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**2024**

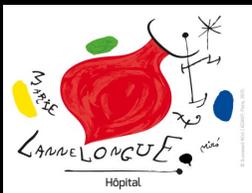
[www.sres-symposium.org](http://www.sres-symposium.org)

## Anévrisme rompu à haut risque chirurgical Quelles sont les solutions endovasculaires?

**Dominique Fabre**, Thomas Le Houerou, Antoine Gaudin, Jeremy Bendavid, Alessandro Costanzo, Lucas Le Guillou, Alexandra Hauguel, Stephan Haulon.



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# Disclosure

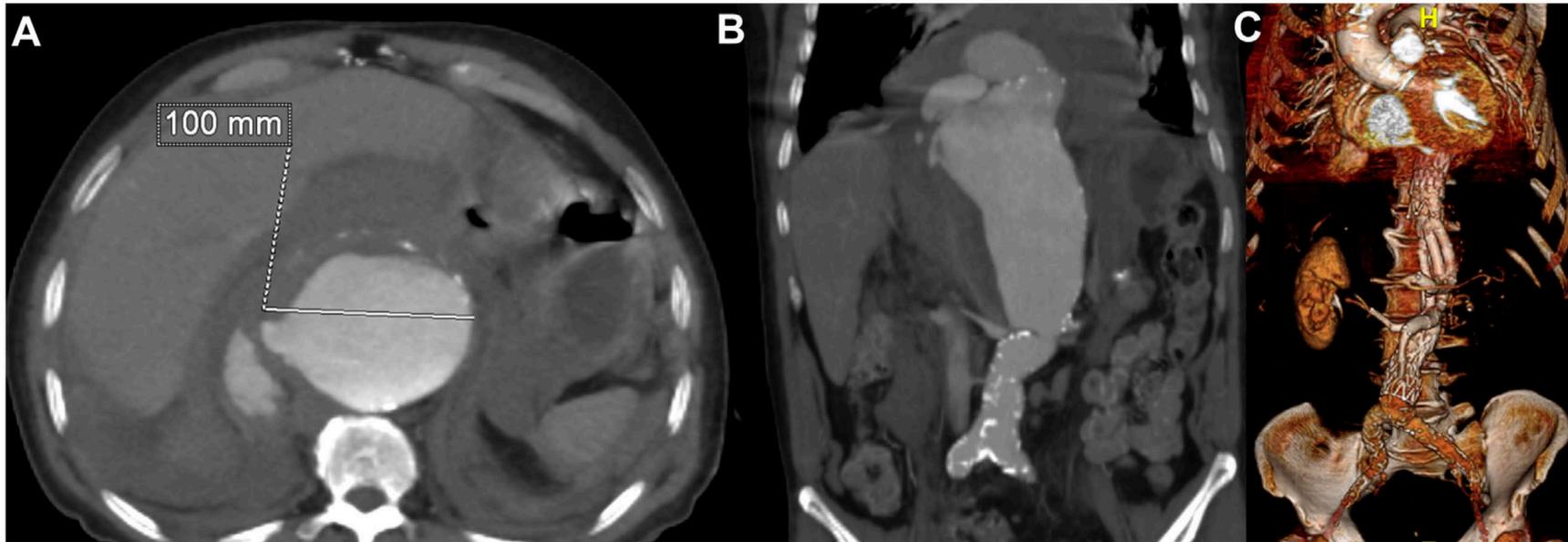
- ◆ I have the following conflicts of interest:
  - ◆ Gore

# AAA rompu

## Qu'est ce qu'un haut risque chirurgical?

Guo et al

JVS-Vascular Insights  
2024



**Fig 3.** (A) Axial and (B) coronal multiplanar computed tomography (CT) reconstructions of a patient who presented with ruptured thoracoabdominal aortic aneurysm (rTAAA) with severely diseased left renal artery and atrophic left kidney. (C) CT three-dimensional volume rendering reconstruction of the postrepair aorta with a t-branch; the left renal branch on the device was occluded with a vascular plug, and the left renal artery was stented.

# AAA rompu

## Qu'est ce qu'un haut risque chirurgical?

### Terrain

Atcd / EVAR  
Etat général  
Age  
Comorbidités  
Tt médical

### Anatomie

Collet  
Angulation  
Shaggy  
Accès vasculaires  
PAD

### Géographie

Rayon action  
Pays  
Suivi médical  
SAMU

### Team

Accès Endoprothèses  
Etat général  
Expérience Chir  
Rea

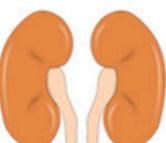
# Terrain /AAA rompu

## Qu'est ce qu'un haut risque chirurgical?

**Risk Score for Prediction of Mortality After Repair of Ruptured Abdominal Aortic Aneurysm (rAAA)**

Retrospective, single center study 303 patients with rAAA

**Preoperative Variables Predicting Mortality**

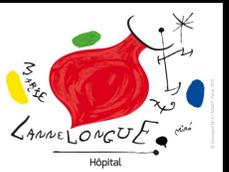
	<b>Age &gt; 76 years</b> OR 2.1		<b>Systolic BP &lt; 70 mmHg</b> OR 2.7
	<b>Se Creatinine &gt; 2.0mg/dL</b> OR 3.7		<b>pH &lt; 7.2</b> OR 2.6

Risk Score (N. of Variables Present)	30 Day Mortality
1	22%
2	69%
3	80%
4	100%

**JVS Journal of Vascular Surgery**  
Official Publication of the Society for Vascular Surgery

**Garland et al. J Vasc Surg October 2018**  
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# AAA rompu instable / on peut les opérer!

- ◆ Les patients instables = scanner impossible....
- ◆ Si l'anatomie aortique est difficile ou complexe la chirurgie ouverte est plus facilement choisie, par opposition aux patients hémodynamiquement stables et à ceux dont l'anatomie est favorable (collet de 15 mm) qui subissent une EVAR...

*Briggs CS, Sibille JA, Yammine H, Ballast JK, Anderson W, Nussbaum T, et al. Short-term and midterm survival of ruptured abdominal aortic aneurysms in the contemporary endovascular era. J Vasc Surg 2018;68:408e14.*

*Broos PP, t Mannetje YW, Stokmans RA, Houterman S, Corte G, Cuypers PW, et al. A 15-year single-center experience of endo-vascular repair for elective and ruptured abdominal aortic aneurysms. J Endovasc Ther 2016*

*Budtz-Lilly J, Björck M, Venermo M, Debus S, Behrendt CA, Altreuther M, et al. The impact of centralisation and endovascular aneurysm repair on treatment of ruptured abdominal aortic aneurysms based on international registries. Eur J Vasc Endovasc Surg 2018*

# AAA rompu instable = endoclamping



**Table 1.** Pre-operative assessment of both groups of patients included in the ECAR trial.

	OSR ( <i>n</i> = 51)	EVAR ( <i>n</i> = 56)	<i>p</i>
Mean age (years)	73.8 (54.0–93.0)	75.0 (56.0–96.0)	.548
Sex (male), <i>n</i> (%)	46 (90.0)	51 (91.0)	.877
Height (cm)	175 (164–187)	172 (150–190)	.052
Weight (kg)	78.5 (55.0–117.0)	77.1 (50.0–125.0)	.630
SBP (mean mmHg)	110.9	105.9	.393
Endoclamping balloon, <i>n</i> (%)	11 (21.6)	7 (12.5)	.210
Loss of consciousness, <i>n</i> (%)	6 (11.8)	6 (10.8)	.863
Retroperitoneal rupture, <i>n</i> (%)	49 (96)	51 (91.0)	.335
Hardman index	1.1 (0–5)	1.0 (0–3.0)	.880
IGSII score	40.1 (18.0–82.0)	35.9 (0–83.0)	.128
Creatinine level (μmol/L)	123.7 (57.0–309.0)	137.5 (56.0–584.0)	.355
Hemoglobin level (g/dl)	10.6 (5.0–140.0)	13.5 (6.0–85.0)	.450
Troponin level	0.7 (0–15.0)	0.3 (0–4.8)	.386
Abnormal ECG, <i>n</i> (%)	9 (18)	10 (11)	1.000
Delay to treatment (h)	1.3 (0–5.5)	2.9 (0.2–17.0)	.005

Note. Values are given as mean (range) unless otherwise indicated. ECAR = Endovasculaire ou Chirurgie dans les Anévrismes aorto-iliaques Rompus; OSR = open surgical repair; EVAR = endovascular aneurysm repair; SBP = systolic blood pressure; ECG = electrocardiogram.

Eur J Vasc Endovasc Surg (2015) 50, 303–310

**Editor's Choice – ECAR (Endovasculaire ou Chirurgie dans les Anévrismes aorto-iliaques Rompus): A French Randomized Controlled Trial of Endovascular Versus Open Surgical Repair of Ruptured Aorto-iliac Aneurysms**

P. Desgranges<sup>a,b</sup>, H. Kobelter<sup>b</sup>, S. Katsahian<sup>c</sup>, M. Bouffi<sup>d</sup>, P. Gouny<sup>e</sup>, J.-P. Favre<sup>f</sup>, J.M. Alsac<sup>g</sup>, J. Sobocinski<sup>h</sup>, P. Julia<sup>i</sup>, Y. Alimi<sup>j</sup>, E. Steinmetz<sup>k</sup>, S. Haulon<sup>l</sup>, P. Alric<sup>m</sup>, L. Canaud<sup>n</sup>, Y. Castier<sup>o</sup>, E. Jean-Baptiste<sup>p</sup>, R. Hassen-Khodja<sup>q</sup>, P. Lermusiaux<sup>r</sup>, P. Feuglier<sup>s</sup>, L. Destrieux-Garnier<sup>t</sup>, A. Charles-Nelson<sup>u</sup>, J. Marzelle<sup>v</sup>, M. Majewski<sup>w</sup>, A. Bourmaud<sup>x</sup>, J.-P. Becquemin<sup>y</sup>, the ECAR Investigators

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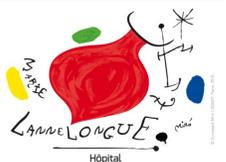
<sup>l</sup>Vascular Surgery Unit, CHU Nice, Nice, France

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Univariate analysis identified factors influencing 30 day survival: use of endoclamping,



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# AAA rompu = Endo+++++++



Clinical Practice Guidelines

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



## 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<sup>☆</sup>

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

## Recommendation 80

Changed

For patients with a ruptured abdominal aortic aneurysm and suitable anatomy, endovascular repair is recommended as the first line treatment option.

Class	Level	References	ToE
I	A	IMPROVE Trial Investigators (2017), <sup>518</sup> Gupta <i>et al.</i> (2018), <sup>624</sup> Salata <i>et al.</i> (2020), <sup>627</sup> Wang <i>et al.</i> (2020), <sup>628</sup> D'Oria <i>et al.</i> (2023), <sup>636</sup> IMPROVE Trial Investigators (2015), <sup>637</sup> Sweeting <i>et al.</i> (2015), <sup>638</sup> Kontopodis <i>et al.</i> (2020) <sup>640</sup>	



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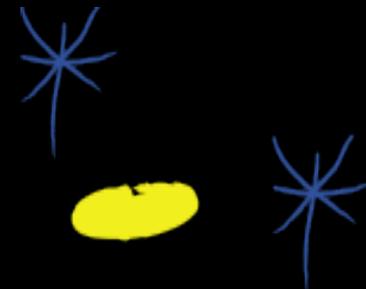
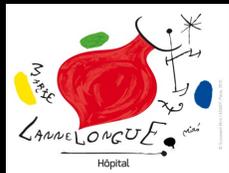
# Suitable anatomy ???

