PITFALLS IN EMERGENCY VASCULAR SURGERY

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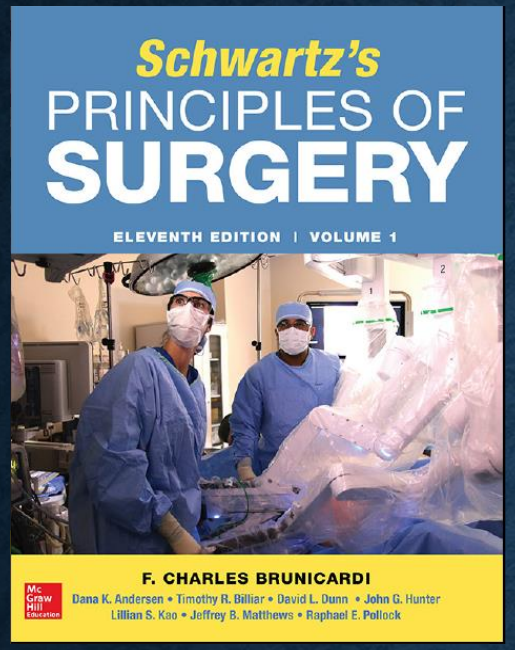
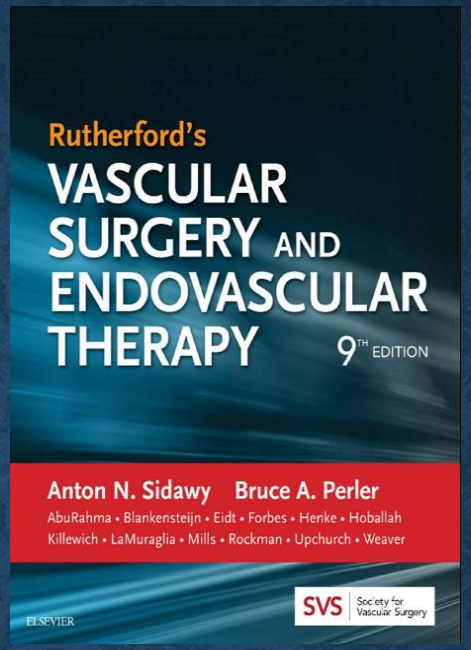
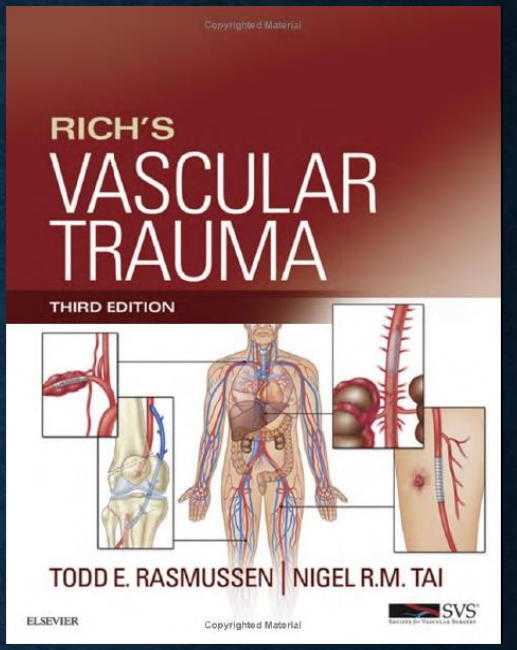
WE LEARN MORE FROM MISTAKE THAN FROM SUCCESS

"The Making of Surgeons"

William A Nolen MD

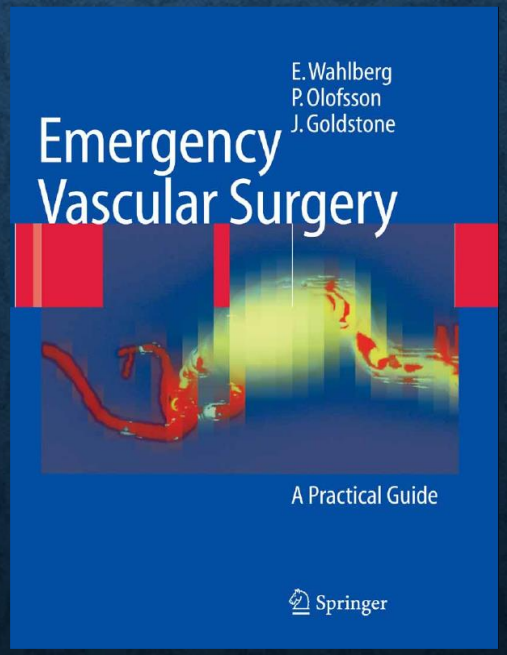


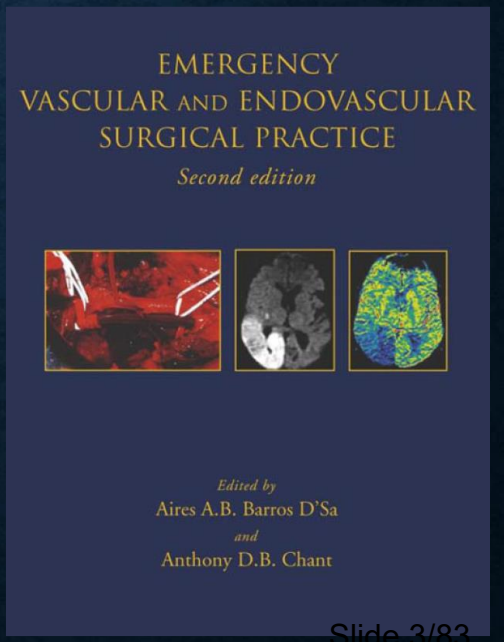




The Management of Peripheral Arterial Injuries

February in Phoenix - Trauma Symposium
February 15th, 2019





อาคารสมเด็จพระเทพรัตน์

คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี

Faculty of Medicine Ramathibodi Hospital
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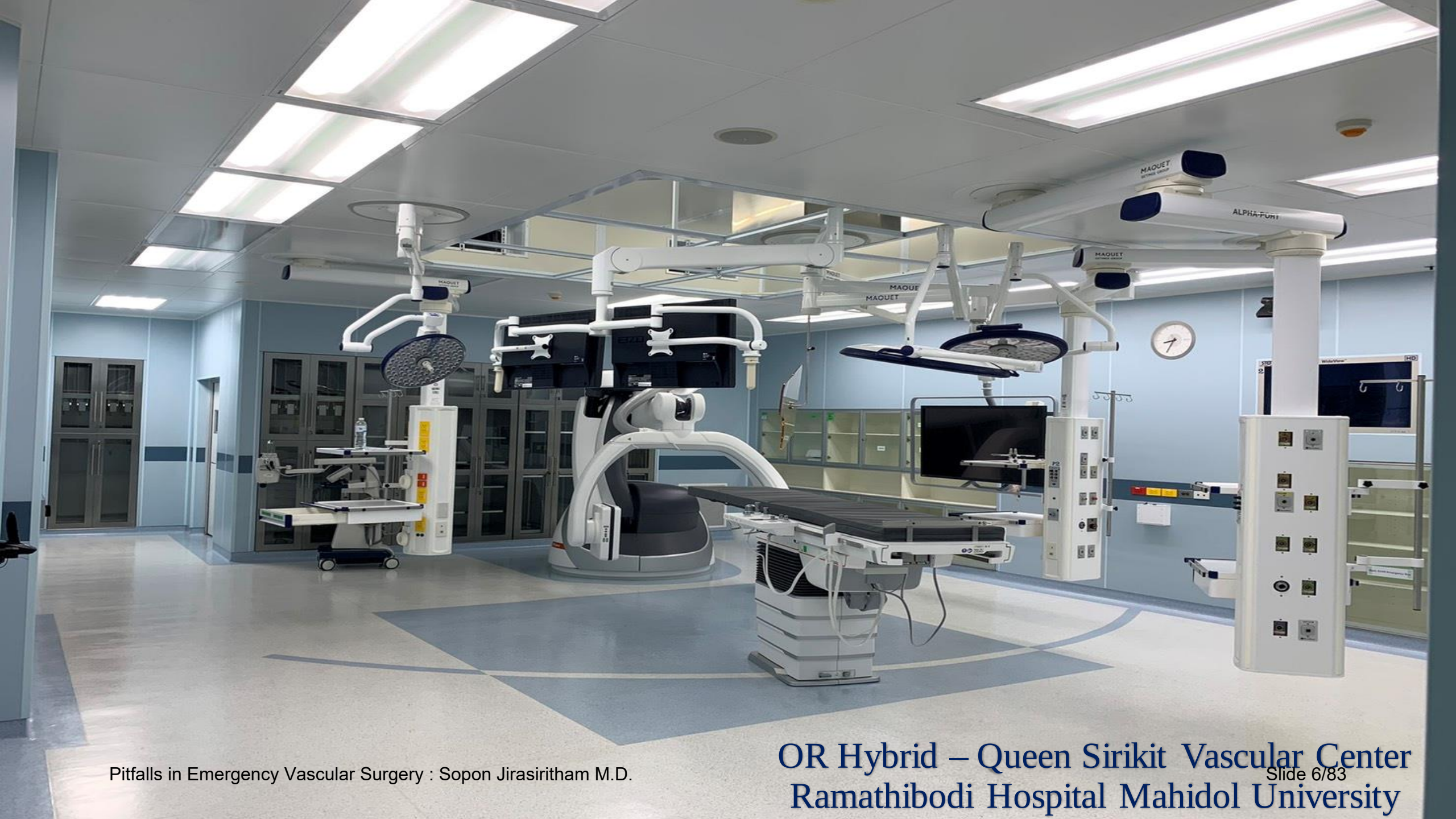

OR Hybrid – Queen Sirikit Vascular Center
Ramathibodi Hospital Mahidol University

