

**CIV**  
**WORLD**  
CHALLENGES & INNOVATIONS IN VASCULAR WORLD

31 MARS  
1<sup>ER</sup> AVRIL **2026**

MÉRIDIEN PARIS ARC DE TRIOMPHE  
PARIS

**Tout augmente .....  
même les diamètres seuils pour le  
traitement des anévrismes des  
artères viscérales !**

**Pr Yves CASTIER**

**chir**  
**vtt**

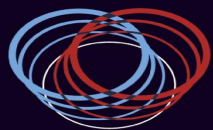
**SURVIO**  
Structure d'URgences Vasculaires Intestinales

**LNTS**  
Laboratory for Vascular Translational Science

# Conflits et liens d'intérêts



Je n'ai aucun conflit d'intérêt potentiel à déclarer



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**ANEVRYSME Artères DIGESTIVES**

**ANEVRYSME ILIAQUE INTERNE**

**ANEVRYSME RENALE**



2017

Eur J Vasc Endovasc Surg (2017) 53, 460–510

**Editor's Choice — Management of the Diseases of Mesenteric Arteries and Veins**

**Clinical Practice Guidelines of the European Society of Vascular Surgery (ESVS)**

M. Björck<sup>a</sup>, M. Koelemay<sup>a</sup>, S. Acosta<sup>a</sup>, F. Bastos Goncalves<sup>a</sup>, T. Kölbl<sup>a</sup>, J.J. Kolkman<sup>a</sup>, T. Lees<sup>a</sup>, J.H. Lefevre<sup>a</sup>, G. Menyhei<sup>a</sup>, G. Oderich<sup>a</sup>,  
ESVS Guidelines Committee<sup>b</sup>, P. Kolh, G.J. de Borst, N. Chakfe, S. Debus, R. Hinchliffe, S. Kakkos, I. Koncar, J. Sanddal Lindholt, M. Vega de Ceniga, F. Vermassen, F. Verzini,  
Document Reviewers<sup>c</sup>, B. Geelkerken, P. Gloviczki, T. Huber, R. Naylor

**Keywords:** Guidelines, Acute mesenteric ischaemia, Arterial thrombosis, Arterial embolism, Chronic mesenteric ischaemia, Non-occlusive mesenteric ischaemia, Venous mesenteric ischaemia, Mesenteric venous thrombosis, Mesenteric arterial aneurysms, Isolated dissections of the mesenteric arteries

# Artères Viscérales

SOCIETY FOR VASCULAR SURGERY

2020

**The Society for Vascular Surgery clinical practice guidelines on the management of visceral aneurysms**

[Check for updates](#)

Rabih A. Chaer, MD,<sup>a</sup> Christopher J. Abularrage, MD,<sup>b</sup> Dawn M. Coleman, MD,<sup>c</sup> Mohammad H. Eslami, MD,<sup>a</sup> Vikram S. Kashyap, MD,<sup>d</sup> Caron Rockman, MD,<sup>e</sup> and M. Hassan Murad, MD,<sup>f</sup> Pittsburgh, Pa; Baltimore, Md; Ann Arbor, Mich; Cleveland, Ohio; New York, NY; and Rochester, Minn

**ABSTRACT**

These Society for Vascular Surgery Clinical Practice Guidelines describe the care of patients with aneurysms of the visceral arteries. They include evidence-based size thresholds for repair of aneurysms of the renal arteries, splenic artery, celiac artery, and hepatic artery, among others. Specific open surgical and endovascular repair strategies are also discussed. They also describe specific circumstances in which aneurysms may be repaired at smaller sizes than these size thresholds, including in women of childbearing age and false aneurysms. These Guidelines offer important recommendations for the care of patients with aneurysms of the visceral arteries and long-awaited guidance for clinicians who treat these patients. (J Vasc Surg 2020;72:3S-39S.)



Clinical Practice Guidelines

Eur J Vasc Endovasc Surg (2025) 70, 153–218

2025

**CLINICAL PRACTICE GUIDELINE DOCUMENT**

**Editor's Choice — European Society for Vascular Surgery (ESVS) 2025 Clinical Practice Guidelines on the Management of Diseases of the Mesenteric and Renal Arteries and Veins** ☆

Mark J. Koelemay, (Chair)<sup>a</sup>, Robert H. Geelkerken, (Co-chair), Jussi Kärkkäinen, (Co-chair), Nicola Leone, (Co-chair), George A. Antoniou, Jorg L. de Bruin, Alexander Gombert, Anders Gottsäter, Elena Iborra, Sonia Ronchey, Konstantinos Spanos, Jos C. van den Berg, Sabine Wipper, Frederico Bastos Gonçalves, Martin Björck, Raphael Coscas, Sandro Lepidi, Timothy A. Resch, Jean-Baptiste Ricco, Riikka Tulamo, Anders Wanhainen, Olivier Corcos, Thomas S. Huber, Alexander Oberhuber, Annika Reintam Blaser, Matti Tolonen<sup>†</sup>

2019

Artères  
Iliques

**Editor's Choice — European Society for Vascular Surgery (ESVS) 2019 Clinical Practice Guidelines on the Management of Abdominal Aorto-iliac Artery Aneurysms**