La morphologie aortique est considérée comme un facteur de confusion important. Il a été rapporté que les patients présentant une anatomie aortique favorable sont traités préférentiellement par EVAR.

Les résultats supérieurs de l'EVAR par rapport à la réparation chirurgicale ouverte en situation d'urgence peuvent être liés à l'anatomie plus favorable des patients subissant une EVAR. Cette hypothèse est corroborée par les résultats actuels.

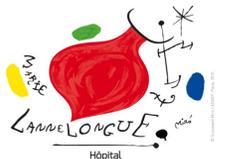
*Endovascular aneurysm repair versus open repair for patients with a ruptured abdominal aortic aneurysm: a systematic review and meta-analysis of short-term survival. van Beek SC, Conijn AP, Koelemay MJ, Balm R.*

*Eur J Vasc Endovasc Surg 2014*



# Unsuitable anatomy = Quels patients ne faut-il pas traiter en endo?

1. Accès vasculaires trop petits ou trop calcifiés
2. Shaggy aorta
3. Couverture endovasculaire extensive avec risque d'ischémie médullaire
4. Absence de matériel suffisant: pas de logiciel de fusion, pas d'arsenal d'endoprothèses, pas d'introducteur orientable,.....
5. Absence d'expérience technique
6. Nécessité de 2 chirurgiens experts

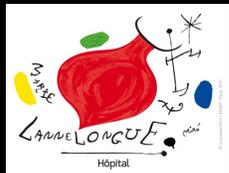
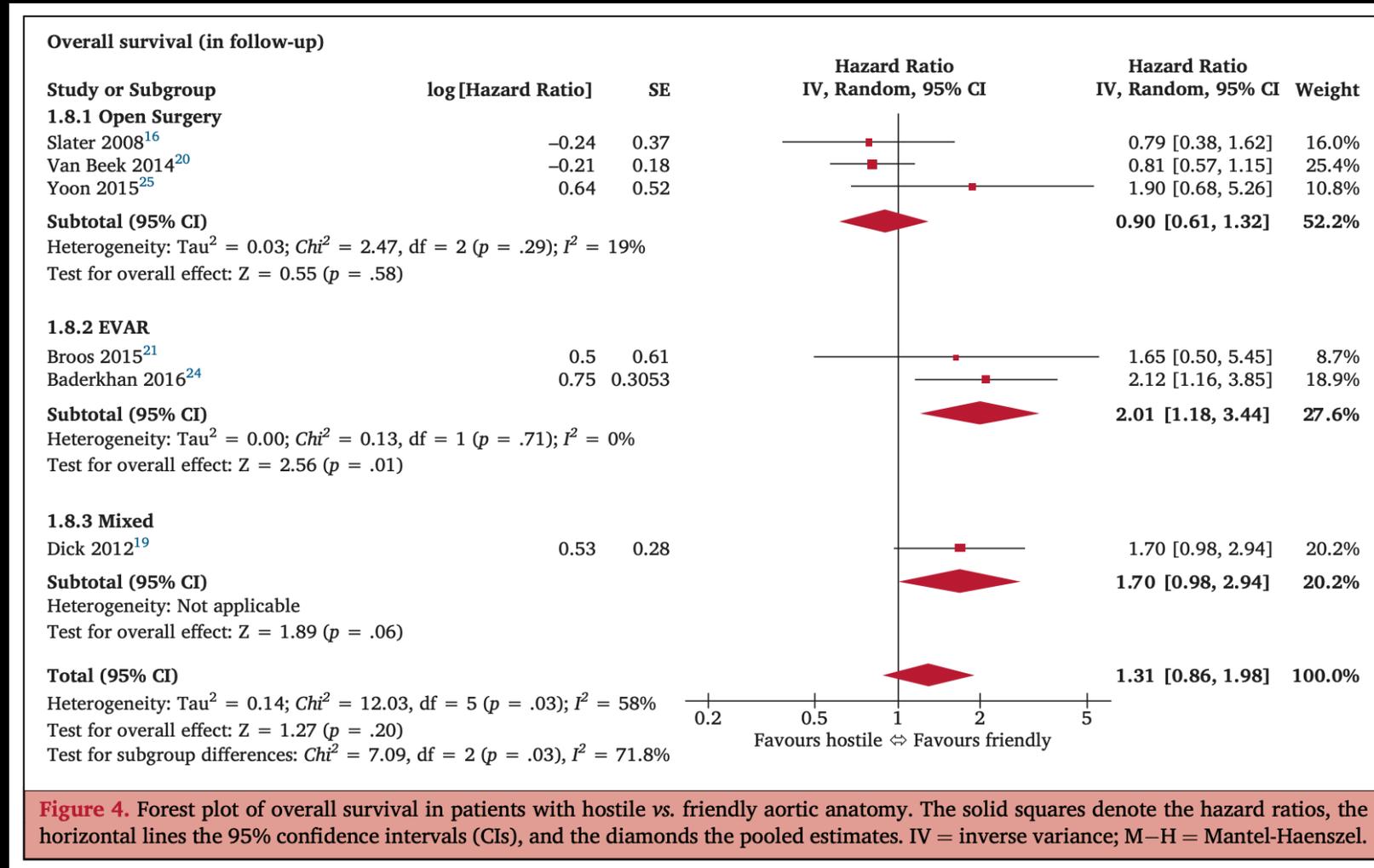


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# Hostile neck / Friendly neck Survival



# Endovascular solutions for rAAA

1. Physician-modified fenestrated branched EVAR
2. OTS BRANCH ENDOGRAFTS
3. LfEVAR = **L**aser fenestrated endograft
4. Parallel stent grafts
5. Debranching

## Endovascular management options and techniques for ruptured thoracoabdominal aortic aneurysm

Ming Hao Guo, MD, MSc,<sup>a,b</sup> Thomas Le Houérou, MD,<sup>a</sup> Antoine Gaudin, MD,<sup>a</sup> Alessandro Costanzo, MD,<sup>a</sup> Dominique Fabre, MD, PhD,<sup>a</sup> and Stéphan Haulon, MD, PhD,<sup>a</sup> *Le Plessis-Robinson, France; and Ottawa, Canada*

### ABSTRACT

**Objective:** Open surgical repair of ruptured thoracoabdominal aortic aneurysms (rTAAs) carries significant risk of mortality and morbidity; in recent years, endovascular repair has emerged as a suitable alternative. This article aims to review currently available technologies, techniques, and outcomes for endovascular repair of rTAAA.

**Methods:** A narrative review of current literature was performed.

**Results:** Off-the-shelf branched endografts are available and are often the first-line endovascular therapy for types I, II, and III rTAAA or type IV rTAAA with a lumen diameter  $\geq 24$  mm at the level of the renovisceral vessels. In patients with anatomy unsuitable for off-the-shelf branch devices, particularly those with ruptured type IV or pararenal TAAA with a narrow aortic lumen, endovascular repair with in situ laser fenestration is a reasonable alternative. Physician-modified devices as well as endovascular repair with parallel stent grafts (chimney, periscope, sandwich, or Octopus) have been described by select centers with satisfactory outcomes.

**Conclusions:** Patients with rTAAA and suitable anatomy who are at high or prohibitive surgical risk can be managed endovascularly with comparable outcomes. Various techniques are described in the literature, and the choice of technique used should depend on patient anatomy and surgeon expertise. (JVS-Vascular Insights 2024;2:100098.)

**Keywords:** Endovascular repair; Thoracoabdominal; Aortic aneurysm; Rupture; Emergent

# 1/Physician-modified fenestrated branched EVAR

Long time for fenestration and reloading (2-3h)

Depends experience and number of fenestrations

Straight vs angulated anatomy

Access issues

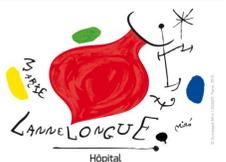
*Outcomes Following Urgent Fenestrated-Branched Endovascular Repair for Pararenal and Thoracoabdominal Aortic Aneurysms. Biggs JH, Tenorio ER, DeMartino RR, Oderich GS, Mendes BC. Ann Vasc Surg. 2022*

32 patients

urgente AAA ht risque pararénale ou TAAA, 44 % des patients ont eu une rupture contenue,

Durée moyenne de la procédure = 5-6 heures  
Taux de réussite technique de 97 %.

Mortalité de 6 %

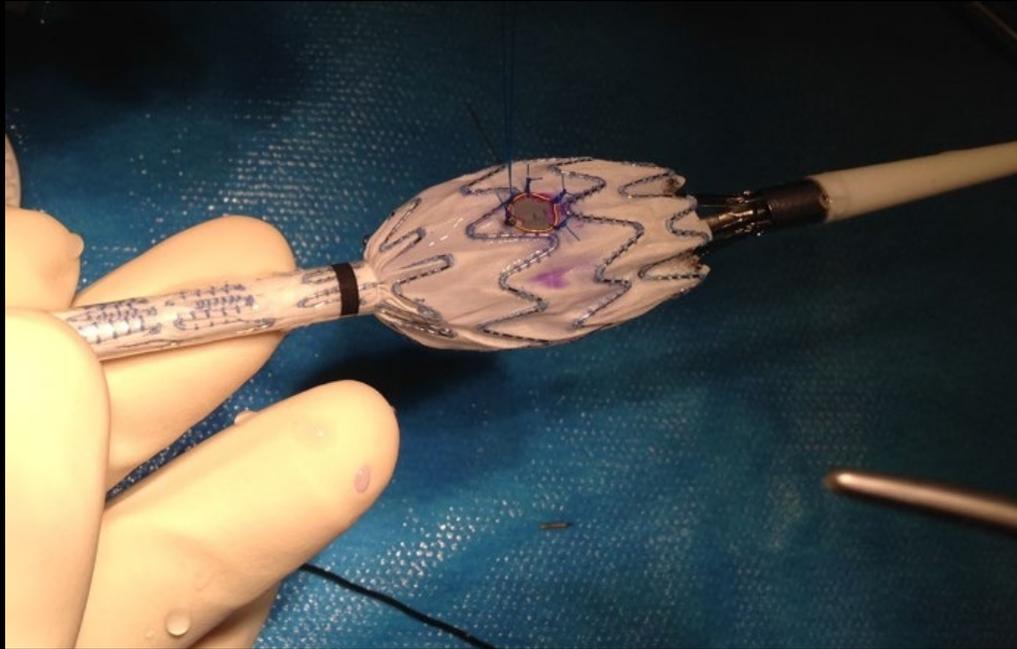


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# 1/ Physician-modified fenestrated branched EVAR





