



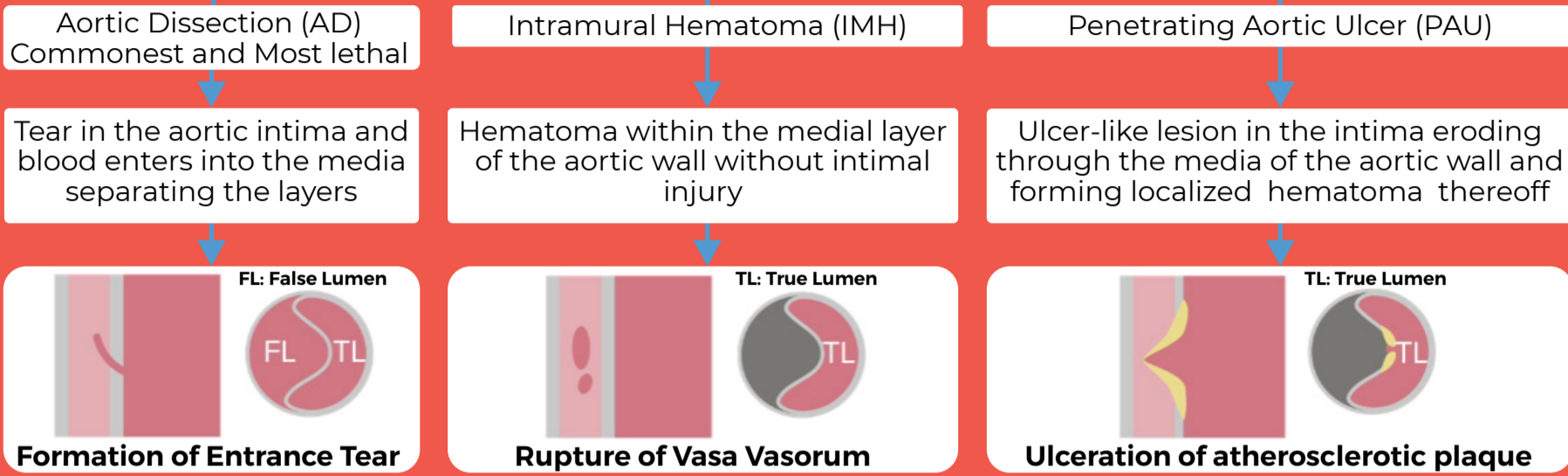
# Standard Treatment Workflow ACUTE AORTIC SYNDROME

ICD-10-M31.4

## ACUTE AORTIC SYNDROME

Acute aortic syndrome (AAS) is a term used to describe a constellation of life-threatening aortic diseases that have similar presentation, but appear to have distinct demographic, clinical, pathological and survival characteristics

## ACUTE AORTIC SYNDROME (AAS)



## AORTIC DISSECTION: PATHOPHYSIOLOGY

- Blood enters through the intimal tear and separates the intima from the media and or adventitia. This creates an additional false lumen in the layers of aorta
  - Dissection can proceed antegrade or retrograde
  - The aorta gets weakened and can rupture causing cardiac tamponade or hemothorax, shock and even death
  - Dissection can compromise the aortic true lumen and side branches causing various malperfusion syndromes such as myocardial ischemia, cerebral ischemia, spinal cord ischemia, mesenteric, renal and limb ischemia
  - If the dissection involves aortic root it may cause acute aortic valve insufficiency
  - If a patient survives acute episode, the false lumen may either get thrombosed or may dilate aneurysmally
- Two factors are primarily responsible for pathogenesis of dissection**
- Higher wall stress due to hypertension or dilatation of aorta
  - Inherently weak/degenerated aortic media

## Predisposing factors

- The commonest risk factor is hypertension.
  - Genetically mediated aortopathies like
    - Marfan's syndrome
    - Vascular Ehlers-Danlos syndrome
    - Bicuspid aortic valve
    - Familial aortic dissection
- Trauma and iatrogenic injury are also emerging as important causes of aortic dissection

## CLASSIFICATION

**A. Chronological Classification:** Depending upon the presentation from the onset of pain

- Acute dissection: within 14 days
- Subacute dissection: between 15 and 90 days
- Chronic dissection: more than 90 days

**B. Anatomical Classification:** Stanford Classification is the most commonly used classification. Two types based on involvement of intrapericardial aorta (ascending aorta and aortic root)

**Type A:**  
Dissection involves the intrapericardial aorta regardless of the site of intimal tear. It is also known as Proximal dissection



**Type B:**  
Dissection does not involve the intrapericardial aorta. It is also known as Distal dissection

## CLINICAL PRESENTATION AND COMPLICATIONS

- Abrupt onset of severe chest and/or back pain is the most typical feature.
- The pain is sharp, ripping, tearing, knife-like, and typically different from other causes of chest pain.
- Anterior chest pain is more common in acute Type A dissection, whereas back or abdominal pain is more common with Type B dissection.
- The pain may migrate from its point of origin to other sites, following the dissection path
- Other manifestations may include
  - Shock
  - Myocardial ischemia
  - Syncope
  - Lower extremity ischemia
  - Neurological deficit including stroke and paraplegia
  - Renal and visceral ischemia
  - Acute congestive heart failure
  - Sudden death

## IMPORTANT COMPLICATIONS OF DISSECTION, CAUSATIVE MECHANISMS, AND PRESENTATIONS

COMPLICATION	CAUSATIVE MECHANISM	PRESENTATION
Aortic Regurgitation	Loss of support and distortion of aortic valve	Diastolic murmur, Severe acute regurgitation can cause heart failure and pulmonary edema
Myocardial Ischemia	Dissection process involves one or more coronary ostia	Chest pain and ECG suggestive of myocardial infarction. Cardiac enzymes may be raised
Congestive heart failure	Acute severe aortic regurgitation, extensive myocardial ischemia	Hypotension, features of low cardiac output
Cardiac Tamponade	Leak/rupture of aorta in pericardial cavity	Raised JVP, muffled heart sounds, hypotension
Pleural effusion	Leak/rupture of aorta in pleural cavity	Diminished breath sounds. Diagnosed on X-ray, Ultrasound, CT Scan
Hypotension and Shock	Hypotension and shock may result from aortic rupture, acute severe aortic regurgitation, extensive myocardial ischemia, cardiac tamponade	Hypotension, features of low cardiac output
Neurological Complication	Involvement of arch vessels or intercostal arteries, low output syndrome, pericardial tamponade, hypoxia.	Confusion/agitation, Syncope, Stroke, Coma, Paraplegia/paraparesis
Mesenteric malperfusion	Involvement of visceral arteries, Compression of true lumen	Hypotension, abdominal distension, absent bowel sounds, shock, acidosis
Renal failure	Involvement of renal arteries, Compression of true lumen, low output syndrome	Abnormal renal function tests and decreased urine output
Acute Lower Limb Ischemia	Involvement of iliac arteries, Compression of true lumen	Pain in lower limbs, absent pulses, cold and pale limbs, gangrene
Inflammatory Syndrome	Inflammatory response to blood /thrombus in the media	Fever, Leucocytosis

## MYOCARDIAL INFARCTION VS ACUTE TYPE A DISSECTION

- Clinically, a dissection-related coronary malperfusion may present with ECG changes of primary myocardial ischemia or infarction. This may increase the likelihood of misdiagnosis and inappropriate therapeutic intervention
- Before starting the treatment algorithm for myocardial ischemia, it is important to differentiate between a primary coronary event and coronary malperfusion secondary to dissection process
- In dissection, pain is usually abrupt, piercing, and well localized. Presence of diastolic murmur of aortic regurgitation, unequal pulses, limb ischemia or neurological complications favor the diagnosis of acute dissection
- If dissection is diagnosed with myocardial ischemia it should be managed on the line of dissection and thrombolytic therapy should NOT be initiated**

