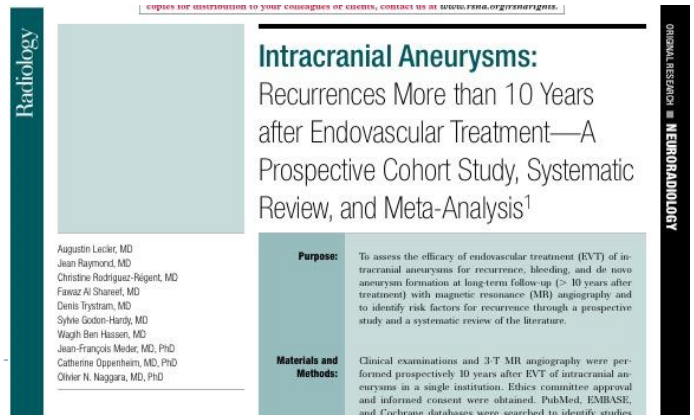
Et ailleurs ?



A Lecler, et al. Radiology 2015

À quel patient proposer un suivi long terme?

	RR (99% CI)	Hétérogénéité I^2 et Q
Sac > 10 mm	4.4 (1.8–10.4)	
Grade 2	7.1 (1.2–40.4)	
Location, ruptured, basilar tip..	*NS*	



A Lecler, et al. Radiology 2015

<1% après 10 ans: le suivi est il utile ?

- **Chiffre faible, confirmé par ISAT 2015**
- **Contre le suivi**
  - Coûteux
  - Stressant
  - Il n'y a quasi-rien à prévenir…

	Number of patients	Total patient-years	Incidence per 1000 patient-years
Number of rebleeds*			
Endovascular group	13	8351	1·56 (0·69–2·40)
Neurosurgery group	4	8228	0·49 (0.01–0.96)
Death and disability due to rebleed†			
Endovascular group	6	8384	0·72 (0·14–1·29)
Neurosurgery group	4	8228	0·49 (0·01–0·96)

Data in parentheses are 95% CI. *Rebleeds from target aneurysm assessed from 1 year up to 17·6 years' of follow-up in the UK population. †Rebleeds from target aneurysm resulting in death within 60 days or score of 3–5 on the modified Rankin scale.

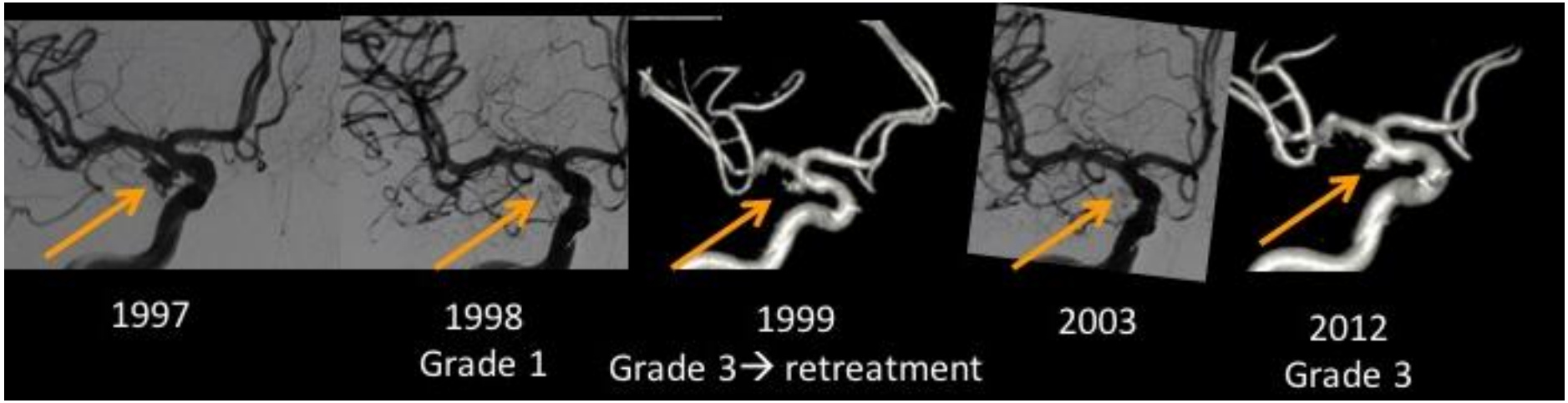
Table 3: **Incidence of recurrent subarachnoid haemorrhage from target aneurysm and of resulting death or disability (mRS 3–5)**

AJ Molyneux, et al. Lancet Neurol 2015

Mais….

- **5-15% de retraitement (9% ISAT)**
- **Anévrisme de novo 5-10%**
- **Patients jeunes**

(47 ans dans A. Lecler et al. 2773 patients)



A Lecler, et al. Radiology 2015
S Soize et al. Stroke 2016

Au total

- **Minimum 3-5 ans**
- **Contrôle tardif au delà de 10 ans si:**
- Sac > 10 mm
- Collet résiduel (grade 2)
- Retraitement dans les 3-5 ans

A Lecler, et al. Radiology 2015
S Soize et al. Stroke 2016

Contrôle tardif, c'est la mode.
patients opérés par mise en place de clip

- Surveillance si
- Sac > 12 mm
- Age < 45 ans

- 616 anévrismes clipés (Essen)
- À 5 ans :

112 (18%) de reliquats (grade 3)

28 retraitements (5%)

2 resaignements → 0.06%/an

- Pas d' information > 5 ans

Jabarli R et al. J Neurosurg. 2016 Feb 12:1-7.

Ces chiffres de recanalisation élevés sont ils valables avec les nouveaux outils de traitement ?

- Données obtenues sur des patients traités au siècle dernier

- Depuis :

remodelling par ballon – stents – diversion de flux – dispositifs intra-sac..

90’s

2015

Interv Neuroradiol. 2015 Jun;21(3):300-10. doi: 10.1177/1591019915583119. Epub 2015 May 26.

Long-term occlusion results with XXXX flow diversion in 28 aneurysms: Do recanalizations occur during follow-up?

Abstract

BACKGROUND AND PURPOSE:

The purpose of this article is to report on the long-term success rates of Silk flow-diverter (FD) treatment in a multicenter prospective study for the treatment of complex aneurysms.

METHODS:

Between May 2008 and January 2011, all consecutive patients featuring complex intracranial aneurysms eligible for FD treatment with the Silk in three neurovascular centers were included. Clinical and imaging data were assessed during hospitalization and follow-up.