## 2/ OTS BRANCH ENDOGRAFTS 4 branch devices

Long extension in Thoracic Aorta

Increase risk of Spinal Cord Ischemia

1 or 2 sealing stents

Through 1 femoral Access with 16 fr APTUS

Off the shelf available and reimbursed  
stentgraft

Preferred for rTAAA



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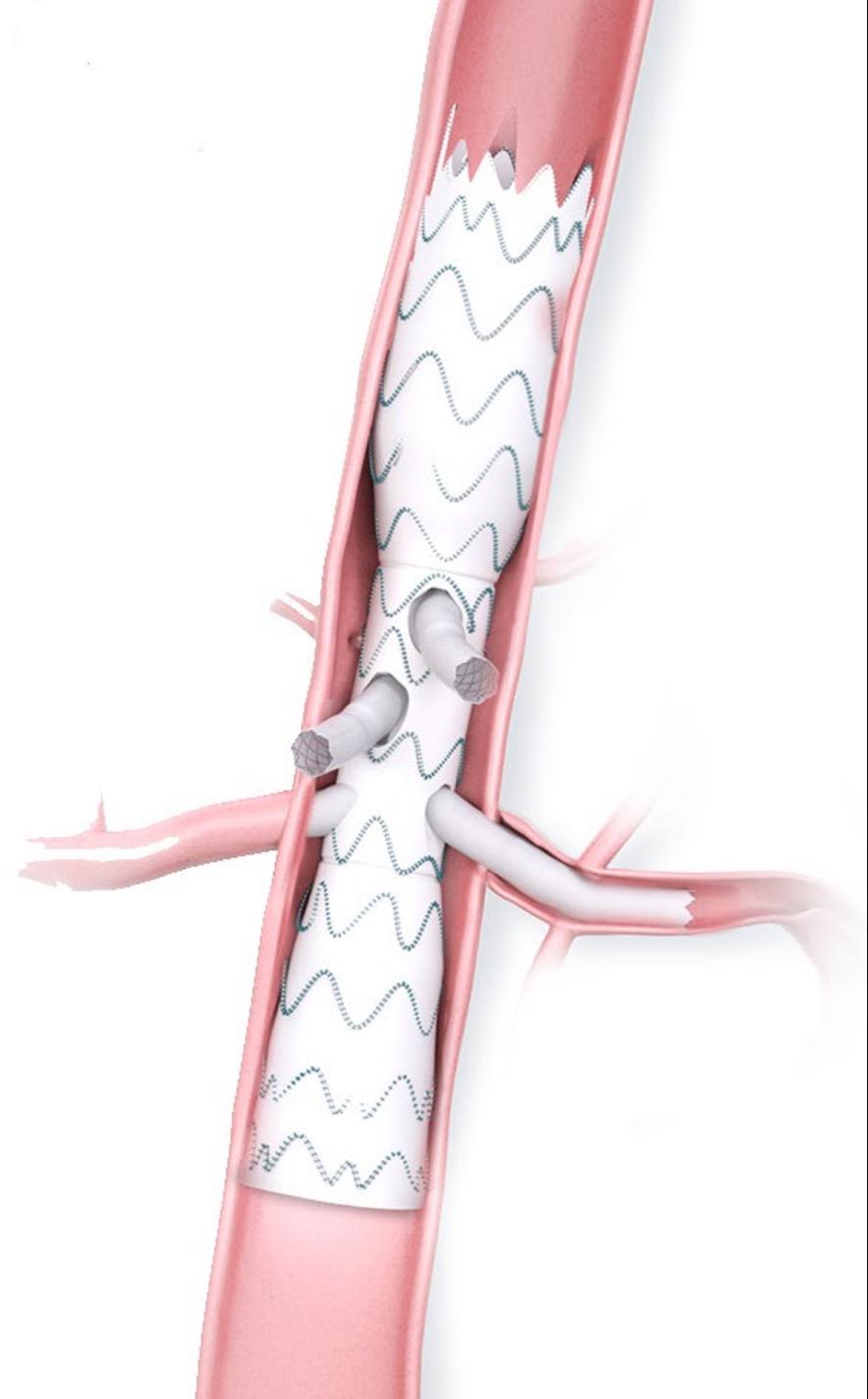
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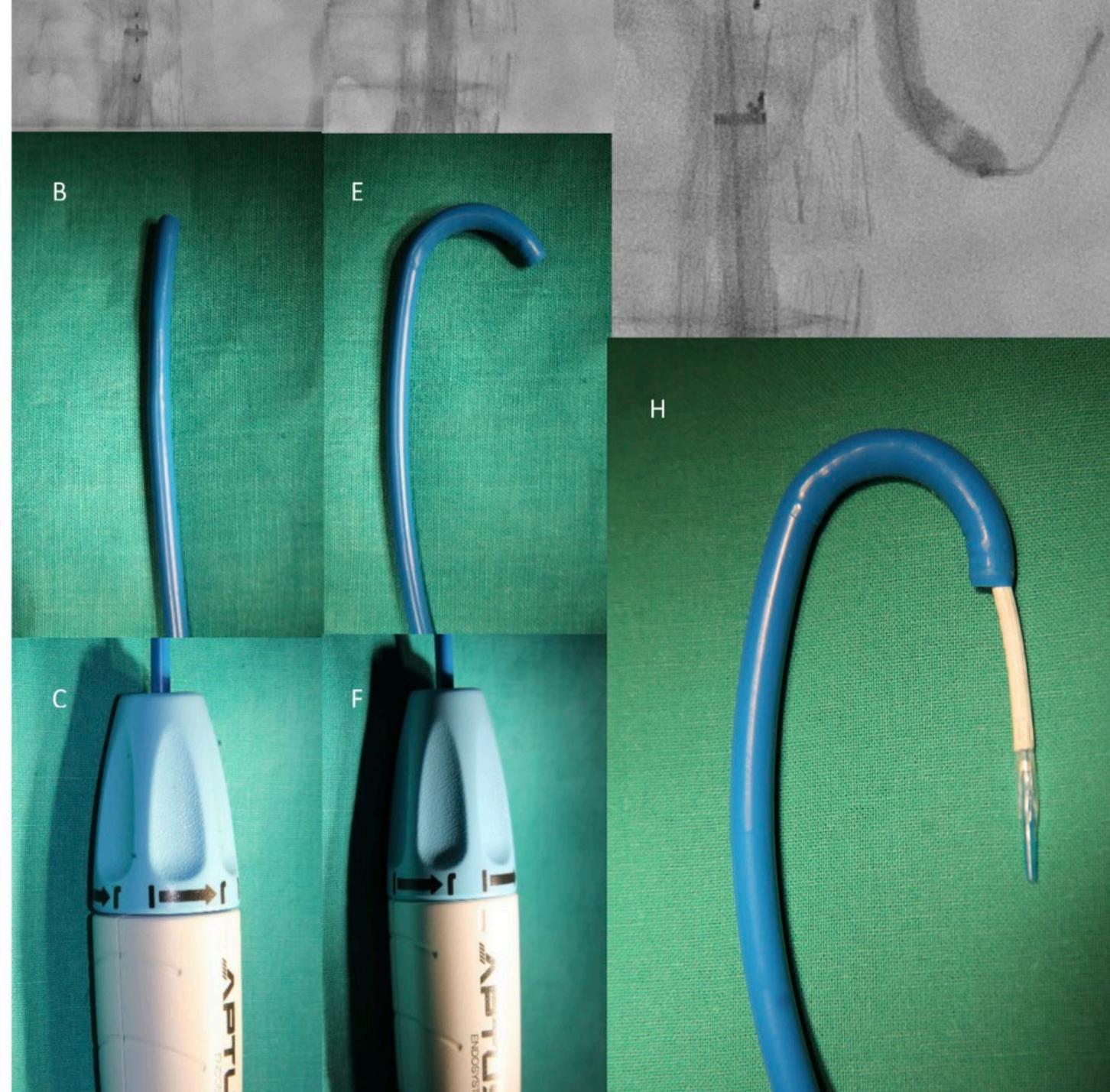
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# 2/ OTS BRANCH ENDOGRAFTS 4 branch devices

3 graft available choice for endo-vascular repair for rTAAA

1. T-branch (Cook )Medical, Bloomington, IN)
2. Gore TAMBE (W. L. Gore & Associates, Flagstaff, AZ)
3. CryoLife E-nside (CryoLife, Kennesaw, GA).





**Fig 2.** Transfemoral approach to branch vessel (superior mesenteric artery in this case) catheterization, facilitated by 16F steerable sheath. The celiac artery (CA) had already been stented using the same technique.

# 3/ Laser fenestration

No preparation

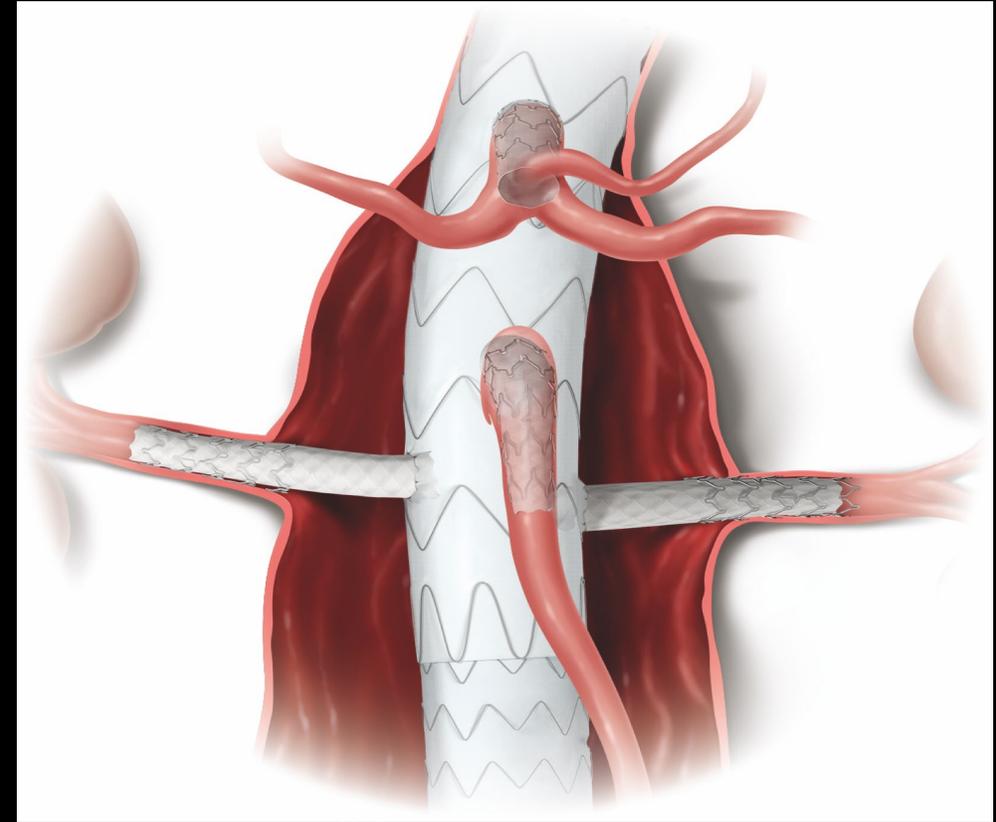
Direct coverage of the visceral and renal arteries

