

Allen D. Hamdan MD

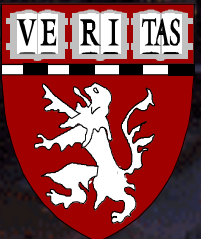
KDIGO Central & Peripheral Arterial Diseases Conference

Aortic Aneurysms and Dissections

Director of Operation- DOS

Beth Israel Deaconess Medical Center

Associate Professor of Surgery Harvard Medical School



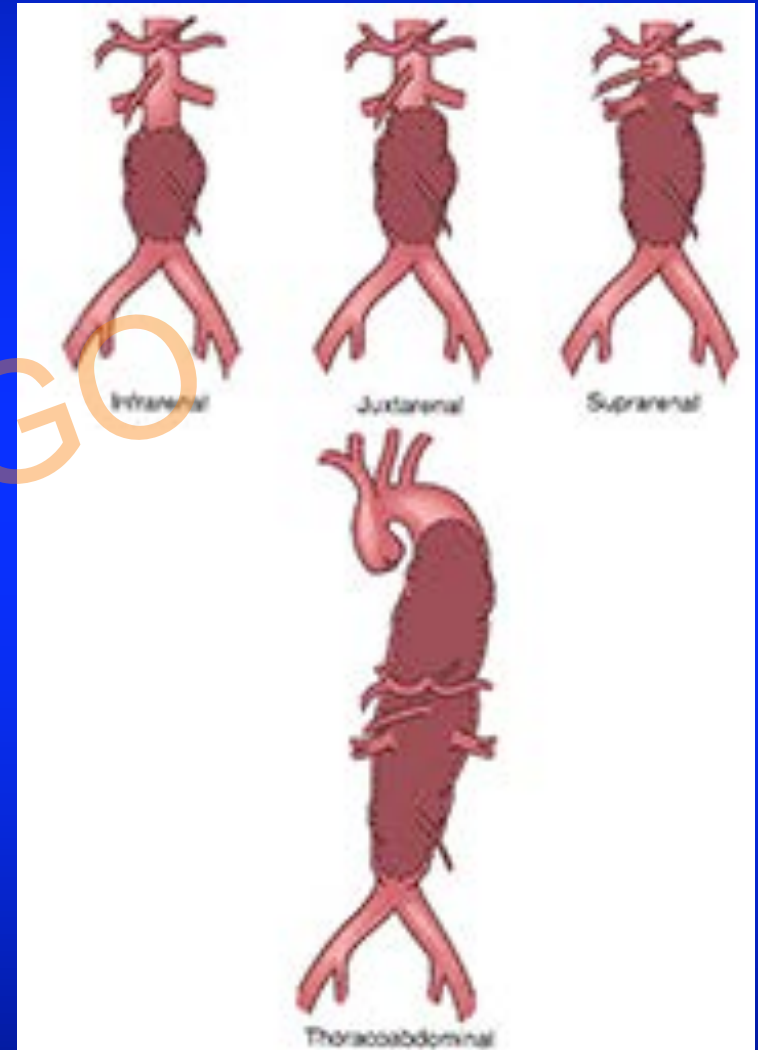
Disclosures

- Co-Owner and Medical Director



Aneurysms

- Definitions and classifications
 - Infrarenal >95% AAA
 - Usually ~1.5-2cm proximal segment of normal aorta below renal arteries
 - Juxtarenal
 - Extend to level Renal Arteries
 - Suprarenal
 - Extend to level SMA or Celiac



Aneurysms: Principles of Management

- Risk is small for diameter <5cm
 - Annual risk of 5% or less
- Risk increases to 10% for 6cm
- Risk 20% for 7cm
- 5 –year rupture risk of 50% for 6cm
- 5 –year rupture risk of 100% for 7cm

ESTIMATED ANNUAL RUPTURE RISK

AAA DIAMETER (cm) RUPTURE RISK (%/y)

<4	0
4-5	0.5-5
5-6	3-15
6-7	10-20
7-8	20-40
>8	30-50

AAA, abdominal aortic aneurysm.

From Brewster DC, Cronenwett JL, Hallett JW Jr., et al. Guidelines for the treatment of abdominal aortic aneurysms.



Aneurysms: Principles of Management



- Mortality of operative repair
 - Depends on status of aneurysm (symptomatic, asymptomatic, ruptured) and method of repair (open vs endovascular)
 - Mortality of open repair of intact aneurysms in U.S. 4.2%
 - 2.2% age 50-59
 - 9.2% age >80
 - Mortality significantly > in women (6.1 vs 3.7%)
 - Mortality from Endovascular repair significantly lower
 - DREAM Trial 1.2% vs 4.6%
 - EVAR Trial 1.7% vs 4.7%



Aneurysms: Operative Indications

- All patients with symptomatic or ruptured AAA
 - Unless they have underlying medical condition that precludes long-term survival
- Repair of intact/asymptomatic AAA complex and needs to be tailored to individual patient
 - AAA size, life expectancy, comorbidities, preference, and anatomic considerations

INDEPENDENT RISK FACTORS FOR OPERATIVE MORTALITY AFTER ELECTIVE ABDOMINAL AORTIC ANEURYSM REPAIR

RISK FACTOR	ODDS RATIO
Creatinine >1.8 mg/dL	3.3
Congestive heart failure	2.3
ECG ischemia	2.2
Pulmonary dysfunction	1.9
Older age (per decade)	1.5
Female gender	1.5

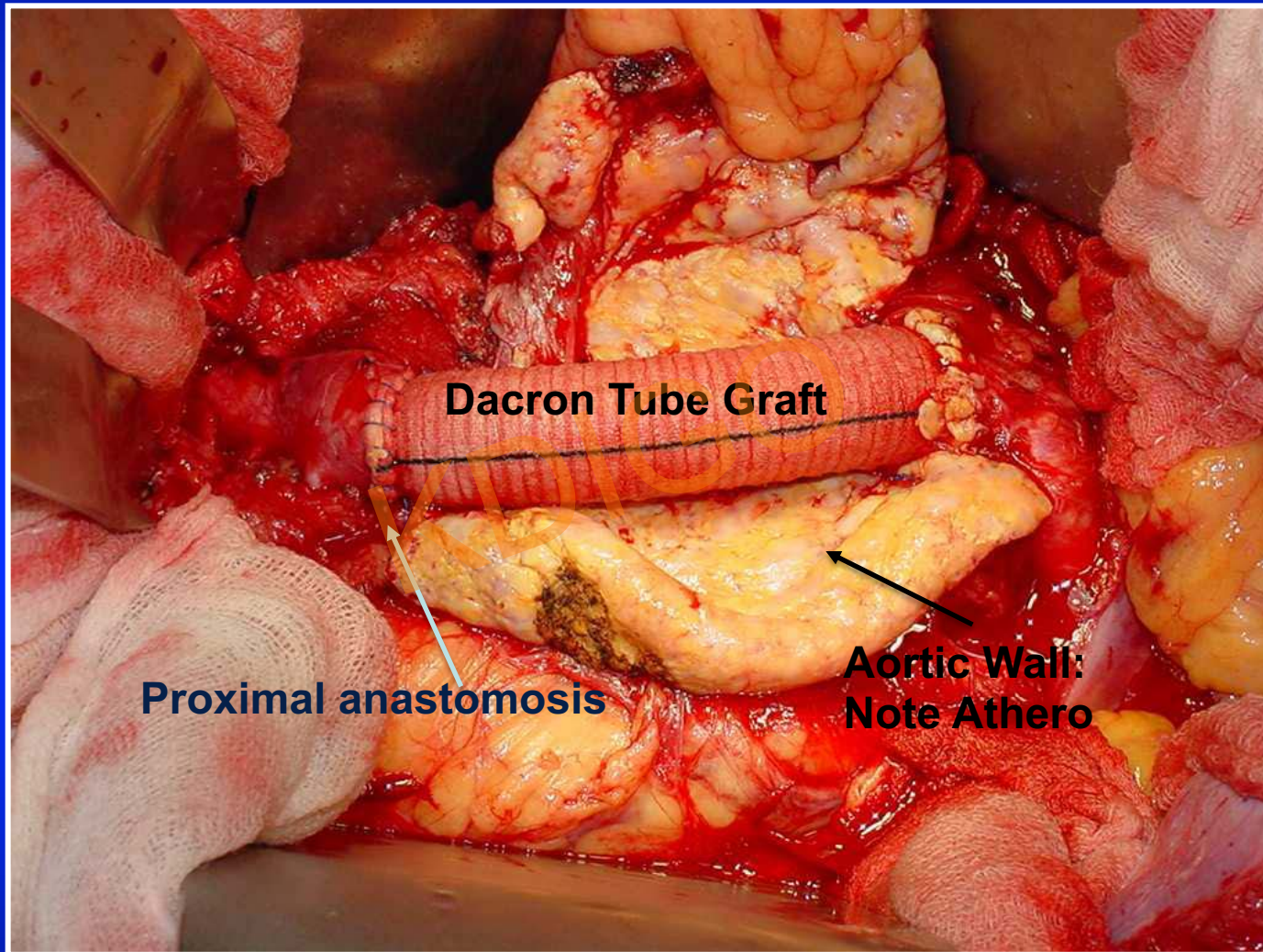


Aneurysms: Repair

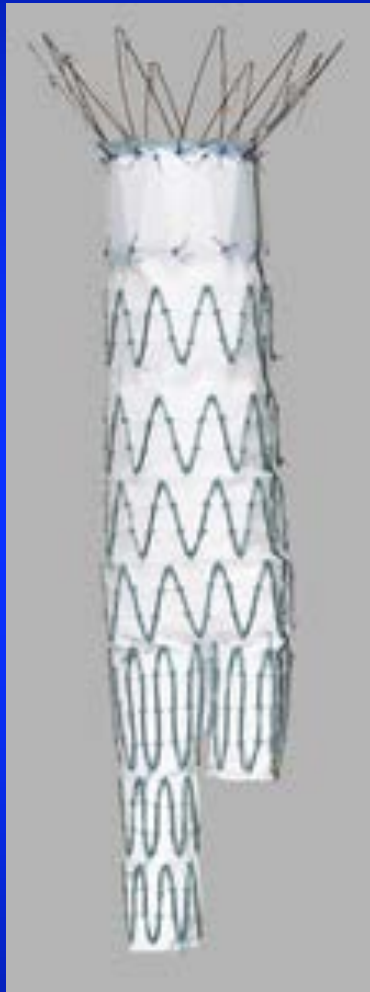
- Open vs Endovascular
 - Anatomic configuration of aorta, aneurysm, and access vessels
 - Number of available devices and specific characteristics constantly evolving
 - Infraarenal landing zone: $\geq 15\text{mm}$ in length; $\leq 26\text{-}32\text{mm}$ in diameter
 - Proximal neck angle ≤ 45 degrees
 - Infraarenal neck relatively free of thrombus and calcification
 - Iliac artery should have landing zone $\geq 20\text{mm}$ with diameter $7\text{-}20\text{mm}$
 - Facilitates anchoring graft and passing device into aorta