RESULTS:

Five patients were initially asymptomatic, 20 patients showed various neurological symptoms. Twenty-eight FDs were implanted in 25 patients treating 28 aneurysms. The immediate procedure-related morbidity was 8% (two of 25), mortality 0%. One procedure-related death was observed during follow-up (in-stent thrombosis). Compared to the immediate result nearly two of three aneurysms improved during follow-up; all angiographically confirmed inflow changes took place with**in six months after treatment**. Final anatomic outcome in 24 aneurysms of 22 patients comprised 14 (59%) with complete occlusion, seven (29%) with a neck remnant, two (8%) with residual filling <50%, none with residual filling >50% and one (4%) unchanged in comparison to its pretreatment status. Postinterventional recanalizations were seen in three of 13 (23%) aneurysms treated with FD alone; none were observed in 15 aneurysms treated with adjunctive coiling.

CONCLUSION:

Anatomic presentation and location are key for successful FD treatment. The rate of successful occlusion increases during follow-up. Postinterventional monitoring for at least six months is paramount, as anatomic outcome is not reliably predictable and recanalizations may occur in initially completely occluded aneurysms.

AJNR Am J Neuroradiol. 2015 Sep;36(9):1728-34. doi: 10.3174/ajnr.A4329. Epub 2015 May 21.

Long-Term Follow-Up Results following Elective Treatment of Unruptured Intracranial Aneurysms with the XXXX Device.

Abstract

BACKGROUND AND PURPOSE:

Numerous reports of treatment of wide-neck aneurysms by flow diverters have been published; however, long-term outcomes remain uncertain. This article reports the imaging results of unruptured aneurysms treated electively with the XXX Device for up to 56 months and clinical results for up to 61 months.

MATERIALS AND METHODS:

One hundred nineteen aneurysms in 98 patients from 3 centers admitted between August 2009 and June 2011 were followed at 6-month, 1-year, and 2+-year postprocedural timeframes. Analyses on the effects of incorporated vessels, previous stent placement, aneurysm size, and morphology on aneurysm occlusion were performed.

RESULTS:

The 1- and 2+-year imaging follow-ups were performed, on average, 13 and 28 months postprocedure.

At 2+-year follow-up, clinical data were 100% complete and imaging data were complete for 105/116 aneurysms (88.8%) with a 93.2% occlusion rate. From 0 to 6 months, TIA, minor stroke, and major stroke rates were 4.2%, 3.4%, and 0.8% respectively. After 6 months, 1 patient had a TIA of uncertain cause, with an overall XXXXDevice-related mortality rate of 0.8%. An incorporated vessel was significant for a delay in occlusion (P = .009) and nonocclusion at 6 months and 1 year, with a delayed mean time of occlusion from 9.1 months (95% CI, 7.1-11.1 months) to 16.7 months (95% CI, 11.4-22.0 months). Other factors were nonsignificant.

CONCLUSIONS:

The XXXXX Device demonstrates continued very high closure rates at 2+ years, with few delayed clinical adverse sequelae. The presence of an incorporated vessel in the wall of the aneurysm causes a delay in occlusion that approaches sidewall closure rates by 2 years.

- AJNR Am J Neuroradiol. 2015 Dec;36(12):2320-4. doi: 10.3174/ajnr.A4457. Epub 2015 Aug 20.
- **One-Year Angiographic Follow-Up after XXXX Endovascular Treatment of Wide-Neck Bifurcation Intracranial Aneurysms.**
- **Abstract**

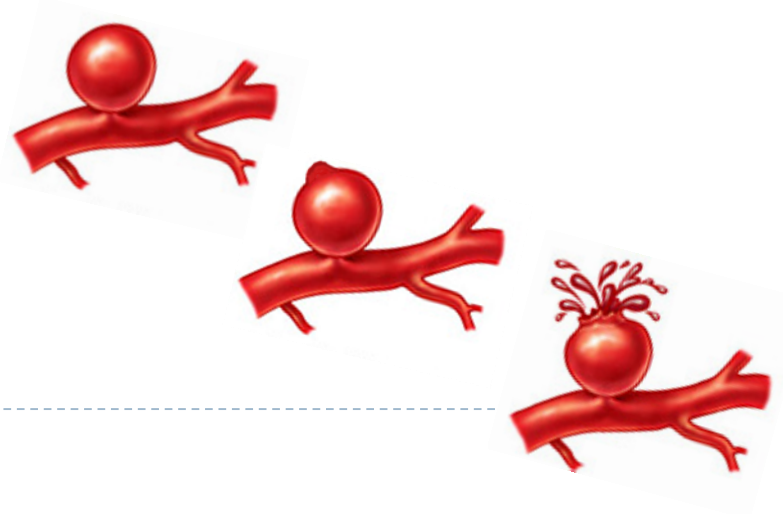
- **BACKGROUND AND PURPOSE:**
- Endovascular coiling of wide-neck intracranial aneurysms is associated with low rates of initial angiographic occlusion and high rates of recurrence. The XXXX intrasaccular device has been developed specifically for this indication. To date, there has been no report of the long-term follow-up of a series of patients with aneurysms treated with this type of device, to our knowledge. Our aim was to evaluate a 1-year follow-up of angiographic results in a prospective single-center series of patients treated with the XXXX device.
- **MATERIALS AND METHODS:**
- All patients treated with the XXXX device in our center between August 2013 and May 2014 were prospectively included. One-year angiographic outcomes were assessed. Results at follow-up were graded as complete occlusion, neck remnant, or residual aneurysm.
- **RESULTS:**
- Eight patients with 8 unruptured wide-neck aneurysms were enrolled in this study. Average dome width was 7.5 mm (range, 5.4-10.7 mm), and average neck size was 4.9 mm (range, 2.6-6.5 mm). One-year angiographic follow-up obtained in all aneurysms included 1 complete aneurysm occlusion (12.5%), 6 neck remnants (75%), and 1 aneurysm remnant (12.5%). Of 8 aneurysms, worsening of aneurysm occlusion was observed in 2 (25%) by compression of the XXXX device. There was no angiographic recurrence of initially totally occluded aneurysms. No bleeding was observed during the follow-up period.
- **CONCLUSIONS:**
- Endovascular therapy of intracranial aneurysms with the XXXX device allows treatment of wide-neck aneurysms with a high rate of neck remnant at 1 year, at least partially explained by XXXX compression. Initial size selection and technologic improvements could be an option for optimization of aneurysm occlusion in XXXX treatment.

