BSER
British Society of Emergency Radiology

All imaging anonymised and pseudoanonymised

ESER
European Society of Emergency Radiology

Key Decisions and Key Imaging Features in Blunt Solid Organ Trauma

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MTC MAJOR TRAUMA CENTRE ST MARY'S LONDON

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TRAUMA RADIOLOGY

12TH NORDIC COURSE

JUNE 10TH – 13TH, 2024
STOCKHOLM, SWEDEN

Disclosures

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1.GC Global Healthcare/RANZCR:

Speaker sponsorship for RANZCR Brisbane 2023

2.Everlight Radiology: honorarium (2023) donated to Crisis Rescue Foundation and Meningitis Now

Blunt Solid Organ Trauma

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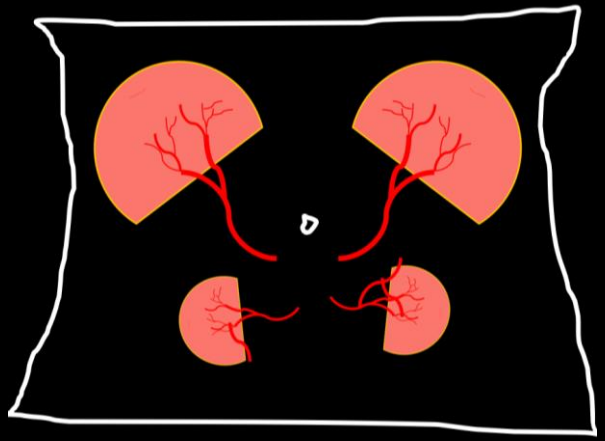

AAST Injury Scoring Scale: Next Talk

THE AMERICAN ASSOCIATION FOR THE SURGERY OF TRAUMA
ADVANCING TRAUMA AND ACUTE CARE SURGERY THROUGH COMPASSION, DISCOVERY, AND DEDICATION

Key Decisions

Conservative Rx

Interventional Radiology

Surgery

LIVER

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Liver Injury: How should patient be managed?

Conservative Rx

Interventional Radiology

Surgery

Liver Injury: How should patient be managed?

STABLE

UNSTABLE

Conservative Rx

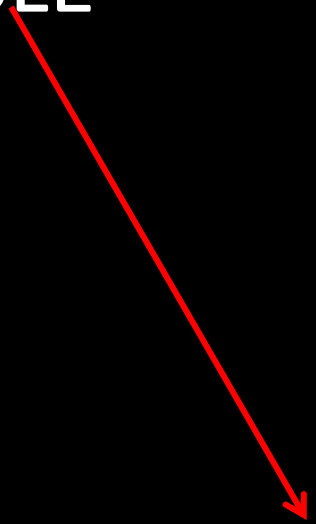
Interventional Radiology

Surgery

Liver Injury: How should patient be managed?

STABLE

UNSTABLE



Conservative Rx

Interventional Radiology

Surgery

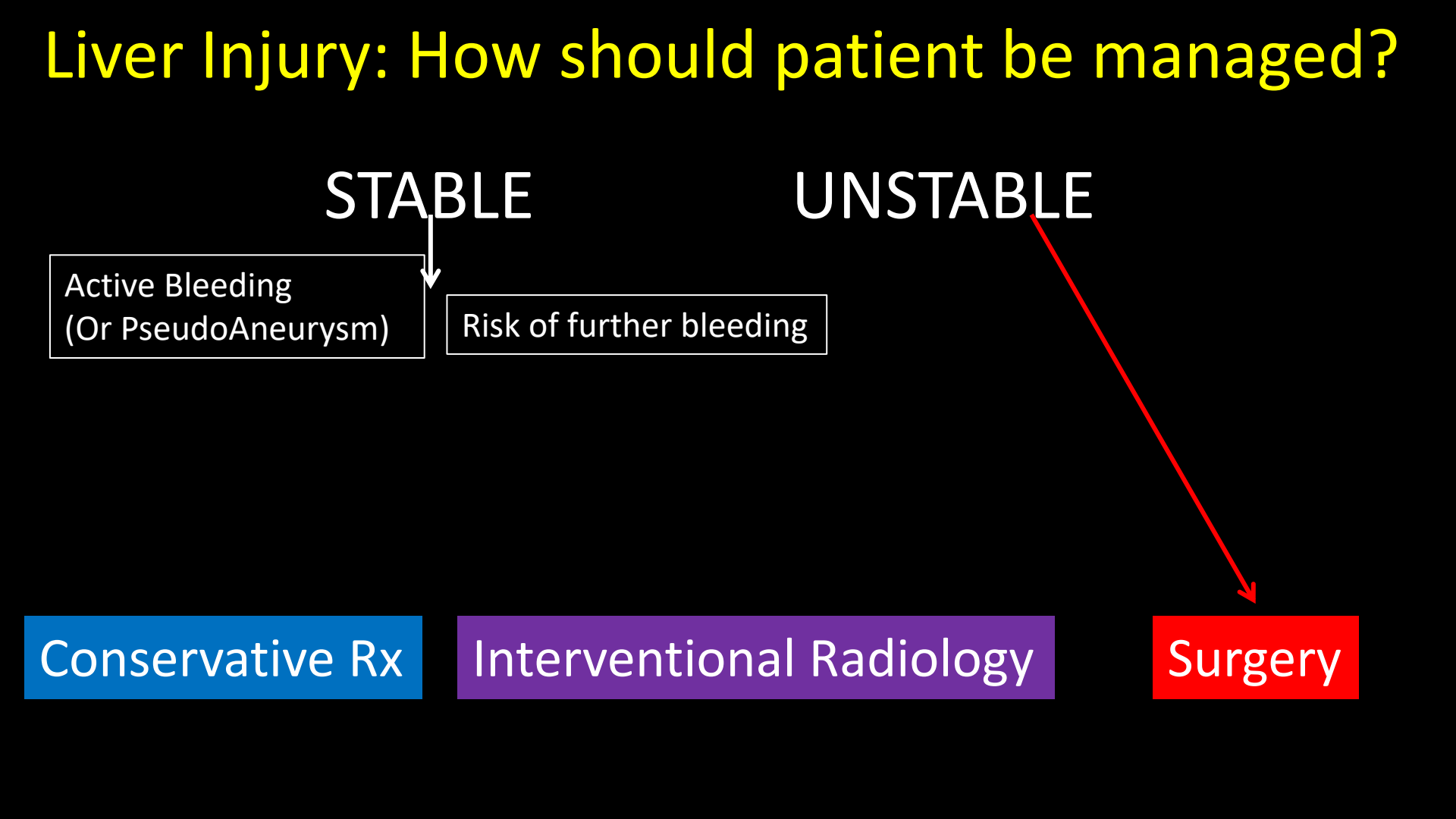
Liver Injury: How should patient be managed?

STABLE

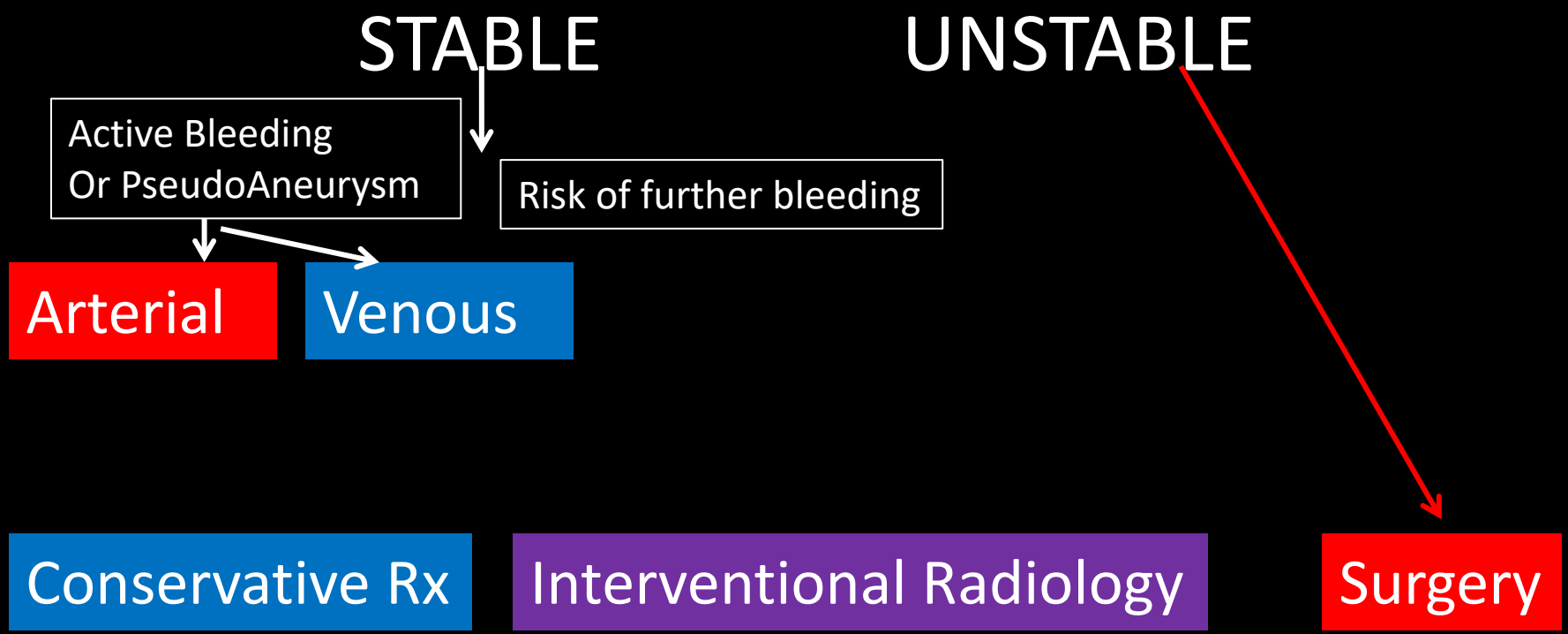
UNSTABLE

Active Bleeding
(Or PseudoAneurysm)

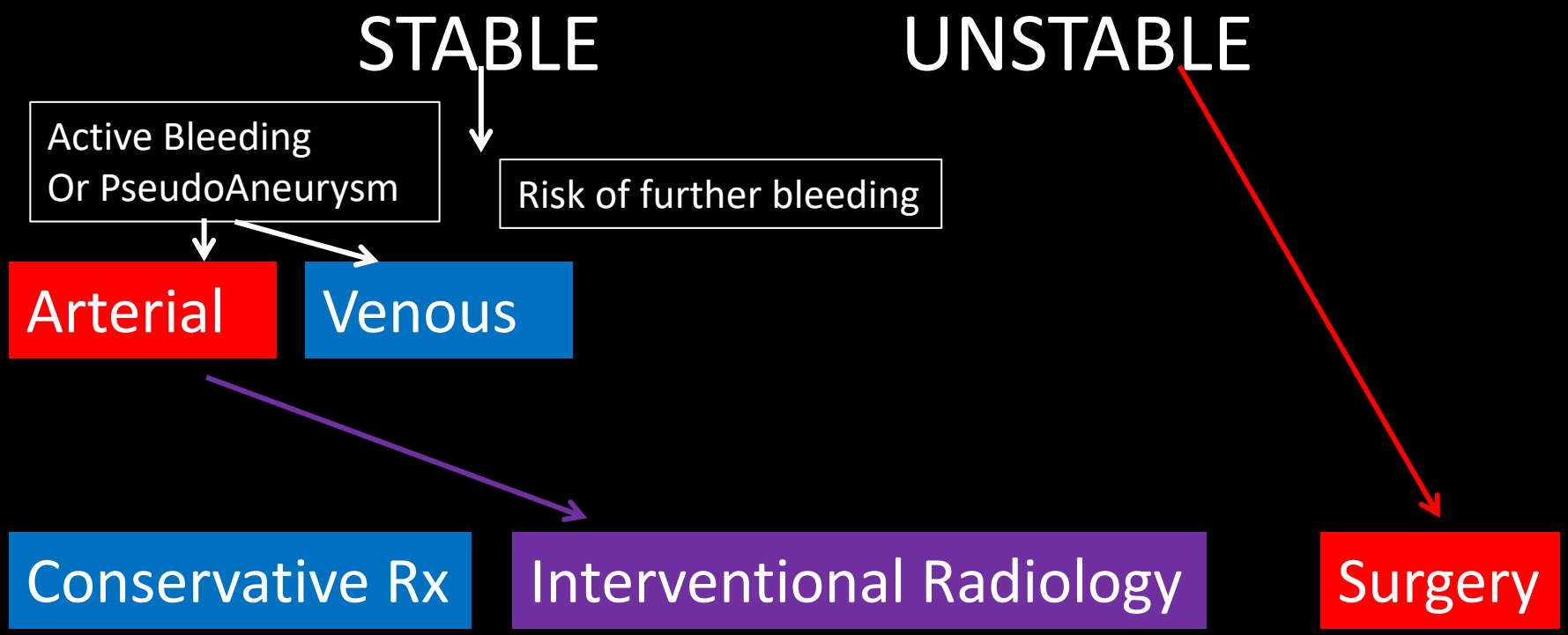
Risk of further bleeding



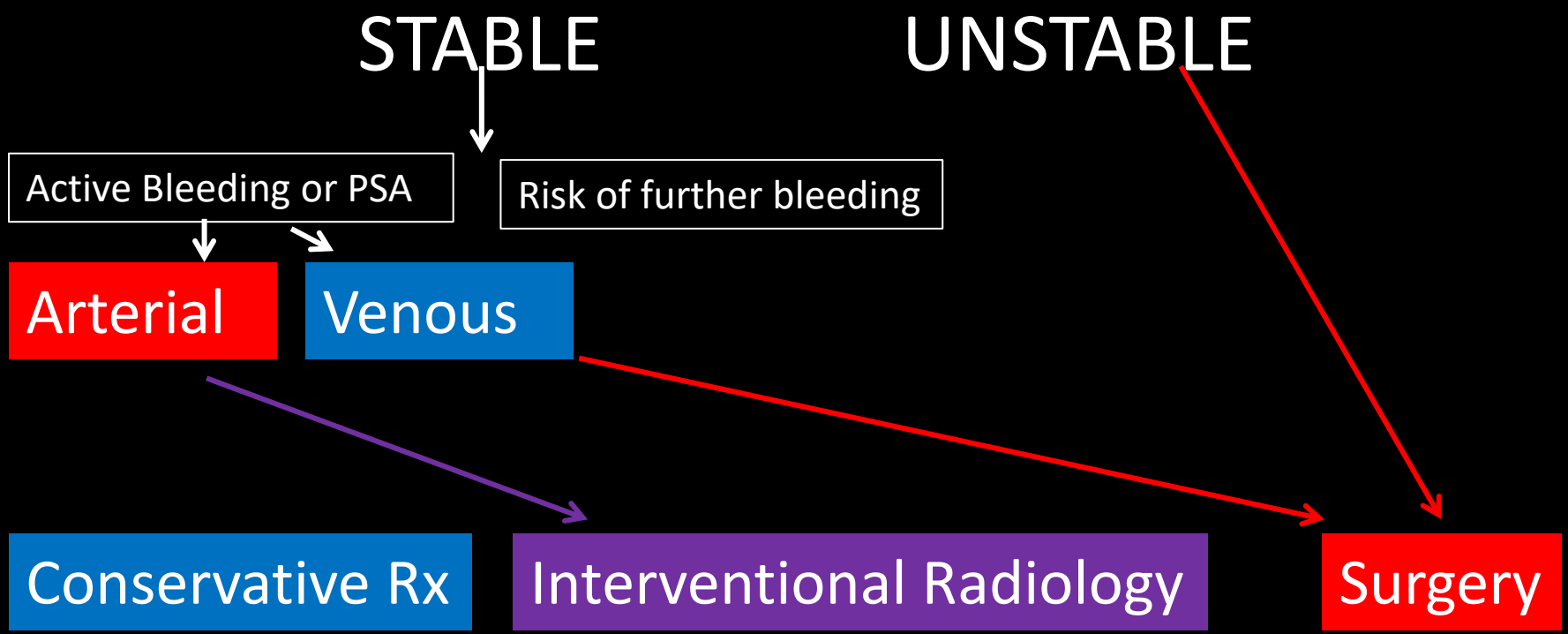
Liver Injury: How should patient be managed?



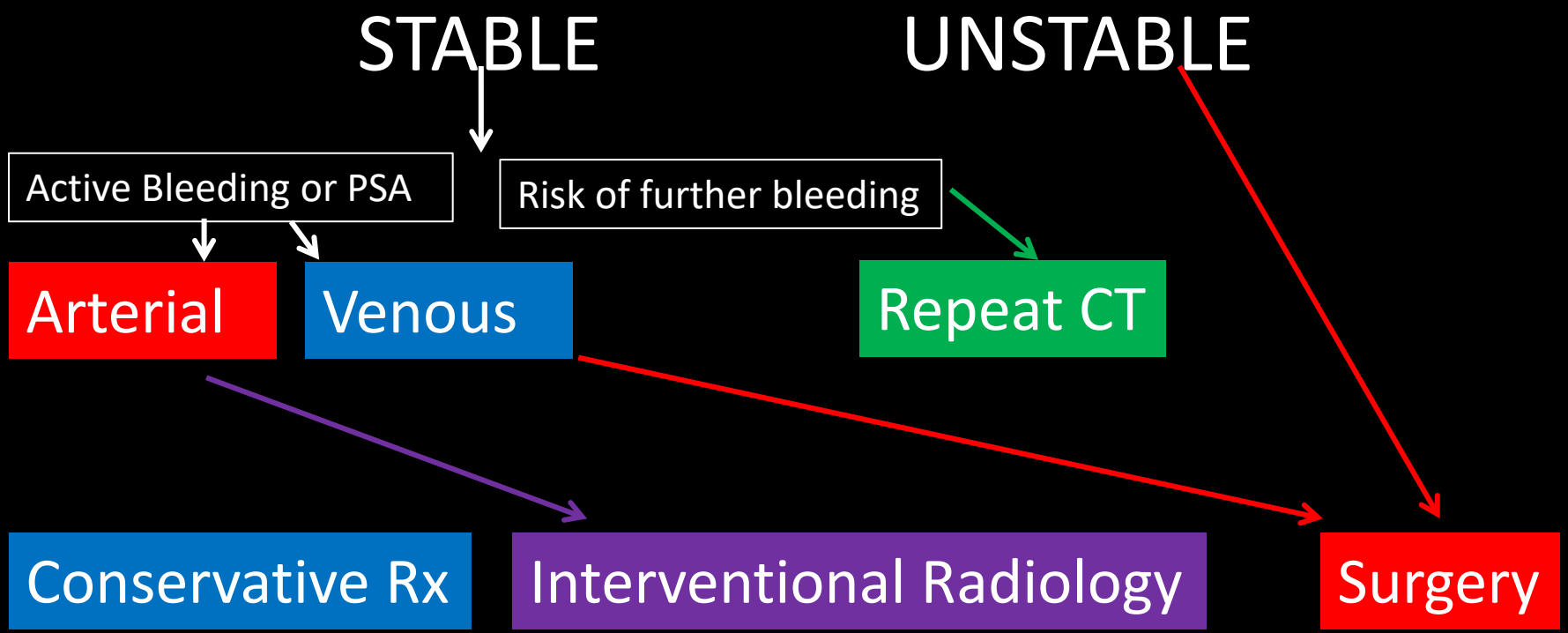
Liver Injury: How should patient be managed?



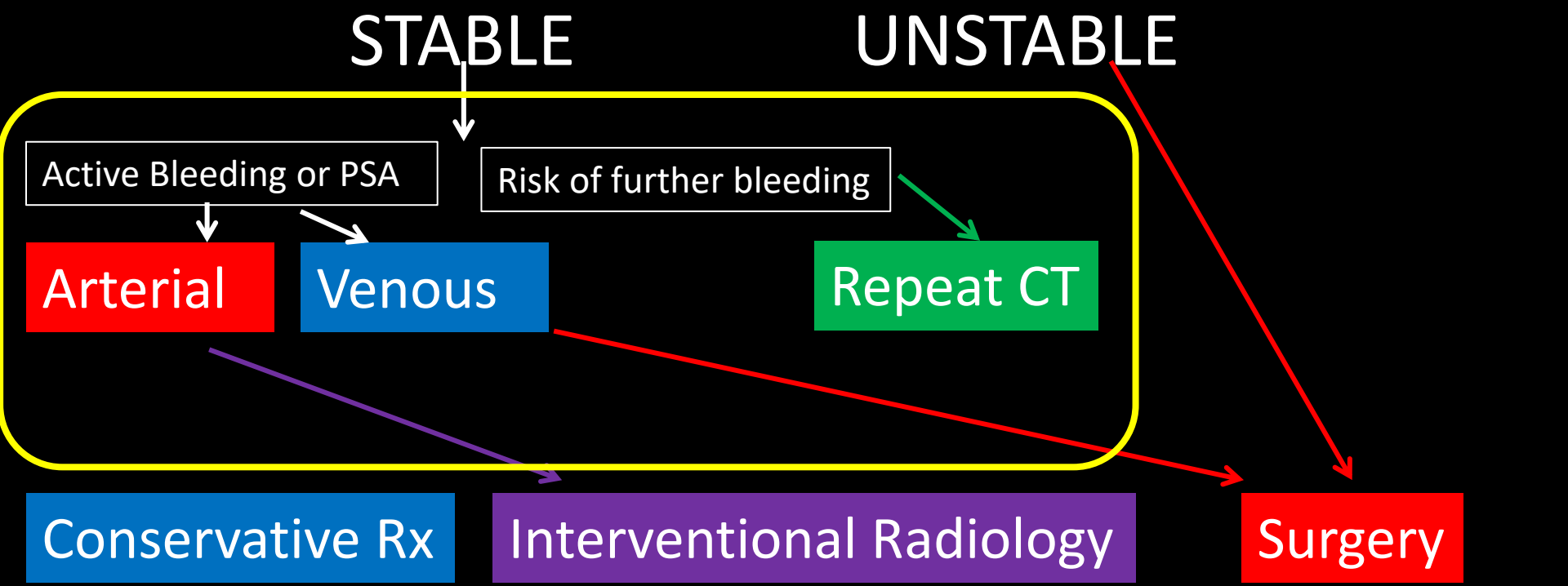
Liver Injury: How should patient be managed?



Liver Injury: How should patient be managed?



Liver Injury: How should patient be managed?



Active Bleeding or risk of further bleeding

Key Imaging Features

- Capsular breach?
- Vascular damage? (contrast extravasation, pseudoaneurysm, AV Fistula)
- Is the porta affected?

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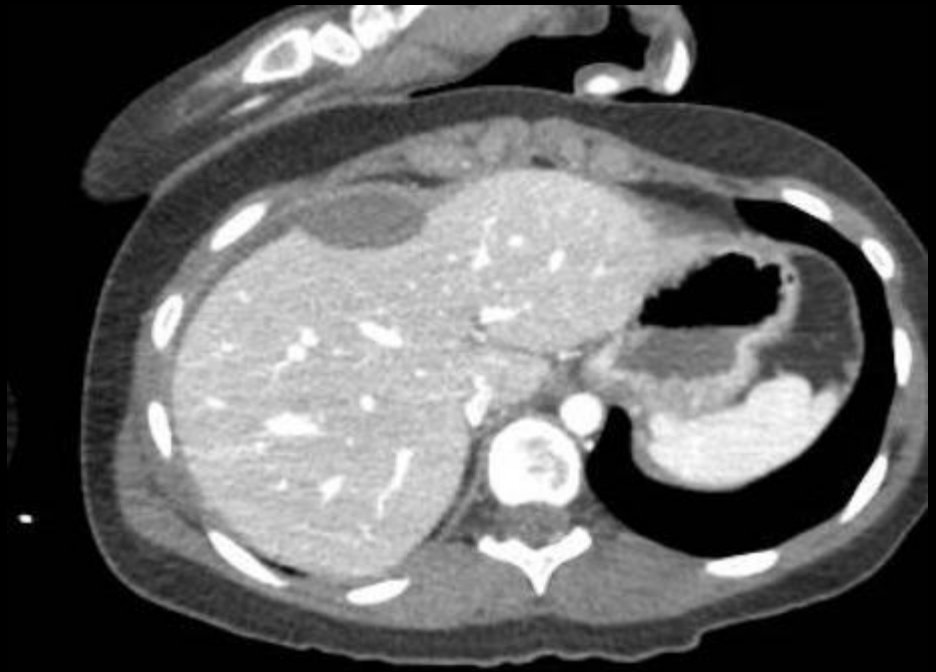
CASE 1

Blunt Injury, Road Traffic Collision Stable



1. Capsular breach
2. Vascular damage
3. porta

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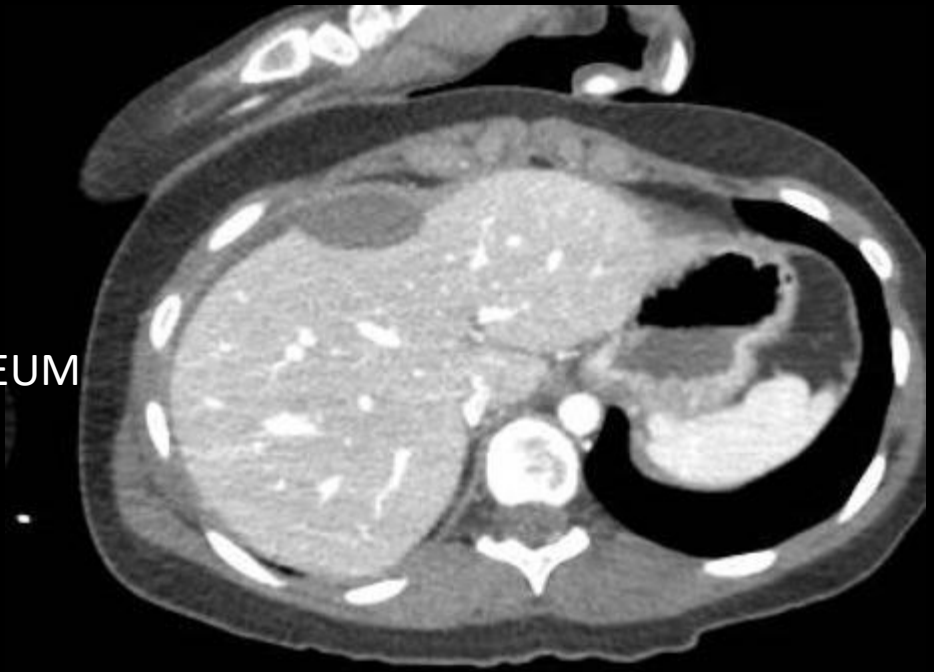
CASE 1

Blunt Injury, Road Traffic Collision Stable

1. Capsular breach
2. Vascular damage
3. porta



NO HAEMOPERITONEUM

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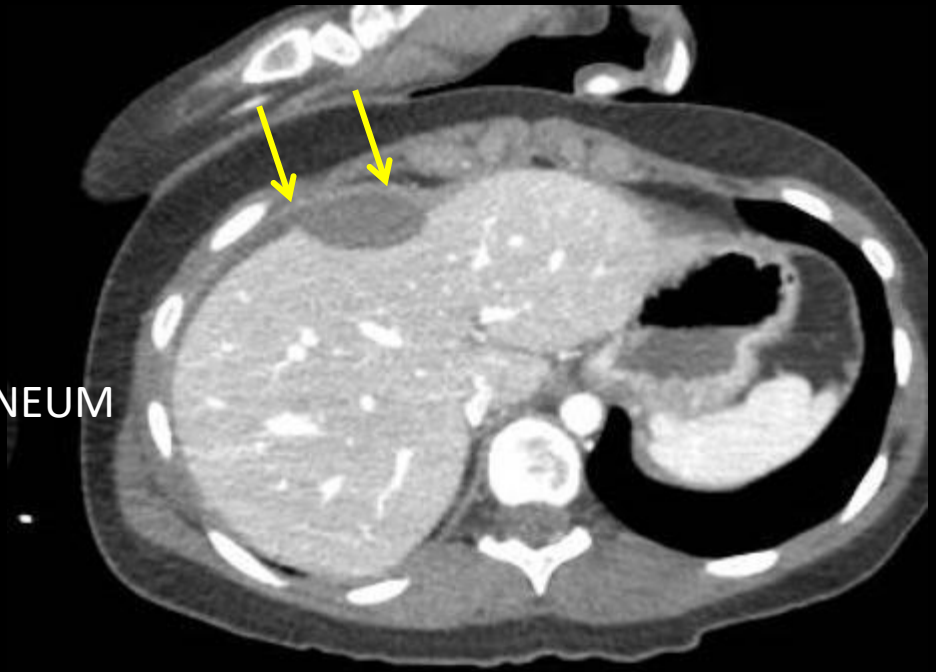
CASE 1

Blunt Injury, Road Traffic Collision Stable

1. Capsular breach
2. Vascular damage
3. porta



NO HAEMOPERITONEUM

Contained subcapsular haematoma, no haemoperitoneum

Grade II: Subcapsular haematoma 10-50% surface

Q1.How should this Grade II liver injury be managed?