Aneurysms: Open Repair



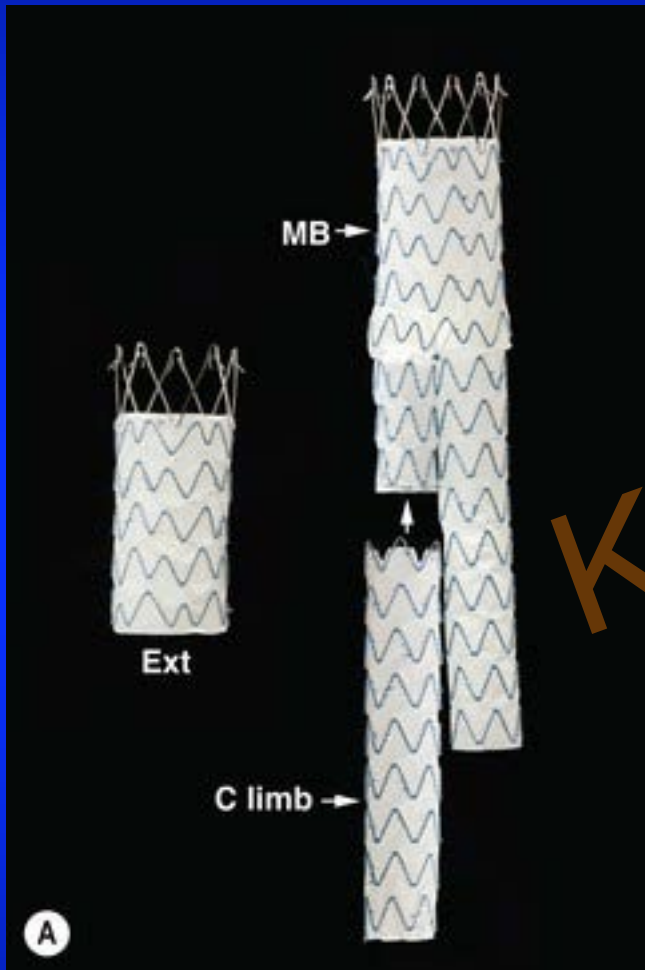
Aneurysms: Endovascular Repair



- Main Device
 - The main body device for the abdominal aorta is usually bifurcated
 - The grafts rely primarily on outward tension in the proximal graft to maintain position
 - Although may include barbs or a suprarenal uncovered extension



Aneurysms: Endovascular Repair



- Device / Limb Extensions
 - One or more extension devices may be required to provide a complete seal
 - Following deployment of main device and any necessary extensions an aortogram is performed
 - This ensures that the graft has completely excluded the aneurysm from the circulation



CKD

- One of the risk factors most associated with worse outcomes after repair of both intact and ruptured AAA
- EVAR accounts for majority of intact and will soon be also in rupture
- This makes all open repairs more complicated and more likely to require suprarenal clamp



Current Approach-Intact

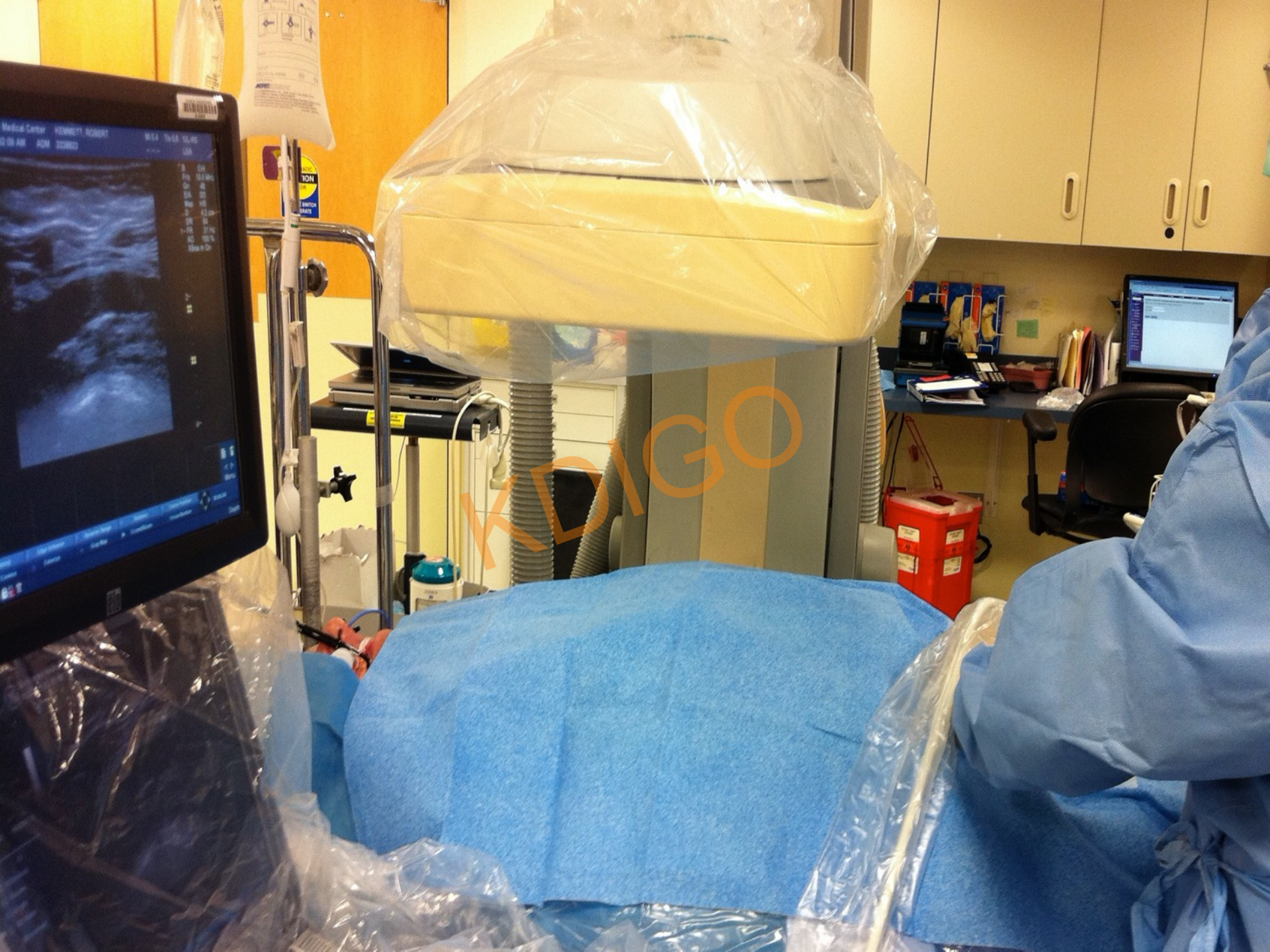
- Use combination of anatomy and patient wishes/characteristics to decide on EVAR, FEVAR, PMEG, Open
- Pendulum swinging back to Open in younger patients or those outside IFU
- Still about 70% being done with EVAR

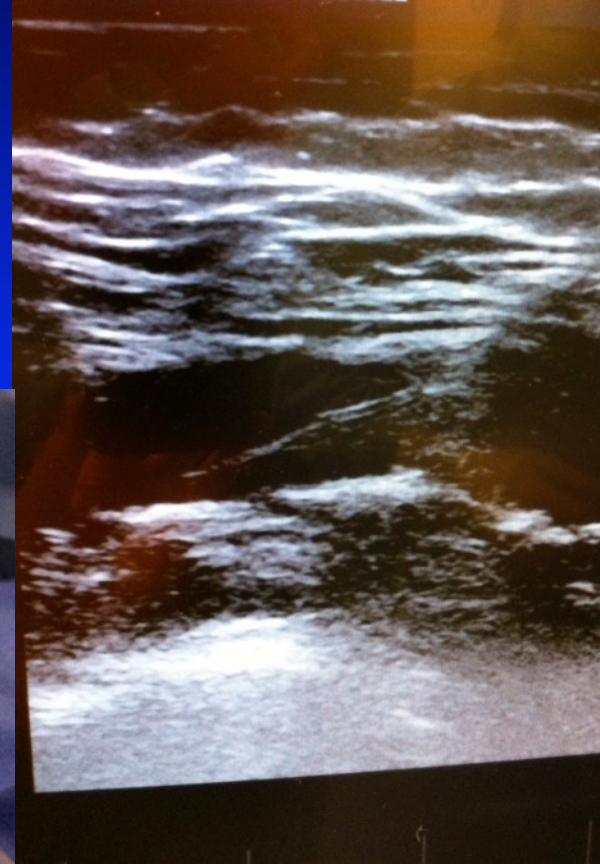
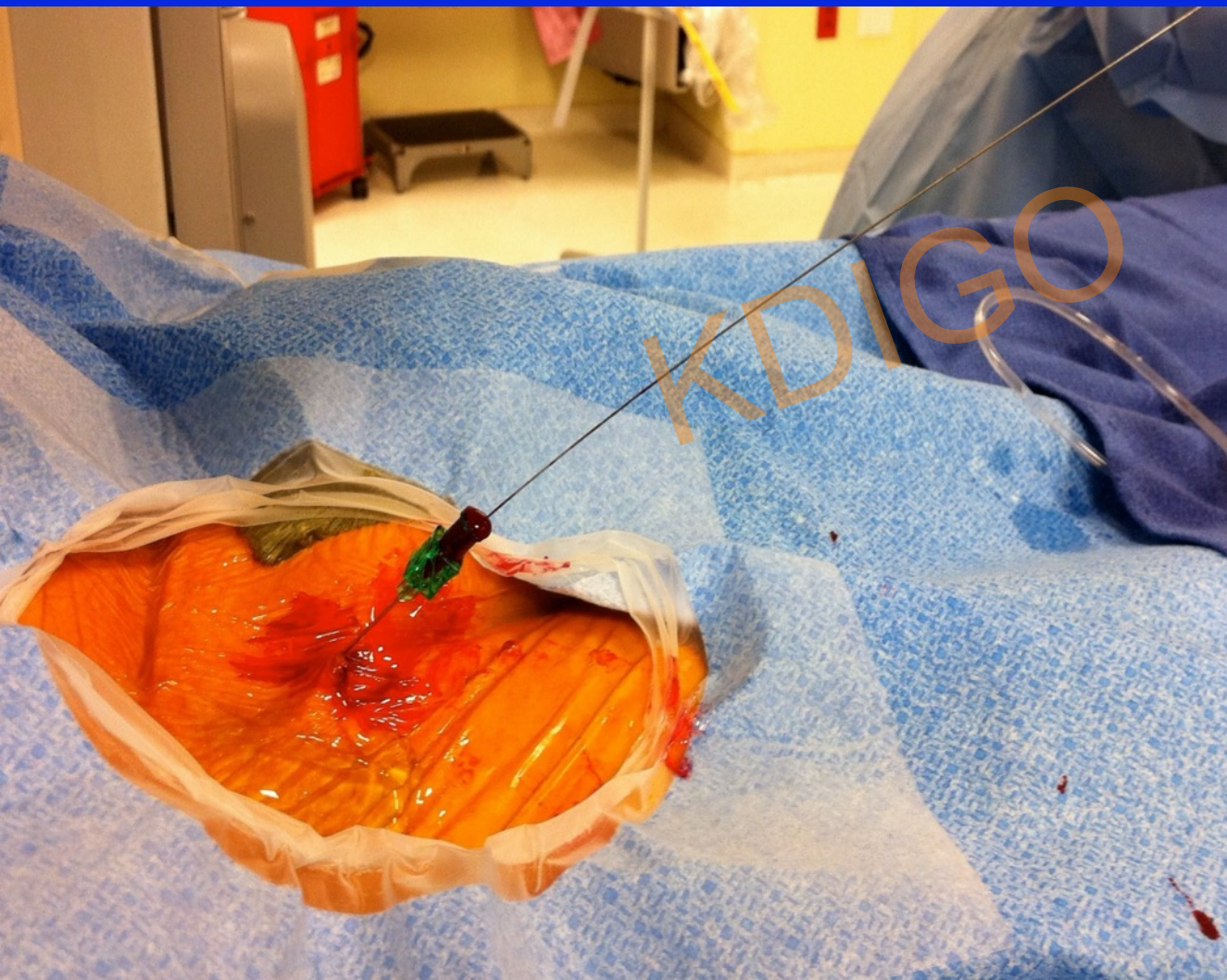