Anders Wanhainen <sup>a,\*</sup>, Fabio Verzini <sup>a,†</sup>, Isabelle Van Herzele <sup>a</sup>, Eric Allaire <sup>a</sup>, Matthew Bown <sup>a</sup>, Tina Cohnert <sup>a</sup>, Florian Dick <sup>a</sup>, Joost van Herwaarden <sup>a</sup>, Christos Karkos <sup>a</sup>, Mark Koelemay <sup>a</sup>, Tilo Kölbel <sup>a</sup>, Ian Loftus <sup>a</sup>, Kevin Mani <sup>a</sup>, Germano Melissano <sup>a</sup>, Janet Powell <sup>a</sup>, Zoltán Szeberin <sup>a</sup>

ESVS Guidelines Committee <sup>b</sup>, Gert J. de Borst, Nabil Chakfe, Sebastian Debus, Rob Hinchliffe, Stavros Kakkos, Igor Koncar, Philippe Kolh, Jes S. Lindholt, Melina de Vega, Frank Vermassen

Document reviewers <sup>c</sup>, Martin Björck, Stephen Cheng, Ronald Dalman, Lazar Davidovic, Konstantinos Donas, Jonathan Earnshaw, Hans-Henning Eckstein, Jonathan Golledge, Stephan Haulon, Tara Mastracci, Ross Naylor, Jean-Baptiste Ricco, Henc Verhagen

Clinical Practice Guidelines



Eur J Vasc Endovasc Surg (2024) 67, 192–331

2024

CLINICAL PRACTICE GUIDELINE DOCUMENT

**Editor's Choice — European Society for Vascular Surgery (ESVS) 2024 Clinical Practice Guidelines on the Management of Abdominal Aorto-Iliac Artery Aneurysms** ☆

Anders Wanhainen <sup>a,\*</sup>, Isabelle Van Herzele <sup>a</sup>, Frederico Bastos Goncalves <sup>a</sup>, Sergi Bellmunt Montoya <sup>a</sup>, Xavier Berard <sup>a</sup>, Jonathan R. Boyle <sup>a</sup>, Mario D'Oria <sup>a</sup>, Carlota F. Prendes <sup>a</sup>, Christos D. Karkos <sup>a</sup>, Arkadiusz Kazimierczak <sup>a</sup>, Mark J.W. Koelemay <sup>a</sup>, Tilo Kölbel <sup>a</sup>, Kevin Mani <sup>a</sup>, Germano Melissano <sup>a</sup>, Janet T. Powell <sup>a</sup>, Santi Trimarchi <sup>a</sup>, Nikolaos Tsilimparis <sup>a</sup>

ESVS Guidelines Committee <sup>b</sup>, George A. Antoniou, Martin Björck, Raphael Coscas, Nuno V. Dias, Philippe Kolh, Sandro Lepidi, Barend M.E. Mees, Timothy A. Resch, Jean Baptiste Ricco, Riikka Tulamo, Christopher P. Twine

Document Reviewers <sup>c</sup>, Daniela Branzan, Stephen W.K. Cheng, Ronald L. Dalman, Florian Dick, Jonathan Golledge, Stephan Haulon, Joost A. van Herwaarden, Nikola S. Ilic, Arkadiusz Jawien, Tara M. Mastracci, Gustavo S. Oderich, Fabio Verzini, Kak Khee Yeung

# Niveau de preuve



Level of Evidence A	Data derived from multiple randomised trials or meta-analyses of randomised trials
Level of Evidence B	Data derived from a single randomised trial, large non-randomised studies or a meta-analysis of non-randomised studies
Level of Evidence C	Consensus opinion of experts and/or small studies, retrospective studies, registries <sup>†</sup>