Team experience required / 2 surgeons

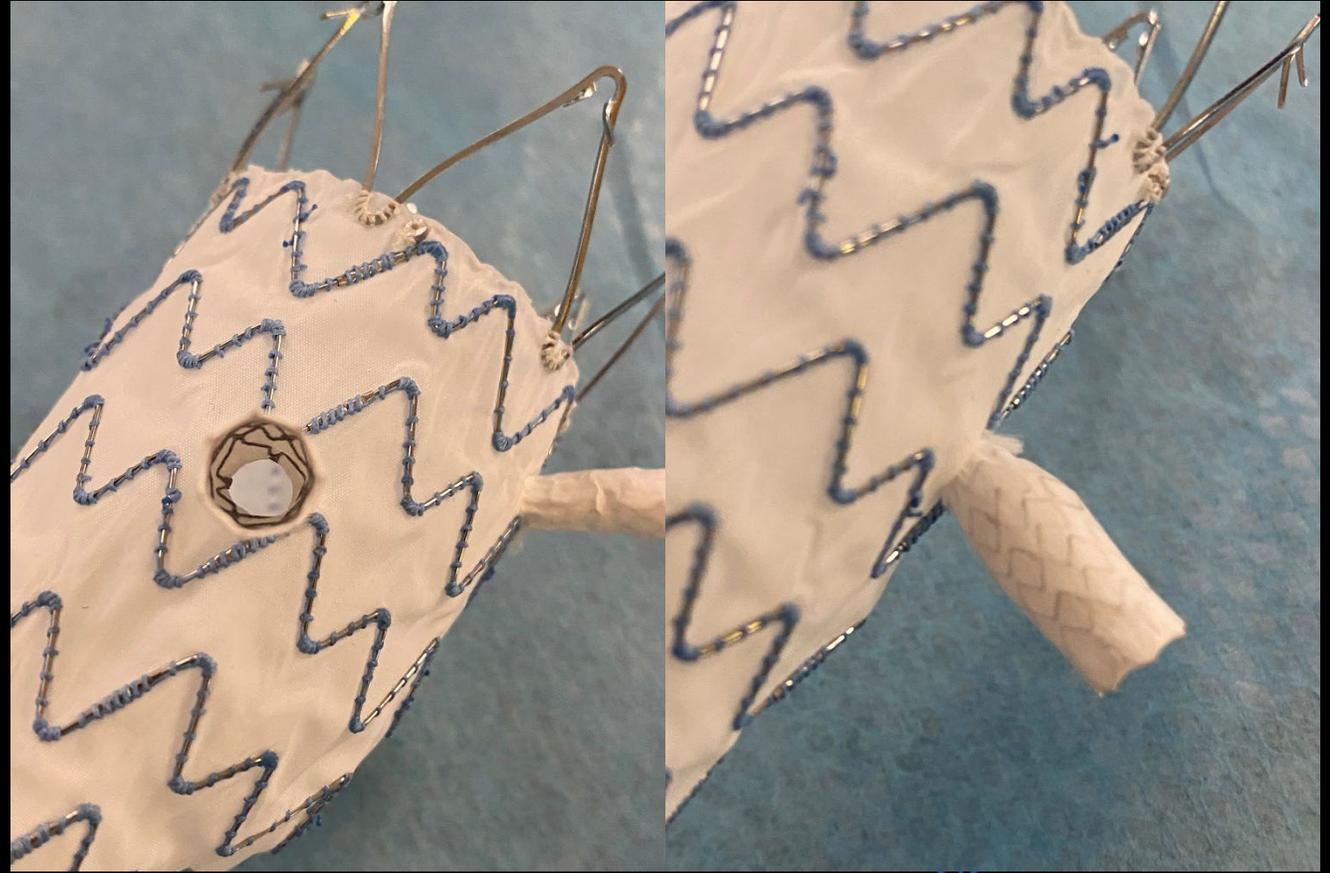
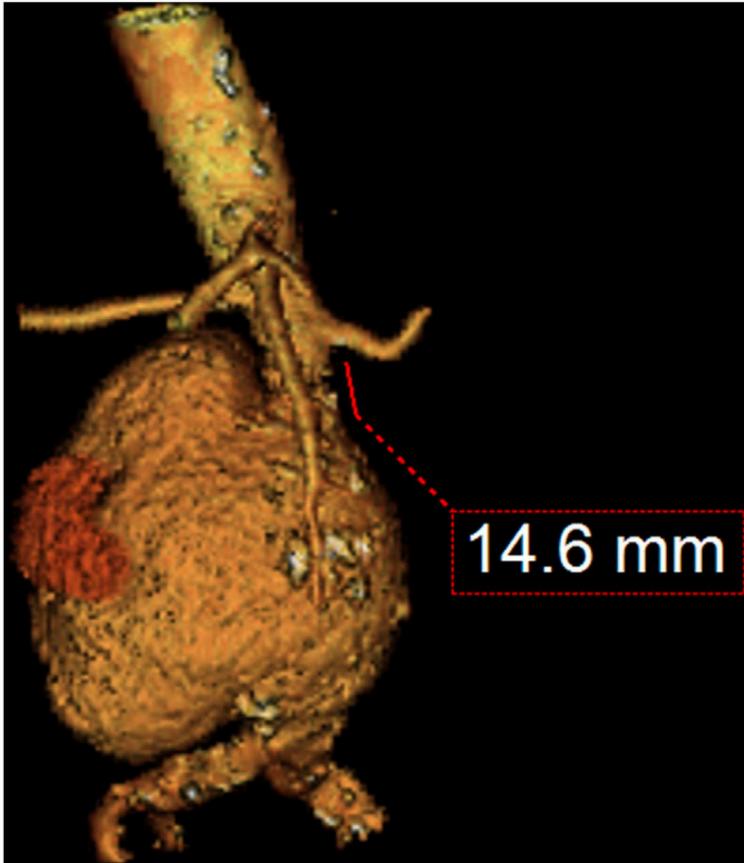
Very simple technique

Availability of the LASER Tools

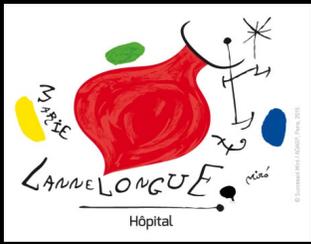
Preferred for Juxta and Pararenal AAA



# rAAA / Laser fenestration



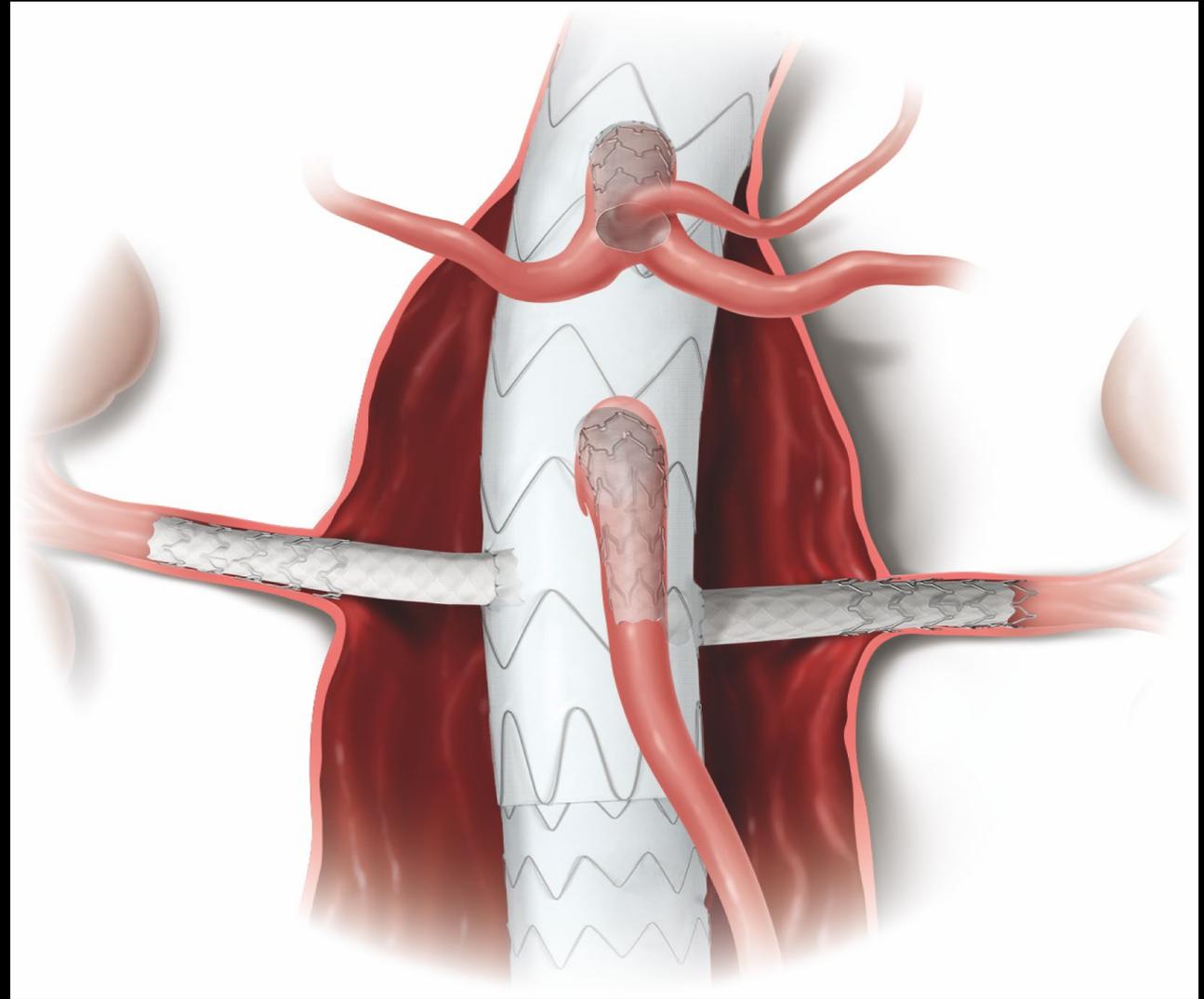
**Fig 4.** Aneurysm anatomy more suitable for endovascular aortic repair (EVAR) with in situ laser fenestration rather than t-branch.