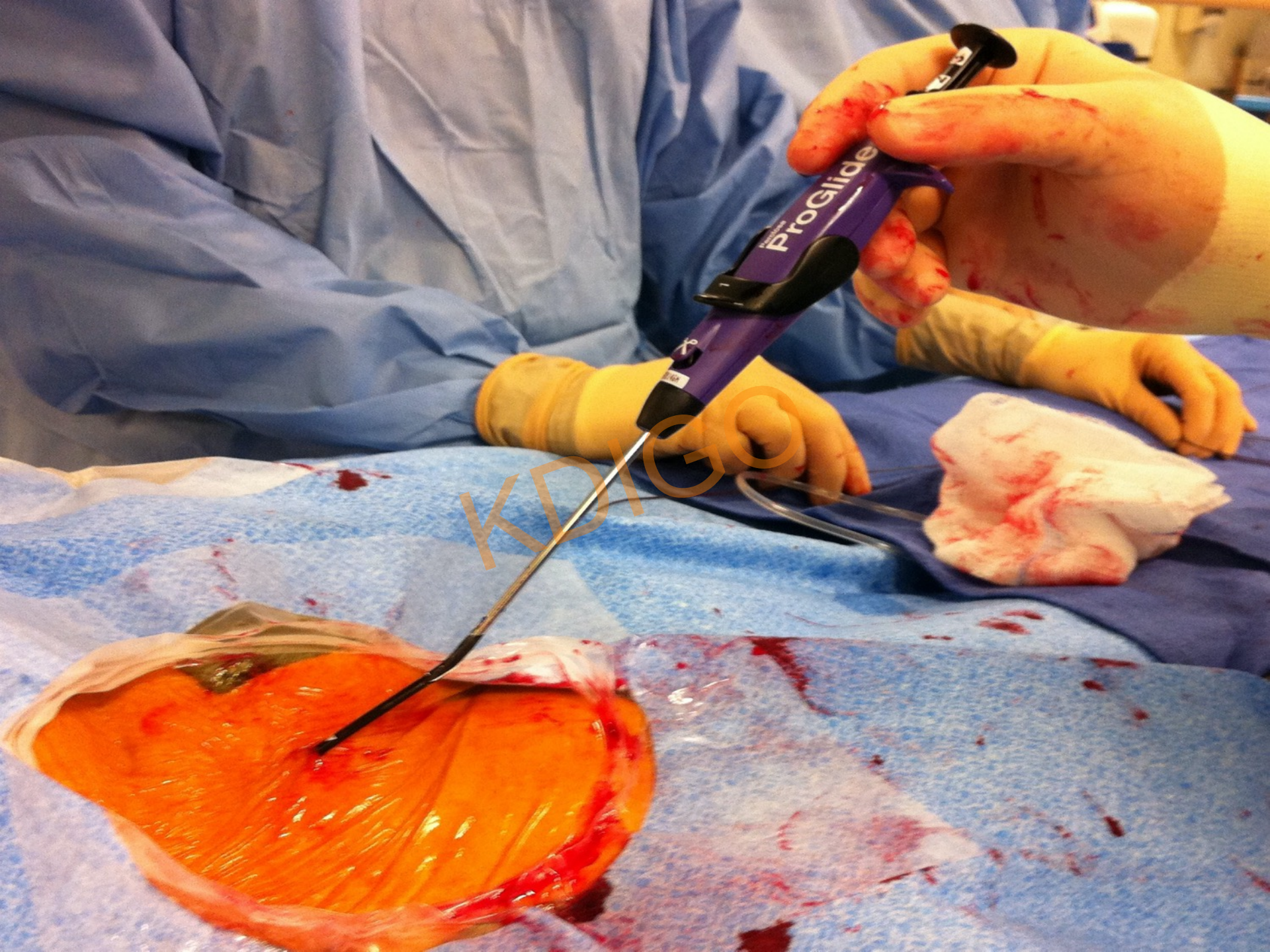
Current Approach-Rupture

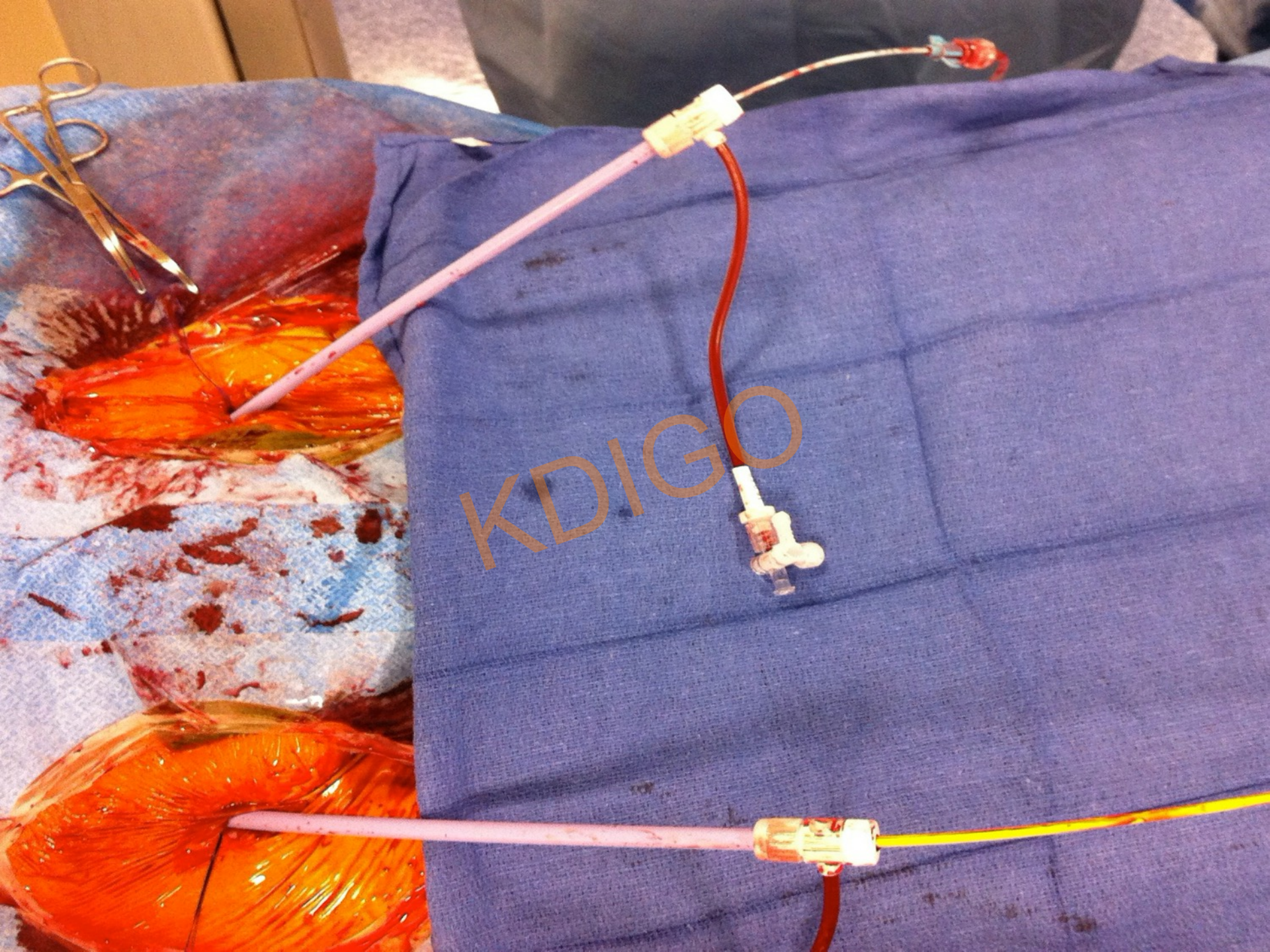
- Code Aorta
- CTA in ER and direct to room with team in place
- Percutaneous balloon placement under local
- If not at all anatomically feasible- balloon in place for clamp
- Even if borderline- EVAR