**23 / Anévrysmes art viscérales**  
**4 / Anévrysmes art iliaques**

**Niveau de preuve**

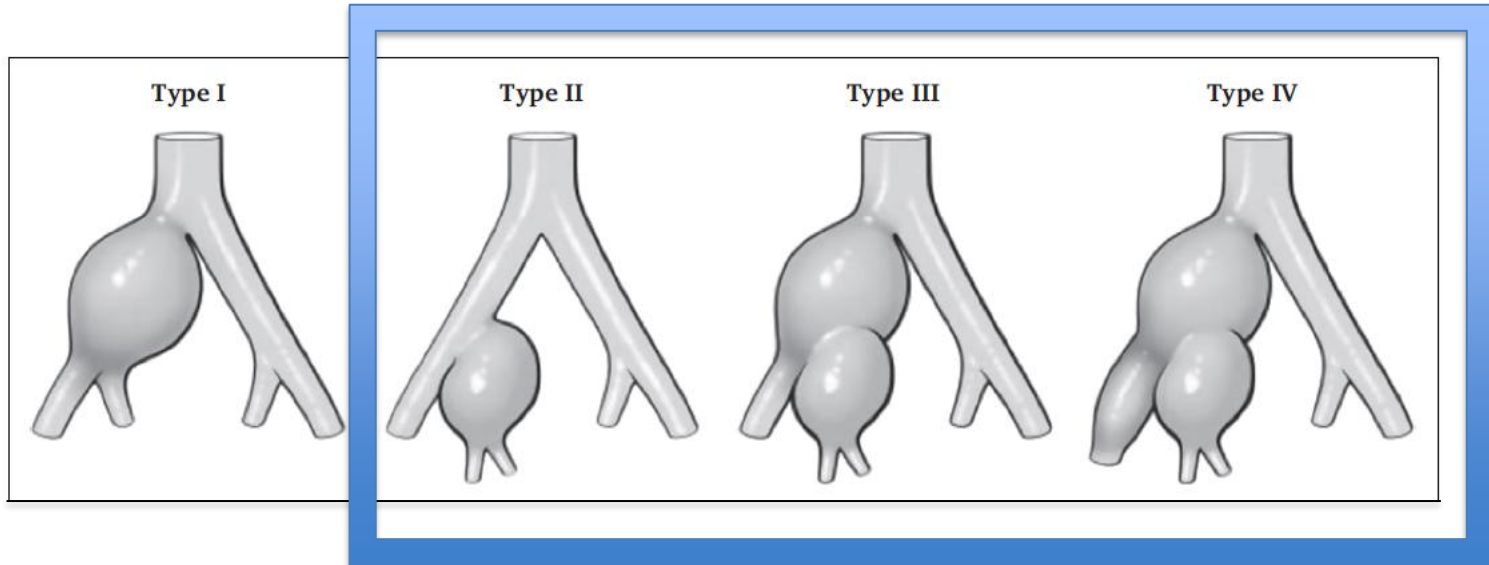
- C : 26 96%
- B : 1

# ANEVRYSME ILIAQUE INTERNE



> 8mm

- Homme 9/10
- 70 ans
- < 2 % des Anévrismes aorto-iliaques



# ANEVRYSME ILIAQUE INTERNE



Recommendation 135		Changed	
Patients with an iliac artery aneurysm (common iliac artery, internal iliac artery, and external iliac artery, or combination thereof) should be considered for elective repair at a <u>diameter of <math>\geq 40</math> mm</u> .			
Class	Level	References	ToE
Ia	C	Charisis <i>et al.</i> (2021), <sup>826</sup> Laine <i>et al.</i> (2017), <sup>1065</sup> Krupski <i>et al.</i> (1998), <sup>1066</sup> Chaer <i>et al.</i> (2008), <sup>1072</sup> Steenberge <i>et al.</i> (2022), <sup>1077</sup> Huang <i>et al.</i> (2008), <sup>1079</sup> Jalalzadeh <i>et al.</i> (2020), <sup>1081</sup> Fossaceca <i>et al.</i> (2015), <sup>1083</sup> Kasirajan <i>et al.</i> (1998), <sup>1084</sup> Kobe <i>et al.</i> (2018) <sup>1085</sup>	

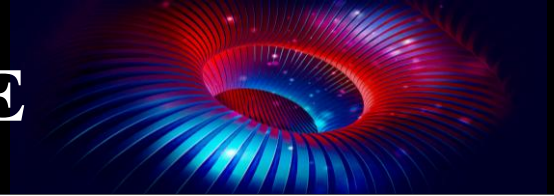
**Traitement  
> 40mm**

~~35 mm~~

Recommendation 134		New	
For patients with an iliac artery aneurysm (common iliac artery, internal iliac artery, and external iliac artery, or combination thereof), imaging surveillance using ultrasound should be considered; every three years for aneurysms 20 – 24 mm in diameter, every two years for aneurysms 25 – 29 mm in diameter, and <u>yearly for aneurysms <math>\geq 30</math> mm</u> , taking into account life expectancy, suitability for future repair, concomitant aortic dilatation, and patient preferences.			
Class	Level	References	ToE
Ia	C	Steenberge <i>et al.</i> (2022) <sup>1077</sup>	

**Surveillance  
annuelle > 30mm**

# ANEVRYSME ILIAQUE INTERNE



- Pas de distinction IP vs IInt !!
- > 40 mm pour I Int



*Laine et al. Few internal iliac artery aneurysm rupture under 4 cm. J Vasc Surg 2017.*

## **Analyse de registre de 28 centres mondiaux**

63 ruptures D'anévrysme Iint      Diamètre moyen 67 mm      Age moy : 76 ans  
4 ruptures < 40 mm      6,3%

*P Perini et al. Surgical and endovascular management of isolated internal iliac artery aneurysms : a systematic review and meta-analysis. Vasc Endovasc Surg 2021.*