Anévrismes intracrâniens et suivi

- Anévrismes traités
- Anévrismes non traités

Pourquoi suivre un Anévrisme non traité ?

- Objectif : dépister une modification morphologique / une augmentation de taille
- → Hypothèse : le processus conduisant à la modification d'un anévrisme et le processus conduisant à la rupture d'un anévrisme sont identiques
- → Risque de rupture de x12 à x60
- → Fort consensus pour traiter un anévrisme modifié



Villablanca JP et al. Radiology 2013
Chalouhi N et al. Stroke 2013
Inoue T et al. Jneurosurg 2012
Juvela S et al. Stroke 2001

SFNR SOCIETE FRANCAISE DE NEURORADIOLOGIE

Fort consensus pour traiter un anévrisme modifié

Table 2. Aneurysm-Related Factors

	Median	IQR	Relevance	Skew	*P* Value	Change Between Rounds 2 and 3	v_r*	IRA
Importance of aneurysm size supporting UIA treatment								
Aneurysm size >25 mm	10	0	High	−4.282	0.722		0.000	Very high
Aneurysm size 13–24 mm	8	2	High	−0.463	0.967		0.047	Very high
Aneurysm size 7–12 mm	6	2	Moderate	0.183	0.870		0.063	High
Aneurysm size 4–6 mm	3	2	Low	0.463	0.904		0.126	Moderate
Aneurysm size 1–3 mm	1	2	Low	0.209	0.439		0.378	Low
Importance of aneurysm morphology supporting UIA treatment								
Aneurysm lobulation	7	3	High	−0.172	0.380		0.072	High
Size ratio†	4	3	Moderate	0.313	0.542		0.148	Moderate
Aspect ratio†	4	3	Moderate	0.181	0.431		0.127	Moderate
Aneurysm sphericity	3	2	Low	0.269	0.527		0.113	Moderate
Aneurysm ellipticity	3	3	Low	0.502	0.749		0.169	Low
Importance of aneurysm location supporting UIA treatment								
AComA and PcomA	7	3	High	−0.380	0.589		0.085	High
Basilar artery bifurcation	7	3	High	−0.537	0.653		0.072	High
Vertebral artery	5	3	Moderate	0.203	0.221		0.113	Moderate
Importance of radiological findings supporting UIA treatment								
Aneurysm growth on serial imaging	9	2	High	−1.657	0.034		0.038	Very high
De novo aneurysm formation on serial imaging	8	3.75	High	−0.593	0.008		0.090	Very high
Aneurysm location (parent vessel, per se)	6	3	Moderate	0.007	<0.001	Decrease	0.085	Very high
Aneurysm multiplicity	4	3	Moderate	0.368	<0.001	Decrease	0.148	Moderate
Importance of clinical symptoms supporting UIA treatment								
Cranial nerve deficits†	9	2	High	−1.488	0.558		0.038	Very high
Clinical or radiological signs of mass effect because of aneurysm†	10	2	High	−1.243	0.129		0.038	Very high
Thromboembolic event from the aneurysm	7	3	High	−0.263	0.002	Decrease	0.099	Very high
Epilepsy	3	5	Low	0.424	0.391		0.310	Moderate
Chronic headaches	1	2	Low	0.675	0.594		0.338	Low

Importance of all aneurysm-related items in relation to treatment indications for unruptured intracranial aneurysms (UIAs) and corresponding

SFNR SOCIETE FRANCAISE DE NEURORADIOLOGIE

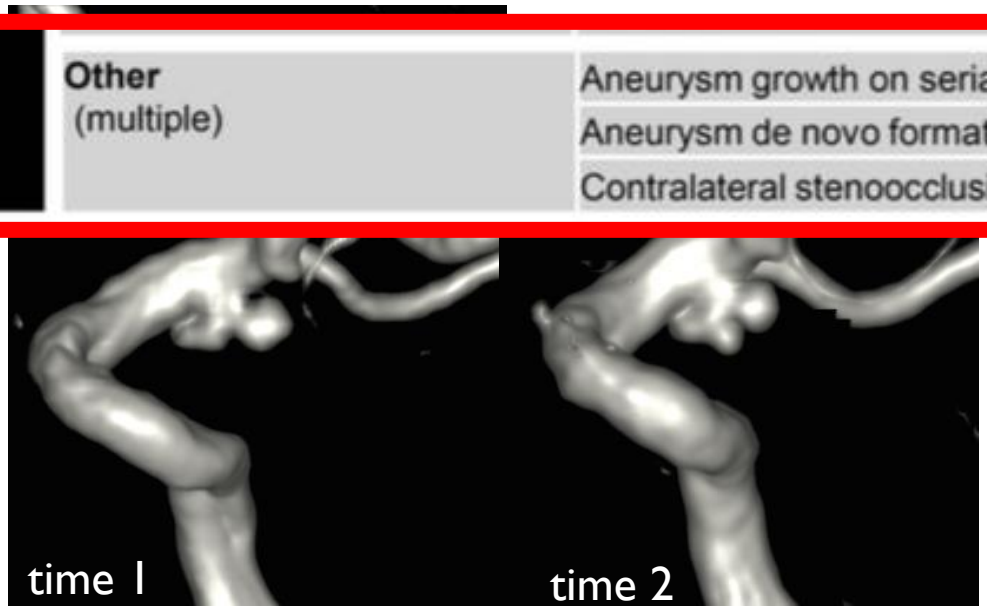
Multidisciplinary Consensus on Assessment of Unruptured Intracranial Aneurysms
Etminan N et al. Stroke 2014

Pourquoi suivre un Anévrisme non traité ?