A. Conservative Mx, no further imaging or Rx needed
B. Repeat CT in 48 to 72 hours
C. Interventional Radiology (Hepatic Angiography)
D. Operative

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How should this grade 2 liver injury be managed

Conservative

0%

repeat CT in 48 to 72 hours

0%

Interventional Radiology (Hepatic Angiography)

0%

Operative

0%

How should this Grade II liver injury be managed?

A. Conservative Mx, no further imaging or Rx needed
B. Repeat CT in 48 to 72 hours
C. Interventional Radiology (Hepatic Angiography)
D. Operative

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How should this Grade II liver injury be managed?

A. Conservative Mx, no further imaging or Rx needed
B. Repeat CT in 48 to 72 hours
C. Interventional Radiology (Hepatic Angiography)
D. Operative

Contained subscapular haematoma, no haemoperitoneum

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CASE 2

Driver Car vs car Polytrauma

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CASE 2

Capsular breach and haemoperitoneum

1. Capsular breach
2. Vascular damage
3. porta

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CASE 2

Capsular breach and haemoperitoneum

1. Capsular breach
2. Vascular damage
3. porta

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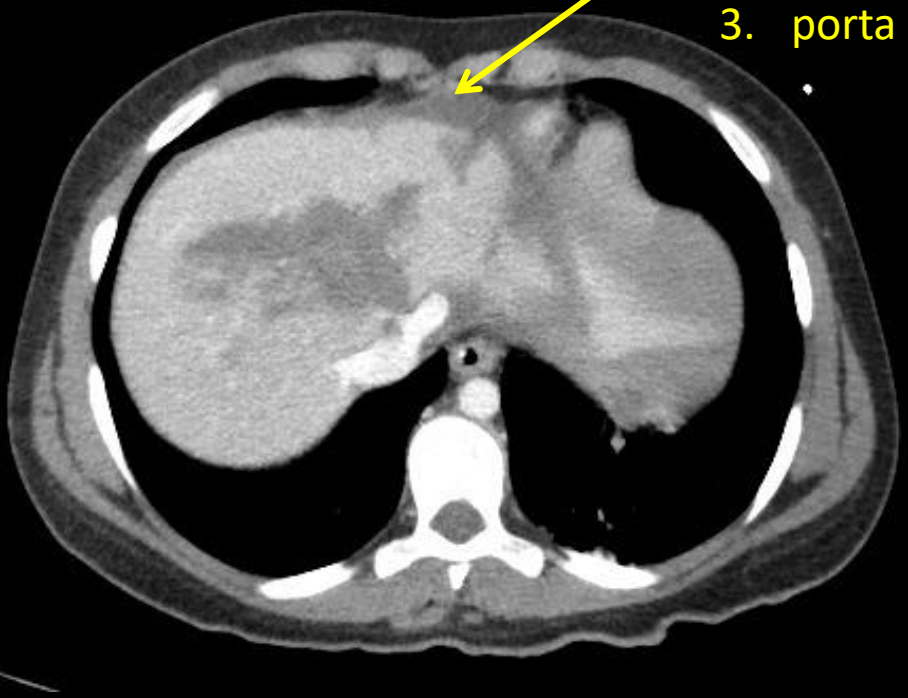
Haemoperitoneum = capsule breach

Capsular breach and haemoperitoneum

1. Capsular breach
2. Vascular damage
3. porta

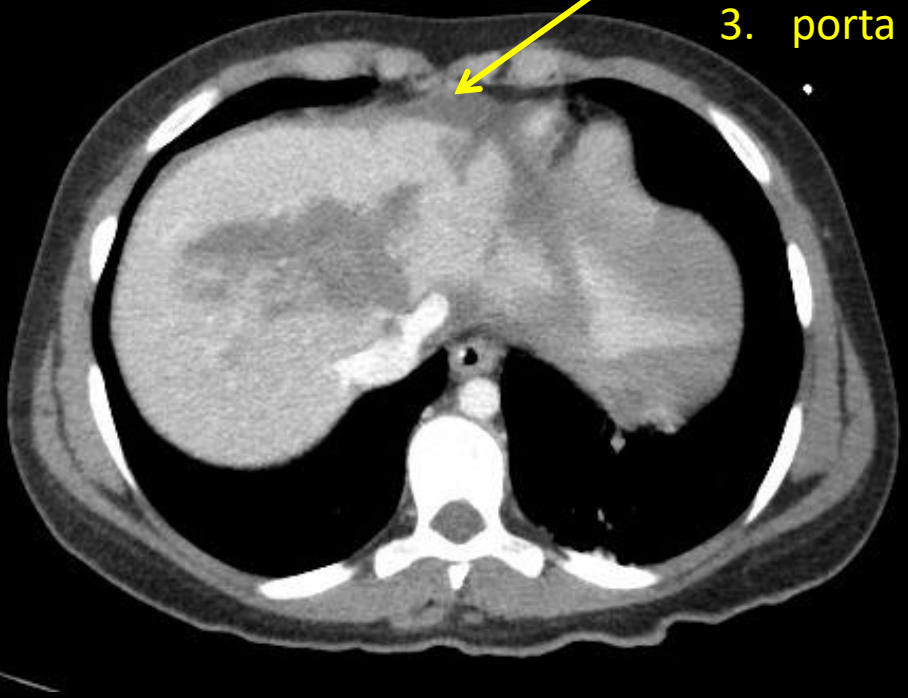


Haemoperitoneum = capsule breach

CASE 2

Capsular breach and haemoperitoneum

1. Capsular breach
2. Vascular damage
3. porta



Grade V liver laceration (to hilum)

Haemoperitoneum = capsule breach

Q2.How should this liver injury be managed?

A. Conservative Mx, no further imaging or Rx needed
B. Repeat CT in 48 to 72 hours
C. Interventional Radiology (Hepatic Angiography)
D. Operative

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How should this grade 2 liver injury be managed

Conservative

0%

repeat CT in 48 to 72 hours

0%

Interventional Radiology (Hepatic Angiography)

0%

Operative

0%

How should this liver injury be managed?

A. Conservative Mx, no further imaging or Rx needed
B. Repeat CT in 48 to 72 hours
C. Interventional Radiology (Hepatic Angiography)
D. Operative

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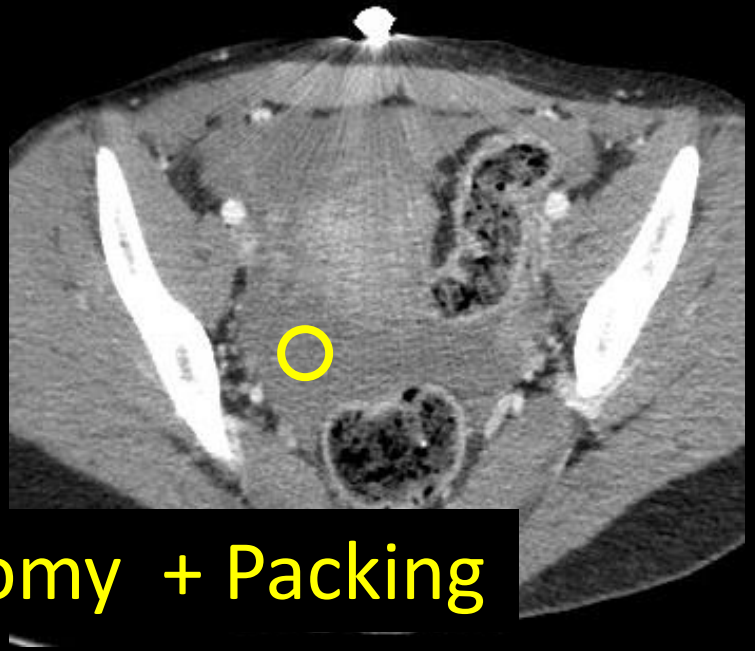
CASE 2

Capsular breach and haemoperitoneum

1. Capsular breach
2. Vascular damage
3. porta



Damage Control Laparotomy + Packing

Haemoperitoneum = capsule breach

CASE 3

Pedestrian vs car
Stable

1. Capsular breach
2. Vascular damage
3. porta

Thanks to Dr Elika Kashef

CASE 3

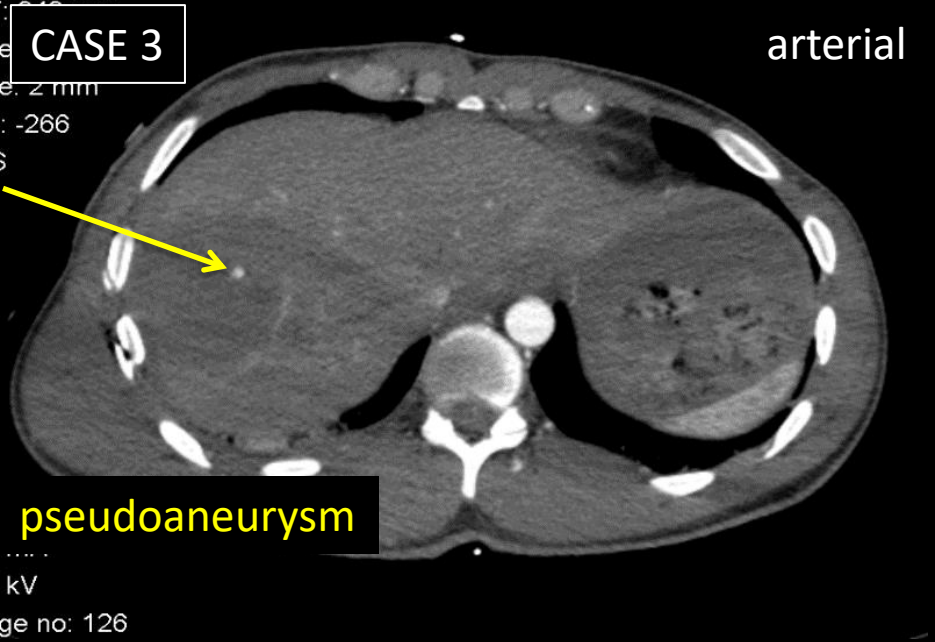
arterial

Pedestrian vs car
Stable

1. Capsular breach
2. Vascular damage
3. porta

Thanks to Dr Elika Kashef

CASE 3



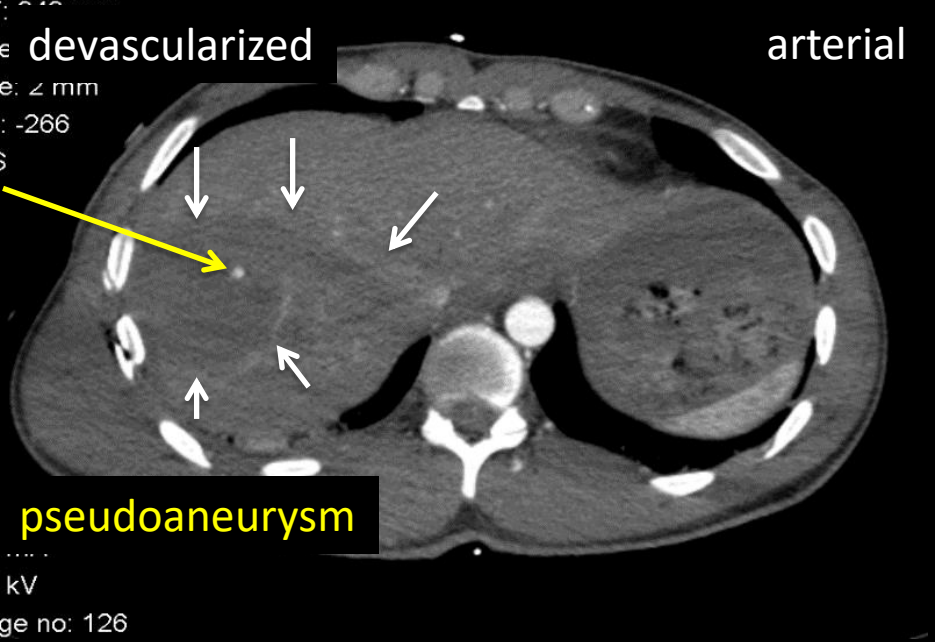
Pedestrian vs car
Stable

1. Capsular breach
2. Vascular damage
3. porta

Thanks to Dr Elika Kashef

CASE 3

Pedestrian vs car
Stable



1. Capsular breach
2. Vascular damage
3. porta

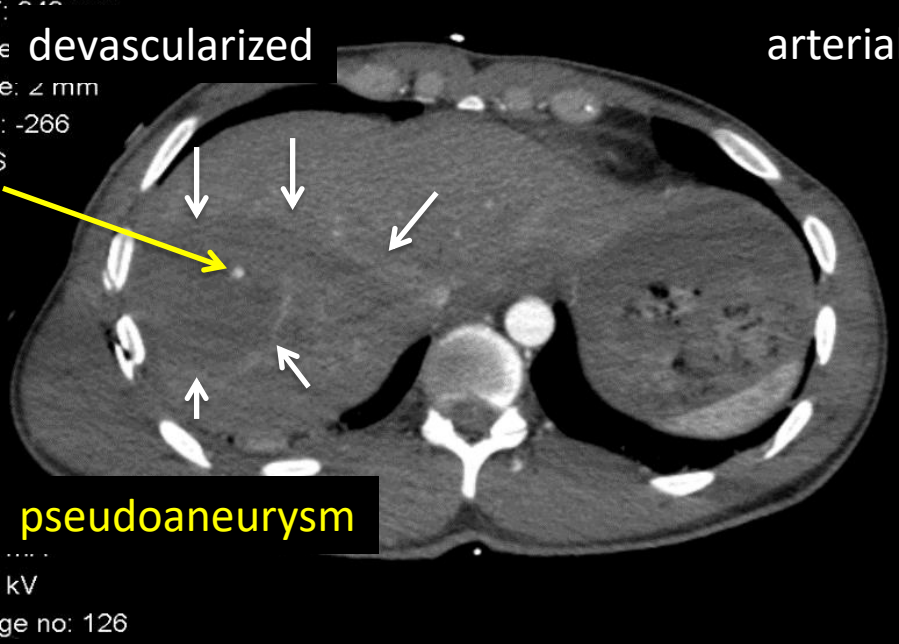
Thanks to Dr Elika Kashef

CASE 3

Pedestrian vs car
Stable

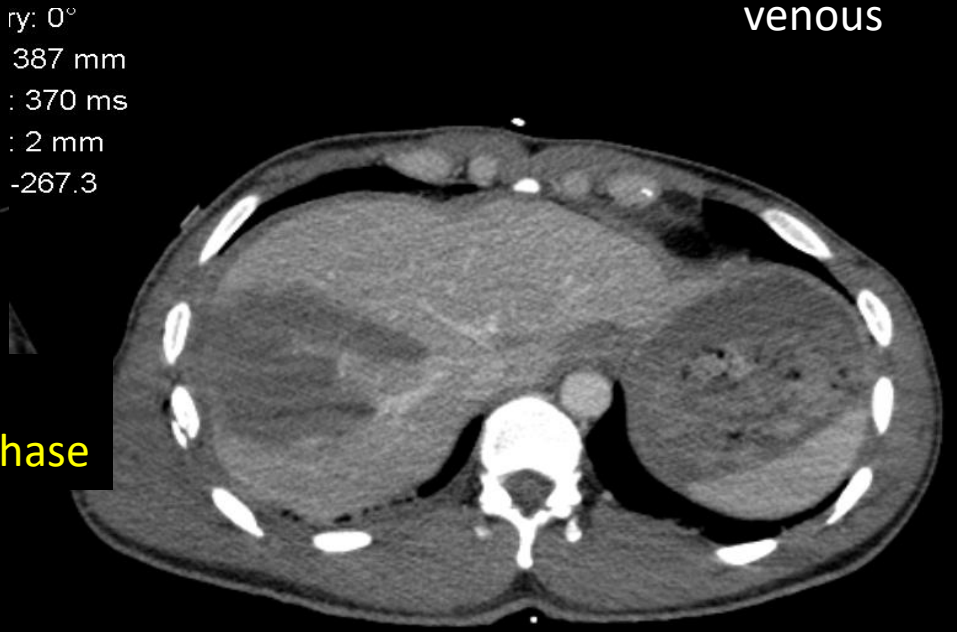
devascularized

arterial



pseudoaneurysm

venous

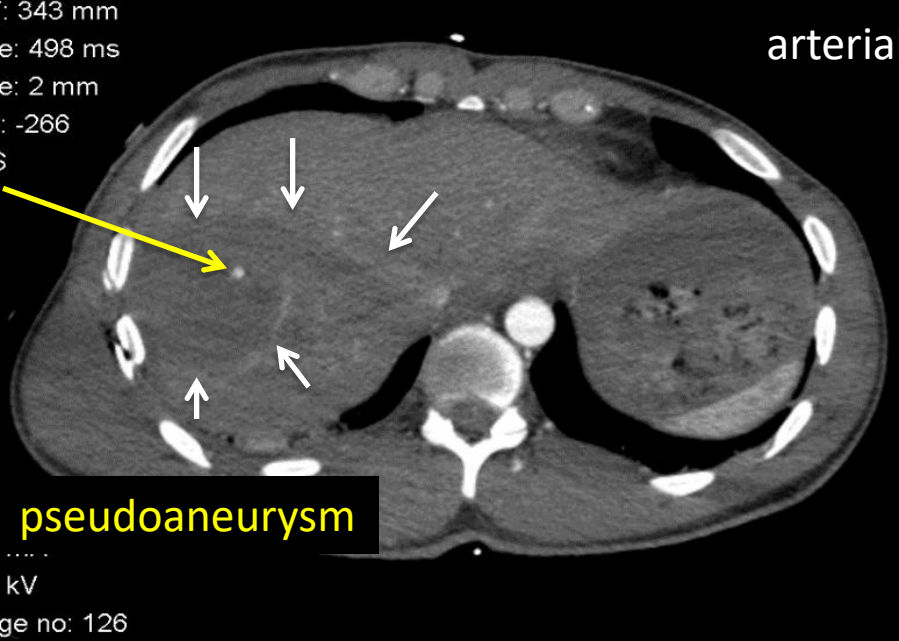


Pseudoaneurysm
-fades in venous phase

Thanks to Dr Elika Kashef

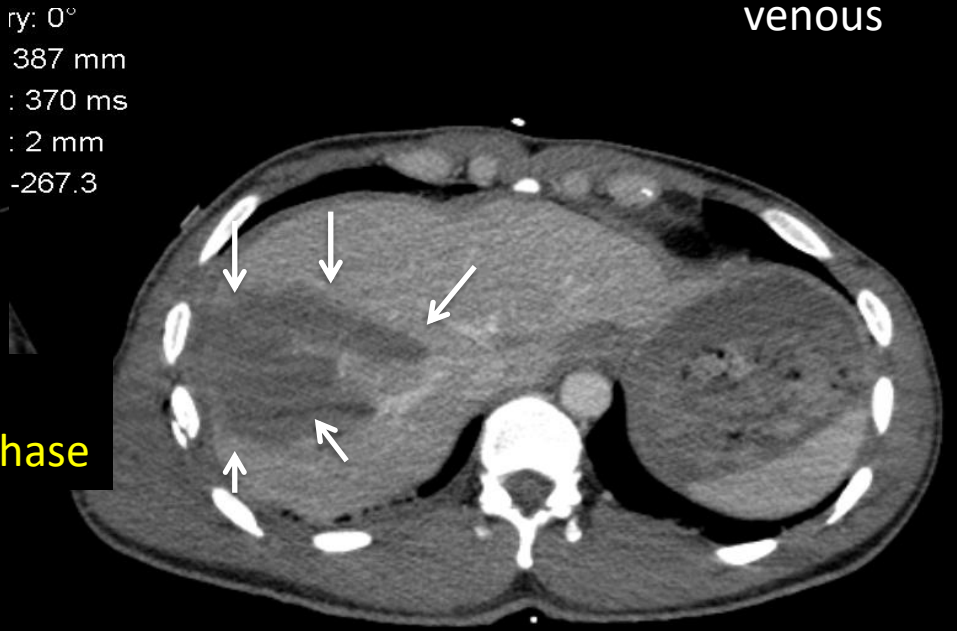
CASE 3

arterial



pseudoaneurysm

venous



Pseudoaneurysm
-fades in venous phase

Thanks to Dr Elika Kashef

CASE 3

Q3. How should this liver injury be managed?

