



IX Congresso
Novas Fronteiras
em Medicina
Cardiovascular

22 a 24 de Fevereiro 2019

The Village Praia
D'El Rey - Óbidos



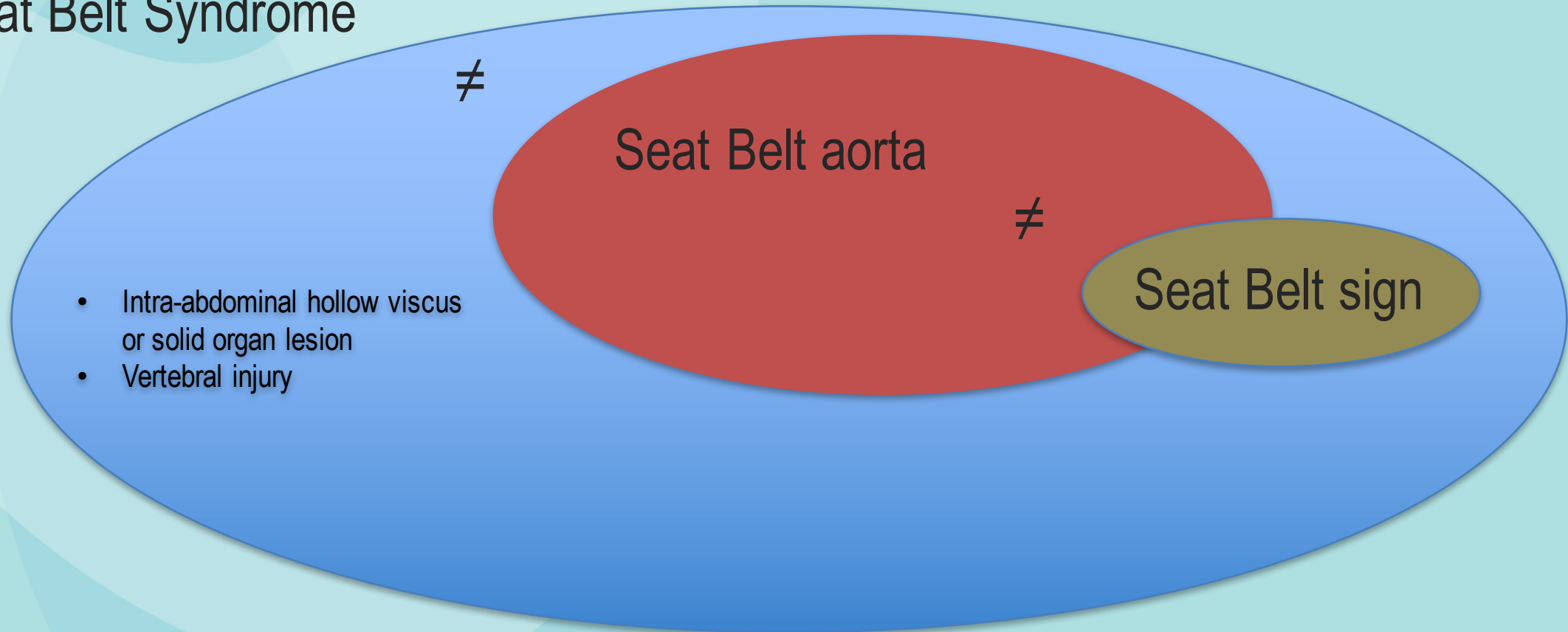
Clinical aspects and modern management of the “seat belt aorta”

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Introduction

Seat Belt Syndrome

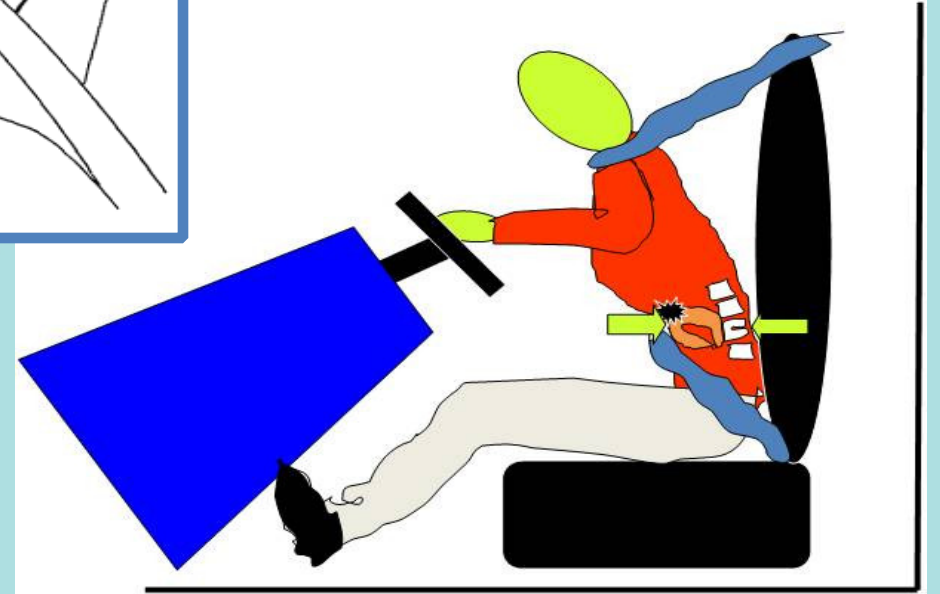
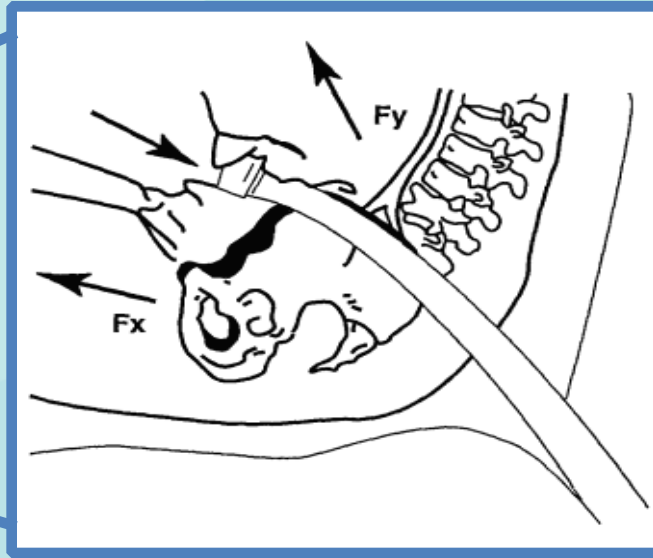
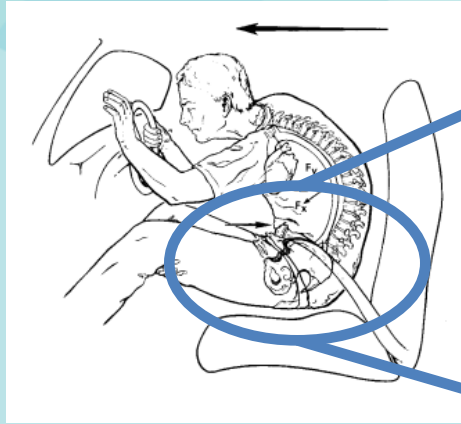


Classically defined as a *seat belt sign* plus an intra-abdominal organ injury (e.g. bowel perforations) and/or thoraco-lumbar vertebral fractures. Disruption of the abdominal wall musculature can also occur but is relatively uncommon.

Introduction

- The first historical description of aortic injury, presumably blunt trauma - Vesalius in 1557.
- German anatomist Rindfleisch introduced the observation of a traumatic rupture of the aorta into modern scientific literature in 1893
- **Blunt abdominal trauma is found to be rare.** Aortic implication (0.01% - 0.07% secondary to blunt abdominal trauma.)
- Steering wheel and **seat belt injury secondary to motor vehicle accident the most frequent**
- **Frequently, abdominal pain and seat belt sign are associated with other findings** such as back pain, skeletal fractures, hypovolemic shock, sphincteric tone loss, and lower limbs symptoms.
- The presence of abdominal wall ecchymosis (**seat belt sign**) **increases the chance of intraabdominal injuries by eight folds (65% vs 8%)**
- **Suspicion of vascular lesion is mandatory** even more in the presence of intra-abdominal hollow viscus or solid organ lesions
- **If an aortic damage is detected, then injuries to vertebral column or abdominal viscus are almost invariably present**
- Acute vascular peripheral ischemia is by far the most frequent cause of lower limb symptoms (discomfort and numbness to hypothermia, motor impairment, or even paraplegia)
- Partial or circumferential aortic intimal tear **below the renal arteries**, with or without dissection, is the most common pathologic feature (**74-90%**)

Introduction



Classification of TRAUMATIC AORTIC INJURY

GRADE I
Intimal Tear

Intima
Media
Adventitia

GRADE II
Intramural Hematoma

GRADE III
Pseudoaneurysm

GRADE IV
Rupture

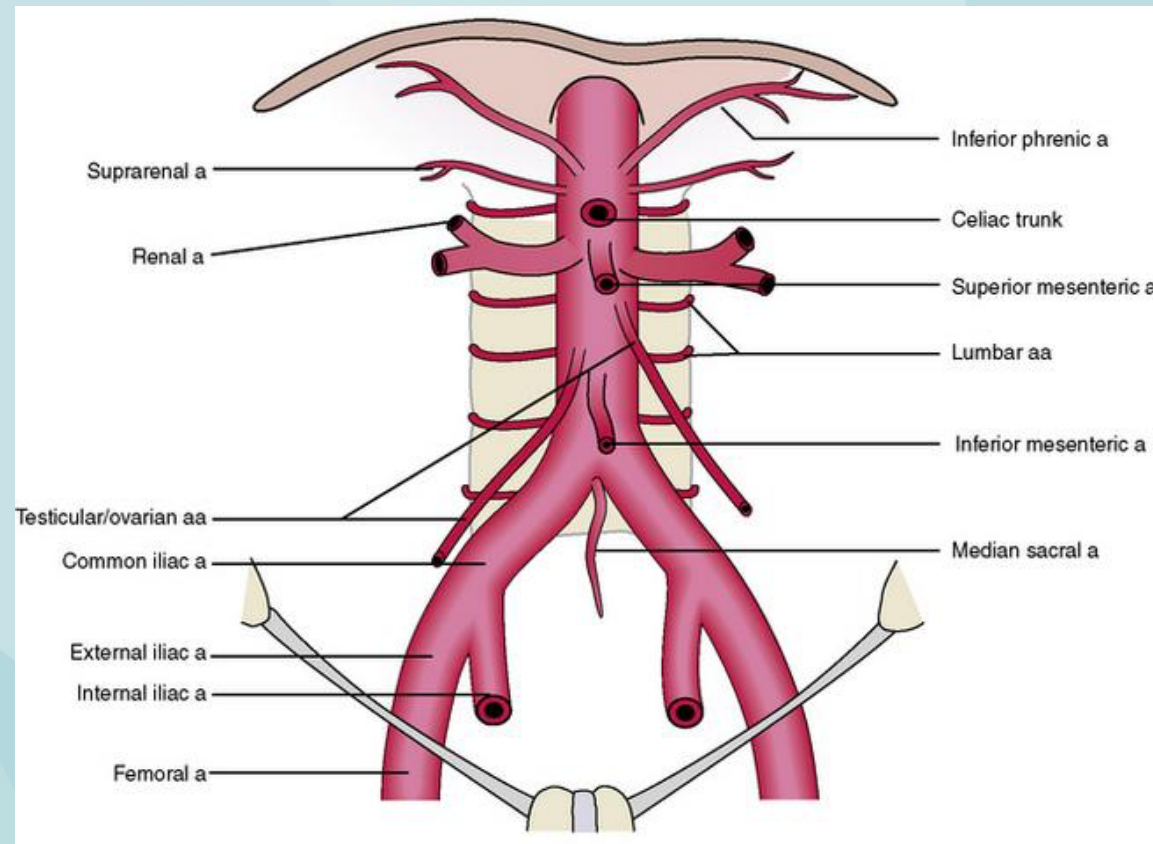
VIGILANCE

SURGERY

Fig 1. Classification system for traumatic aortic injury.

Abdominal aorta lesion – Classification:

- **Zone I:** Diafrgm to SMA
- **Zone II:** SMA to renal arteries
- **Zona III:** Below renals to aortic bifurcation (74-92 % of all cases)



From the Western Vascular Society

Blunt abdominal aortic injury

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Background: Blunt abdominal aortic injury (BAAI) is a rare injury with less than 200 cases in the current reported world literature, mostly in case report format. We sought to describe the experience of a high-volume trauma center and to provide a contemporary review of the literature to better understand the natural history and management of this injury.

Methods: This was a retrospective review of patients with BAAI between 1996 and 2010. Data collected included demographics, mechanism of injury, associated injuries, type of intervention, subsequent imaging, and follow-up. BAAI was classified by the presence of external aortic contour abnormality noted as an intimal tear, large intimal flap, pseudoaneurysm, or free rupture. Abdominal aorta zones of injury were classified by possible surgical approaches as zone I (diaphragmatic hiatus to superior mesenteric artery [SMA]), zone II (includes SMA and renal arteries), and zone III (from the inferior aspect of the renal arteries to the aortic bifurcation).

Results: We identified 28 individuals (68% male) with BAAI (median age, 28.5; range, 6-61 years). The median injury severity score was 45 (range, 16-75), and 39% were hypotensive at presentation. BAAI presented as intimal tear (21%), large intimal flap (39%), pseudoaneurysm (11%), and free rupture (29%). Zone III was the most common location of injury. Management depended on the location and type of injury: nonoperative (32%), open aortic repair (36%), endovascular repair (21%), and multimodality (10%). Overall mortality was 32%. Most deaths occurred during the initial operative exploration. The mortality rate of free aortic rupture was 100%. Intimal tears resolved or remained stable. Median follow-up was 15.5 months (range, 8 days-7.5 years). Vascular complications due to repair included a thrombosed access femoral artery during an endovascular repair and death of a patient who underwent a hybrid repair.

Conclusions: This is the largest BAAI series described in the English literature at one institution. BAAIs range from intimal tears to free rupture, with outcomes and management correlating with type and location of injury. Nonoperative management with blood pressure control using β -blockers coupled with antiplatelet therapy and close follow-up is successful in individuals with intimal tears with minimal thrombus formation because they remain stable or resolve on follow-up. Free rupture remains a devastating injury, with 100% mortality. For all other categories of aortic injury, successful repair correlates with a favorable prognosis. (J Vasc Surg 2012;55:1277-86.)