- Facteur de risque de rupture individuel robuste

igure 2 The unruptured intracranial aneurysm treatment score

Patient	**Age** (single)	< 40 years	4
		40-60 years	3
		61-70 years	2
		71-80 years	1
		> 80 years	0
	Risk factor incidence (multiple)	Previous SAH from a different aneurysm	4
		Familial intracranial aneurysms or SAH	3
		Japanese, Finnish, Inuit ethnicity	2
		Current cigarette smoking	3
		Hypertension (systolic BP > 140 mm Hg)	2
		Autosomal-polycystic kidney disease	2
		Current drug abuse (cocaine, amphetamine)	2
		Current alcohol abuse	1
	Clinical Symptoms related to UIA (multiple)	Cranial nerve deficit	4
		Clinical or radiological mass effect	4
		Thromboembolic events from the aneurysm	3
		Epilepsy	1
	Other (multiple)	Reduced quality of life due to fear of rupture	2
		Aneurysm multiplicity	1
Aneurysm		≥ 25 mm	4
	Morphology (multiple)	Irregularity or lobulation	3
		Size ratio > 3 or aspect ratio > 1.6	1
	Location (single)	BasA bifurcation	5
		Vertebral/basilar artery	4
		AcomA or PcomA	2
	Other (multiple)	Aneurysm growth on serial imaging	4
		Aneurysm de novo formation on serial imaging	3
		Contralateral stenoocclusive vessel disease	1
Treatment	**Age-related risk** (single)	< 40 years	0
		41-60 years	1
		61-70 years	3
		71-80 years	4
		> 80 years	5
	Aneurysm size-related risk (single)	< 6.0 mm	0
		6.0-10.0 mm	1
		10.1-20.0 mm	3
		> 20 mm	5
	Aneurysm complexity-related risk	High	3
		Low	0



The unruptured intracranial aneurysm treatment score.
N Etminan et al. Neurology 2015

Pourquoi suivre un Anévrisme non traité ?

- Objectif : dépister une modification morphologique / une augmentation de taille

Box 1 | Summary of the AHA/ASA guidelines for UIAs

- Several characteristics of the aneurysm (size, location, morphology, multiplicity and documented growth in serial imaging) should be considered in decision-making
- Patient-related characteristics conferring increased risk of SAH include prior history of SAH from a different aneurysm, and familial intracranial aneurysms
- Patients requiring UIA treatment should be informed about the risks and benefits of both microsurgical and endovascular aneurysm repair (for example, microsurgical clipping can confer more durable protection against regrowth, whereas coil embolization could incur a lower periprocedural risk of complications, shorter length of stay, and lower hospital costs)
- Treatment outcomes are inferior at centres with fewer than 20 cases per year
- Observation can sometimes be a reasonable alternative to operation if the the patient is old or has medical comorbidities
- Observation can also be the preferred option if the patient has small, asymptomatic UIAs, which can have a low risk of rupture on the basis of their location, diameter, morphology and the patient's family history

Abbreviations: AHA, American Heart Association; ASA, American Stroke Association; SAH, subarachnoid haemorrhage; UIA, unruptured intracranial aneurysm.

SFNR SOCIETE FRANCAISE DE NEURORADIOLOGIE

Villablanca JP et al. Radiology 2013
Chalouhi N et al. Stroke 2013
Thompson BG et al. Stroke 2015 guidelines

Quelle est la définition d'un anévrisme modifié ?

- ≥0.5, 1, 2 mm ?
- Grand diamètre ?
- Tout diamètre ?
- ≥ 1 mm si sac <5 mm ?
- ≥ 2 mm si sac >5 mm ?
- ≥ 1.5x le grand diamètre ?
- Bleb ?
- Forme ?

"None of the aneurysms had indisputable change in shape without simultaneous growth in size"

Table 2. Overview of the Definitions of Growth and the Imaging Modalities Used to Assess Aneurysm Growth

First Author	Definition of Aneurysm Growth	Imaging Modality
Juvela et al[9]	≥1-mm increase in its greatest dimension	CTA or DSA or autopsy
Matsubara et al[10]	≥0.5-mm increase in maximum diameter	CTA
Miyazawa et al[11]	≥2-mm increase in maximum diameter	0.5T MRA
Burns et al[12]*	Aneurysms <5 mm: ≥1-mm increase in maximum transverse diameter	1.5T MRA or 3T MRA
	Aneurysms ≥5 mm: ≥2-mm increase in maximum transverse diameter	1.5T MRA or 3T MRA
So et al[15]	Undefined	Angiographic films
Sonobe et al[16]	Undefined	CTA or MRA or DSA
Ferns et al[17]	≥1-mm increase in maximum diameter	3T MRA
Inoue et al[18]	≥1.5× increase of maximum diameter or the appearance of a bleb	1.5T MRA
Igase et al[19]	≥1 mm increase in size or development of subarachnoid hemorrhage†	1.5T MRA
Chien et al[20]	Overall change in size of >0.75 mm	CTA
Matsumoto et al[21]	≥1-mm increase in maximum diameter	1.5T MRA
Kubo et al[22]	≥2-mm increase in maximum diameter or obvious morphological change	CTA or MRA
Jeon et al[23]	≥1.5× increase of maximum aneurysm size or morphological change	DSA or MRA
Mehan et al[24]	>2-mm increase measured size in any dimension	CTA
Backes et al[6]‡	≥1.0-mm increase in 1 dimension or indisputable change in shape	CTA or 1.5T MRA or 3T MRA
	≥0.5-mm increase in 2 dimensions or indisputable change in shape (identical imaging modalities)	CTA or 1.5T MRA or 3T MRA

CTA indicates computed tomographic angiography; DSA, digital subtraction angiography; MRA, magnetic resonance angiography; and T, Tesla.
*Including Phan et al[13] and Irazabal et al.[14]

SFNR SOCIETE FRANCAISE DE NEURORADIOLOGIE

Backes et al. Risk of Aneurysm Growth; Stroke Apr 2016
Bor AS et al. Stroke 2015 *57/468 modifiés*

Quelle est la définition d'un anévrisme modifié ?

- Probablement une définition « défensive »

→ toute modification perceptible

→ utilisant une technique identique (pas CTA vs. IRM ou 1.5 vs. 3T !) aux deux temps différents

→ car l'incidence est rare

21 études

3954 patients

4990 anévrismes

13,294 anévrismes – années de suivi

3% par anévrisme – année

W. Brinjikji, et al. AJNR 2015

3% par an, voire moins….

Table 5. Risk Ratio of Aneurysm Growth According to Study Design and Quality

	No. of Cohorts*	No. of Aneurysms With Growth (%)	Follow-Up in Aneurysm-Years	Risk Ratio (95% CI)
Study design				
Retrospective	12	378 (9)	11.695	Reference
Prospective	3	59 (8)	2.292	0.80 (0.61–1.05)
Study quality				
Poor/ moderate	6	146 (7)	3.370	Reference
High	9	291 (10)	10.617	0.63 (0.52–0.77)

CI indicates confidence interval.