A. Conservative Mx, no further imaging or Rx needed
B. Repeat CT in 48 to 72 hours
C. Interventional Radiology (Hepatic Angiography)
D. Operative

pollEv.com/edick900

How should this liver injury be managed

Conservative

0%

repeat CT in 48 to 72 hours

0%

Interventional Radiology (Hepatic Angiography)

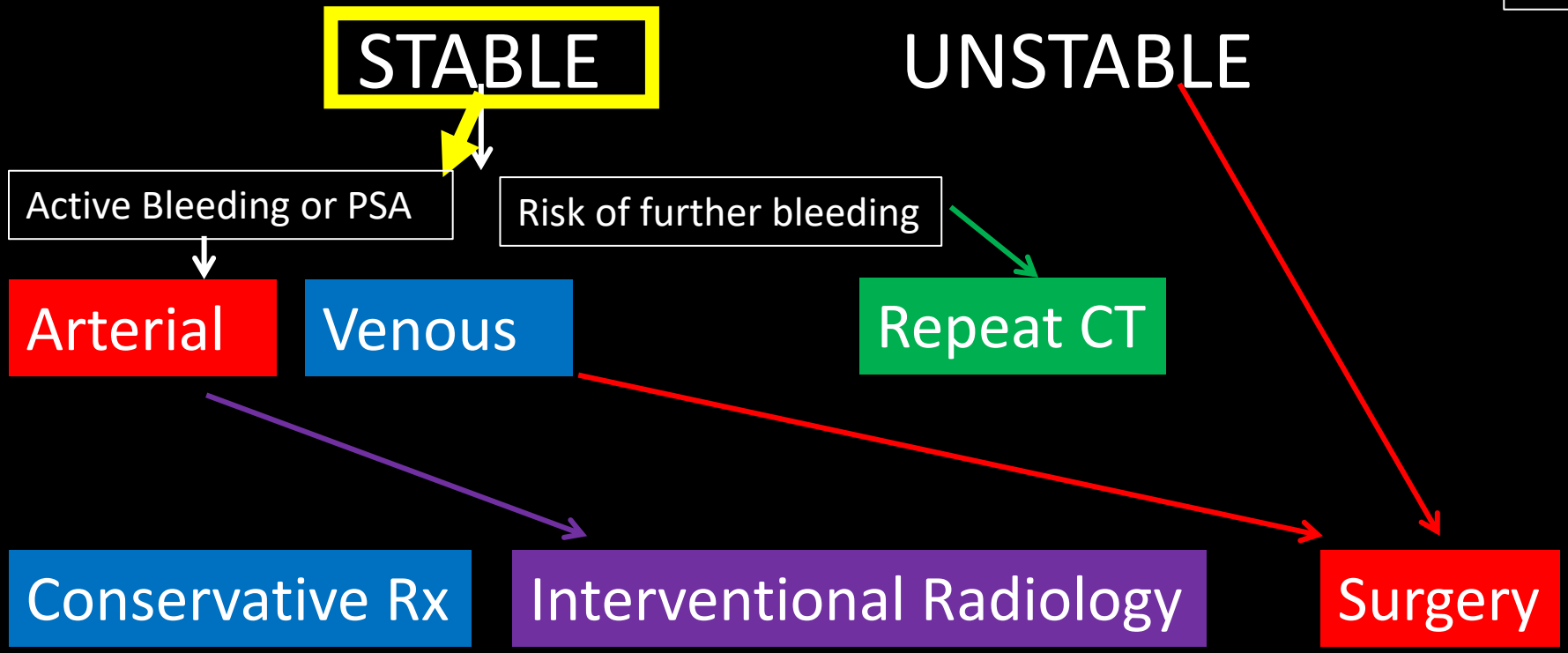
0%

Operative

0%

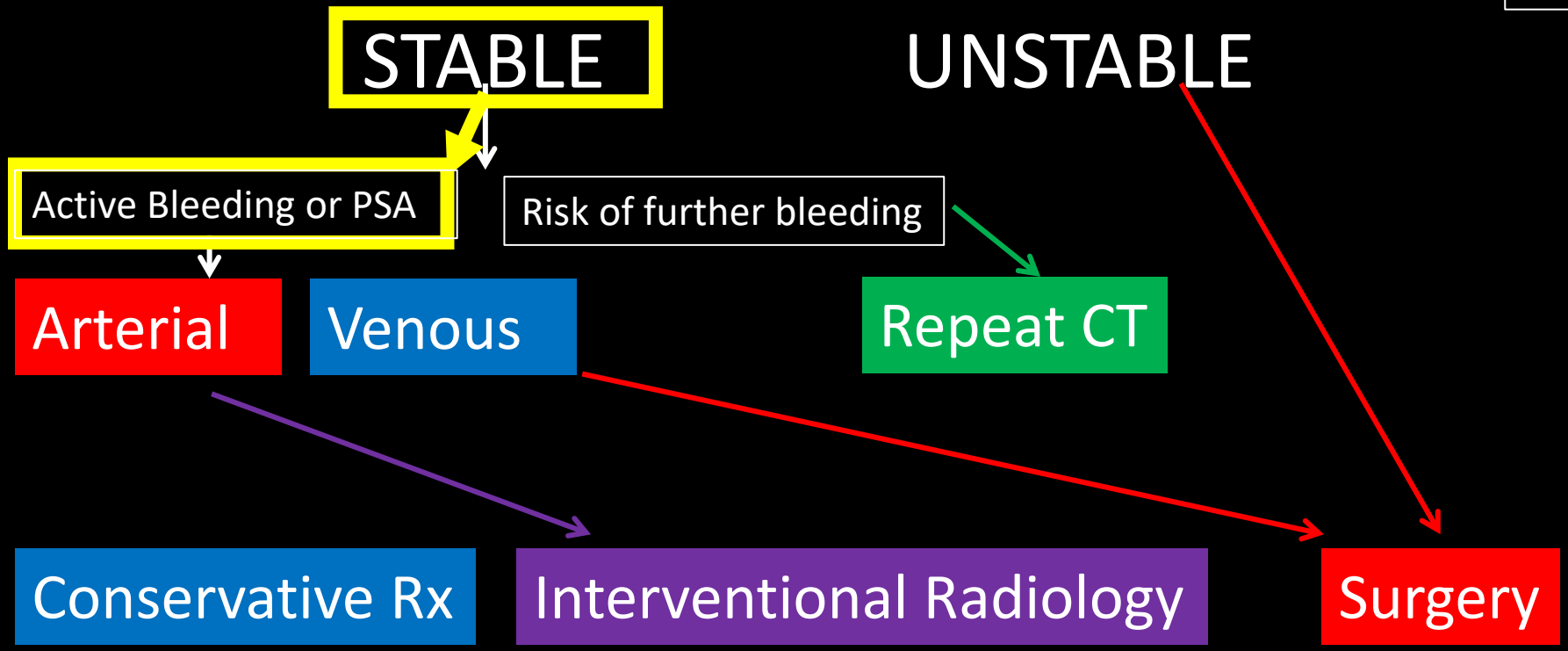
Liver Injury: How should patient be managed?

CASE 3

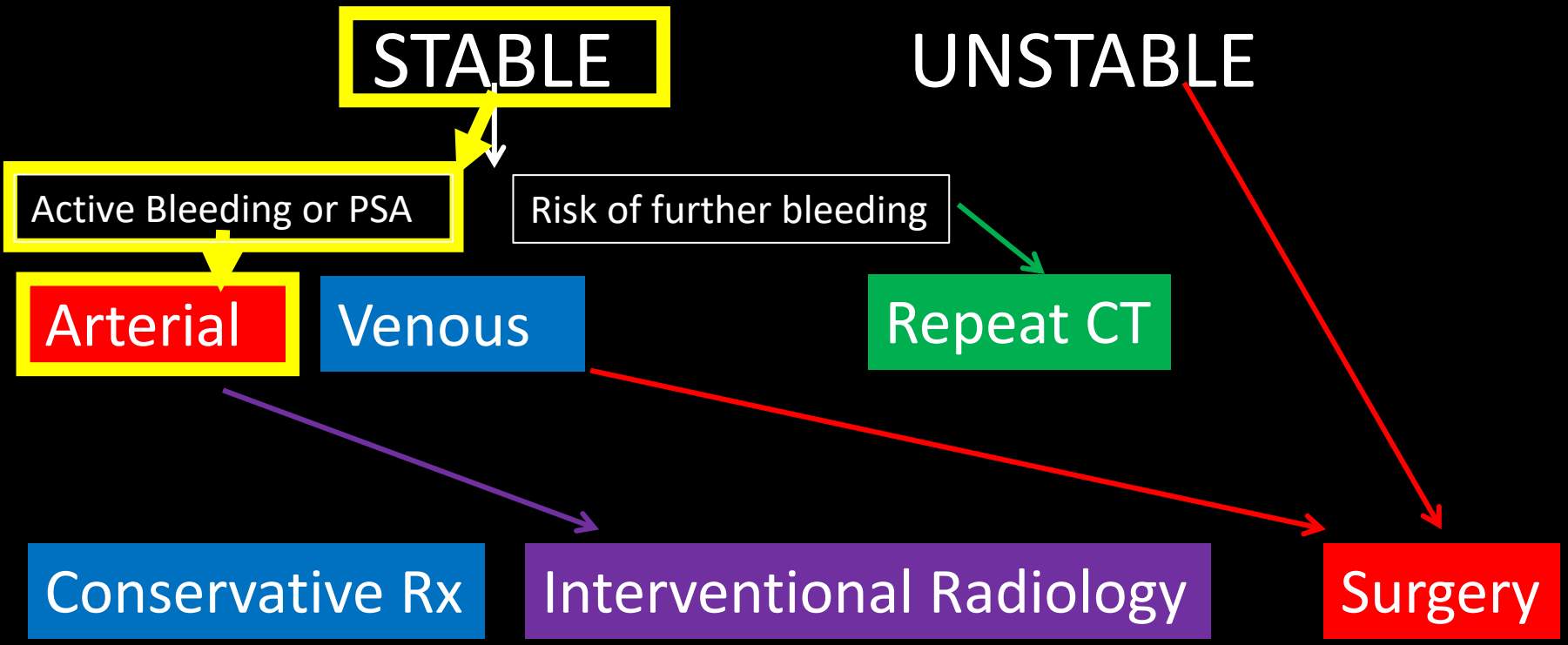


Liver Injury: How should patient be managed?

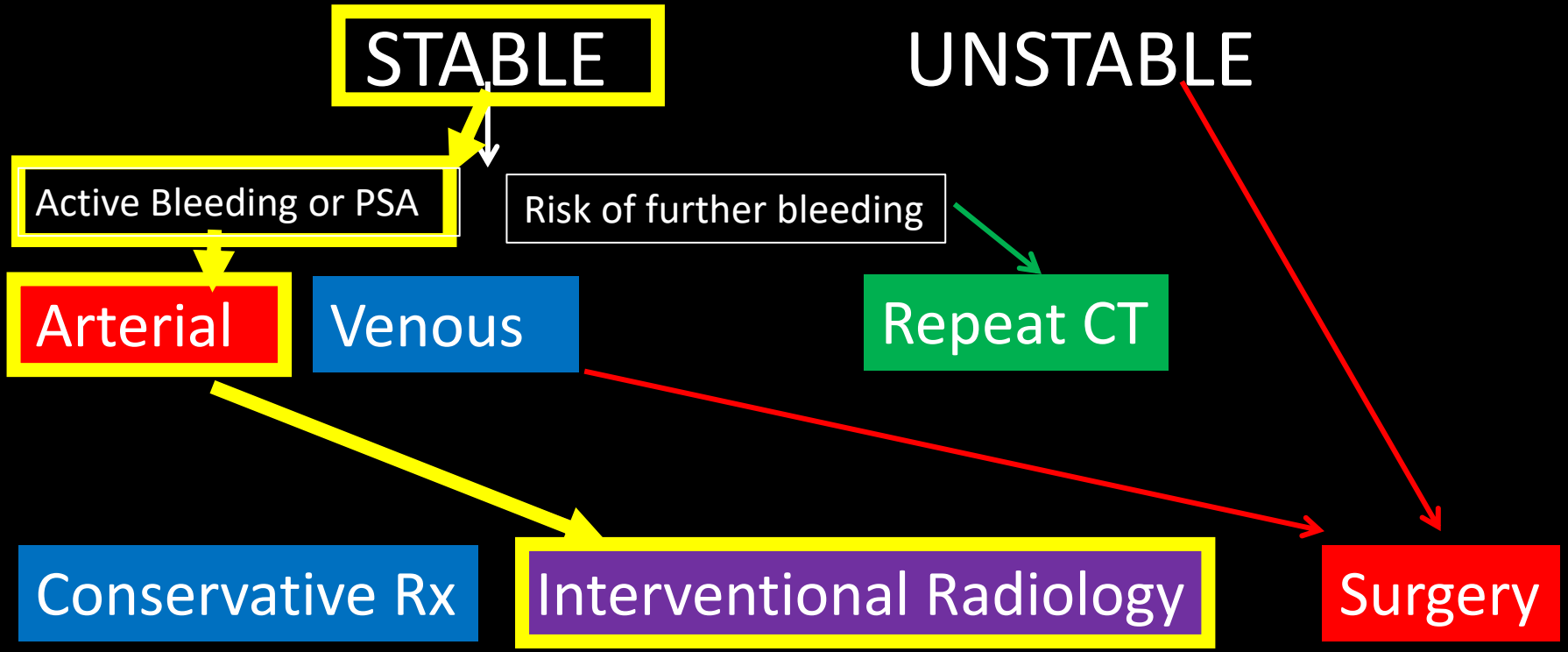
CASE 3



Liver Injury: How should patient be managed?



Liver Injury: How should patient be managed?



How should this liver injury be managed?

A. Conservative Mx, no further imaging or Rx needed
B. Repeat CT in 48 to 72 hours
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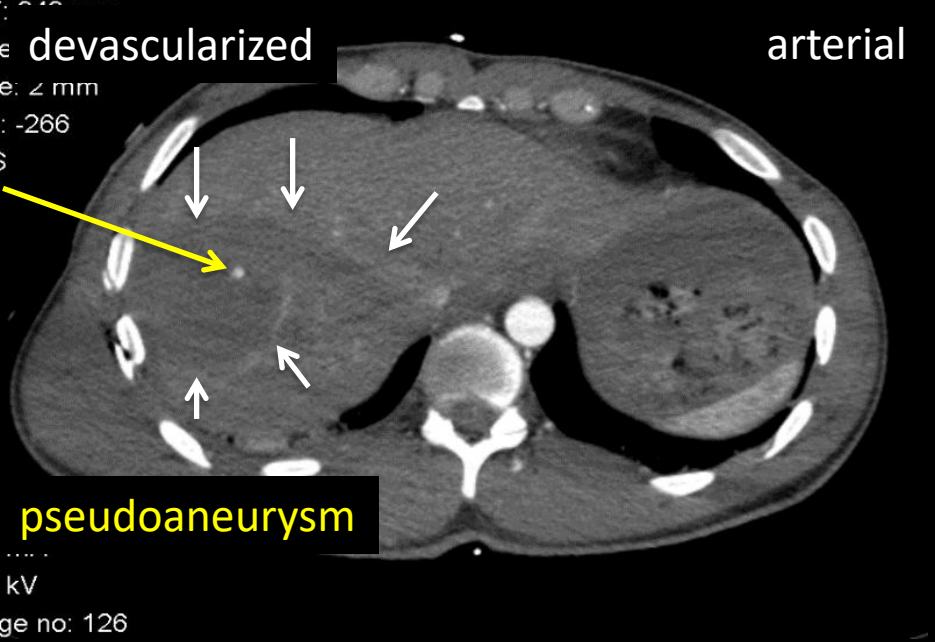
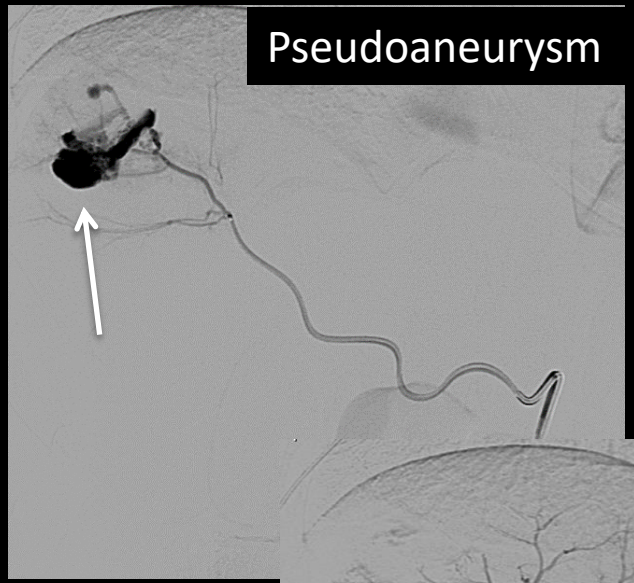
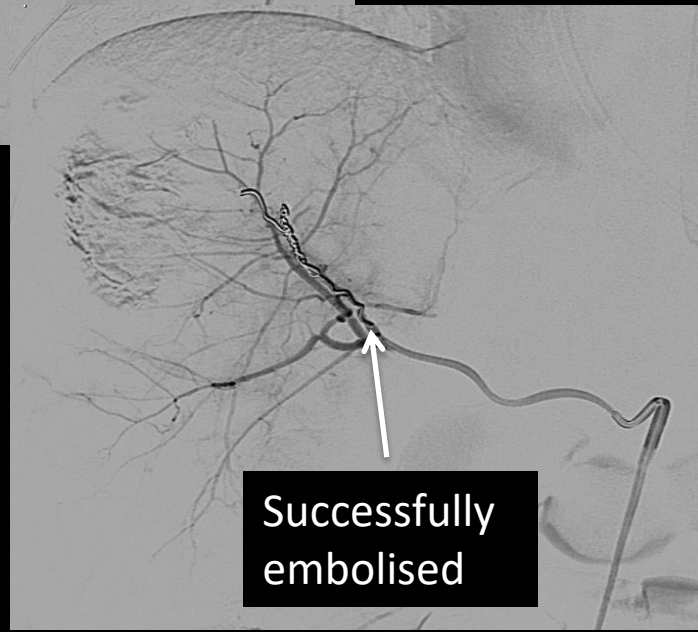
D. Operative





CASE 3



Thanks to Dr Elika Kashef

CASE 5

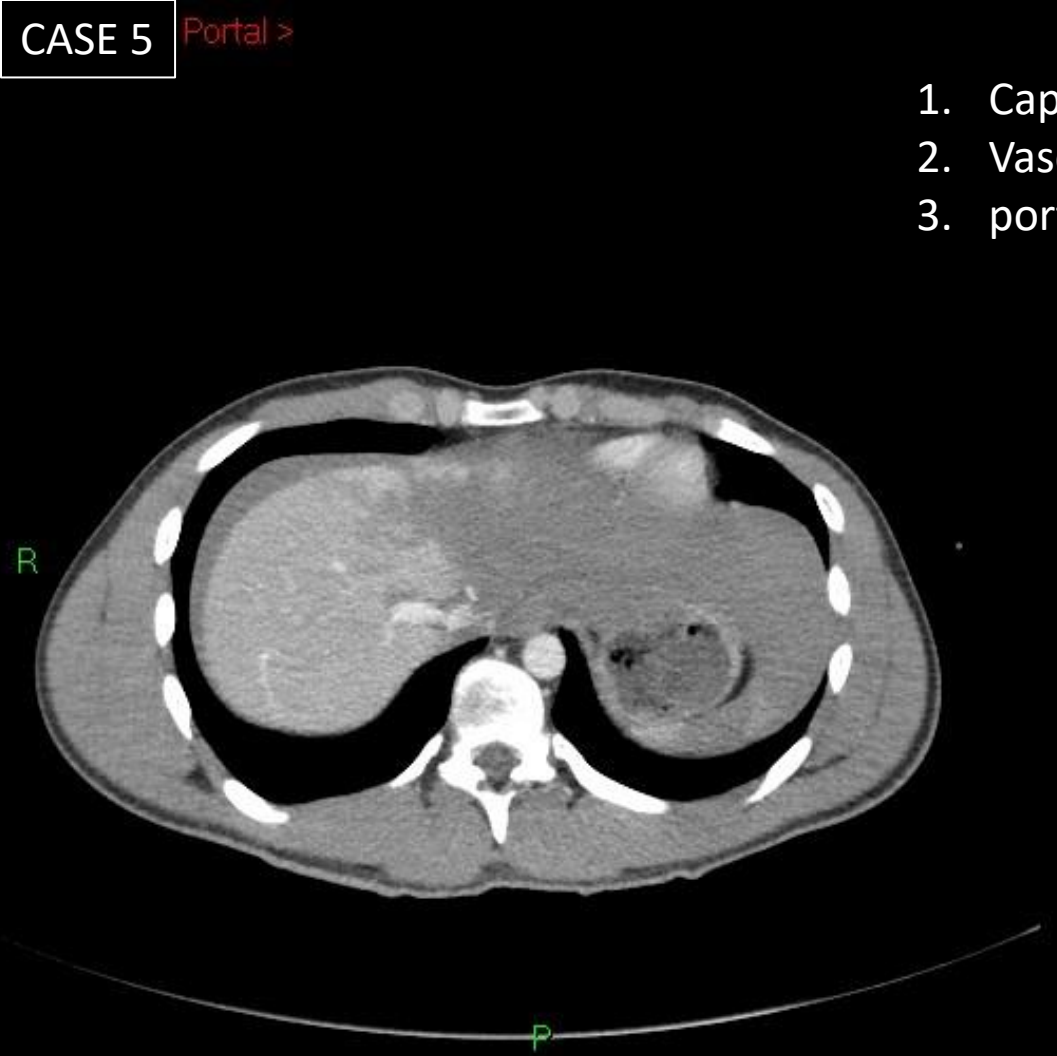
Car vs van 100kmph

Shocked Physiologically unstable

CASE 5

Portal phase

CASE 5



1. Capsular breach
2. Vascular damage
3. porta

CASE 5

Portal >

1. Capsular breach
2. Vascular damage
3. porta

Laceration left hepatic vein

CASE 5

Portal >

1. Capsular breach
2. Vascular damage
3. porta

Laceration left hepatic vein

CASE 5

Portal >

1. Capsular breach
2. Vascular damage
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Laceration left hepatic vein

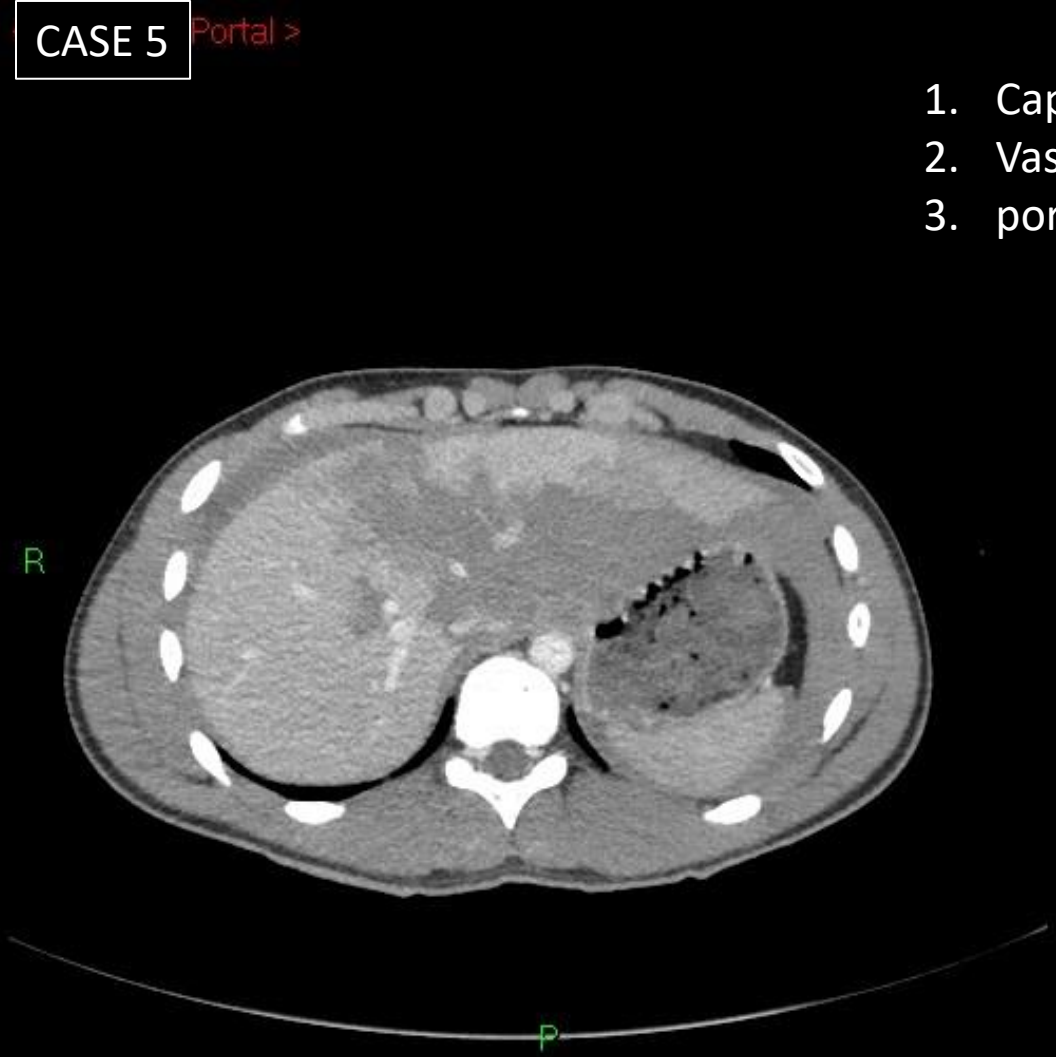
CASE 5

Portal >

1. Capsular breach
2. Vascular damage
3. porta

Laceration left hepatic vein

CASE 5



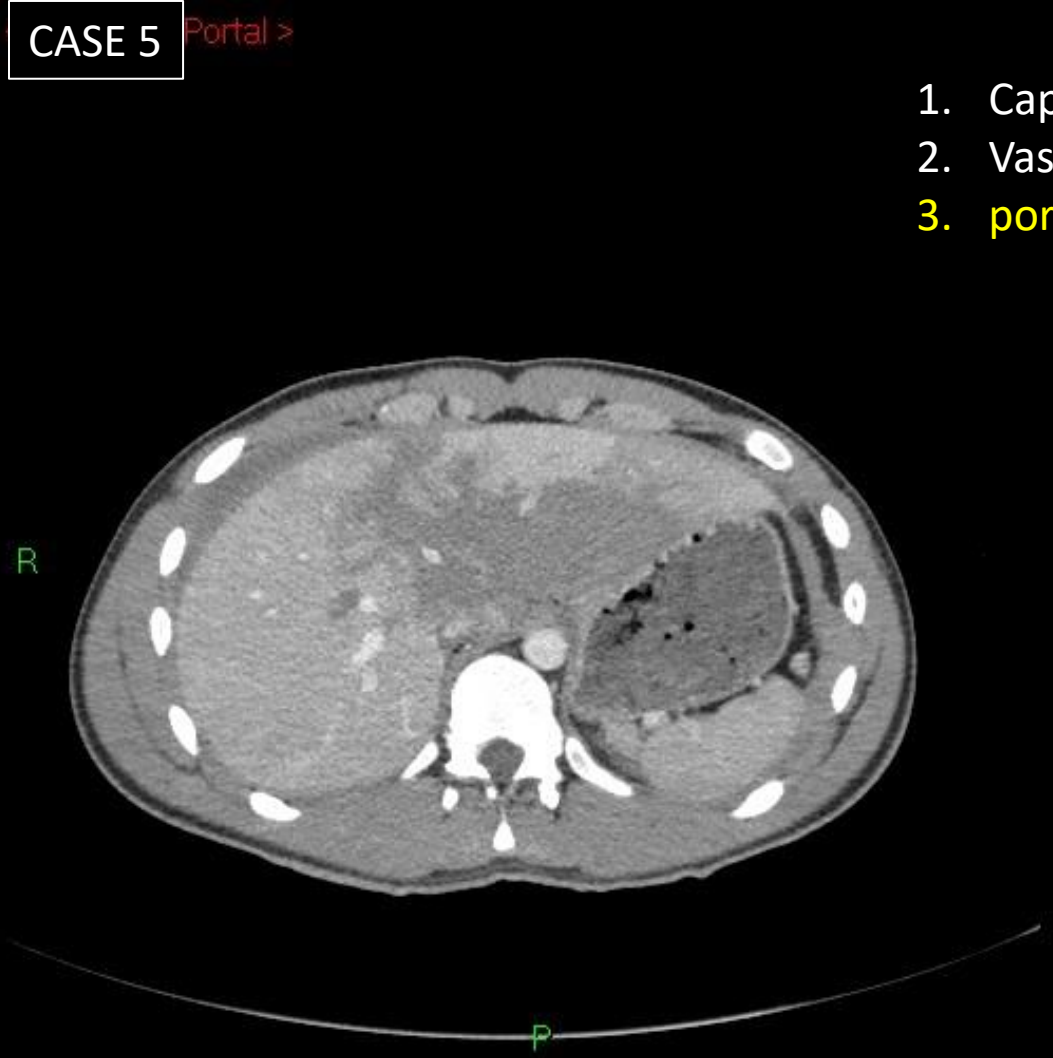
1. Capsular breach
2. Vascular damage
3. porta

CASE 5

Laceration to porta

1. Capsular breach
2. Vascular damage
3. porta

CASE 5



1. Capsular breach
2. Vascular damage
3. porta

>75% left lobe lacerated, extends to hepatic veins

1. Capsular breach
2. Vascular damage
3. porta

>75% left lobe lacerated, extends to hepatic veins

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2. Vascular damage
3. porta

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1. Capsular breach
2. Vascular damage
3. porta

>75% left lobe lacerated, extends to hepatic veins

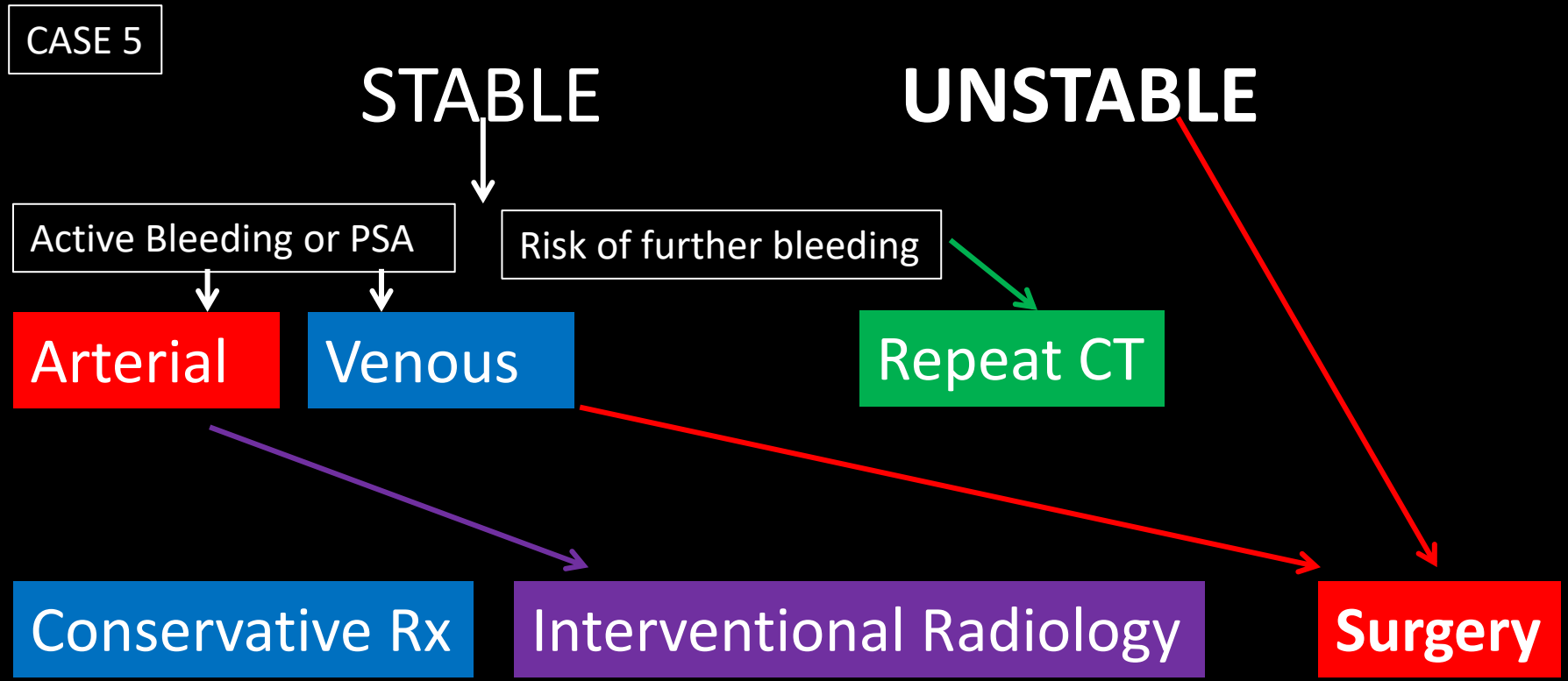
1. Capsular breach
2. Vascular damage
3. porta

How should this unstable shocked patient be managed?