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Ramathibodi Hospital Mahidol University

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Ramathibodi Hospital Mahidol University

Hybrid Operating Room

Queen Sirikit Vascular Center

EMERGENCY VASCULAR SURGERY

- Acute Limb Ischemia (ALI)
- Rupture Abdominal Aortic Aneurysm (rAAA)
- Vascular Injury
- Acute Deep Vein Thrombosis
- Acute mesenteric artery occlusion
- Acute aortic dissection

EMERGENCY VASCULAR SURGERY

- Acute Limb Ischemia (ALI)
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ACUTE LIMB ISCHEMIA

- ALI is defined as sudden loss of limb perfusion, and the term is applicable up to 2 weeks after event
- Amputation rate 10-30% , mortality rate 15-20 % .
- Presentation : “five Ps” (6) *p*ain, *p*allor, *p*aresthesias, *p*aralysis, *p*ulselessness, *p*oikilothermia
- Most common site : Common femoral artery
- Staging : Rutherford classification
- Initial management : Heparin (after test for hypercoagulability investigation
- Treatment : Surgical embolectomy – Thrombectomy
- Complication : - Limb amputation
  - Reperfusion syndrome
  - Compartment syndrome

Schwartz’s Principles of Surgery 11 ed 2019 p 952-957

5 COMMON PITFALLS IN ALI

- 1. Diagnosis
- 2. Investigation
- 3. Treatment
- 4. Procedure
- 5. Post operative complication
- 6. Amputation
- 7. Endovascular treatment
- 8. Thrombolysis

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5 COMMON PITFALLS IN ALI

- 1. Diagnosis : Miss diagnosis , Over diagnosis , Confused diagnosis
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- Confused with critical limb ischemia
- Confused with gangrene
- Confused with infection (diabetic)
- Refer without full PE of pulse


Dorsal is pedis 2+

5 COMMON PITFALLS IN ALI

- 1. Diagnosis : Miss diagnosis , Over diagnosis , Confused diagnosis
- 2. Investigation : No need for timing angiography (Rutherford 2B) , Doppler signal,
- 3. Treatment
- 4. Procedure
- 5. Post operative complication
- 6. Amputation
- 7. Endovascular treatment
- 8. Thrombolysis

SEVERITY OF ISCHEMIA:

(RUTHERFORD'S CLASSIFICATION)

Table 161-1 Classification of Acute Limb Ischemia

		Findings		Doppler Signals	
Category	**Description / Prognosis**	**Sensory Loss**	**Muscle Weakness**	**Arterial**	**Venous**
I. Viable	Not immediately threatened	None	None	Audible	Audible
II. Threatened					
a. Marginally	Salvageable if promptly treated	Minimal (toes) or none	None	Inaudible	Audible
b. Immediately	Salvageable with immediate revascularization	More than toes, associated with rest pain	Mild, moderate	Inaudible	Audible
III. Irreversible	Major tissue loss or permanent nerve damage inevitable	Profound, anesthetic	Profound, paralysis (rigor)	Inaudible	Inaudible

5 COMMON PITFALLS IN ALI

- 1. Diagnosis : Miss diagnosis , Over diagnosis , Confused diagnosis
- 2. Investigation
- 3. Treatment : ~~Embolism vs Thrombosis~~ , Delayed initial Heparinization , ~~LMWH , NOAC~~
- 4. Procedure
- 5. Post operative complication
- 6. Amputation
- 7. Endovascular treatment
- 8. Thrombolysis

5 COMMON PITFALLS IN ALI

- 1. Diagnosis : Miss diagnosis , Over diagnosis , Confused diagnosis
- 2. Investigation
- 3. Treatment : Embolism vs Thrombosis , delayed initial heparinization , LMWH , NOAC
- 4. Procedure : Backflow bleeding , Fogarty catheter complication , Completion angiogram
- 5. Post operative complication
- 6. Amputation
- 7. Endovascular treatment
- 8. Thrombolysis

5 COMMON PITFALLS IN ALI

- 1. Diagnosis : Miss diagnosis , Over diagnosis , Confused diagnosis
- 2. Investigation
- 3. Treatment : Embolism vs Thrombosis , delayed initial heparinization , LMWH , NOAC
- 4. Procedure : Backflow bleeding , Fogarty catheter complication , Completeness angiogram
- 5. Post operative complication : Reperfusion syndrome , Compartment syndrome , delayed amputation
- 6. Amputation
- 7. Endovascular treatment
- 8. Thrombolysis

POST OPERATIVE MANAGEMENT

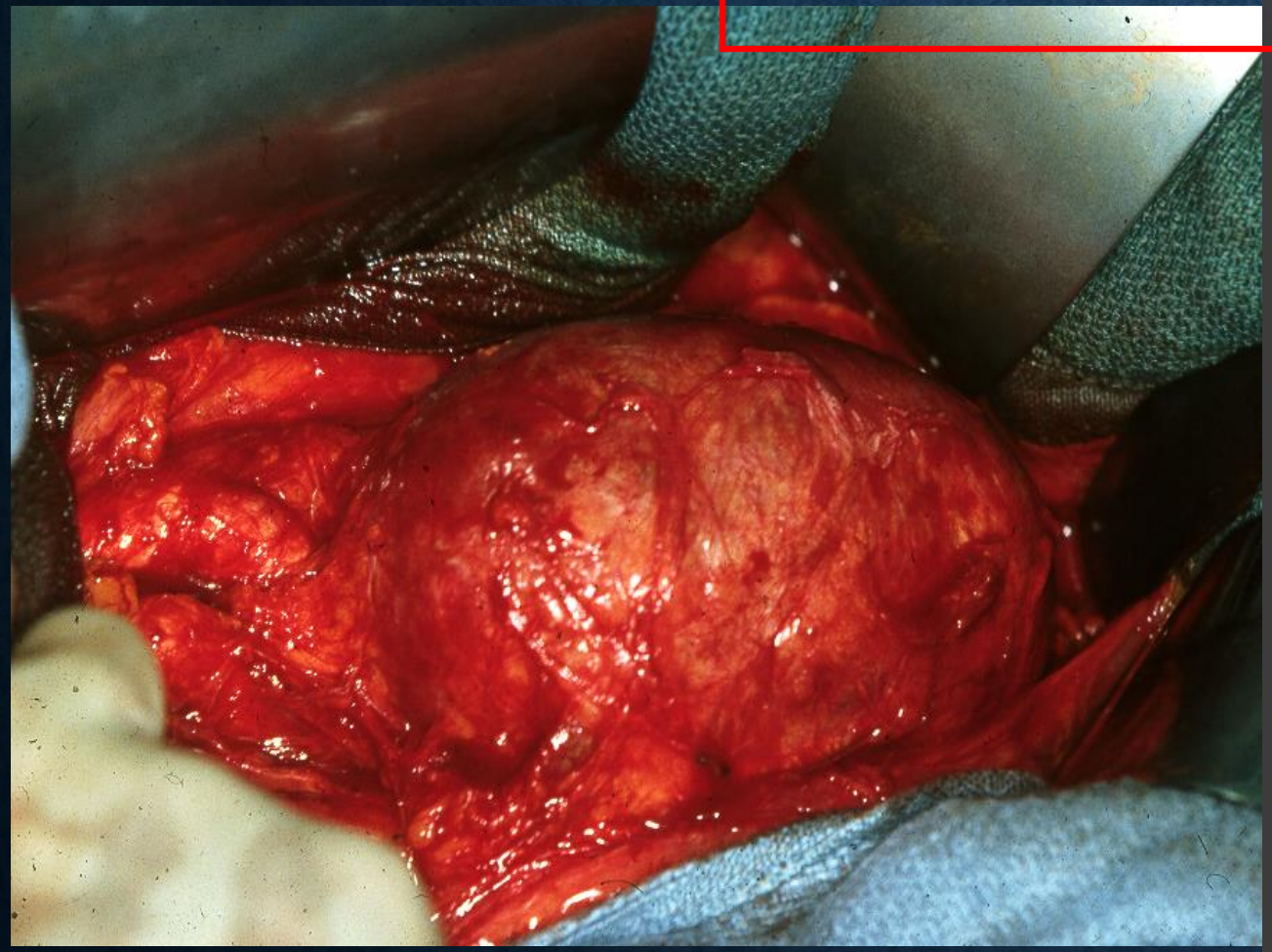
- Heparinization: indication
  - cannot correct etiologic cause: AF, hypercoagulable state
  - poor run off
  - re do operation
- Observe pulse closely : Manual and Doppler
- Monitor compartment syndrome : swelling , pain
- Monitor reperfusion syndrome : hyperkalemia , acidosis