*The publication with the largest number of patients was included in this analysis in case of multiple publications on the same patient population.

SFNR SOCIETE FRANCAISE DE NEURORADIOLOGIE

Backes et al. Stroke Apr 2016

Sommes nous capables de détecter une modification ?

Centre hospitalier Sainte-Anne

Inter/Intra-observer variability in interpretation of evolutive intracranial aneurysm follow-up imaging

Date:
Name of rater:
Email :

How many years have you been treating/interpreting aneurysm cases?

Save

Send

In order to evaluate inter observer and intra observer variability in the interpretation of MRA results regarding aneuvrysm evolution over time, we ask you to assess the following 45 set of images and then assess the final result regarding the evolution.

Of course, you are provided only with selected images and you must make your judgements based on the images provided.
This is an interactive PDF form, best viewed in Acrobat reader 9.3 but compatible with version 7 and up. The latest free version of Adobe Reader can be downloaded at: http://get.adobe.com/reader.

Attention MAC user: Basically you need to save the form on your computer. Open Acrobat/Acrobat Reader and then open the file. MAC Preview app will not permit you to save the value of each field.
If you do not see the fields to fill, please press 'highlight fields' in the top right corner of the document.

Once completed, press the 'send by email' button and if your mail service does not permit this action, please save the file on your computer and follow the typical procedure to attach a file in the email program (or webmail) that you use to compose messages and send the file to:
Dr Olivier NAGGARA (o.naggara@ch-sainte-anne.fr)

Your answers will be processed anonymously. We required your name, email and date only to keep track of responses. Thank you very much for your collaboration!

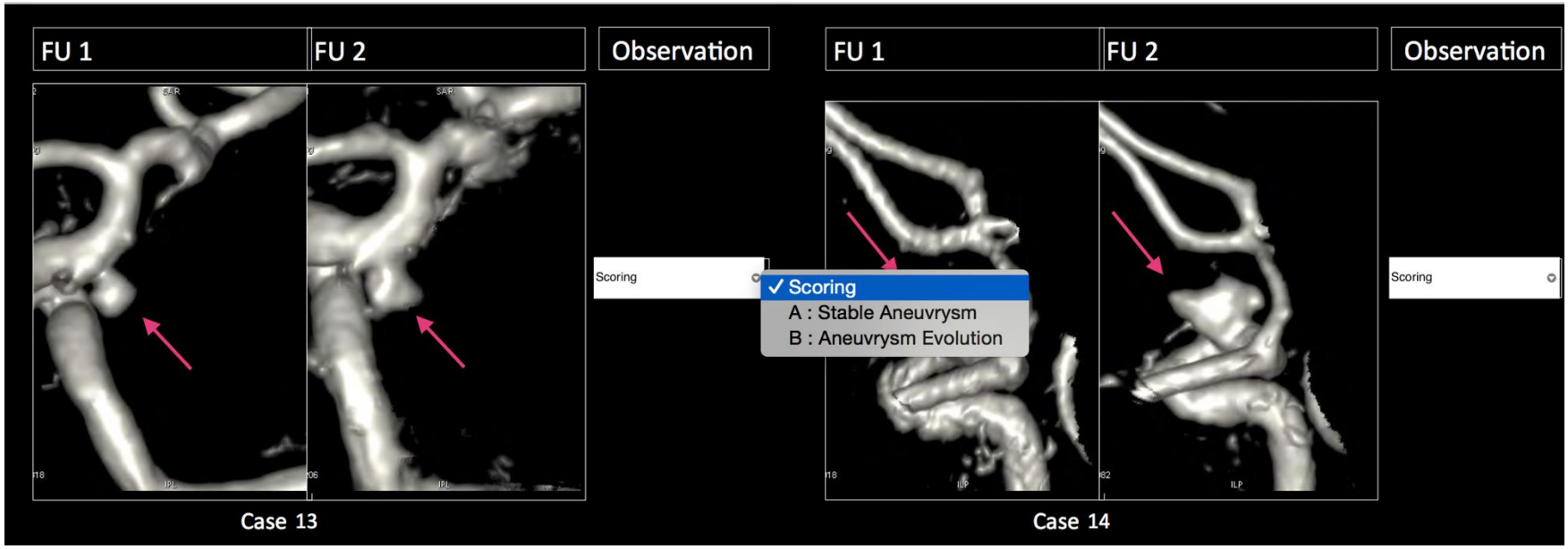
Scoring instructions:
Please assess each set of images
Score images according to the following classification (A : stable aneurysm, B : aneurysm evolution) using the drop-down menu.

SFNR SOCIETE FRANCAISE DE NEURORADIOLOGIE

Francois Eugene et al. In prep

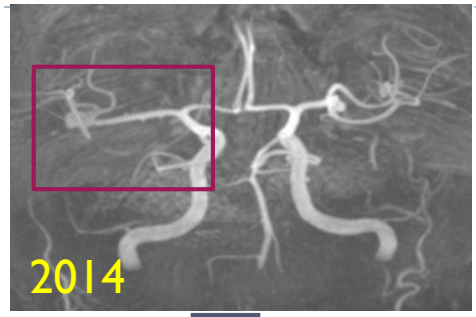
Sommes nous capables de détecter une modification ?

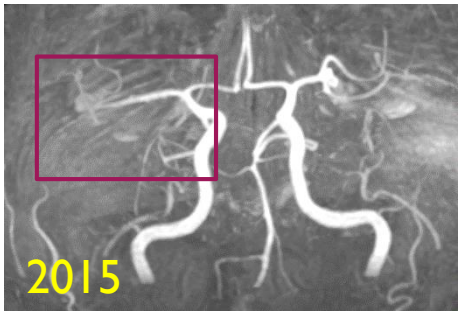
- 16 experts – 12 ans d'expérience en moyenne - 45 cas



Francois Eugene et al. In prep

Sommes nous capables de détecter une modification ?





Agrément : 0.53 (0.42-0.65)

Francois Eugene et al. In prep

Sommes nous capables de détecter une modification ?