Table III. Management of blunt aortic injury by type and by location

<i>Variable</i>	<i>No.</i>	<i>Nonoperative No. (%)</i>	<i>Open No. (%)</i>	<i>Endovascular No. (%)</i>	<i>Combined^a No. (%)</i>
Patients	28	9 (32)	10 (36)	6 (21)	3 (11)
By type					
Intimal tear	6	6 (100)	0	0	0
LIF	11	3 (27)	3 (27)	4 (36)	1 (9)
PSA	3	0	1 (33)	2 (67)	0
Rupture	8	0	6 (75)	0	2 (25)
By location					
Zone I	5	1 (20)	1 (20)	0	3 (60)
Zone II	3	0	3 (100)	0	0
Zone III	20	8 (40)	6 (30)	6 (30)	0

LIF, Large intimal flap; *OR*, operating room; *PSA*, pseudoaneurysm.

^aThere were three combined cases in this series: (1) Patient with hemodynamic compromise assessed to be due to pelvic trauma and the diagnosis of renal artery avulsion was made via an aortography. An intra-aortic occlusion balloon was placed to facilitate transportation to the OR for primary repair. (2) Patient in whom exposure of an avulsed celiac artery was challenging despite bilateral thoracotomy and laparotomy. This was managed by placement of a Gore extension stent (W. L. Gore and Assoc, Flagstaff, Ariz) and coil embolization of the transected celiac artery trunk. (3) A patient who underwent true hybrid repair with debranching of the celiac and superior mesenteric arteries.

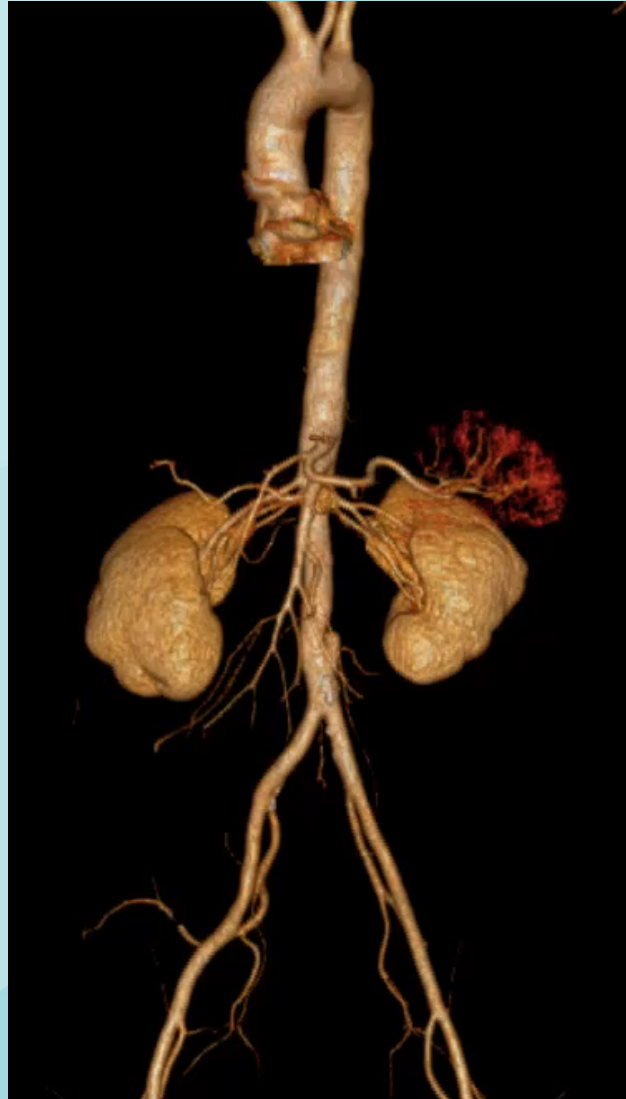
Case 1

- 49 years-old, male
- High-speed motor vehicle collision
- Politrauma:
 - Cranioencephalic trauma (Subarachnoid haemorrhage; facial fractures)
 - Cervical trauma (C7 fracture without spinal cord injury)
 - Thoracic trauma (rib fractures; right lung contusion; hemomediastinum)
 - **Abdominal trauma**
 - Complete transverse transection of the abdominal muscles
 - Transection of small bowel and colon
 - **Aorta dissection at IMA level without arterial compromise – Grade I**
 - **Inferior vena cava and right iliac vein thrombosis**

Case 1

- Exploratory laparotomy
 - Sigmoidectomy and multiple segmental enterectomies
 - Terminal ileostomy
 - Open abdomen with negative pressure wound therapy
- Vascular surgery
 - Anticoagulation – enoxaparin 1mg/kg 12/12h
 - No intervention
 - Vascular consultation; CT scan control

Case 1 – CT scan control

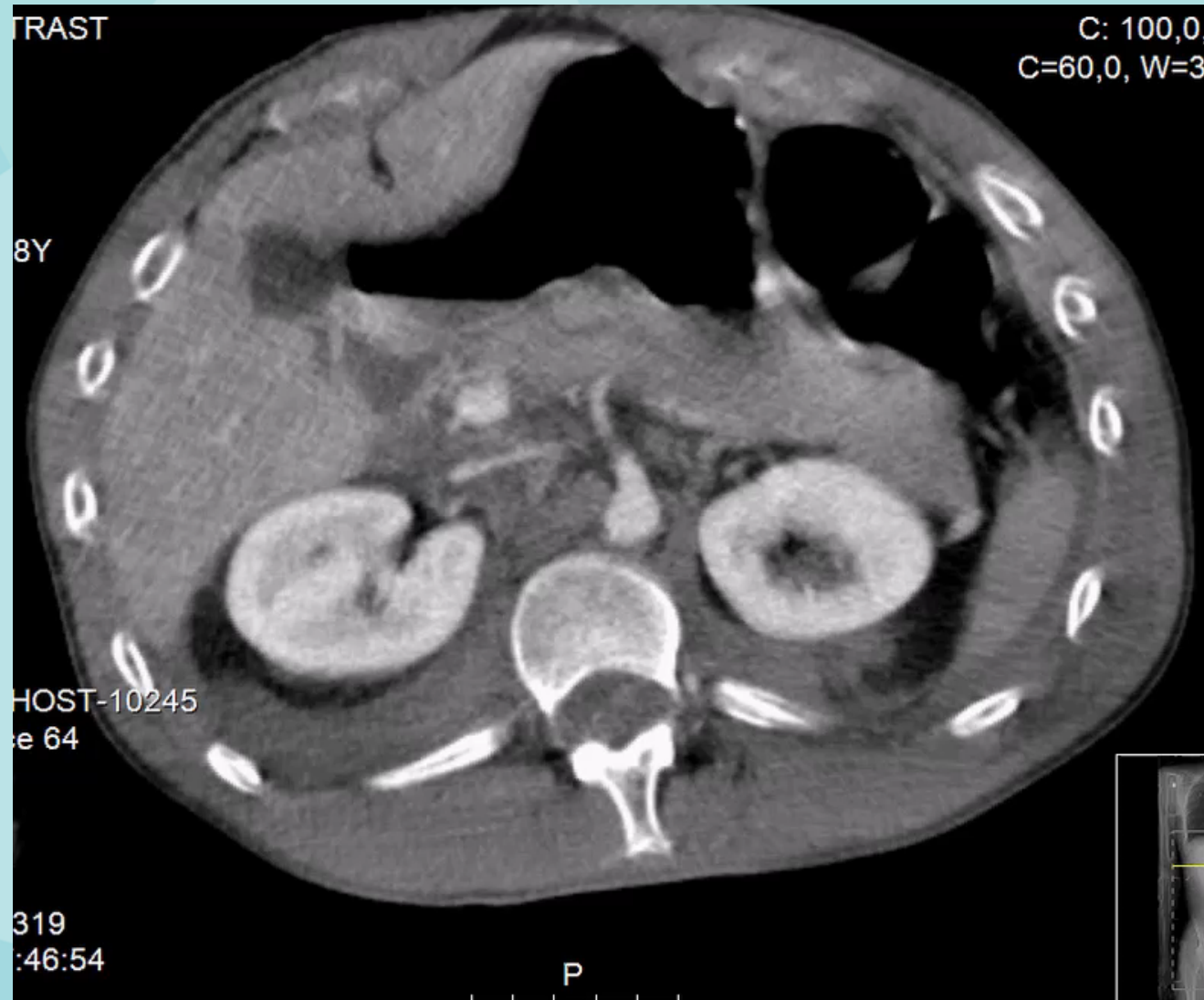


Case 2

- 28 years-old, male
- High-speed motor vehicle collision
- Co-pilot seat with a 3-point seatbelt
- Politrauma:
 - Cranioencephalic trauma
 - Vertebral trauma (L1-2 fracture without spinal cord injury)
 - Thoracic trauma (rib fractures; right pneumothorax)
 - Left femur fracture
 - **Abdominal trauma:**
 - Hemoperitoneum; pneumatosis intestinalis; splenic contusion;
 - **Traumatic dissection of the infra-renal aorta**



Case 2

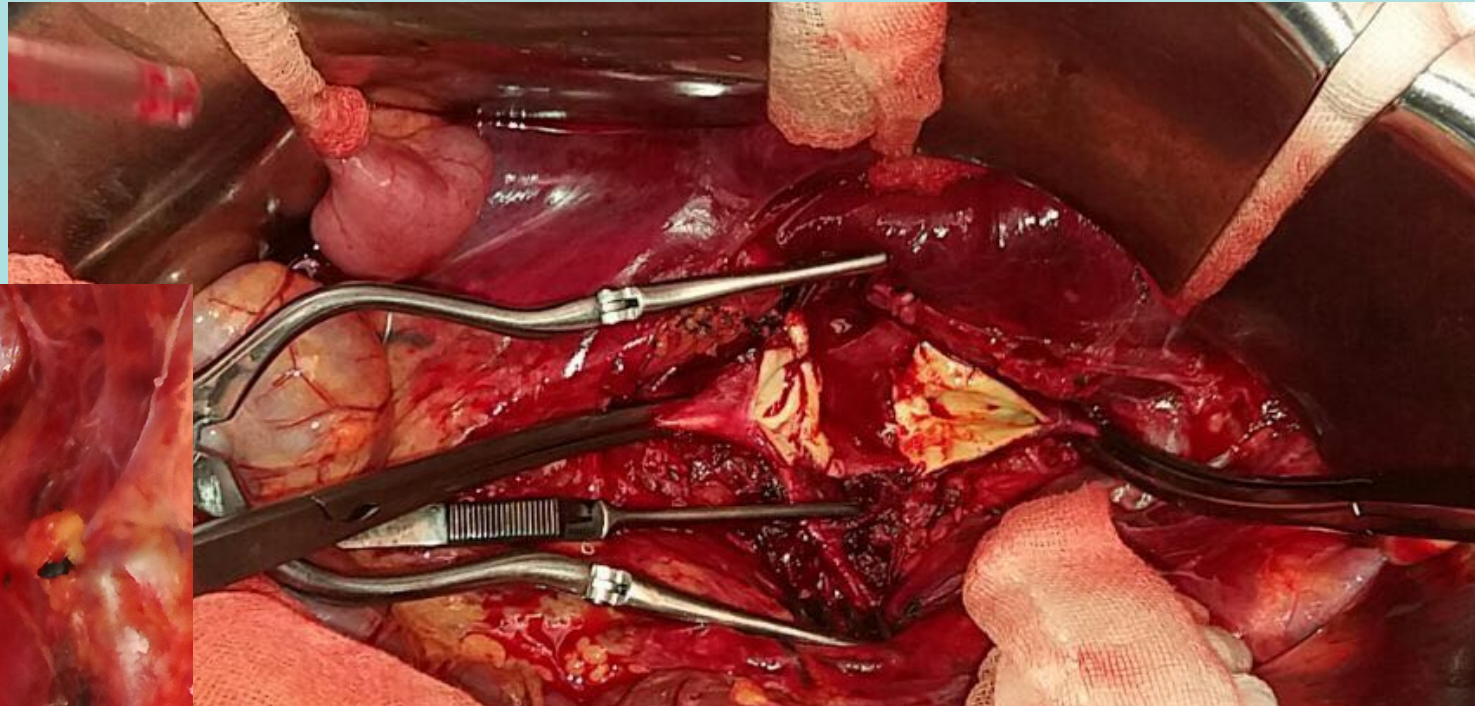


Case 2

- Exploratory laparotomy
- Aorto-aortic graft interposition
- Reimplantation of IMA
- Partial duodenectomy, gastrojejunostomy, segmental enterectomy and left hemicolectomy
- Open abdomen with negative pressure wound therapy