**Méta-analyse / 13 études**      202 Anev IInt  
Diamètre 46 mm / 18% étaient symptomatiques

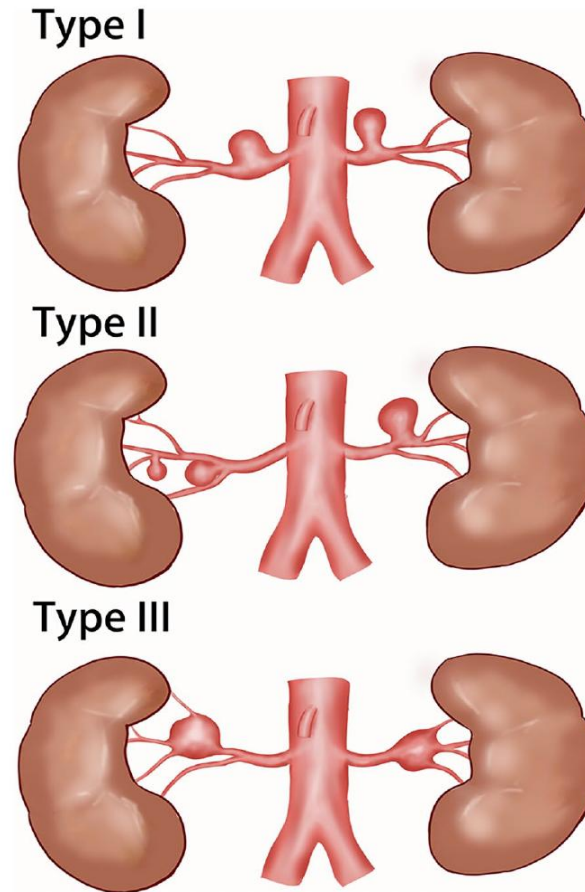
Mortalité post-op : 3,1%

# ANEVRYSME Artère RENALE



- H=F
- 50 ans
- Découverte fortuite
- HTA associée (2/3)

90% extra-parenchymateux  
SACCULAIRES



# ANEVRYSME Artère RENALE



Recommendation 92			New
Endovascular or open surgical treatment should be considered for patients with an asymptomatic renal artery aneurysm with a <u>diameter <math>\geq 30</math> mm</u> .			
Class	Level	References	ToE
Ia	C	Klausner <i>et al.</i> (2015), <sup>319</sup> Wayne <i>et al.</i> (2014), <sup>356</sup> Brownstein <i>et al.</i> (2018), <sup>357</sup> Zhang <i>et al.</i> (2023), <sup>358</sup> Choksi <i>et al.</i> (2023) <sup>363</sup>	

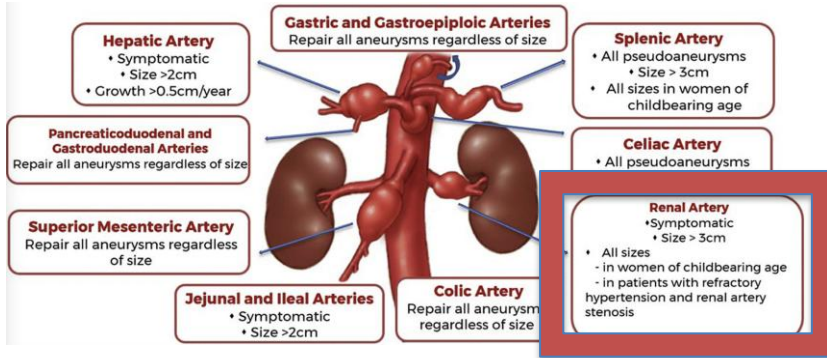
**30mm**

Recommendation 93			New
Annual surveillance with imaging should be considered for patients with an asymptomatic renal artery aneurysm with a <u>diameter <math>&lt; 30</math> mm</u> .			
Class	Level	References	ToE
Ia	C	Klausner <i>et al.</i> (2015), <sup>319</sup> Wayne <i>et al.</i> (2014), <sup>356</sup> Brownstein <i>et al.</i> (2018), <sup>357</sup> Zhang <i>et al.</i> (2023) <sup>358</sup>	

## INDICATIONS FORMELLES

- ✓ Anévrisme symptomatique
- ✓ Femme enceinte

# ANEVRYSME Artère RENALE



## SVS 2020

- ✓ PAS de différence Taille
- ✓ Femme en âge de procréer
- ✓ Sténose & HTA

ACC/AHA 2005 Practice guidelines for the management of patients with peripheral arterial disease.

Circulation 2006;113: 1474-547

## ACC-AHA 2006

- ✓ 2 cm



- Klausner et al. JVS 2015 Multicentrique n= 547
- Zhang et al. JVS 2023 Unicentrique n= 331

# ANEVRYSMES Artère SPLENIQUE



60% des Anev Art Dig

- ✓ Femme
- ✓ Multiparité
- ✓ Hypertension Portale

Recommendation 80		New	
Endovascular or open surgical treatment should be considered for patients with an asymptomatic splenic artery aneurysm with a diameter $\geq 30$ mm.			
Class	Level	References	ToE
Ia	C	Barrionuevo <i>et al.</i> (2020), <sup>315</sup> Battagini <i>et al.</i> (2021), <sup>320</sup> Saltzberg <i>et al.</i> (2005), <sup>332</sup> Lakin <i>et al.</i> (2011), <sup>333</sup> Hoogendoorn <i>et al.</i> (2014) <sup>336</sup>	