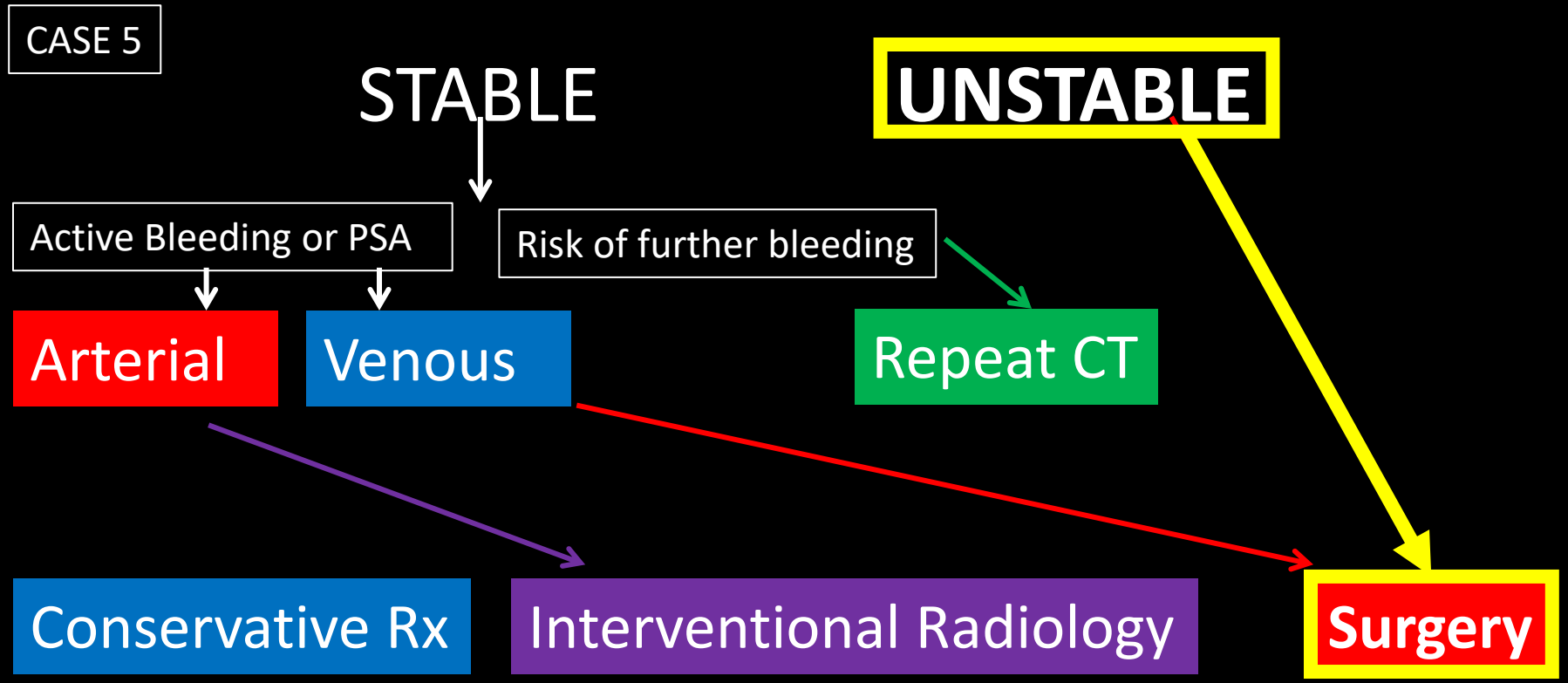
A. Conservative Mx, no further imaging or Rx needed
B. Repeat CT in 48 to 72 hours
C. Interventional Radiology (Hepatic Angiography)
D. Operative

RELAX: YOU DO NOT NEED TO VOTE!!

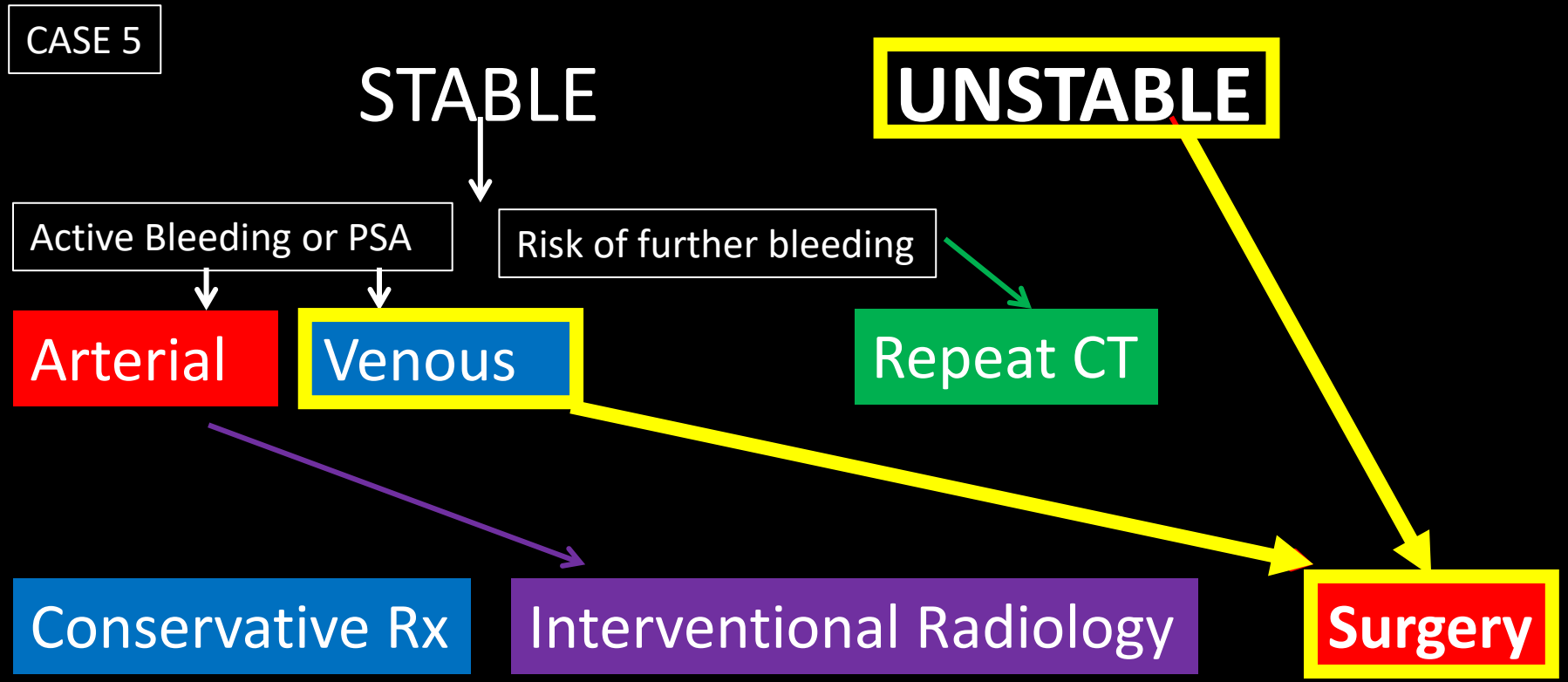
Liver Injury: How should patient be managed?



Liver Injury: How should patient be managed?



Liver Injury: How should patient be managed?



How should this unstable shocked patient be managed?

A. Conservative Mx, no further imaging or Rx needed
B. Repeat CT in 48 to 72 hours
C. Interventional Radiology (Hepatic Angiography)
D. Operative VENOUS INJURY = SURGERY

Follow up

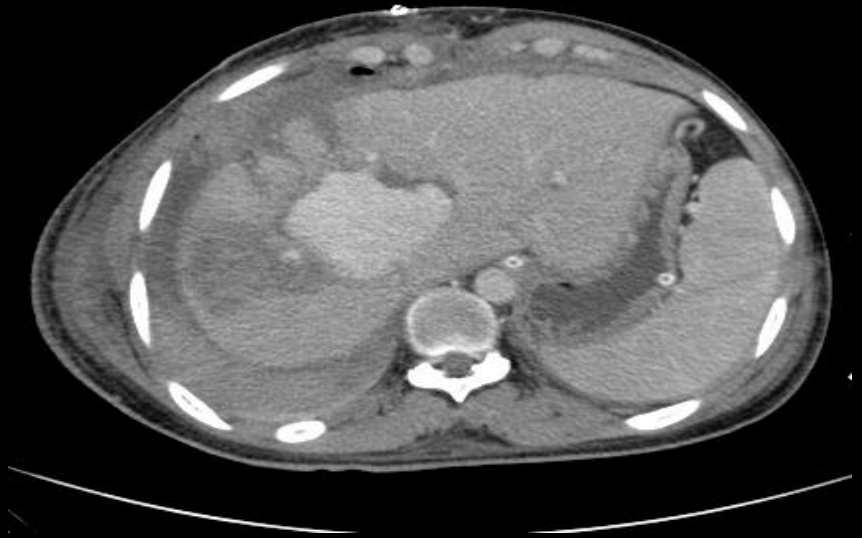
- Risk of developing pseudoaneurysm or AV fistula 24 hours to 72 hours post injury

CASE 6

Case 6: Blunt trauma straight to theatre without CT

DAY 0: Grade IV liver laceration, haemoperitoneum

DAY 2: FOLLOW UP CT

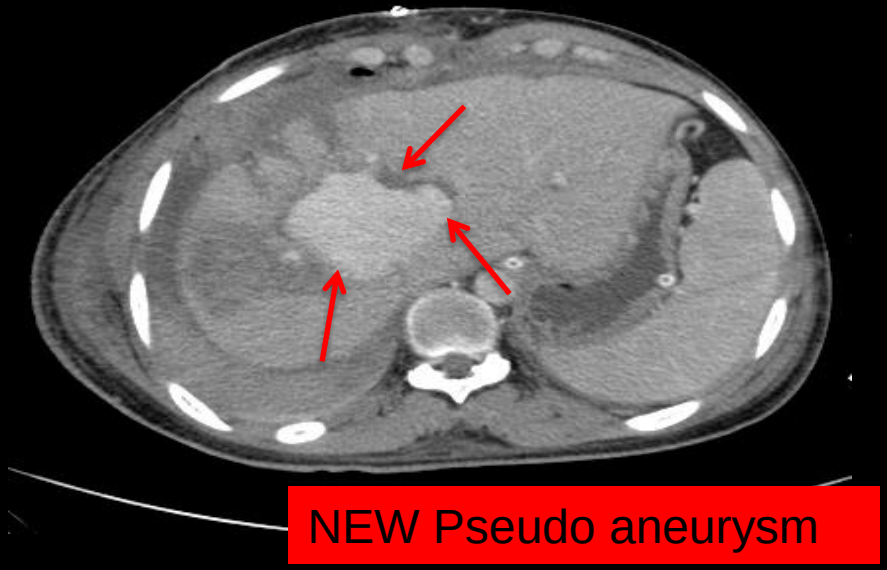


Thanks to Dr Elika Kashef

Osterballe et al, J Trauma Mx & Outcomes 2014,
Durkin et al, J Ped Surgery 2016 (paediatric population)
Patel et al, Trauma, 2021 (Imperial)

DAY 2: FOLLOW UP CT

CASE 6



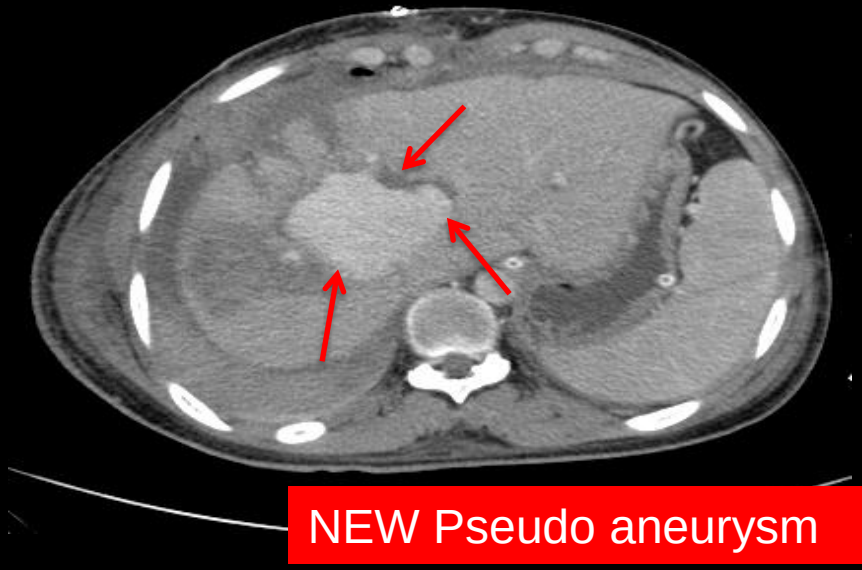
NEW Pseudo aneurysm

Thanks to Dr Elika Kashef

Osterballe et al, J Trauma Mx & Outcomes 2014,
Durkin et al, J Ped Surgery 2016 (paediatric population)
Patel et al, Trauma, 2021 (Imperial)

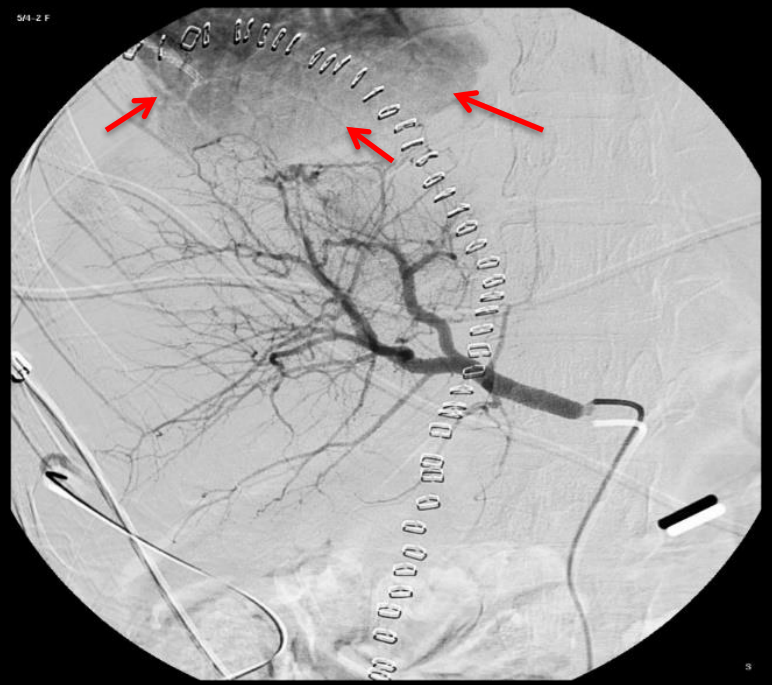
DAY 2: FOLLOW UP CT

CASE 6



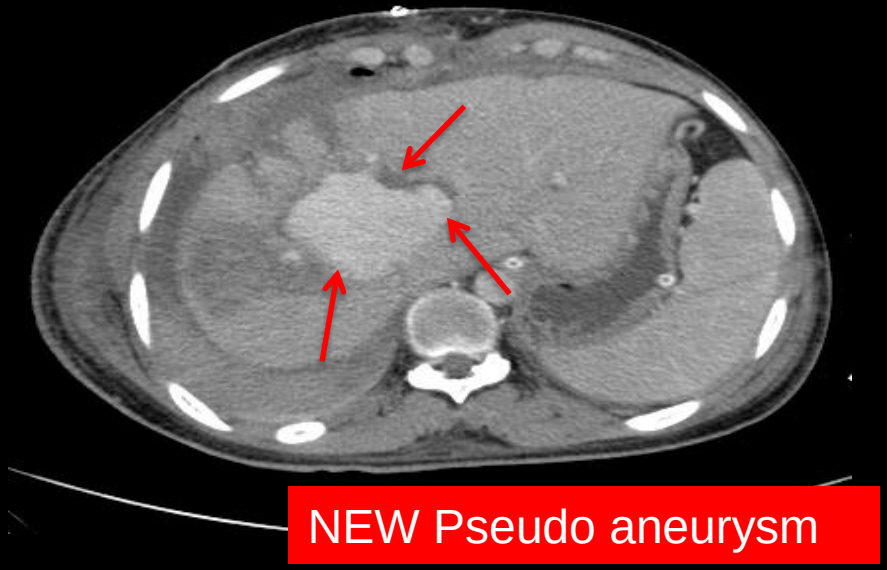
NEW Pseudo aneurysm

Pseudo aneurysm



Thanks to Dr Elika Kashef

Risk of Pseudoaneurysm developing within 72 hrs

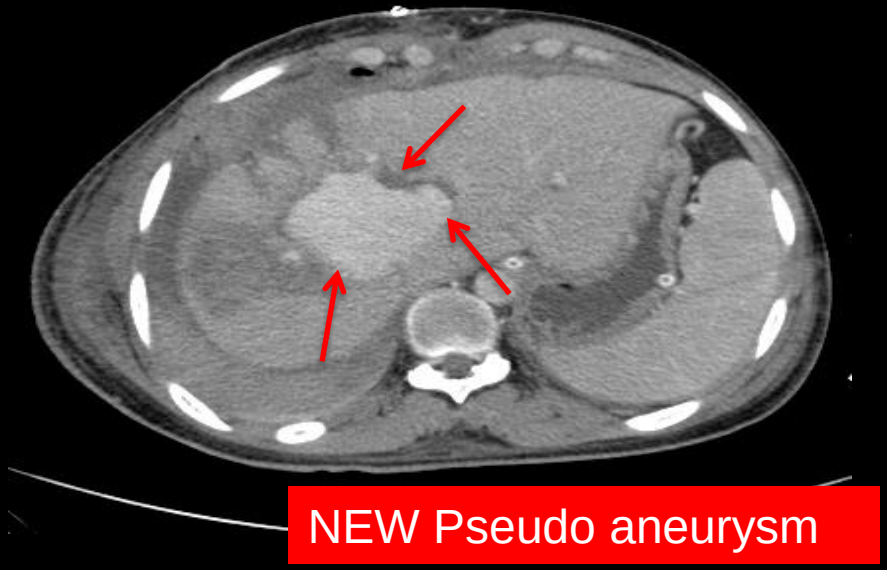


- Osterballe et al: (LIVER)
- N=188 post traumatic liver injury 4% developed pseudoaneurysms
- Does not depend on grade of injury
- 75% asymptomatic
- Patel et al: (LIVER)
- n=149 (blunt and penetrating) Imperial College London
- 5% developed Pseudoaneurysms

Thanks to Dr Elika Kashef

Osterballe et al, J Trauma Mx & Outcomes 2014,
Durkin et al, J Ped Surgery 2016 (paediatric population)
Patel et al, Trauma, 2021 (Imperial)

Risk of Pseudoaneurysm developing within 72 hrs

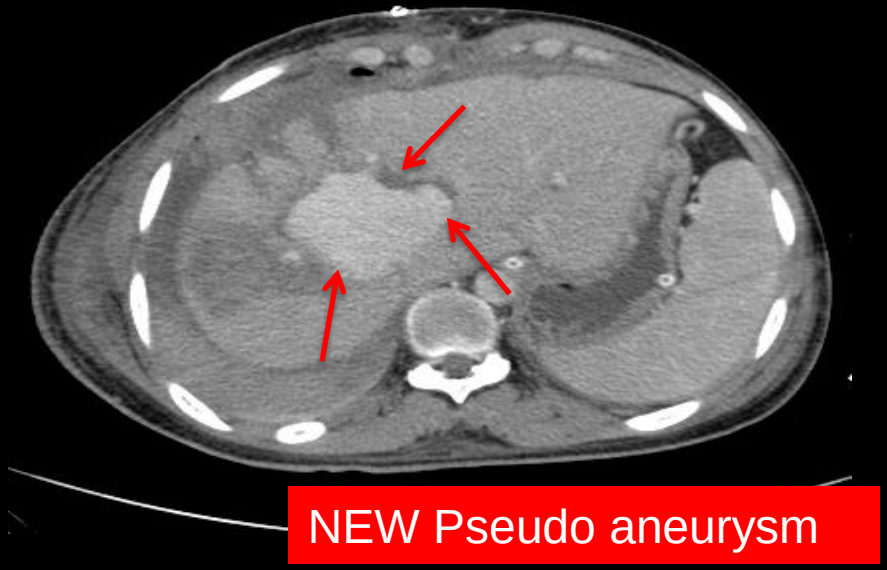


- Osterballe et al: (LIVER)
- N=188 post traumatic liver injury 4% developed pseudoaneurysms
- Does not depend on grade of injury
- 75% asymptomatic
- Patel et al: (LIVER)
- n=149 (blunt and penetrating) Imperial College London
- 5% developed Pseudoaneurysms

Thanks to Dr Elika Kashef

Osterballe et al, J Trauma Mx & Outcomes 2014,
Durkin et al, J Ped Surgery 2016 (paediatric population)
Patel et al, Trauma, 2021 (Imperial)

Risk of Pseudoaneurysm developing within 72 hrs



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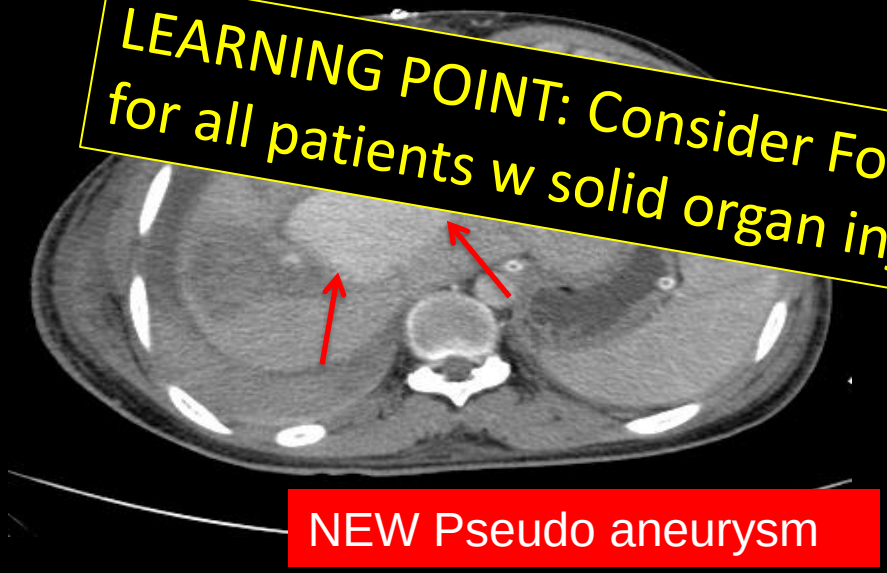
Thanks to Dr Elika Kashef