6 U RBC
14 U plasma
2 pool platelets
8g fibrinogen

Case 2



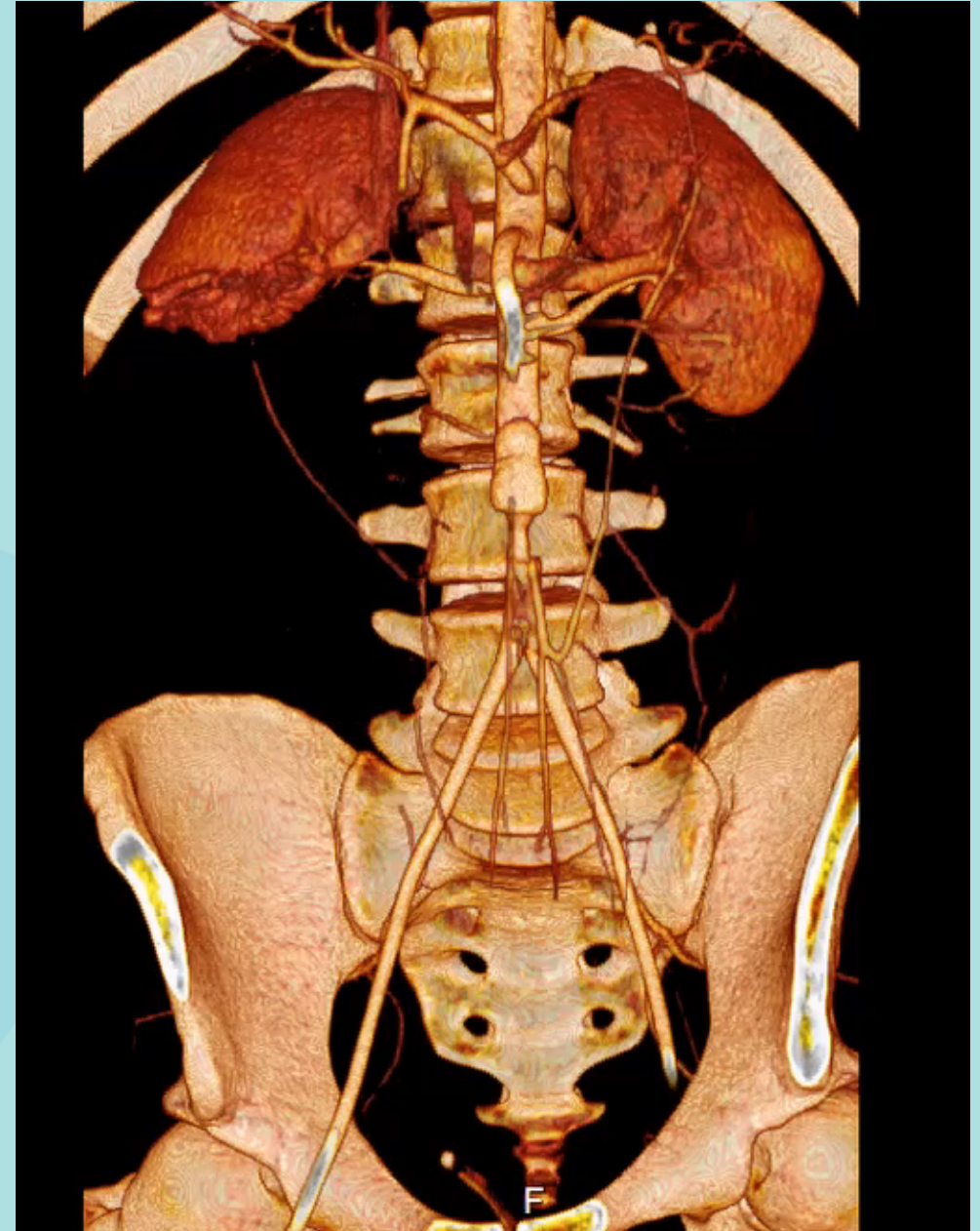
Case 2

- Post-op on ICU
 - Ischemic pancreatitis
 - Peritonitis
 - Multiples surgical revisions to close abdominal wall
- Almost 2 years later
 - Digestive reconstruction

Case 3

- 21 years-old, male
- High-speed motor vehicle collision
- Rear seat passenger with a 2-point seatbelt
- **Politrauma:**
 - Cranioencephalic trauma (normal cranioencephalic CT Scan; facial fractures)
 - Vertebral trauma (L1-L3 fractures with spinal cord injury - paraplegia)
 - Thoracic trauma (rib fractures)
 - **Severe abdominal trauma**
 - Pneumo and hemoperitoneum
 - Right kidney contusion
 - Perforation and contusion of multiple intestinal segments
 - Traumatic dissection of the infra-renal aorta with acute left lower limb ischemia

Case 3



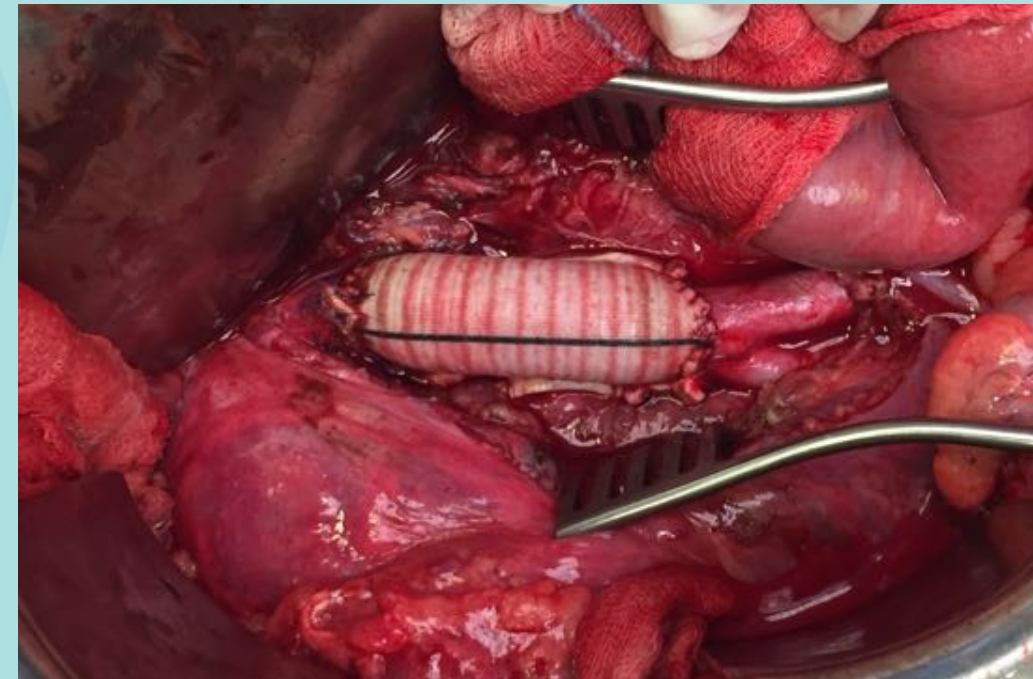
Case 3

- Regional hospital
 - Emergent exploratory laparotomy
 - Right nephrectomy; right hemicolectomy; duodenorrhaphy and segmental enterectomy;
- Signs of acute left lower limb ischemia
 - Tertiary Hospital (Vascular Surgery)



Case 3

- Tertiary hospital (Vascular Surgery)
 - Aorto-aortic graft interposition
 - Left lower limb thrombectomy and fasciotomy
 - Open abdomen with negative pressure wound therapy (NTP)



Case 3 – Post-op CT scan



Case 3

- NTP change at D2 post-op
 - Ischemic perfuration of small bowel involving previous anastomosis, without dehiscence
 - Segmental resection and ileostomy
- D20 post-op
 - Ortopedic intervention:
 - L1-L4 fixation
- Discharge 2 months later mantaining intensive physiotherapy

Case 4

- 68 years-old, female
- High-speed motor vehicle collision
- Co-pilot seat with a 3-point seatbelt
- Politrauma
 - Left wrist fracture
 - Hemopneumoperitoneum; splenic trauma;
 - Traumatic dissection of the infra-renal aorta with severe stenosis of the right common iliac artery;

Case 4

- Regional hospital:
 - Exploratory laparotomy
 - Splenectomy
- Signs of acute bilateral lower limb ischemia
 - Tertiary hospital (Vascular Surgery)

Case 4



Case 4

- Vascular surgery:
 - Axillo-bi-femoral bypass with PTFE 8mm Ø
 - Right lower limb thrombectomy
- General surgery:
 - Left hemicolectomy and colostomy (colon ischemia)

7 hours

Case 4 – D1 post-op



Case 4

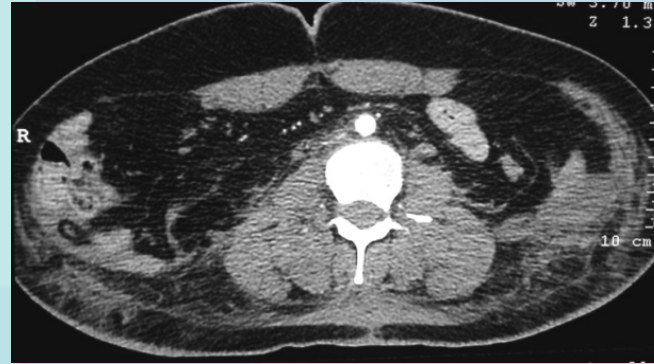
- Refractory shock with multiple organ failure
- Disseminated intravascular coagulation
- Death at 3 days after surgery

Case 5

- 44 yrs-old, female
- High-speed motor vehicle collision
- Co-pilot seat with a 2-point seatbelt
 - Vertebral trauma (L1-L4 fracture)
 - Thoracic trauma (bilateral lung contusion; pleural effusion)
 - **Abdominal trauma**
 - complete transverse transection of the abdominal muscles
 - transection of small bowel and colon
 - **traumatic thrombosis of aorta below IMA with acute bilateral lower limb ischemia**

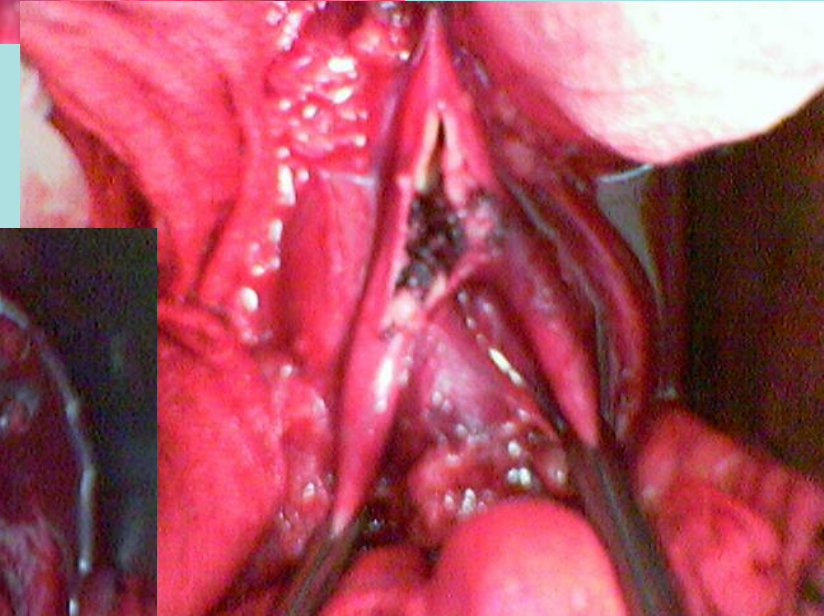


Case 5



Case 5

- Aorto-bi-iliac graft interposition (Dacron 16x8mm)
- Segmental enterectomy with latero-lateral anastomosis
- Segmental colectomy
- Open abdomen with negative pressure wound therapy
- Death at D31 post-op (multiorgan failure)

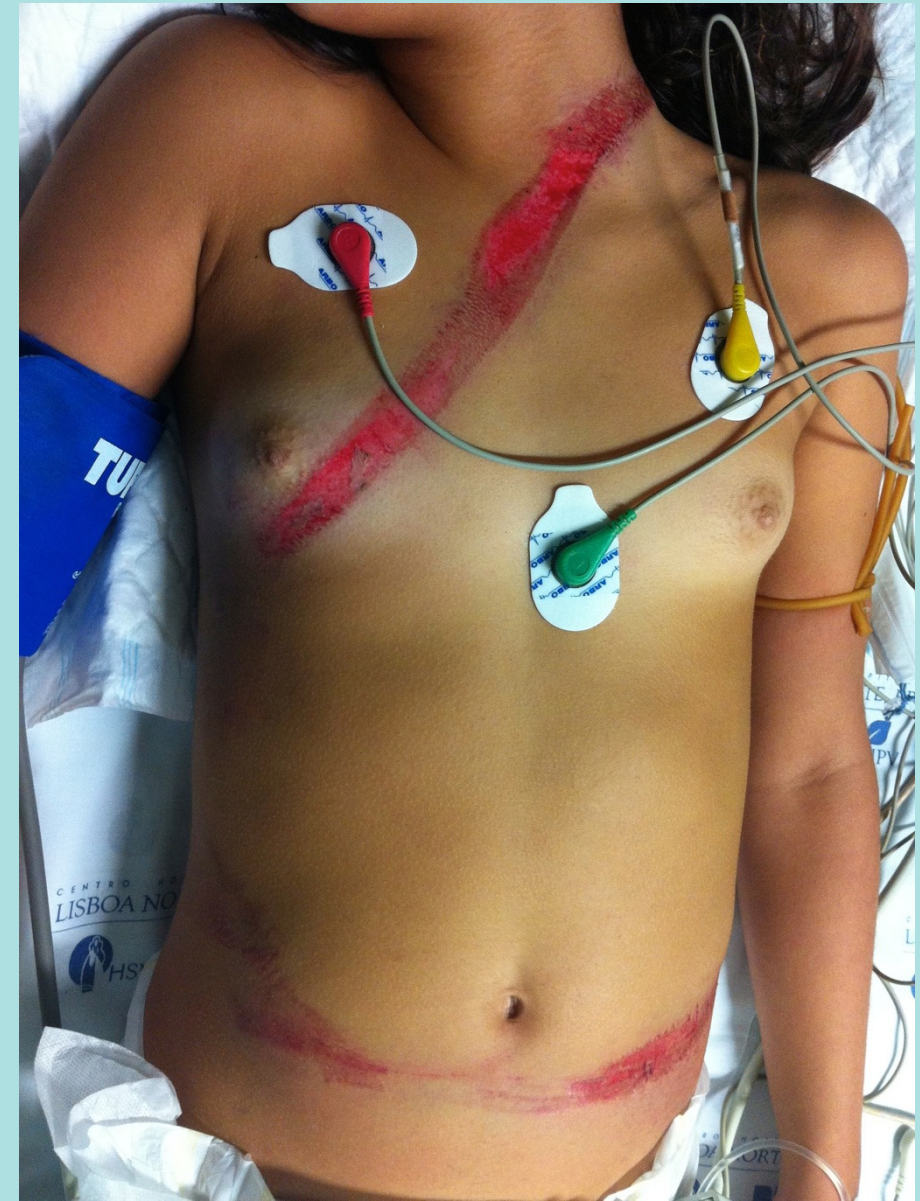


Endo in trauma...