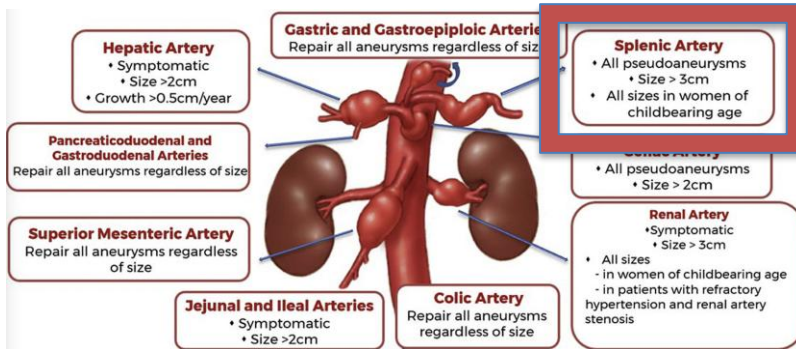
**30mm**

Recommendation 81		New	
Surveillance with individualised imaging follow up should be considered for patients with an asymptomatic splenic artery aneurysm with a diameter $< 30$ mm.			
Class	Level	References	ToE
Ia	C	Barrionuevo <i>et al.</i> (2020), <sup>315</sup> Battagini <i>et al.</i> (2021), <sup>320</sup> Saltzberg <i>et al.</i> (2005), <sup>332</sup> Lakin <i>et al.</i> (2011), <sup>333</sup> Hoogendoorn <i>et al.</i> (2014) <sup>336</sup>	

## INDICATIONS FORMELLES

- ✓ Anévrisme symptomatique
- ✓ Femme enceinte
- ✓ Femme en âge de procréer

# ANEVRYSMES Artère SPLENIQUE



SVS 2020

✓ PAS de différence

ACC/AHA 2005 Practice guidelines for the management of patients with peripheral arterial disease.

Circulation 2006;113: 1474-547

ACC-AHA 2006

✓ 2 cm



*Petites séries*

*Monocentrique & rétrospectif*

*Taux de perdue de vue ++*

*Croissance 1 mm / an*

# ANEVRYSME Artère HEPATIQUE



20% des Anev Art Dig

EXTRA-Hépatique

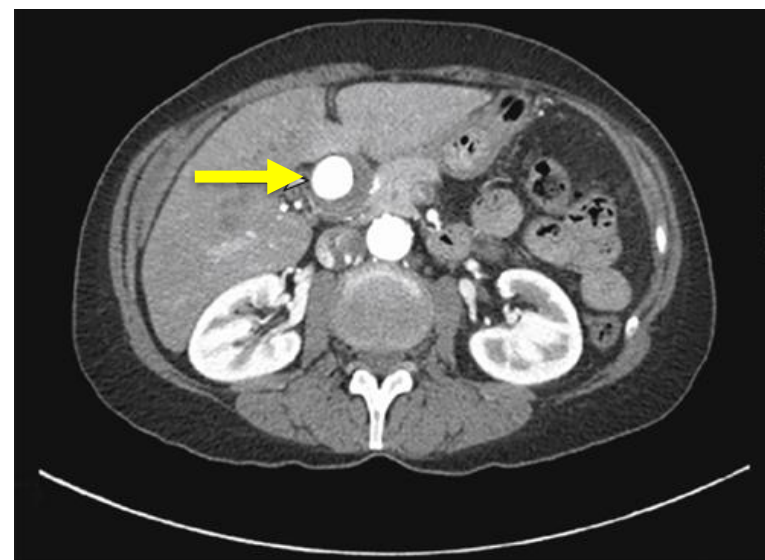
Unique

> 60 ans +++

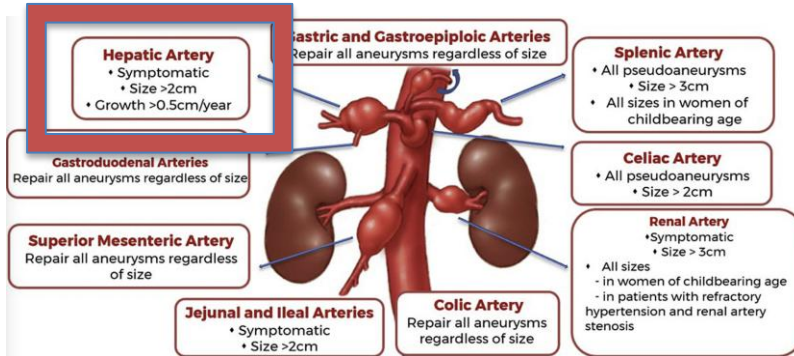
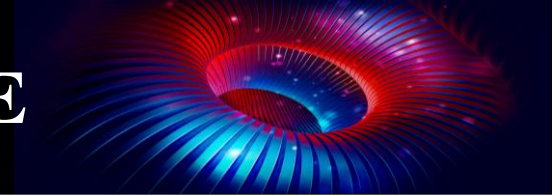
Recommendation 84		New	
Endovascular or open surgical treatment should be considered for patients with an asymptomatic hepatic artery aneurysm with a <u>diameter <math>\geq 30</math> mm</u> .			
Class	Level	References	ToE
Ila	C	Barrionuevo <i>et al.</i> (2020), <sup>315</sup> Erben <i>et al.</i> (2015), <sup>339</sup> Stark <i>et al.</i> (2022), <sup>341</sup> Melissano <i>et al.</i> (2018) <sup>342</sup>	