## DIAGNOSTIC IMAGING IN ACUTE AORTIC DISSECTION

- The main purpose of imaging is the comprehensive assessment of the entire aorta and its branches with primary goals of confirmation of diagnosis, classification of dissection, assessment of branch vessels, and identification of complications (aortic rupture, aortic regurgitation, and malperfusion)
- Besides these, imaging is also needed to assess myocardial and valvular function, pulmonary parenchyma, and state of kidneys

## IMAGING AND DIAGNOSTIC ALGORITHM

- Combination of ECG, Chest X-ray, Echocardiography and ECG gated CT angiography provides desired information. If clinical examination or CT angiography suggests involvement of innominate artery, common carotid arteries, subclavian arteries, and iliac arteries, an additional vascular ultrasound examination is performed. Conventional catheter based coronary angiogram and aortogram are not needed in diagnostic work up of acute dissection
- In a stable patient with low index of suspicion of dissection, D-dimers can be assessed. Normal levels of D-dimers virtually rule out dissection. However, IMH and PAU may still be present. In dissection, the level of D-dimers is immediately very high, compared with other disorders in which the D-dimers level increases gradually

If Acute Aortic Syndrome is suspected kindly refer the patient to higher center



# Standard Treatment Workflow ACUTE AORTIC SYNDROME

(Continued)

## DIAGNOSTIC METHODS AND OUTPUT

Diagnostic method	Output
Chest X-ray	Any evidence of leak: widened mediastinum, pleural collection
CT angiography	Confirmation of diagnosis of dissection, Anatomical extent of dissection, Localization of entry and re-entry tears, Aortic rupture, State of arch vessels, coronary arteries, visceral arteries, renal arteries, and ilio-femoral arteries, State of lungs and kidneys
Transthoracic Echocardiography	Evaluation of aortic valve, Pericardial effusion, Evidence of tamponade, Myocardial function, Mitral and Tricuspid valve function
ECG	Evidence of myocardial ischemia
Vascular Ultrasound	State of axillary, carotid and femoral arteries



CT Angiography showing Type A Aortic Dissection



CT Angiography showing Type B Aortic Dissection

## TREATMENT OF ACUTE DISSECTION

- Acute Type A dissection is a surgical emergency. Acute Type B dissection is mostly subjected to medical treatment unless complicated. Irrespective of surgical or endovascular intervention, medical therapy to control blood pressure and pain is essential

### Initial Medical Therapy

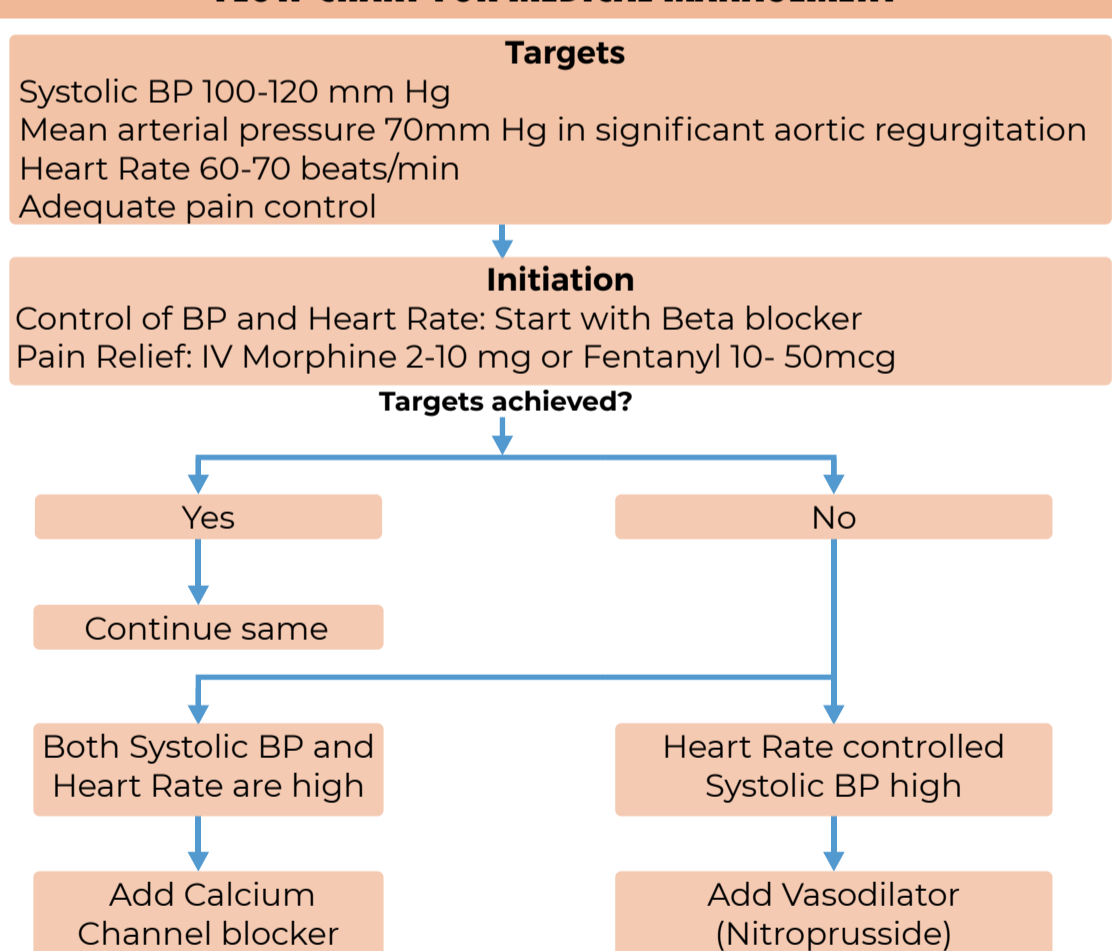
- Initial management of dissection is directed at pain control and limiting the propagation of dissection by reducing the aortic wall stress. Aortic wall stress is affected by the velocity of ventricular contraction (dP/dt), the rate of ventricular contraction and blood pressure
- Initial medical treatment with beta blockers controls these 3 parameters by reducing heart rate and blood pressure to the lowest amounts that will still maintain adequate end-organ perfusion. Reasonable initial targets are a heart rate nearly 60/minute and a systolic blood pressure between 100 and 120 mm Hg
- In patients with severe aortic regurgitation, it is important to maintain a mean arterial pressure between 70-80 mm of Hg to ensure adequate end-organ perfusion. In presence of significant aortic regurgitation target heart rate is kept near 80/minute as lowering the heart rate further may prolong diastole and aggravate regurgitation

Dissection patients need management at specialized centers. Hence, after initiation of medical therapy, patient should be referred to specialized centre as soon as possible

## ANTIHYPERTENSIVE DRUGS IN MANAGEMENT OF ACUTE DISSECTION

Group	Drugs	Dose	Special precaution/contraindication
β-Blockers (one of these to be used)	Labetalol	Loading: 20 mg IV in 2 minutes Maintenance: 1-2 mg/minute	Hypersensitivity, Severe asthma, Heart block, Uncompensated heart failure Severe chronic obstructive pulmonary disease, Severe Aortic Regurgitation (avoid extreme bradycardia)
	Esmolol	Loading : 250-500 µg/kg in one minute Maintenance: 50-100 µg/kg/min (maximum upto 300 µg/kg/min)	
	Metoprolol	Loading dose: 5mg IV over 2min, up to 3 doses; Maintenance dose: 3-5 mg every hour	
Calcium channel blockers (in addition to β blocker)	Diltiazem	Loading dose: 0.25 mg/kg over 2 to 5 min, Maintenance dose: 5mg/h IV infusion	Hypersensitivity, Atrioventricular block, Sick sinus syndrome, Ventricular dysfunction Pulmonary congestion
	Nicardipine	2.5-15 mg/hour IV infusion	
Vasodilator (in addition to β blocker)	Nitroprusside	0.3-0.5 µg/kg/min (Maximum upto 10 µg/kg/min)	Hypersensitivity

## FLOW CHART FOR MEDICAL MANAGEMENT



## SURGERY FOR ACUTE TYPE A DISSECTION

- Surgery is life - saving procedure in case of acute Type A dissection
- Type A dissection in itself is an indication for surgery
- The exceptions:
  - Extremely old and moribund patients with significant co-morbidities
  - Deeply comatose patients
  - Patients with advanced features of mesenteric ischemia, gangrene, and sepsis

Type A dissection is a surgical emergency and the ultimate aim is to save life

This primary objective can be achieved by replacing the ascending aorta and excision of the primary tear

Other objectives include correction of aortic regurgitation, treatment of coronary ostial dissection, restoration of distal true lumen and correction of malperfusion.