- Patients ↓ aortic diameter. No aneurysm or occlusive disease
- Aortic implications in long term?
- Patients under 18yrs?
- Stents deformities may occur - mainly 1st month
- Device to use? (diameters/material/self vs balloon expandable)?
- Out of IFU

Case 6

- 10 years-ols, female
- High-speed motor vehicle collision
- Politrauma:
 - Thoracic trauma (rib fractures)
 - **Abdominal trauma**
 - Hepatic laceration
 - Intimal tear and pseudoaneurysm of the infra-renal aorta

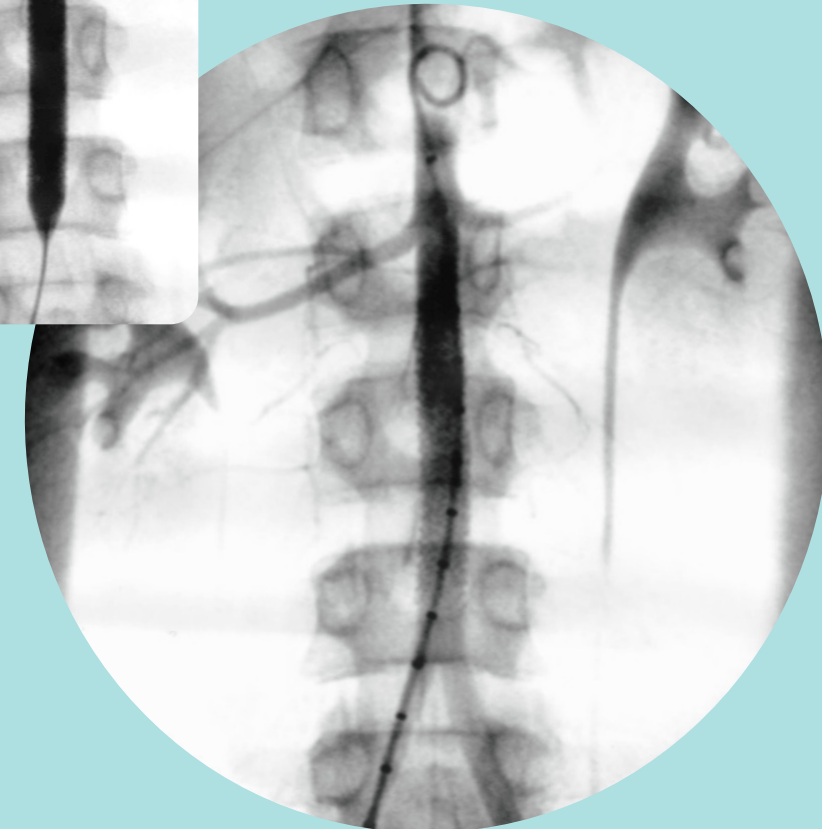
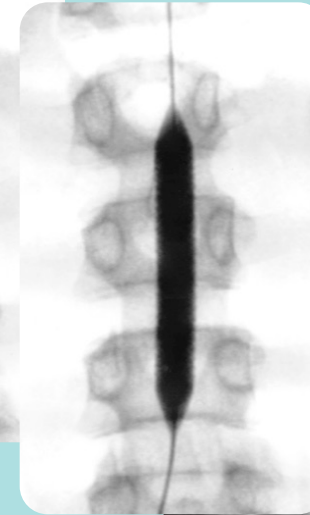
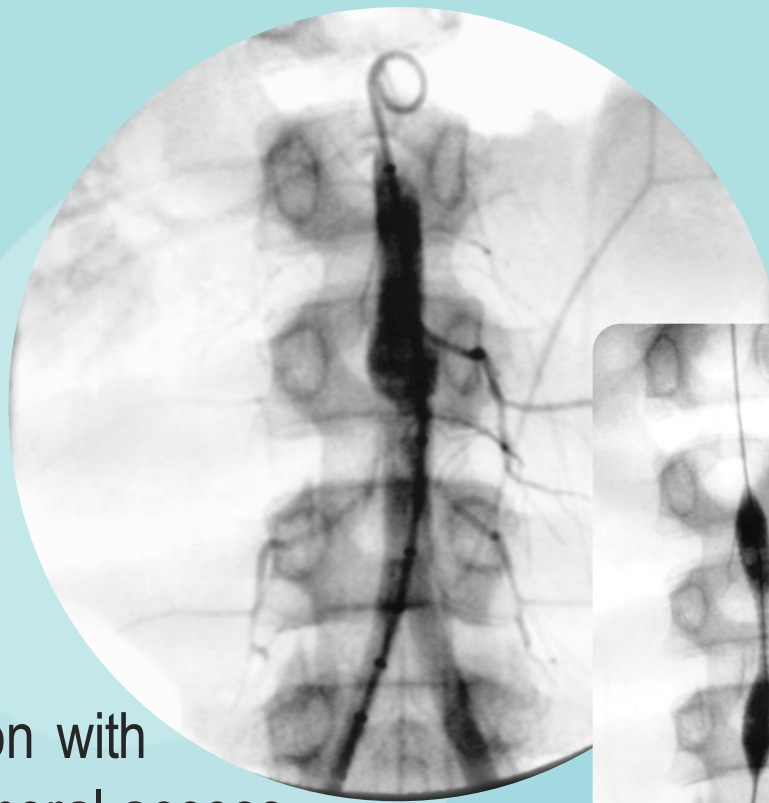


Case 6

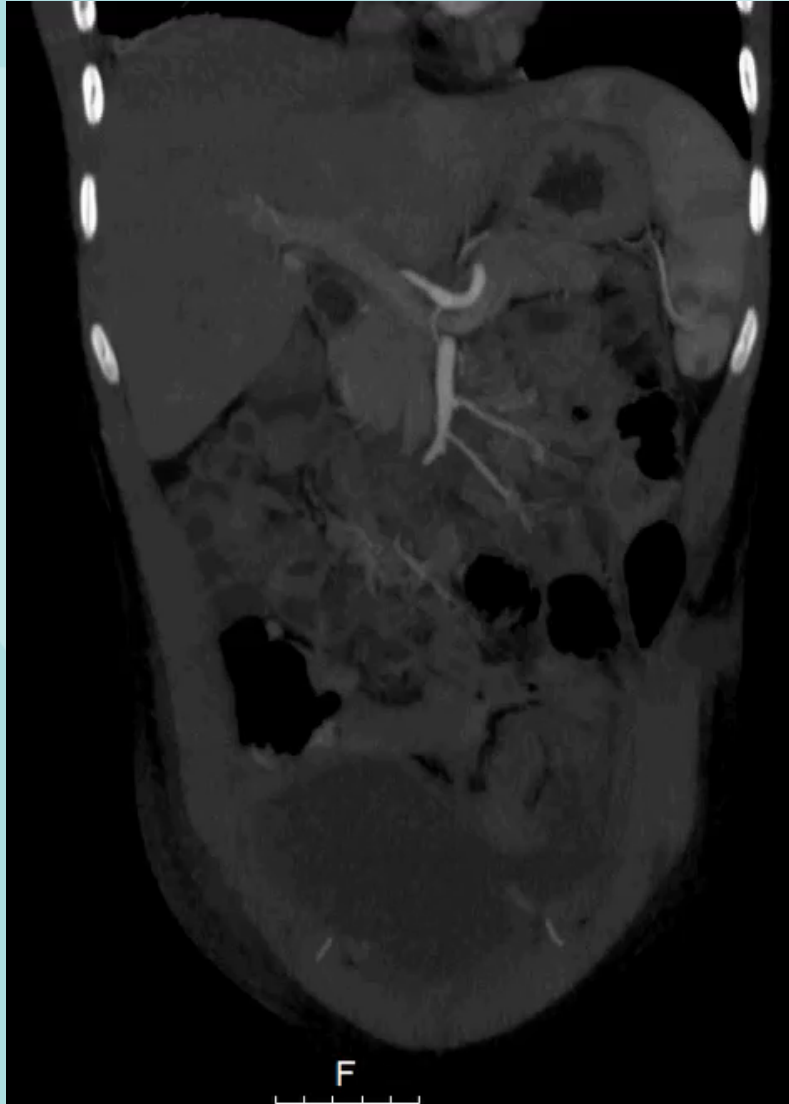


Case 6

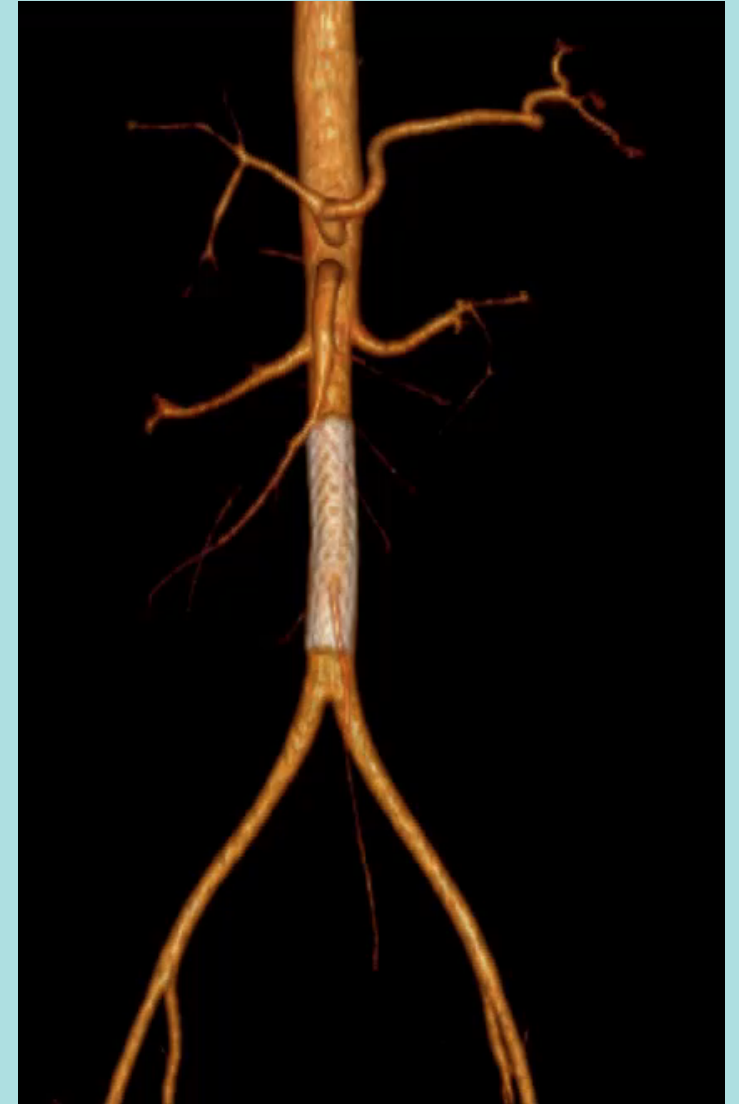
- Vascular surgery:
 - Aortic stent implantation with percutaneous right femoral access (10x59 mm -Atrium ADVANTA™ V12)



Case 6 – 2 weeks CT-scan

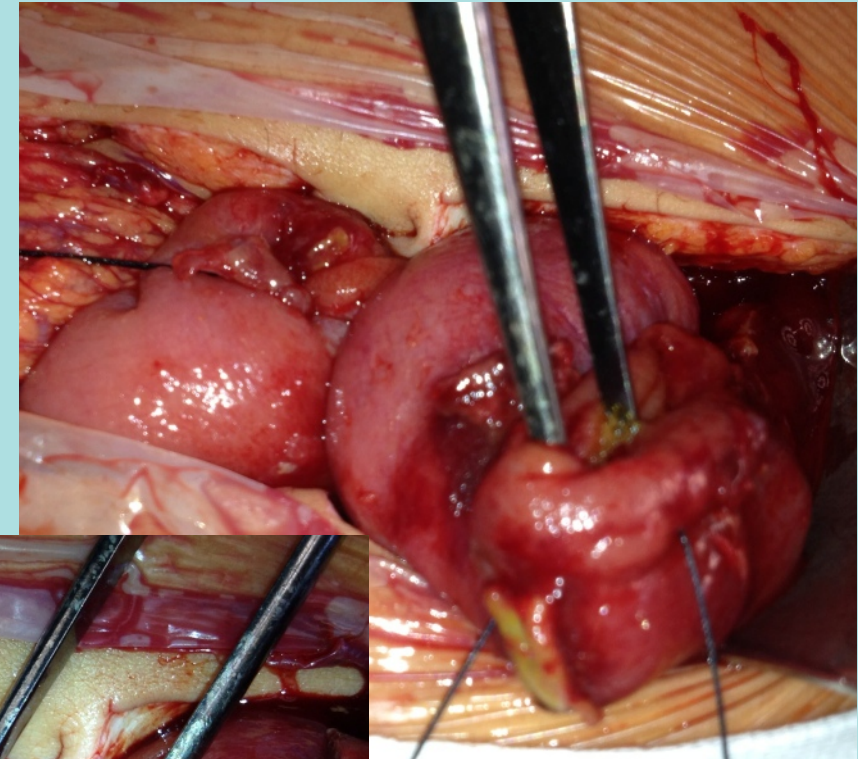
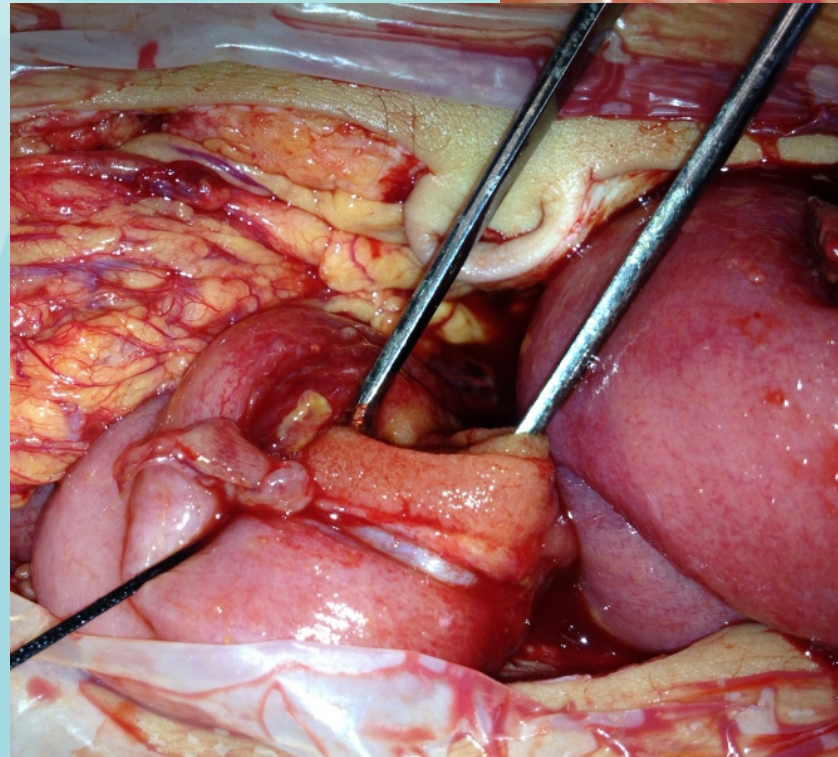


- Normal patency of the aortic stent
- Intrabdominal abscess and extraluminal air suggestive of intestinal perforation

