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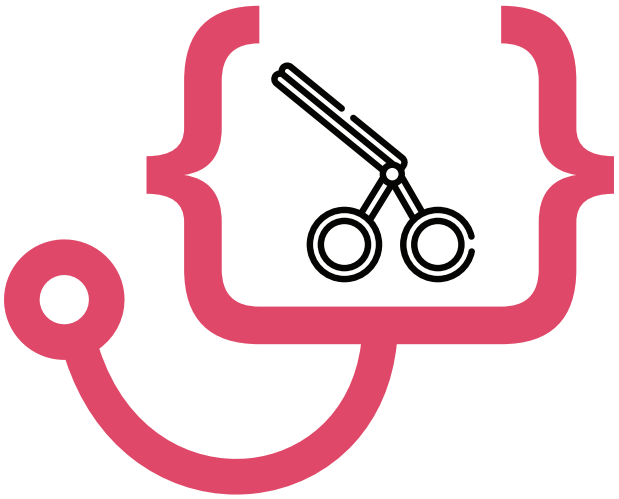
2024 Edition, Vol. IV

STANDARD TREATMENT WORKFLOWS of India

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STANDARD TREATMENT WORKFLOWS of India



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Suggested Citation: Standard Treatment Workflows of India, 2024, Edition Vol. 4, New Delhi, Indian Council of Medical Research, Department of Health Research, Ministry of Health and Family Welfare, Government of India.

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CONTENTS

- INTRODUCTION
- SPECIALITIES COVERED IN THIS EDITION

CARDIOTHORACIC AND VASCULAR SURGERY (CTVS)
Acute Aortic Syndrome
Acute Limb Ischemia
Chest Trauma
Chronic Lower Limb Ischemia (CLLI)
Surgical Management of Coronary Artery Disease

Interventional Radiology
Image Guided Drainage of Intra Abdominal Abscess
Image Guided Management of Haemoptysis
Image Guided Therapies for Primary Liver Tumors
Image Guided Management of Obstructive Jaundice
Image Guided Management of Stroke
Image Guided Management of Vaginal Bleeding
Image Guided Management of Varicose Veins (Chronic Venous Insufficiency)

Neurosurgery
Suspected Brain Tumor
Head Injury
Spinal Injury

Orthopaedics
Ankle Fractures
Distal Femur Fractures
Fracture Distal End Radius
Fracture Neck of Femur
Hip Osteoarthritis
Intertrochanteric Femoral Fractures
Lower Back Pain
Neck Pain
Open Fractures
Osteoarthritis of Knee Joint
Tibial Plateau Fractures

Pediatric Cardiology
Acute Rheumatic Fever
Critical Heart Disease in the Newborn
Pediatric Heart Failure
Kawasaki Disease
Left to Right Shunt Lesions
Tachyarrhythmias

INTRODUCTION

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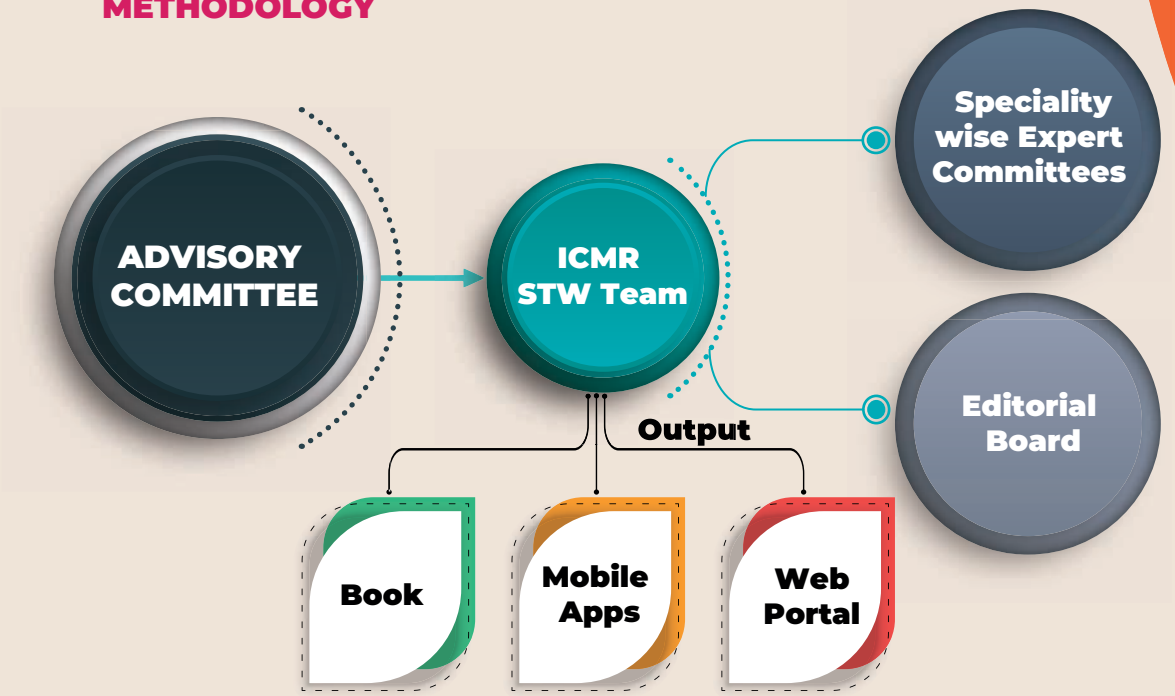
GOAL

To empower the primary, secondary and tertiary care physicians/ surgeons towards achieving the overall goal of Universal Health Coverage with disease management protocols and pre-defined referral mechanisms by decoding complex guidelines.