- Outils d'aide à la détection

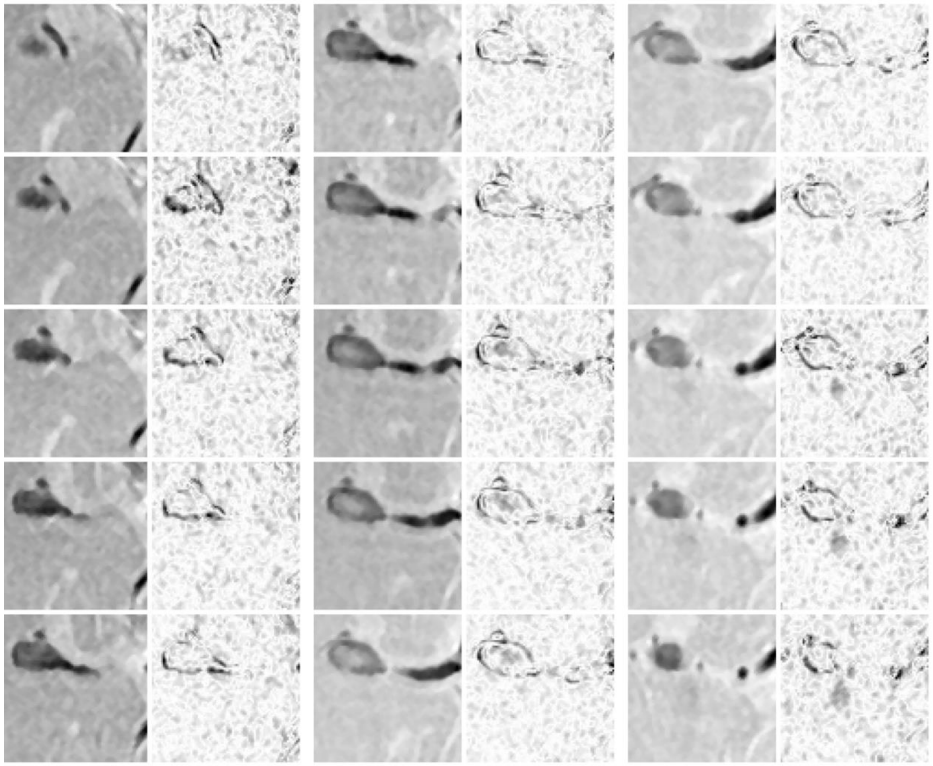


Figure 14: Median filtering pre-processing

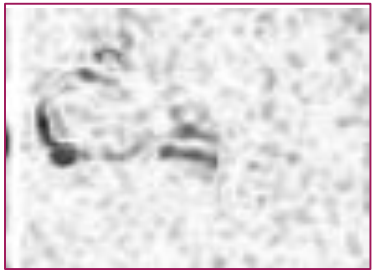


Image differences

Stepan-Buksakowska et al. AJNR 2014 Computer-Aided Diagnosis Improves Detection of Small Intracranial Aneurysms on MRA in a Clinical Setting

N Beauger Master Telecom Paris Tech 2014

Quels patients sont les plus à risque d'une modification de l'anévrisme ?

Table 3. Risk Ratio of Aneurysm Growth According to Patient Characteristics

	No. of Cohorts	Risk Ratio (95% CI)	Heterogeneity I^2 (%)
Population			
North America/Europe other than Finnish	5	Reference	…
Japanese	7	0.75 (0.58–0.96)	…
Finnish	1	0.64 (0.45–0.90)	…
Age, y			
<50	5	Reference	85
≥60	4	0.68 (0.40–1.14)	67
≥70	4	1.36 (0.80–2.33)	95
Female sex	14	1.26 (0.97–1.62)	59
Hypertension	11	1.24 (0.98–1.58)	40
Previous subarachnoid hemorrhage	13	0.88 (0.67–1.16)	93
Previous smoking or smoking at baseline	4	0.84 (0.58–1.22)	78
Smoking at baseline	9	2.03 (1.52–2.71)	59
Family history of aneurysms	9	1.24 (0.84–1.85)	91
Multiple unruptured aneurysms	10	2.04 (1.56–2.66)	90
Diabetes mellitus	6	1.31 (0.72–2.41)	30
Hyperlipidemia	4	1.41 (0.79–2.51)	26
Excessive alcohol use	2	1.83 (0.78–4.25)	42
Cerebrovascular disease	3	1.54 (0.88–2.70)	0
Coronary artery disease	3	0.99 (0.45–2.17)	0

CI indicates confidence interval.

Table 4. Risk Ratio of Aneurysm Growth According to Aneurysm Characteristics

	No. of Cohorts	Risk Ratio (95% CI)	Heterogeneity I^2 (%)
Aneurysm location			
MCA	12	Reference	20
ICA including PCOM*	12	0.99 (0.78–1.27)	17
PCOM	6	1.11 (0.69–1.81)	0
ACOM or ACA	12	0.86 (0.61–1.21)	3
ACOM	11	0.95 (0.65–1.38)	0
ACA	11	0.83 (0.43–1.58)	0
Posterior circulation†	13	1.77 (1.30–2.41)	30
Basilar artery	11	1.94 (1.32–2.83)	57
Aneurysm size			
≤4 mm	11	Reference	65
≥5 mm	9	2.56 (1.93–3.39)	98
≥7 mm	9	2.80 (2.01–3.90)	96
≥10 mm	8	5.38 (3.76–7.70)	97
Irregular aneurysm shape	4	2.32 (1.46–3.68)	91

3990 patients
4972 anévrismes

Backes et al. Stroke Apr 2016

Quels patients sont les plus à risque d'une modification de l'anévrisme ?

Risk factors for aneurysm growth

	No. of Studies	Proportion of Growing Aneurysms per Patient-Year (95% CI)	I^2	*P* Value
Overall growth rate	21	3.0 (2.0–4.0)	95	–
Age (yr)				
50 or younger	6	0.9 (0.0–24.7)	93	<.0001
50 or older	3	3.8 (1.3–11.5)	96	
70 or younger	5	2.4 (0.4–16.3)	96	.04
70 or older	1	2.5 (1.2–5.4)	NA	
Population				
Japanese	9	2.7 (1.5–4.7)	82	–
Finnish	1	2.4 (1.7–3.3)	NA	–
Sex				
Male	12	1.3 (0.5–3.6)	90	<.01
Female	12	3.2 (1.6–6.3)	95	
Aneurysm location				
ICA	13	2.5 (1.1–5.5)	92	<.01
MCA	13	3.3 (1.4–7.9)	87	
ACA/AcomA	13	1.8 (0.8–4.2)	89	
VBA	12	3.6 (1.3–9.9)	85	
Cavernous carotid artery	2	14.4 (5.1–40.2)	75	
Anterior vs posterior				
Anterior	14	2.7 (1.4–5.0)	95	<.01
Posterior	13	3.8 (1.5–9.9)	84	
Multiple aneurysms				
Yes	13	2.3 (1.1–4.8)	85	.80
No	11	3.0 (1.7–5.4)	86	
Prior SAH				
Yes	9	2.2 (0.7–6.8)	92	.06
No	8	4.7 (1.9–11.6)	95	
Family history				
Yes	7	5.0 (1.6–15.1)	79	.58
No	7	3.8 (1.5–9.3)	97	
HTN				
Yes	11	3.9 (1.9–8.0)	92	.88
No	11	4.0 (1.9–8.0)	93	
Smoking				
Yes	12	5.5 (3.0–9.9)	81	<.01
No	11	3.5 (1.7–7.1)	94	