Osterballe et al, J Trauma Mx & Outcomes 2014,
Durkin et al, J Ped Surgery 2016 (paediatric population)
Patel et al, Trauma, 2021 (Imperial)

CASE 6

Risk of Pseudoaneurysm developing within 72 hrs



NEW Pseudo aneurysm

LEARNING POINT: Consider Follow UP IMAGING 2-3 days later for all patients w solid organ injury (3 phase CT or US)

- Osterballe et al: (LIVER)
- N=188 post traumatic liver injury 4% developed pseudoaneurysms
- [illegible] on grade of injury
- Patel et [illegible]
- n=149 (blunt and penetrating) Imperial College London
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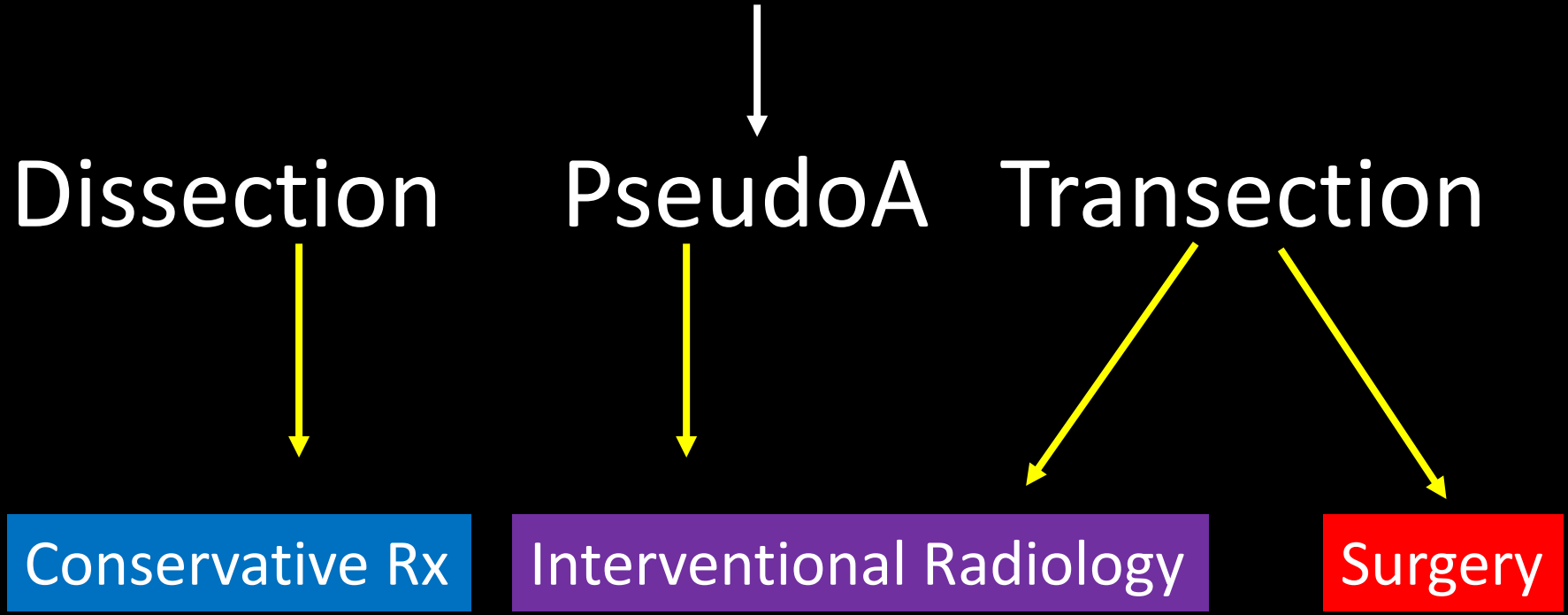
Osterballe et al, J Trauma Mx & Outcomes 2014,
Durkin et al, J Ped Surgery 2016 (paediatric population)
Patel et al, Trauma, 2021 (Imperial)

Renal

RENAL VASCULAR INJURY



RENAL VASCULAR INJU

Key Findings:
1.Haematoma+++
2.Vascular contour

Dissection

PseudoA

Transection

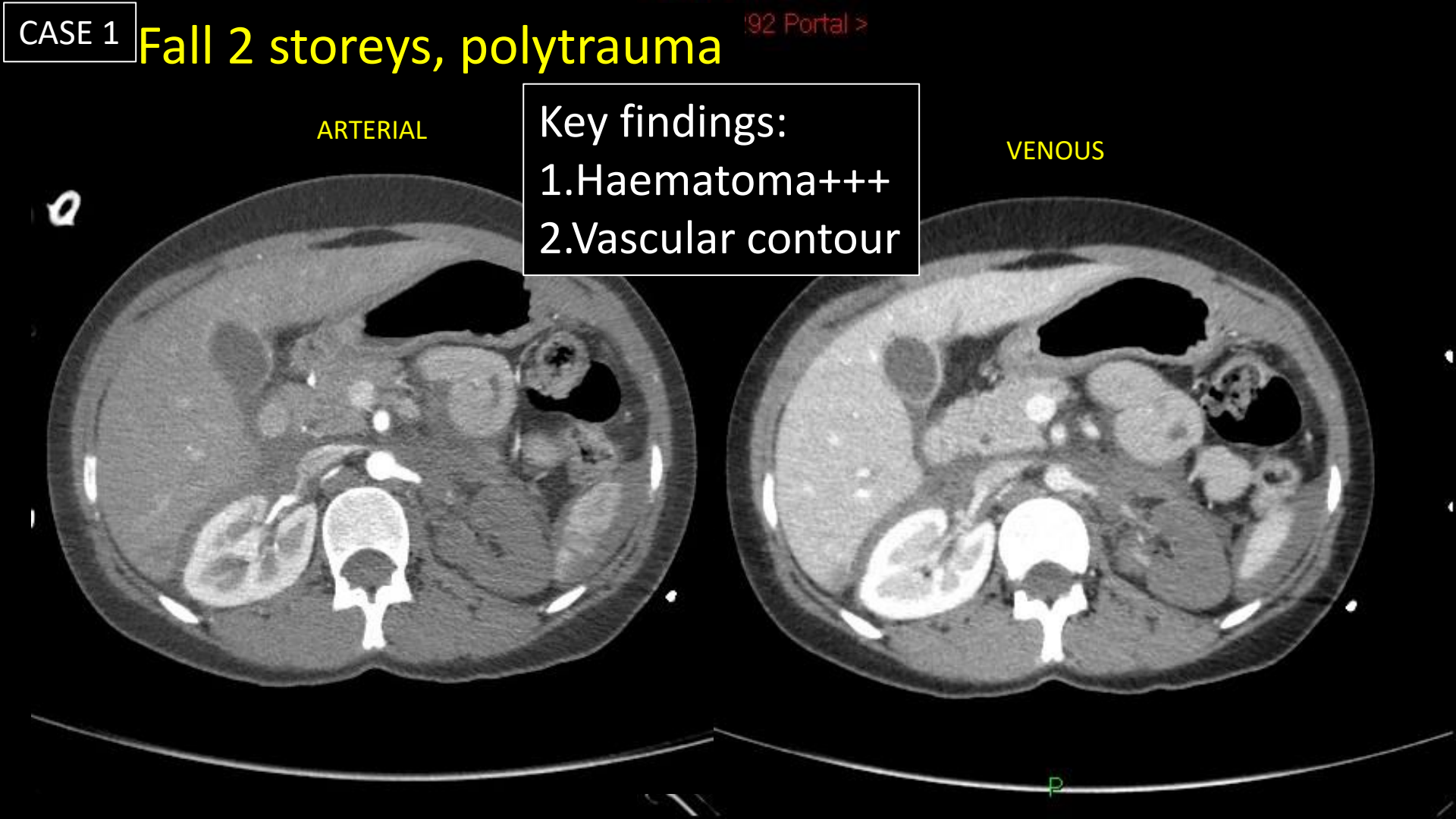
Conservative Rx

Interventional Radiology

Surgery

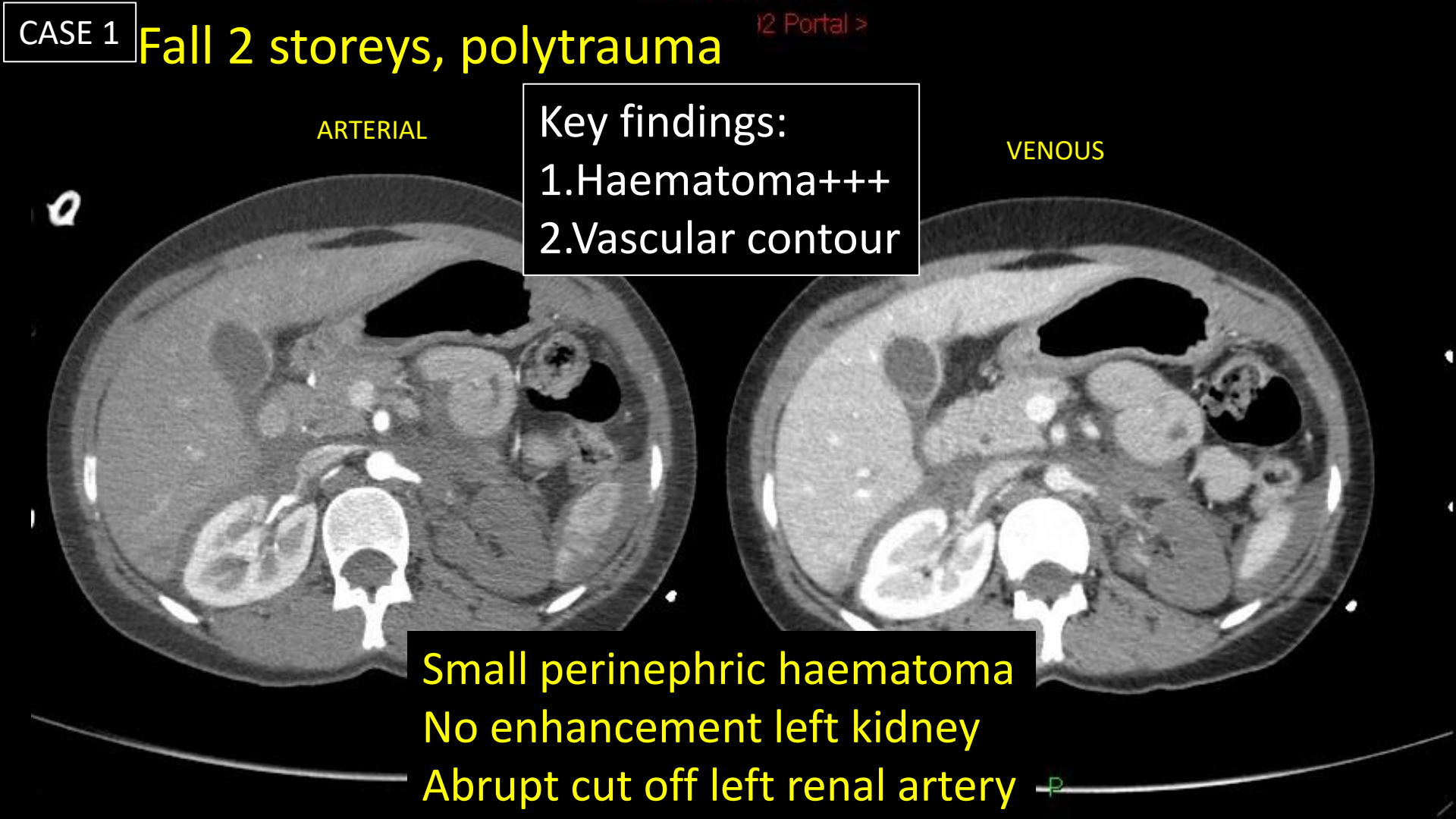
CASE 1

Fall 2 storeys, polytrauma



CASE 1

Fall 2 storeys, polytrauma

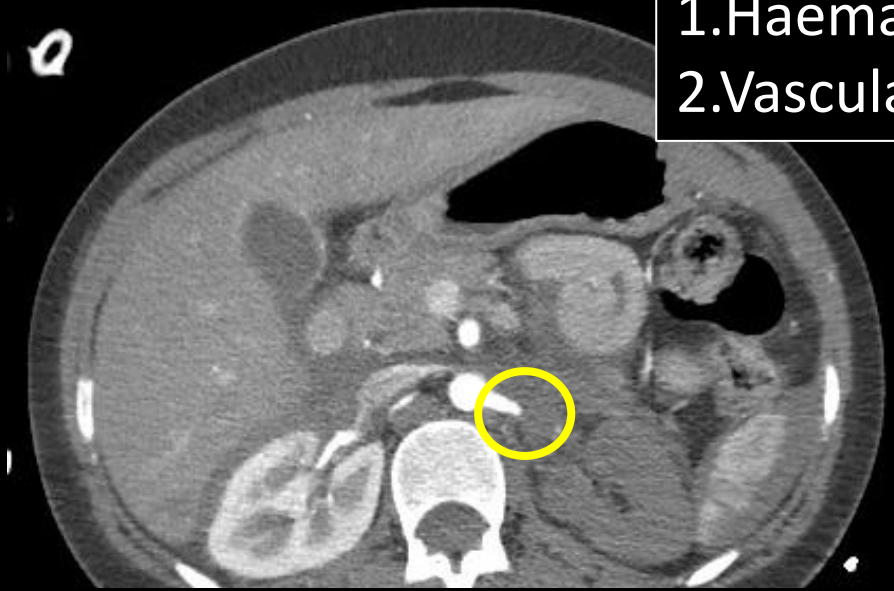


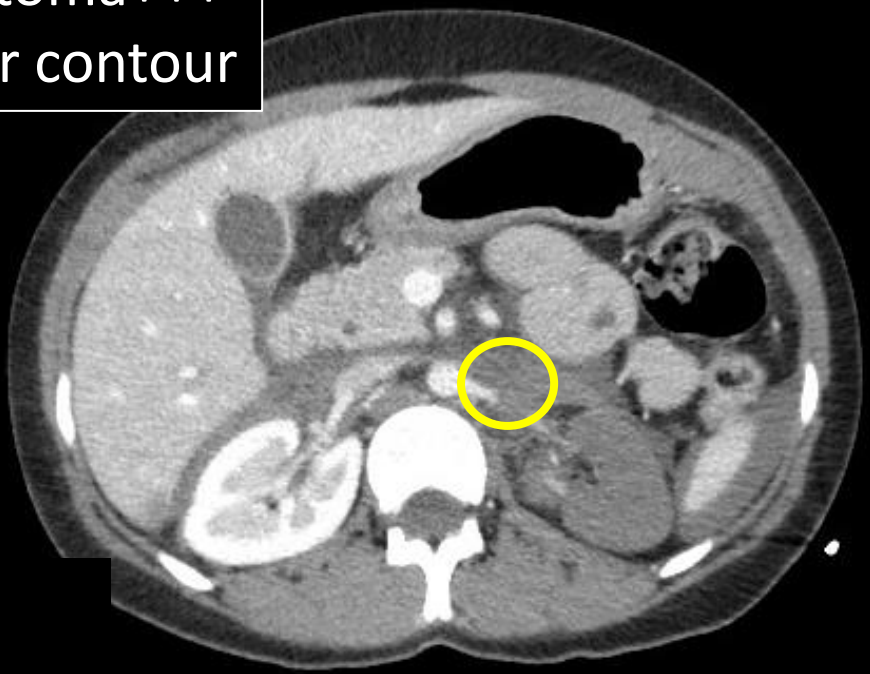
CASE 1

ARTERIAL

Key findings:
1.Haematoma+++
2.Vascular contour

VENOUS





Truncation –
Dissection or transection?

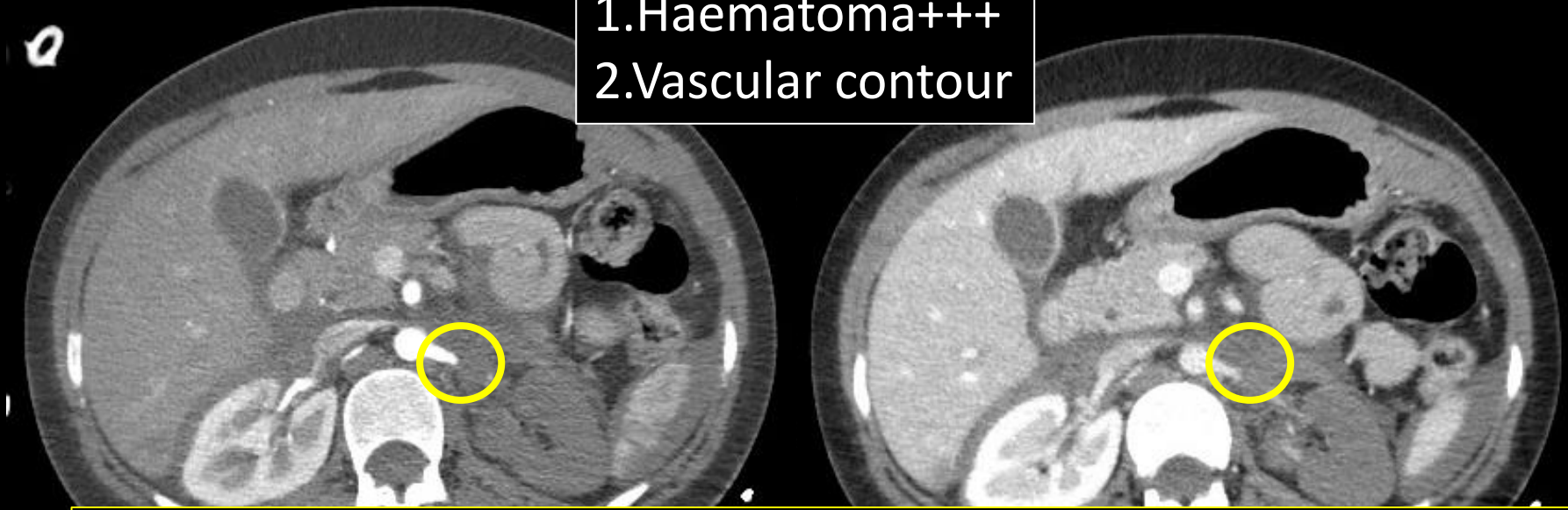
Baghdanian et al CT of Major Vascular Injury in Blunt Abdominal Pelivc Trauma Radiographics 2016

CASE 1

ARTERIAL

Key Findings:
1.Haematoma+++
2.Vascular contour

VENOUS



Truncation PLUS small haematoma = Dissection

Dissection or transection?

Baghdanian et al CT of Major Vascular Injury in Blunt Abdominal Pelivc Trauma Radiographics 2016

CASE 1

ARTERIAL

Key Findings:
1.Haematoma+++
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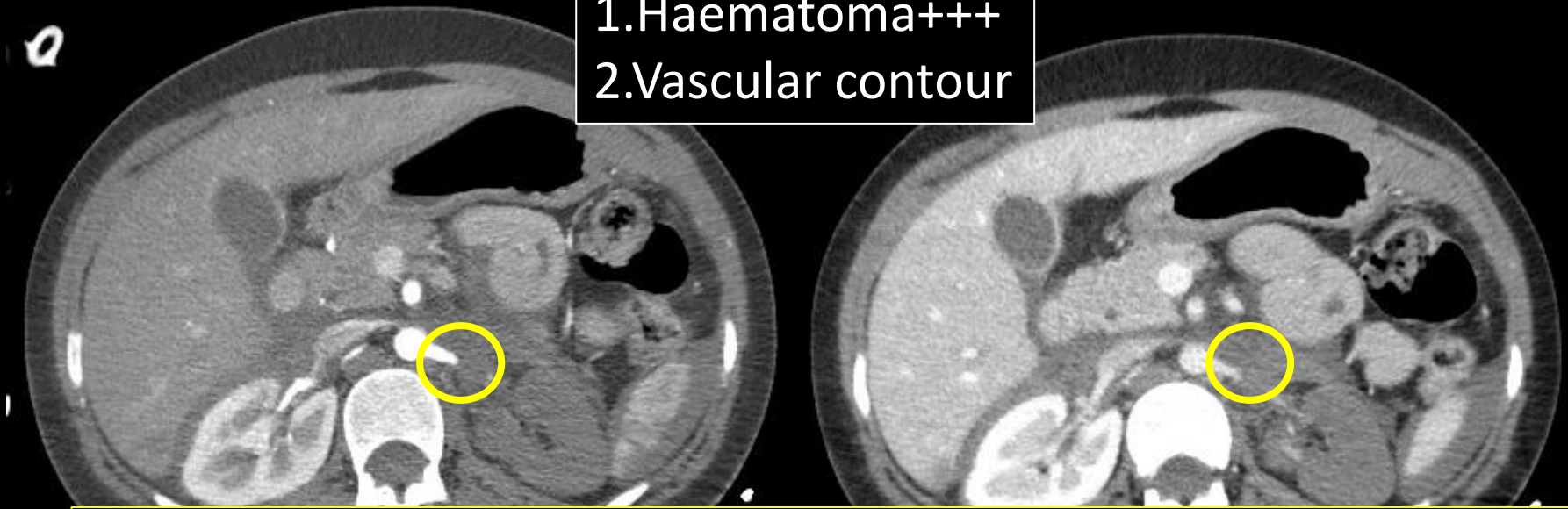
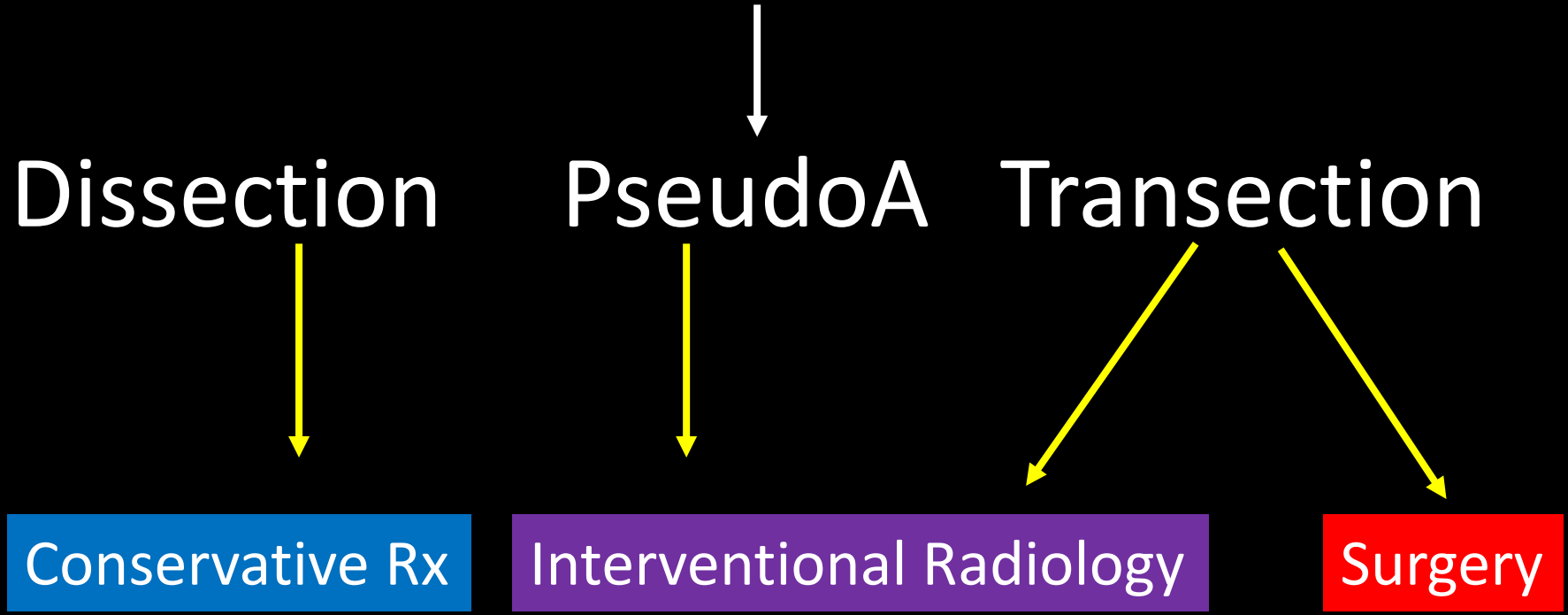
VENOUS