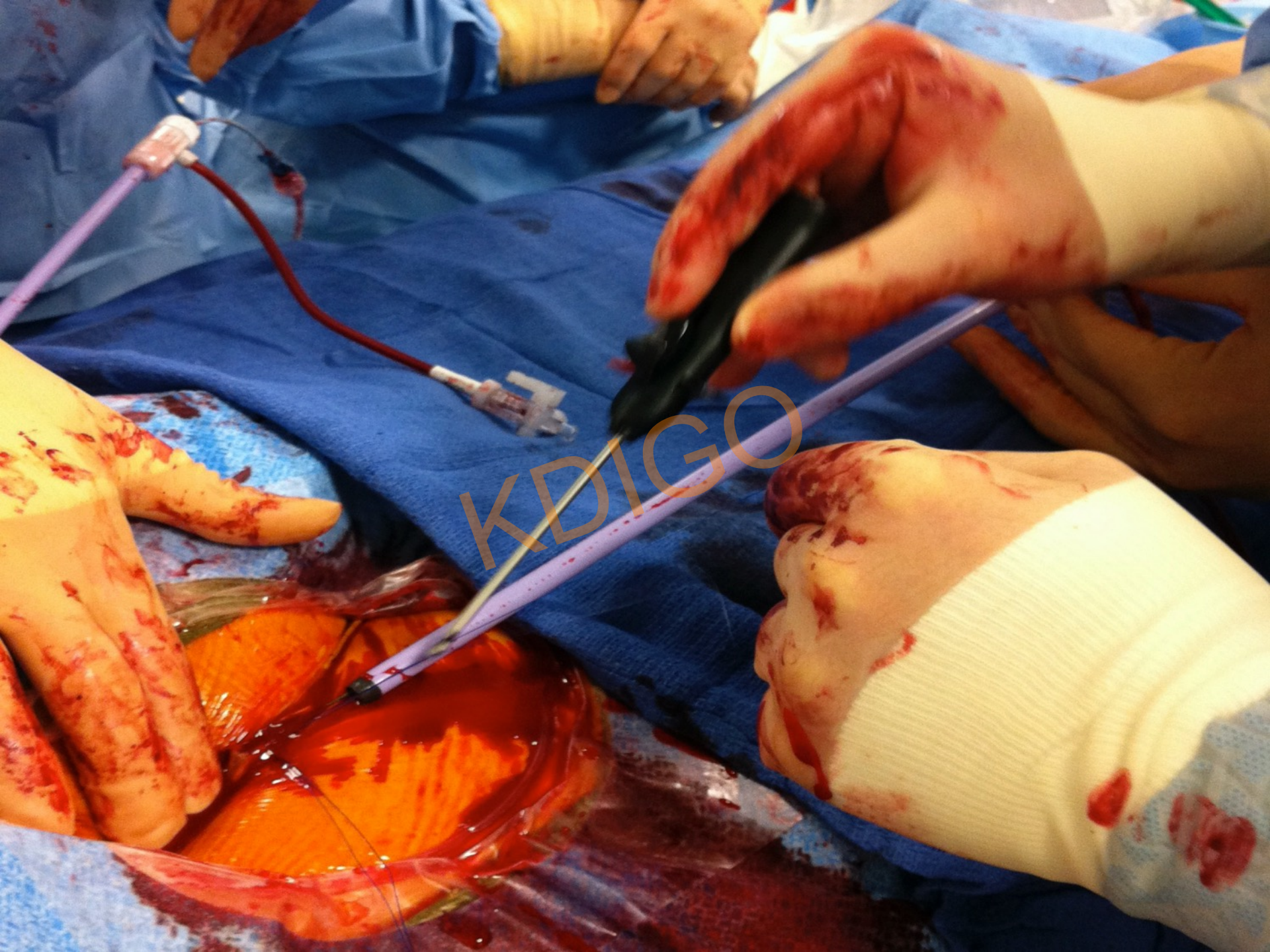


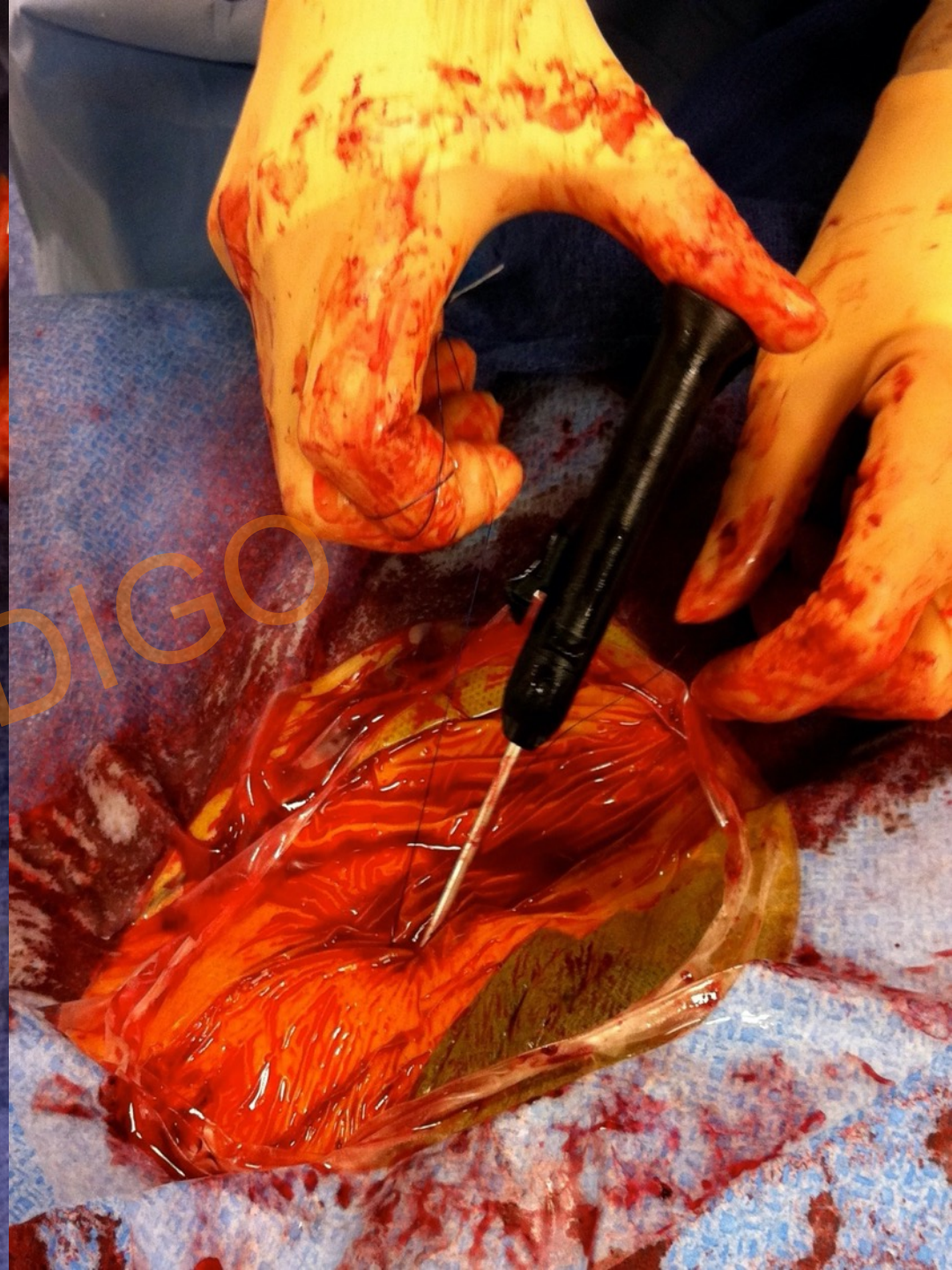
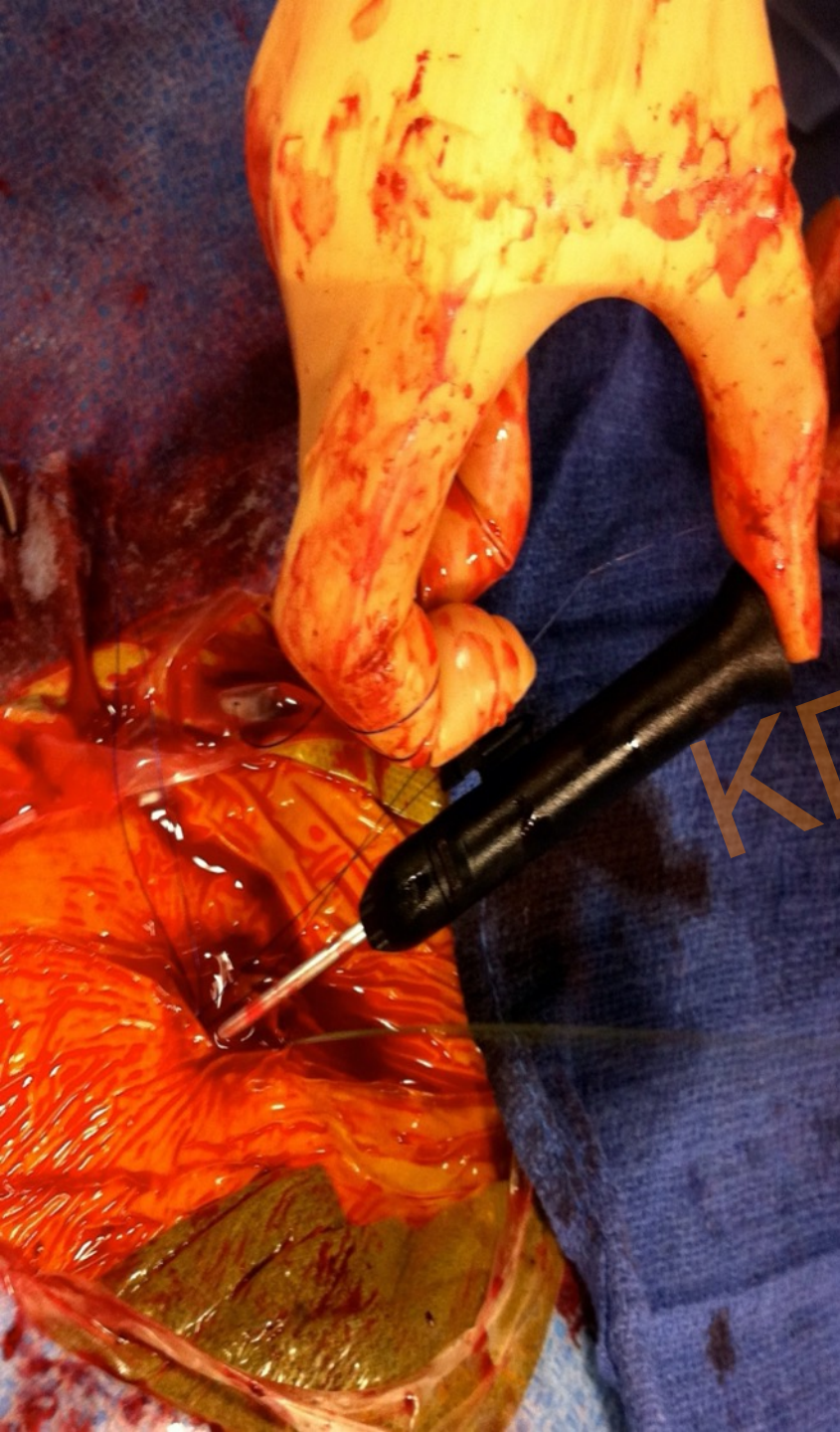














- 87 y.o. male transferred with ruptured 10cm AAA
- - h/o low back pain over past 3 months
- - worsened over past 24 hours
- - hypotensive
- PMH: Parkinson's, HTN, GERD, BPH, Chol
- PSH: neg
- Meds: Norvasc, Losartan, Sinemet, ASA, Simvastatin, Paxil, Omeprazole



Se:3
Im:65
SL:-151.3mm

[A]