Risk factors for aneurysm growth

	No. of Studies	Proportion of Growing Aneurysms per Patient-Year (95% CI)	I^2	*P* Value
Shape				
Saccular	4	5.2 (2.3–11.8)	75	<.01
Lobular	2	15.2 (5.8–40.2)	0	
Daughter sac	1	16.7 (4.9–56.7)	NA	
Fusiform	1	13.7 (6.4–29.5)	NA	
Shape				
Saccular	4	5.2 (2.3–11.8)	75	<.01
Nonsaccular	4	14.7 (8.6–25.2)	0	
Size (mm)				
<3	4	4.1 (1.3–12.9)	88	<.01
>3	15	5.2 (2.9–9.3)	87	
<5	9	2.3 (1.2–4.2)	89	<.01
>5	13	6.5 (3.6–12.0)	84	
<7	11	2.5 (1.5–4.1)	90	<.01
>7	10	9.2 (4.1–20.6)	84	
<10	15	2.9 (1.6–5.2)	96	<.01
>10	10	9.7 (4.0–23.8)	81	
<13	15	3.0 (1.6–5.3)	96	<.01
>13	5	8.1 (1.8–36.1)	83	
Study risk of bias				
High	15	2.9 (1.6–5.6)	95	<.01
Medium	4	1.7 (0.4–7.2)	92	
Low	2	1.7 (0.8–3.4)	86	

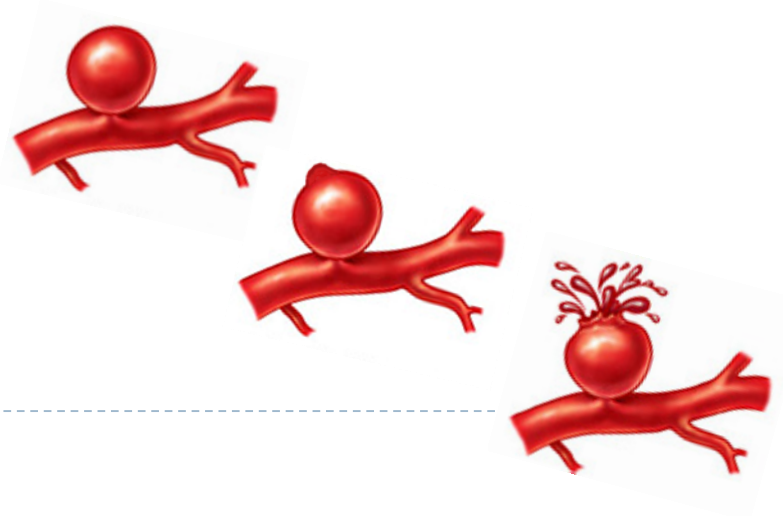
Note:—AcomA indicates anterior communicating artery; VBA, vertebrobasilar artery; HTN, hypertension; ACA, anterior cerebral artery; NA, not applicable.

3954 patients
4990 anévrismes

W. Brinjikji, et al. AJNR 2015

Quels patients sont les plus à risque d'une modification de l'anévrisme ?

- Anévrisme >10 mm
- Circulation postérieure
- Irrégulier
- Multiples
- Chez une fumeuse
- ….



W. Brinjikji, et al. AJNR 2015
Backes et al. Stroke Apr 2016

Pourquoi suivre un Anévrisme non traité ?