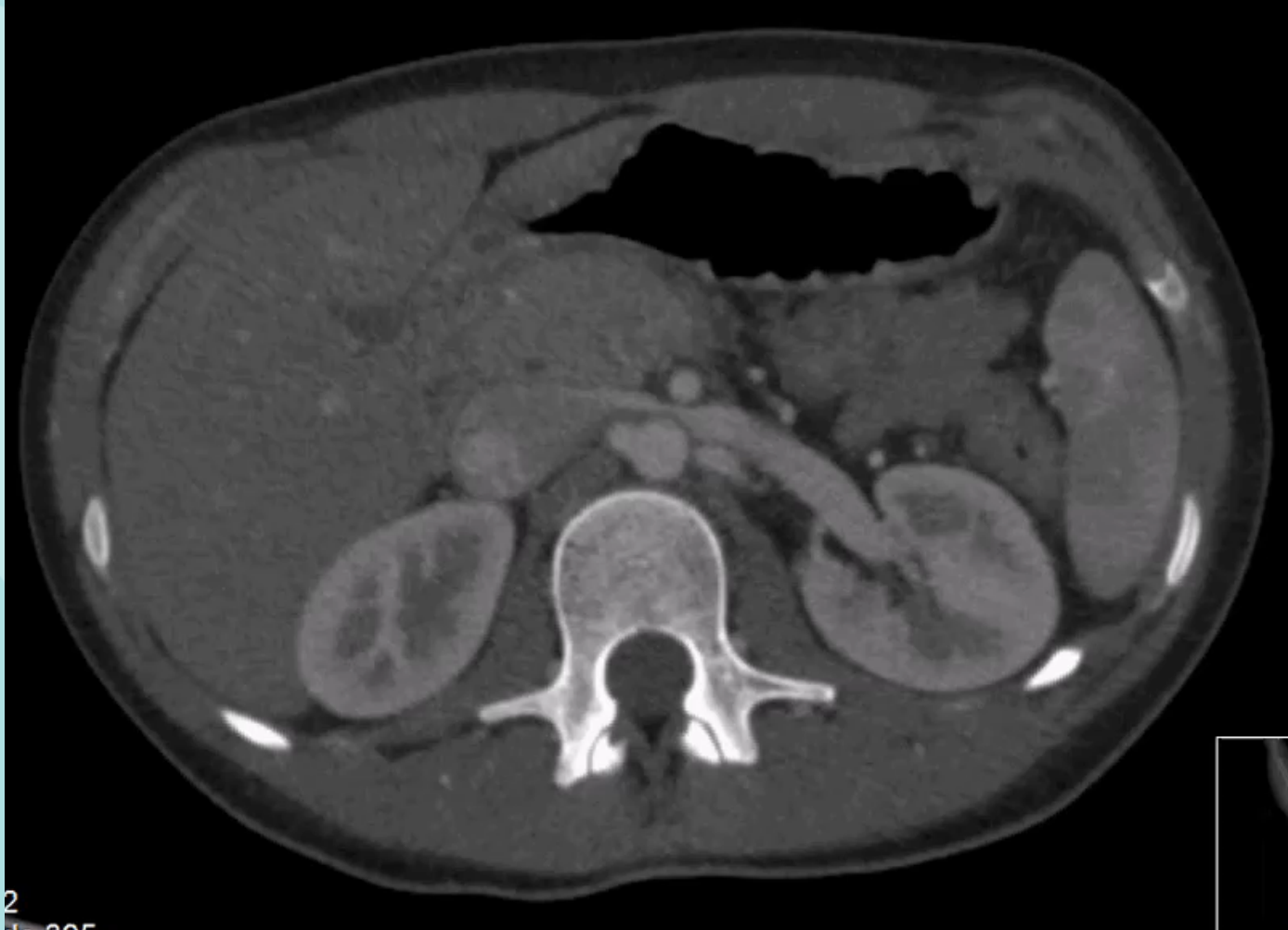


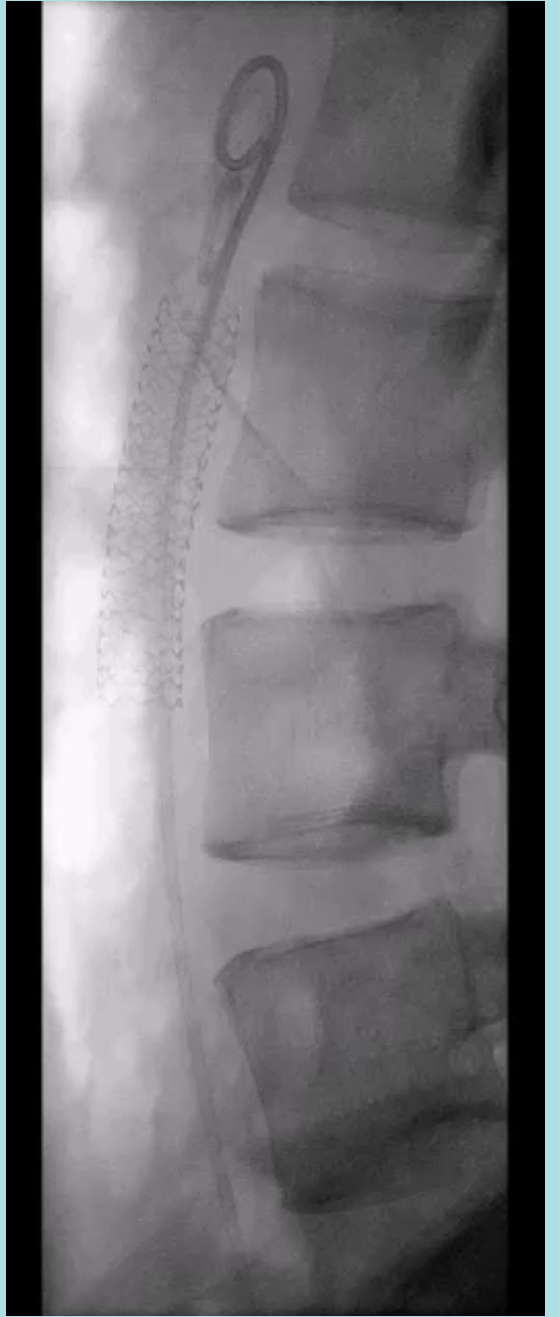
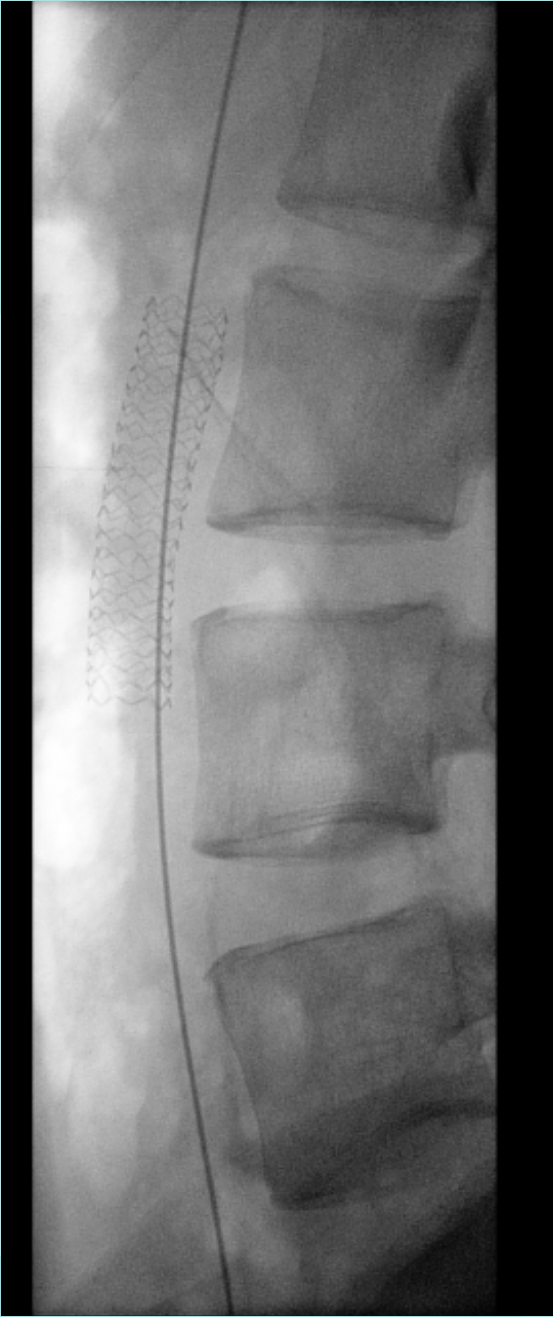
Case 6

- Pediatric Surgery
 - Exploratory surgery
 - Segmental enterectomy with end-to-end anastomosis
- Discharged at D19 post-op



Case 6 – 5 years CT scan control



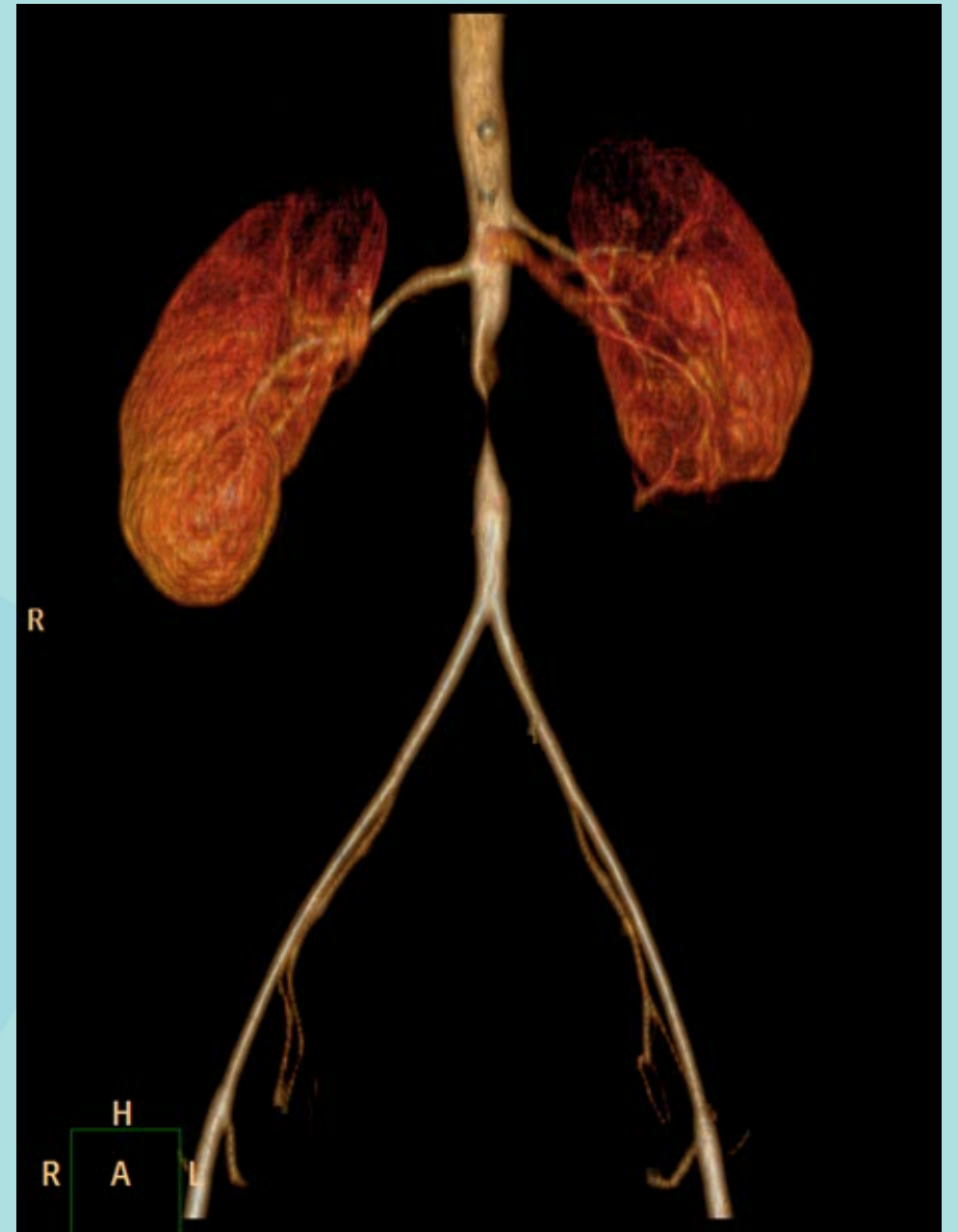


Case 7

- 23 years-old, female
- High-speed motor vehicle collision
- Wearing 3-point seatbelt
- Bilateral lower limb claudication since the accident
- Progression to:
 - Pain at rest
 - Bilateral acrocyanosis in the foot
 - Skin ulceration of the 1st left toe