## MANAGEMENT OF TYPE B DISSECTION

- Gold standard in management of Type B dissection
  - Optimal medical therapy
  - Control of blood pressure and pain
- Surgery or endovascular repair is reserved for complicated or high risk acute Type B dissections
- Surgery aims at resection of the primary intimal tear and ruptured/aneurysmal aorta
- Thoracic Endo-vascular Aortic Repair (TEVAR)** aims at
  - Covering the primary intimal tear
  - Expansion of the true lumen
  - Thrombosis/remodeling of false lumen
  - Correction of malperfusion

## MANAGEMENT OF IMH AND PAU

- The diagnosis of IMH and PAU is radiological and management is similar to acute aortic dissection

## TYPE B DISSECTION REQUIRING INTERVENTION

### Complications such as

- Unremitting pain
- Persistent, un-controlled hypertension
- Hemodynamic instability
- Rupture/Impending rupture/Leak
- Rapid Aortic Expansion
- Malperfusion
- Retrograde Ascending aortic dissection
- Aneurysmal dilatation (>5.5 cm)

## ABBREVIATIONS

**AAS:** Acute Aortic Syndrome  
**AD:** Aortic Dissection  
**CT:** Computed Tomography

**FL:** False Lumen  
**IMH:** Intramural Hematoma  
**JVP:** Jugular Venous Pressure

**PAU:** Penetrating Aortic Ulcer  
**TL:** True Lumen

## REFERENCES

- Choudhary SK, Bhoje A. Adult cardiac surgery. In: Prabhakaran D, Raman KK, Naik N, editors. Tandon's textbook of Cardiology. 1st edition. Walters Kluwer (India); 2019: p679-727
- Writing Committee Members, Isselbacher EM, Preventza O, Hamilton Black III J, Augoustides JG, Beck AW, Bolen MA, Braverman AC, Bray BE, Brown-Zimmerman MM, Chen EP. 2022 ACC/AHA guideline for the diagnosis and management of aortic disease: a report of the American Heart Association/American College of Cardiology Joint Committee on Clinical Practice Guidelines. Journal of the American College of Cardiology. 2022 Dec 13;80(24):e223-393

👉 HIGH INDEX OF SUSPICION AT THE EARLIEST IS LIFE SAVING



# Standard Treatment Workflow ACUTE LIMB ISCHEMIA

ICD-10-M62.262

## WHAT IS ACUTE LIMB ISCHEMIA?

A sudden decrease in limb perfusion that threatens limb viability and requires urgent evaluation and management

**P5**

### SYMPTOMS

Pain at rest, paresthesia, muscle weakness/paralysis of the affected limb

### SIGNS

Absence of pulses distal to the occlusion, cool and pale or mottled skin, reduced sensation and decreased strength

### REMEMBER THE FIVE P'S:

**Pain, Pallor, Pulselessness, Paresthesia, and Paralysis\***  
\*The last two may or may not be present depending upon extent and duration of vascular occlusion. In advanced cases, there may be frank gangrene

## COMMON CAUSES OF LIMB ISCHEMIA

### NON-TRAUMATIC

#### EMBOLIC:

Embolism from the heart or atherosclerotic aorta. Embolus may arise from heart in case of atrial fibrillation, acute myocardial infarction, mitral stenosis, left ventricular dysfunction, left atrial myxoma, prosthetic heart valves or endocarditis

#### THROMBOSIS:

Acute thrombosis of a limb artery may occur at the site of a pre-existing atherosclerotic plaque

### TRAUMATIC

#### BLUNT INJURY:

Traction injury or contusion

Sharp or penetrating injury

## EVALUATION

### HISTORY

- Duration of symptoms
- H/o intermittent claudication
- H/o cardiac disorder (palpitations, chest pain, shortness of breath, loss of consciousness)
- H/o Diabetes, Hypertension, Smoking, Drugs (OCPs, HRT)
- Long standing fever
- H/o trauma/surgical or endovascular interventions

### PHYSICAL EXAMINATION

- Blood Pressure
- All peripheral pulses
- Condition of the limb: temperature, colour, hair loss, nail bed capillary filling, sensation and motor power, gangrene/pre-gangrene
- Cardiac Murmurs
- Wound Inspection
- Bone injury/Nerve injury in case of traumatic ischemia

### DUPLEX ULTRASOUND/DOPPLER FOR ARTERIES AND VEINS

Doppler examination is helpful in evaluation of flow in the arteries and veins and condition of arterial wall



Right Limb Discolouration  
Acute Limb Ischaemia

### EMBOLISM VS THROMBOSIS

- History suggestive of cardiac disorder (palpitations, chest pain, shortness of breath, loss of consciousness) predicts acute embolism whereas a history of previous claudication suggests acute thrombosis in a pre-existing atherosclerotic lesion
- Doppler evaluation can differentiate between hypoechoic thrombus in otherwise normal and distended blood vessel (suggestive of acute embolism) and heterogeneous echogenic plaque with multiple areas of calcification (thrombosis in artery with atherosclerotic plaque)

## STAGES OF ACUTE LIMB ISCHEMIA

STAGE	DESCRIPTION AND PROGNOSIS	SENSORY LOSS	MUSCLE WEAKNESS	ARTERIAL DOPPLER	VENOUS DOPPLER
I	Limb viable, not immediately threatened	None	None	Audible	Audible
IIa	Limb marginally threatened, salvageable if promptly treated	Minimal (toes) or none	None	Audible	Audible
IIb	Limb immediately threatened, salvageable with immediate revascularization	More than toes, associated with rest pain	Mild or moderate	Usually inaudible	Audible
III	Limb irreversibly damaged, major tissue loss or permanent nerve damage inevitable	Profound, anaesthetic	Profound, paralysis (rigor)	Inaudible	Inaudible

## MANAGEMENT OF TRAUMATIC ACUTE LIMB ISCHEMIA

### A. SHARP/PENETRATING INJURY

- Control bleeding by applying pressure bandage over the wound
- Resuscitation
- Vascular repair (Stage I, IIa, IIb ischemia), Amputation (Stage III ischemia)
- Concomitant bone/nerve injury should be managed simultaneously
- Supportive treatment, pain relief/antibiotic prophylaxis/tetanus prophylaxis

### B. BLUNT INJURY: TRACTION INJURY OR CONTUSION

- Vascular repair (Stage I, IIa, IIb ischemia), Amputation (Stage III ischemia)
- Concomitant bone/nerve injury should be managed simultaneously
- Supportive treatment, pain relief/antibiotic prophylaxis

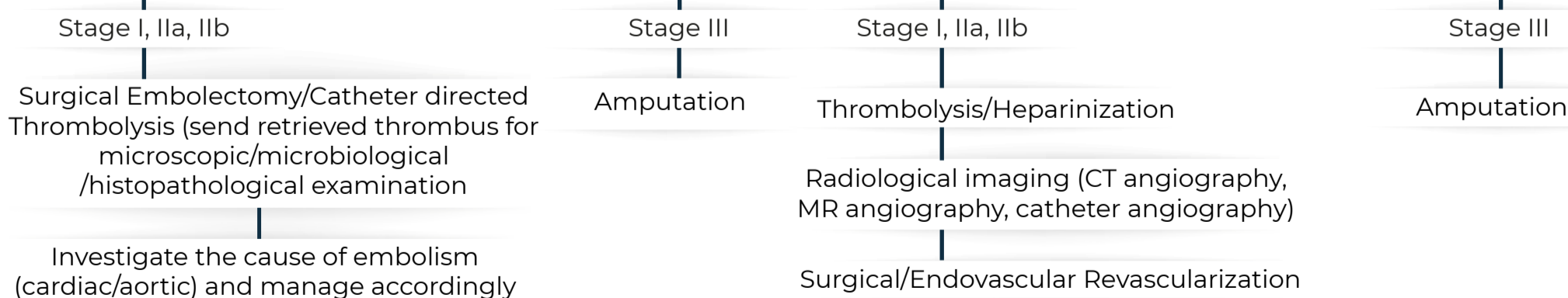
## MANAGEMENT OF NON-TRAUMATIC ACUTE LIMB ISCHEMIA

