STANFORD
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Stanford University Medical Center

The Snorkel Technique for Juxtarenal Aneurysms

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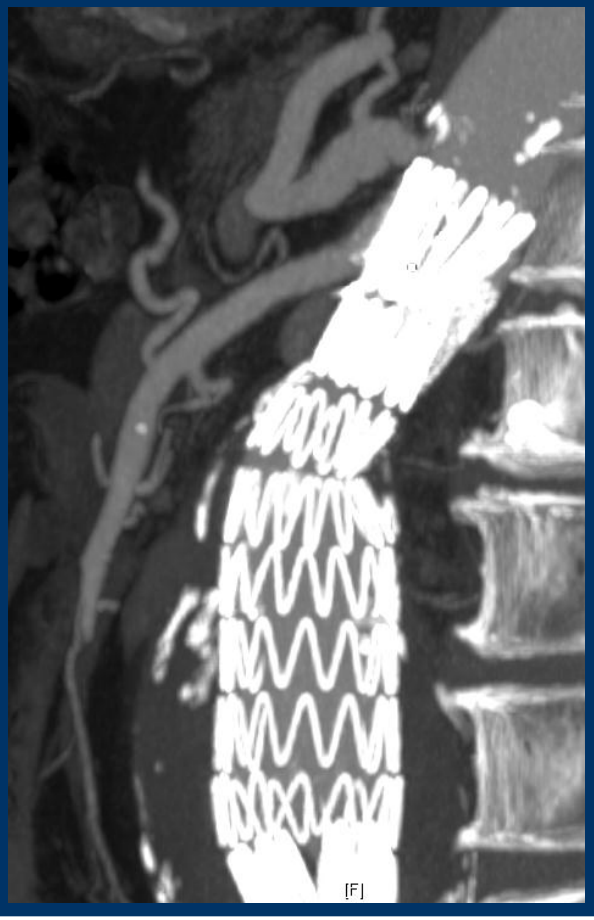
IMAD
Liege, Belgium
October 5, 2012

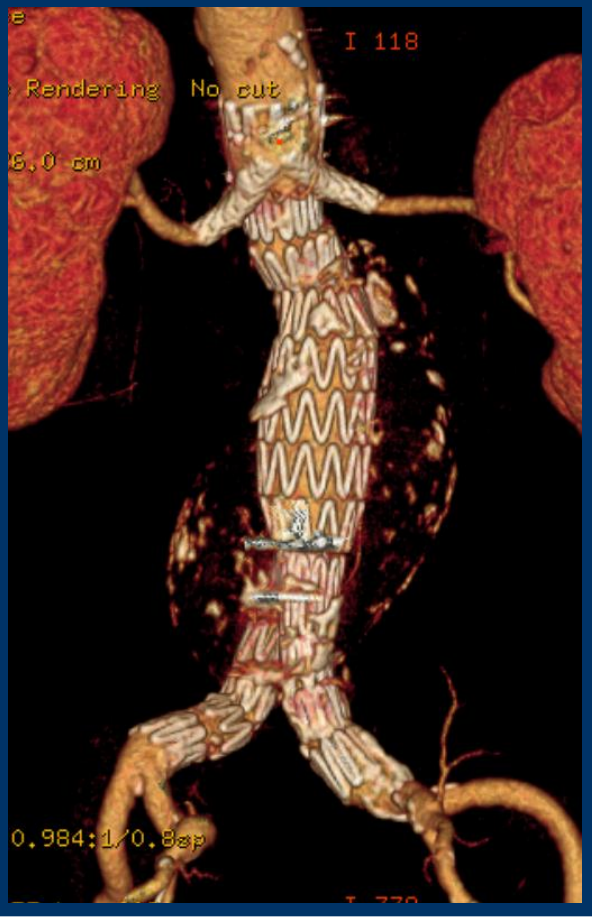
*NO DISCLOSURES

**OFF LABEL USE OF DEVICES

Basic Definitions

- Parallel graft alongside the main aortic endoprosthesis to maintain flow in a covered branch vessel.



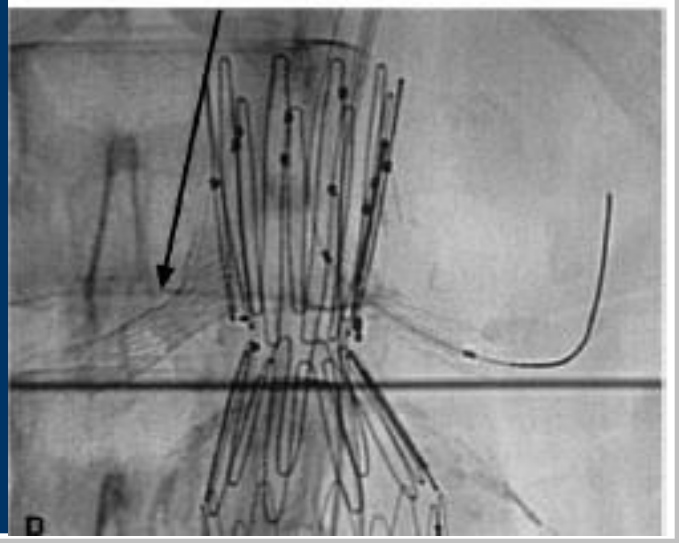


Should patients with challenging anatomy be offered endovascular aneurysm repair?

Roy K. Greenberg, MD,[a,b] Daniel Clair, MD,[a] Sunita Srivastava, MD,[a] Guru Bhandari, MS,[a] Adrian Turc, MD,[a] Jennifer Hampton, RN,[a] Matt Popa, BS,[a] Richard Green, MD,[a] and Kenneth Ouriel, MD,[a] *Cleveland, Ohio; and Rochester, NY*

Objectives: Treatment of abdominal aortic aneurysm is controversial in patients at high physiologic risk for op high anatomic risk for endovascular repair. We compared outcome in patients at high risk because of anato angulated neck), severe occlusive disease, or bilateral iliac aneurysms (group A) with outcome in patient (group B).

Material and methods: Patients at high anatomic risk who underwent treatment between October 1998 and with the Zenith endovascular graft (group A) were compared with patients at low anatomic risk enrolled in multicenter trial (group B). Variables compared included overall mortality, need for secondary interventio



Self-expanding bare metal stents

Effectively raise renal orifice a few mm

Ensure graft material in region of renals without compromising renal flow

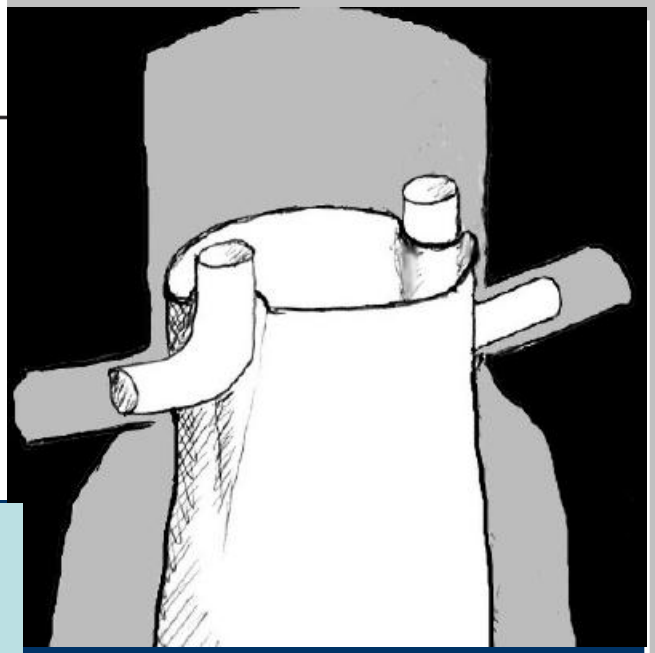
J ENDOVASC THER
2008;15:427–432

◆TECHNICAL NOTE

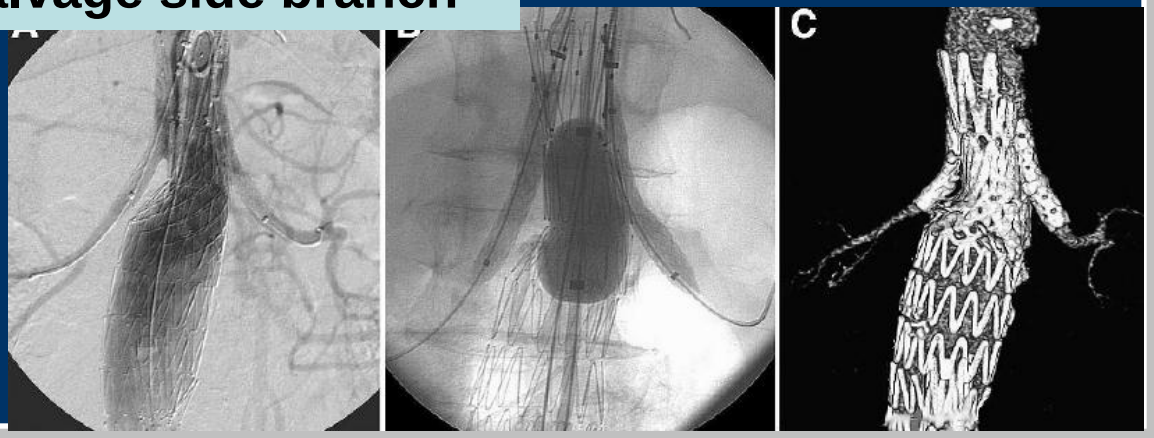
The Chimney Graft: A Technique for Preserving or Rescuing Aortic Branch Vessels in Stent-Graft Sealing Zones

Tomas Ohrlander, MD; Björn Sonesson, MD, PhD; Krasnodar Ivancev, MD, PhD; Timothy Resch, MD, PhD; Nuno Dias, MD, PhD; and Martin Malina, MD, PhD

Vascular Center Malmö-Lund, Malmö University Hospital, Malmö, Sweden.



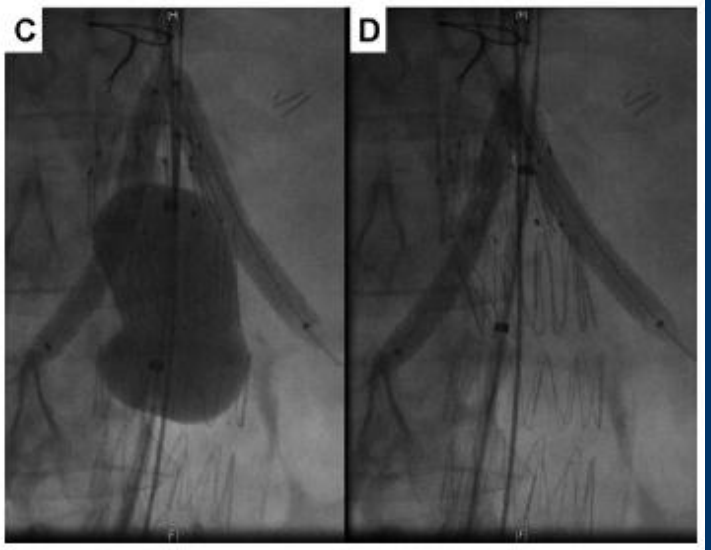
- **6 juxtarenal cases (2 ruptured, 3 urgent)**
- **Covered stents**
- **Valid alternative to fenestrated during emergency setting or unsuitable for FBE**
- **Rescue procedure to salvage side branch**



Early experience with the snorkel technique for juxtarenal aneurysms

Jason T. Lee, MD, Joshua I. Greenberg, MD, and Ronald L. Dalman, MD, *Stan*

Objective: The lack of readily available branched and fenestrated endovascular aneurysm created an opportunity for creative deployment of endograft components to treat juxtaren early experience with "snorkel" or "chimney" techniques in the endovascular management
Methods: We retrospectively reviewed planned snorkel procedures for juxtarenal aneurysm 2009 to August 2011. Our standardized technique included axillary or brachial cutdown f stents and mostly percutaneous femoral access for the main body endograft.
Results: Fifty-six snorkel grafts were successfully placed in 28 consecutive patients (mean aneurysms. Mean aneurysm size was 64.8 mm (range, 53-87 mm). The snorkel configurati zone from an unsuitable infrarenal neck for standard EVAR (median diameter, 33.5 mm; neck diameter of 24.5 mm and length of 18.0 mm. Five patients had unilateral renal sn snorkels, and six had celiac/superior mesenteric artery/renal combinations. Technical succ 98.2%, with loss of wire access leading to one renal stent deployment failure. Thirty-day m was readmitted 1 week postoperatively with pneumonia and died of sepsis; one patie hemispheric stroke. Other major complications included perinephric hematomas, 7.1%; p iliac artery injury requiring endoconduit placement, 3.6%; and brachial plexus nerve injury included self-limited arrhythmias (14.3%) and one non-Q-wave myocardial infarctio coronary intervention. Mean follow-up was 10.7 months (range, 3-25 months). related causes at 3 months (89.3% survival). Postoperative imaging revealed one re at 3 months (98.2% overall primary patency). Seven (25%) early endoleaks were n tomography angiography: two type I, three type II, and two type III (25%), leading with bridging cuff placement (type III). The small type Ia endoleaks and other type scan. Mean sac regression at the latest follow-up was 7.3 mm. No aneurysm has e
Conclusions: Early success with the snorkel technique for juxtarenal aneurysms has complex short-neck to no-neck EVAR. Although long-term follow-up is needed, t and lack of requirement for custom-built devices may make this approach more at stent grafts. (J Vasc Surg 2012;55:935-46.)