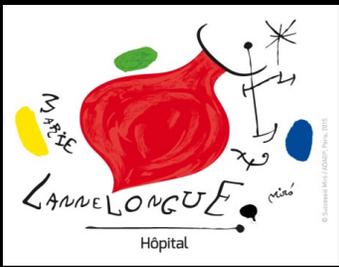


Coverage of all  
visceral arteries

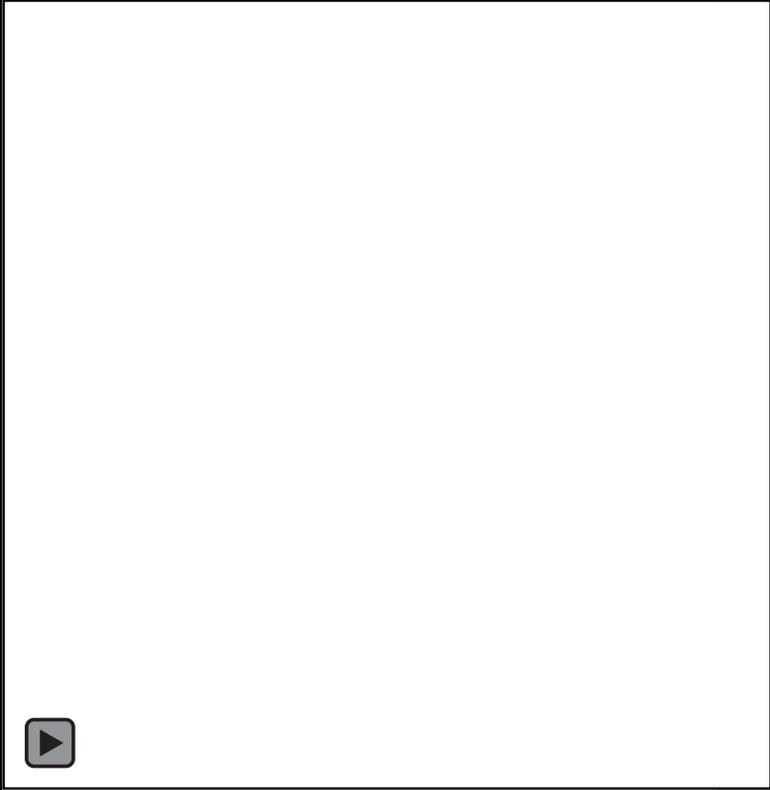
=

Ischemic time after  
releasing the  
polyester graft!





# SMA 3' / Laser Right renal Lfen 7'



# Cutting balloon 2.5 mm

Zoom=2.1

img 624

GEORGES

21% de 3 Gy  
mGy/min 8.3

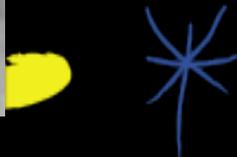
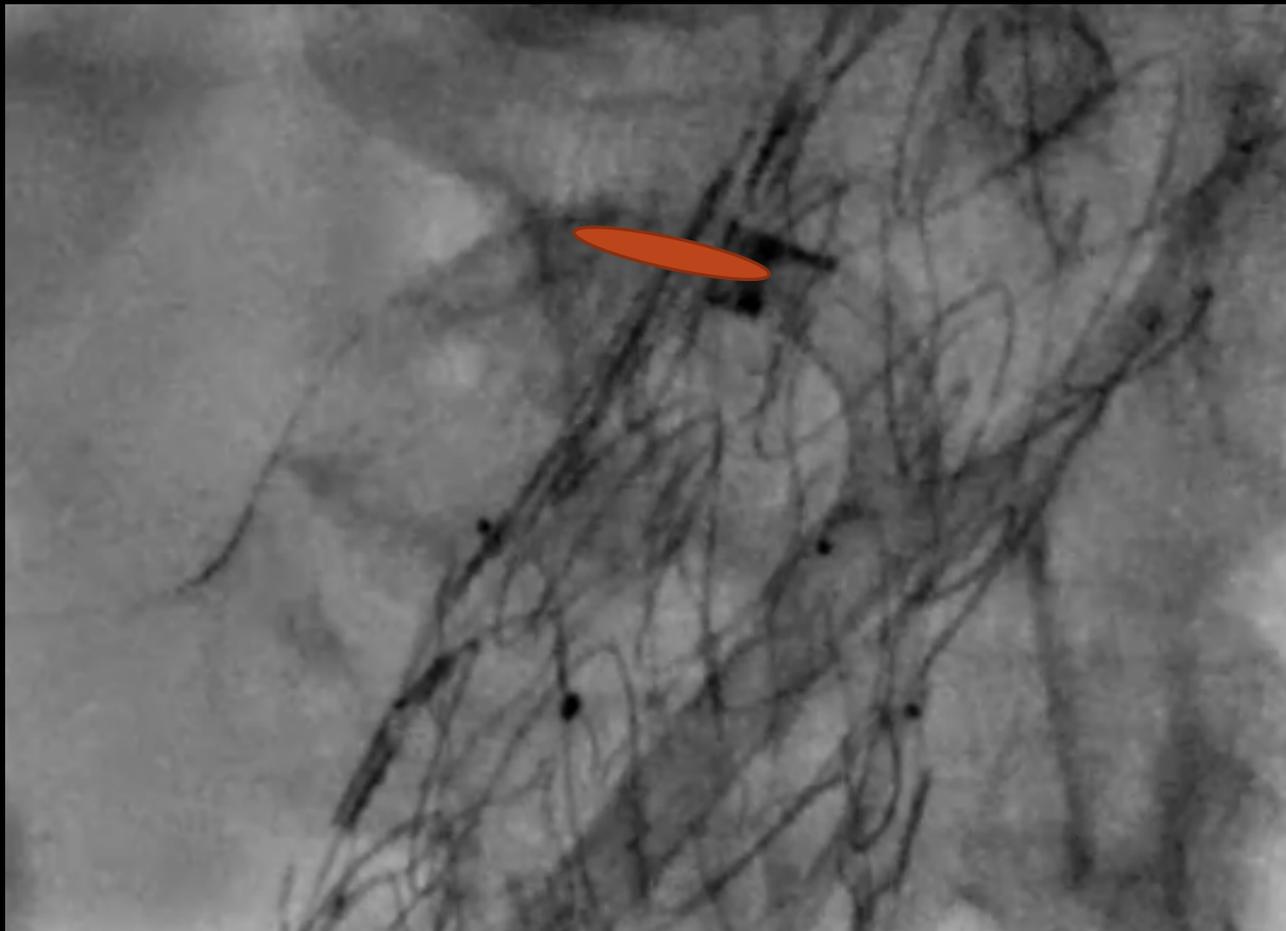
40 cm  
150 cm  
119 cm

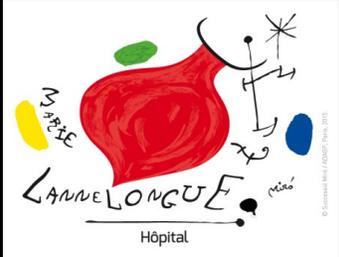
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LAO 0 deg  
CRA 0 deg

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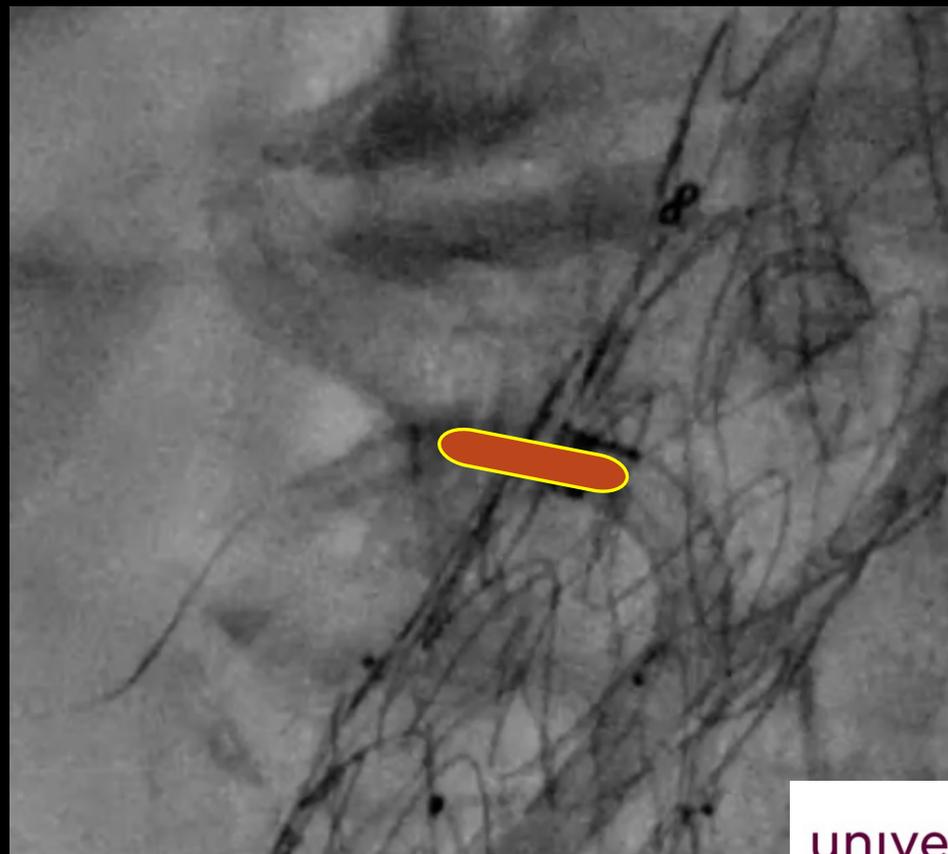
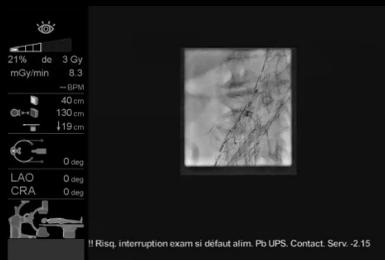
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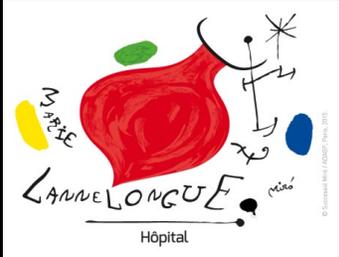
# 4 mm balloon



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# 0.035 catheter / angio

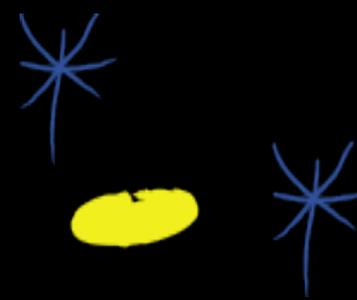


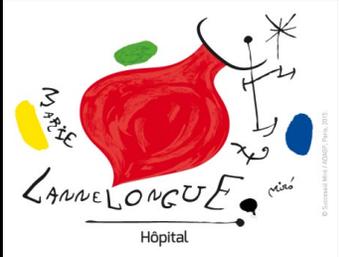
21%	de	3 Gy
mGy/min		2.9
		--BPM
		40 cm
		116 cm
		↓19 cm
		0 deg
LAO		1 deg
CRA		0 deg