After 15 minutes ,

30 Amputations have been done

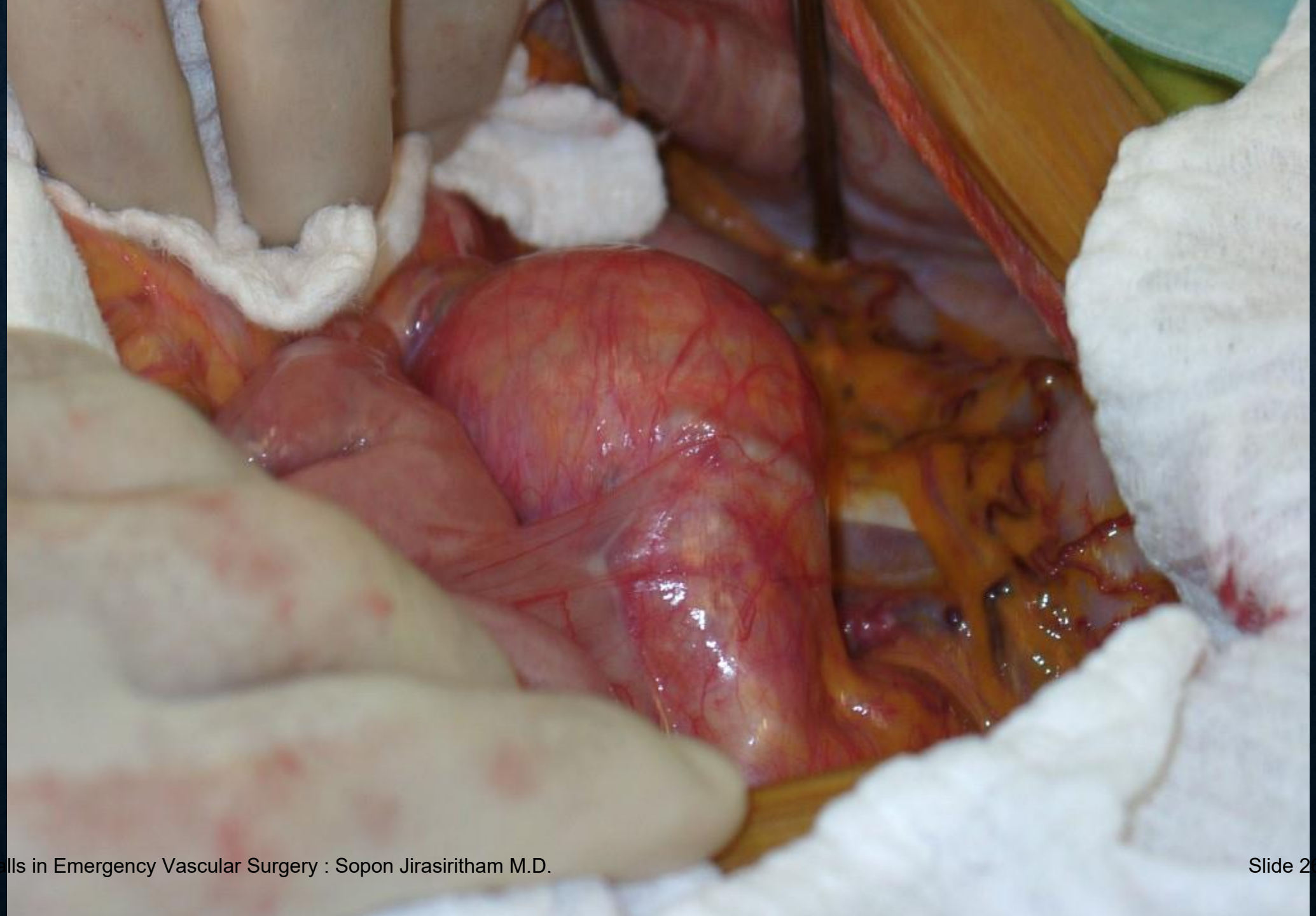
There is one Amputation every 30 seconds in the world

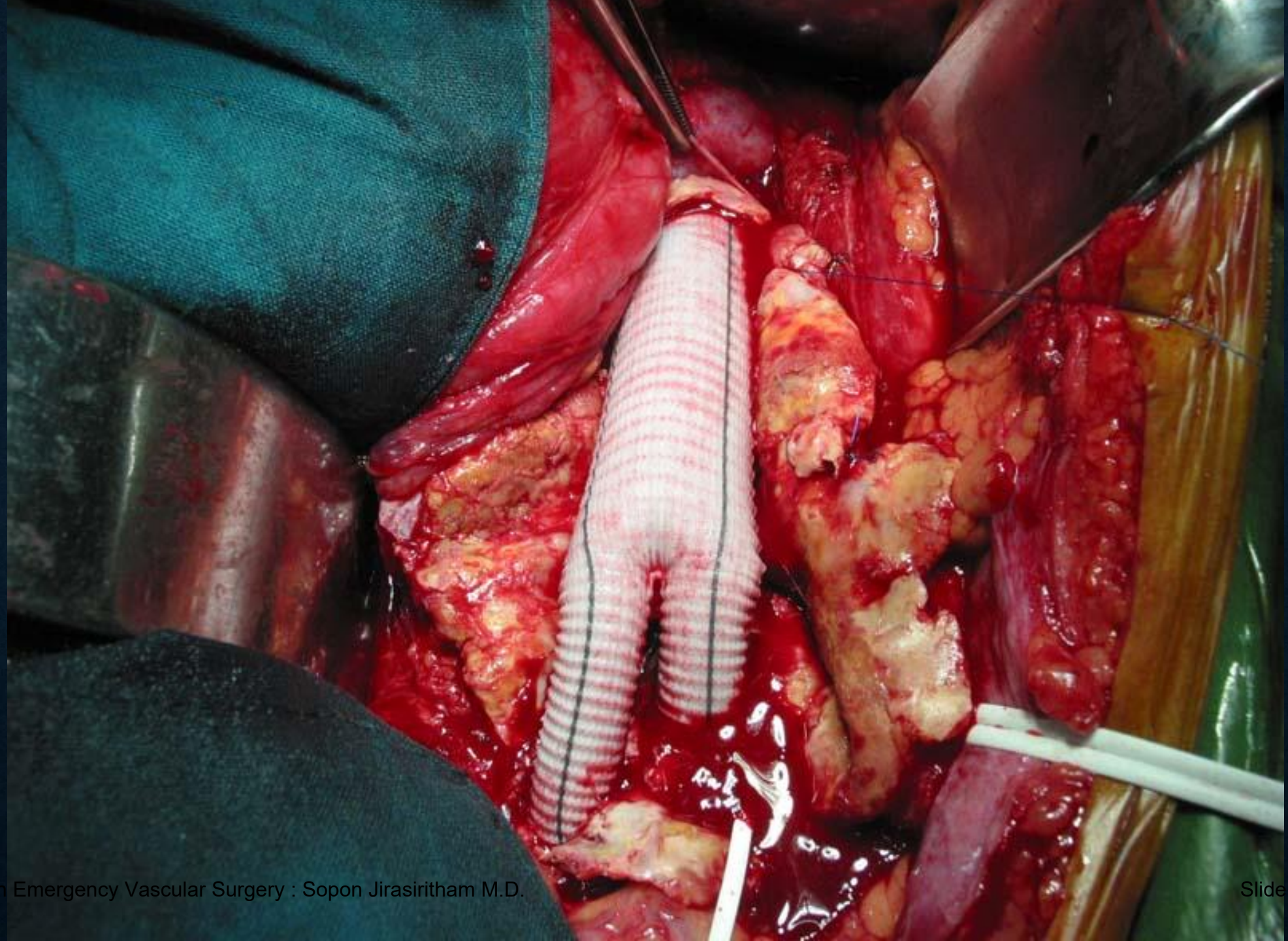
rAAA



Mortality rate 3-5 %

Mortality rate 50 %





RUPTURED ABDOMINAL AORTIC ANEURYSM

- One of the THREE most cruciating abdominal pain
- Mortality rate : 10-fold than elective repair,53-65.9 % (USA –UK) ,
  EVAR ↓ MR 4.2 – 14 % (EVAR vs OR : 33.8 vs 47 %)
  Postoperative MR 42 % :- MI, Colon ischemia , AKI , SCI , MOF
- A contained rupture – rupture confined to the retroperitoneal space
- A free rupture – rupture directly into the peritoneal cavity.
- Symptomatic AAA: acute expansion of the wall, intramural hemorrhage,
  wall degeneration, or bleeding into the thrombus -prelude to rupture require rapid / urgent diagnosis and urgent management

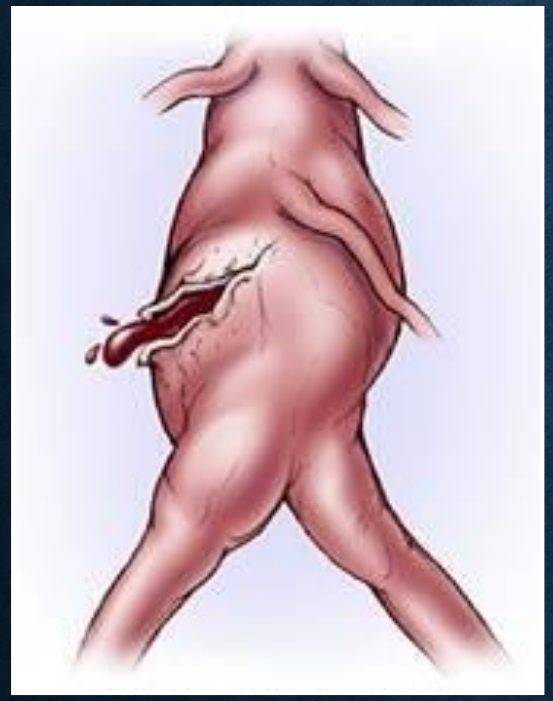
Rutherford's Vascular Surgery and Endovascular Therapy 9th ed ,2019 : 944

RUPTURED ABDOMINAL AORTIC ANEURYSM

- Clinical Features : Triad of Abdominal pain , hypotension , pulsatile mass (9 vs 34%)
- 23 % correctly diagnosed by the first physician
- The most common misdiagnosis : renal colic , perforated viscus , diverticulitis
- Investigation : Plain abd. X-Ray 90 % - 65% cal aortic wall , 75 % psoas shadow
- Presence of pulsatile mass :26% of misDx group vs 72% of correctly diagnosed group
- Ultrasonography , CTA (sense 77% spcf 100 %) - Timing : 25 minutes
- Permissive Hypotension : 70-80 systolic pressure