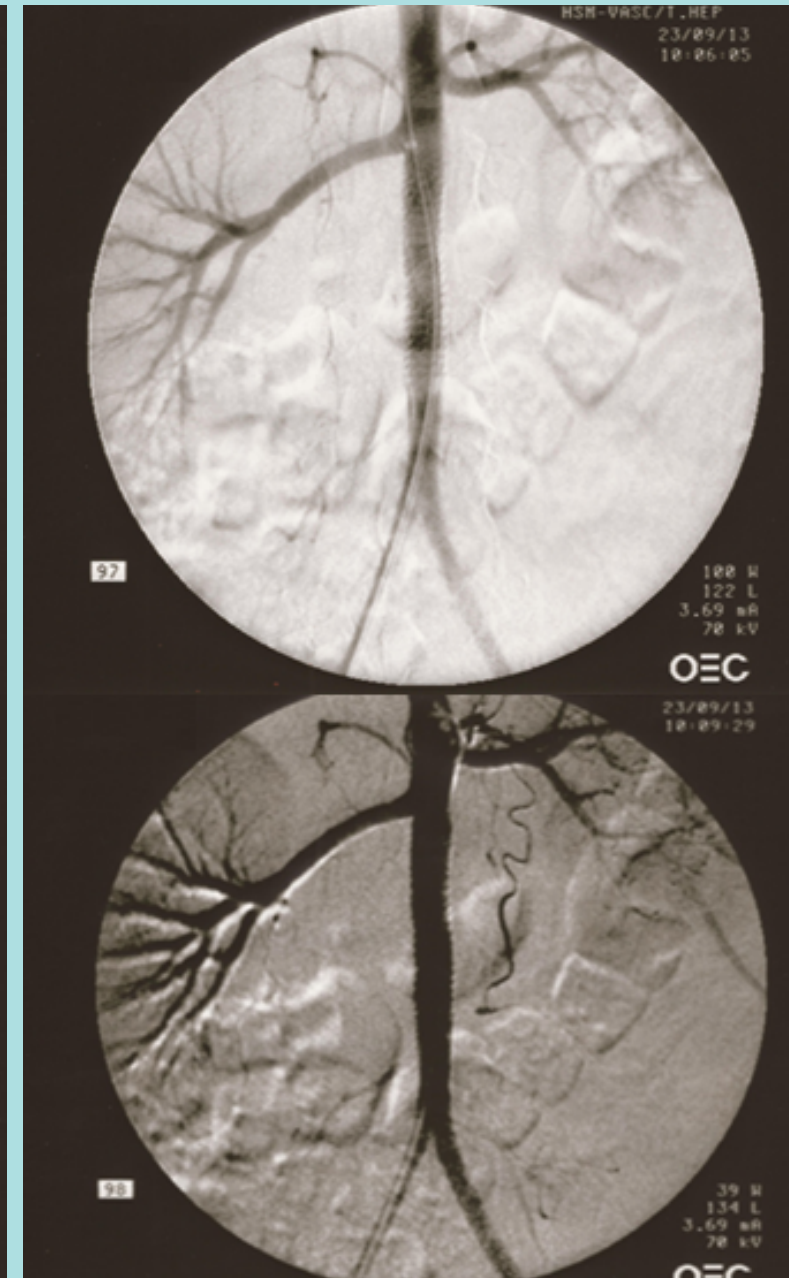
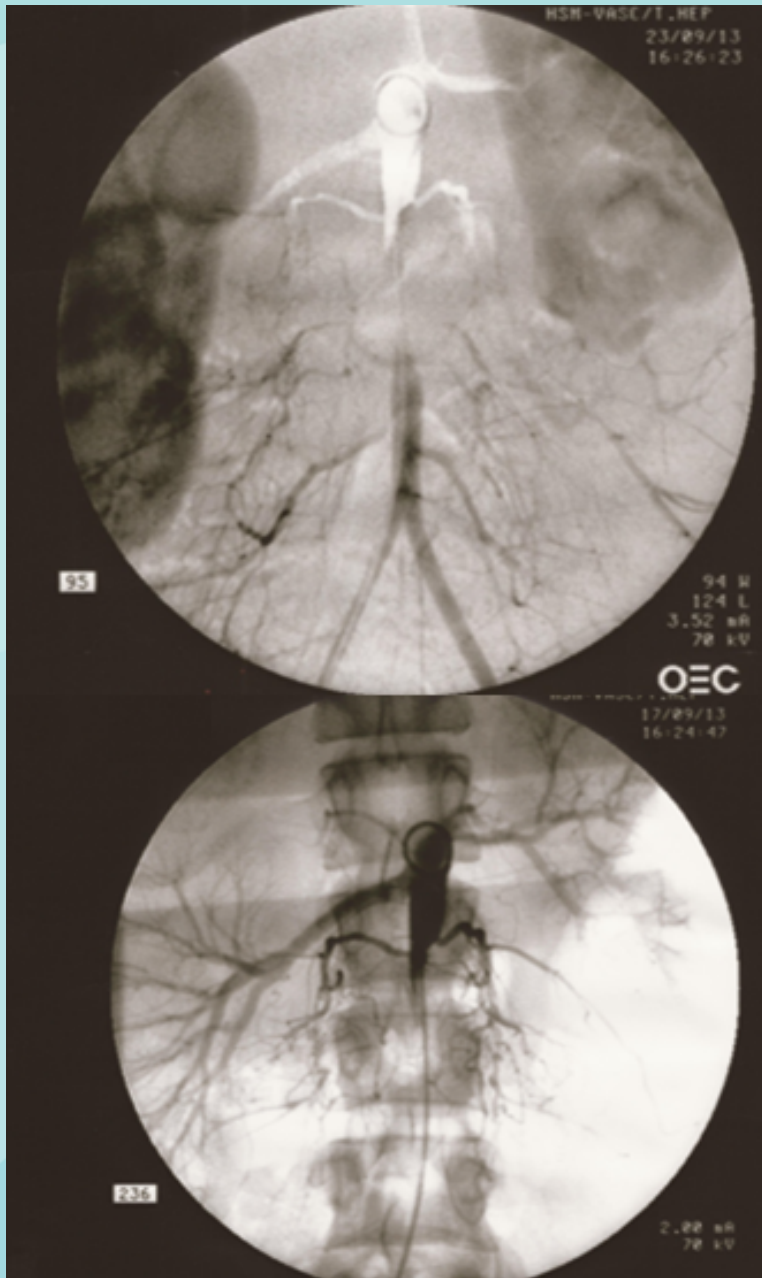


Case 7

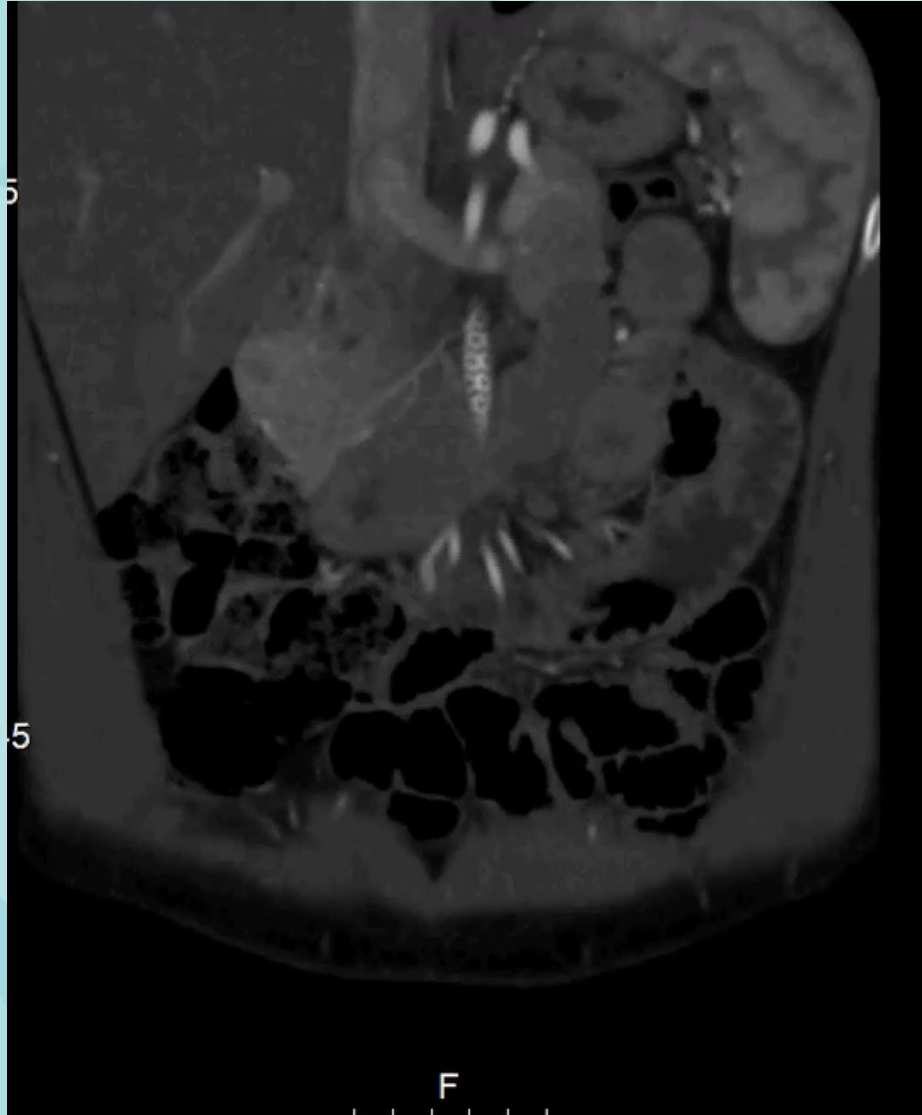


Case 7

Percutaneous balloon expandable covered stent deployment in the infrarenal aorta (Atrium Advanta V12® 10x59 mm)



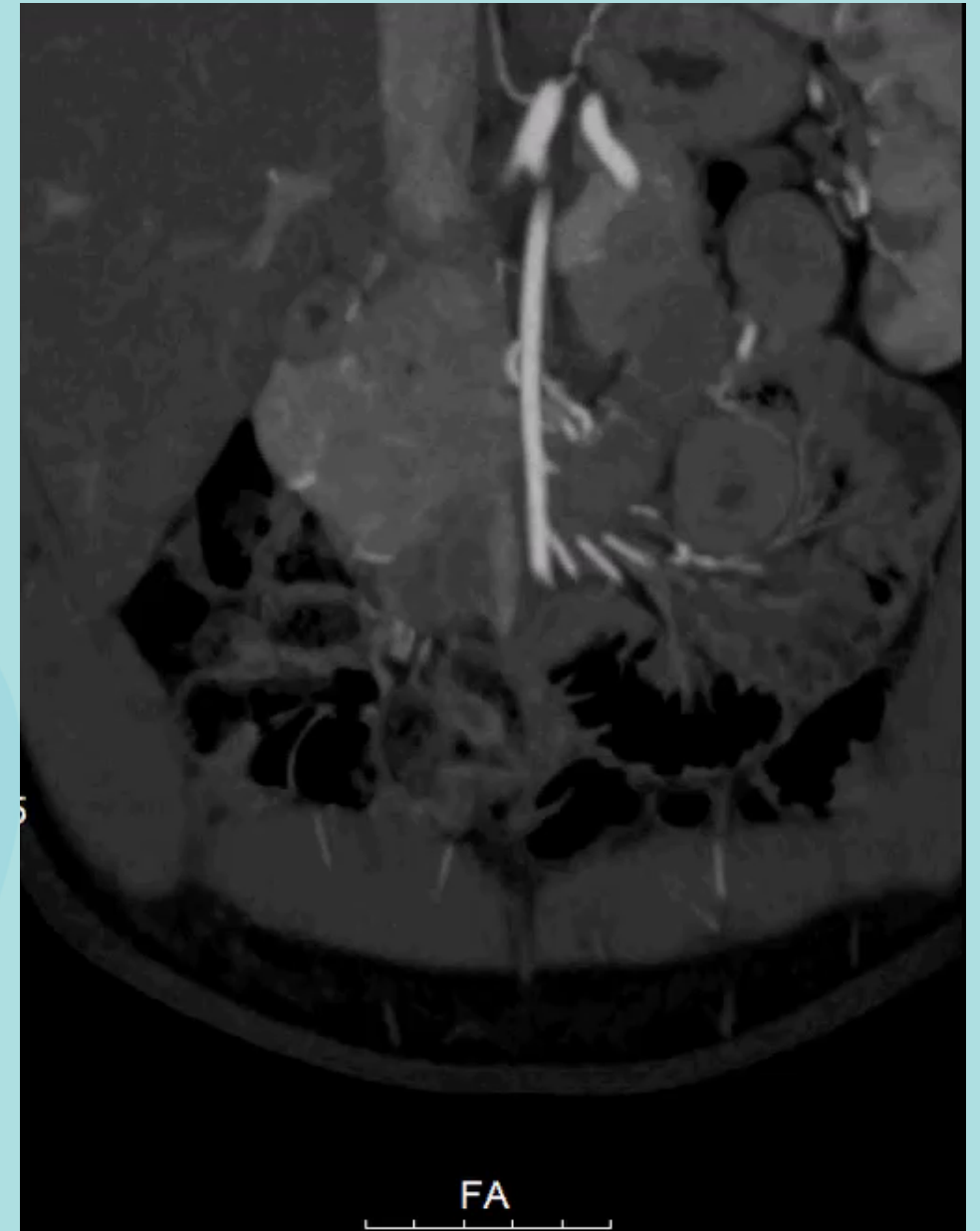
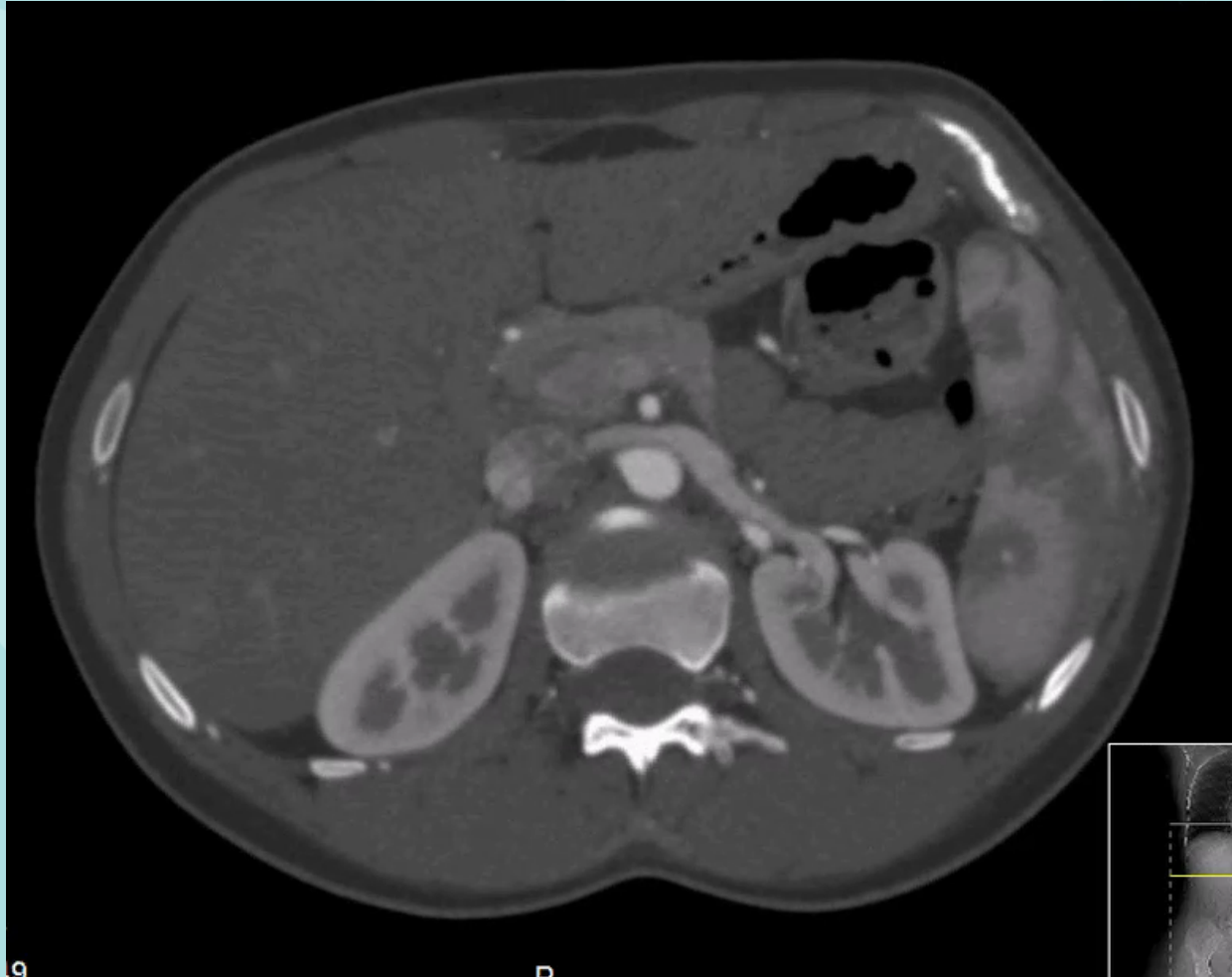
Case 7