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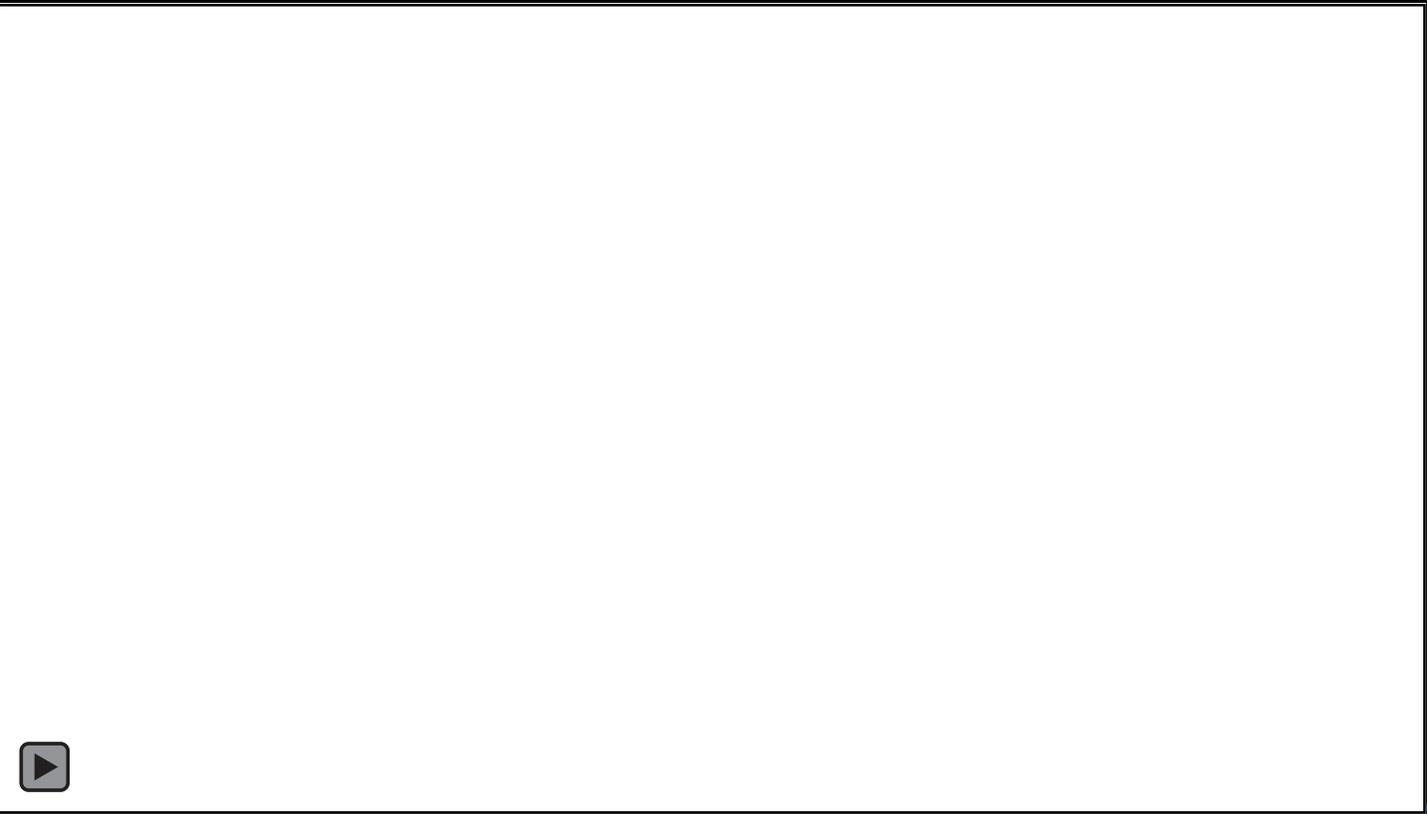
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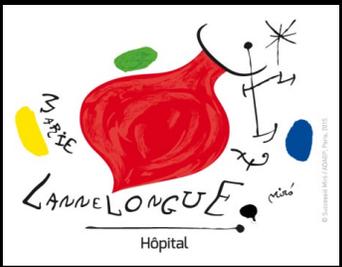
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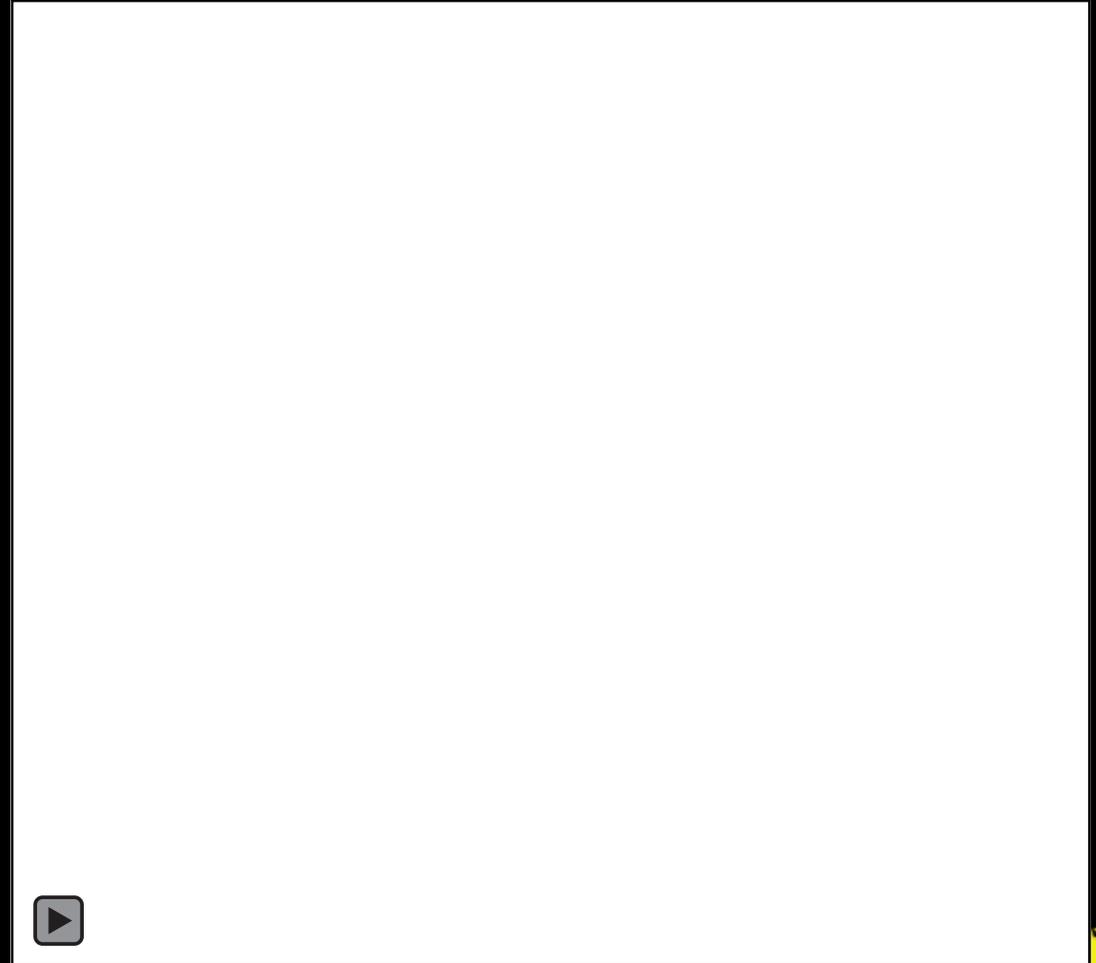
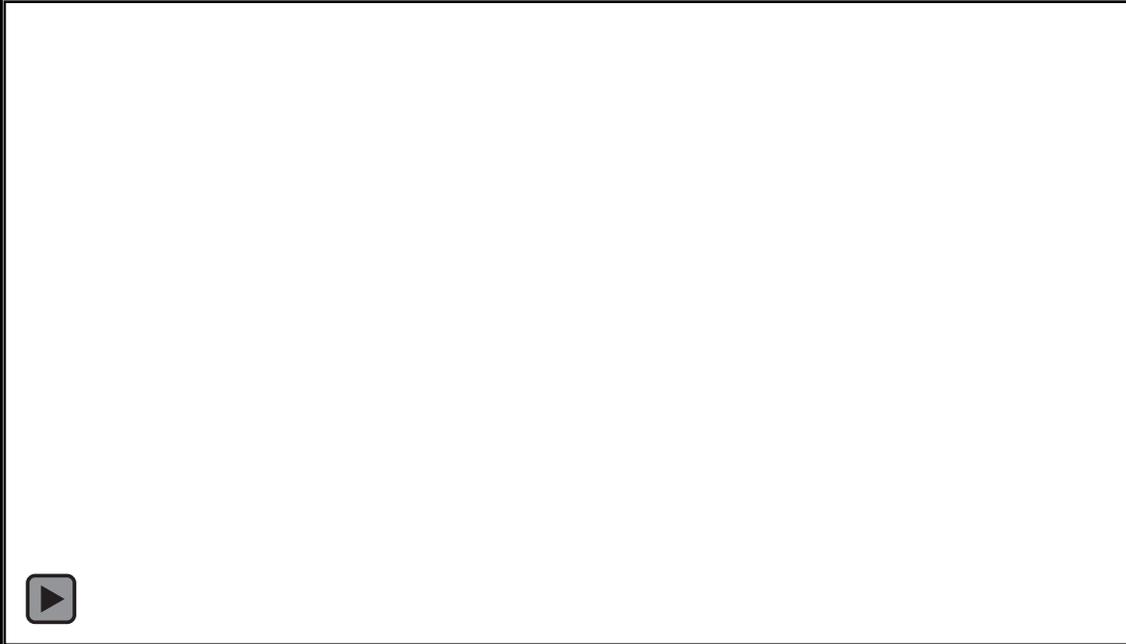


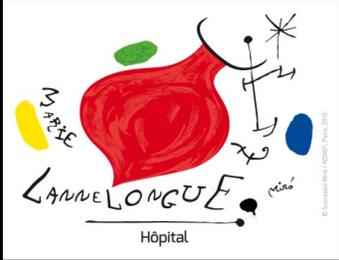
# Rosen wire / 6 fr sheath





# bridging stent / flaring





sture  
 ige préc./suiv.

#140 ANGIO SUB

img 11 / 19  
 Masque 1

--BPM  
 40 cm  
 116 cm  
 ↓19 cm

R L

0 deg  
 LAO 1 deg  
 CRA 0 deg

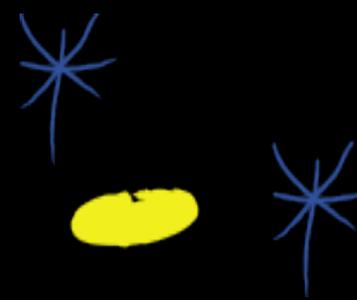
FOV 40 cm  
 LAO 1 deg  
 CRA 0 deg  
 L 0 deg

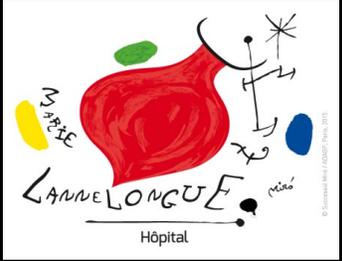
!! Risq. interruption exam si défaut alim. Pb UPS. Contact. Serv. -2.15