Injection Heparin 100 units/Kg Intravenous

### EVALUATION

#### EMBOLISM

#### THROMBOSIS



## CONTRAINDICATIONS TO THROMBOLYSIS

- Established cerebrovascular event (excluding TIA within previous 2 months)
- Active bleeding diathesis
- Recent gastrointestinal bleeding (within previous 10 days)
- Neurosurgery (intracranial, spinal) within previous 3 months
- Intracranial trauma within previous 3 months

## POST REVASCUARIZATION

### COMPARTMENT SYNDROME

- Can occur in Stage II ischemia due to revascularization edema
- Symptoms:** Severe pain, hypoesthesia and weakness of the affected limb
- Lab:** Myoglobinuria and elevation of the creatine kinase level
- Four-compartment fasciotomy to be performed when there is even an iota of doubt

### REPERFUSION INJURY

- Revascularization in advanced ischemia can also cause hyperkalemia, acidosis, myoglobinuria and cardiopulmonary depression
- Patients require monitoring, proper hydration

## ABBREVIATIONS

**CT:** Computed Tomography    **HRT:** Hormone Replacement Therapy    **OCPs:** Oral Contraceptive Pills    **TIA:** Transient Ischaemic Attack

## REFERENCES

- Björck M, Earnshaw JJ, Acosta S, Bastos Gonçalves F, Cochenne F, Debus ES, Hinchliffe R, Jongkind V, Koelemay MJW, Menyhei G, Svetlikov AV, Tshomba Y, Van Den Berg JC, Esvs Guidelines Committee, de Borst GJ, Chakfé N, Kakkos SK, Koncar I, Lindholt JS, Tulamo R, Vega de Ceniga M, Vermassen F, Document Reviewers, Boyle JR, Mani K, Azuma N, Choke ETC, Cohnert TU, Fitridge RA, Forbes TL, Hamady MS, Munoz A, Müller-Hülsbeck S, Rai K. Editor's Choice - European Society for Vascular Surgery (ESVS) 2020 Clinical Practice Guidelines on the Management of Acute Limb Ischaemia. Eur J Vasc Endovasc Surg. 2020 Feb;59(2):173-218. doi: 10.1016/j.ejvs.2019.09.006. Epub 2019 Dec 31. PMID: 31899099.



## Standard Treatment Workflow

# CHEST TRAUMA

ICD-10-S29.9

### MECHANISM AND SCENARIO

- Body acceleration and deceleration (Road traffic injury)
- Body compression (Crush injuries fall from height)
- Penetrating injuries (Missile injuries, stabs)

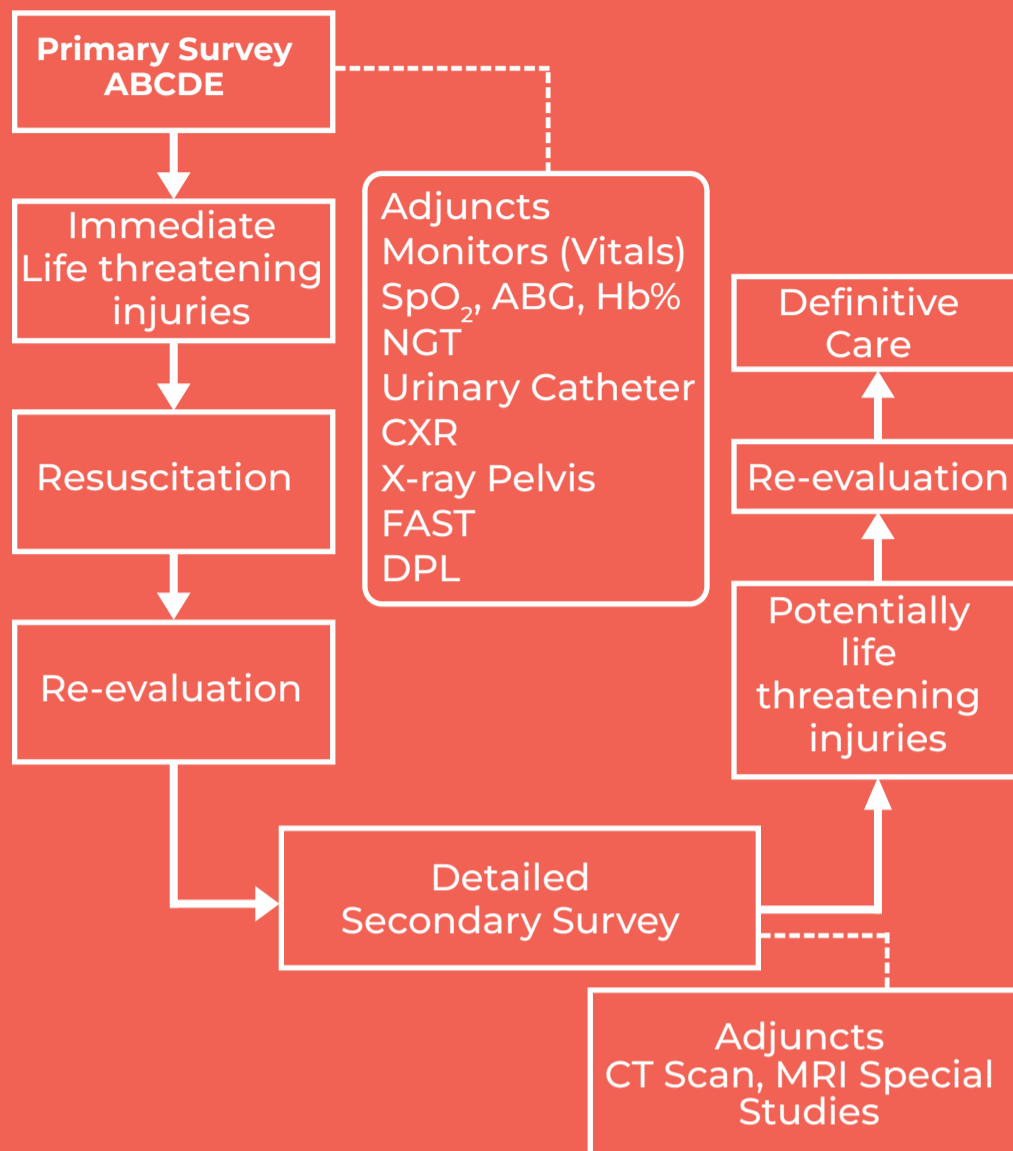
### PRESENTATION

- Pain over the chest
- Shortness of breath
- Cyanosis
- Swelling of chest wall
- Facial/limb puffiness
- Unconsciousness
- Associated blood loss/pallor

### ADJUNCT TO PRIMARY SURVEY

- Obtain a portable AP chest x-ray to assess:
- Intra-thoracic injuries
  - Endotracheal tube placement (if intubated)
  - Post chest tube insertion

### INITIAL ASSESSMENT & MANAGEMENT OF A TRAUMA PATIENT



### INITIAL ASSESSMENT AND PRIMARY SURVEY

Primary survey (ABCDEs) aims at recognition and management of immediate life-threatening injuries largely based on clinical examination.