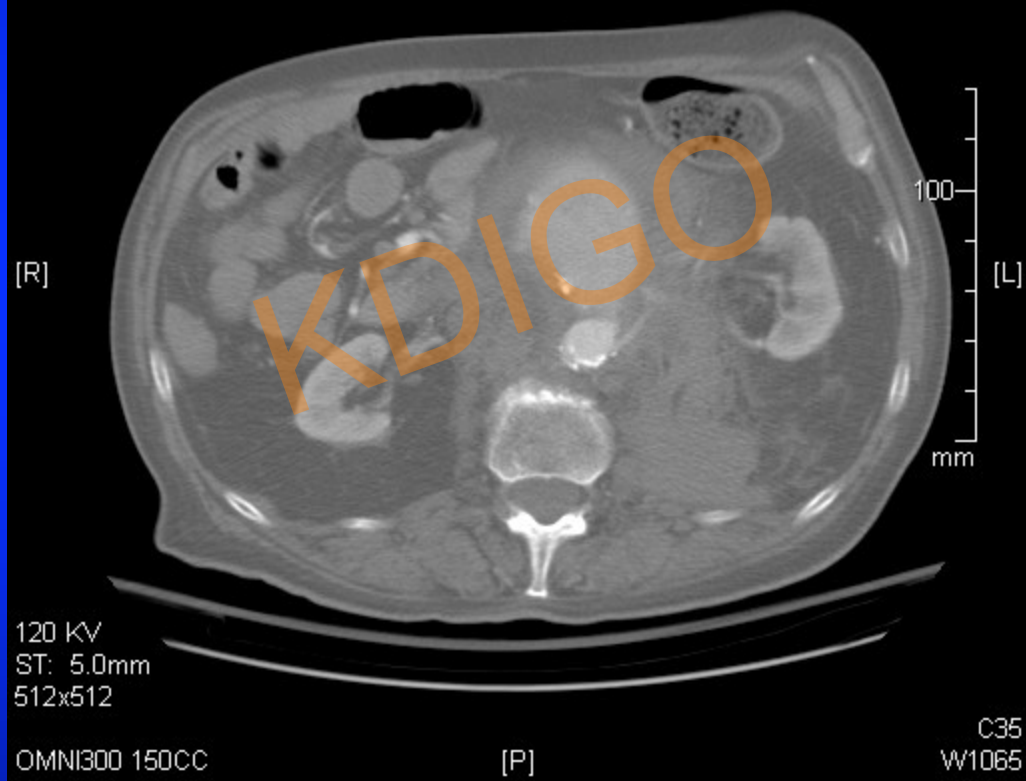
L.ELLIOT
Study Date:11/5/2008
Study Time:1:08:19 PM
MRN:
DOB:
Sex:



Se:3
Im:68
SL:-166.3mm

[A]

L.ELLIOT
Study Date:11/5/2008
Study Time:1:08:19 PM
MRN:
DOB:
Sex:



Se:3
Im:75
SL:-201.3mm

[A]

L.ELLIOT
Study Date:11/5/2008
Study Time:1:08:19 PM
MRN:
DOB:
Sex:



- Transported by ambulance directly to Endovascular OR
- Vitals: P 80's, BP 110/70
- Awake and alert c/o abdominal and back pain
- Abdomen distended, tender in all 4 quadrants
- Hct 35, Creatinine 1.5



LATEZ, ELLIOT
2302583
POMPOSELLI, FRANK, DR.
BIDMC

SUBTRACTION

11/5/2008 2:17:52 PM

R200811051403258

1
17
1/

0°
0°
FD 48 cm



KDIGO

0:00
2:67
15:00:44

1
1-17



LATEZ, ELLIOT
2302583
POMPOSELLI, FRANK, , DR
BIDMC

AS 18

CAUD 0°

FD 37 cm

SUBTRACTION

11/5/2008 2:17:52 PM

R200811051403258

5
1
1/



KDIGO

0:00
2:00
15:10:44

5
1-8..13



LATEZ, ELLIOT
2302583
POMPOSELLI, FRANK, , DR
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Filter: Enhance 3

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6
6
15/34

KDIGO

29.70 RAO
0.10 CRA



LATEZ, ELLIOT
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POMPOSELLI, FRANK, , DR
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7
7
129/131

KDIGO

24.10 LAO
0.08 CAU



LATEZ, ELLIOT
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COMPOSPELL, FRANK, , DR
BIDMC

SUBTRACTION

11/5/2008 2:17:52 PM
R200811051403258
8
1
1/

RAO 2°
CRAN 0°
FD 48 cm



KDIGO

0:00
4:83
15:40:18

8
1-8..30





Future

- Physician modified
- Cut holes in pre-made graft for viscerals and renals
- Place stent grafts in branch vessels
- Still percutaneous



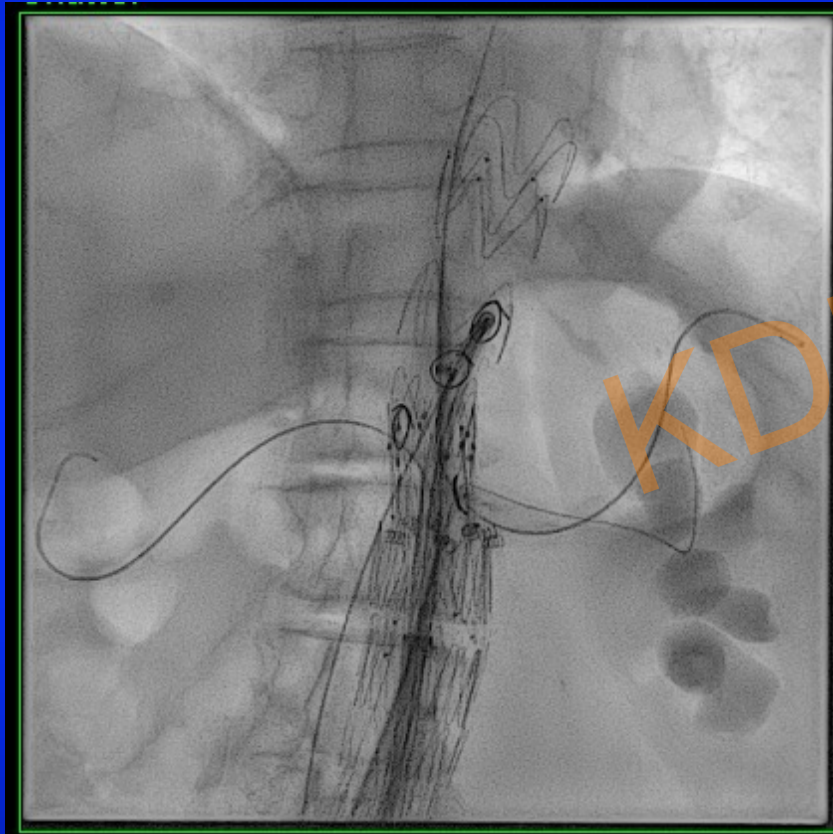
Future

- Off the shelf branched devices
- Use in ruptures even in “bad” anatomy

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PMEG



Suprarenal Fixation

- **Comparison of Endovascular Stent Grafts for Abdominal Aortic Aneurysm Repair in Medicare Beneficiaries.**
- [Buck DB](#)¹, [Soden PA](#)¹, [Deery SE](#)¹, [Zettervall SL](#)¹, [Ultee KHJ](#)¹, [Landon BE](#)², [O'Malley AJ](#)³, [Schermerhorn ML](#)⁴
- The suprarenal fixation patients had higher rates of perioperative mortality (1.7% vs. 1.3%, $P < 0.01$), renal failure (6.0% vs. 4.7%, $P < 0.001$), and mesenteric ischemia (0.7% vs. 0.4%, $P < 0.01$) and longer length of stay (3.4 days vs. 3.0 days, $P < 0.001$) compared with patients with infrarenal fixation



Is there a way to prevent AKI?

- Clamp Time?
- Mannitol
- Lasix
- Volume
- Cold perfusion

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Predictors and Consequence of Renal Dysfunction

- 2635 open juxtarenal repairs, of which 621 (24%) were complicated by AKI. The majority of these (20% of the overall cohort) were AKI alone, but 2.2% required temporary RRT and an additional 1.7% were permanently dialysis dependent.
- Factors independently associated with postoperative renal dysfunction included renal-visceral ischemia time (per minute: odds ratio [OR], 1.01 [1.01-1.02]; $P < .001$), clamp site (above both renal arteries: OR, 1.4 [1.1-1.8; $P = .02$]; supraceliac: OR, 1.7 [1.1-2.5; $P = .01$]), and preoperative renal function (glomerular filtration rate [GFR] of 45-60 mL/min/1.73 m²: OR, 1.8 [1.3-2.5; $P < .001$]; GFR of 30-45 mL/min/1.73 m²: OR, 1.9 [1.2-2.8; $P = .003$]; GFR of <30 mL/min/1.73 m²: OR, 6.2 [3.1-12.2; $P < .001$]).
- Factors associated with postoperative renal dysfunction and the subsequent impact on survival after open juxtarenal abdominal aortic aneurysm repair.
- [O'Donnell TFX¹](#), [Boitano LT¹](#), [Deery SE¹](#), [Clouse WD¹](#), [Siracuse JJ²](#), [Schmerhorn ML³](#), [Green R⁴](#), [Takayama H⁴](#), [Patel VI⁵](#).



Predictors and Consequence of Renal Dysfunction

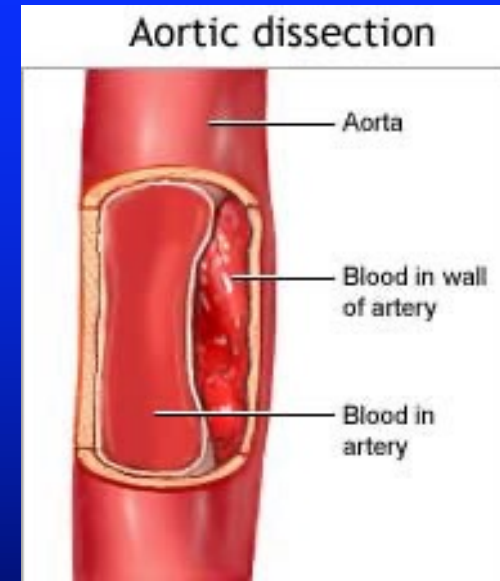
- When renal-visceral ischemia time was categorized, there was no difference in risk of postoperative renal dysfunction until >25 minutes, but risk increased stepwise thereafter (25-39 minutes: OR, 1.6 [1.2-2.1; $P = .004$]; 40+ minutes: OR, 2.6 [1.9-3.5; $P < .001$]).
- Neither mannitol nor the use of cold renal perfusion was associated with renal complications or mortality in the overall cohort
- Postoperative renal dysfunction was associated with higher adjusted perioperative mortality (AKI: OR, 2.6 [1.4-5.0; $P < .01$]; RRT: OR, 10.5 [4.0-27.6; $P < .001$]) and significantly higher risk of long-term mortality (AKI: hazard ratio, 1.5 [1.0-2.1; $P = .049$]; RRT: hazard ratio, 5.8 [3.2-10.3; $P < .001$]).



Aortic Dissection

- Primary event is a tear in the aortic intima.
- Cystic medial degeneration present
- Blood passes into the aortic media through the tear, separating the intima from the media and creating a false lumen.