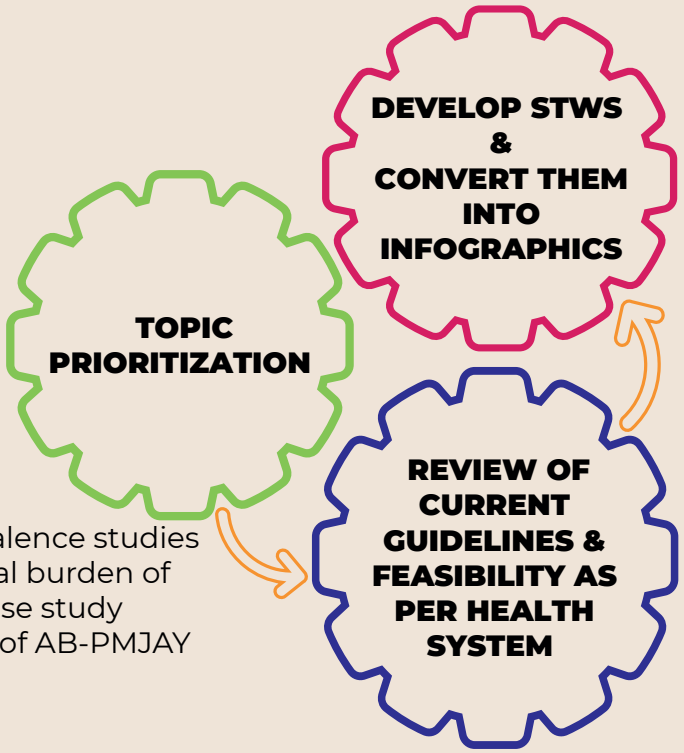
OBJECTIVES

To formulate treatment algorithms for common and serious medical & surgical conditions for both OPD & IPD management at primary, secondary and tertiary levels of India's healthcare system that are scientific, robust and locally contextual.

METHODOLOGY



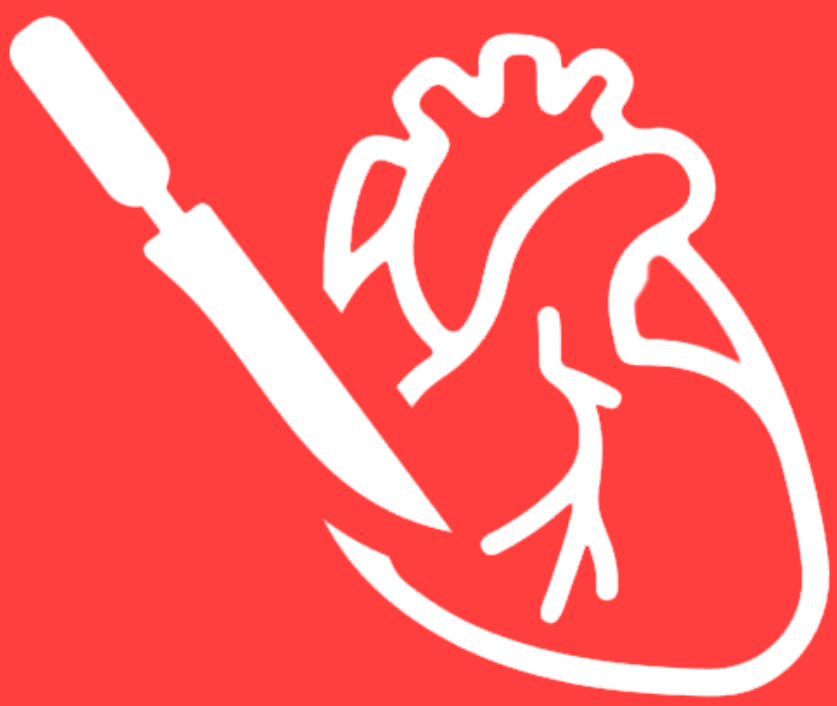
PROCESS OVERVIEW



- Participation also from Public Health Specialists, Strategists Graphic Designers

- Prevalence studies
- Global burden of disease study
- HBP of AB-PMJAY

- Review by Editorial Board
- Approval by Advisory Committee



CARDIOTHORACIC AND VASCULAR SURGERY (CTVS)