#### ABCDE

- Airway maintenance with cervical spine control
- Breathing and ventilation
- Circulation with haemorrhage control
- Disability (brief neurological assessment)
- Exposure/Environmental control: Prevent Hypothermia

#### OTHER VITALS

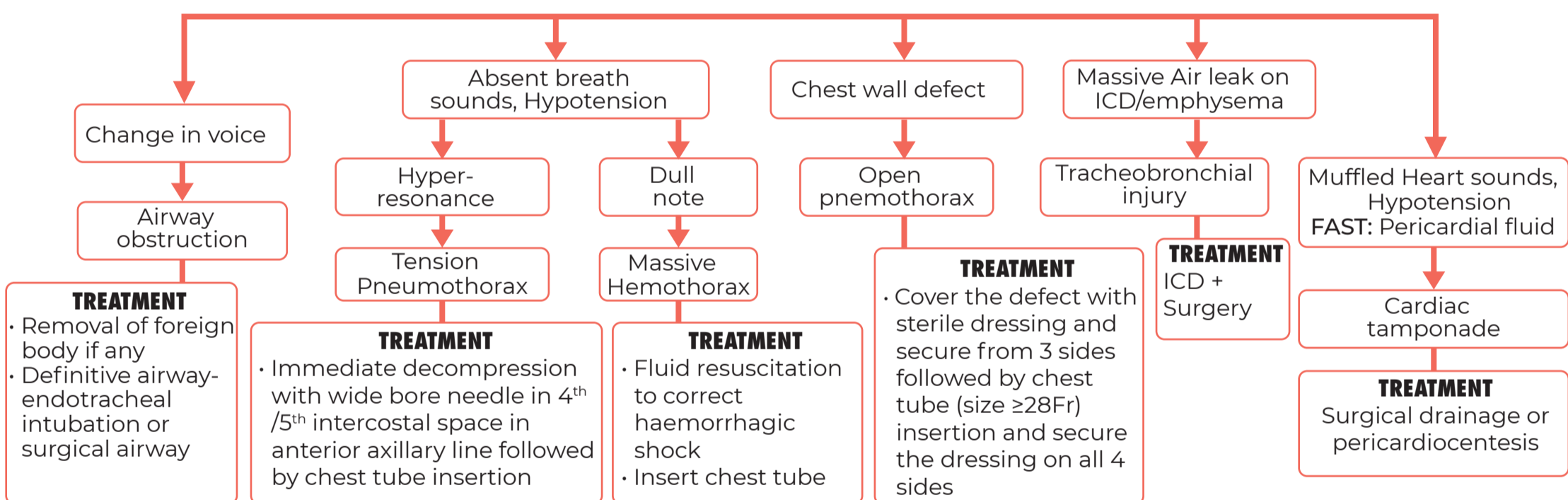
- Blood pressure
- All peripheral pulses
- Altered/Muffled Heart Sounds

#### ALSO LOOK FOR

- Neurological deficits
- Tenderness over chest, first rib fracture
- Subcutaneous emphysema

### IMMEDIATE LIFE THREATENING CHEST INJURIES (LETHAL SIX)

#### Respiratory distress, Tachypnoea, Low SpO<sub>2</sub>



### POTENTIALLY LIFE THREATENING CHEST INJURIES (HIDDEN SEVEN)

#### OESOPHAGEAL INJURY

##### DIAGNOSIS

- Diagnosed by food particles in ICD drainage or leak of dye in pleural cavity

##### MANAGEMENT

- Surgery

#### FLAIL CHEST

##### MANAGEMENT

- Pain control
- Oxygenation- Consider endotracheal intubation
- Chest tube insertion if associated with pneumothorax/hemothorax
- Consider transfer to closest appropriate facility

#### PULMONARY CONTUSION

##### CLINICAL FEATURES

- Dyspnoea, Tachypnoea, Tachycardia, Chest wall bruising, Flail Chest

##### DIAGNOSIS

- Diagnosed on Chest x-ray

##### MANAGEMENT

- Adequate analgesia
- Humidified oxygenation
- Consider endotracheal intubation
- Consider transfer to closest appropriate facility

#### RUPTURED THORACIC AORTA

##### DIAGNOSIS

- Suspected on Chest x-ray  
Confirmation on CT angiography chest

##### MANAGEMENT

- Stenting/open surgery

#### CARDIAC CONTUSION

##### DIAGNOSIS

- By ECG, Echocardiograph and troponin levels

##### MANAGEMENT

- Give supportive treatment and consider transfer to closest appropriate facility

#### SIMPLE PNEUMOTHORAX

##### TREATMENT

- Chest tube insertion (> 28Fr) in 4<sup>th</sup>/5<sup>th</sup> intercostal space just anterior to midaxillary line

#### RUPTURED DIAPHRAGM

- Surgery

### ABBREVIATION

**ABG:** Arterial Blood Gas

**CT:** Computed Tomography

**CXR:** Chest Radiography

**DPL:** Diagnostic Peritoneal Lavage

**ECG:** Electrocardiogram

**ICD:** Intercostal Drainage Tube

**FAST:** Focused Assessment with Sonography in Trauma

**MRI:** Magnetic Resonance Imaging

**NGT:** Nasogastric Tube

### REFERENCE

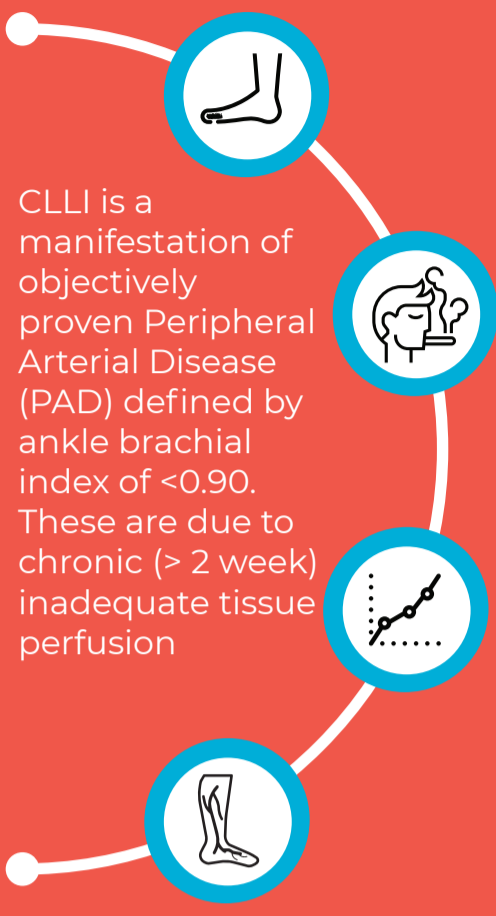
1. Subcommittee AT, International ATLS Working Group. Advanced trauma life support (ATLS®): the ninth edition. The journal of trauma and acute care surgery. 2013 May;74(5):1363-6.

**KEEP A HIGH THRESHOLD FOR INVASIVE PROCEDURES**



# Standard Treatment Workflow CHRONIC LOWER LIMB ISCHEMIA (CLLI)

ICD-10-M62.262



**PRESENTATION**

- Claudication or pain at rest, paresthesia, with or without tissue loss, impaired healing or infection (ulcer or gangrene)
- Absent/weak pulse depending on level of occlusion

**COMMON CAUSES OF CLLI**

- Atherosclerosis: Elderly, smokers with diabetes mellitus or chronic renal insufficiency
- Vasculitis: Buerger's disease, Takayasu arteritis
- Aortic coarctation
- Delayed presentation of an Acute Ischemic Insult: Trauma, Thromboembolism, Dissection

**CLINICAL STAGING**  
The clinical profile is classified into

- Asymptomatic
- Mild claudication (No life-style limitation)
- Moderate or severe claudication (Life style limiting)
- Chronic severe (or critical) limb ischemia: Compromised blood flow, causing limb pain at rest +/- ulcers or gangrene

**ANKLE BRACHIAL INDEX:** Ratio of Blood Pressure in ankle and in arm. The resting ankle brachial index (ABI) is the initial diagnostic test

- Interpretation
  - 0.90 to 1.40 is normal
  - <0.90 is abnormal and indicates presence of PAD
  - 0.41 to 0.90 indicates mild to moderate PAD
  - <0.40 indicates severe PAD
  - >1.40 indicates abnormal (calcified arteries)