28 consecutive elective patients (2009-2011)

IRB approved protocol

98% technical success

7.1% 30-day mortality

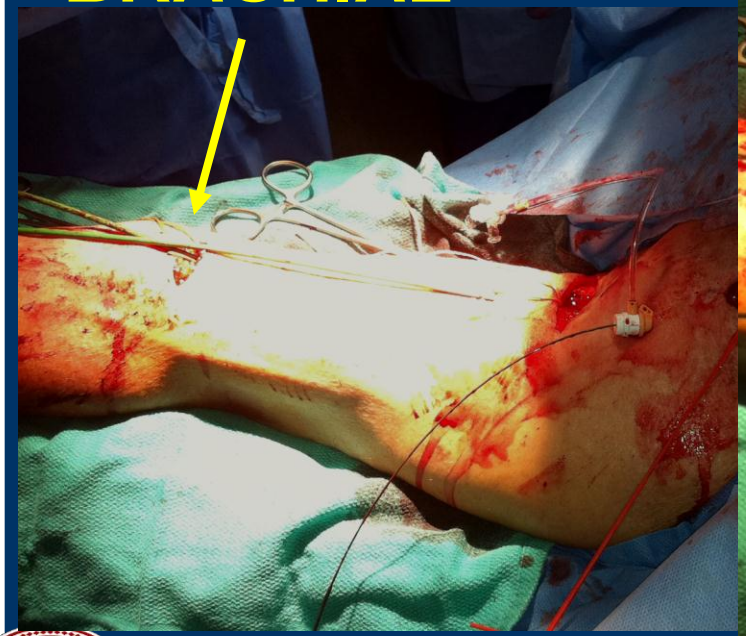
98% primary patency

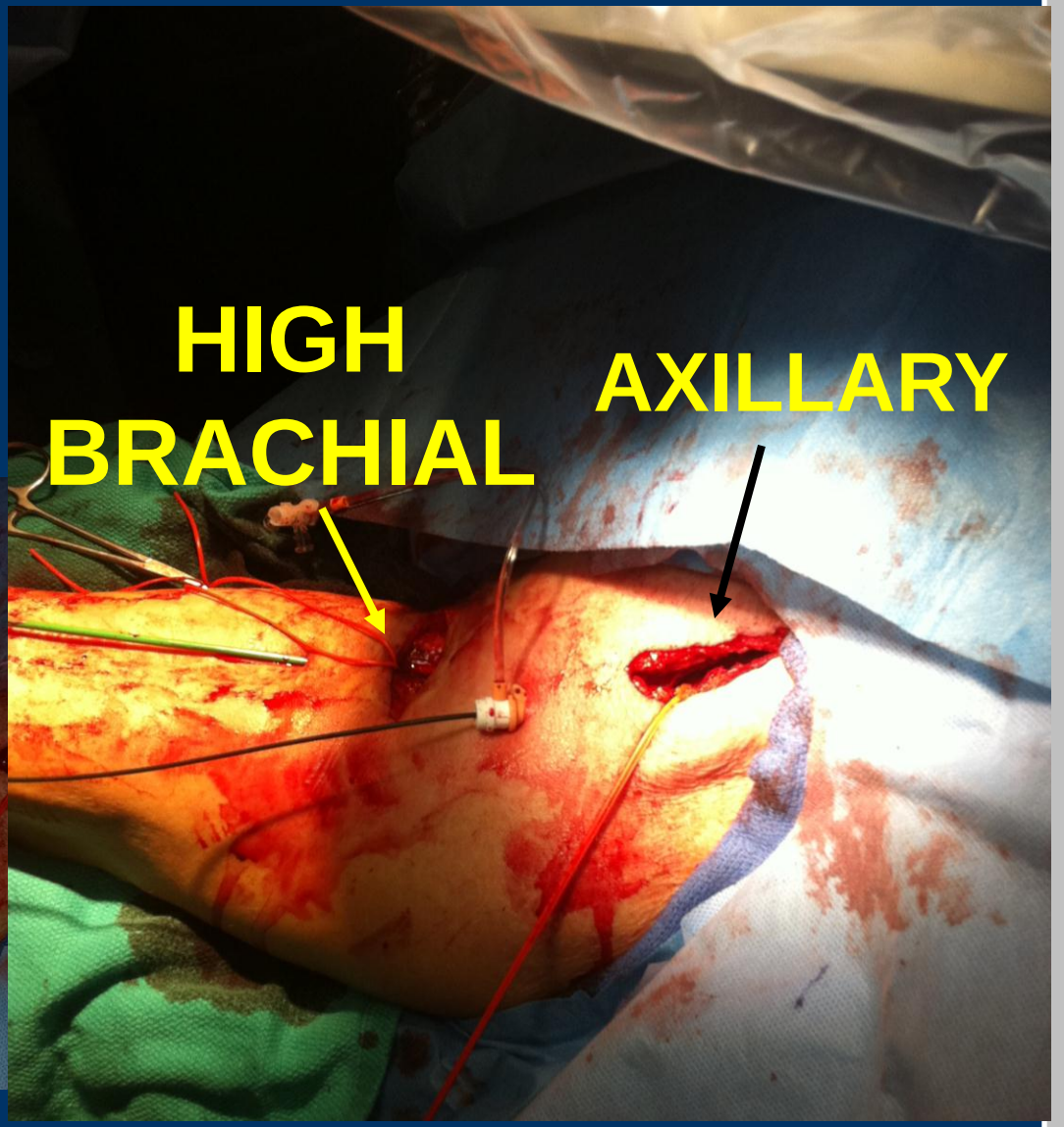
Survival 89% at one year

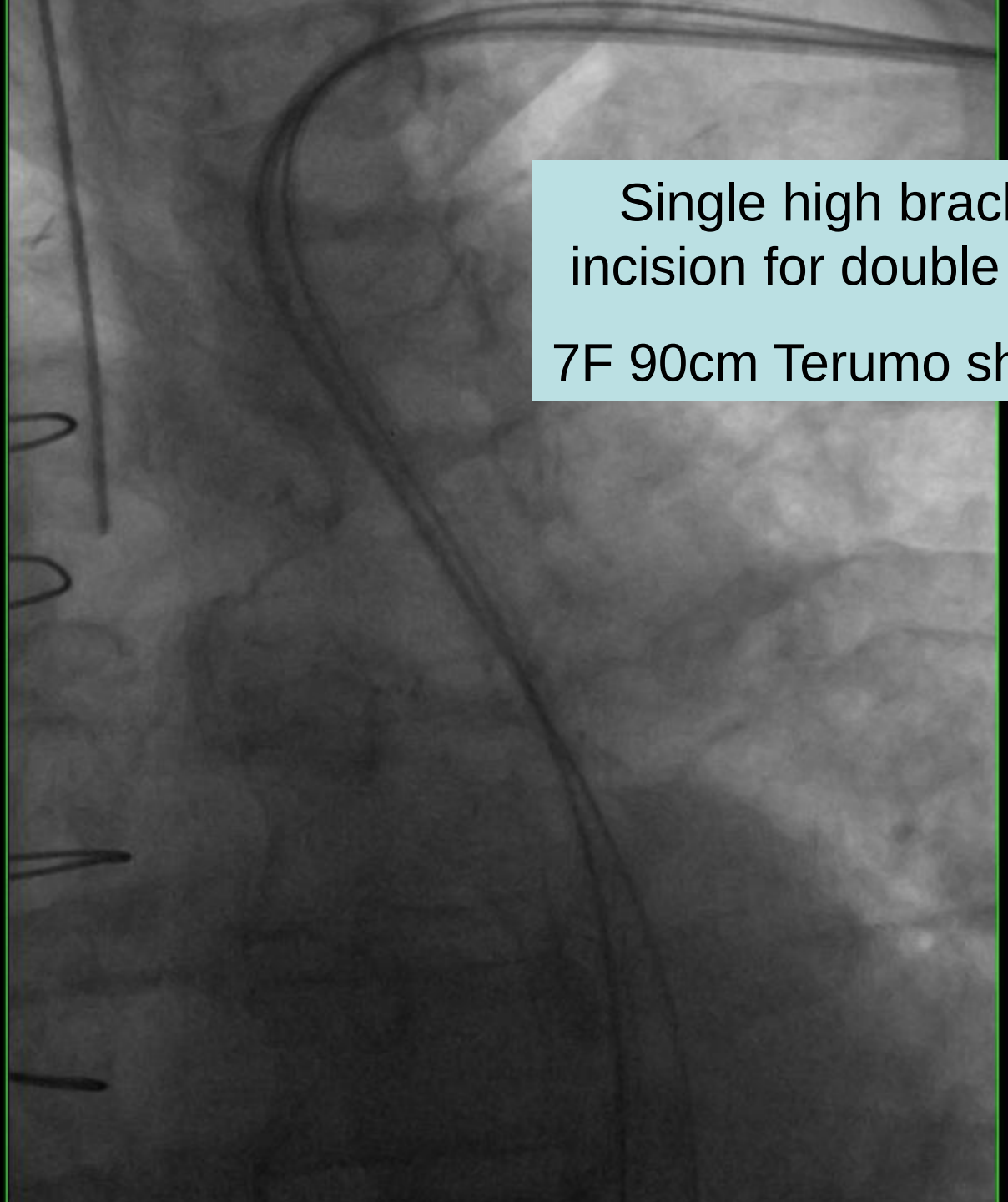
TECHNIQUE
Hybrid Suite

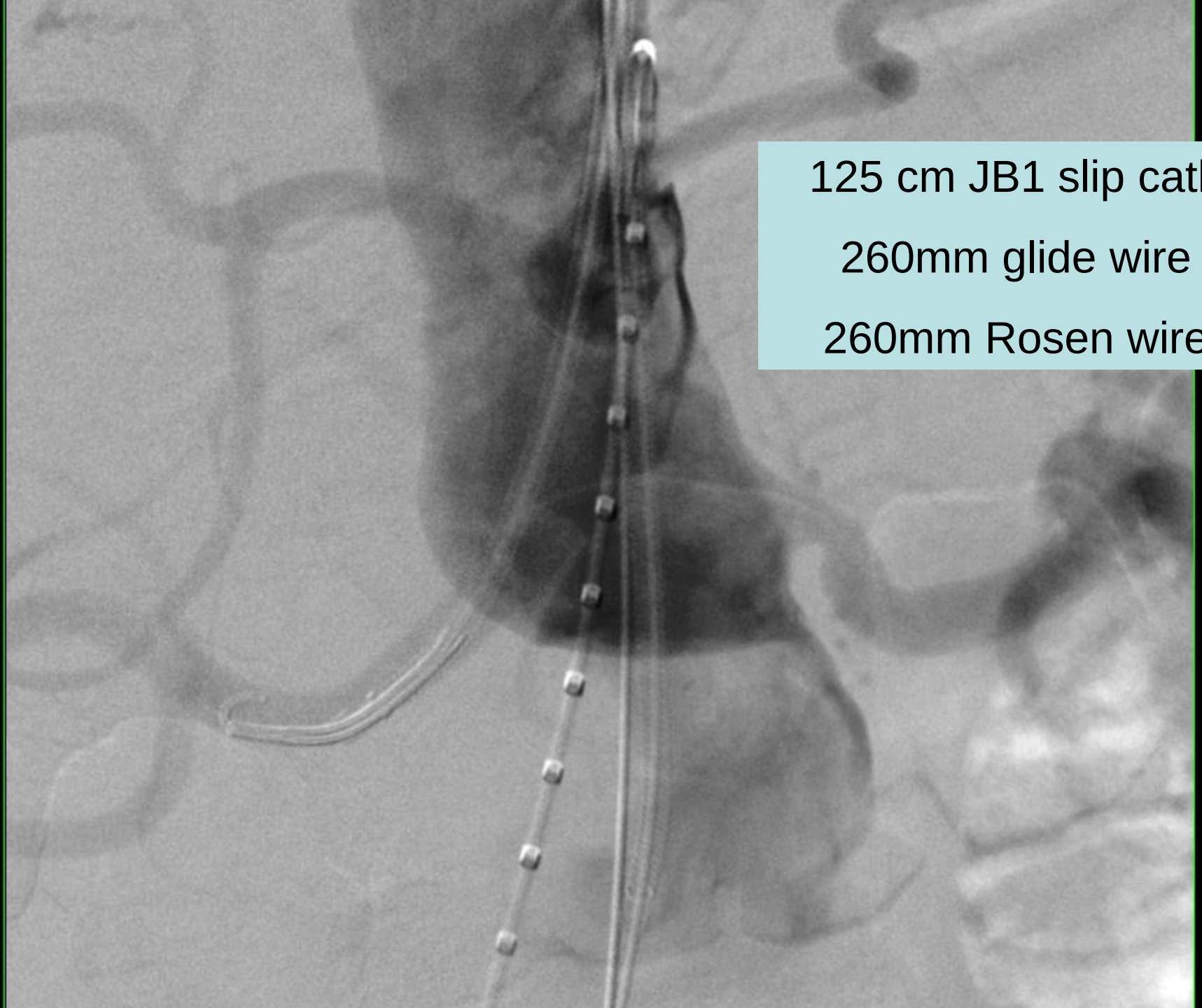
Recommended Access

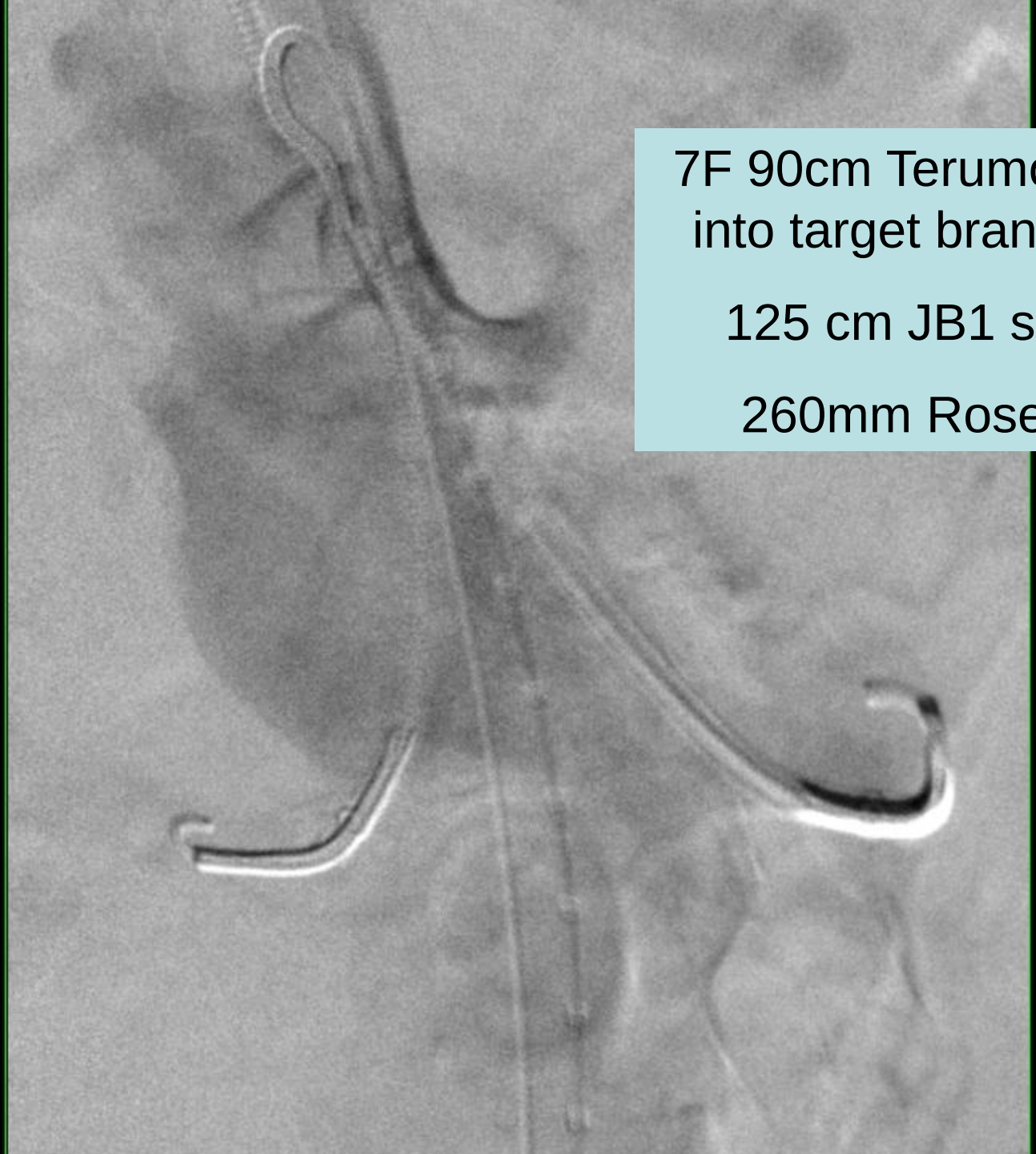
LOW BRACHIAL






Single high brachial incision for double renal
7F 90cm Terumo sheaths

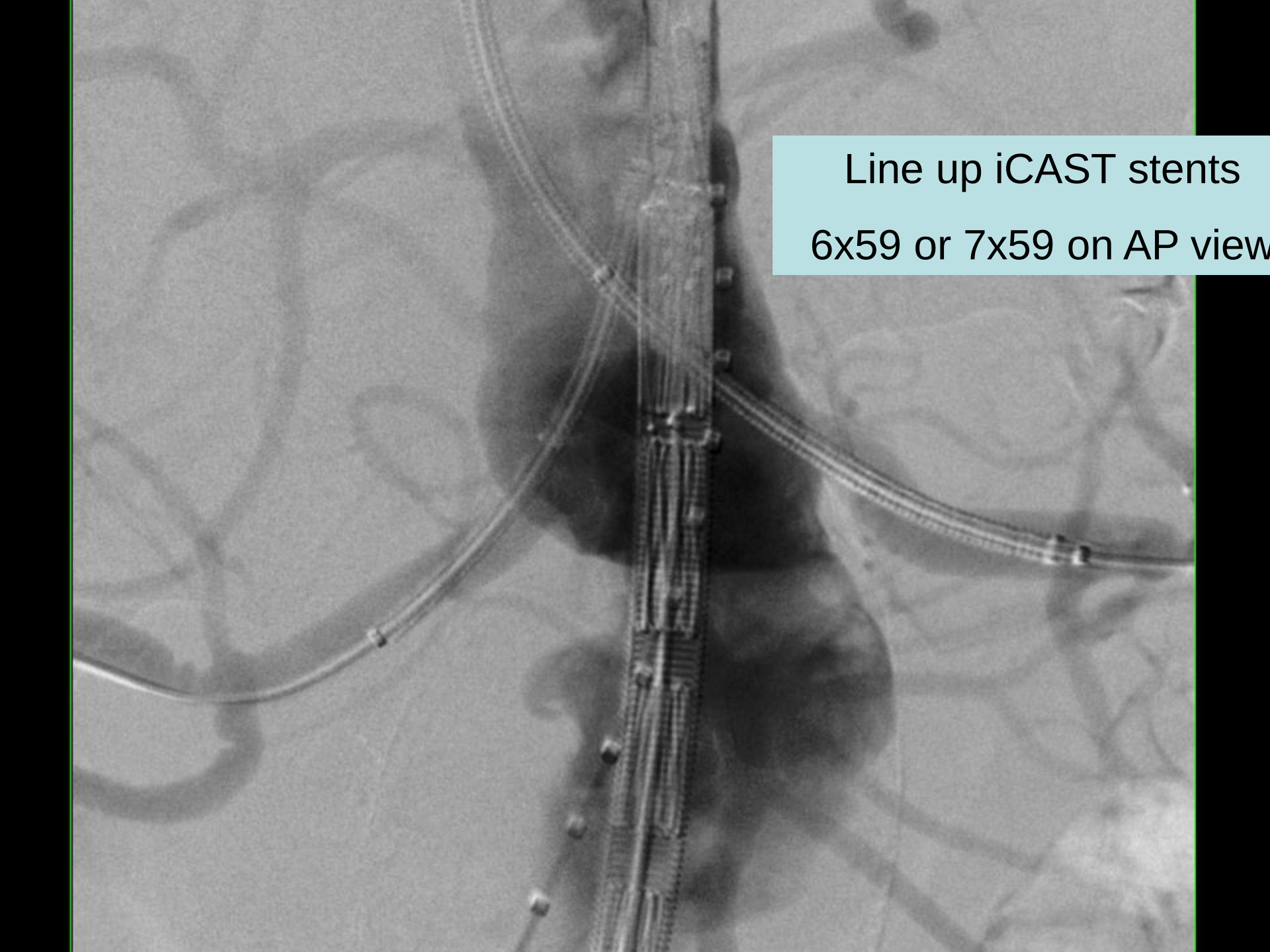

125 cm JB1 slip cath
260mm glide wire
260mm Rosen wire

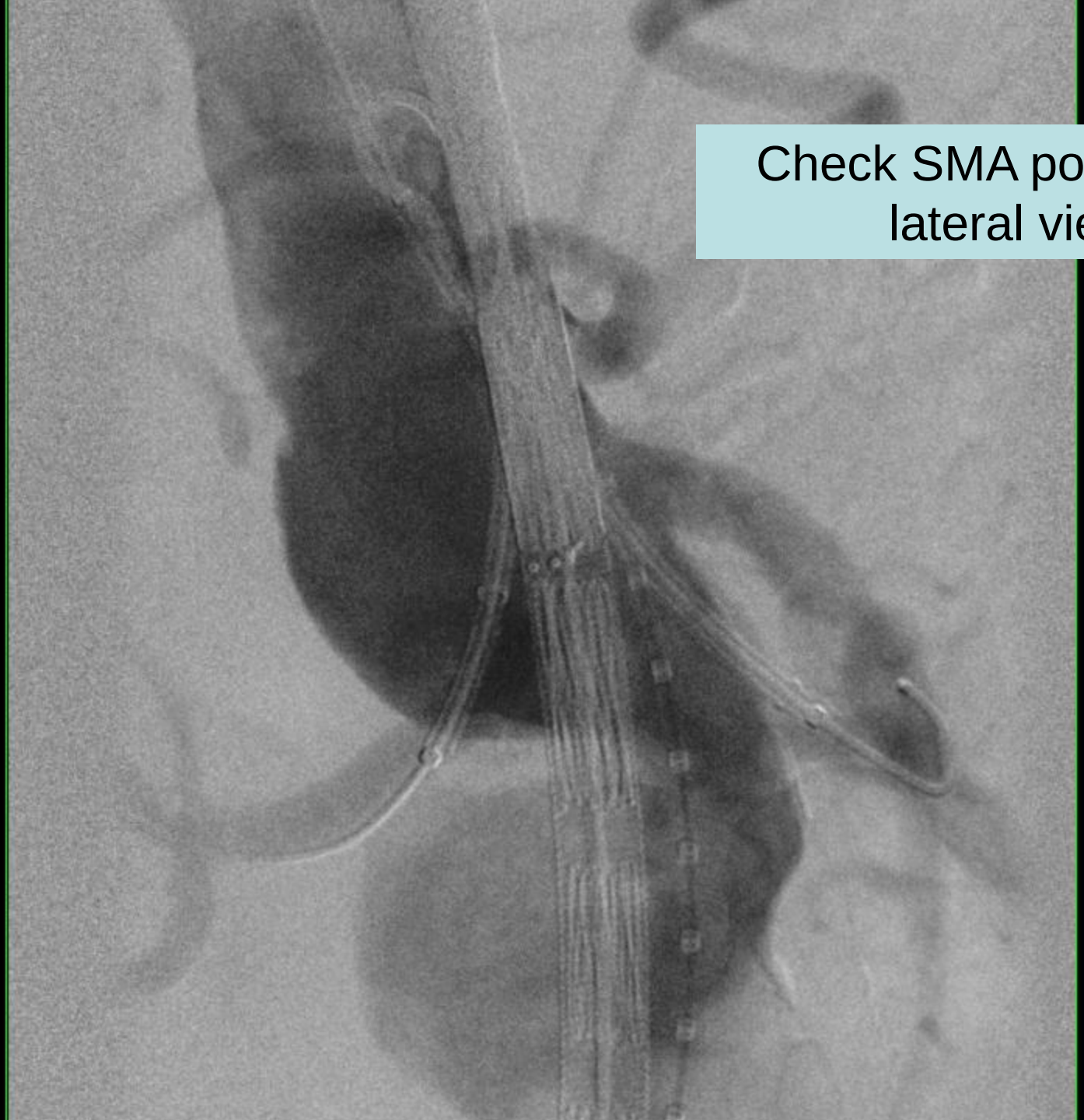


7F 90cm Terumo sheaths into target branch origin

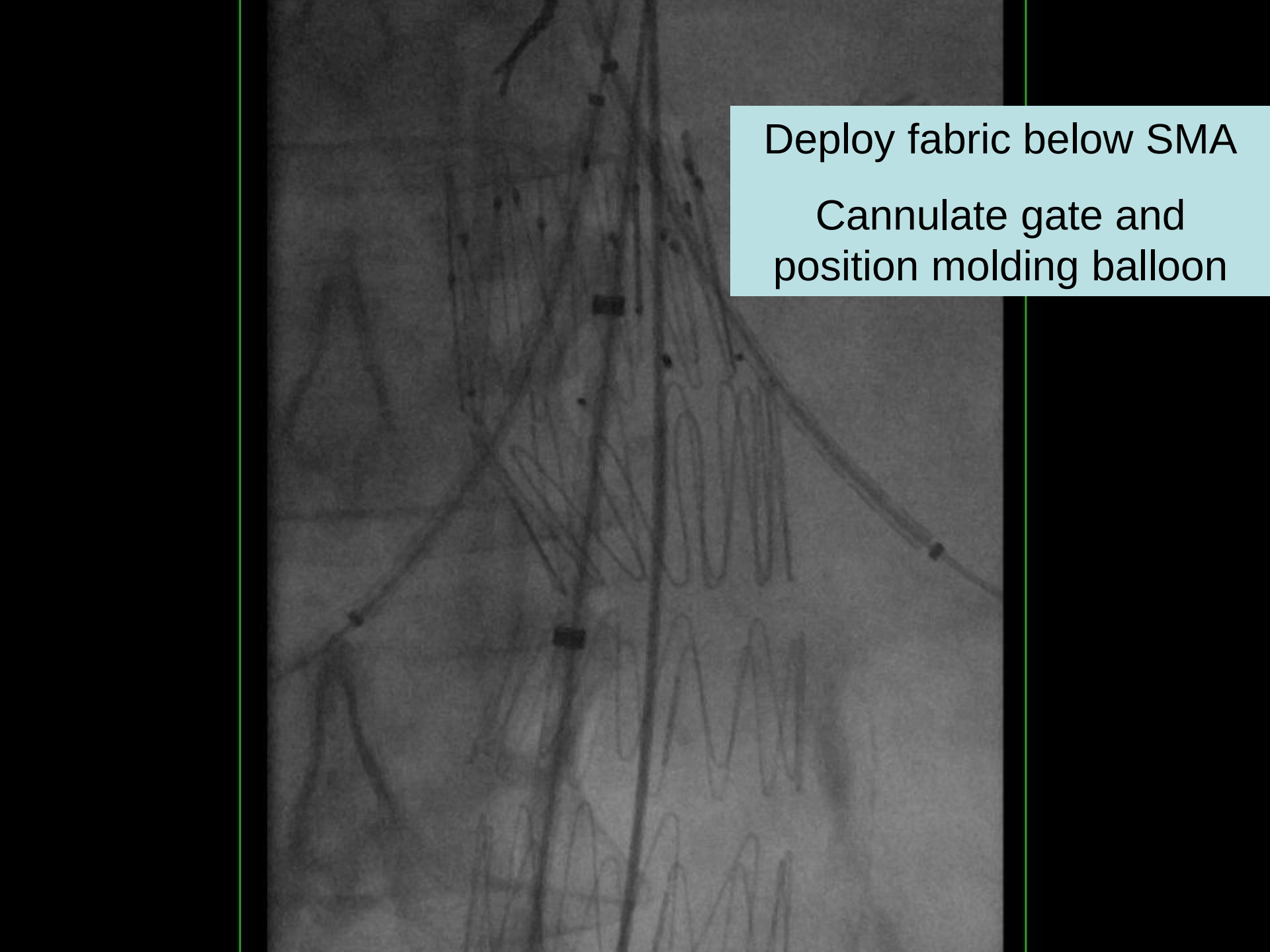
125 cm JB1 slip cath

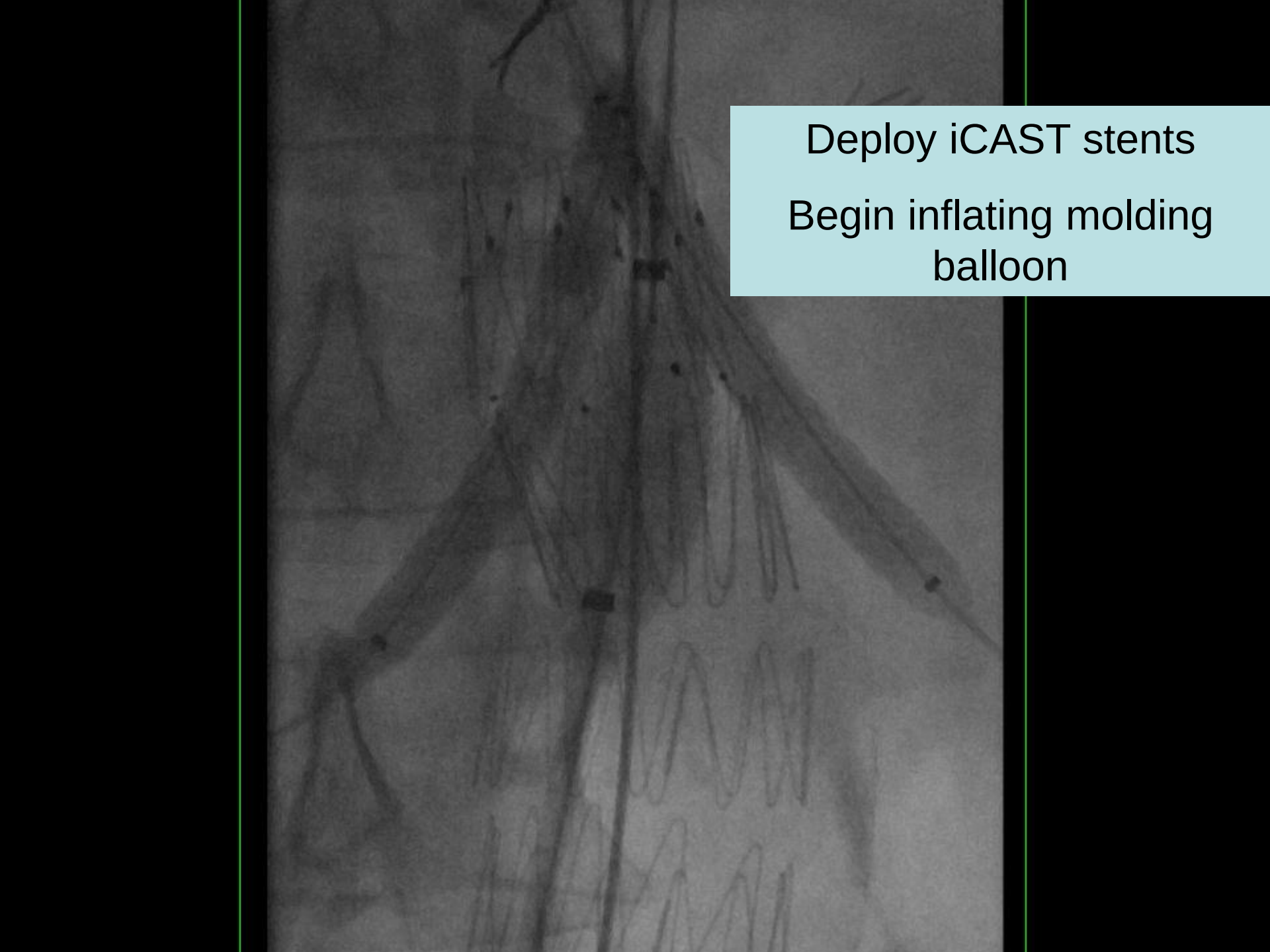
260mm Rosen wire


Line up iCAST stents
6x59 or 7x59 on AP view



Check SMA position on lateral view