30mm

Recommendation 85		New	
Surveillance with individualised imaging follow up should be considered for patients with an asymptomatic hepatic artery aneurysm with a <u>diameter &lt; 30 mm</u> .			
Class	Level	References	ToE
Ila	C	Barrionuevo <i>et al.</i> (2020), <sup>315</sup> Erben <i>et al.</i> (2015), <sup>339</sup> Stark <i>et al.</i> (2022), <sup>341</sup> Melissano <i>et al.</i> (2018) <sup>342</sup>	



# ANEVRYSME Artère HEPATIQUE



SVS 2020  
20mm  
> 5mm par an



???

*Taux de croissance faible 1mm/an ?*

# ANEVRYSMES Artère MES SUP

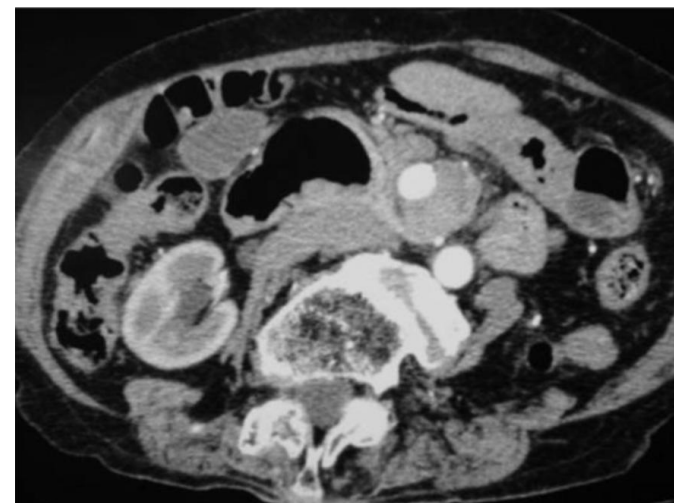


3 à 6% des Anev Art Dig  
H=F  
Étiologie variée

Recommendation 89		New	
Endovascular or open surgical treatment should be considered for patients with an asymptomatic superior mesenteric artery aneurysm with a <u>diameter <math>\geq 30</math> mm</u> .			
Class	Level	References	ToE
Ila	C	Barrionuevo <i>et al.</i> (2020), <sup>315</sup> Shukla <i>et al.</i> (2015), <sup>328</sup> Stone <i>et al.</i> (2002), <sup>350</sup> Jacobs <i>et al.</i> (2021) <sup>351</sup>	

**30mm**

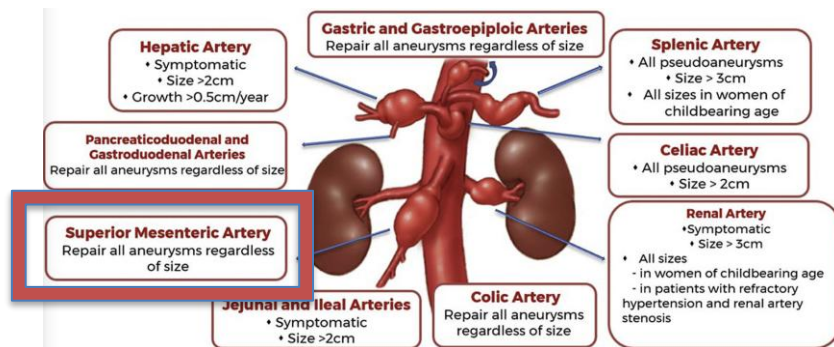
Recommendation 90		New	
Surveillance with individualised imaging follow up should be considered for patients with an asymptomatic superior mesenteric artery aneurysm with a <u>diameter <math>&lt; 30</math> mm</u> .			
Class	Level	References	ToE
Ila	C	Barrionuevo <i>et al.</i> (2020), <sup>315</sup> Shukla <i>et al.</i> (2015), <sup>328</sup> Stone <i>et al.</i> (2002), <sup>350</sup> Jacobs <i>et al.</i> (2021) <sup>351</sup>	



# ANEVRYSME Artère MES SUP

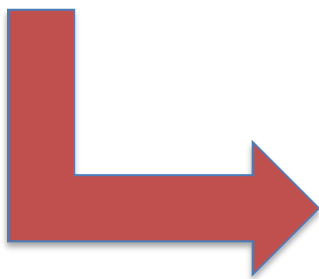


## ANEVRYSME Artère MES SUP



SVS 2020

*Intervention !*



- *Mortalité des ruptures 40 à 90%*
- *Incidence de rupture*
- *Endovasculaire souvent possible peu morbide*