## CLINICAL EVALUATION

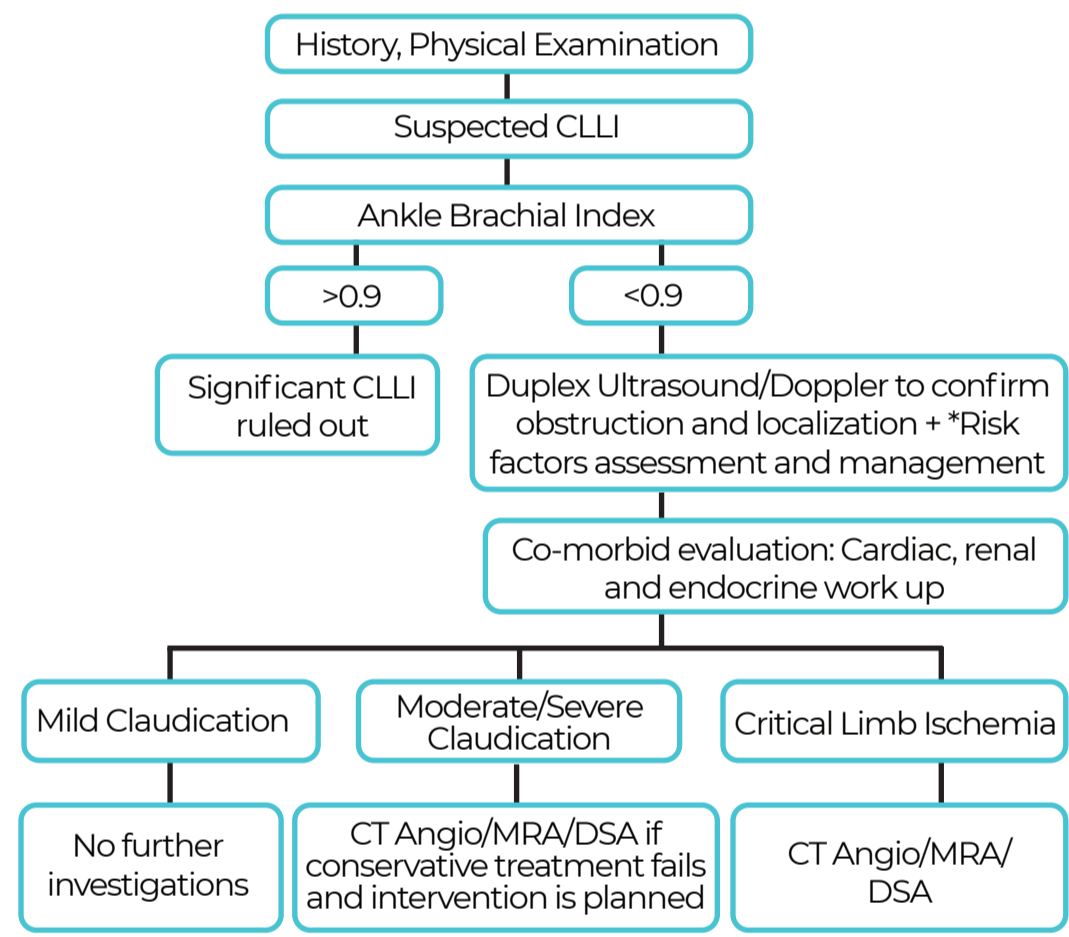
### HISTORY

- Claudication: Pain/cramp in calf/foot/thigh/buttock with walking that is relieved with rest
- Duration and progress of symptoms
- Onset, duration and progress of ulcer/gangrene, if any
- Rest pain
- Identifying risk factors: Diabetes, hypertension, smoking, ischemic heart disease, family history, dyslipidaemia
- Syncope/blackout/stroke/mesenteric ischemia
- History suggestive of cardiac disorder (angina/palpitations, shortness of breath/loss of consciousness)

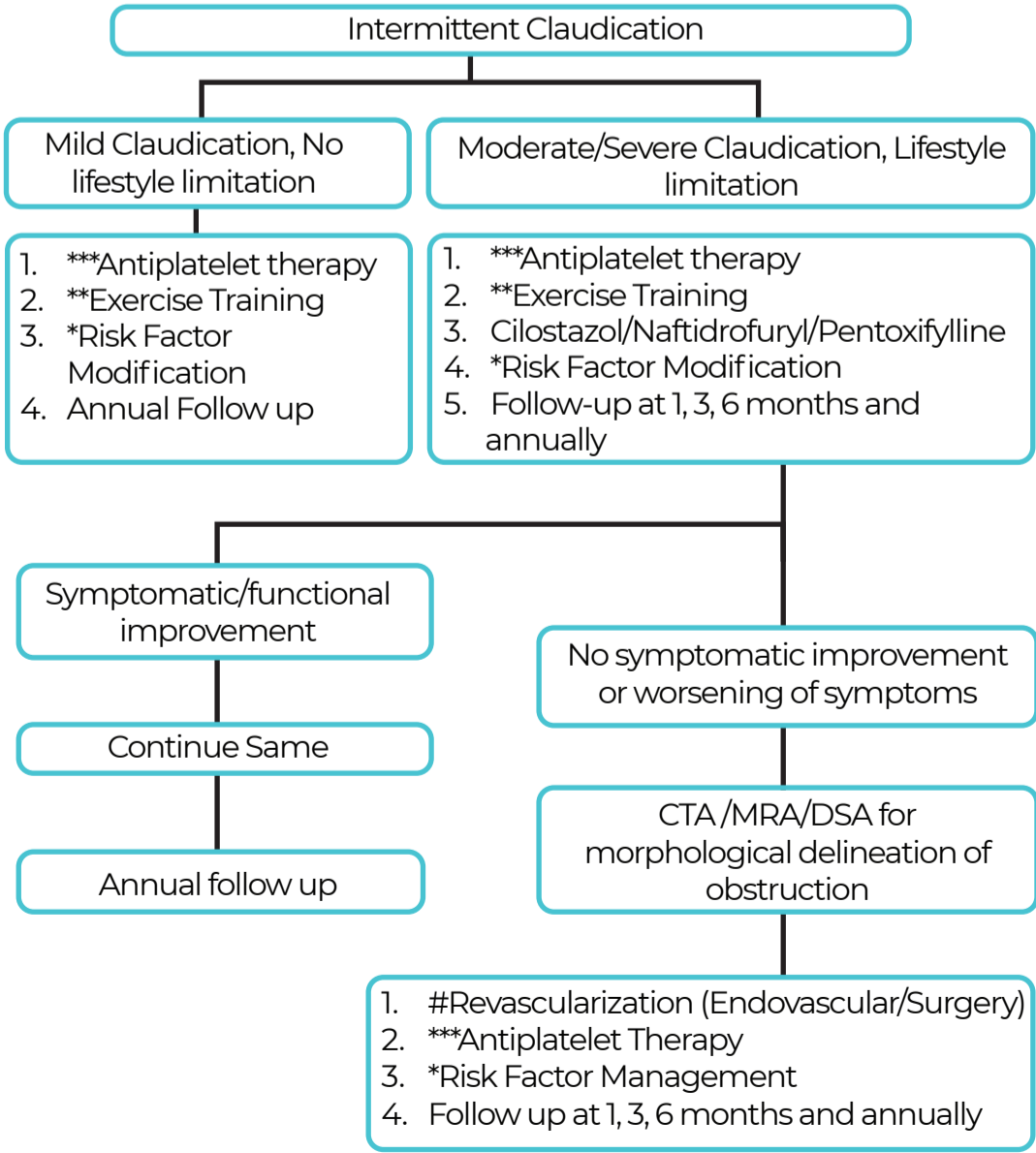
### EXAMINATION

- Blood Pressure (Including ankle-brachial index, toe-brachial index in diabetes, elderly, renal insufficiency)
- All peripheral pulses
- Condition of the limb: temperature, colour, hair loss, atrophy, nail bed capillary filling, sensation and motor power, gangrene/pre-gangrene
- Wound inspection (if any)
- Comorbidity evaluation: CVS, Renal Diabetes mellitus, CNS, neuropathy
- Evaluation for possible venous conduits