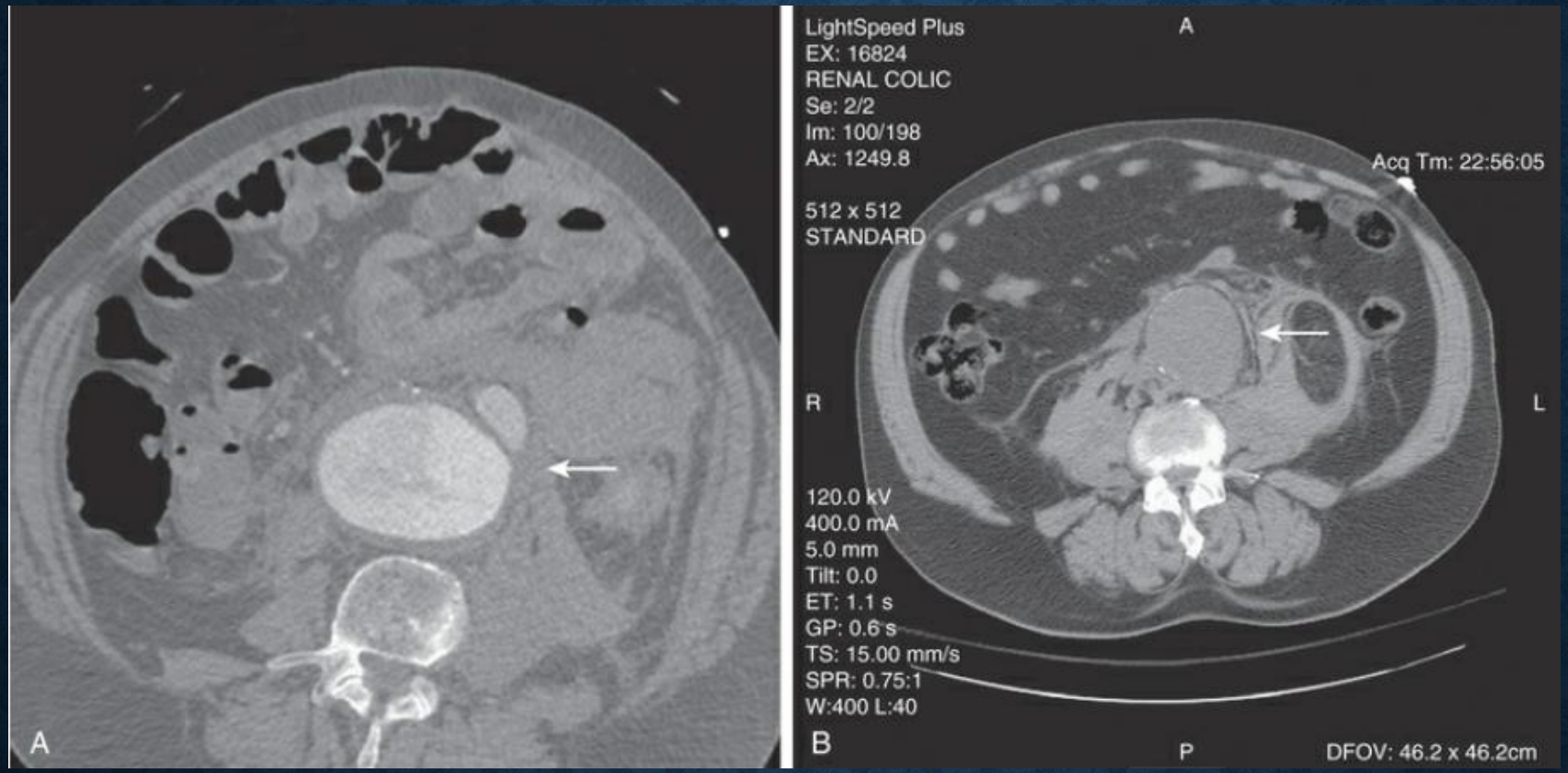
Rutherford's Vascular Surgery and Endovascular Therapy 9th ed ,2019 : 944

Clinical Predictors of Aneurysm Rupture



- Aneurysm diameter (expansion)
- Smoking
- Hypertension
- Female sex
- Aneurysm morphology
- COPD

Choke et al EJVES 2005



A . Frank rupture of an infrarenal abdominal aortic aneurysm with contained extravasation (arrow)

B. Comuted tomografphy scan of a ruptured abdominal aortic aneurysm.

No contrast material was used , the scan was done for diagnosis of renal colic

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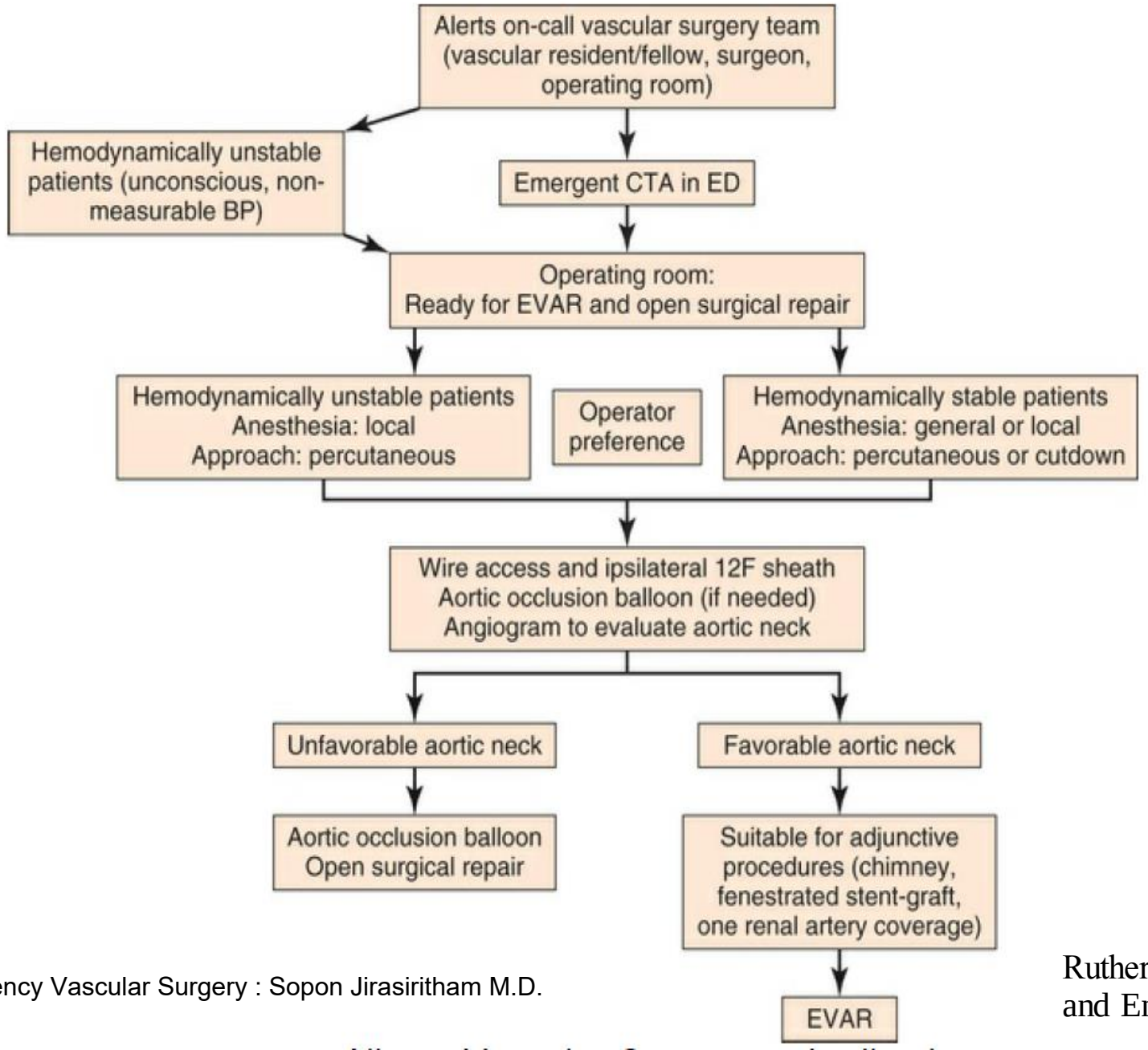

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COMPLICATIONS AFTER REPAIR RAAA

- Local complications
  - Post-op bleeding
  - Limb ischemia
  - Colonic ischemia
  - Paraplegia and paraparesis
- Systemic complications
  - Respiratory failure
  - Renal dysfunction
  - Irreversible shock
  - Cardiac complications
  - Liver failure
  - MOF

Rutherford's Vascular Surgery and Endovascular Therapy 9th ed ,2019 : 944

5 COMMON PITFALLS IN RAAA

- 1. Diagnosis :
- 2. Investigation
- 3. Treatment :
- 4. Procedure :
- 5. Endovascular treatment
- 6. Post operative complication