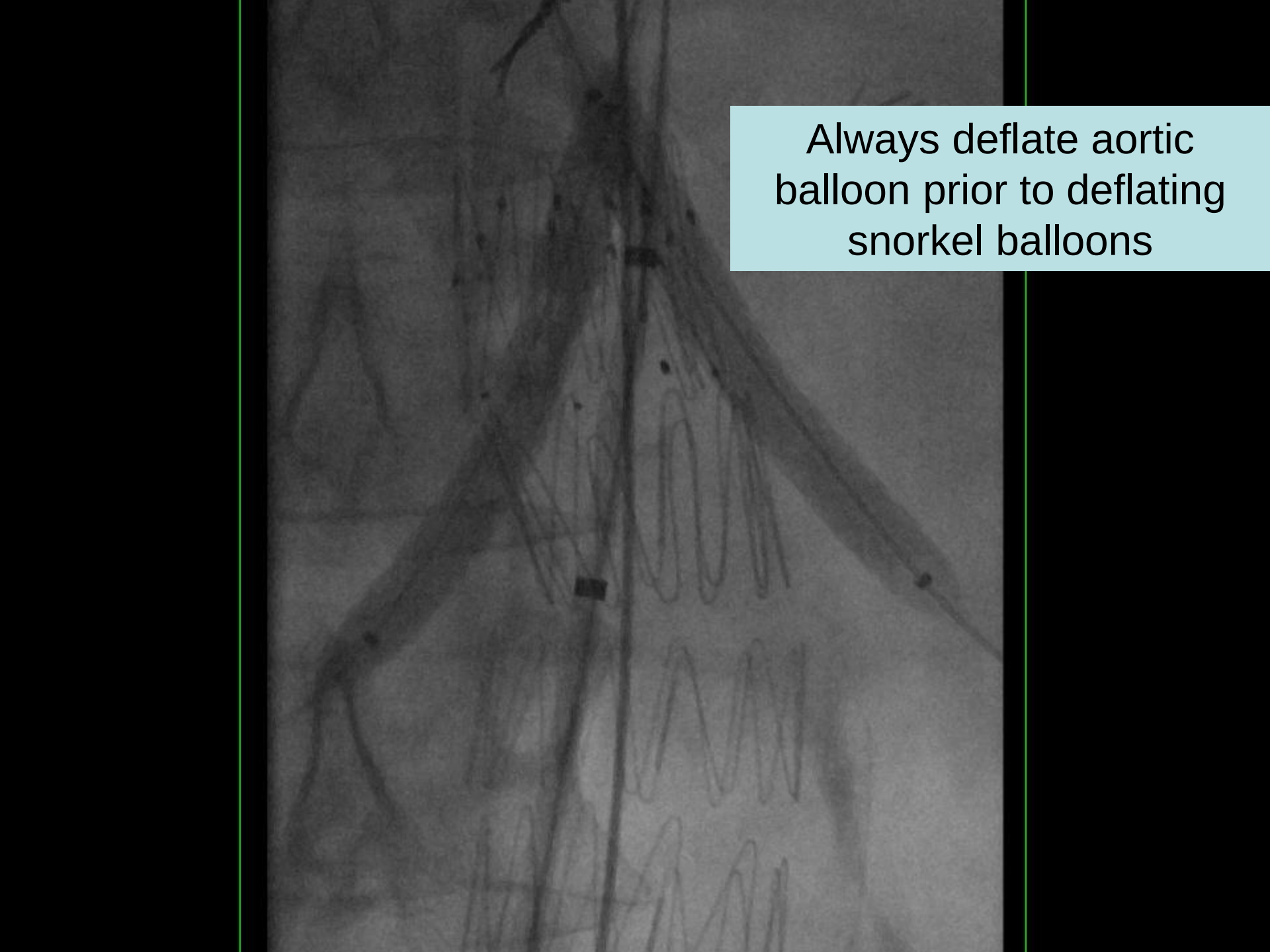

Deploy fabric below SMA
Cannulate gate and position molding balloon

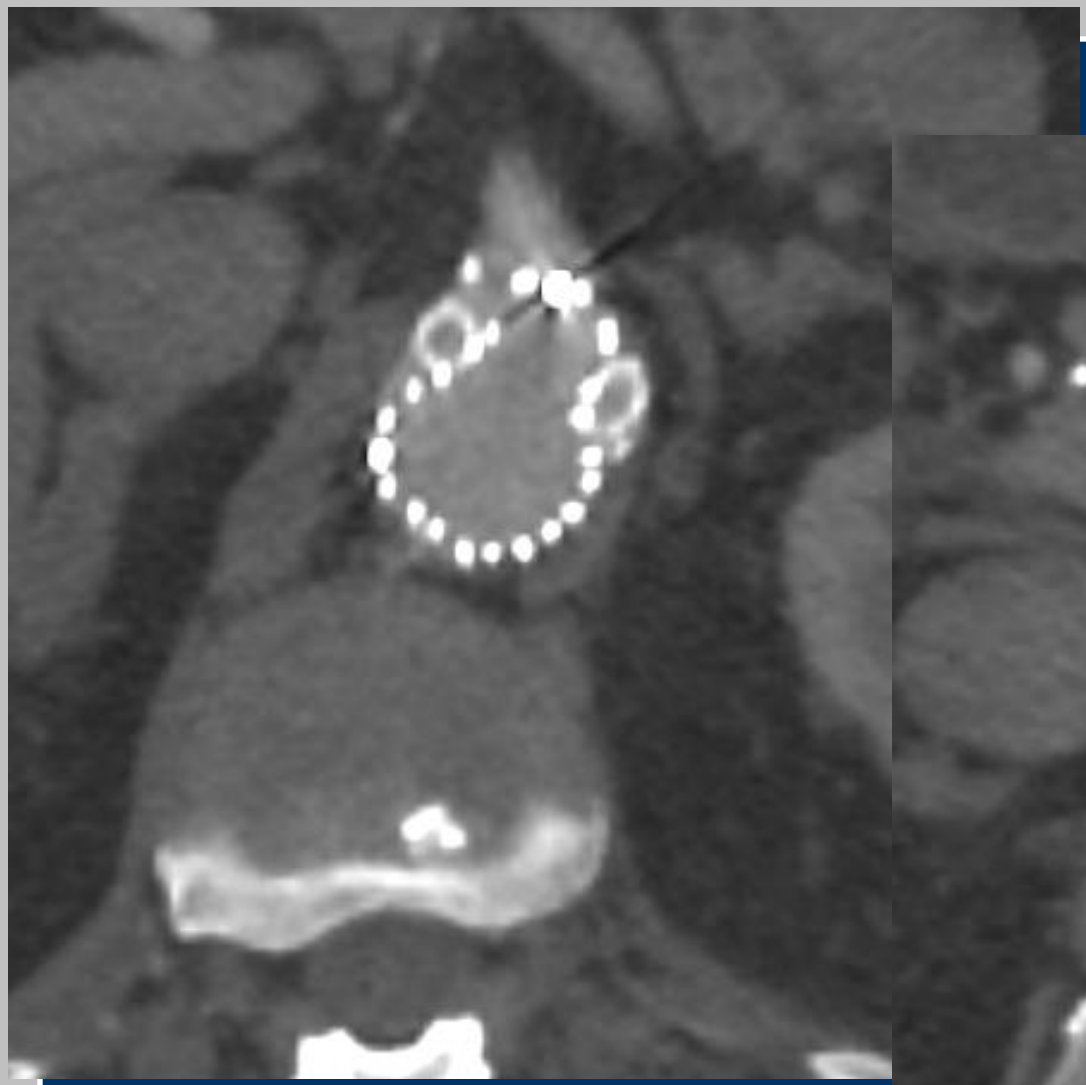


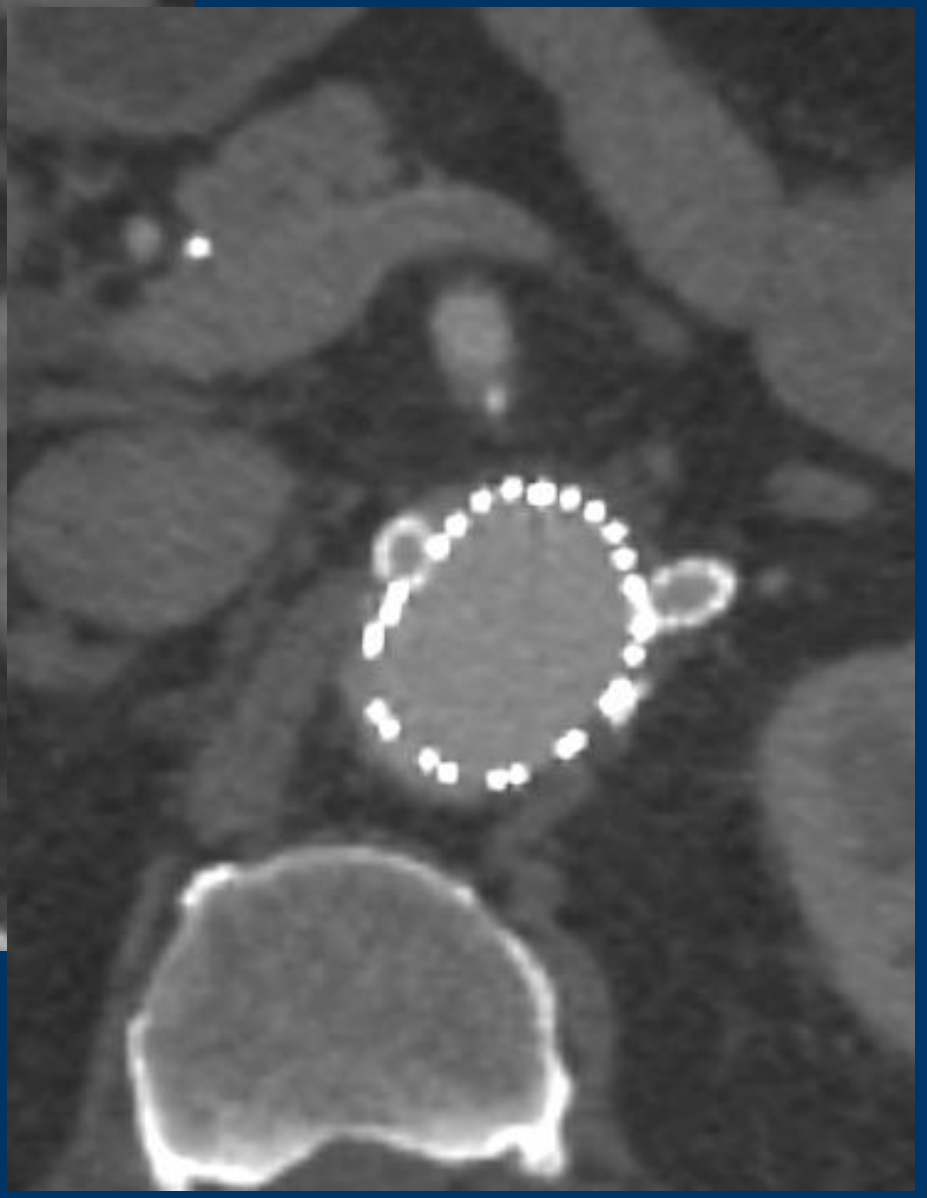
Deploy iCAST stents

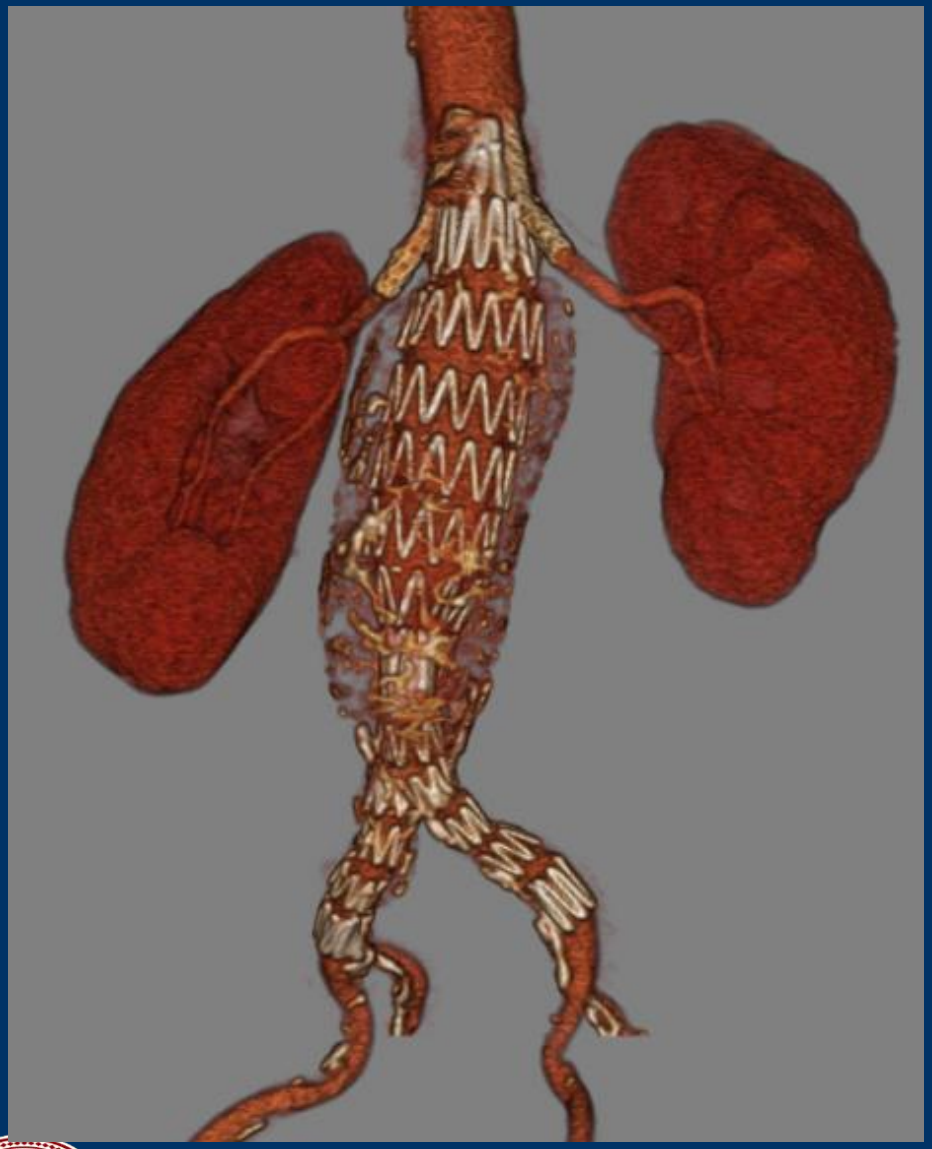
Begin inflating molding balloon

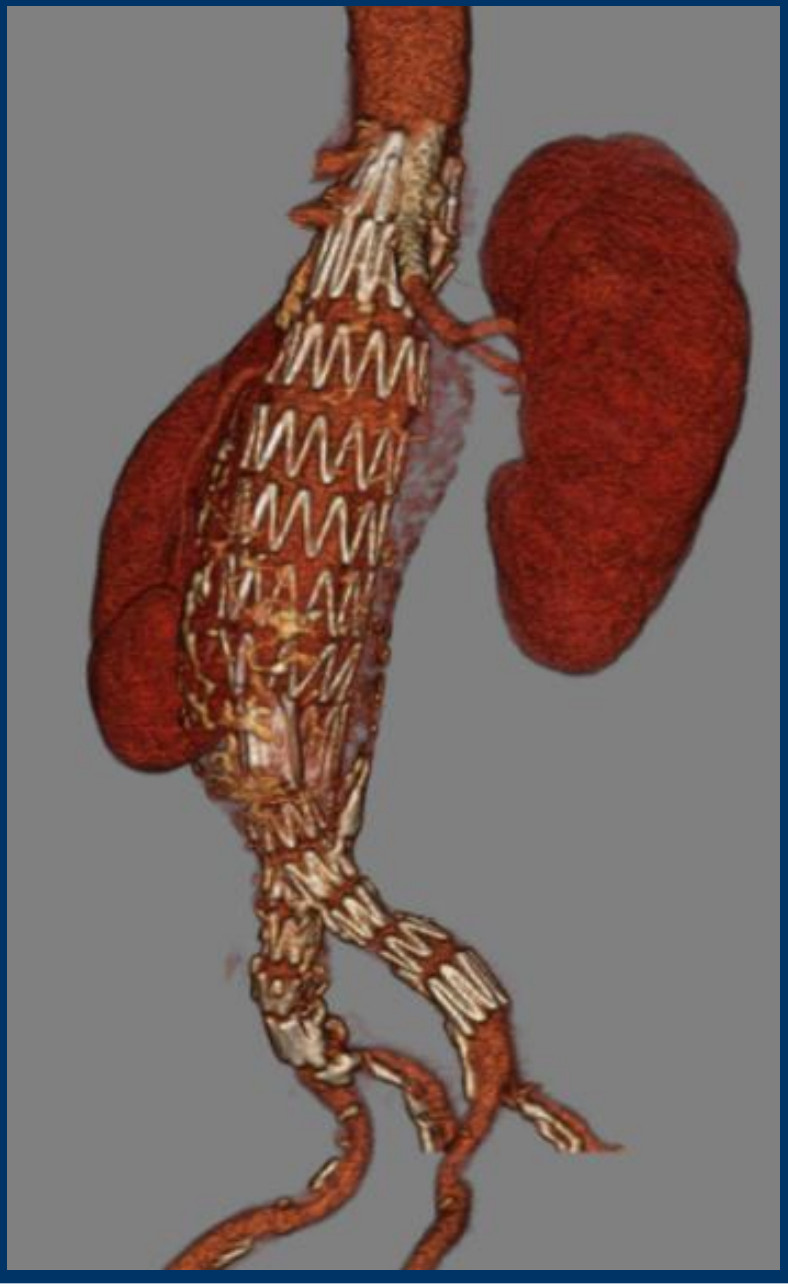

“Triple Kissing” Balloons


Always deflate aortic balloon prior to deflating snorkel balloons





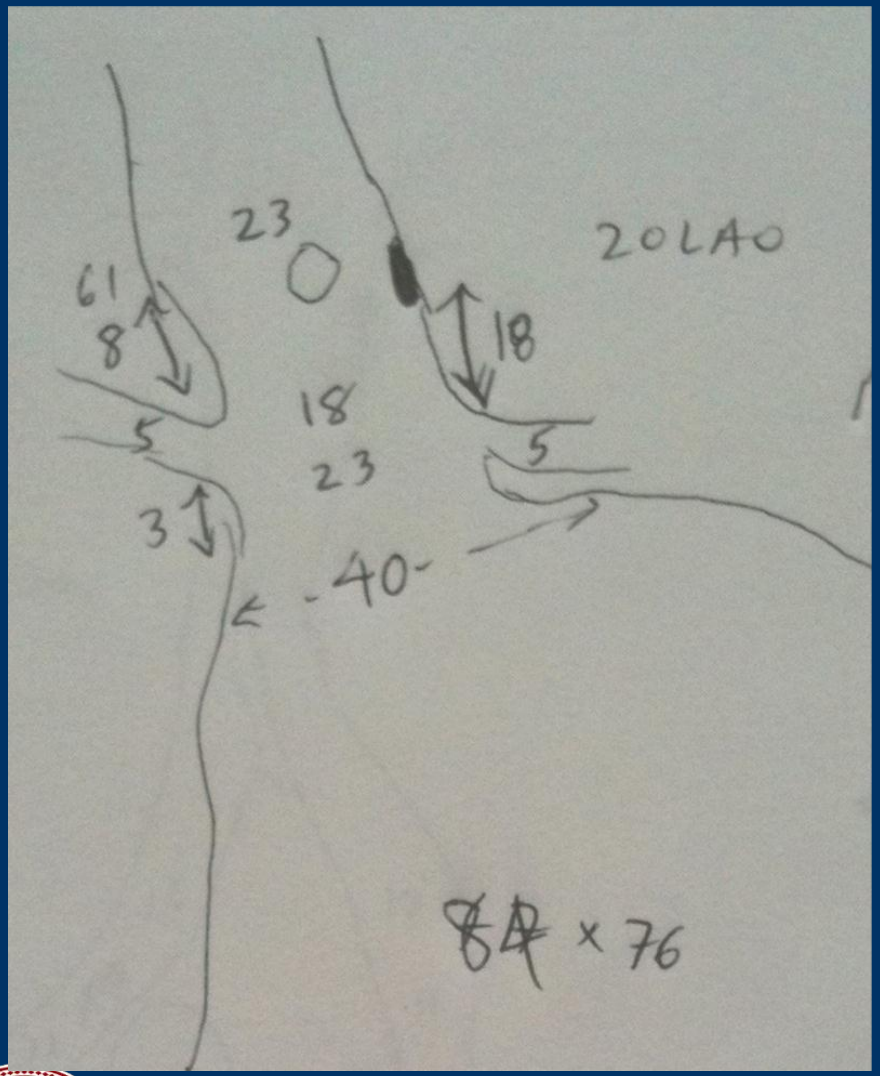




Results
2009-2012

- 70% male
- Age 75 years (60-88)
- AAA size 65.1mm (51-95)
- Most not suitable for open repair
  - Severe CAD (79%), COPD (46%), CHF (32%)
  - 100% ASA Class 3 or worse
- All elective cases
  - 79% juxtarenal AAAs
  - 12% previous Type I endoleaks
  - 9% with previous open repair

Results



- Pre-snorkel Neck
  - 32.6 mm diameter (18-45)
  - 1.5 mm length (0-5)
- “Post-snorkel” Neck