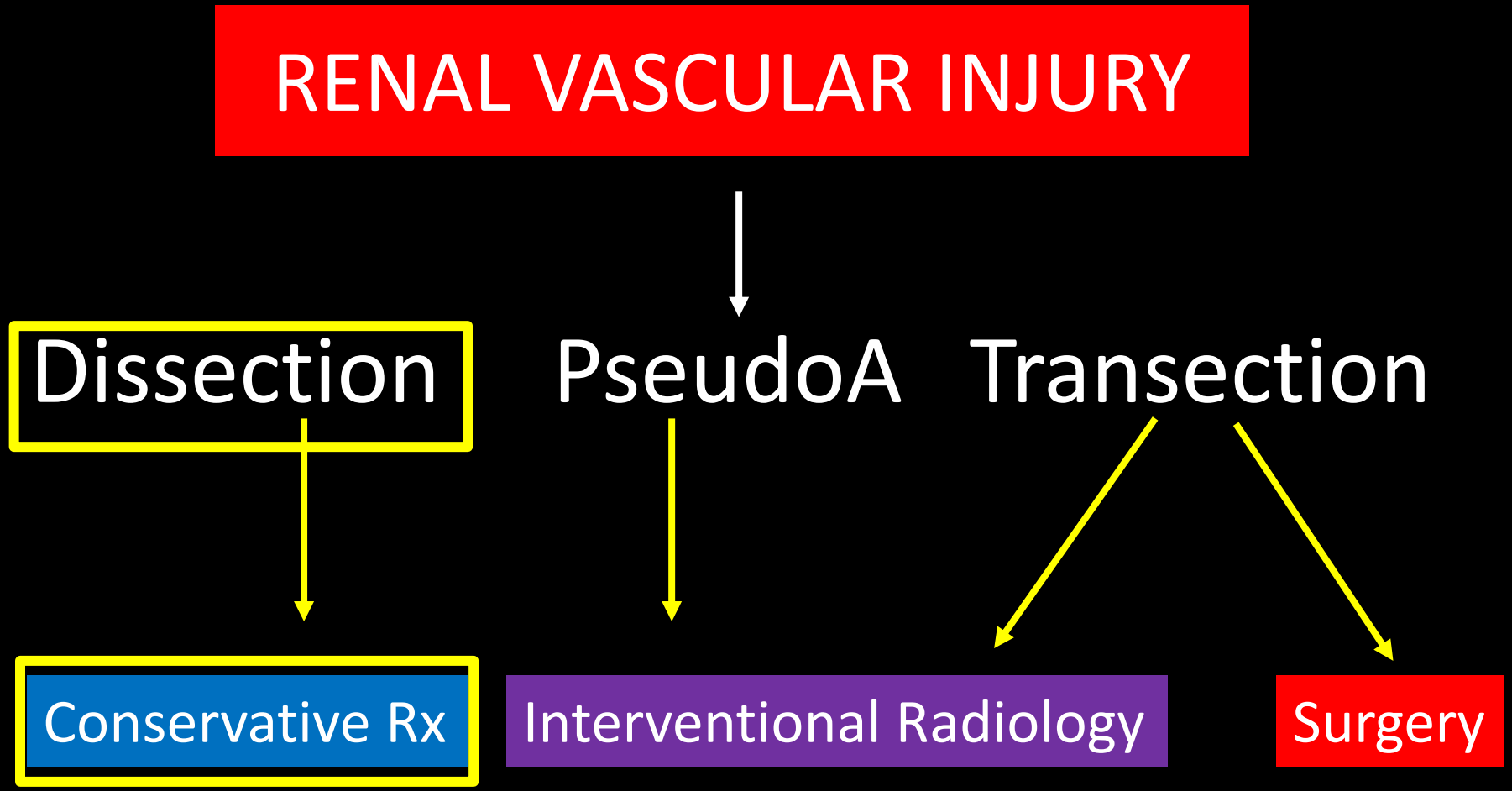


Truncation PLUS small haematoma = Dissection
Low risk of future bleeding

Baghdanian et al CT of Major Vascular Injury in Blunt Abdominal Pelivc Trauma Radiographics 2016

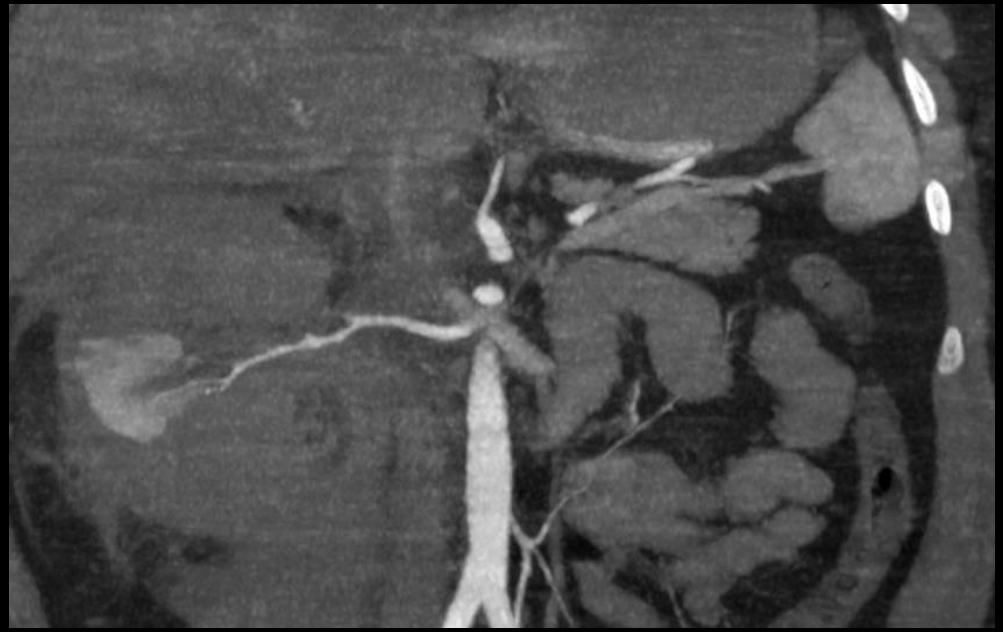
RENAL VASCULAR INJURY




RENAL VASCULAR INJURY
Dissection
PseudoA
Transection
Conservative Rx
Interventional Radiology
Surgery

CASE 3

Crush injury, Code Red



Arterial

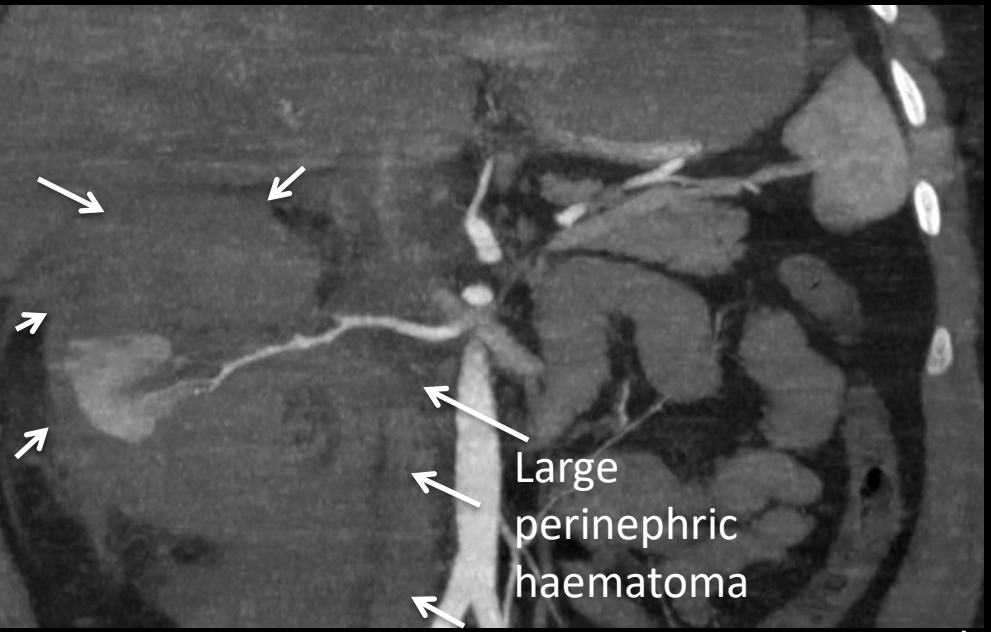
CASE 3

Crush injury, Code Red

Arterial

CASE 3

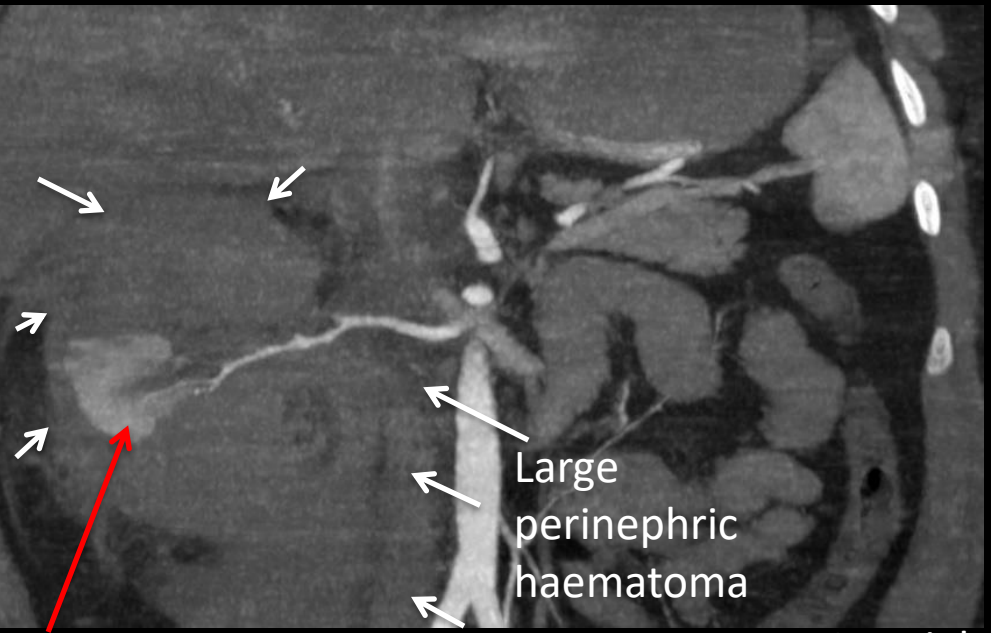
Crush injury, Code Red



Arterial

CASE 3

Crush injury, Code Red



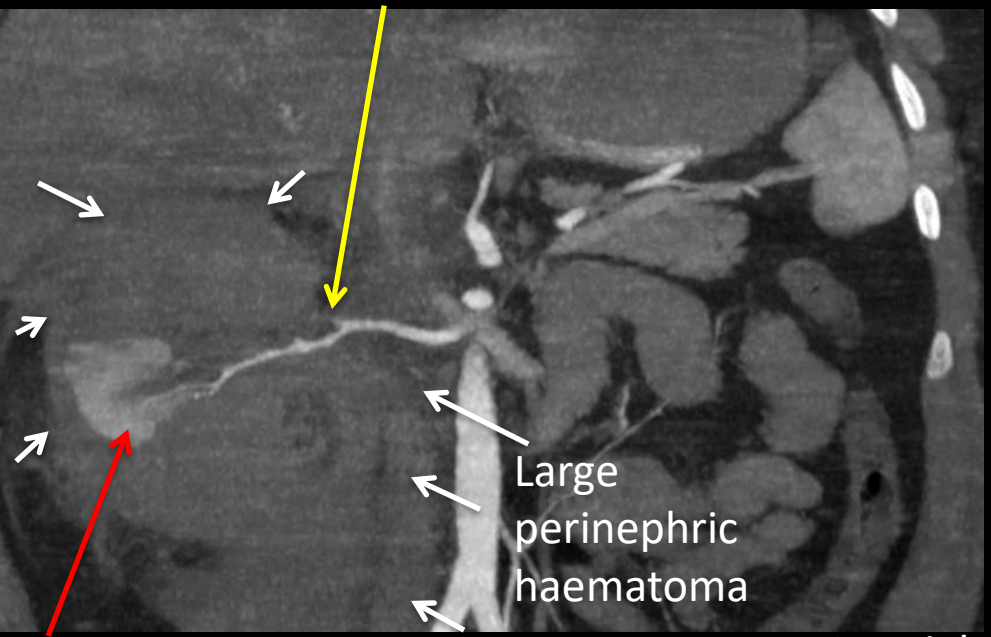
Arterial

Little renal parenchmal enhancement

CASE 3

Crush injury, Code Red

Where is superior renal pole artery?



Arterial

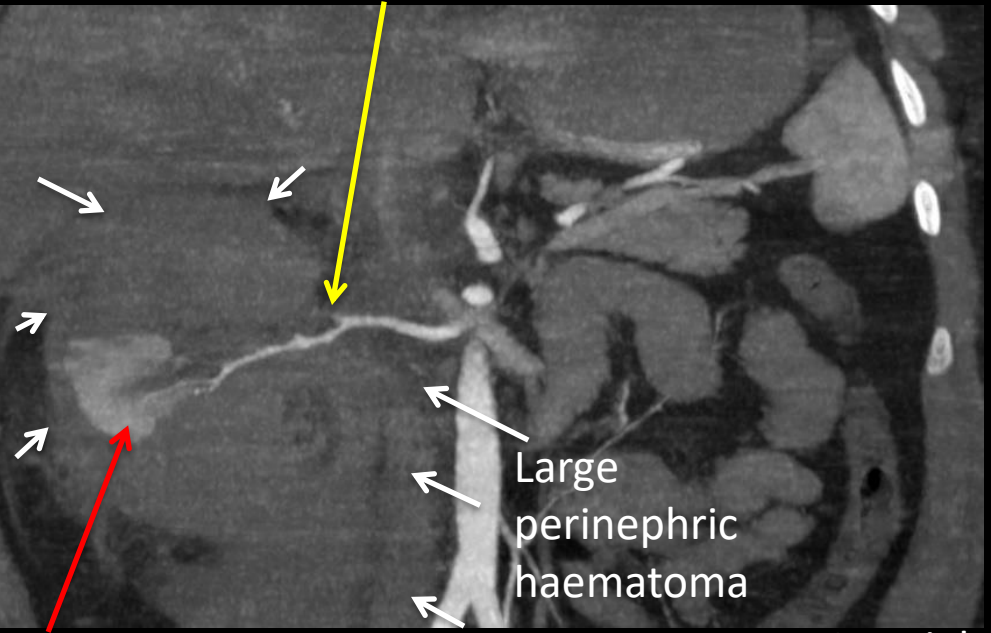
Little renal parenchmal enhancement

CASE 3

Crush injury, Code Red

Where is superior renal pole artery?

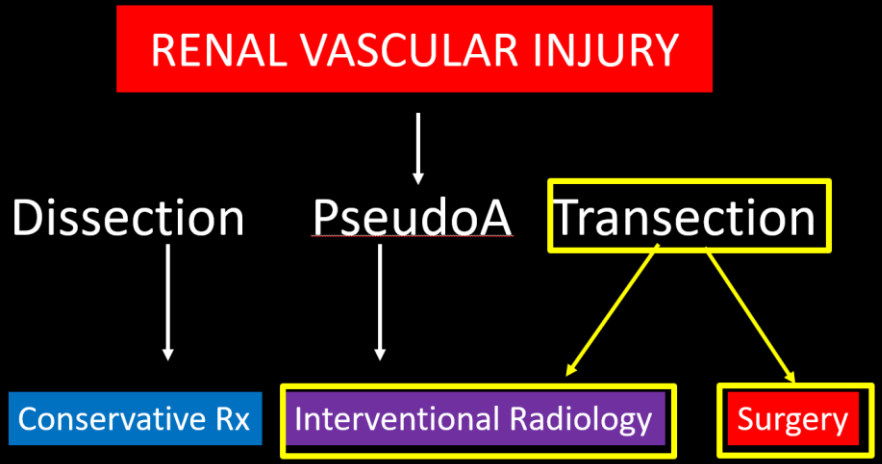
Does vessel have a smooth contour?



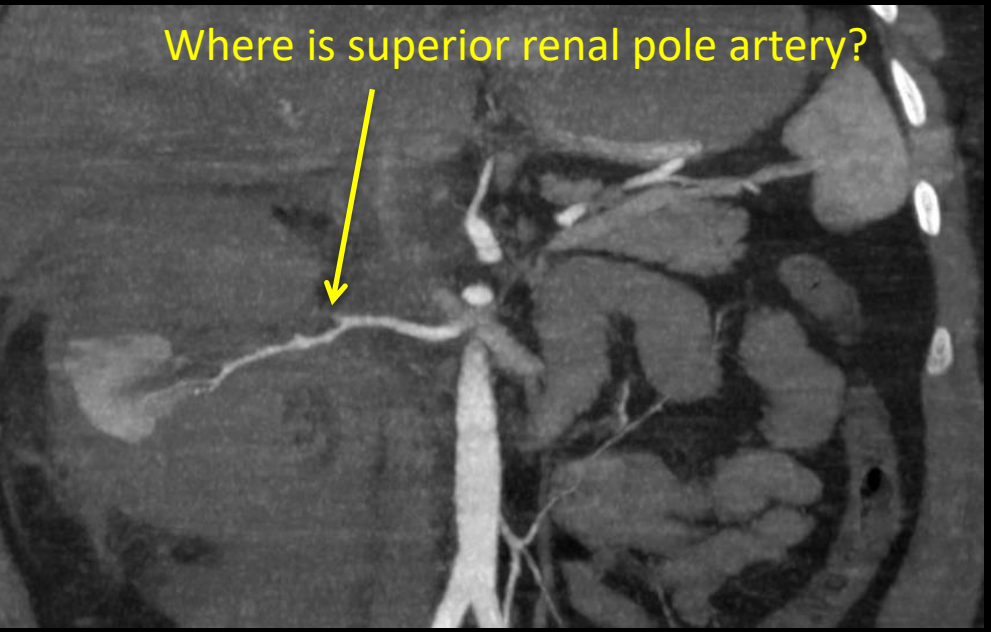
Arterial

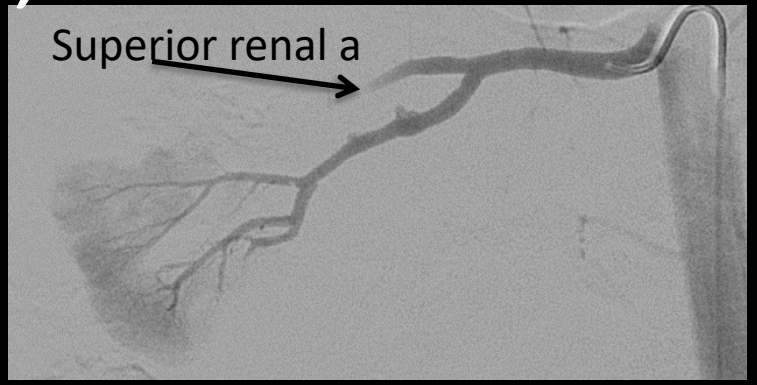
Little renal parenchmal enhancement

Large haematoma plus
TRUNCATION



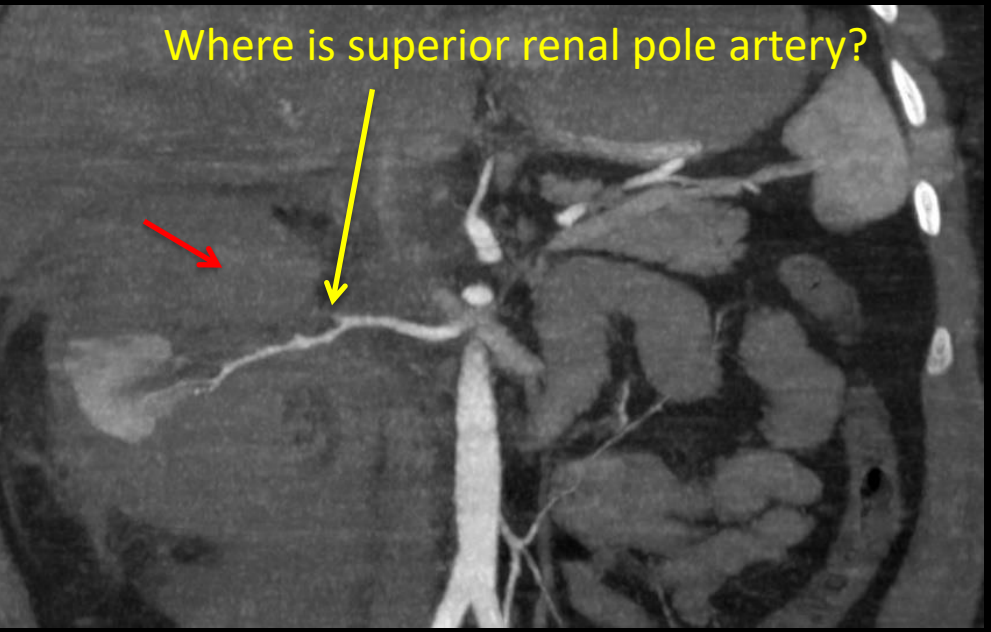
Crush injury, Code Red

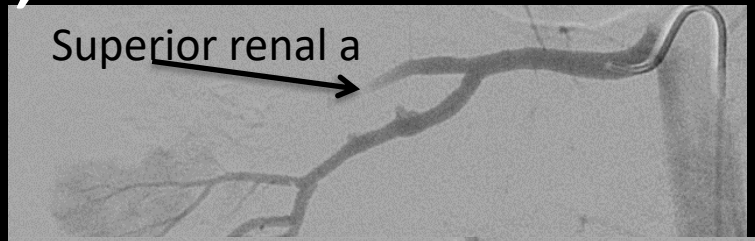


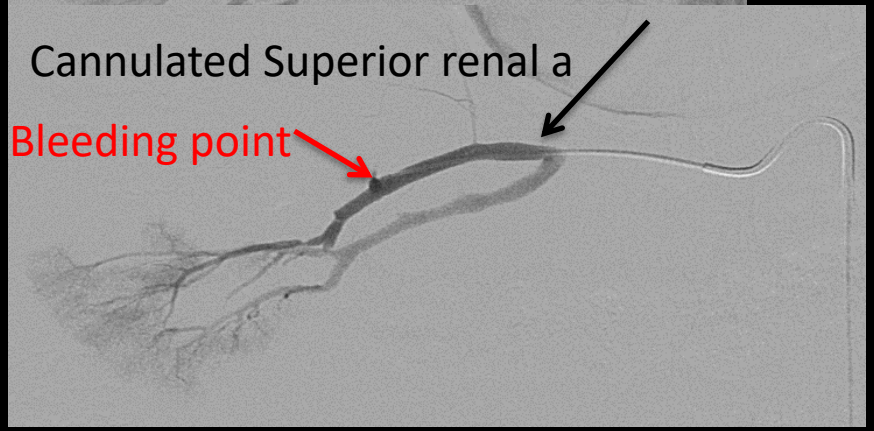


Thanks to Dr Elika Kashef

Crush injury, Code Red







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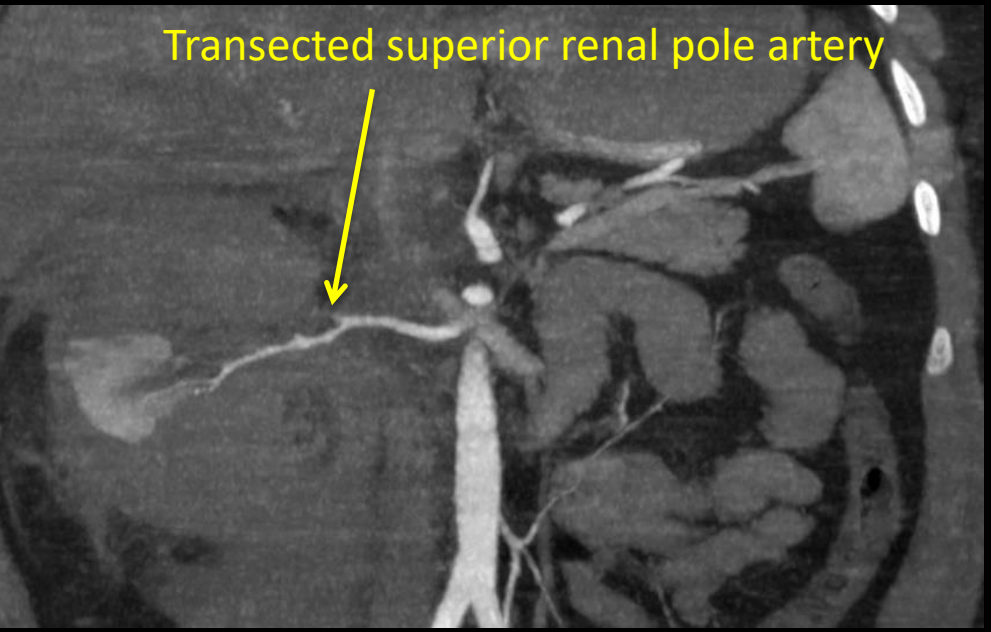
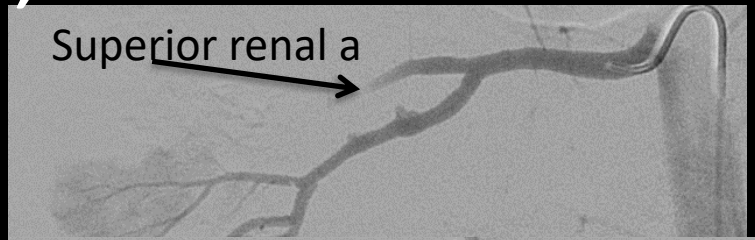
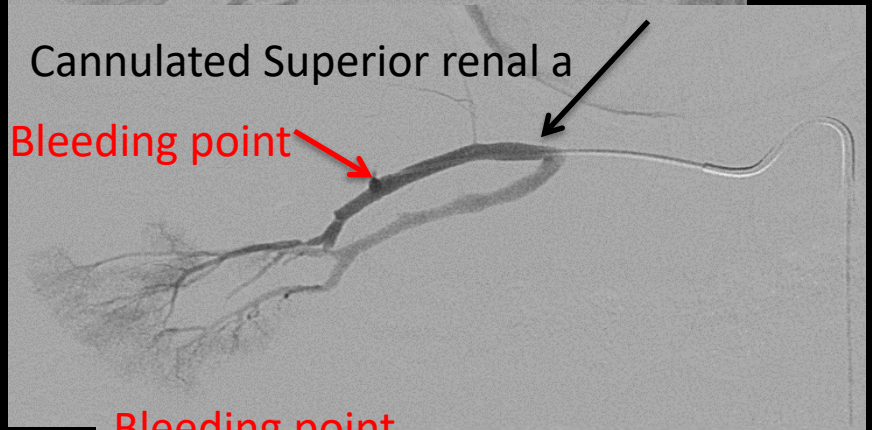
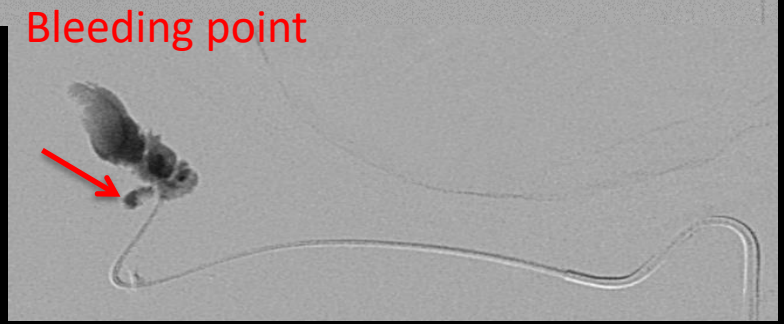
Crush injury, Code Red