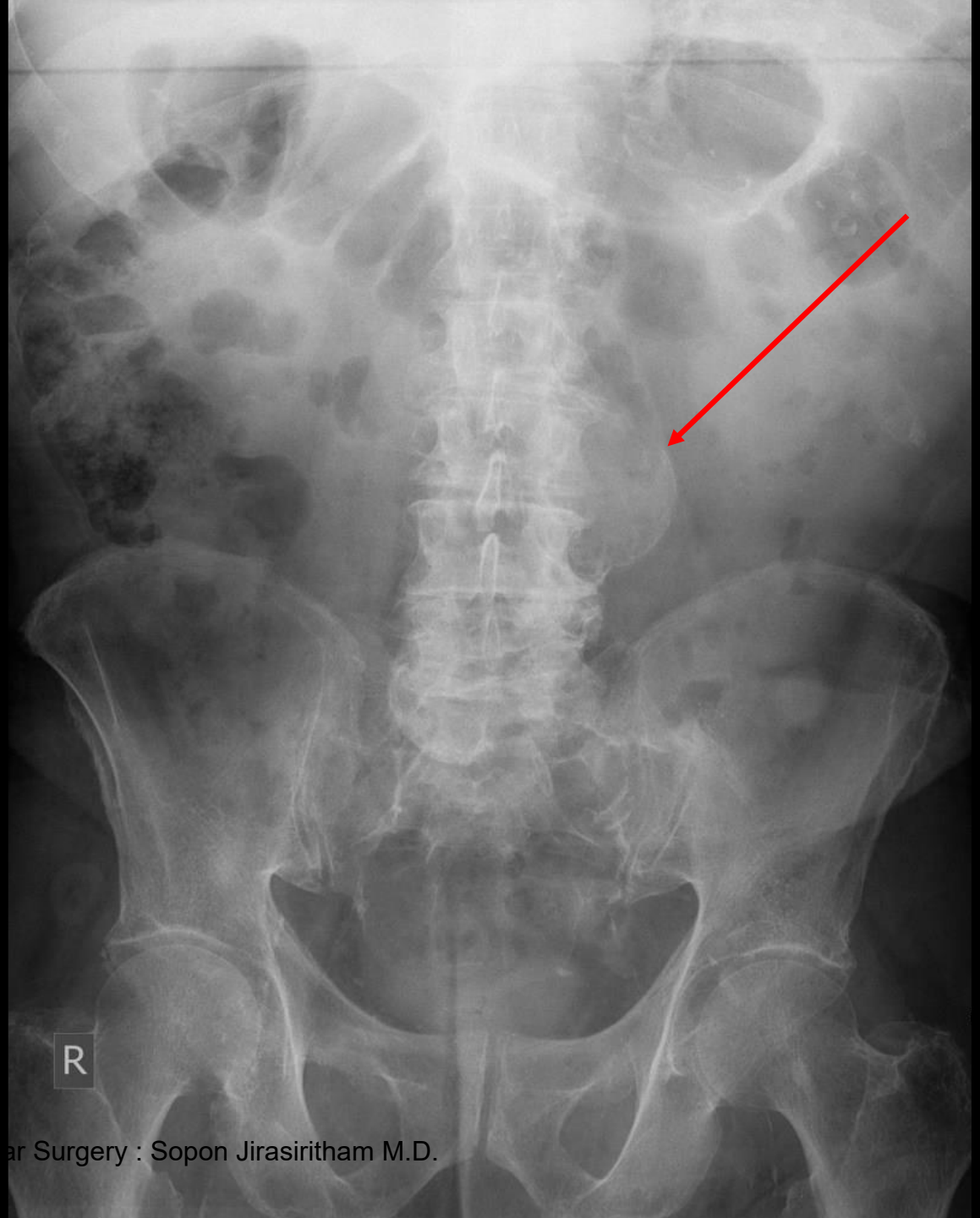
5 COMMON PITFALLS IN RAAA

- 1. Diagnosis : Miss diagnosis , Confused diagnosis , Over diagnosis
- 2. Investigation
- 3. Treatment
- 4. Procedure
- 5. Endovasc
- 6. Post operative complication

One of the :
- Catastrophic situation of acute abdomen
- Agonizing pain
- Timing : Masking phase
- Timing limitation


urgery : Sopon Jirasiritham M.D.


SUPIN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: Sopon Jirasiritham M.D.

5 COMMON PITFALLS IN RAAA

- 1. Diagnosis :
- 2. Investigation : wasting time ,before or after transfer , ineffective protocol ,
- 3. Treatment :
- 4. Procedure :
- 5. Endovascular treatment
- 6. Post operative complication

5 COMMON PITFALLS IN RAAA

- 1. Diagnosis :
- 2. Investigation
- 3. Treatment : Management :- relatives , consciousness, systolic pressure , blood component .
  coordination – ER , OR , Gen Anesthesia , surgical team , blood component , equipment
- 4. Procedure :
- 5. Endovascular treatment
- 6. Post operative complication

5 COMMON PITFALLS IN RAAA

- 1. Diagnosis :
- 2. Investigation
- 3. Treatment :
- 4. Procedure : Graft , Easy thing done firs- iliac . Beware adjacent vein :- IVC , iliac vein .
- 5. Endovascular treatment
- 6. Post operative complication

5 COMMON PITFALLS IN RAAA

- 1. Diagnosis :
- 2. Investigation
- 3. Treatment :
- 4. Procedure :
- 5. Endovascular treatment
- 6. Post operative complication : perioperative care , Postoperative MR 42 % :- ACS , SCI , Colon ischemia , MI, AKI , MOF

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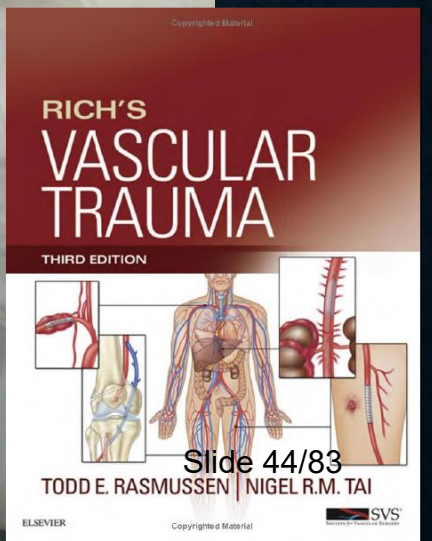
Vascular Injury



VASCULAR INJURY

- Vascular Injury : Accident , Assault , Iatrogenic
- Persistent Hypotension : 5 sources – scalp , chest , abdomen , pelvis , extremities
- FAST , CXR , Pelvic X-Ray , CT
- Hypotensive resuscitation : SBP < 90 mmHg in arterial injury , > 100 mmHg in BI
- Mechanism/Pattern / Direction of injury
- Blunt trauma – multiple injury , velocity , height
- Penetrating injury- wounding agent , high velocity GSW , SGW (2000)
- Iatrogenic injury – consultation – anatomy recall , how to control

VASCULAR INJURY

- Intraoperative percutaneous arteriography or cut down technique
- Patients with palpable thrill or audible bruit- AV fistula – not emergency situation
- Multiple life-threatening injury : Brain , Abdomen , Vascular – Temporary control hemorrhage and temporary intra-arterial shunt (only when needed)
- Avoid external bleeding by direct pressure on wound without tourniquet
- Two separate incision to obtain proximal and distal control before entering the hematoma
- Post operative - Compartment syndrome

Table 7-1

Immediately life-threatening injuries to be identified during the primary survey

Airway
- Airway obstruction
- Airway injury

Breathing
- Tension pneumothorax
- Open pneumothorax
- Massive air leak from tracheobronchial injury
- Flail chest with underlying pulmonary contusion

Circulation

Hemorrhagic shock
- Massive hemothorax
- Massive hemoperitoneum
- Mechanically unstable pelvis fracture with bleeding
- Extremity blood loss

Cardiogenic shock
- Cardiac tamponade

Neurogenic shock

Disability
- Intracranial hemorrhage
- Cervical spine injury

Schwartz'Principles of Surgery 11th ed ; 2019: 184

VASCULAR INJURY

HARD SIGNS

1. Pulsatile hemorrhage
2. Expanding hematoma
3. Bruit of thrill over area of injury
4. Absent extremity pulses
5. Arterial pressure index < 0.9

SOFT SIGNS

1. History of Hemorrhage
2. Wounds unexplained hemorrhagic Shock
3. Neurologic deficit proximity to vessels
4. High risk fracture, dislocation , penetrating wound.

Rich's VascularTrauma 3rd ed 2016, p 39

INDICATION FOR ANGIOGRAPHY IN EXTREMITY TRAUMA

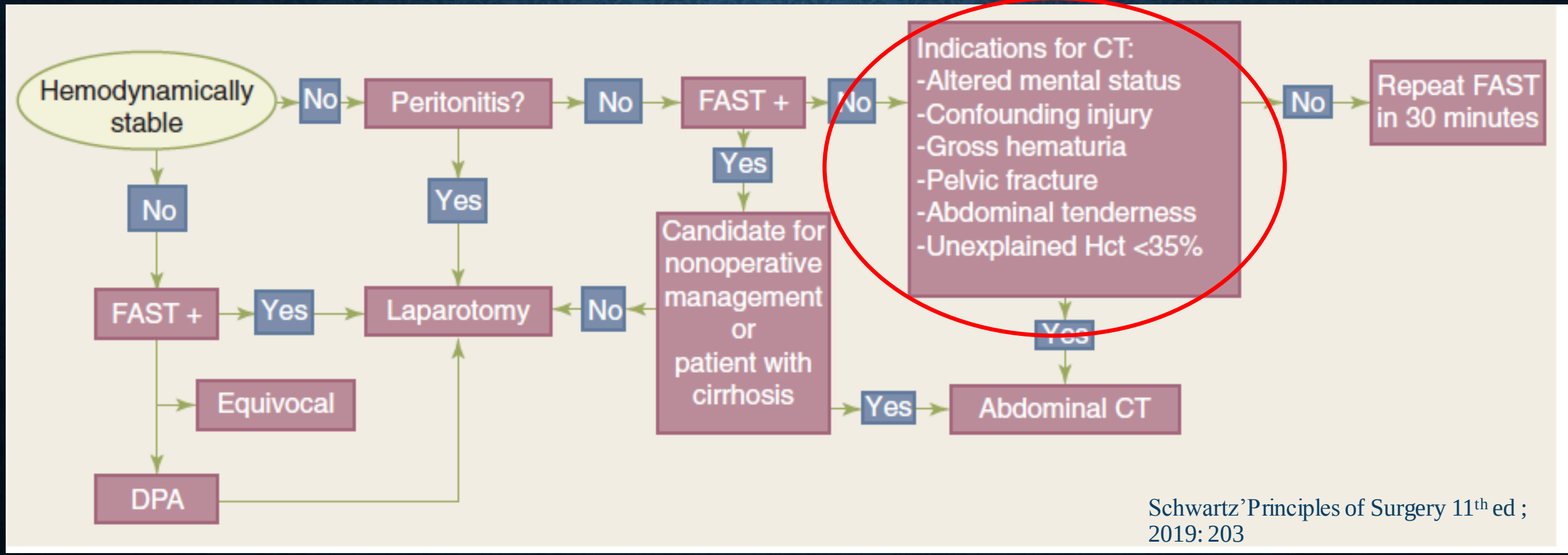
No severe ischemia , less than 6 hours after event

- Unclear location of vascular injury
- Extensive soft tissue injury
- Fracture or dislocation (compression)
- Trajectory parallel to an artery
- Multiple wound
- Short gun wound
- Peripheral arterial disease

ry : Sopon Jirasiritham M.D.