## DIAGNOSTIC EVALUATION OF A PATIENT WITH CLLI



## MANAGEMENT OF INTERMITTENT CLAUDICATION

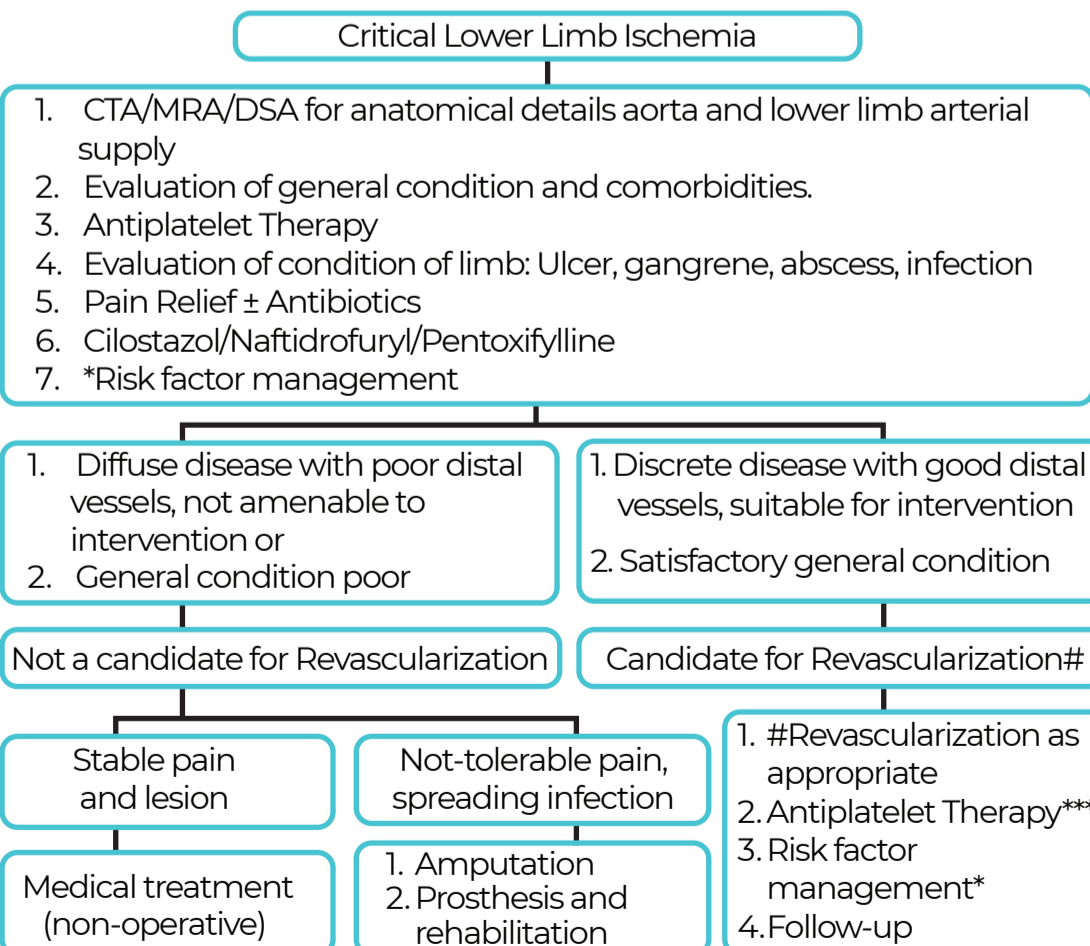


DIFFERENTIAL DIAGNOSIS OF CLLI	DIFFERENTIATING TEST
Spinal stenosis, root compression	Ankle brachial index (ABI), Doppler
Arthritis	ABI, Doppler, X-Ray
Venous Claudication	ABI, Doppler
Compartment Syndrome	ABI, Doppler, compartment pressure

## MANAGEMENT

RISK FACTOR MANAGEMENT	MEDICAL MANAGEMENT
<ul style="list-style-type: none"> <li>• Lifestyle modification (graded exercise)</li> <li>• Control of HTN (BP &lt; 140/90), Control of Diabetes Mellitus (HbA1c &lt; 7.0)</li> <li>• Low fat diet, exercise</li> <li>• Atherosclerosis: Start statins, antiplatelets</li> </ul>	<ul style="list-style-type: none"> <li>• Antiplatelets*** – Aspirin 75-100mg orally/ Clopidogrel 75mg orally OD</li> <li>• Analgesic – Paracetamol + Opioid</li> </ul>
EXERCISE REHABILITATION FOR CLAUDICATION	CIRCULATORY MODULATORS
<p>Graded and supervised walking three times a week, beginning with 30mins and increasing to 1 hour per session, at an intensity that will induce claudication within 3-5 mins</p>	<ul style="list-style-type: none"> <li>• Cilostazol 100mg orally. (C.I. in CHF, unstable Angina, Recent M.I., Tachyarrhythmias)</li> <li>• Naftidrofuryl 200mg orally TDS</li> <li>• Pentoxifylline 400mg orally TDS (C.I. in recent cerebral/retinal haemorrhage, intolerance of methyl xanthines)</li> </ul>
REVASCULARISATION (PREREQUISITES)	LOCAL WOUND MANAGEMENT
<ul style="list-style-type: none"> <li>• Good distal vessels (run-off)</li> <li>• Able to walk before critical limb ischemia</li> <li>• Life expectancy of &gt;1 year</li> <li>• Satisfactory general condition</li> </ul>	<ul style="list-style-type: none"> <li>• Prevention and treatment of infection</li> <li>• Leg dependency, off-loading, non-adherent dressing, abscess drainage, debridement, digital amputation<sup>§</sup></li> </ul>
AMPUTATION <sup>§</sup>	AMPUTATION <sup>§</sup>
	<ul style="list-style-type: none"> <li>• Non-salvageable limbs, fixed contractures, severe infected/necrosis, failed revascularisation with persistent tissue loss</li> </ul>

## MANAGEMENT OF CRITICAL LOWER LIMB ISCHEMIA



## ABBREVIATIONS

**CT:** Computed Tomography Angiography  
**DSA:** Digital Subtraction Angiography  
**MRA:** Magnetic Resonance Angiography  
**PAD:** Peripheral Arterial Disease

## REFERENCE

1. Conte MS, Bradbury AW, Kohli P, White JV, Dick F, Fitrildo R, Mills JL, Ricco JB, Suresh KR, Murad MH, Aboyans V, Aksoy M, Alexandrescu VA, Armstrong D, Azuma N, Belch J, Bergoing M, Bjorck M, Chakf N, Cheng S, Dawson J, Debus ES, Dueck A, Duval S, Eckstein HH, Ferraresi R, Gambhir R, Gargiulo M, Geraghty P, Goode S, Gray B, Guo W, Gupta PC, Hinchliffe R, Jetty P, Komori K, Lavery L, Liang W, Lookstein R, Menard M, Misra S, Miyata T, Moneta G, Munoz Prado JA, Munoz A, Paolini JE, Patel M, Pomposelli F, Powell R, Robless P, Rogers L, Schanzer A, Schneider P, Taylor S, De Ceniaga MV, Veller M, Vermassen F, Wang J, Wang S; CVG Writing Group for the Joint Guidelines of the Society for Vascular Surgery (SVS), European Society for Vascular Surgery (ESVS), and World Federation of Vascular Societies (WFVS). Global Vascular Guidelines on the Management of Chronic Limb-Threatening Ischemia. Eur J Vasc Endovasc Surg. 2019 Jul;58(15):S1-S109.e33. doi: 10.1016/j.ejvs.2019.05.006. Epub 2019 Jun 8. Erratum in: Eur J Vasc Endovasc Surg. 2020 Mar;59(3):492-493. doi: 10.1016/j.ejvs.2019.11.025. Erratum in: Eur J Vasc Endovasc Surg. 2020 Jul;60(1):158-159. doi: 10.1016/j.ejvs.2020.04.033. PMID: 31822334; PMCID: PMC68369495.