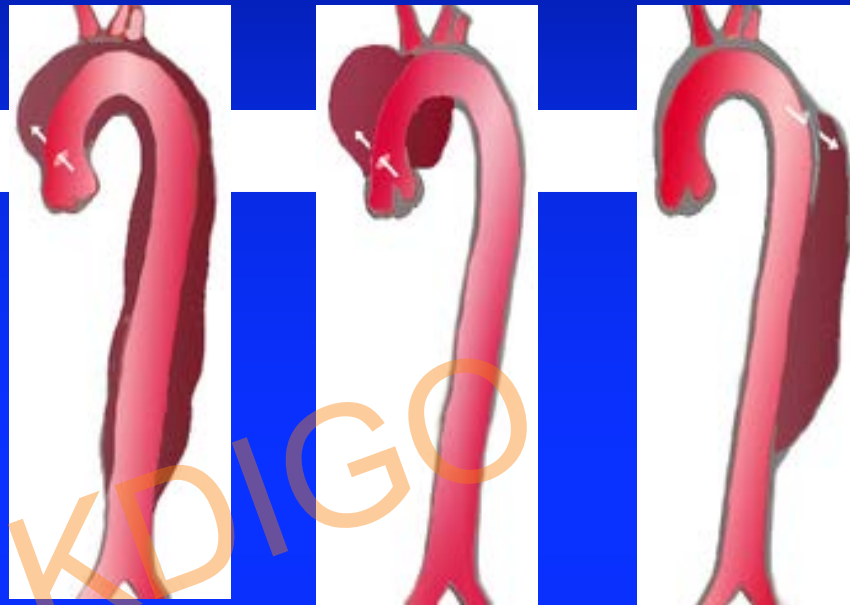
- **Unclear whether the initiating event is a primary rupture of the intima with secondary dissection of the media, or hemorrhage within the media and subsequent rupture of the intima**



Mechanism

- Propagation of the dissection can occur both distally and proximally to the initial tear
- Complications of dissection:
 - ischemia (coronary, cerebral, spinal, or visceral)
 - aortic regurgitation
 - Pericardial effusion/cardiac tamponade





Percentage	60%	10-15%	25-30%
Type	DeBakey I	DeBakey II	DeBakey III
	Stanford A		Stanford B
	Proximal		Distal
Classification of aortic dissection			

Incidence

- Ranges from 2-10 per 100,000 person-years
- Evidence of dissection is found in 1-3% of all autopsies

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Who's affected?

- International Registry of Acute Aortic Dissection (IRAD)
 - 65% men
 - Mean age 63 yrs
 - Women tend to present at older ages
- Highest incidence in patients 50 to 70 years old.
- Male-to-female ratio 2:1
- Half of dissections in females before age 40 occur during pregnancy



Mortality

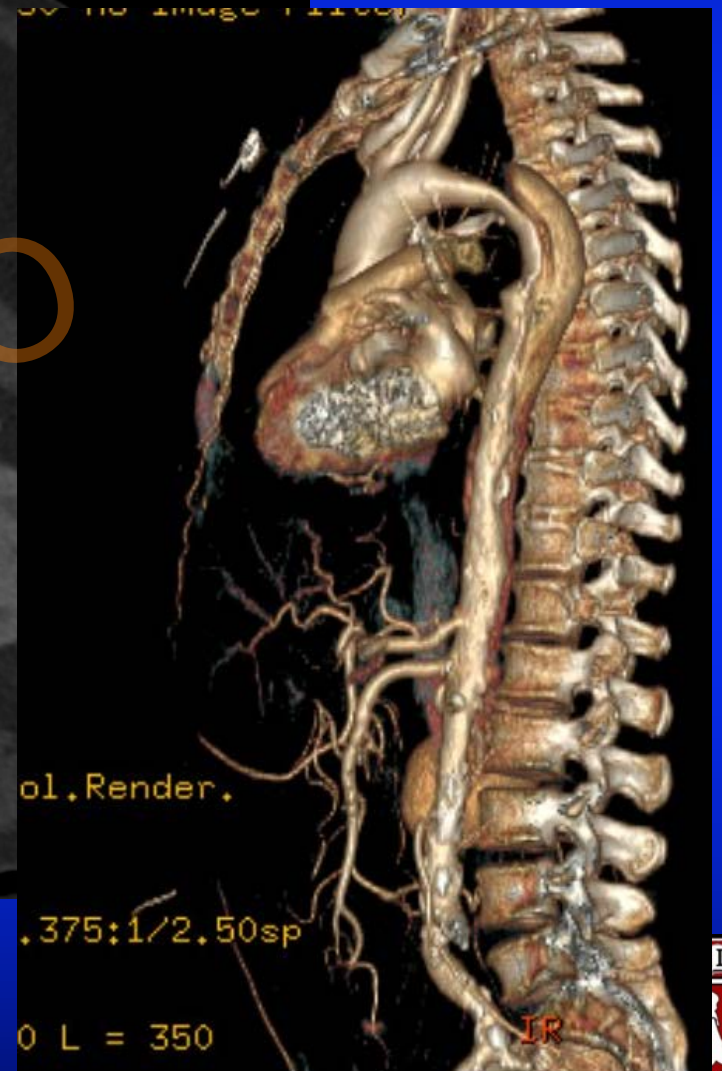
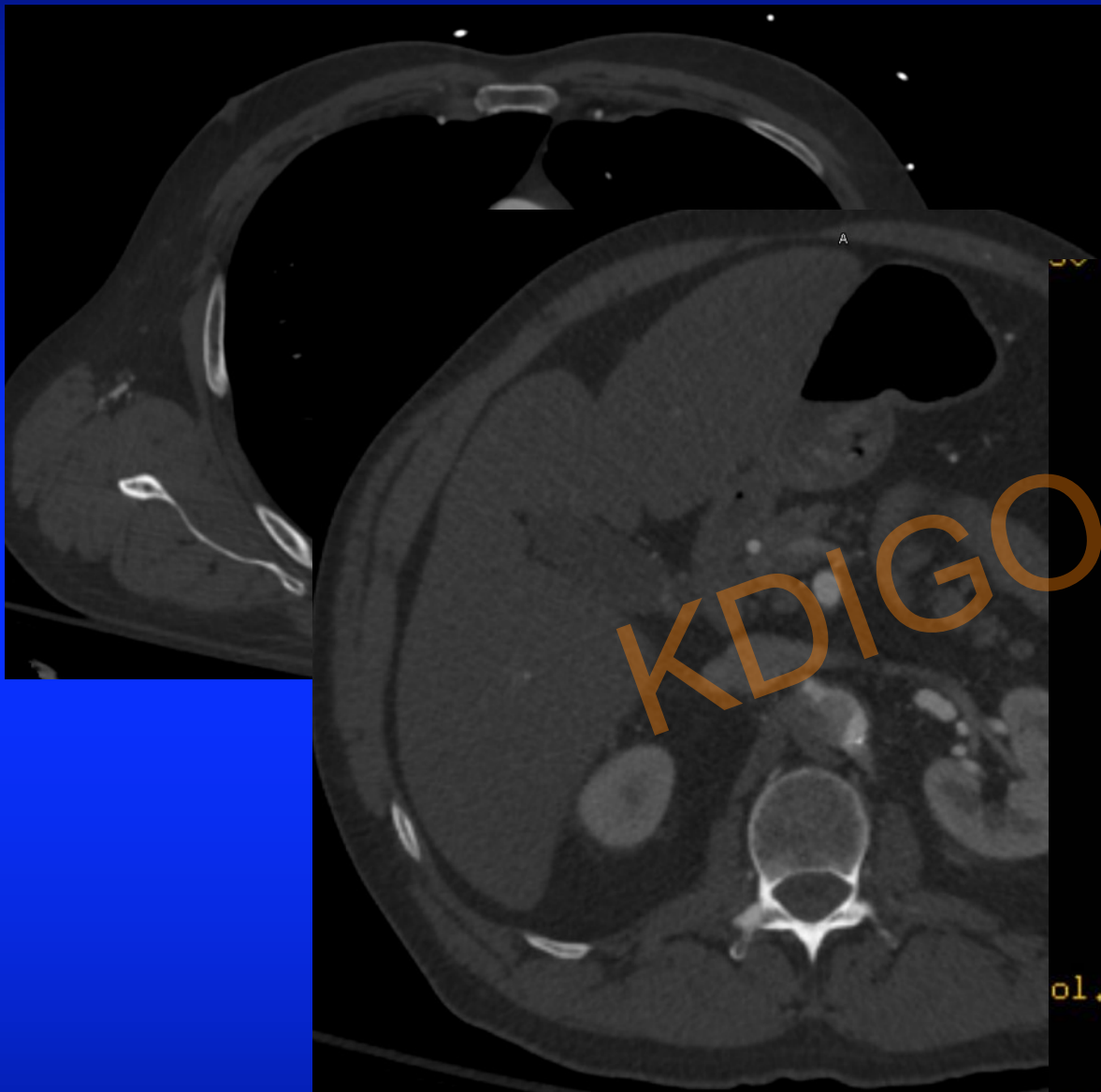
- When left untreated...
 - 33% of patients die within the first 24 hours
 - 50% die within 48 hours
 - ~75% die within 2-weeks



AKI in Dissection

- This can occur through several mechanisms
- Significant decrease in size of true lumen causing decreased perfusion of all visceral vessels as well as lower extremity
- Fenestration with direct change in lumen of renal arteries, can be false or true
- LE ischemia and CPK elevation





Treating AKI in Dissection (past)

- Fenestration – scary
- Basically intentionally creating hole between false and true and than using balloon or “scissor” to tear
- Stents into renal but can make worse



Treating AKI in Dissection (Current)

- Stent graft at tear
- Risk of paralysis based on how much Aorta is “covered”
- Use of adjunctive bare metal stents
- Idea is to preserve and expand the true lumen