Schwartz'Principles of Surgery 11th ed ; 2019: 207

INDICATION FOR CT FOR VASCULAR INJURY



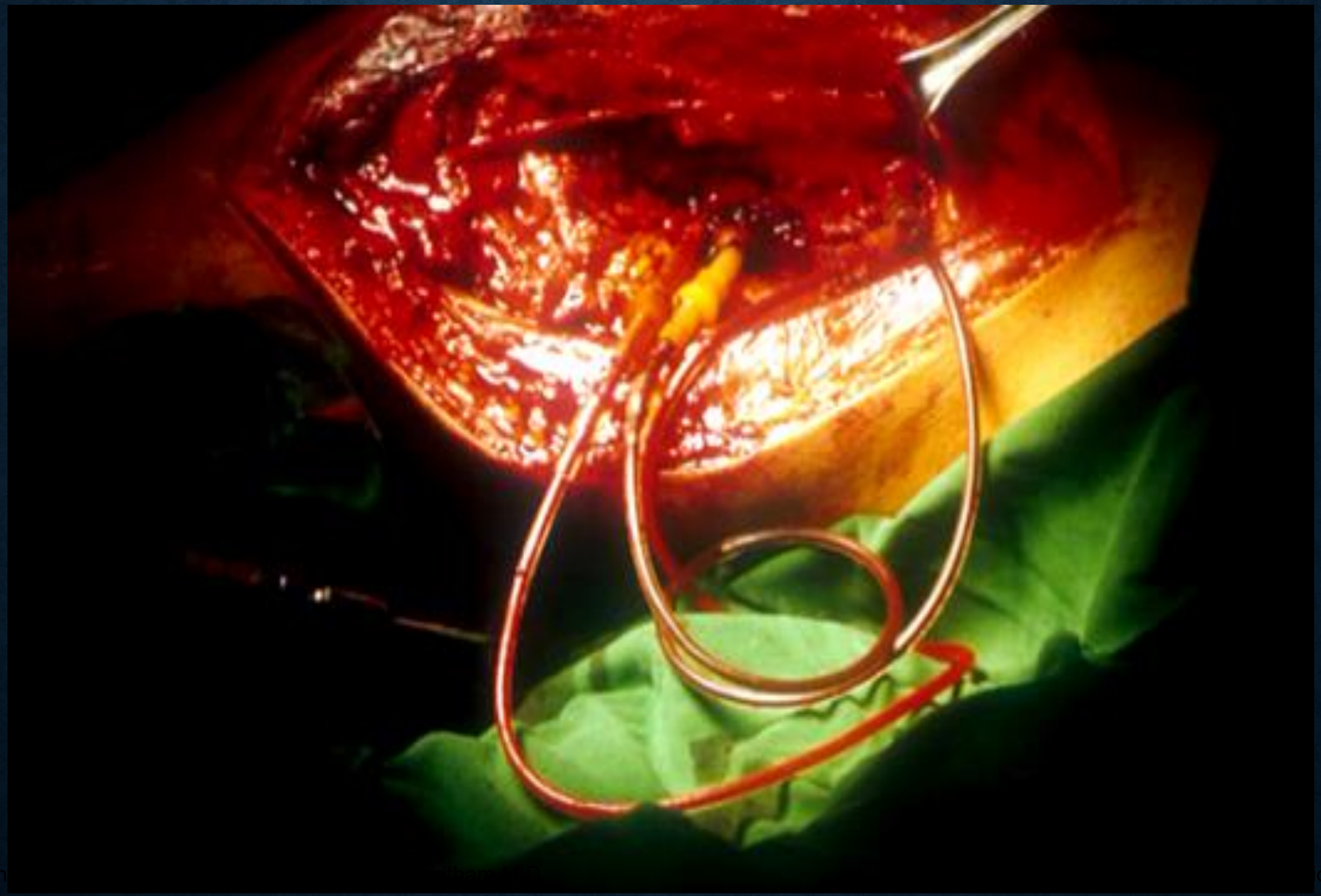
Schwartz'Principles of Surgery 11th ed ; 2019: 203

PRINCIPLE OF REPAIR VASCULAR INJURY

- Control bleeding :- local , direct , specific pressure
- Proximal and distal control – well planned
- Local intravascular heparinized saline (50 u / ml)
- Repair with appropriate material (50/60 polypropylene)
- Vascular shunt if necessary (associated injury)
- Venous injury : ligation , pressure packing , repair

Temporary arterial shunt for damage control in hemodynamic unstable patient

Rutherford's Vascular Surgery and Endovascular Therapy 9th ed ,2019 : 2396



VASCULAR INJURY

SALVAGE VS AMPUTATION

Indication for limb salvage :

- 1. Less than 6 hours " Magical time" from the point of injury 90 % salvageable
- 2. Less Than 30 % of soft tissue loss
- 3. Bone shaft is in continuity – can be fixed
- 4. Major nerve damage can be repairable – less than 2-3 cm loss
- 5. Vascular reconstruction is able to be covered by soft tissue

Rich's VascularTrauma 3rd ed 2016, p 263

MANGLED EXTREMITY SEVERITY SCORE (MESS)

Mangled Extremity Severity Score (MESS)

Type	Characteristics	Injury	Points
1	Low energy	stab wound, simple closed fx, small-caliber GSW	1
2	Medium energy	Open/multilevel fx, dislocation, moderate crush	2
3	High energy	shotgun, high-velocity GSW	3
4	Massive crush	Logging, railroad, oil rig accidents	4
Shock Group			
1	Normotensive	BP stable	0
2	Transiently hypotensive	BP unstable in field but responsive to fliud	1
3	Prolonged hypotension	SBP <90mmHg in field and responsive to IV fluids in OR	2
Ischemia Group			
1	None	Pulsatile, no signs of ischemia	1
2	Mild	Diminished pulses without signs of ischemia	2
3	Moderate	No dopplerable pulse, sluggish cap refill, paresthesia, diminished motor activity	3
4	Advanced	Pulseless, cool, paralyzed, numb without cap refill	4
Age Group			
1	<30y/o		0
2	>30 <50		1

MESS score: six or less consistent with a salvageable limb. Seven or greater amputation generally the eventual result.

From Helfet DL, Clin Orthop 1990 256:80

Vascular Injury in Mangled Extremity

Mangled Extremity Severity Score

Skeletal/Soft Tissue Injury	
Low energy (stab; simple fracture; pistol gunshot wound)	1
Medium energy (open or multiple fractures, dislocation)	2
High energy (high-speed motor vehicle accident or rifle gunshot wound)	3
Very	4
Lim	
Pulse reduced or absent but perfusion normal	1[a]
Pulseless; paresthesias, diminished capillary refill	2
Cool, paralyzed, insensate, numb	3[a]
Shock	
Systolic blood pressure always >90 mm Hg	0
Hypotensive transiently	1
Persistent hypotension	2
Age	
<30 years	0
30-50 years	1
>50 years	2

MESS > 7 correlates well with Primary Amputation

Rutherford's Vascular Surgery and Endovascular Therapy 9th ed ,2019 : 2420

COMPARTMENT SYNDROME

High risk :

1. Delay or prolong treatment for 4-6 hours before inflow
2. Hypotension : systemic – resuscitation , in field
3. Crush injury
4. Arterial and venous injury
5. Ligation of artery and vein
6. Disproportionate pain , tense , swelling
7. Fasciotomy when compartment pressure > 35 mmHg

Feliciano DV: Trauma Surg Acute Care Open 2017;2:1-8

5 COMMON PITFALLS IN VASCULAR INJURY

- Dignosis
- Investigation
- Time
- Treatment and Surgical Technique
- Postoperative complication

5 COMMON PITFALLS IN VASCULAR INJURY

- Dignosis : History , Physical examination , awareness ,
- Investigation
- Time
- Treatment and Surgical Technique
- Postoperative complication

5 COMMON PITFALLS IN VASCULAR INJURY

- Dignosis
- Investigation : On table angiography , Doppler , CTA ,
- Time
- Treatment and Surgical Technique
- Postoperative complication

Box 1 Pitfalls to be avoided in the management of peripheral vascular injuries: preoperative period. ABI, ankle–brachial index; API, arterial pressure index; BBI, brachial–brachial index.

Avoid missed vascular injury

- review field history and physical examination with personnel from emergency medical services
- 'hard' signs except arteriovenous fistula mandate immediate operation
- measure ABI, BBI or API as part of physical examination and perform CT arteriogram if <0.9
- second team perform arteriogram, if needed, during operation for other life-threatening injury.

Initiate systemic heparinization if major peripheral arterial occlusion and no contraindication.

Feliciano DV: Trauma Surg Acute Care Open 2017;2:1-8

5 COMMON PITFALLS IN VASCULAR INJURY

- Dignosis
- Investigation
- Time : diagnosis , refer time – heparin , intervention – surgery
- Treatment and Surgical Technique
- Postoperative complication

5 COMMON PITFALLS IN VASCULAR INJURY

- Dignosis
- Investigation
- Time
- Treatment and Surgical Technique :

  decision making – salvage vs amputation , preparation – draping - exposure , equipment , proximal and distal control , backflow , too long operative time , temporary shunt –when needed, spasm vs intimal injury , completion angiography

.