S

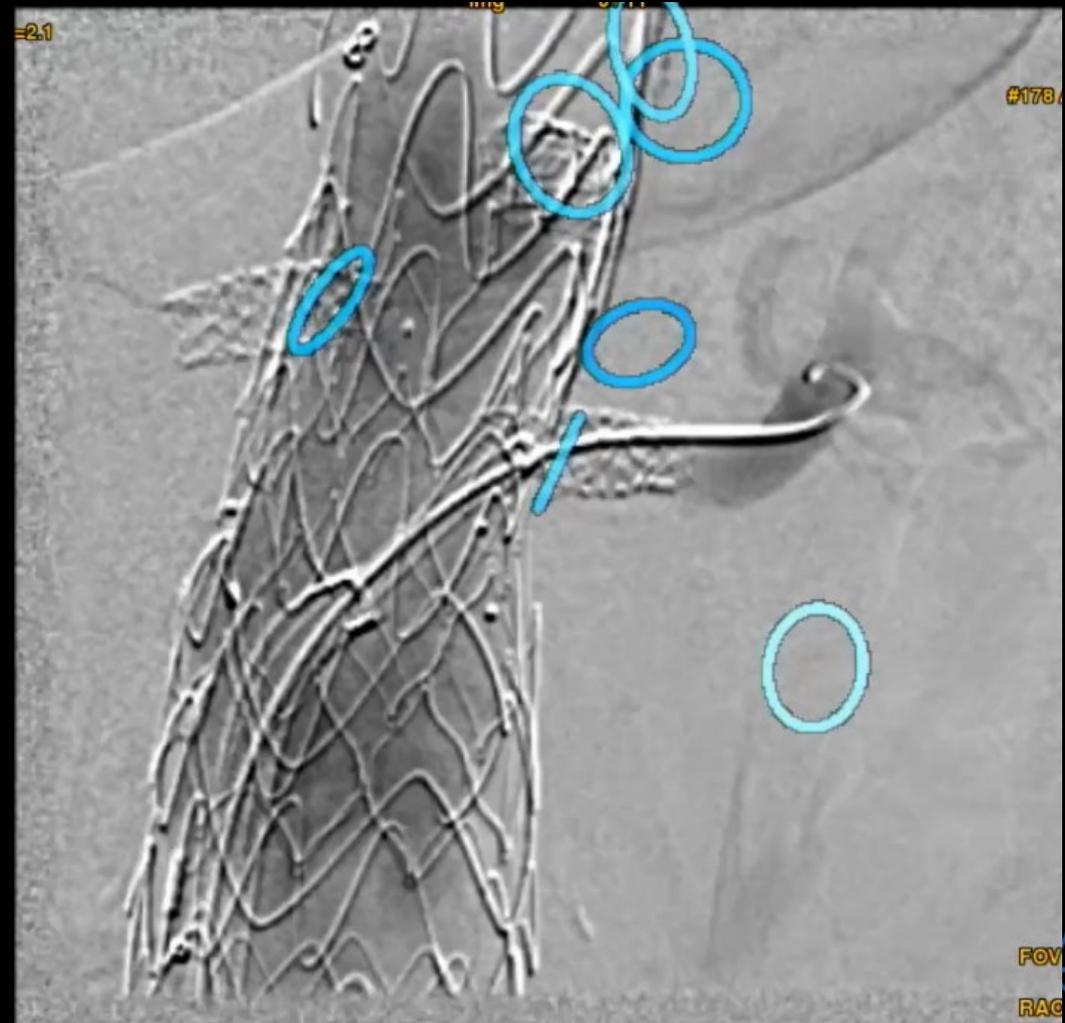
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 18-Sep-2023  
 CHENUIL  
 GEORGES  
 Photo 1 / 1

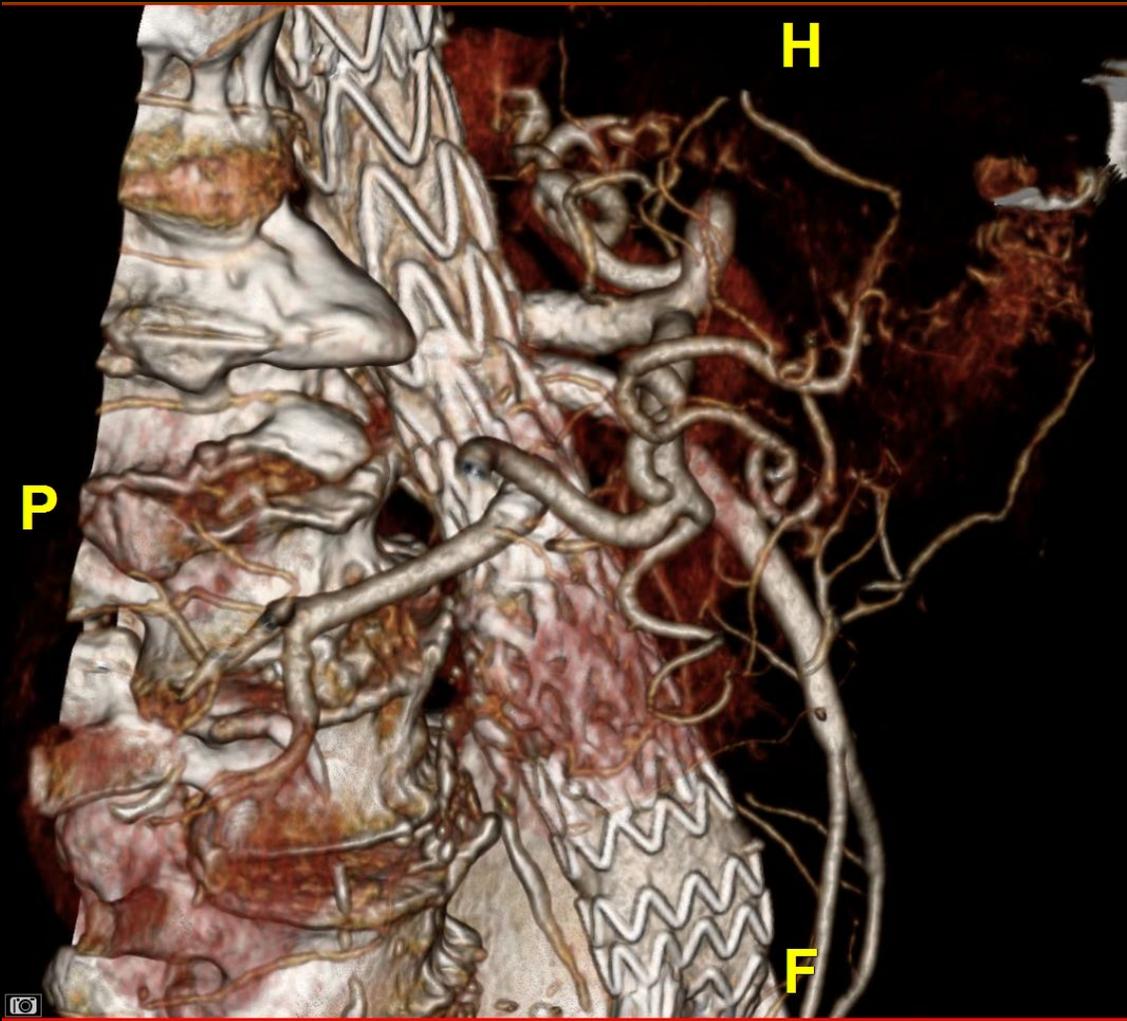
FOV  
 LAO  
 CRA  
 L





# 23' / Left renal artery





# 4/ Parallel graft technique

Simple technique (for 1 or 2 chimney) or periscope

Need an upper access

Usefull and quick

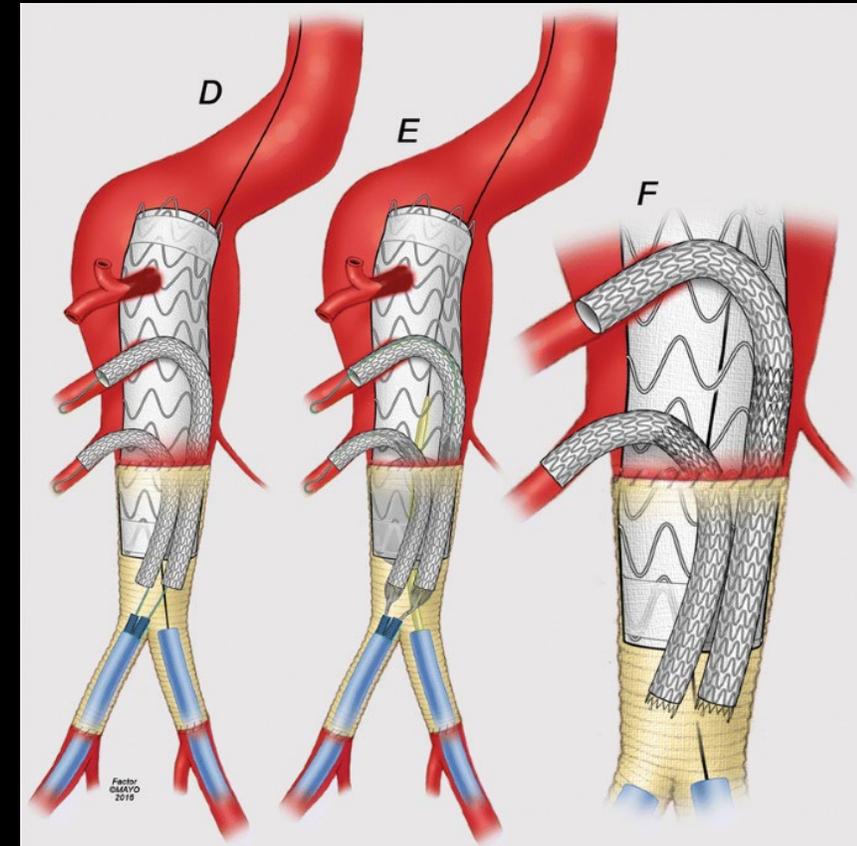
Not expansive

Is always a Backup solution but will close any endo approach after

High risk of endoleak

Interesting technique for very angulated aneurysm

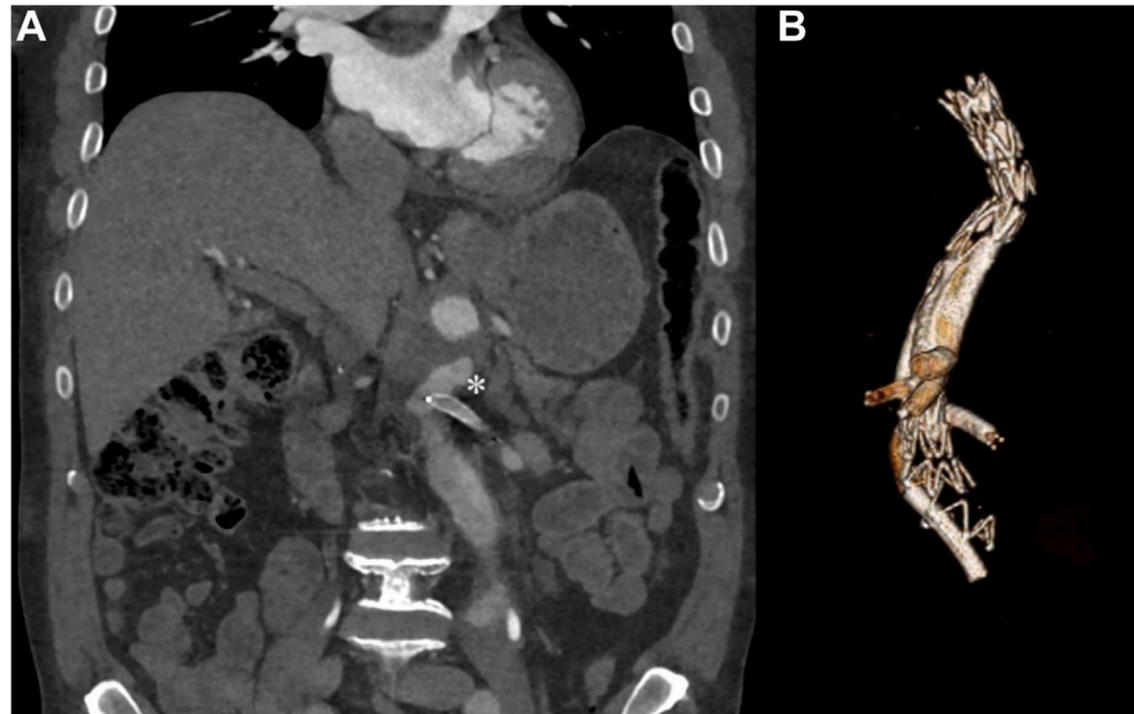
Major risk of leak



# 4/ Parallel graft technique

Guo et al

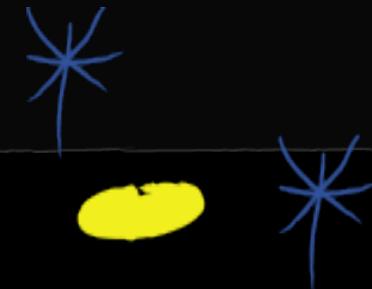
JVS-Vascular Insights  
2024



**Fig 7.** (A) The patient presented with previous left renal stent (\*) protruding significantly into the lumen of the abdominal aorta. (B) Completion branched endovascular aortic repair (EVAR) repair with periscope of the left renal artery vessel.