  - 25.1 mm diameter (18-32)
  - 19.4 mm length (10-30)

Pt	Main body	Snorkel configuration	Stent type[a]
1	32 Renu	Left renal	iCAST
2	28 Zenith	Bilateral renal	iCAST
3	32 Talent	Left renal	iCAST
4	32 Zenith	Bilateral renal	iCAST
5	36 Zenith	Left renal	iCAST
6	22 Zenith	Bilateral renal	iCAST
7	32 Zenith	Bilateral renal	iCAST
8	32 Zenith	Bilateral renal	iCAST
9	32 Zenith	Bilateral renal	iCAST
10	36 Zenith	Left renal	iCAST
11	26 Zenith	Bilateral renal	iCAST
12	28 Endurant	Bilateral renal	iCAST
13	28 Zenith	Right renal	Viabahn
14	32 Zenith	Bilateral renal	Viabahn
15	28 Zenith	Bilateral renal	iCAST
16	28 Zenith	Bilateral renal	Viabahn
17	34 TAG	Left renal/SMA/celiac	Viabahn
18	31 Excluder	Bilateral renal	Mixed
19	38 TX2	SMA/celiac	Viabahn
20	28 Zenith	Right renal/SMA	iCAST
21	36 Zenith	Bilateral renal	iCAST
22	36 Renu	Bilateral renal/SMA	Mixed
23	32 Zenith	Bilateral renal/SMA	Mixed