Decreasing Malperfusion

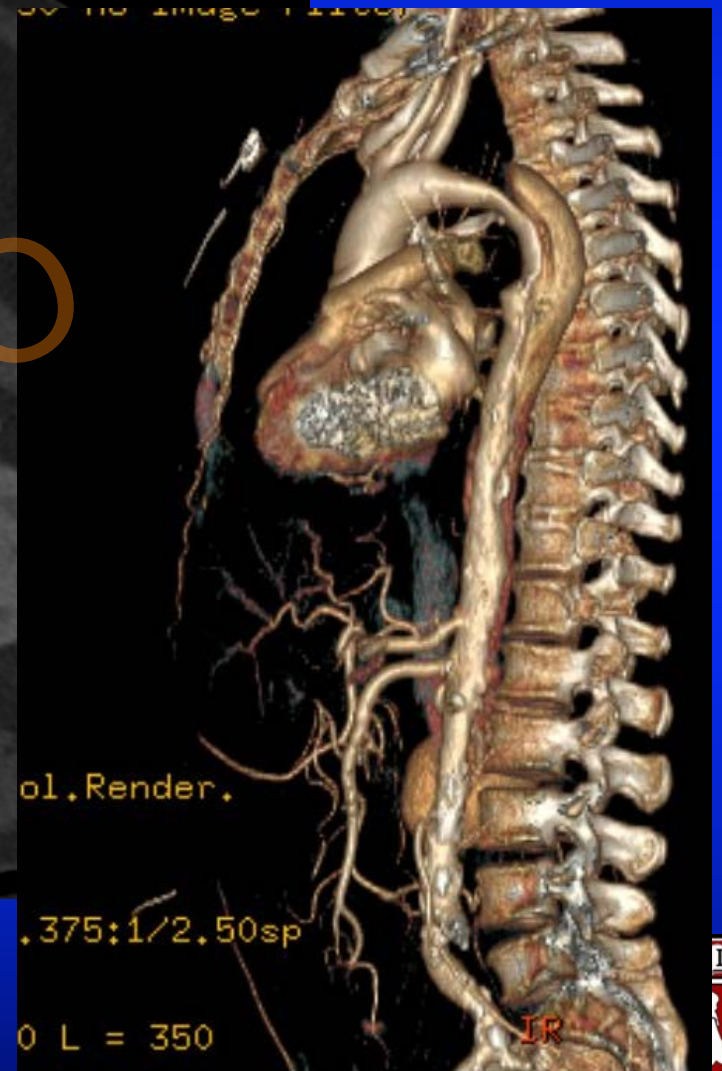
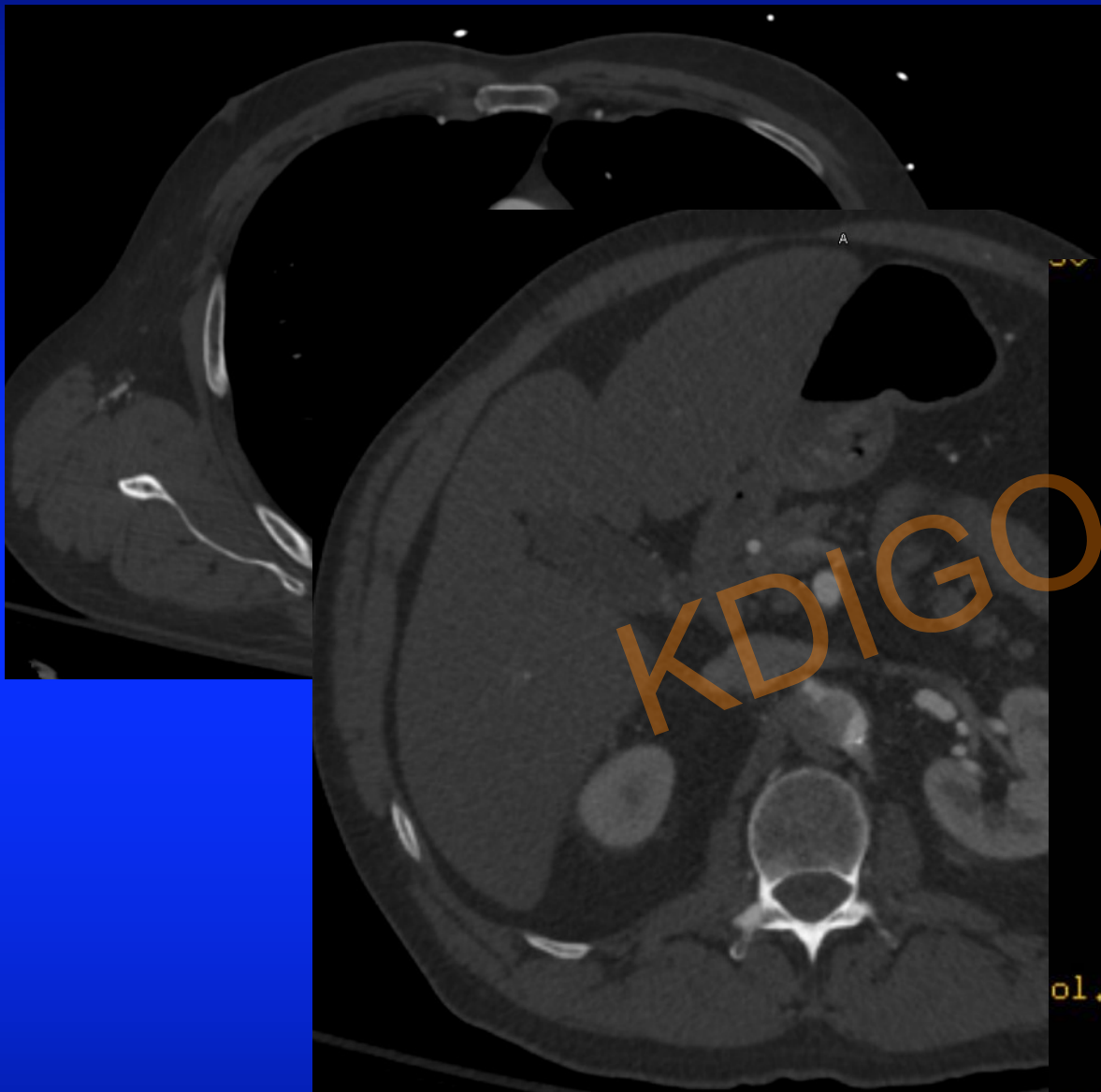
- **STABLE II clinical trial on endovascular treatment of acute, complicated type B aortic dissection with a composite device design.**
- [Lombardi JV¹](#), [Gleason TG²](#), [Panneton JM³](#), [Starnes BW⁴](#), [Dake MD⁵](#), [Haulon S⁶](#), [Mossop PJ⁷](#), [Seale MM⁸](#), [Zhou Q⁸](#); [STABLE II Investigators](#).
- In patients with acute type B aortic dissection in the setting of branch vessel malperfusion, the use of a composite device with proximal stent grafts and distal bare aortic stent appeared to result in lower malperfusion-related mortality than the use of stent grafts alone. The 30-day rates of morbidity and secondary interventions were similar between the groups.

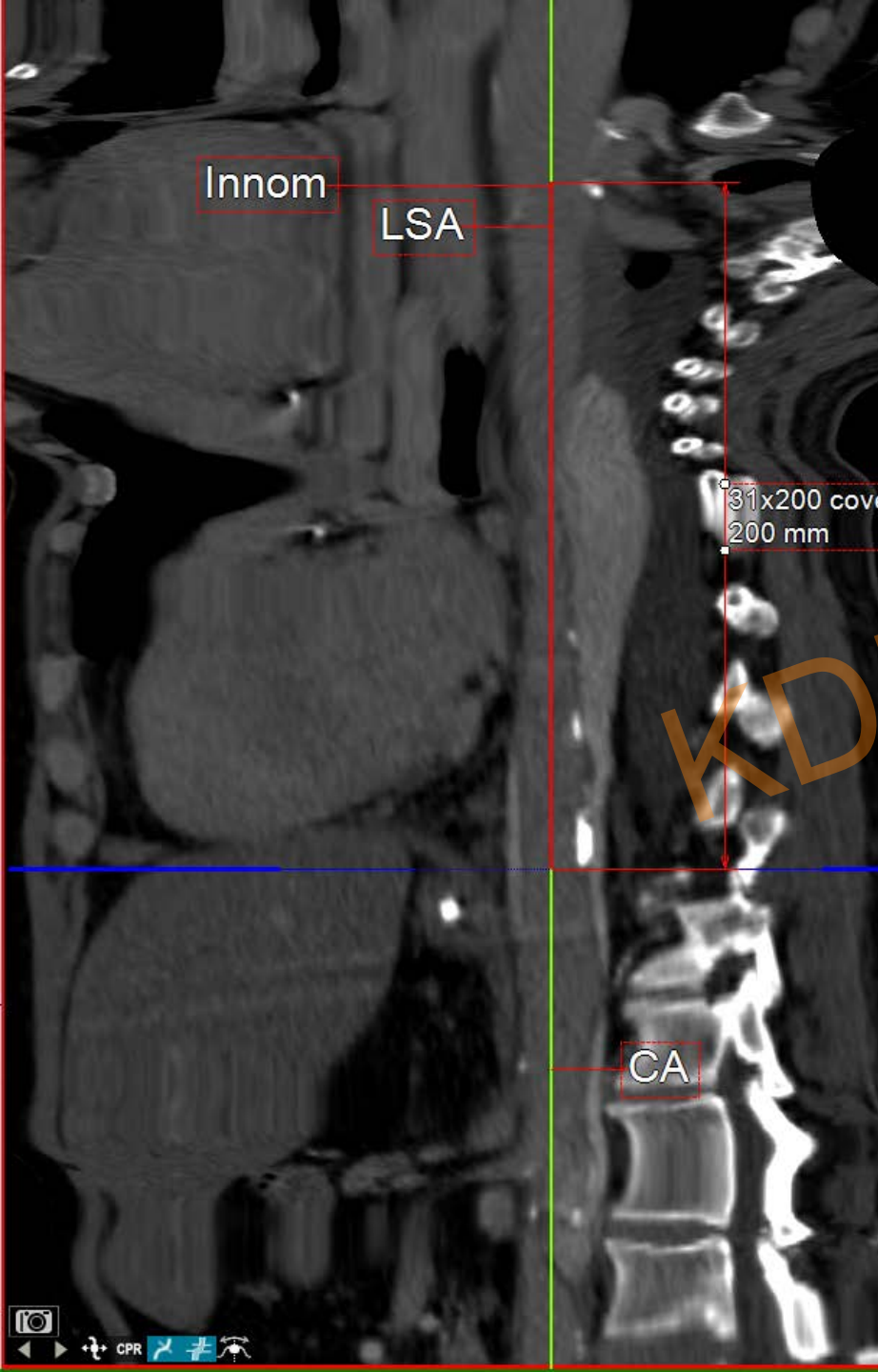


Admission, ER, Initial ICU

- 61 M transfer with chest, back pain and Type B
 - Arrived on esmolol and nicardipine gtt, SBP <120, HR 78 sinus
 - PMH: HTN
 - Meds: Denies any medication
 - SocHx: Smokes 1 PPD. Drinks 1-2 beers daily. History of crack cocaine.
 - FamHx: No aneurysm or dissection. Father HTN, DM2. Brother CABG
 - Cr 1.1, Lactate 2.5.
-
- Admitted to ICU, BP <120. Severe EtOH withdrawal. Developed pneumonia, intubated for respiratory failure, eventually extubated.
 - Uncomplicated from aneurysm perspective. Cr rose to 1.9, By HD 19, still requiring IV BP medicine to keep SBP <140, in addition to Lasix, PO Carvedilol, Amlodipine, Dilt, Captopril & Hydralazine