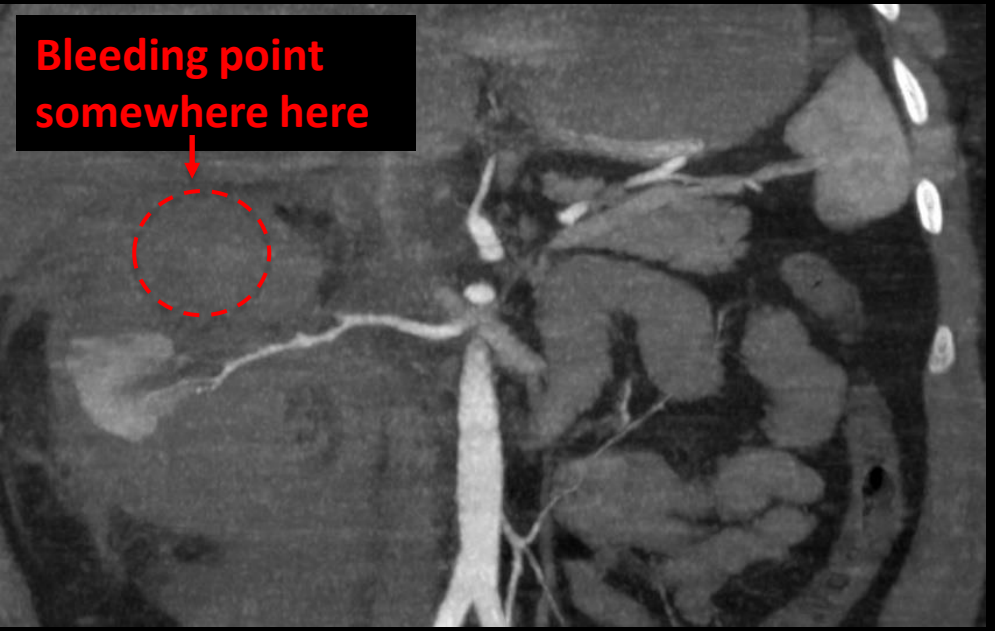


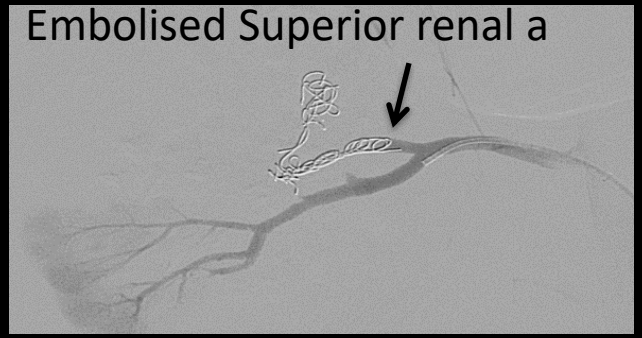


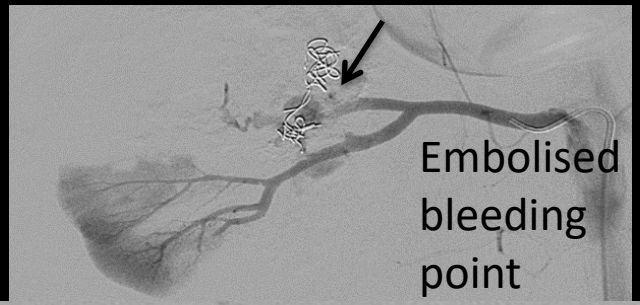
Thanks to Dr Elika Kashef

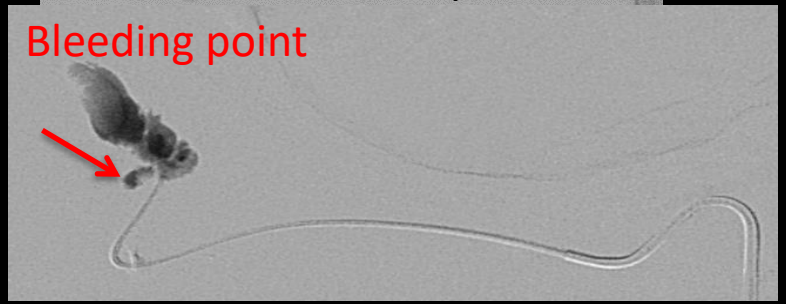
Crush injury, Code Red

Bleeding point and superior renal artery embolized



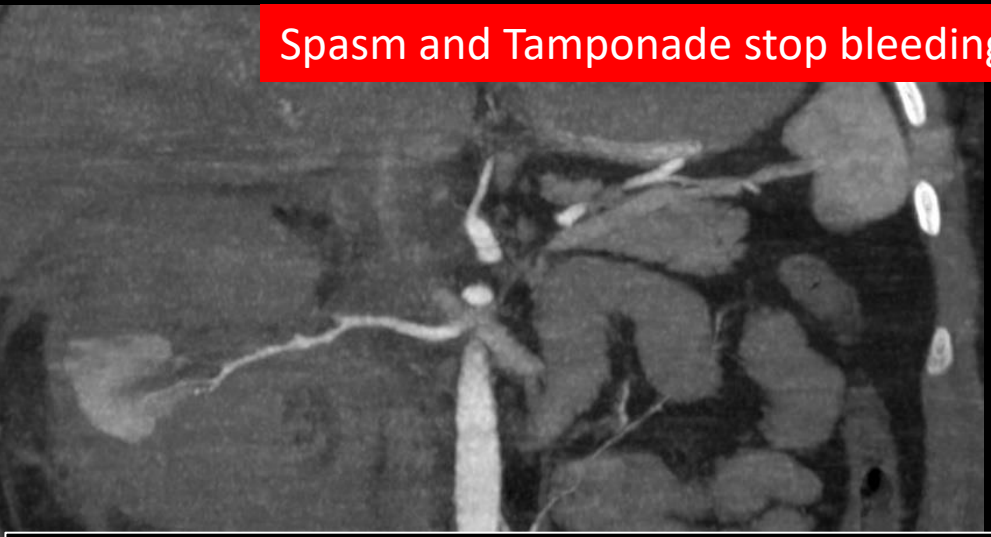




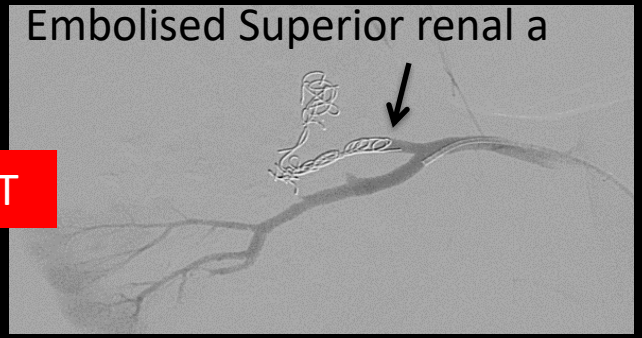


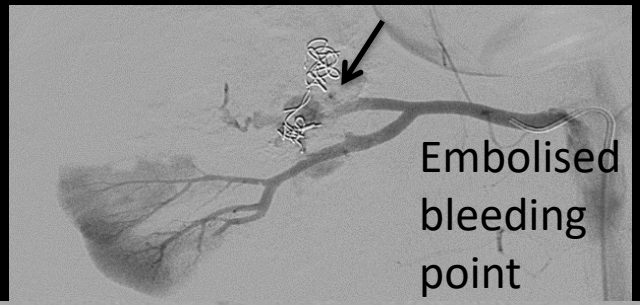
Crush injury, Code Red

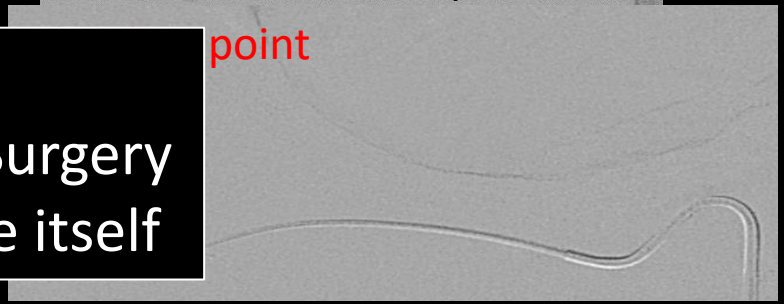
Bleeding point and superior renal artery embolized



Spasm and Tamponade stop bleeding on CT





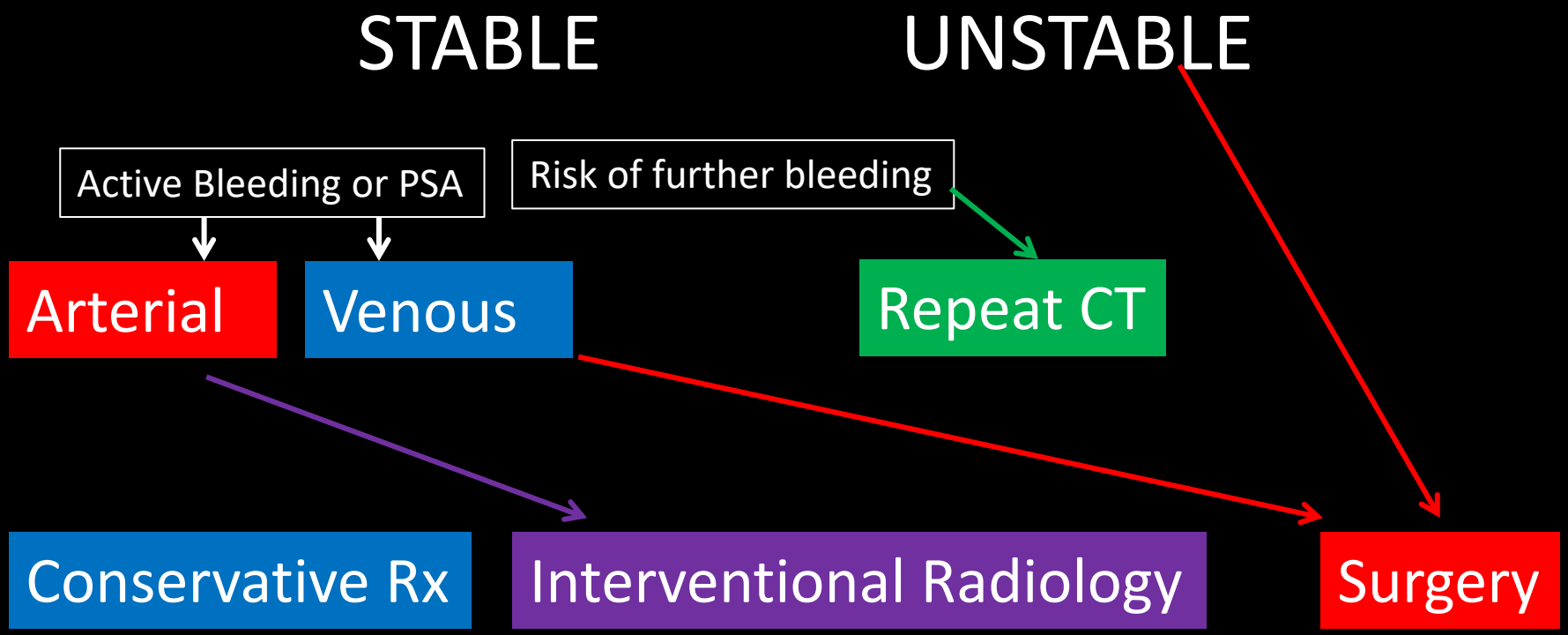


LEARNING POINT:

1. Kidney - Active bleeding – needs IR or Surgery
2. Active bleeding does not always declare itself

SPLEEN

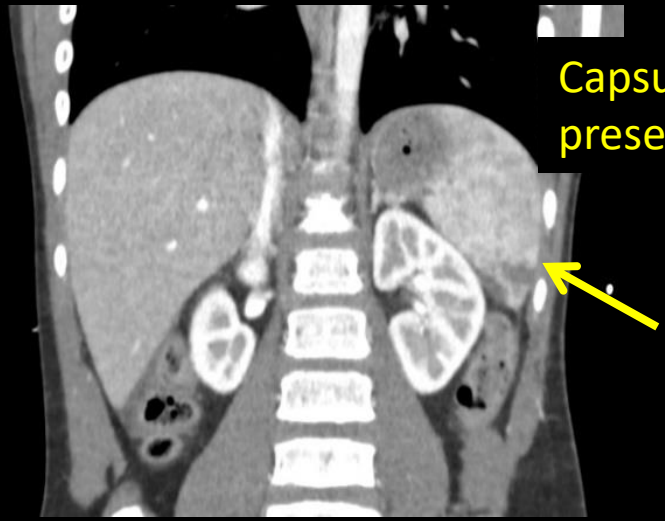
Splenic Injury: How should patient be managed?



Active Bleeding or risk of further bleeding

Case 1

G 3 Laceration & Haematoma



Key Findings

1. Capsular breach
2. Vascular damage (Pseudoaneurysm, AV Fistula?)
3. To Hilum?

Active Bleeding or risk of further bleeding

Case 1

G 3 Laceration & Haematoma

Capsule preserved

Settled with Conservative Rx

Key Findings

1. Capsular breach
2. Vascular damage (Pseudoaneurysm, AV Fistula?)
3. To Hilum?

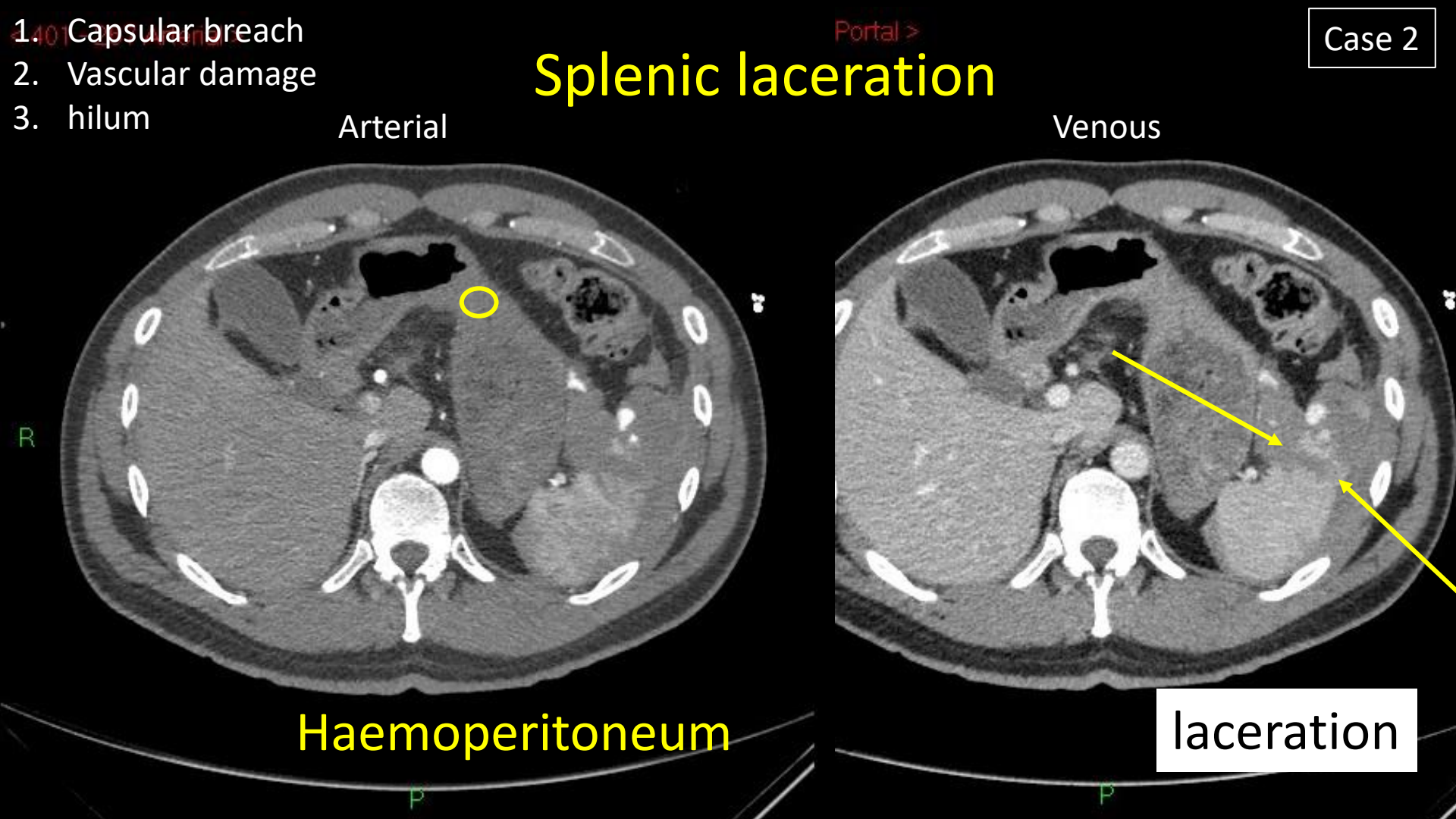
Case 2

Fall from 2 storeys
STABLE

1. Capsular breach
2. Vascular damage
3. hilum

Case 2

Splenic laceration

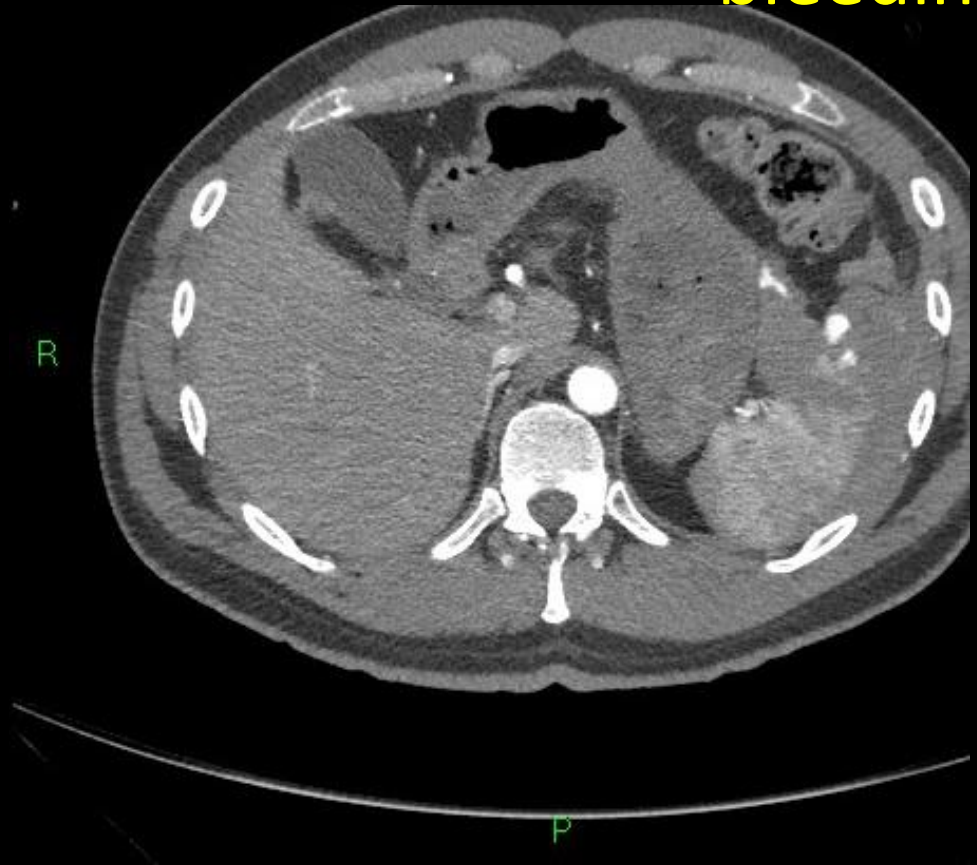


1. Capsular breach
2. Vascular damage
3. hilum

Active arterial bleeding

Case 2

Arterial



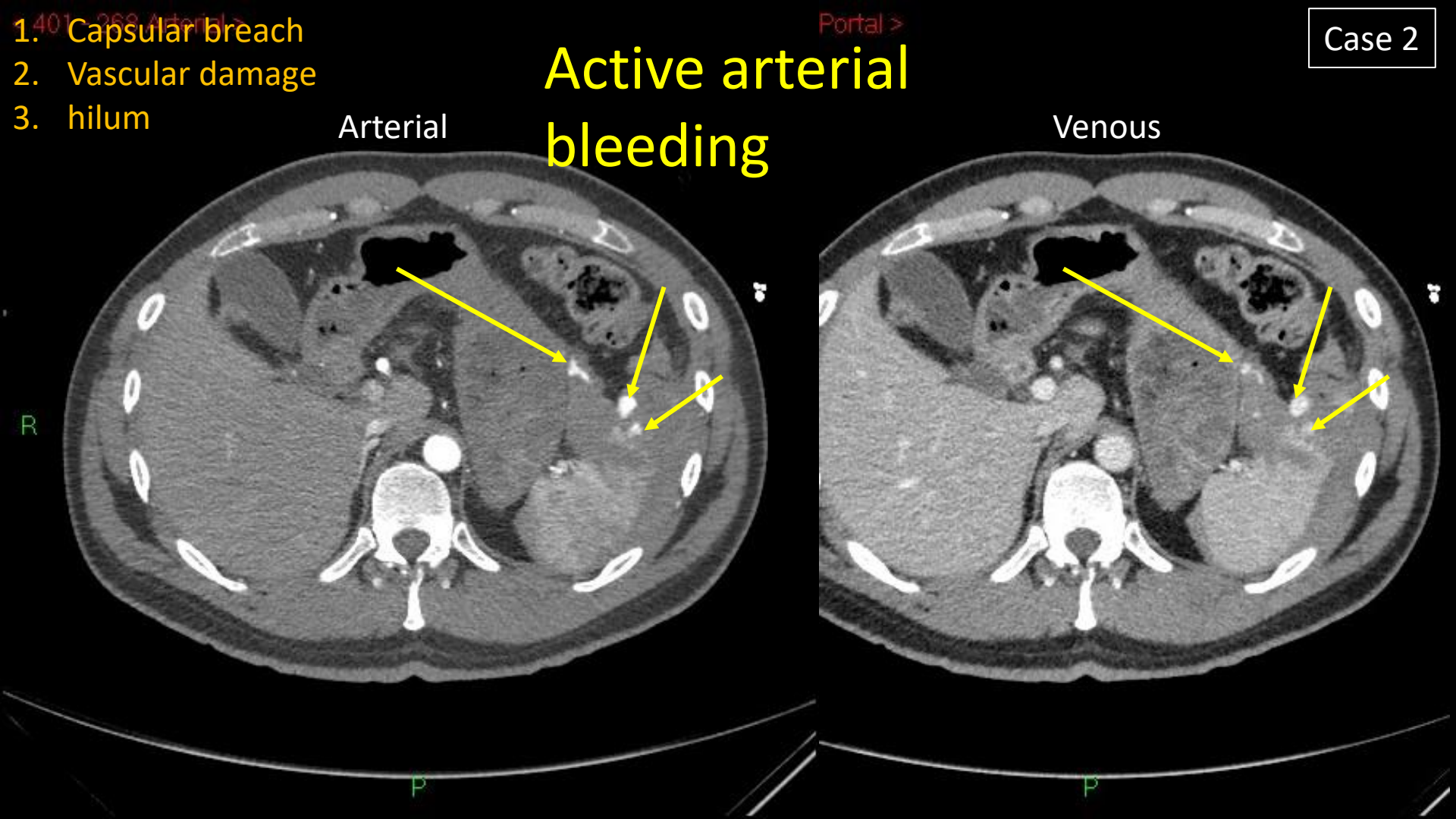
Venous

Where is the active bleeding?

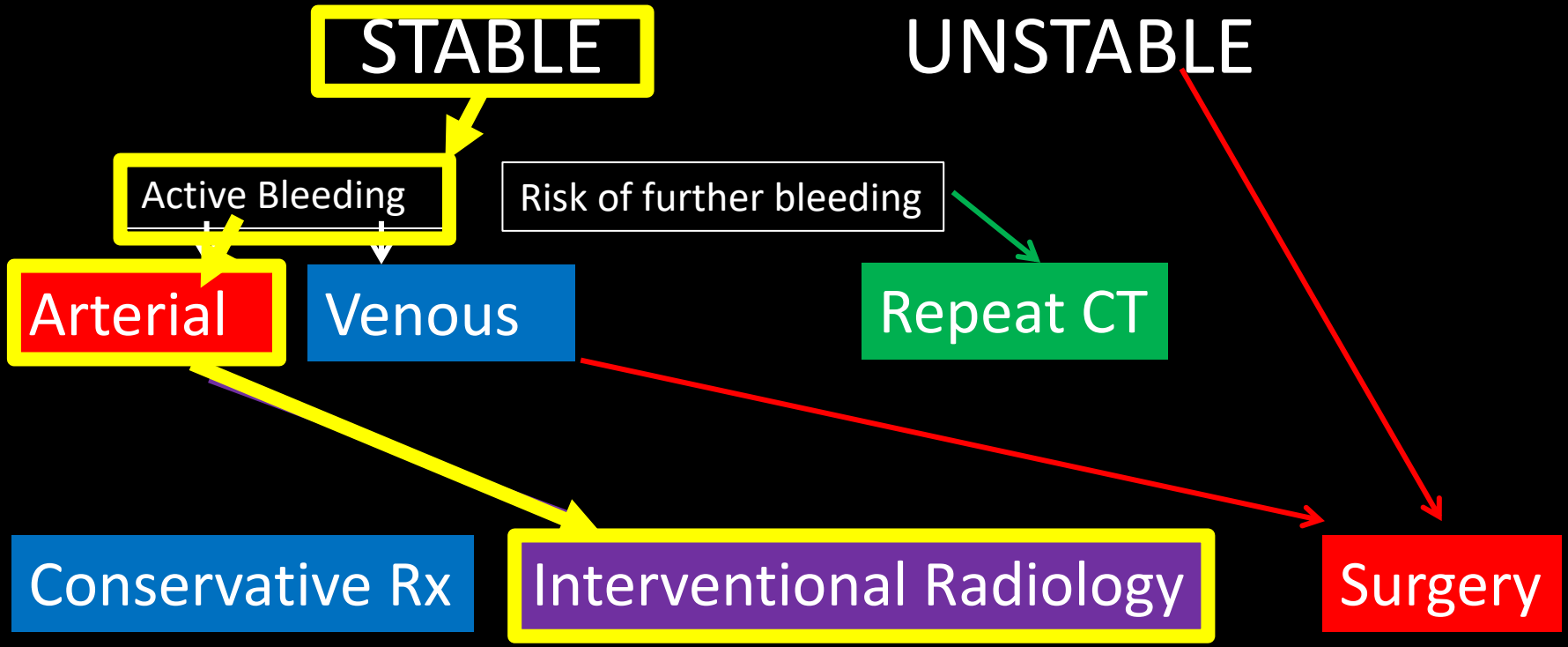
1. Capsular breach
2. Vascular damage
3. hilum

Active arterial bleeding

Case 2



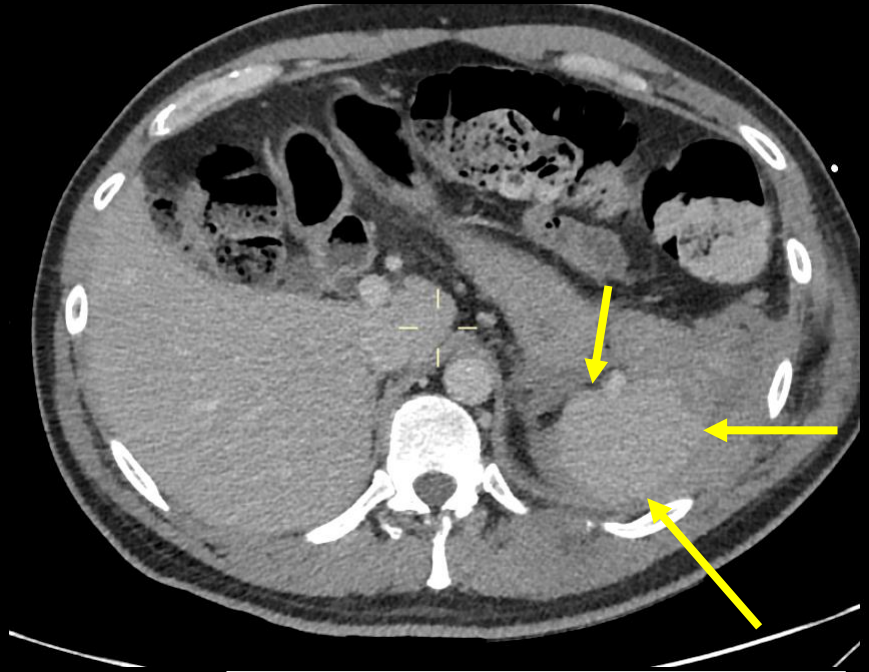
Splenic Injury: How should patient be managed?