- Objectif : dépister une modification de l'anévrisme

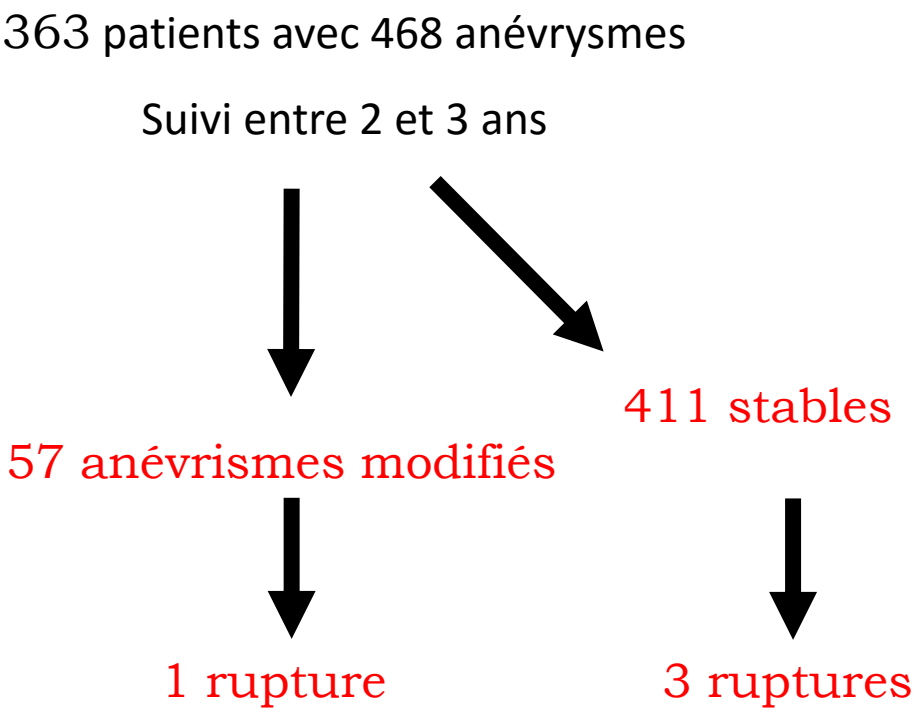
→ Indication formelle de traitement

- mais tous les anévrismes ne se modifient pas avant la rupture

Villablanca JP et al. Radiology 2013
Chalouhi N et al. Stroke 2013

La majorité des anévrismes ne se modifient pas avant de rompre

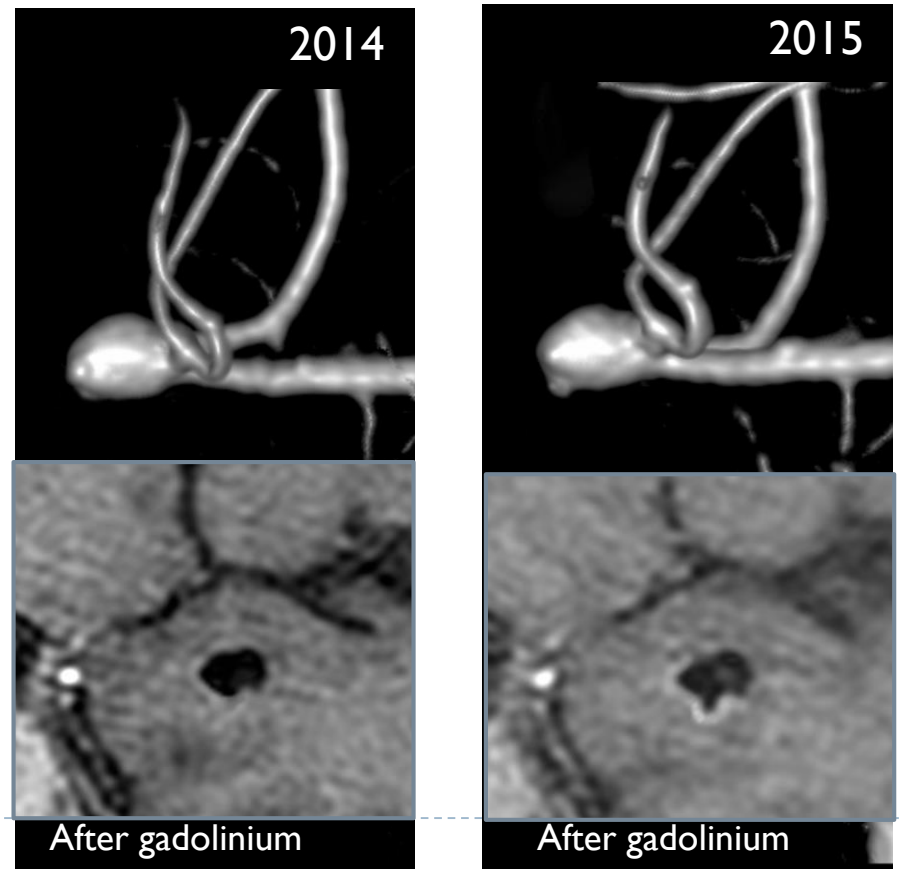
Exemple monocentrique



Bor AS et al. Stroke 2015

Faut il rechercher uniquement une modification de la lumière ?

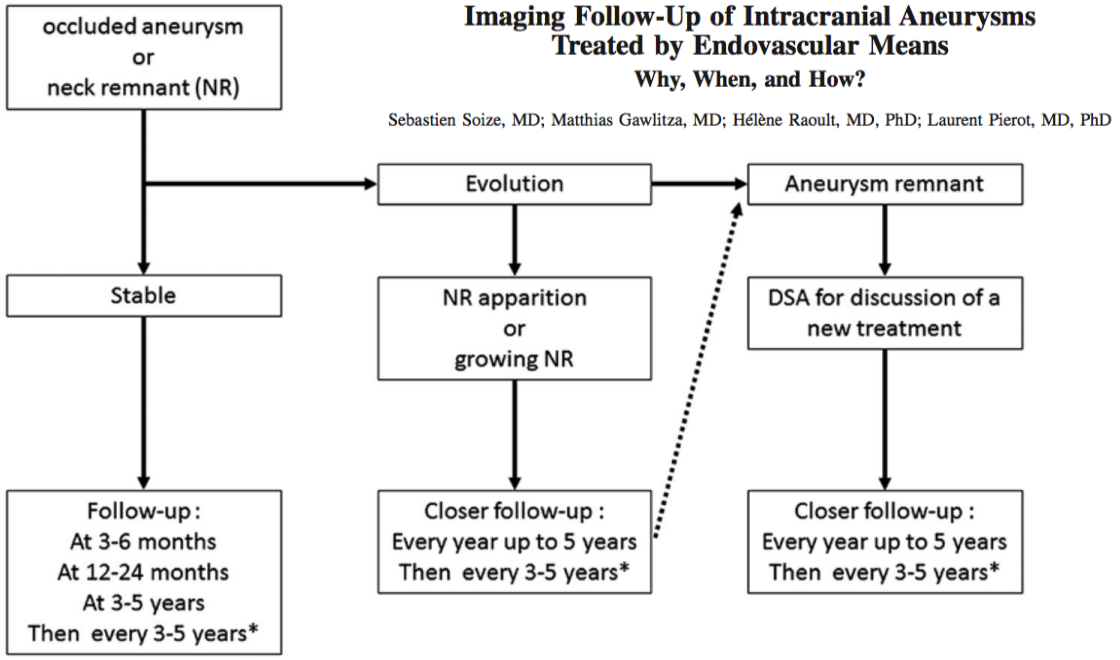
- Modification « beyond the lumen » → inflammation de la paroi → Chélates de gadolinium – ferumoxytol



Edjlali et al Stroke 2015
DM Hasan et al.ATVB 2012

Conclusion

- **Anévrisme traités**



- **Anévrismes non traités**
  - Paramètres et technique similaire
  - Analyse comparative rigoureuse
  - Comparaison de la lumière
  - Comparaison de la paroi ? ➡ Session inflammation à 11H00

SFNR SOCIETE FRANCAISE DE NEURORADIOLOGIE

Pourquoi suivre en imagerie les anévrismes intracrâniens ?

MERCI pour votre ATTENTION

43ème congrès de la SFNR – Paris

FACULTÉ DE MÉDECINE PARIS DESCARTES

Centre hospitalier Sainte-Anne

Necker ENFANTS MALADES HÔPITAL UNIVERSITAIRE