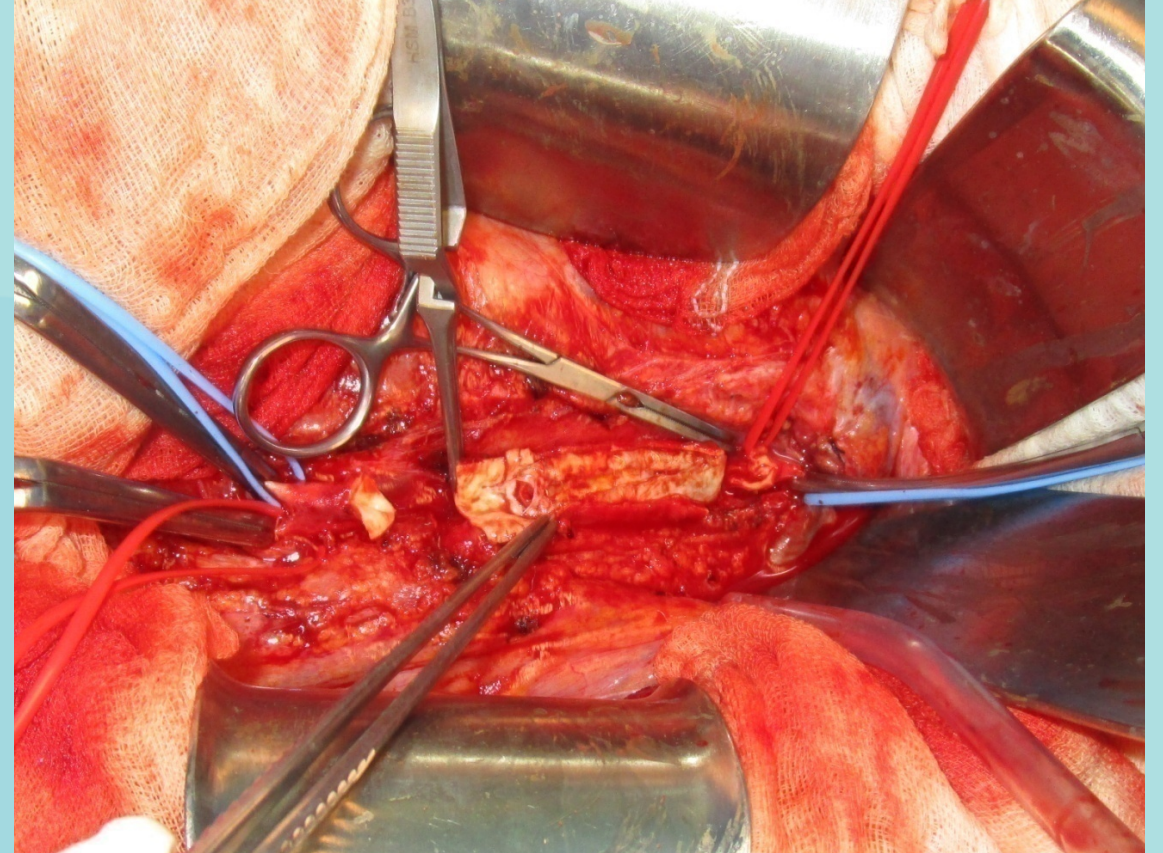
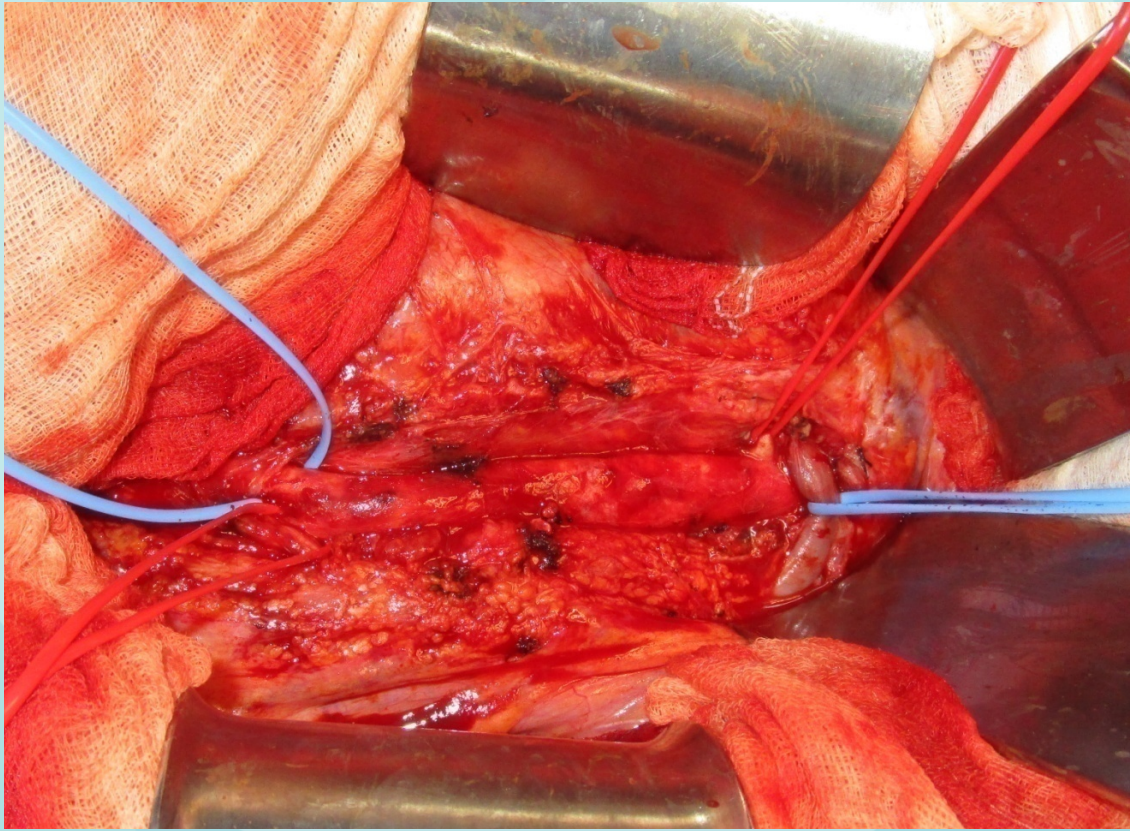
Case 7

- 36 months post-op
 - Bilateral lower limb claudication
 - No bilateral femoral pulses
 - Duplex scan:
 - Monophasic waveform of the femoro-popliteal and tibioperoneal sectors