Innom

LSA

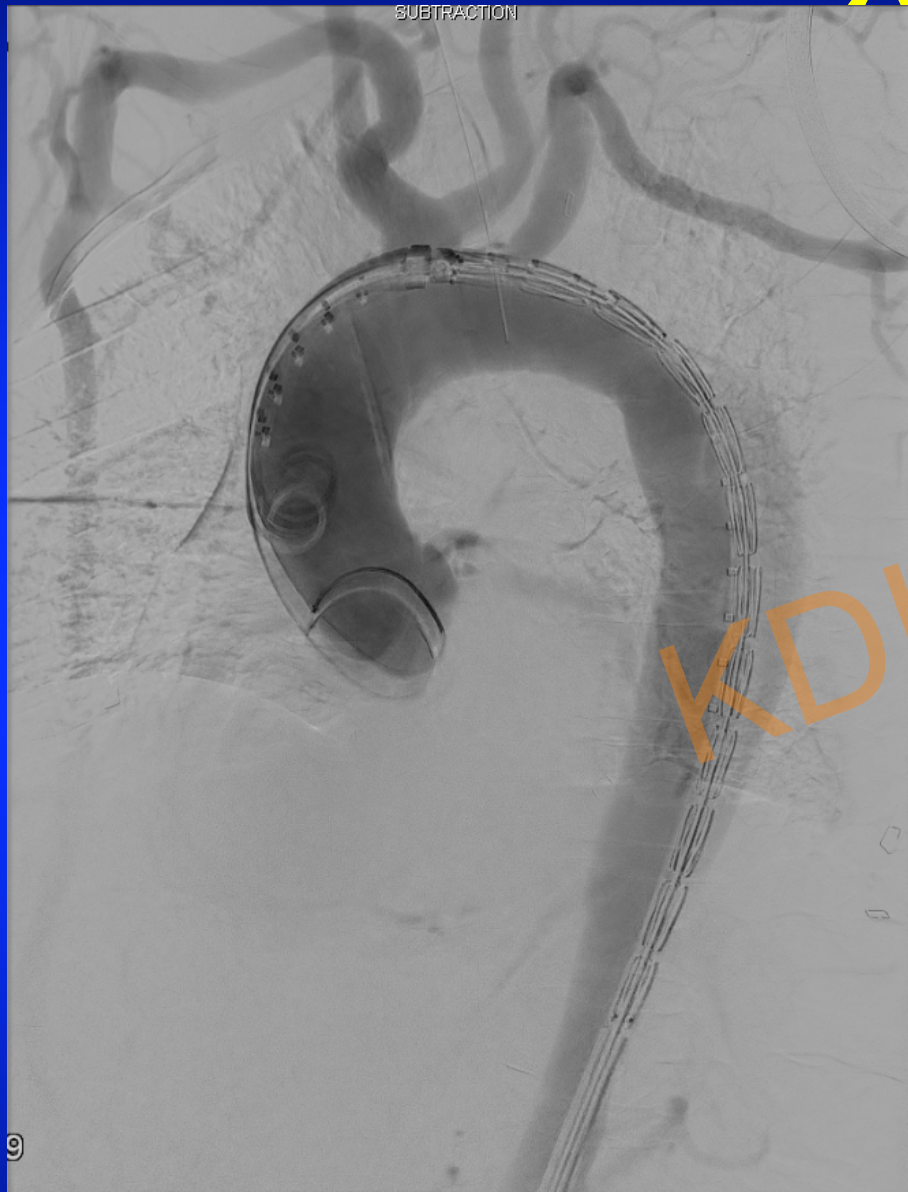
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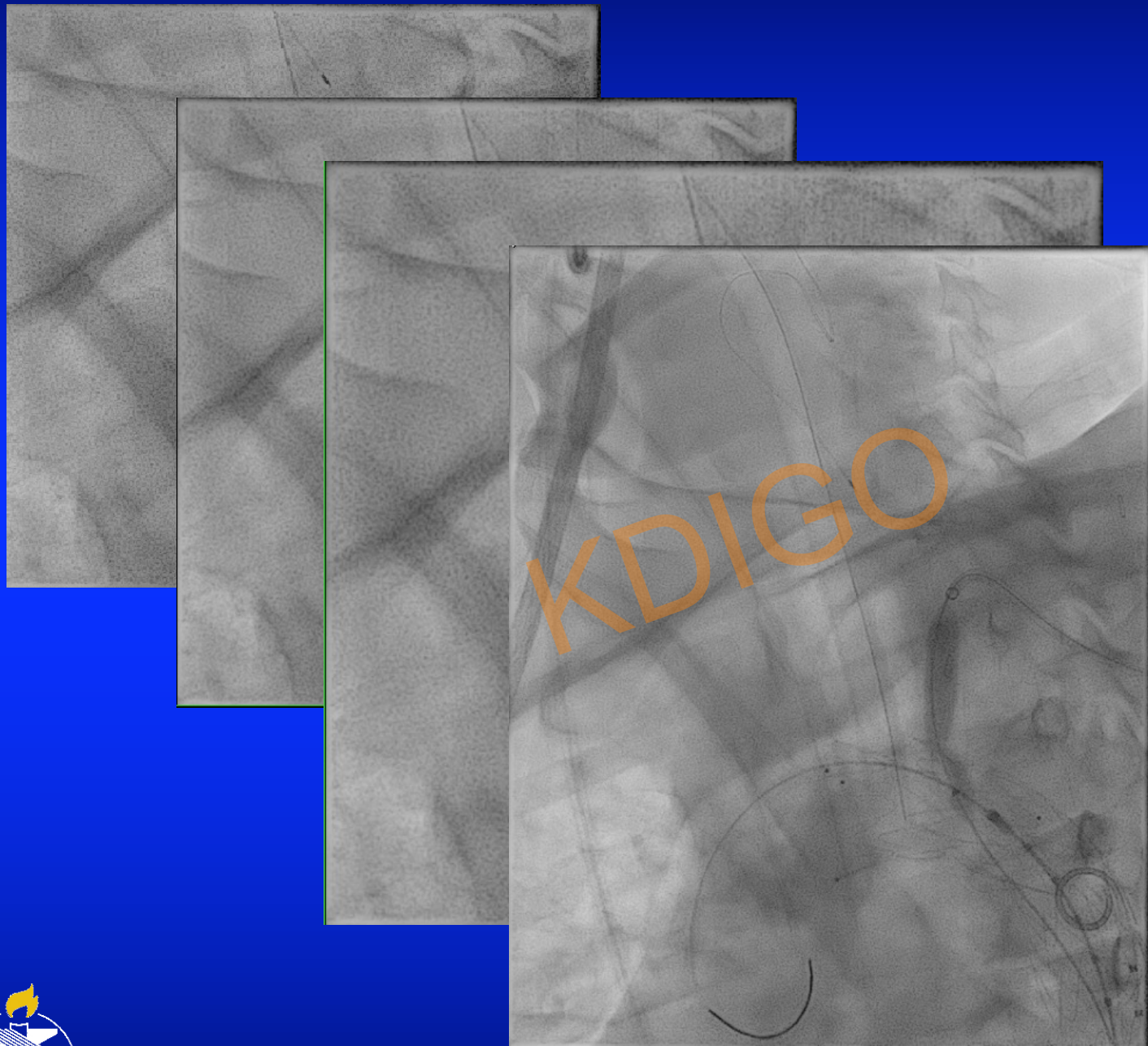
CA

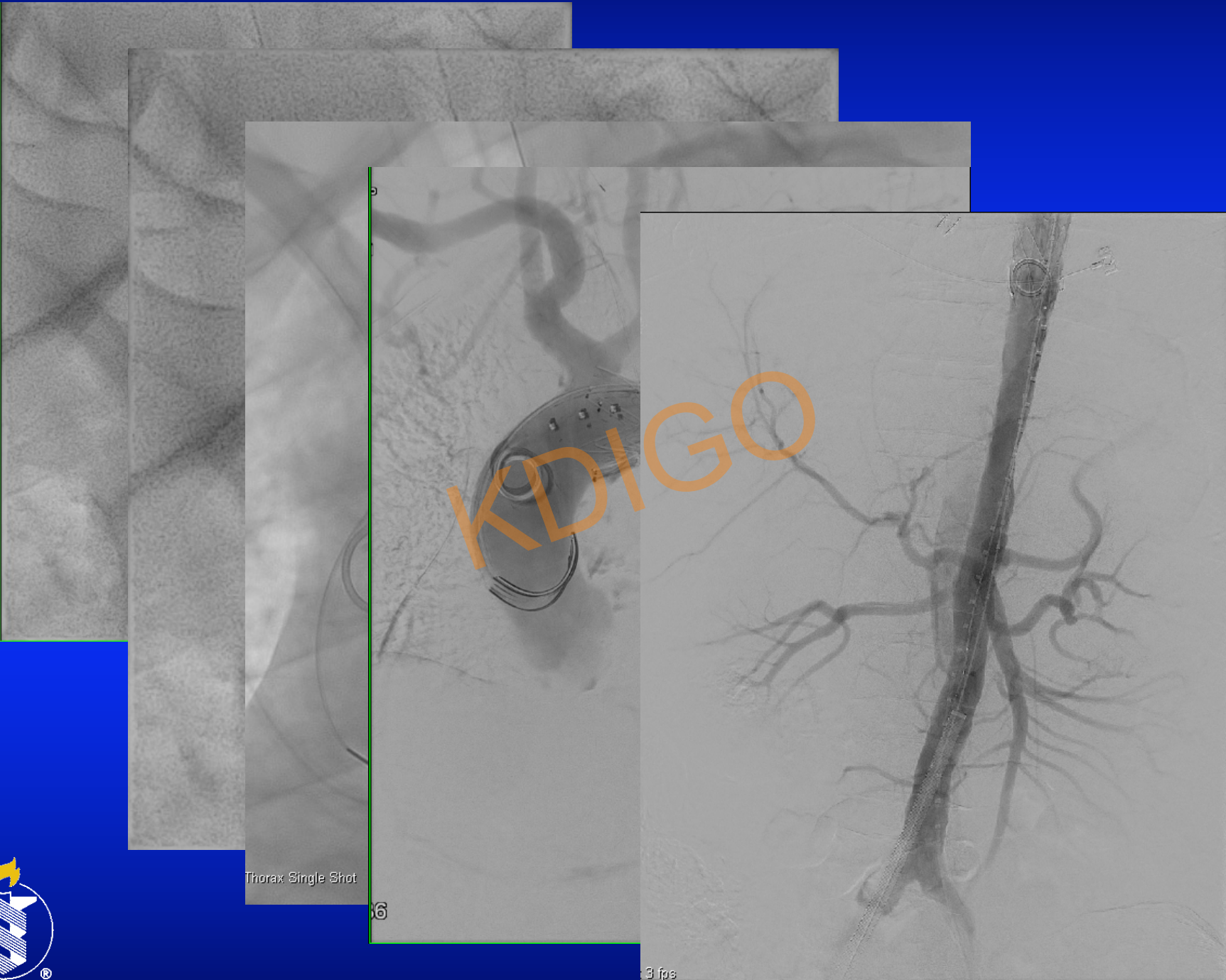


SUBTRACTION

SUBTRACTION;FRAME_SELECTION







Thorax Single Shot

6

18 fps

Post op

- Palpable left radial pulse post-op
- Off vasoactive drips by POD 3
- POD 6, CTA then discharged home
 - ASA/Plavix for innominate shutter
 - Amlodipine, Clonidine, Isosobide, Labetalol, Lisinopril
- Cr 0.8

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Lessons from IRAD

- Patients with renal insufficiency (18%) were at increased risk for drug-resistant hypertension and aortic branch vessel compromise (OR, 5.2). This complication was associated with a significant increase in hospital mortality, both in type A (50% versus 25%, $P<0.001$) and type B (27% versus 9%, $P<0.001$).⁴⁸



Lessons from IRAD

- In the 20 years since the IRAD was established, overall mortality in patients with type A AAD has declined. It is notable that surgical mortality in patients with type A AAD and type B AAD has fallen significantly. Improvements in AAD outcomes may be attributable to a number of factors: earlier detection, improved diagnostic imaging, and advances in surgical and endovascular techniques and perioperative and long-term management



Imaging in AKI

- Prehydrate and CTA
- Vessel navigator
- CO2 angio
- IVUS
- DUS
- MRA

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Questions to the group

- What is the best measure of adequate pre-hydration (CVP, MAP, TEE)
- Does hydration post op help or just prevent second hit ?
- Does lasix help?
- IS early CRT helpful or harmful related to long term renal recovery?





Harvard
Medical School



Beth Israel Deaconess Medical Center
*Official hospital of the Boston Red Sox
and Red Sox Nation*