24	26 Zenith	Bilateral renal	Mixed
25	30 Zenith	Bilateral renal	iCAST
26	36 Zenith	Bilateral renal	iCAST
27	28 Endurant	Bilateral renal	ICAST
28	36 TX2	Bilateral renal/SMA/celiac	Mixed

- Configuration (n=43)
  - 28 (65%) bilateral renal
  - 6 (14%) unilateral renal
  - 9 (21%) combination with visceral
- Main body endograft
  - 26 (60%) Zenith
  - 5 Renu, 5 Endurant, 2 TX2, 2 Excluder, 1 TAG, 1 Talent, 1 Valiant
- 85/87 branches preserved in the 43 patients
  - 97.7% technical success

Outcomes

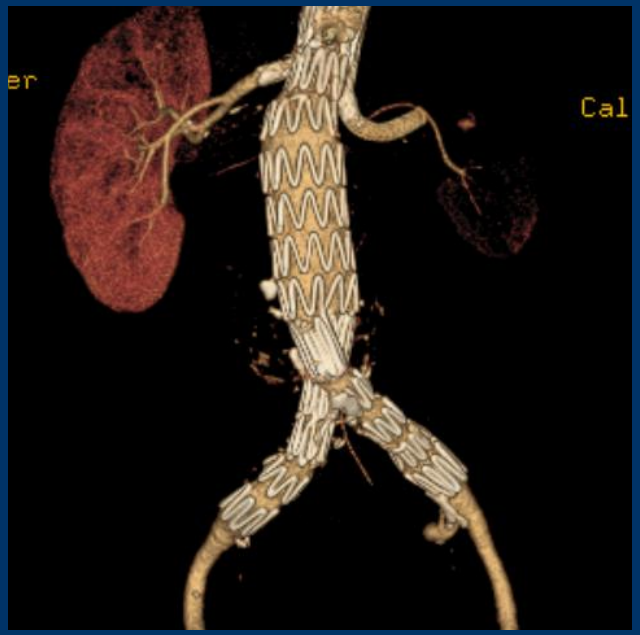
PERIOPERATIVE (n=43)		
Fluoroscopy time (min)	72.9	35-155
Contrast dose (mL)	180.0	66-400
Operative time (min)	236.9	110-515
Estimated blood loss (mL)	413	100-2000
Baseline creatinine (mg/dL)	1.1	0.8-1.6
Highest postop creatinine	1.4	0.9-5.8
Long-term followup creatinine	1.2	0.8-4.4
ICU length of stay (days)	0.8	0-6
Total length of stay (days)	3.4	2-10