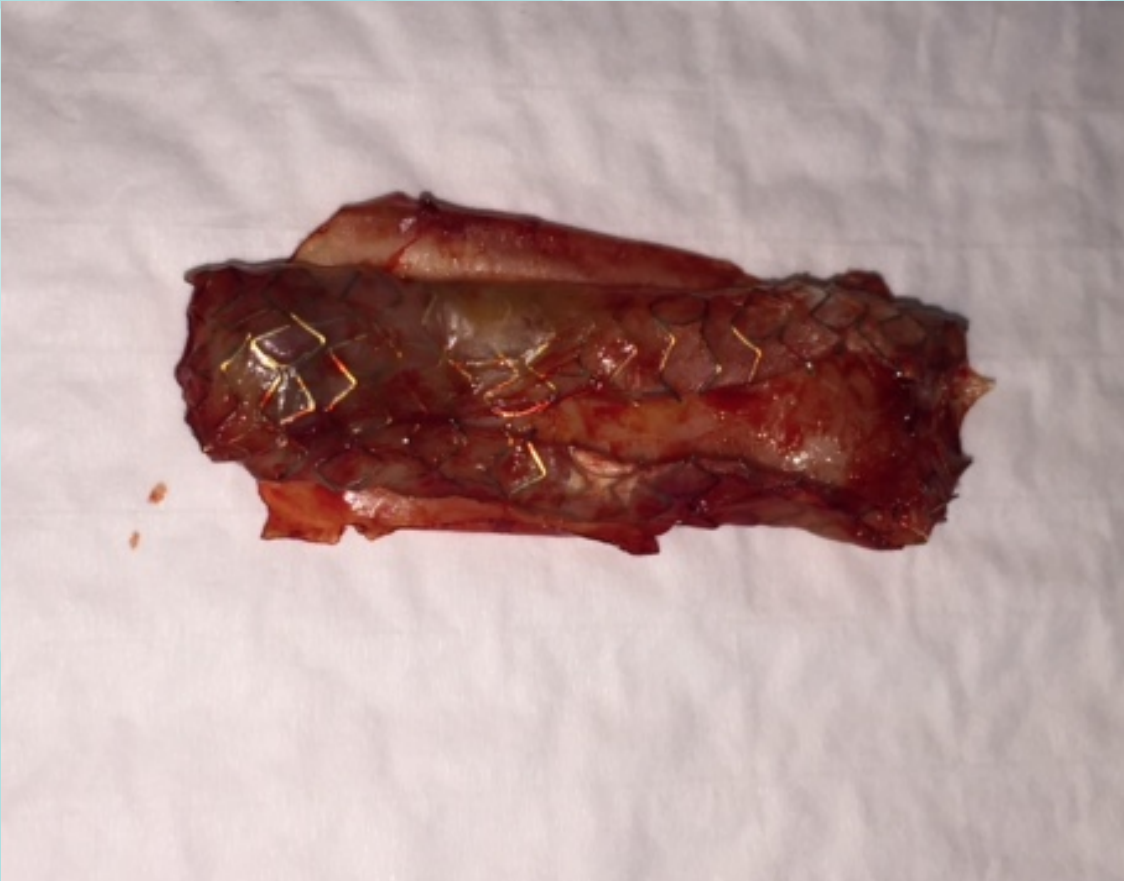
Case 7



Case 7

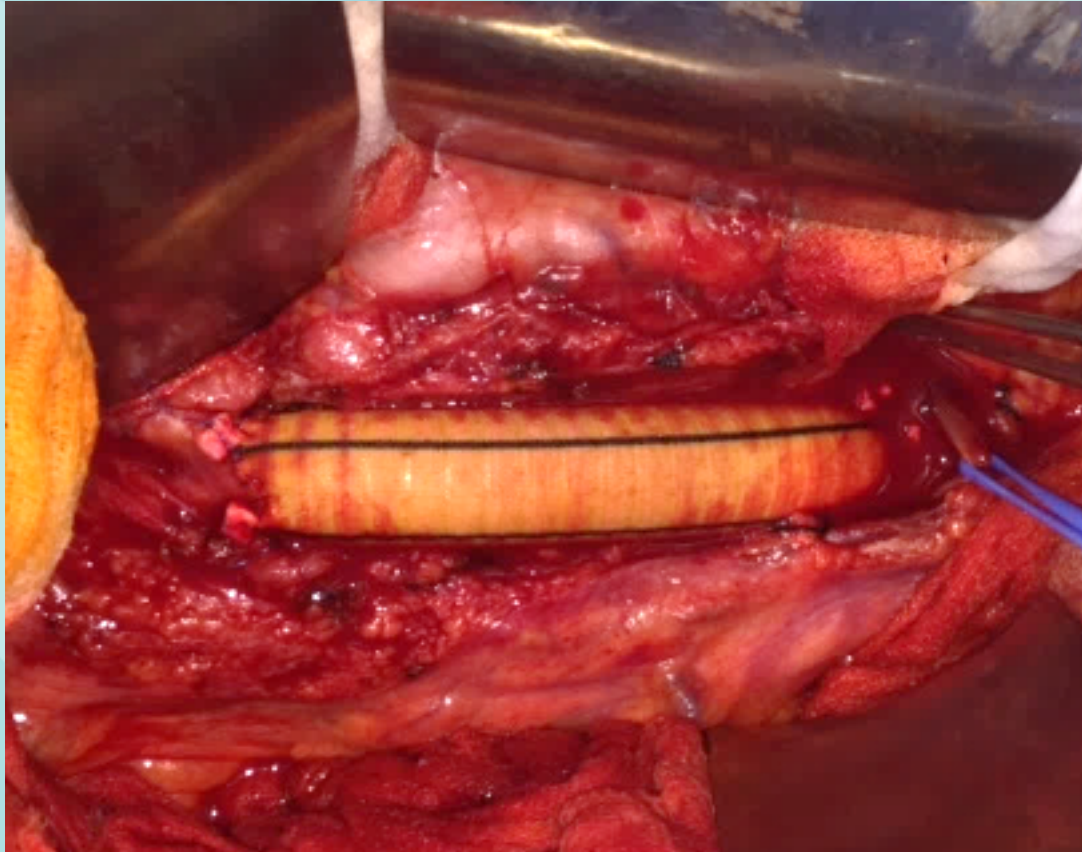


Case 7



- Explantation of aortic stent

Case 7



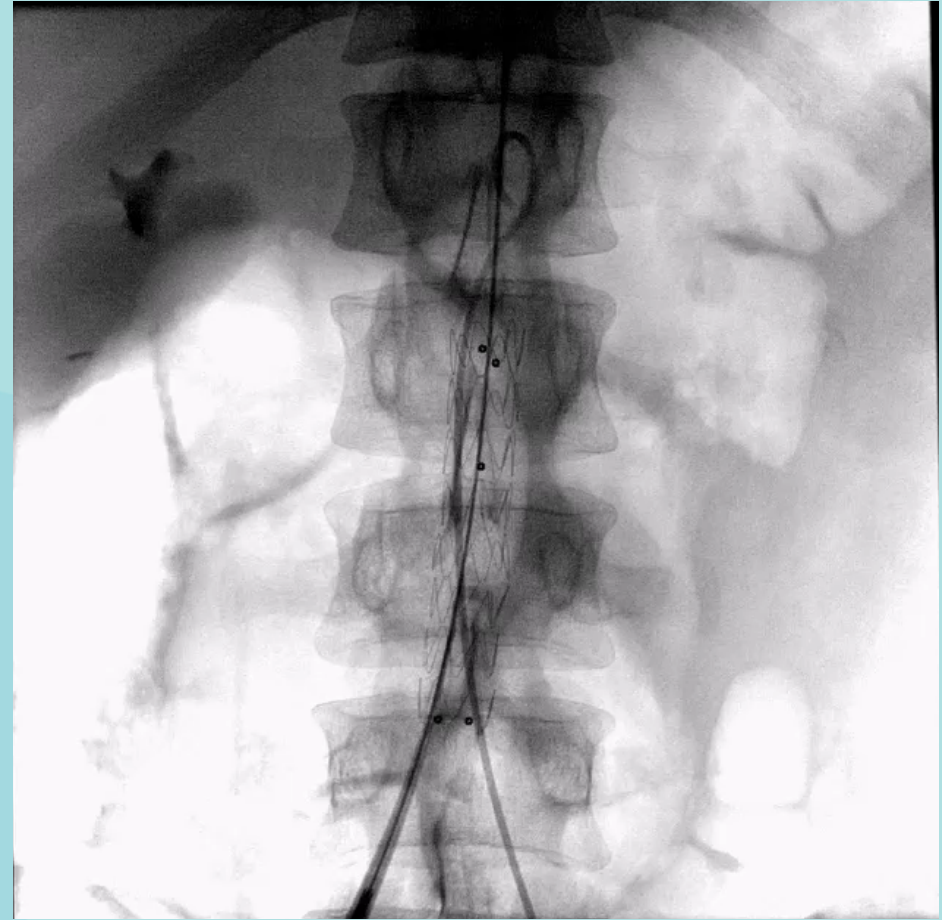
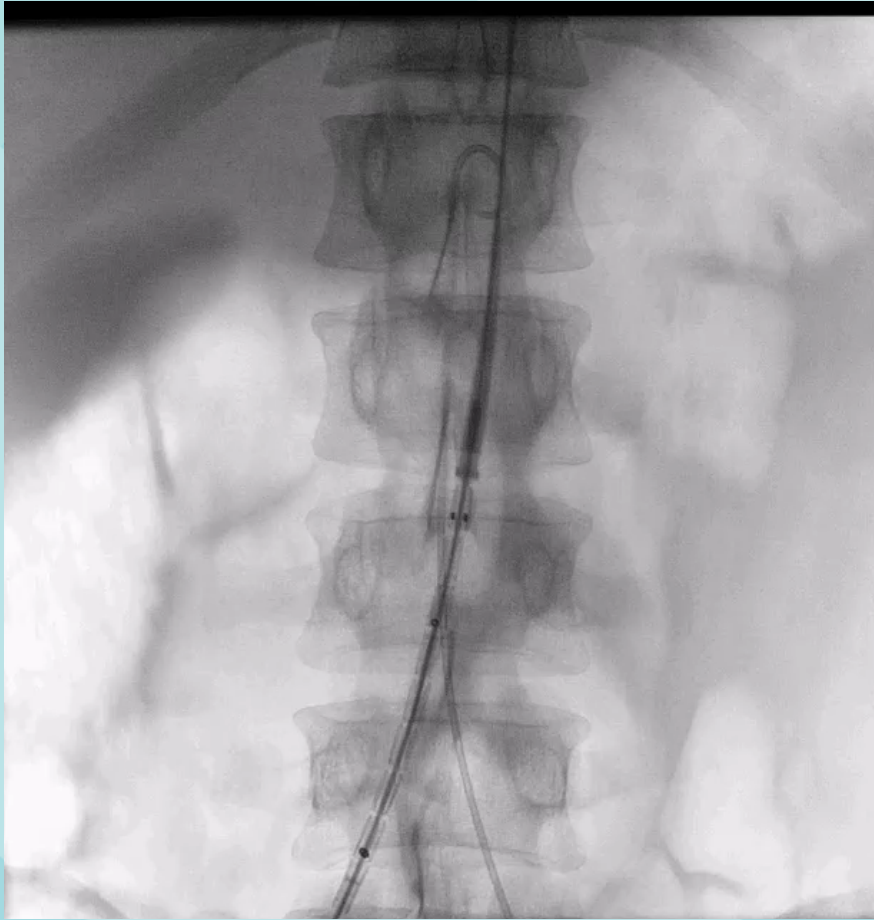
- Aorto-aortic graft interposition

Case 8

- 27 years-old, male
- High-speed motor vehicle collision
- Rear seat passenger with a 3-point seatbelt
- Intimal tear of the infra-renal aorta

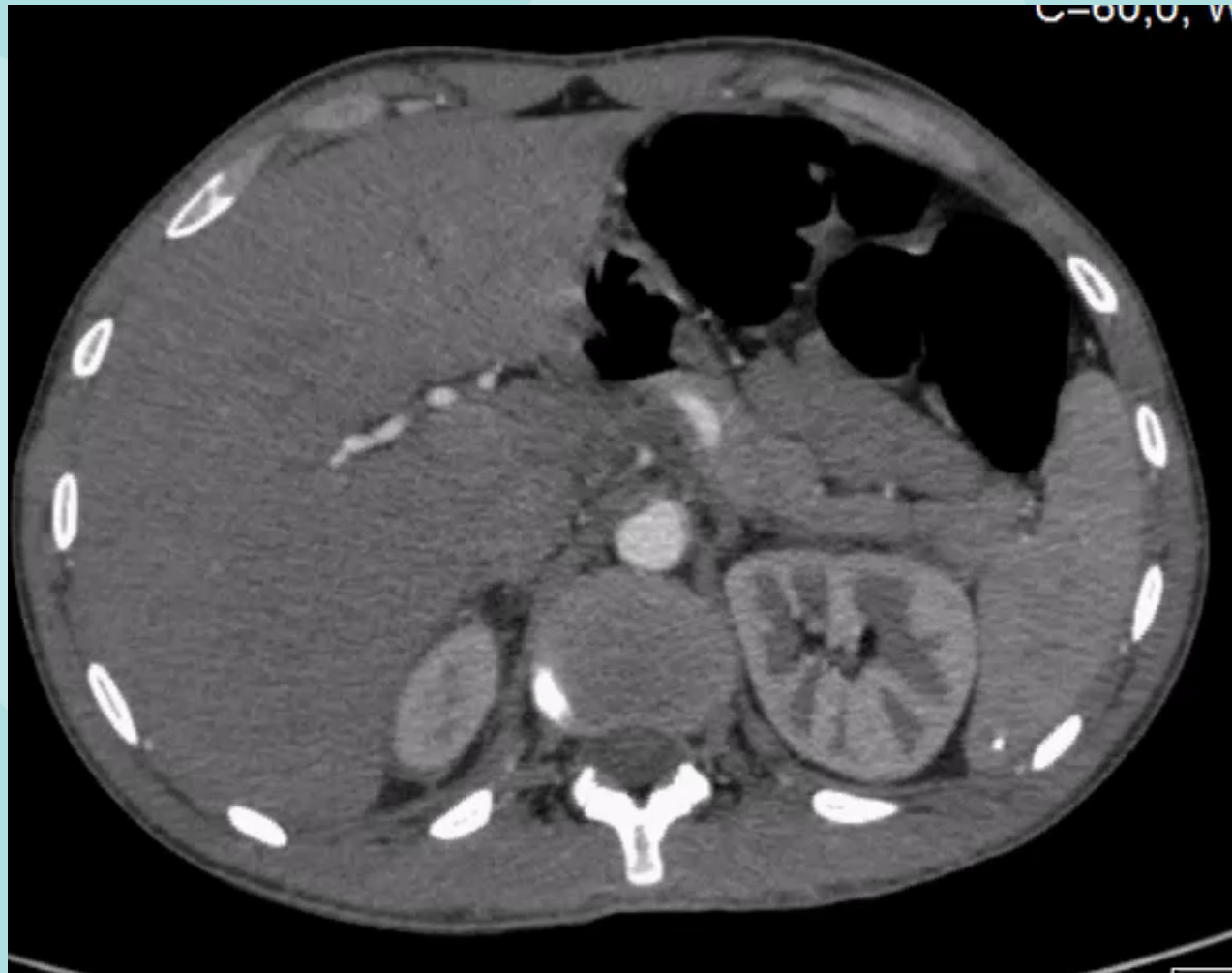


Case 8



Right Femoral access
Endurant II Medtronic® (16x16x82mm)

Case 8



Self vs balloon expandable stents

Self

Less radial force

Flexibility

'Grow' with patient
(theoretically)

Higher profile

Less diameters and lengths
available

Neointimal hyperplasia (limits)

Balloon

Lower profile

Diameters and lengths available

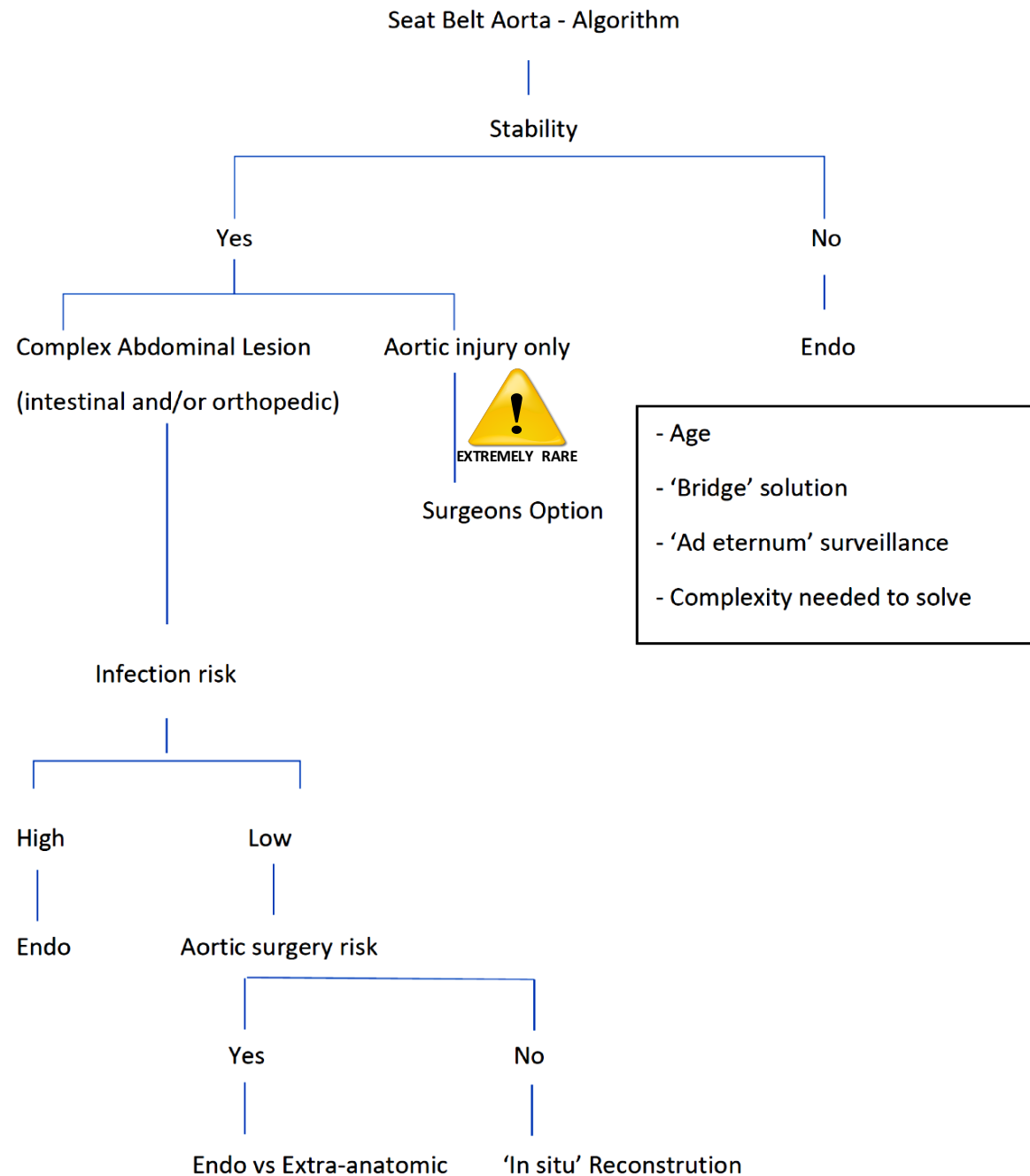
Can reballoon to adjust growth

Kinging/collapsing – THROMBOSIS?

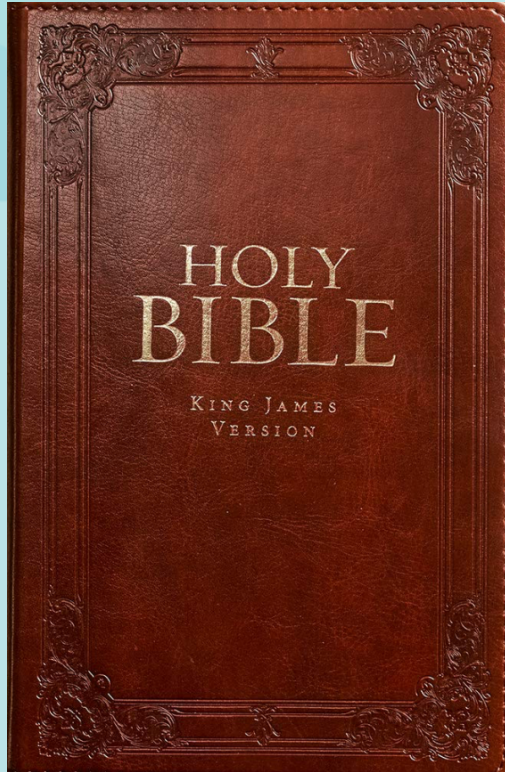
Less Flexibility

Don't 'grow' with patient

Algorithm



Conclusion





Obrigado