## KEEP A HIGH THRESHOLD FOR INVASIVE PROCEDURES



# Standard Treatment Workflow (STW)

## SURGICAL MANAGEMENT OF CORONARY ARTERY DISEASE

### ICD-10-I25.10

For the medical management of Acute Coronary Syndrome, Chronic Stable angina please refer to respective STWs



#### HEART TEAM APPROACH

Decision to operate is a joint decision of the heart team consisting of a Cardiac Surgeon, Interventional Cardiologist, attending Cardiologist or primary physician and the patient

#### CONSIDER DEFINITIVE SURVIVAL BENEFITS OF CABG BEFORE MAKING A FINAL DECISION\*

##### This approach is based on:

- Clinical presentation of the patient
- Morphology and extent of coronary artery lesions
- Condition of the left ventricle, its ejection fraction, associated mitral regurgitation, and left ventricular aneurysm
- Associated comorbidities

#### PREOPERATIVE ASSESSMENT

##### PRE OPERATIVE REQUISITES

- ECG
- Echocardiography
- ± Stress testing
- Catheter coronary angiography
- ± Viability assessment
- Evaluation for conduits

##### EVALUATION FOR CO-MORBIDITIES

- Medical conditions such as diabetes, hypertension, obesity
- Carotid Doppler if age > 60 yrs, h/o TIA/stroke
- Neurological evaluation
- USG for renal arteries, abdominal aorta and ilio femoral arteries in clinically relevant cases
- Pulmonary function tests
- RFT/LFT, lipid profile, TSH
- Screening for viral and bacterial infections

#### PRE-OPERATIVE MEDICATION

Beta-blockers should not be discontinued to avoid acute ischemia

Statins should be continued till day of surgery or initiated if not previously started

Angiotensin-converting enzyme inhibitors and similar drugs might be discontinued 1-2 days prior to surgery

Before elective surgery, discontinue Aspirin 48 hours and other anti-platelet drugs at least 5 days before surgery. Add LMW heparin in high thrombogenic conditions like atrial fibrillation, recent coronary/renal stenting, prosthetic heart valve in-situ, limb ischaemia, and left ventricular clot

#### SURGICAL REVASCUARIZATION IN ACUTE CORONARY SYNDROME (CABG)

##### CABG IN NSTE-ACS

**Indications for CABG**  
CABG is preferred over PCI in left main disease, multivessel CAD and diabetics

**Timing:** After medical stabilization, and or IABP support followed by early CABG

##### CABG IN STEMI (ACUTE)

**Indications for CABG**  
• CABG is preferred over PCI in left main disease, multivessel CAD, and diabetics  
• Mechanical complications (Emergency surgery)  
• Coronary anatomy unsuitable for PCI/failed PCI  
**Timing:** Preferably should wait for one week, until and unless there is hemodynamic instability refractory to medical management/ IABP, or if patient develops mechanical complications of MI

##### CABG IN EVOLVED STEMI (DELAYED)

Choice of procedure depends upon Coronary artery anatomy, Left ventricular function, and myocardial viability

#### TIMING OF CABG

Chronic stable angina

Elective

NSTE-ACS

Performance of early CABG (< 48 hrs), even in higher-risk patients

STEMI

In the absence of persistent pain or haemodynamic instability, surgery should be performed after 7 days

#### REVASCUARIZATION IN CAD PATIENTS WITH HEART FAILURE

- CABG is preferred over PCI in patients with congestive heart failure
- Prior myocardial viability assessment is mandatory
- Surgical ventricular restoration is the procedure of choice in patients with left ventricular aneurysm and concomitant CABG with or without mitral valve repair

#### CORONARY ARTERY BYPASS GRAFTING

On-pump CABG  
(With Cardiopulmonary bypass)

Off-pump CABG  
(beating heart surgery without CPB)

##### CONDUITS USED

- LIMA to LAD is the standard of care and has proven survival benefit. If LIMA is unsuitable, RIMA should be used
- Additional conduits**
  - Saphenous vein
  - RIMA
  - Radial artery

#### DEFINITIVE SURVIVAL BENEFIT OF CABG\* (in the following subsets)

- Left main stenosis greater than 50%
- Three vessel disease with diabetes/LV dysfunction
- Two vessel disease with critical proximal LAD disease
- Two vessel disease without proximal LAD disease (with severe ischemic burden)
- Single vessel disease with critical proximal/ostial LAD disease

#### LONG TERM POST-OP MANAGEMENT. GO WITH THE GUIDELINES GOAL (GWTG)

RISK REDUCTION/THERAPY	LONG-TERM GOAL
Antiplatelets (unless contraindicated or not tolerated)	Single-antiplatelet - Aspirin 75 to 325mg/day, indefinitely
Dual Antiplatelets (unless contraindicated or not tolerated)	Aspirin plus Clopidogrel/Ticagrelor (for one year for OPCAB patients, 6 months for on-pump CABG patients operated during acute coronary syndrome). Thereafter, single antiplatelet agent indefinitely
Beta Blockers	Indefinitely for all patients
ACE inhibitors/ARB/ARNI	Indefinitely for post-MI and CHF, diabetes, hypertension, chronic kidney disease, left ventricular systolic dysfunction, and peripheral vascular disease
Lipid Level Reduction	Diet, Exercise, lipid-lowering agents (statins). Target low density lipoprotein < 70 mg/dl
Diabetes	Hemoglobin A1c <7%
Control of Hypertension	Blood pressure (mm Hg) < 140/85 for most patients, < 130/85 for CHF or renal failure, < 130/80 for diabetes
Smoking	Complete cessation
Physical Activity	30 min (5 times per week)
Weight management	BMI between 18.5 and 24.9

#### POSTOPERATIVE COMPLICATIONS

- Bleeding
- Peri-operative MI
- Rhythm disorders
- Stroke
- Acute kidney injury
- Post-pericardiotomy syndrome
- Pericardial collection
- Pneumothorax
- Sternal wound infection
- Conduit harvest site infection
- Urinary tract infection
- Pulmonary infection
- Septicaemia

#### ABBREVIATIONS

**ACS:** Acute Coronary Syndrome

**ARB:** Angiotensin Receptor Blockers

**ARNI:** Angiotensin Receptor Neprilysin Inhibitor

**BMI:** Body Mass Index

**CABG:** Coronary Artery Bypass Graft

**CAD:** Coronary Artery Disease

**CHF:** Congestive Heart Failure

**CPB:** Cardiopulmonary Bypass

**EKG:** Electrocardiogram

**LAD:** Left Anterior Descending Artery

**LIMA:** Left Internal Mammmary Artery

**MI:** Myocardial Infarction

**OPCAB:** Off-Pump Coronary Artery Bypass Surgery

**PCI:** Percutaneous coronary intervention

**RIMA:** Right Internal Mammmary Artery

**STEMI:** St Elevation Myocardial Infarction

#### REFERENCES

1. Neumann FJ, Sousa-Uva M, Ahlsson A, Alfonso F, Banning AP, Benedetto U, Byrne RA, Collet JP, Falk V, Head SJ, Jüni P, Kastrati A, Koller A, Kristensen SD, Niebauer J, Richter DJ, Seferovic PM, Sibbing D, Stefanini GG, Windecker S, Yadav R, Zembala MO; ESC Scientific Document Group. 2018 ESC/EACTS Guidelines on myocardial revascularization. Eur Heart J. 2019 Jan 7;40(2):87-165. doi: 10.1093/eurheartj/ehy394. Erratum in: Eur Heart J. 2019 Oct 1;40(37):3096. doi: 10.1093/eurheartj/ehz507. PMID: 30165437.

#### KEEP A HIGH THRESHOLD FOR INVASIVE PROCEDURES

This STW has been prepared by national experts of India with feasibility considerations for various levels of healthcare system in the country. These broad guidelines are advisory, and are based on expert opinions and available scientific evidence. There may be variations in the management of an individual patient based on his/her specific condition, as decided by the treating physician. There will be no indemnity for direct or indirect consequences. Kindly visit the website of ICMR for more information: ([icmr.gov.in](http://icmr.gov.in)) for more information. ©Indian Council of Medical Research, Ministry of Health & Family Welfare, Government of India.