- Postoperative complication

Box 2 Pitfalls to be avoided in the management of peripheral vascular injuries: vascular repair

- avoid limiting skin preparation and draping
- control external hemorrhage during skin preparation and draping, and then obtain proximal and distal vascular control
- avoid straight incisions across axillobrachial area, antecubital fossa and medial or posterior popliteal area
- obtain proximal and distal vascular control through short incisions around a large peripheral hematoma
- avoid prolonged vascular repair when indication for temporary intraluminal shunt is present.

Feliciano DV: Trauma Surg Acute Care Open 2017;2:1-8

Box 3 Options for operative peripheral vascular repair*

- Laterally arteriorrhaphy or venorrhaphy
- Patch angioplasty
- Resection
- End-to-end anastomosis
- Interposition graft
- Bypass graft
- Extra-anatomic bypass graft

Feliciano DV: Trauma Surg Acute Care Open 2017;2:1-8

5 COMMON PITFALLS IN VASCULAR INJURY

- Dignosis
- Investigation
- Time
- Treatment and Surgical Technique
- Postoperative complication : reperfusion syndrome , compartment syndrome , associated injury

PATHOPHYSIOLOGY OF VASCULAR INJURY

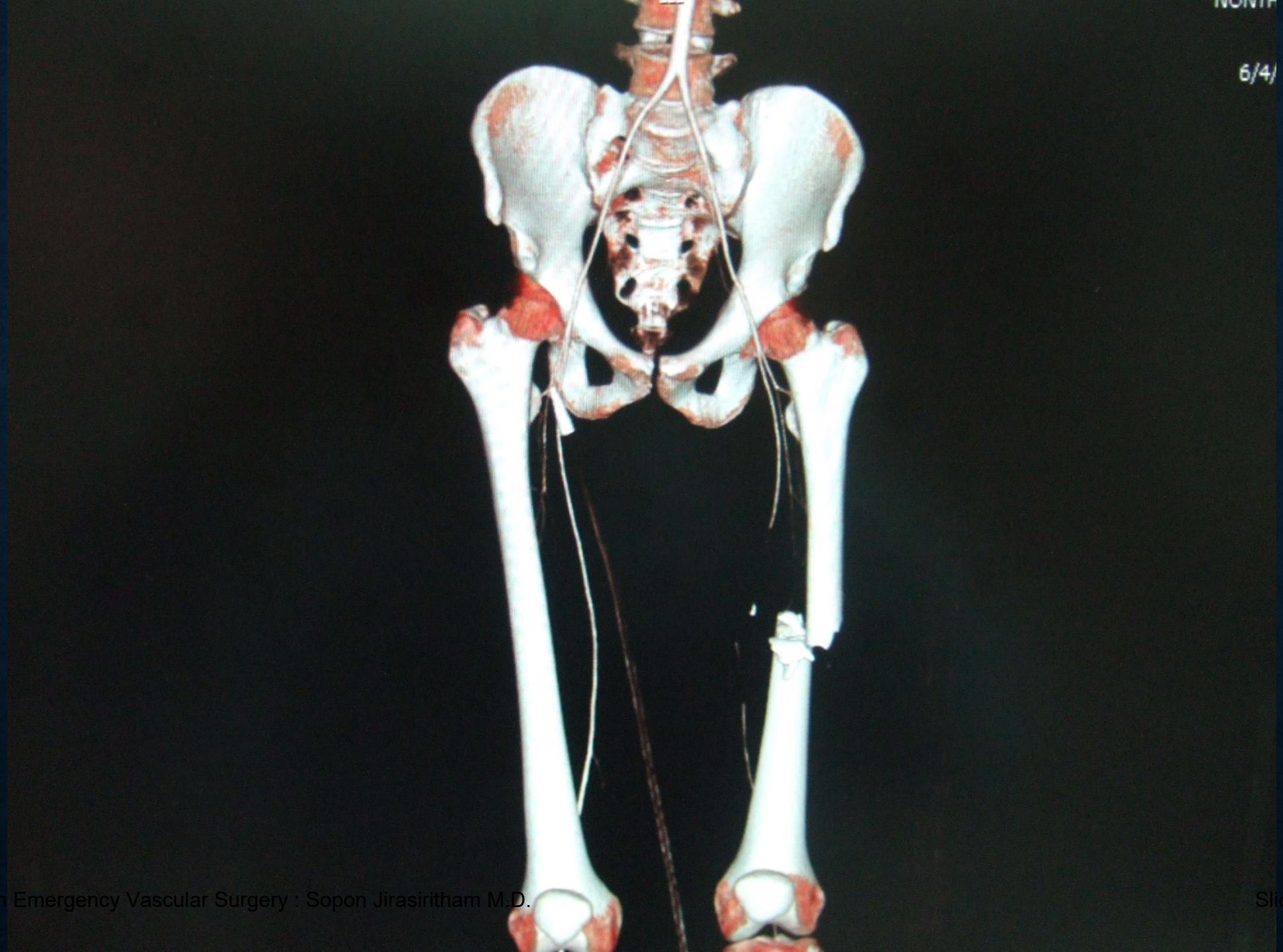
- Systemic Effects
  - Blood Loss
  - Hypotension / Shock
  - Renal Failure
- Region and Local Effects
  - Regional Ischemia
  - Reperfusion Injury
  - Rhabdomyosis
  - Compartment Syndrome
  - Thromboembolism