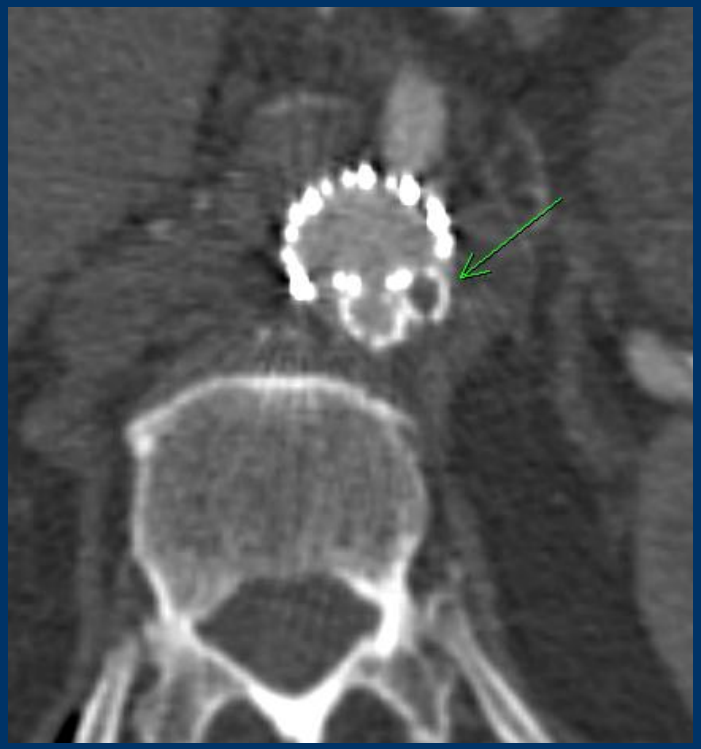
Short-term Results (n=43)

- Complications
  - 2 peri-nephric hematomas (4.6%)
    - Transfusion post-op
    - No renal failure issues or need for HD
  - 4 acute renal failure with 1 requiring permanent HD (2.3%)
    - In double renal/visceral combination snorkels
  - 1 brachial plexus injury (2.3%), 1 iliac artery injury (2.3%)
  - 5 post-op arrhythmias (11.6%), 1 post op MI (resolved)
- 7.0% 30-d mortality (post-op pneumonia/ sepsis, CVA, paraplegia)
- 1 additional death at 3 months (unrelated MI)
- Follow-up time 16.5 months (1-36)
  - Survival 88.4%

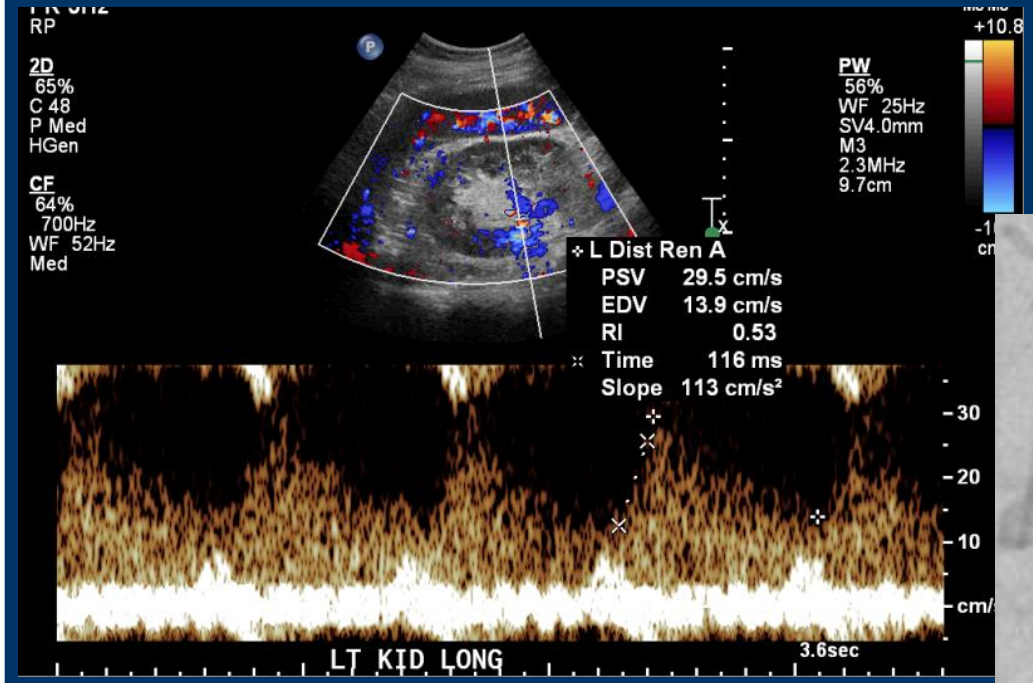
Imaging Follow-Up (n=43)

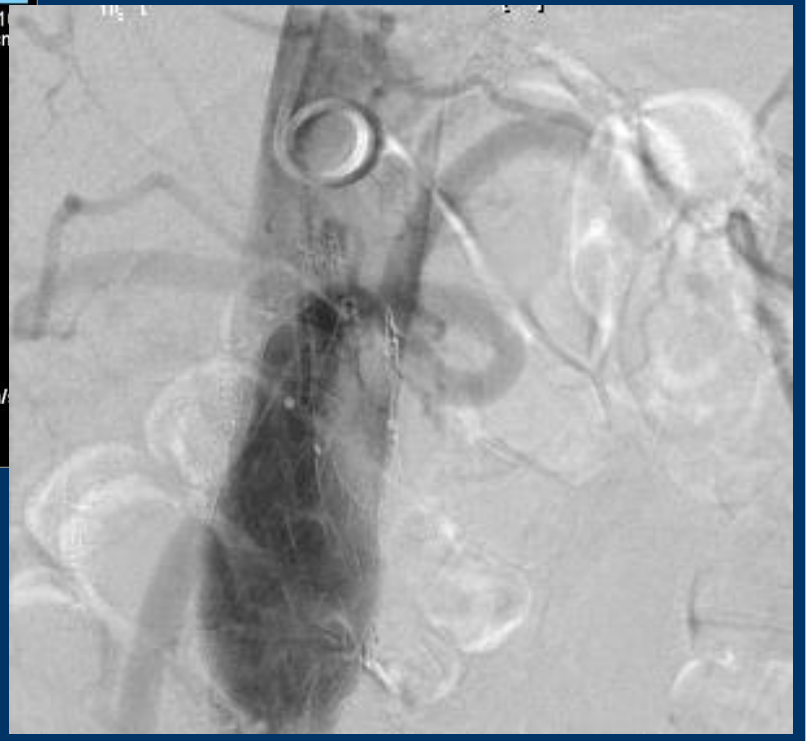
- 96.5% overall primary patency
  - 3 occluded renals
    - 1 at 3 month CT-A
    - 1 during unrelated abdominal operation 3m post-op
    - 1 at 1 month f/u
  - 98.8% secondary patency