# ANEVRYSME Artère PDD

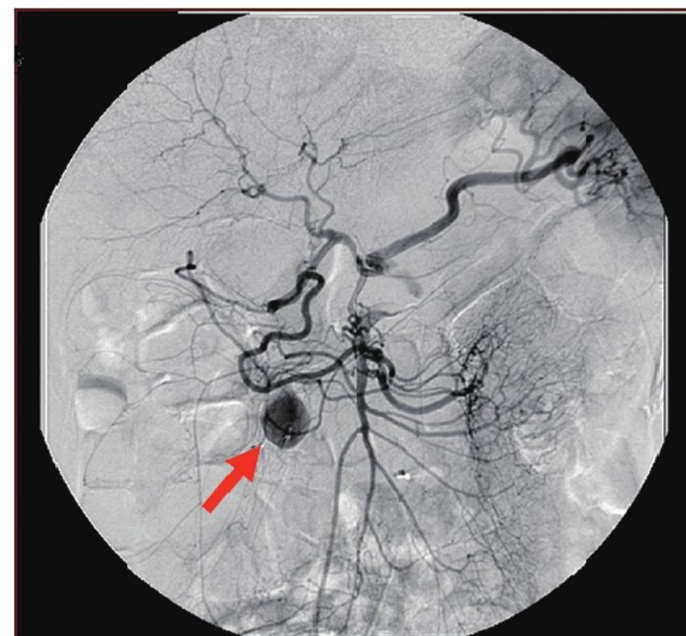


< 2% des Anev Art Dig

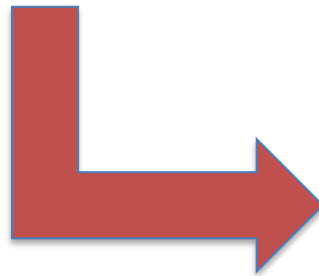
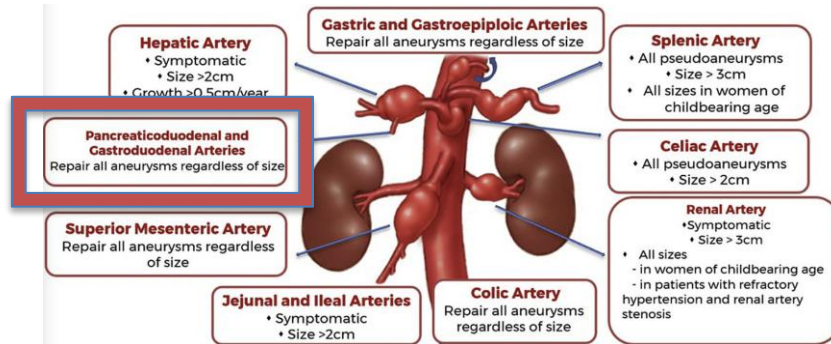
Occlusion / Sténose TC (*Sutton*)

Recommendation 88		New	
Endovascular or open surgical treatment should be considered for patients with an asymptomatic pancreaticoduodenal artery aneurysm with a <u>diameter <math>\geq 15</math> mm</u> .			
Class	Level	References	ToE
Ia	C	Vandy <i>et al.</i> (2017), <sup>347</sup> Illuminati <i>et al.</i> (2021), <sup>348</sup> Stoecker <i>et al.</i> (2022) <sup>349</sup>	

15mm



# ANEVRYSME Artère PDD



SVS 2020  
**Intervention !**



- *Mortalité des ruptures 30%*
- *Endovasculaire 90% / simple*
- *Pas de relation claire taille / rupture*

CLINICAL PRACTICE GUIDELINE DOCUMENT

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Mark J. Koelemay, (Chair) <sup>\*</sup>, Robert H. Geelkerken, (Co-chair), Jussi Kärkkäinen, (Co-chair), Nicola Leone, (Co-chair), George A. Antoniou, Jorg L. de Bruin, Alexander Gombert, Anders Gottsäter, Elena Iborra, Sonia Ronchey, Konstantinos Spanos, Jos C. van den Berg, Sabine Wipper, Frederico Bastos Gonçalves, Martin Björck, Raphael Coscas, Sandro Lepidi, Timothy A. Resch, Jean-Baptiste Ricco, Riikka Tulamo, Anders Wanhainen, Olivier Corcos, Thomas S. Huber, Alexander Oberhuber, Annika Reintam Blaser, Matti Tolonen <sup>†</sup>

■ ***EXPERTS***

■ ***Recommandations de Grade C***

*(Consensus d'expert, petites études, registres, études rétrospectives)*

■ ***Divergences avec les nord-américains / SVS 2020***

■ ***Eviter le Dogme***

***= Décision à adapter pour chaque patient***

# Décision collégiale / RCP



**Chirurgien, radiologue, médecin  
VASCULAIRE**

**Gastro-entérologue, Néphrologue,  
Interniste**

- ✓ Iliaque Int  $> 30$  mm
- ✓ Artère rénale  $> 20$  mm
- ✓ Artère splénique  $> 20$  mm  
distale ou à croissance rapide
- ✓ Artère mes sup
- ✓ Artère pancréatico-duodénale
- ✓ Artère hépatique  $> 20$  mm
- ✓ Cas particuliers :
  - Femme en âge de procréer & Artère rénale