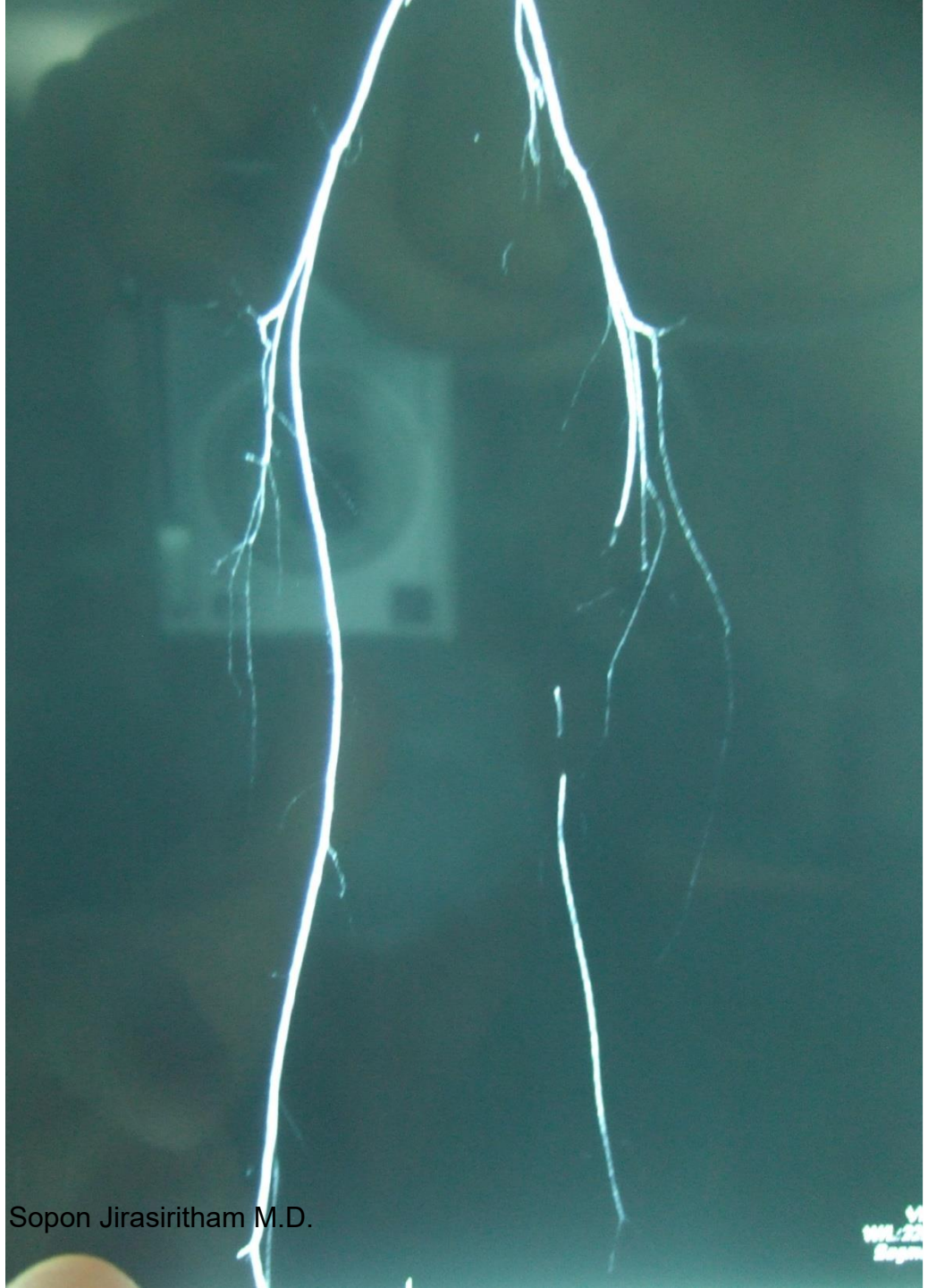
WORST PATHOPHYSIOLOGIC OUTCOME

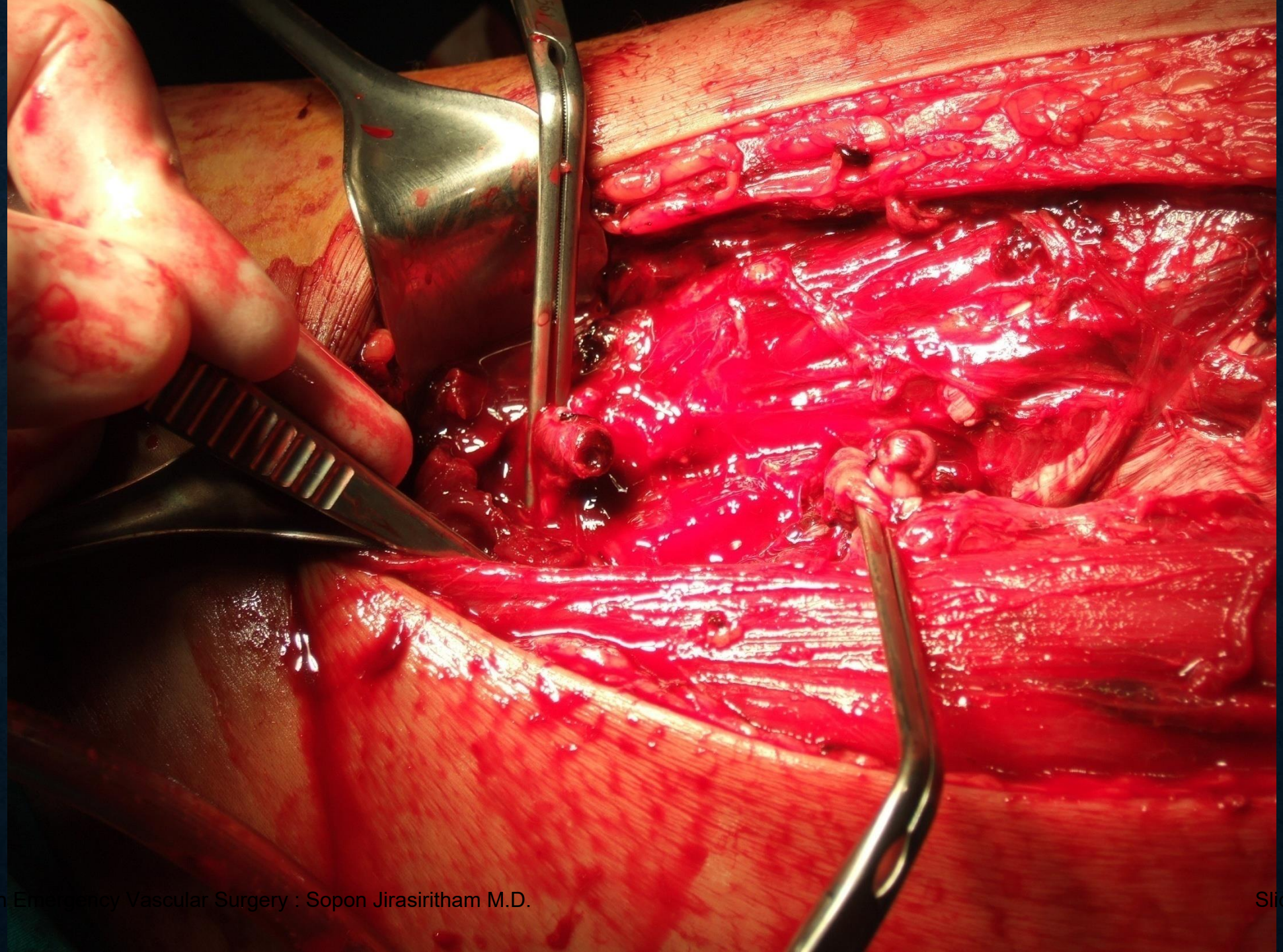
- Hemorrhage : Threatening to life
- Ischemia : Threatening to limb

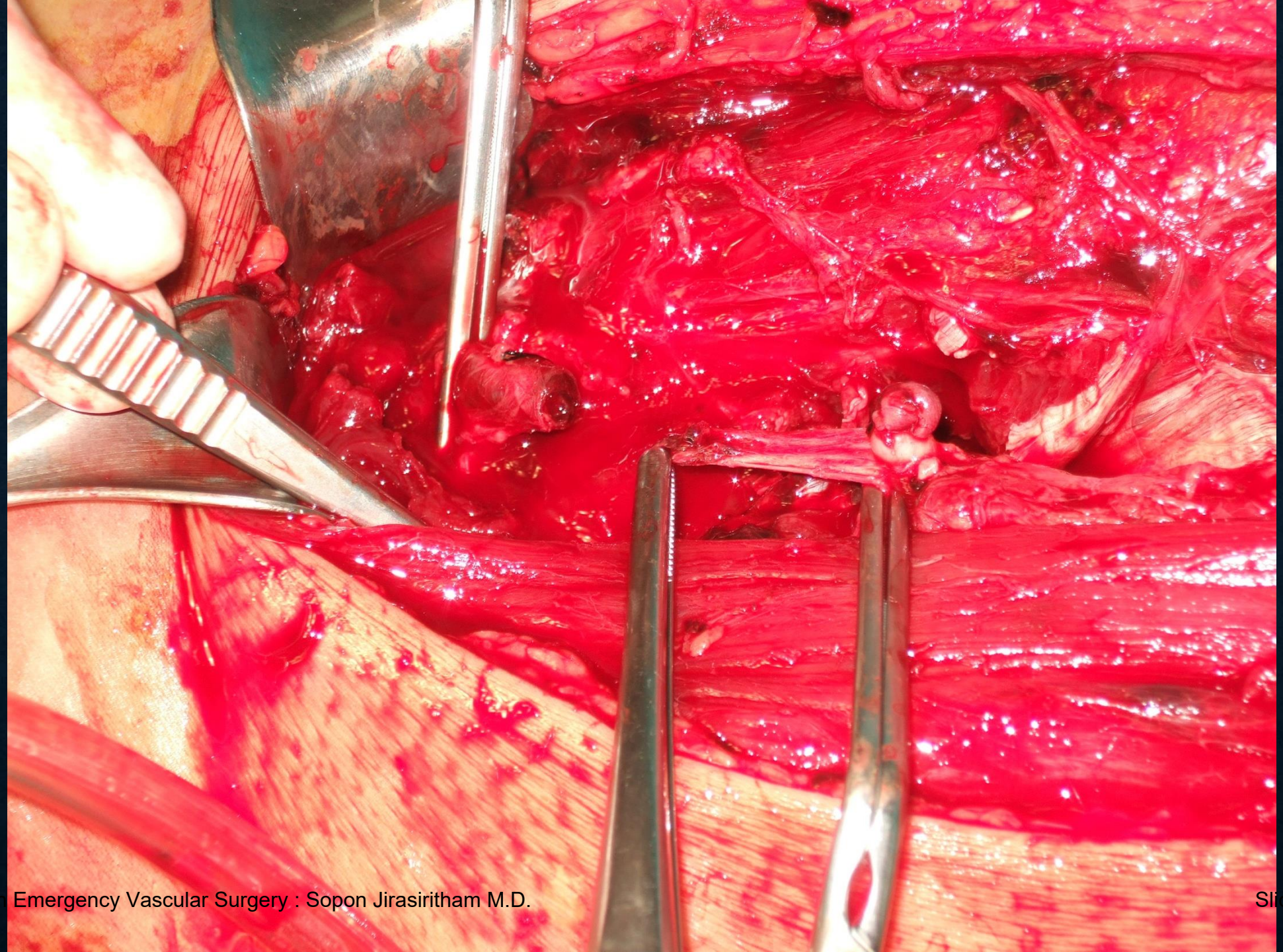
Save life before limb

Save all limb if possible









TAKE HOME MESSAGE

- Diagnosis : awareness, history , PE-pulses , appropriate timing investigation
- Decision Making : timing , refer , protocol , damage control , relatives
- Perioperative care : anticoagulant , antibiotics, postop complication
- Surgical technique : exposure , good control , meticulous technique

Consult vascular surgeon when needed


Thank You

สมาคมแพทย์โรคหลอดเลือดแห่งประเทศไทย ร่วมกับ
สาขาวิชาศัลยศาสตร์หลอดเลือดและปลูกถ่ายอวัยวะ ภาควิชาศัลยศาสตร์ คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี

ขอเชิญร่วมประชุม

Interhospital Vascular Conference

Emergency in vascular surgery

11.00-11.20	รับประทานอาหารร่วมกัน
11.20-11.30	เปิดการประชุมโดย ศ.นพ.ประมุข มุทิรางกูร นายกสมาคมแพทย์โรคหลอดเลือดแห่งประเทศไทย
11.30-11.40	Management in acute limb ischemia

ผศ.พญ.กรวีร์ เทพสัมฤทธิ์พร
คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี

11.40-11.50	Management in ruptured AAA

นพ.เชาวนันท์ พรวรากรณ์
คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี

11.50-12.00	Management in acute pulmonary embolism

พญ.ณัฐสิริ กิตติถิระพงษ์
คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี

Case discussions

12.00-12.25	Discussion Case คณะแพทยศาสตร์ศิริราชพยาบาล
12.25-12.50	Discussion Case คณะแพทยศาสตร์ โรงพยาบาลจุฬาลงกรณ์
12.50-13.15	Discussion Case คณะแพทยศาสตร์ มหาวิทยาลัยธรรมศาสตร์
13.15-13.40	Discussion Case คณะแพทยศาสตร์วชิรพยาบาล
13.40-15.05	Discussion Case โรงพยาบาลพระมงกุฎเกล้า

30 พฤศจิกายน 2563

ณ ห้องประชุมท่านผู้หญิงวิระยา ชวกุล ชั้น 5 อาคารศูนย์การแพทย์สิริกิติ์
คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล

โดยมีการถ่ายทอดผ่าน Teleconference ร่วมกับโรงพยาบาลส่วนภูมิภาค ได้แก่
มหาวิทยาลัยเชียงใหม่ มหาวิทยาลัยสงขลานครินทร์ โรงพยาบาลมหาราชนครราชสีมา และมหาวิทยาลัยขอนแก่น

ภาควิชาศัลยศาสตร์ คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล
270 ถนนพระราม 6 แขวงทุ่งพญาไท เขตราชเทวี กรุงเทพฯ 10400 โทร. 02-201-1527 ต่อ 233 แฟกซ์ 02-201-1316


Thank You