# 4/ Parallel graft technique

Pas besoin de matériel spécifique  
 Risque d'ischémie médullaire faible  
 Faible niveau de transpiration / Laser  
 Technique de recours  
 Type IA endoleak



# 5/ Debranching + endograft

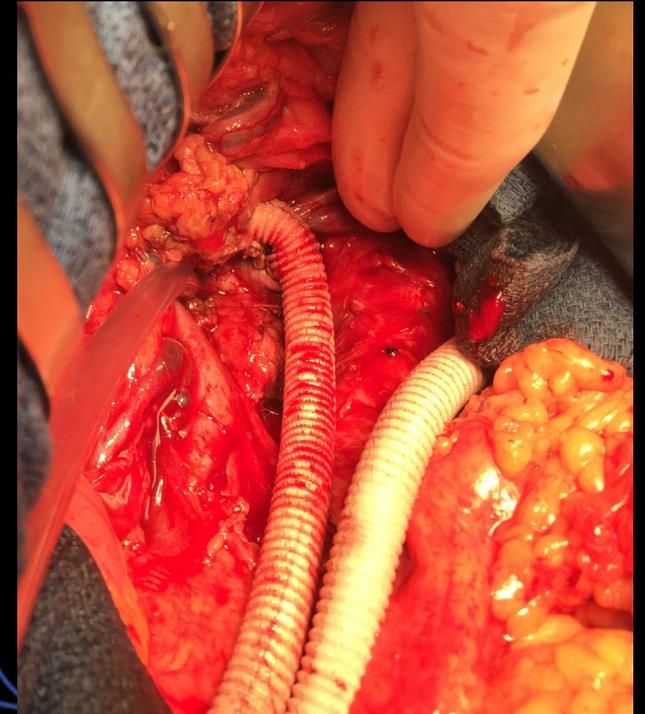
No aortic clamping

Interesting in case of cardiac dysfunction`

Good strategy for Shaggy Aortas

Interesting for very large sac aneurysmoraphy

Retrograde bypass (renal and visceral arteries)





# CASSIS

Centre de congrès  
Oustau Calendal

**SAVE THE DATE**

**26 & 27 septembre**

**2024**

[www.sres-symposium.org](http://www.sres-symposium.org)

## Conclusion

Les patients à haut risque chirurgical avec un AAA rompu **doivent** être pris en charge par voie endovasculaire avec des bons résultats sauf si...

VOUS AVEZ UNE BONNE RAISON POUR NE PAS LE FAIRE

Diverses techniques sont décrites dans la littérature, et le choix de la technique utilisée doit dépendre de l'anatomie du patient et de l'expertise du chirurgien

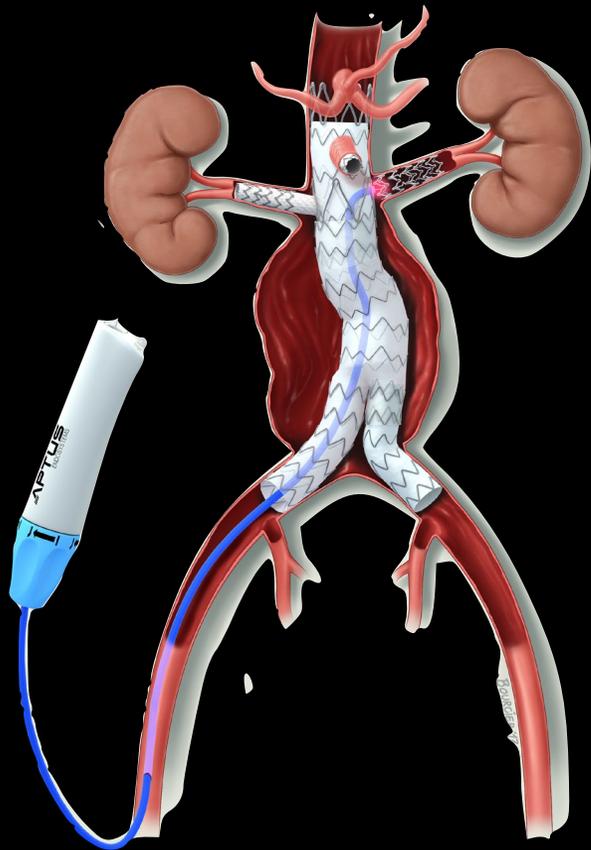


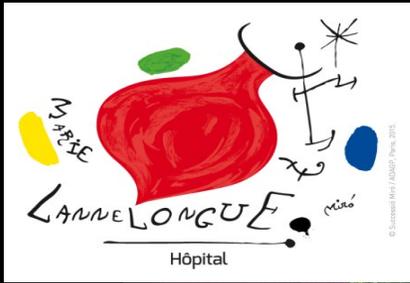
Hôpital  
Marie-Lannelongue

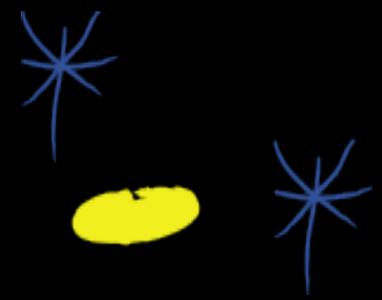
université  
PARIS-SACLAY

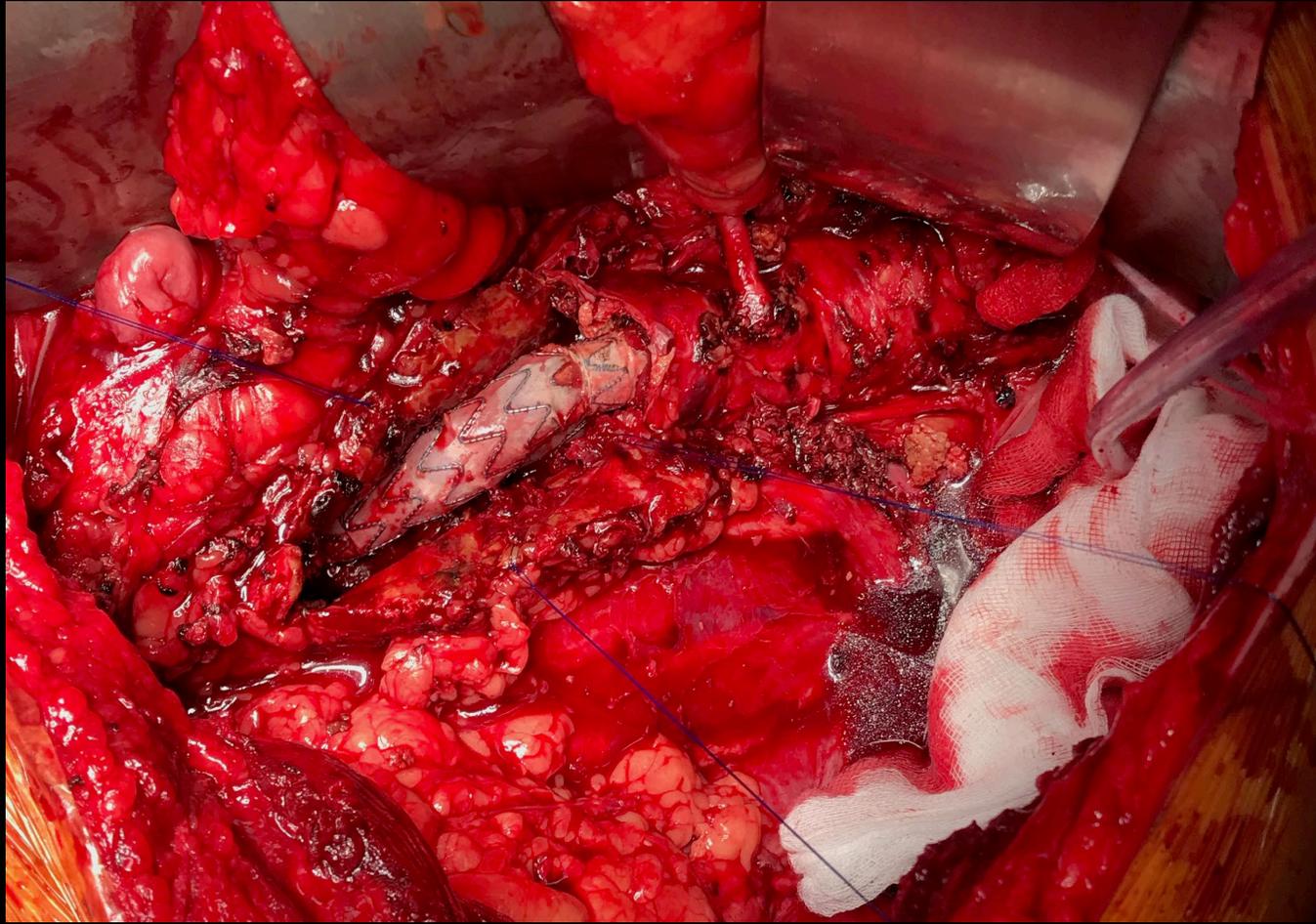
FACULTÉ DE  
MÉDECINE

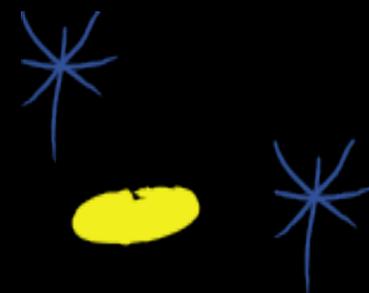
# Training & workshop











# Resultats 2022/ 2024

- ◇ 29 patients
- ◇ 9 patients AAA sous renal
- ◇ 6 patients



Hôpital  
Marie-Lannelongue

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