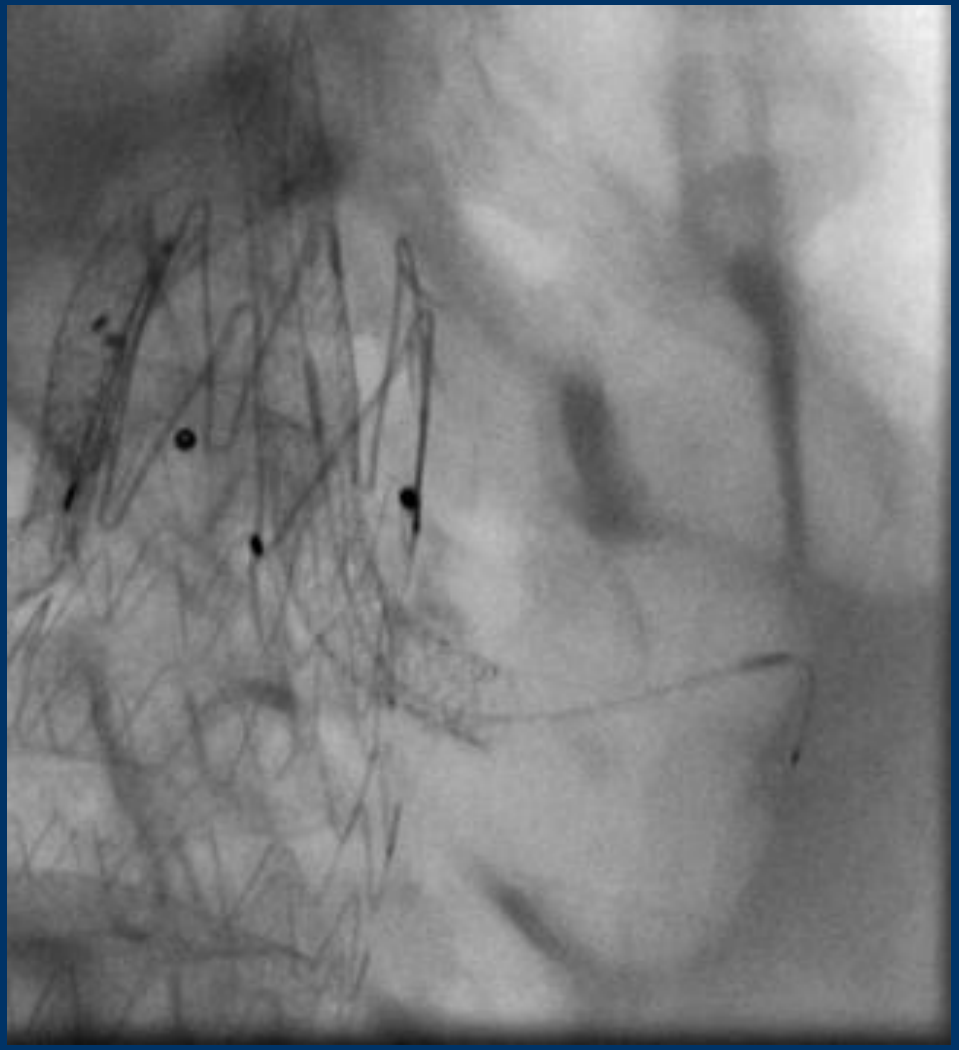


Occluded L renal after abdominal operation with rising creatinine to 7.0

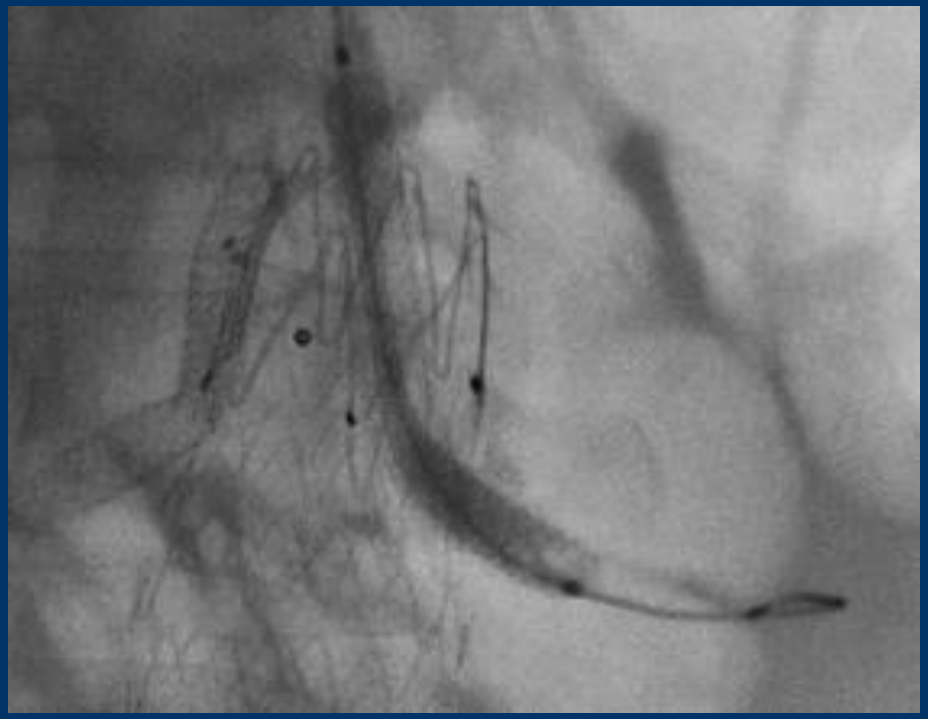


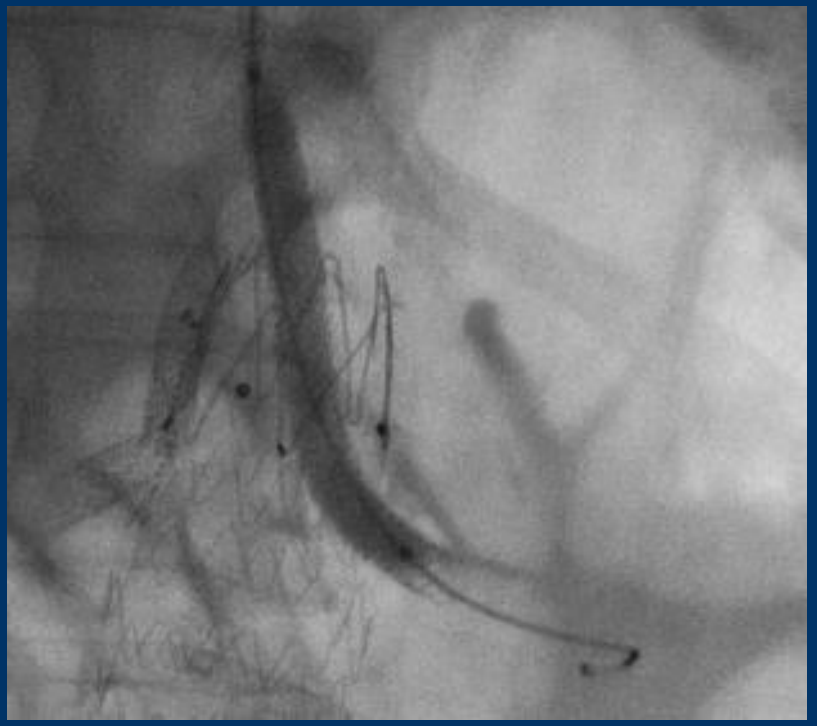


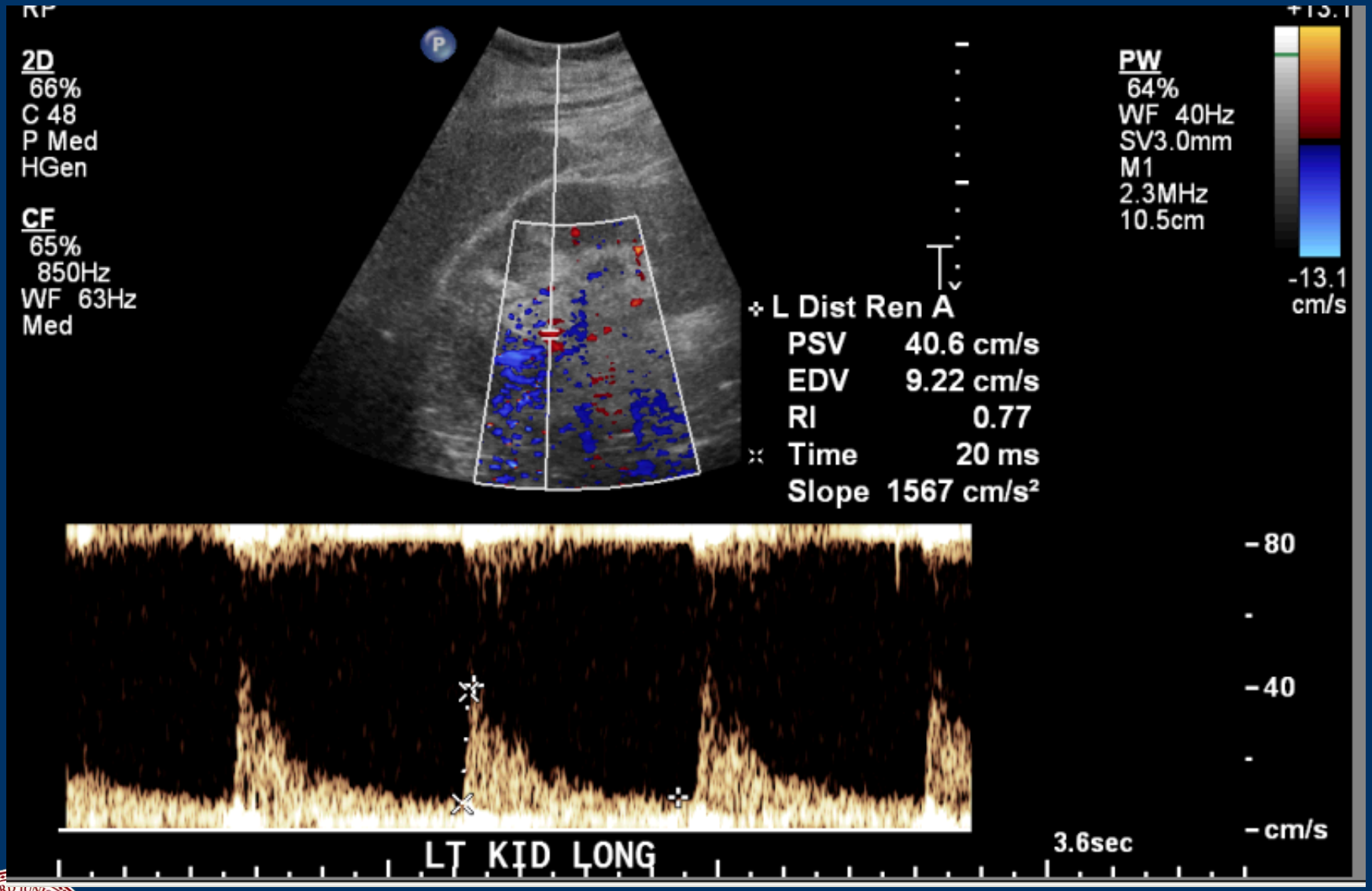

[H]



Re-angioplasty
Re-stented



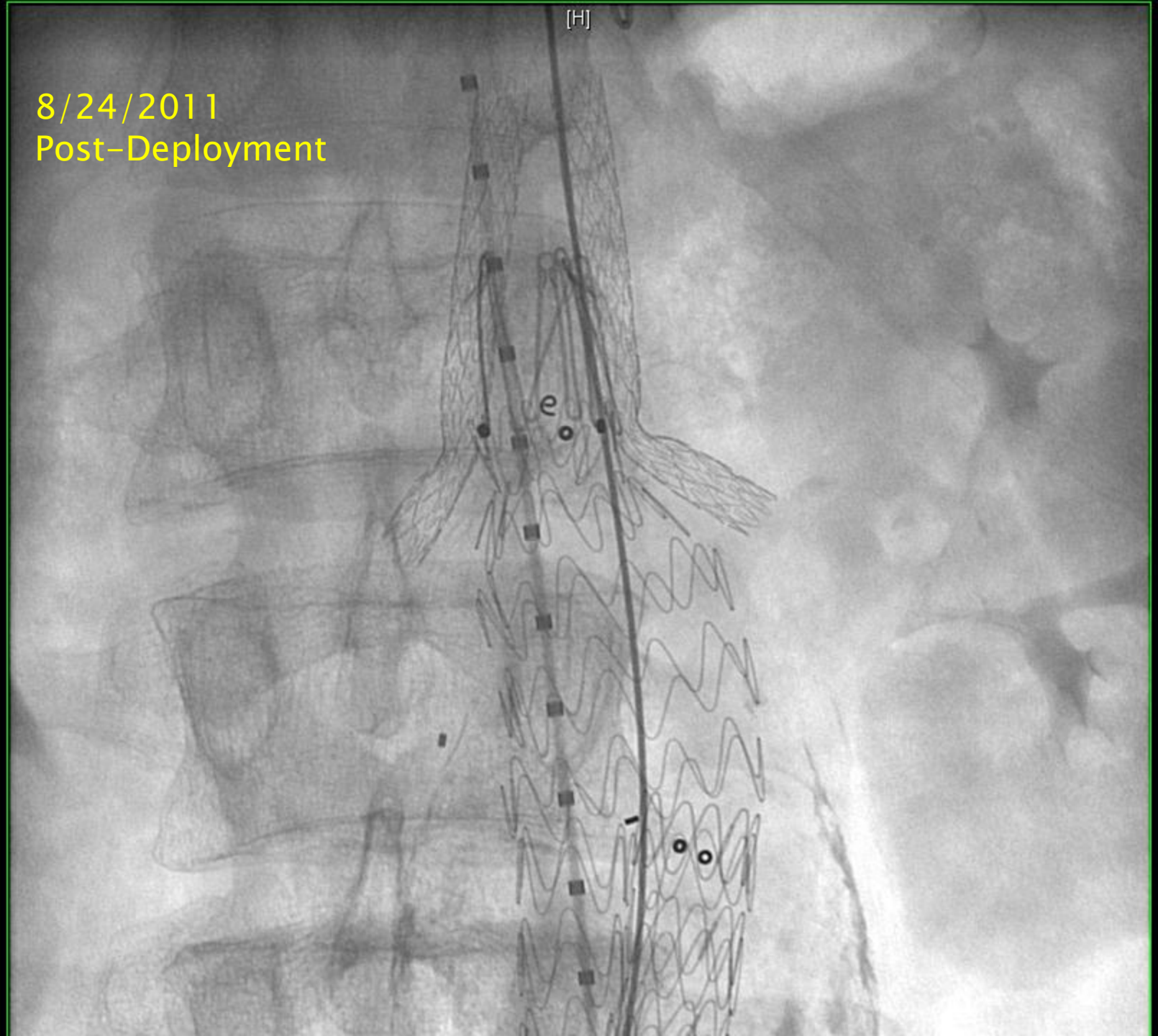


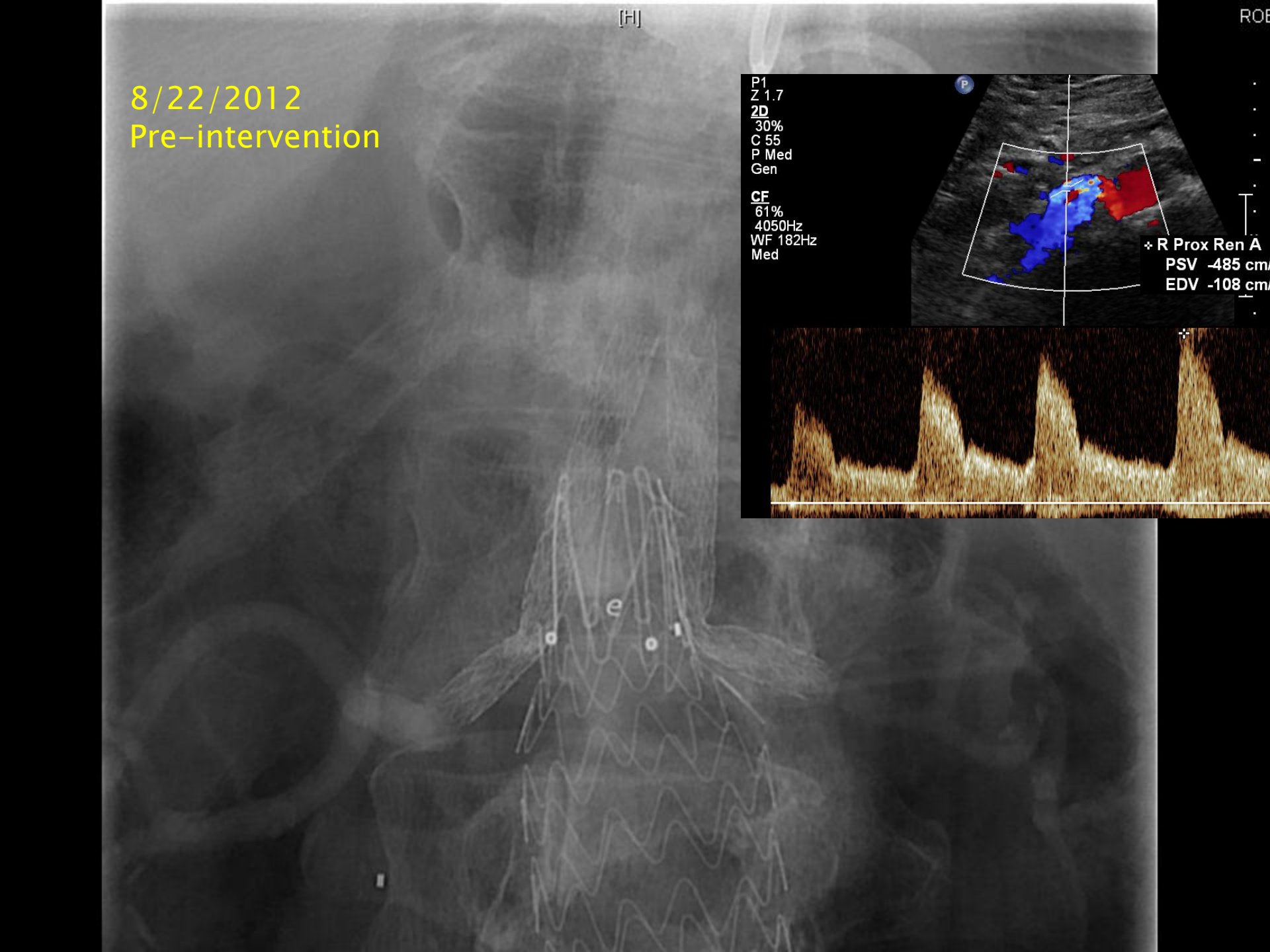

2D
66%
C 48
P Med
HGen
CF
65%
850Hz
WF 63Hz
Med
PW
64%
WF 40Hz
SV3.0mm
M1
2.3MHz
10.5cm
-13.1
cm/s
L Dist Ren A
PSV 40.6 cm/s
EDV 9.22 cm/s
RI 0.77
Time 20 ms
Slope 1567 cm/s²
80
40
cm/s
3.6sec
LT KID LONG

AAA Follow-Up

Preop Aneurysm size (mm)	65.1	51-95
Postop Sac Size (mm)	58.0	32-93
Sac regression at latest f/u (mm)	7.3	-1- -23
F/U time	16.5	1-36

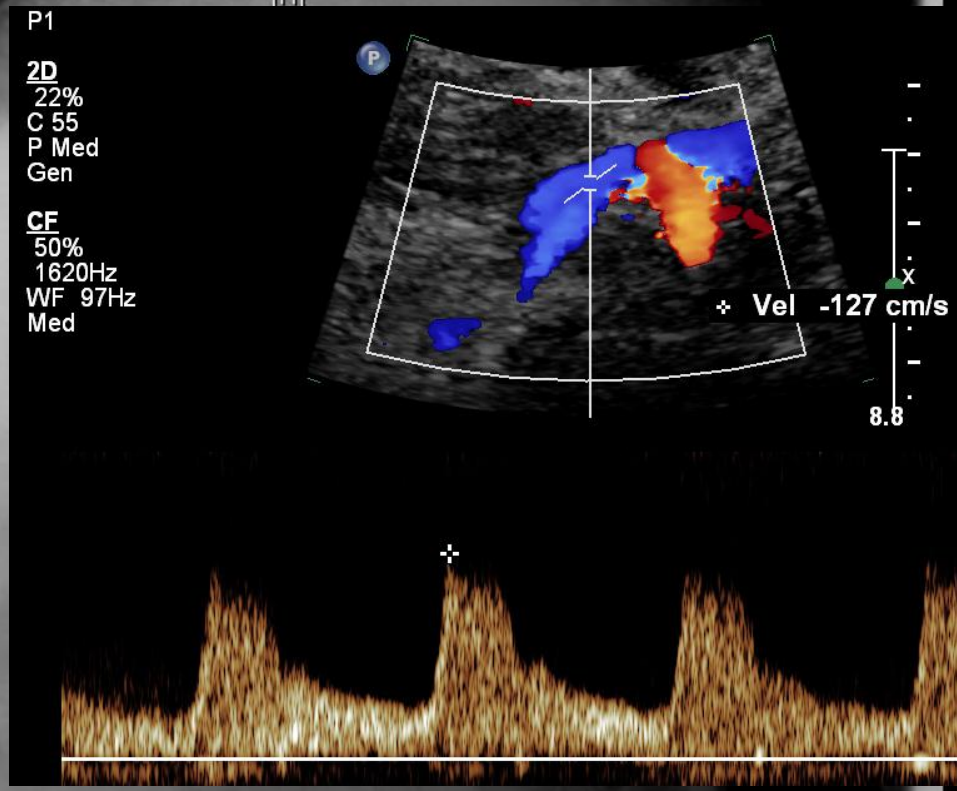
- 8 early endoleaks (18.6%)
  - 3 type I (2 resolved, 1 required additional snorkel and cuff)
  - 3 type II (no sac enlargement, all have resolved at 6 months)
  - 2 type III (cuff placement at 6 mo, resolved on 1 year followup)
- 5 secondary interventions (11.6%)
  - 2 patients with occluded renals
  - 1 type I endoleak
  - 1 type III endoleak
  - 1 kinked renal