# Décision collégiale / RCP



✓ **Croissance de l'anévrisme +++**

Rôle futur de la mesure du volume

✓ **Localisation anatomique**

✓ **TCMM du traitement**

Endovasculaire

✓ **Age**

✓ **Cas particuliers**

✓ **Sexe et Taille du patient**

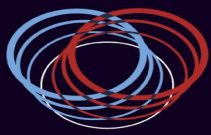
✓ **Etiologie**

✓ **Choix du patient**

**Rythme de surveillance**  
**Quel examen ?**

**Intervention**  
**Quelle intervention ?**





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PARIS

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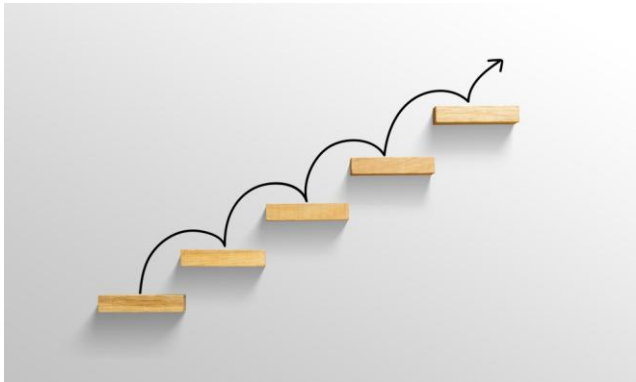
**chir**  
**vtt**

**SURVI** 

Structure d'URgences Vasculaires Intestinales

**LNTS**   
Laboratory for Vascular Translational Science

# Progresser !



## **Registre Prospectif Européen ou Etude prospective multicentrique**

- ✓ Histoire naturelle des Anévrismes des Artères viscérales
- ✓ Traitement Sténose TC / Evolution Anévrisme PPD



## **CROISSANCE ANNUELE MOYENNE des ANEVRYSMES**

<b>ARTERE</b>	<b>mm</b>
<b>Iliaque Interne &gt; 30 mm</b>	<b>1, 3 mm</b>
<b>Rénale</b>	<b>0,8 mm</b> <i>Ni taille ni calcification</i>
<b>Splénique</b>	<b>1 mm</b>
<b>Hépatique</b>	<b>1 mm</b>



> [Ann Vasc Surg.](#) 2026 Apr;125:23-32. doi: 10.1016/j.avsg.2025.12.012.  
Epub 2025 Dec 19.

## Three-Dimensional Assessment of Renal Artery Aneurysm Growth Using Vascular Deformation Mapping

Drew J Braet <sup>1</sup>, Beckett Peterson <sup>2</sup>, Luciano Delbono <sup>3</sup>,  
Chris Johnson-Harwitz <sup>4</sup>, Peter K Henke <sup>3</sup>, Dawn M Coleman <sup>5</sup>,  
C Alberto Figueroa <sup>6</sup>, James C Stanley <sup>3</sup>, Nicholas S Burris <sup>7</sup>

Affiliations [+](#) expand

DOI: [10.1016/j.avsg.2025.12.012](https://doi.org/10.1016/j.avsg.2025.12.012)

PMID: 41422919 [↗](#)

### Abstract

**Background:** Risk factors for renal artery aneurysm (RAA) growth are poorly understood. Vascular deformation mapping (VDM) is known to accurately depict 3-dimensional (3D) growth patterns of aortic aneurysms. This study investigates the feasibility of VDM to accurately define 3D growth of RAAs and the relationship of RAA diameter alone to 3D growth.

**Methods:** Fifty-five RAAs having  $\geq 2$  computed tomography angiograms with  $\leq 2.5$  mm slice thickness,  $\geq 2$  months apart, were studied. RAAs were segmented and their volumes (including calcium, thrombus, lumen, and total) were determined. Change in RAA diameter ( $\Delta$ Diameter) and volume ( $\Delta$ Volume) over time were calculated. VDM was used to quantify 3D growth.  $\Delta$ Volume and mean 3D growth were compared between RAAs having stable diameters and those with increased diameters ( $\geq 0.1$  cm  $\Delta$ Diameter) and the relationship between  $\Delta$ Diameter,  $\Delta$ Volume, and 3D growth was examined.

**Results:** Twenty-five of the 55 RAAs studied had successful VDM analyses. The affected patients' mean age was  $60.1 \pm 8.7$  years and 56% were female. One RAA was symptomatic, with no ruptures. The overall  $\Delta$ Diameter was  $0.86 \pm 1.25$  mm/year (mean CT interval of 43.1 months). Nine (36.0%) RAAs exhibited diameter increases, and when compared to the 16 stable RAAs, there were no differences in  $\Delta$ Volume or 3D growth. There was no correlation of  $\Delta$ Diameter with 3D growth or  $\Delta$ Volume ( $r < 0.4$ ,  $P > 0.05$ ). RAA 3D growth strongly correlated with  $\Delta$ Total Volume ( $r = 0.653$ ,  $P < 0.001$ ) and  $\Delta$ Lumen Volume ( $r = 0.695$ ,  $P < 0.001$ ).

**Conclusion:** VDM is an accurate method for assessing RAA growth, yields additional metrics not provided by diameter alone, and provides a more comprehensive assessment of RAA morphology changes that correlate with  $\Delta$ Volume.