Case 2

Day 4: Spleen embolised proximally, preservation of splenic function

Day 4 preserved splenic function



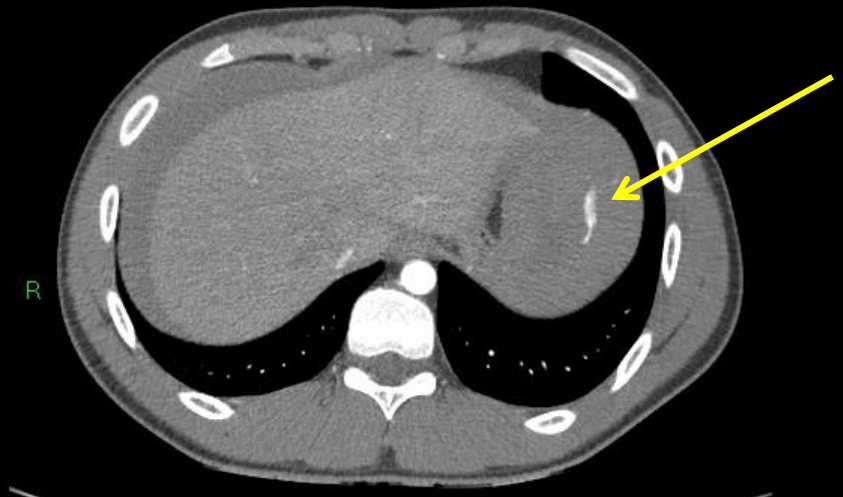
Normal splenic enhancement

Case 3

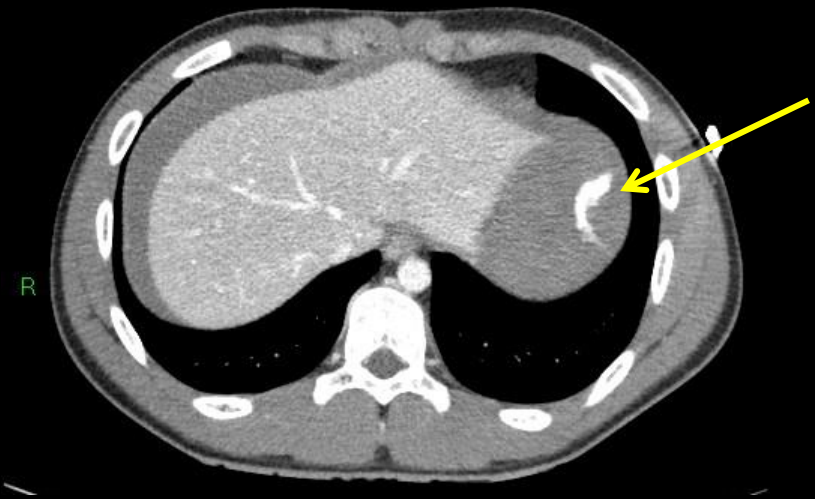
ACTIVE INTRAPERITONEAL BLEEDING

10 yo bike injury, hit handlebar.
Initially well, now hypotensive

ARTERIAL



VENOUS



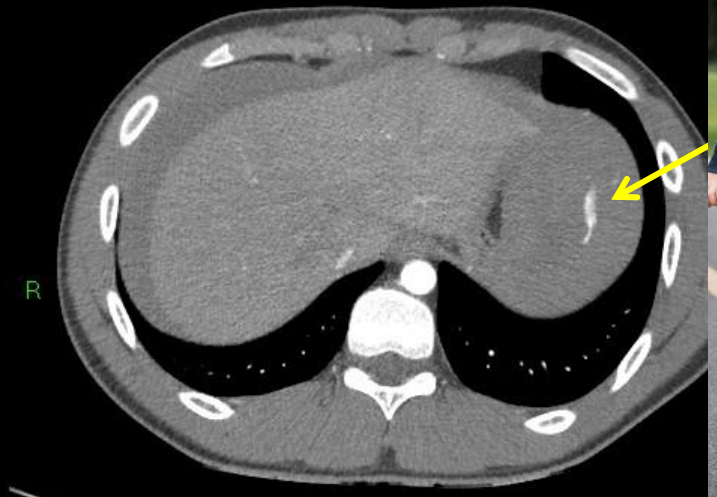
Contrast Jet increases ++++ between arterial and venous phase = ++++Bleeding

Case 3

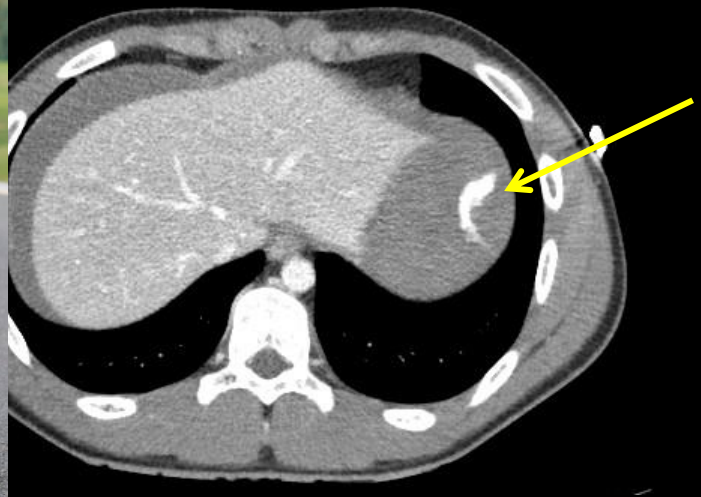
ACTIVE INTRAPERITONEAL BLEEDING

10 yo bike injury, hit handlebar.
Initially well, now hypotensive

ARTERIAL



VENOUS



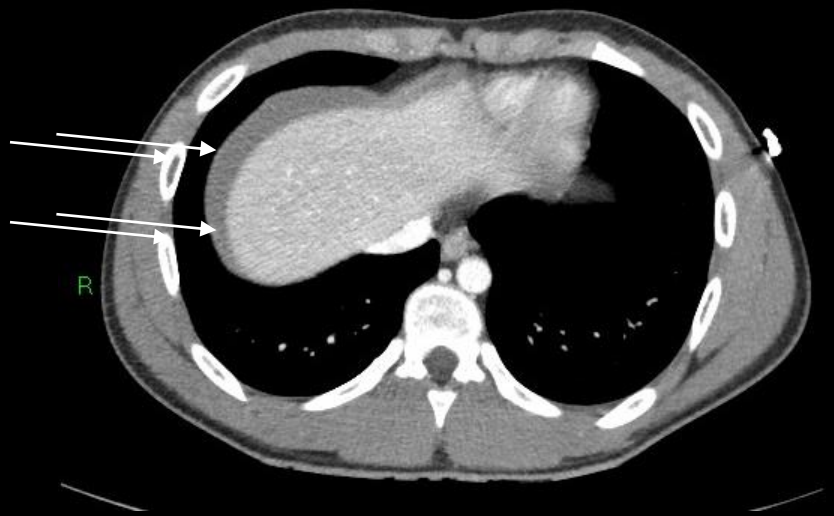
Contrast Jet increases ++++ between arterial and venous phase = ++++Bleeding

Case 3

VENOUS

haemoperitoneum

haemoperitoneum



Case 3

VENOUS

haemoperitoneum

haemoperitoneum

Case 3

VENOUS

haemoperitoneum

haemoperitoneum

Case 3

VENOUS

haemoperitoneum

haemoperitoneum

Case 3

VENOUS

haemoperitoneum

haemoperitoneum

Case 3

VENOUS

haemoperitoneum

ACTIVE BLEEDING

haemoperitoneum

Case 3

VENOUS

haemoperitoneum

haemoperitoneum

ACTIVE BLEEDING

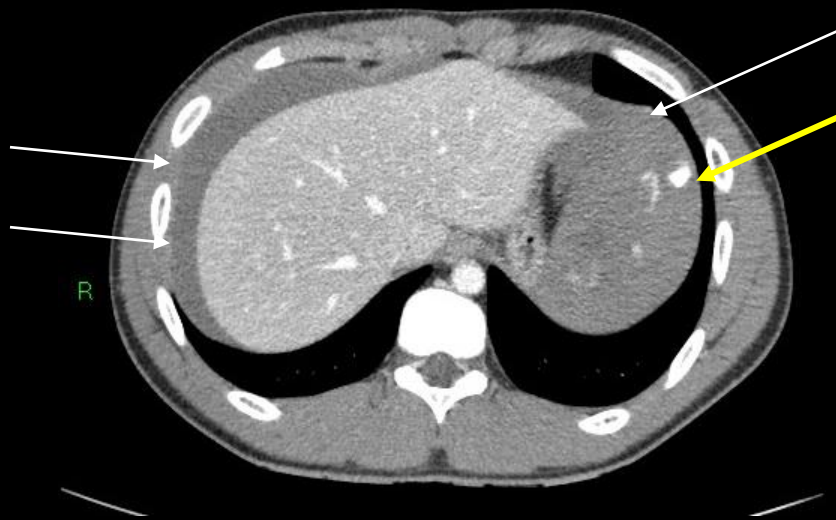
Case 3

VENOUS

haemoperitoneum

ACTIVE BLEEDING

haemoperitoneum



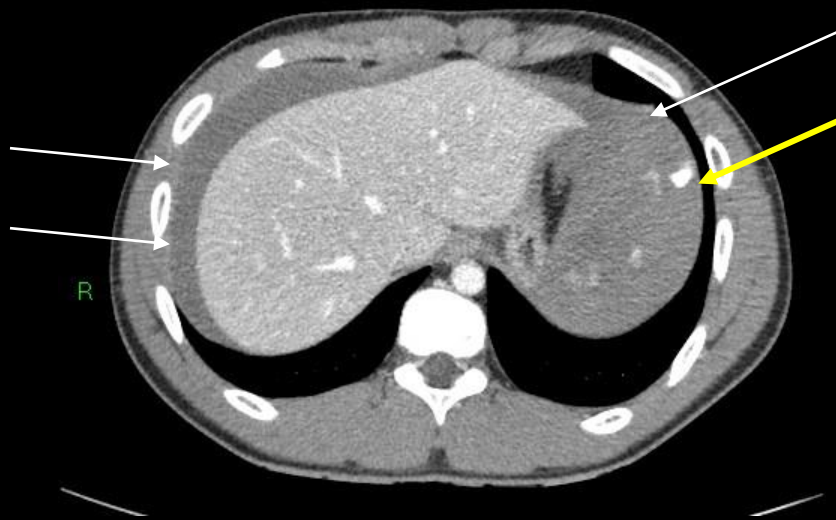
Case 3

VENOUS

haemoperitoneum

ACTIVE BLEEDING

haemoperitoneum



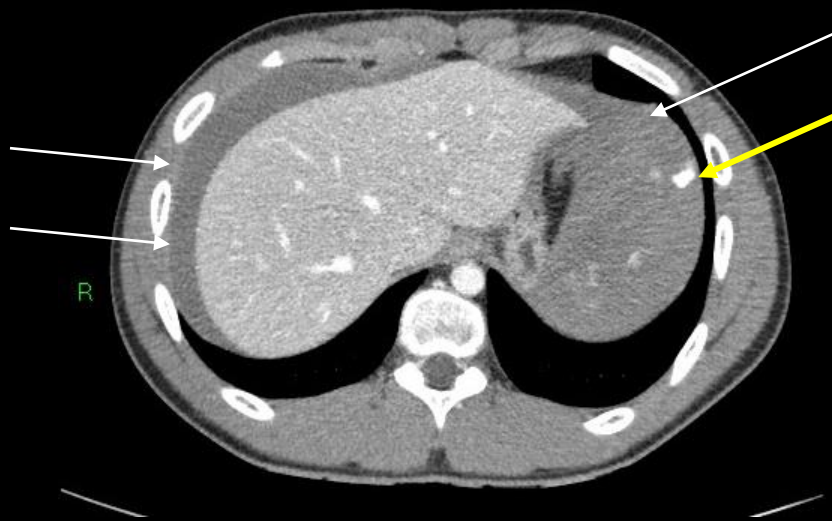
Case 3

VENOUS

haemoperitoneum

ACTIVE BLEEDING

haemoperitoneum



VENOUS

haemoperitoneum

ACTIVE BLEEDING

haemoperitoneum

Case 3

VENOUS

haemoperitoneum

haemoperitoneum

Case 3

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Case 3

VENOUS

haemoperitoneum

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Case 3

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haemoperitoneum

Case 3

VENOUS

haemoperitoneum

Shattered Spleen

Case 3

VENOUS

Case 3

VENOUS

Case 3

VENOUS

Case 3

VENOUS

Case 3

VENOUS

How should the patient be managed?

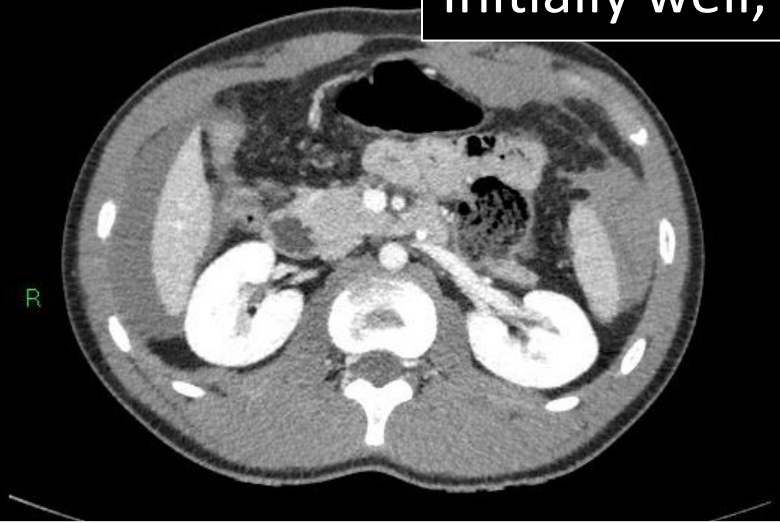
Nobody has responded yet.

Hang tight! Responses are coming in.

Dx: Active bleeding, haemoperitoneum +++, shattered spleen

Emergency splenectomy

10 yo bike injury, hit handlebar.
Initially well, now hypotensive



Learning Point: Beware the child with handlebar injury

Emergency Splenectomy vs Embolisation

Splenectomy

- Mortality up to 8-10%
- Infection 45%
  - (splenic bed abscess)
  - Elsewhere
  - Immunocompromised

Splenic Artery Embolisation

- Post Embolization syndrome (first 24 hrs)
- Abscess (<14%)
- Need for further surgery/re-bleed

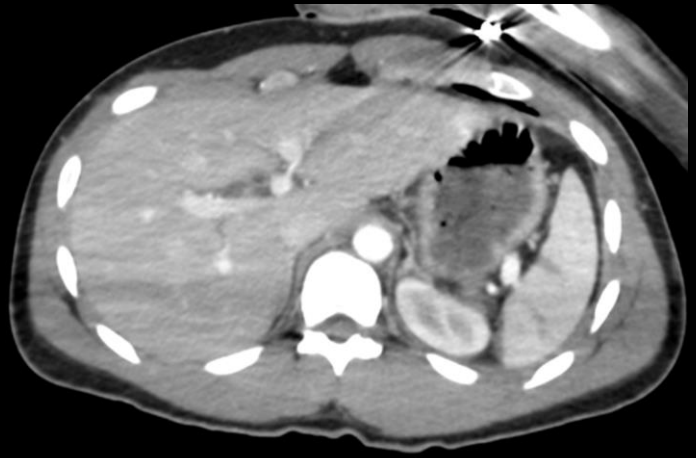
Gauer JM, et al (2008) Twenty years of splenic preservation in trauma: lower early infection rate than in splenectomy. World J Surg 32(12):2730–2735

Case 4

Road traffic accident Grade 2 splenic lacerations.

Case 4

DAY 0
Grade 2 splenic lacerations
no Pseudoaneurysm



Dual phase
Combined arterial and venous

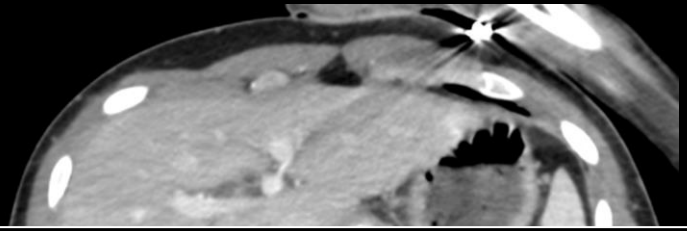
DAY 2
2 x Pseudoaneurysm developed

arterial

venous

Case 4

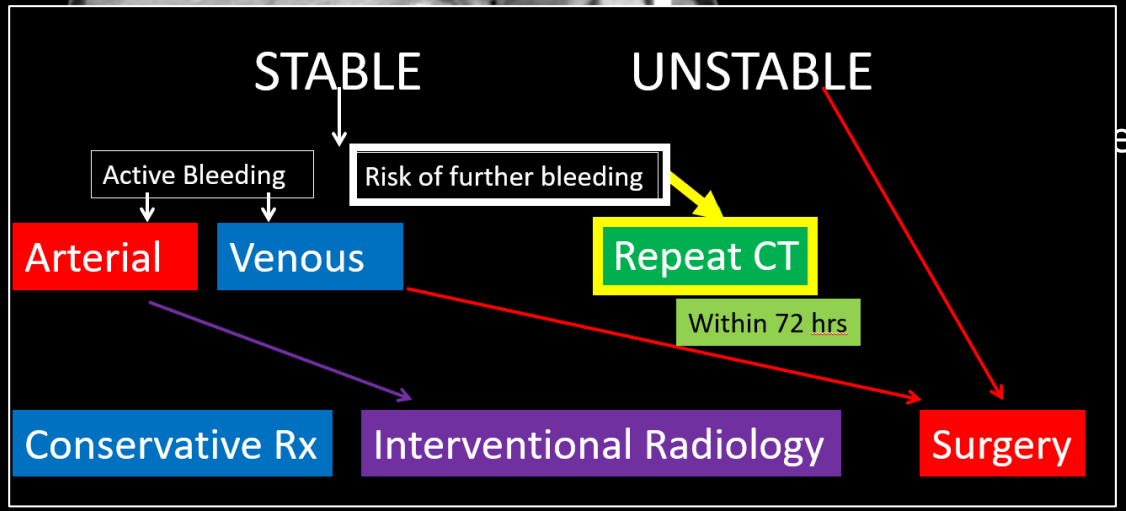
DAY 0
Grade 2 splenic lacerations
no Pseudoaneurysm



DAY 2
2 x Pseudoaneurysm developed

arterial

enous

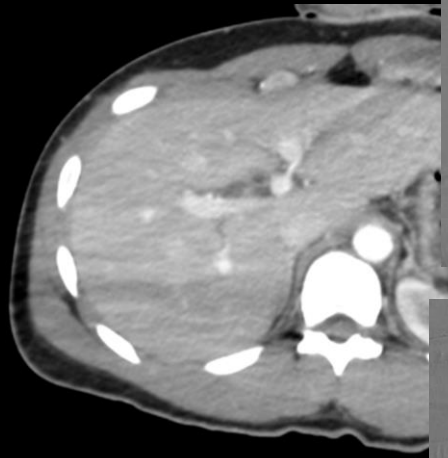


Case 4

DAY 0

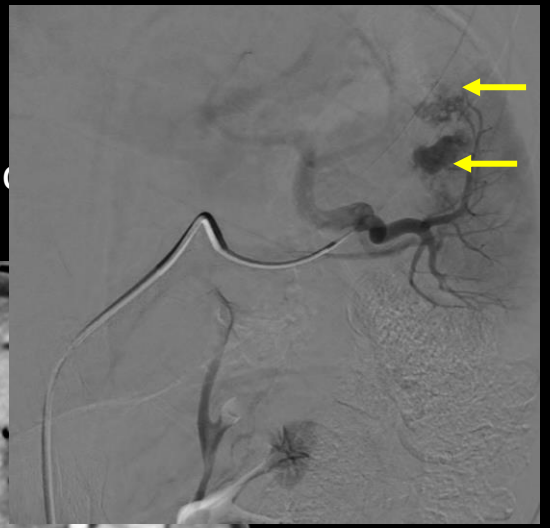
Grade 2 splenic laceratio

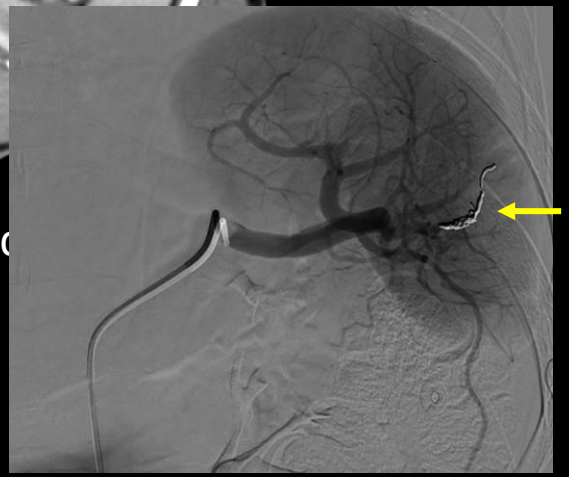
no Pseudoaneurysm



Dual phase

Combined arterial and





DAY 2

2 x Pseudoaneurysm developed

arterial

venous

Learning Point: Don't forget risk of Pseudoaneurysm or AV Fistula in Splenic trauma

- Durkin et al (LIVER/SPLEEN)
- N=43 splenic lacerations, 9% developed pseudoaneurysms
- Most settled w conservative Mx

- Who should be embolised? Team decision

Osterballe et al, J Trauma Mx & Outcomes 2014,
Durkin et al, J Ped Surgery 2016 (paediatric population)
Patel et al, Trauma, 2021 (Imperial)

Learning Points: Solid Organ injury

1. 3 choices – Conservative Mx/IR/Surgery
2. Unstable patients should be treated operatively
3. Arterial bleed – IR
4. Venous bleed – surgeons
5. Do not forget follow up imaging for Pseudoaneurysms

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Thank you

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Dr Andreas Shekkeris

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Dr Nicola Batrick

Dr Elika Kashef

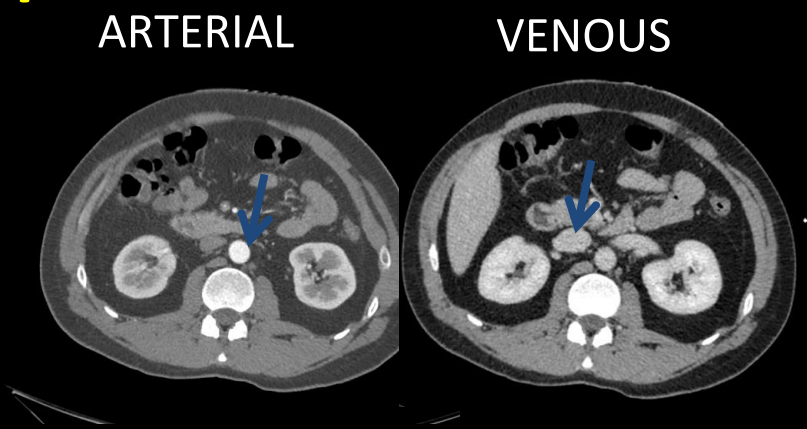
Dr Yassir Al-Radhi

Prof David Nott

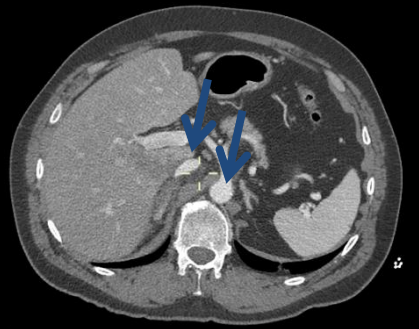
Mr Chris Aylwin

Trauma protocol

- Penetrating Injury/Code Red
  - Arterial and Venous Phase



- Blunt Injury
  - Dual Phase Single Acquisition (COMBISCAN/Camp Bastion)
  - 2 boluses of contrast, then one CT
  - Arterial and venous combined study



Thanks to the team:

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- Dr Raghu Kamanahalli
- Dr Elika Kashef
- Dr Amandeep Sandhu
- Mr Chris Aylwin
- Mr Mansoor Khan
- Mr David Nott

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