8/24/2011
Post-Deployment


8/22/2012
Pre-intervention
P1
Z 1.7
2D
30%
C 55
P Med
Gen
CF
61%
4050Hz
WF 182Hz
Med
R Prox Ren A
PSV -485 cm/
EDV -108 cm/


8/22/2012
Left Renal
Snorkel
Angioplasty

8/22/2012
Left Renal
Snorkel
Post-Angioplasty



SOLICITATION: BAA-NHLBI-CSB-HV-2013-02-JS

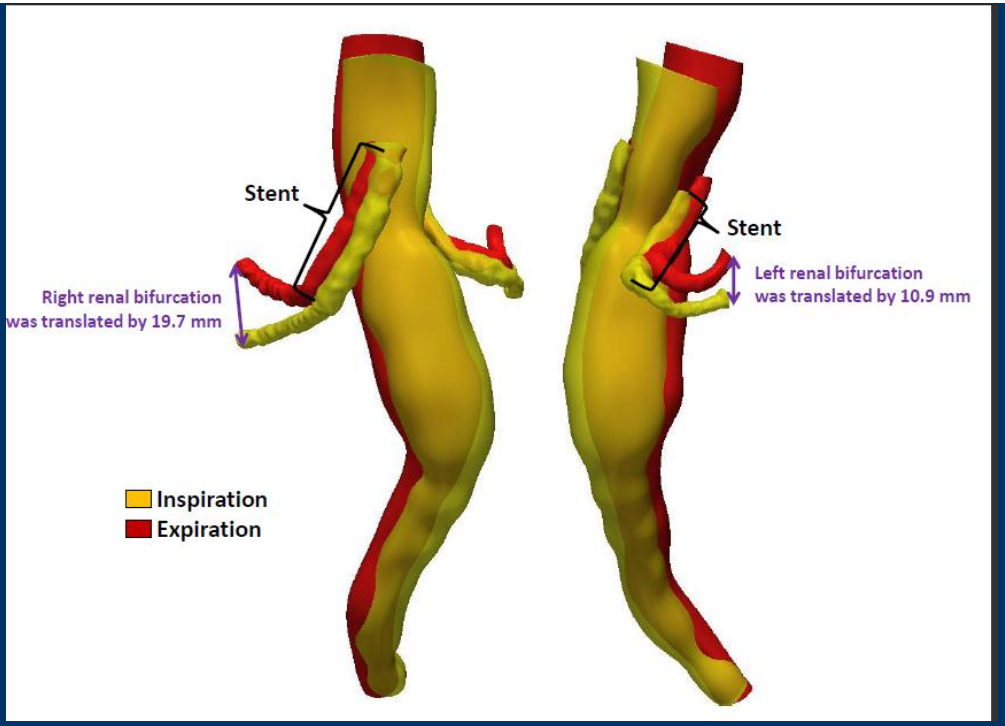
AMENDMENT: Three (3)

TITLE: Vascular Interventions/Innovations and Therapeutic Advances (VITA) Stage-A (Concept to Proof of Principle) & Stage B (Proof of Principle to IND or IDE)

EFFECTIVE DATE: July 5, 2012

ISSUED BY:

National Heart, Lung, and Blood Institute, NIH
Office of Acquisitions, CSB, DERA
6701 Rockledge Drive, Suite 6042, MSC 7902
Bethesda, Maryland 20892-7902



SS8. Chimney and Periscope Grafts: Mid-term Results in 77 Consecutive Patients with Complex Aortic Aneurysms

Mario Lachat[1], Felice Pecoraro[2], Thomas Pfammatter[1], Thomas Frauenfelder[1], Michael Glenck[1], Dominique Bettex[1], Dieter Mayer[1], Zoran Rancic[1], Frank J. Veith[3]

[1]Clinic for Cardiovascular Surgery, University Hospital Zurich, Zurich, Switzerland; [2]University of Palermo, Palermo, Italy; [3]New York University Medical Center, New York, NY.

OBJECTIVE require cov complex th ir orifices to treat

METHODS 2011. Aneu were treate sequentiall patients (1 ber atients en P.

RESULTS: branches. T ruptured ca patent. End underwent SD: 11.76). without EL ral for the ed r Ib) : 5.9; ructions

- **77 patients treated from 2002-2011**
  - **Mixed arch, thoraco, and juxtarenal**
  - **Mixed hybrid and all endovascular**
- **61 patients with Ch-EVAR for juxtarenal**
- **149 renovisceral ch-grafts**
  - **Technical success 99.4%**
  - **30 d mortality 7%**
  - **F/u time 12 months only 3 occlusions (98%)**
  - **25% type II endoleaks, 8% type I all repaired**

Current Literature

Table IV. Reported literature of snorkel/chimney endovascular aortic aneurysm repair for juxtarenal abdo aneurysms (*AAAs*)

Chimney/snorkel series for AAAs (first author)	*No.*	*Urgent (%)*	*Snorkels per patient (mean)*	*Covered stents (%)*	*Type I endoleak (%)*	*6-month patency (%)*
Ohrlander[17]	6	84	1.8	100	0	100
Hiramoto[18]	8	NA	1.0	12.5	12.5	100
Allaqaband[19]	2	0	1.0	50	0	100
Donas[20]	15	33	1.0	100	6.7	94
Bruen[21]	21	5	1.7	100	4.8	94
Coscas[22]	16	25	1.6	100	12.5	96
Current series	28	0	2.0	100	7.1	98

The chimney graft technique for preserving visceral vessels during endovascular treatment of aortic pathologies

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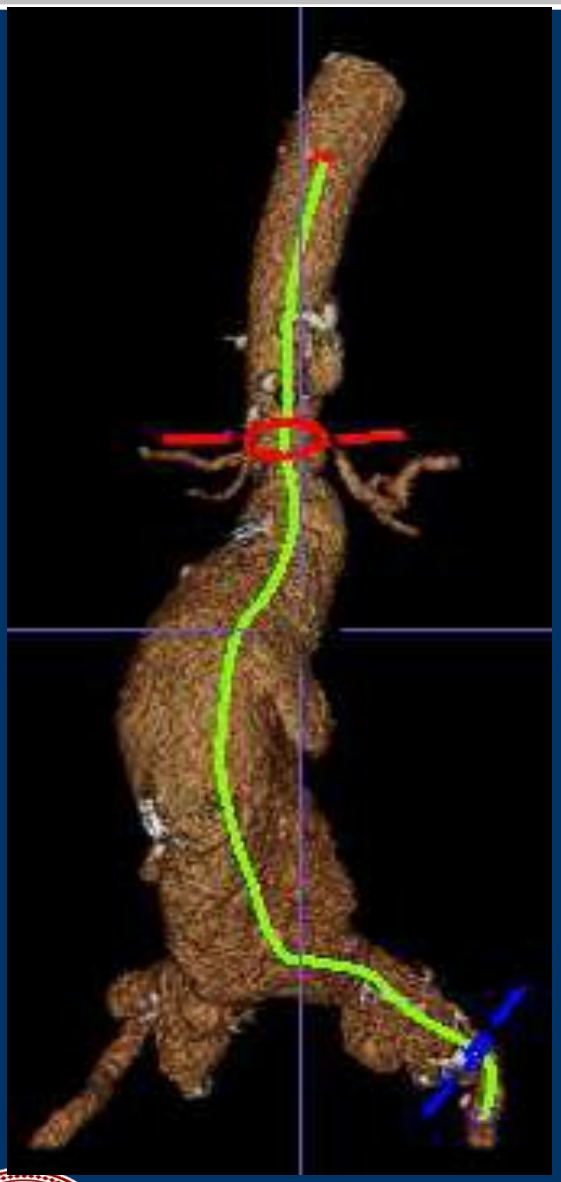
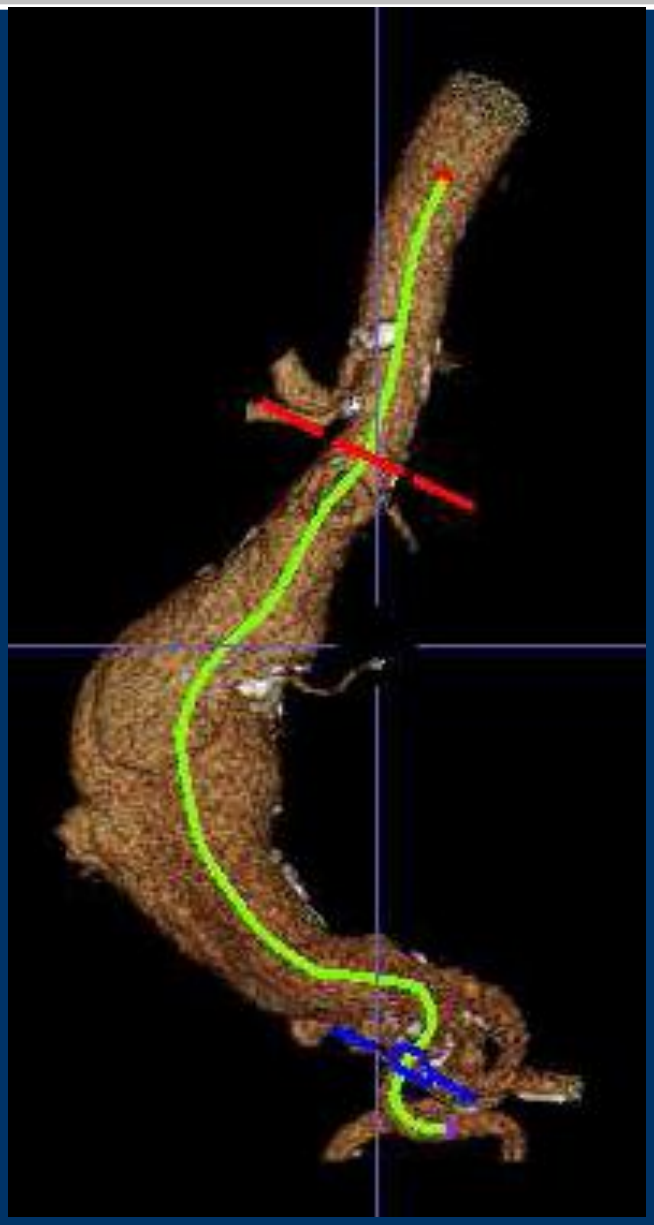
Author	*CG n/direction*	*CG patency*	*Endoleak type I*	*Morbidity*	*30-day mortality*	*follow-up (months)*
Our series (2011)[8,9]	3 proximal, caudal	100% (4/4)	1 type Ia endoleak; coiling and biological glue infusion via microcatheter	None	0	8.6
Coscas et al (2011)[10]	26 proximal	96.1% (25/26)	2 type Ia; 1 coiling, 1 spontaneously resolved	3 renal failure, 1 stroke	12.5% (2/16)	10.7
Richardson et al (2011)[11]	1 proximal	100% (1/1)	—	None	0	5
Ricci et al (2011)[12]	2 proximal	100% (2/2)	—	None	0	1
Bruen et al (2011)[13]	37 proximal	97.3% (36/37)	1 type Ia; spontaneously resolved	5 renal function impairment, 4 access arterial thrombosis, 3 access site pseudoaneurysm, 3 ileus >4 days, 2 stroke	4.8% (1/21)	6
Schlosser et al (2011)[14]	2 proximal	100% (2/2)	Type Ia; the whole chimney procedure was repeated	None	0	6
Ketelsen et al (2011)[15]	1 caudal	100% (1/1)	—	None	0	6
Donas et al (2010)[16]	15 proximal	93.3% (14/15)	—	1 myocardial infarction	0	6.7
Lachat et al (2010)[17]	2 proximal 2 caudal	100% (4/4)	Low flow type Ib; spontaneously resolved	None	0	6
D'Utra et al (2010)[18]	1 proximal	100% (1/1)	1 type ; Amplatzer occluder device deployment	None	0	6
Rancic et al (2010)[19]	4 caudal	100% (4/4)	Low-flow type Ib; spontaneously resolved	ND	0	6
Allaqaband et al (2010)[20]	3 proximal	100% (3/3)	—	None	0	6
Hiramoto et al (2009)[6]	1	100% (8/8)	3 type I; 1 Palmaz, 2 spontaneously resolved	ND	12.5% (1/8)	12.5
Ohrlander et al (2008)[5]	11 proximal	100% (11/11)	—	1 renal failure, 1 asymptomatic compression of a renal CG	0	3.3
Larzon et al (2008)[21]	15 proximal	100% (15/15)	type Ib; embolization of IIA stenting EIA	1 myocardial infarction, 2 renal failure, 1 RP, 1 access fem. thrombosis	0	17
	126 proximal 8 caudal	97.8% (131/13)	13 14.0%		4.1% (4/93)	9.0 ± 1.0

Summary

- Sn-EVAR technique provides acceptable short-term results for elective juxtarenal AAA repair in high risk patients as well as bailout or emergent circumstances
  - 97.7% technical success in branch preservation
  - 96.5% primary patency in follow-up
  - Acceptable morbidity and mortality at 1 year follow-up
  - Protection from aneurysm rupture
  - Secondary interventions are feasible

The $1,000,000 Question





Conclusions

- Sn-EVAR is an excellent alternative to branched/ fenestrated systems until more readily available or we move towards off-the-shelf designs
  - Relies on skills/techniques/devices we are comfortable with
  - Patency and freedom from endoleak comparable to f-EVAR
  - Does not require customization or modification of devices
  - Potentially more flexible in configurations
  - Can be used in urgent cases and bailout scenarios

Thank you!

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