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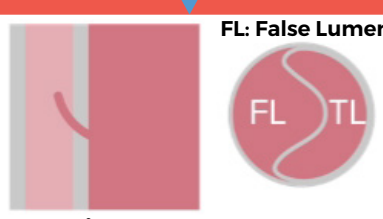
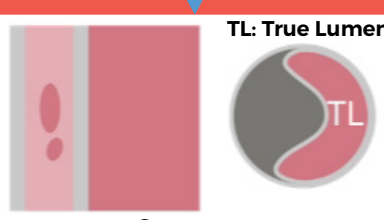
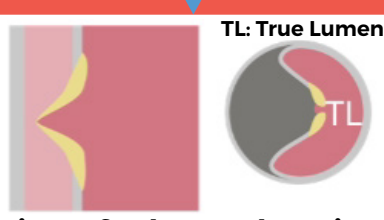
Standard Treatment Workflow
ACUTE AORTIC SYNDROME
ICD-10-M31.4



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 (AD) Commonest and Most lethal	Intramural Hematoma (IMH)	Penetrating Aortic Ulcer (PAU)
Tear in the aortic intima and blood enters into the media separating the layers	Hematoma within the medial layer of the aortic wall without intimal injury	Ulcer-like lesion in the intima eroding through the media of the aortic wall and forming localized hematoma thereoff
 Formation of Entrance Tear	 Rupture of Vasa Vasorum	 Ulceration of atherosclerotic plaque

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

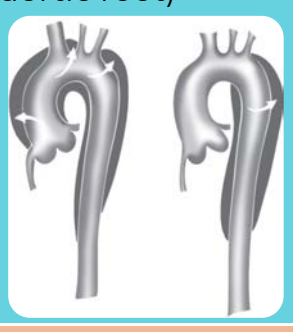
CLASSIFICATION

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
  - Syncope
  - Neurological deficit including stroke and paraplegia
  - Acute congestive heart failure
  - Myocardial ischemia
  - Lower extremity ischemia
  - Renal and visceral ischemia
  - 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

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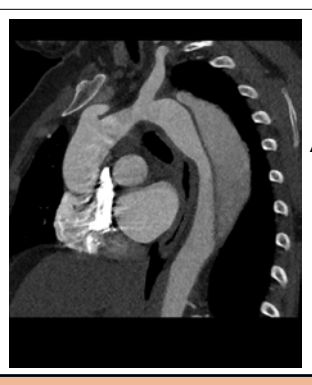
Standard Treatment Workflow
ACUTE AORTIC SYNDROME
(Continued)

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 furthur 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

Targets
Systolic BP 100-120 mm Hg
Mean arterial pressure 70mm Hg in significant aortic regurgitation
Heart Rate 60-70 beats/min
Adequate pain control

↓

Initiation
Control of BP and Heart Rate: Start with Beta blocker
Pain Relief: IV Morphine 2-10 mg or Fentanyl 10- 50mcg

↓

Targets achieved?

- Yes → Continue same
- No →
  - Both Systolic BP and Heart Rate are high → Add Calcium Channel blocker
  - Heart Rate controlled Systolic BP high → Add Vasodilator (Nitroprusside)

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)

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

ABBREVATIONS

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

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HIGH INDEX OF SUSPICION AT THE EARLIEST IS LIFE SAVING

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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, **P**allor, **P**ulselessness, **P**aresthesia, and **P**aralysis*
*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
i. Control bleeding by applying pressure bandage over the wound
ii. Resuscitation
iii. Vascular repair (Stage I, IIa, IIb ischemia), Amputation (Stage III ischemia)
iv. Concomitant bone/nerve injury should be managed simultaneously
v. Supportive treatment, pain relief/antibiotic prophylaxis/tetanus prophylaxis

B. BLUNT INJURY: TRACTION INJURY OR CONTUSION
i. Vascular repair (Stage I, IIa, IIb ischemia), Amputation (Stage III ischemia)
ii. Concomitant bone/nerve injury should be managed simultaneously
iii. Supportive treatment, pain relief/antibiotic prophylaxis

MANAGEMENT OF NON-TRAUMATIC ACUTE LIMB ISCHEMIA

Injection Heparin 100 units/Kg Intravenous

EVALUATION

EMBOLISM

Stage I, IIa, IIb → Surgical Embolectomy/Catheter directed Thrombolysis (send retrieved thrombus for microscopic/microbiological /histopathological examination → Investigate the cause of embolism (cardiac/aortic) and manage accordingly

Stage III → Amputation

THROMBOSIS

Stage I, IIa, IIb → Thrombolysis/Heparinization → Radiological imaging (CT angiography, MR angiography, catheter angiography) → Surgical/Endovascular Revascularization

Stage III → Amputation

CONTRAINDICATIONS TO THROMBOLYSIS
1. Established cerebrovascular event (excluding TIA within previous 2 months)
2. Active bleeding diathesis
3. Recent gastrointestinal bleeding (within previous 10 days)
4. Neurosurgery (intracranial, spinal) within previous 3 months
5. Intracranial trauma within previous 3 months

POST REVASCULARIZATION

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

ABBREVATIONS

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

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KEEP A HIGH THRESHOLD FOR INVASIVE PROCEDURES

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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

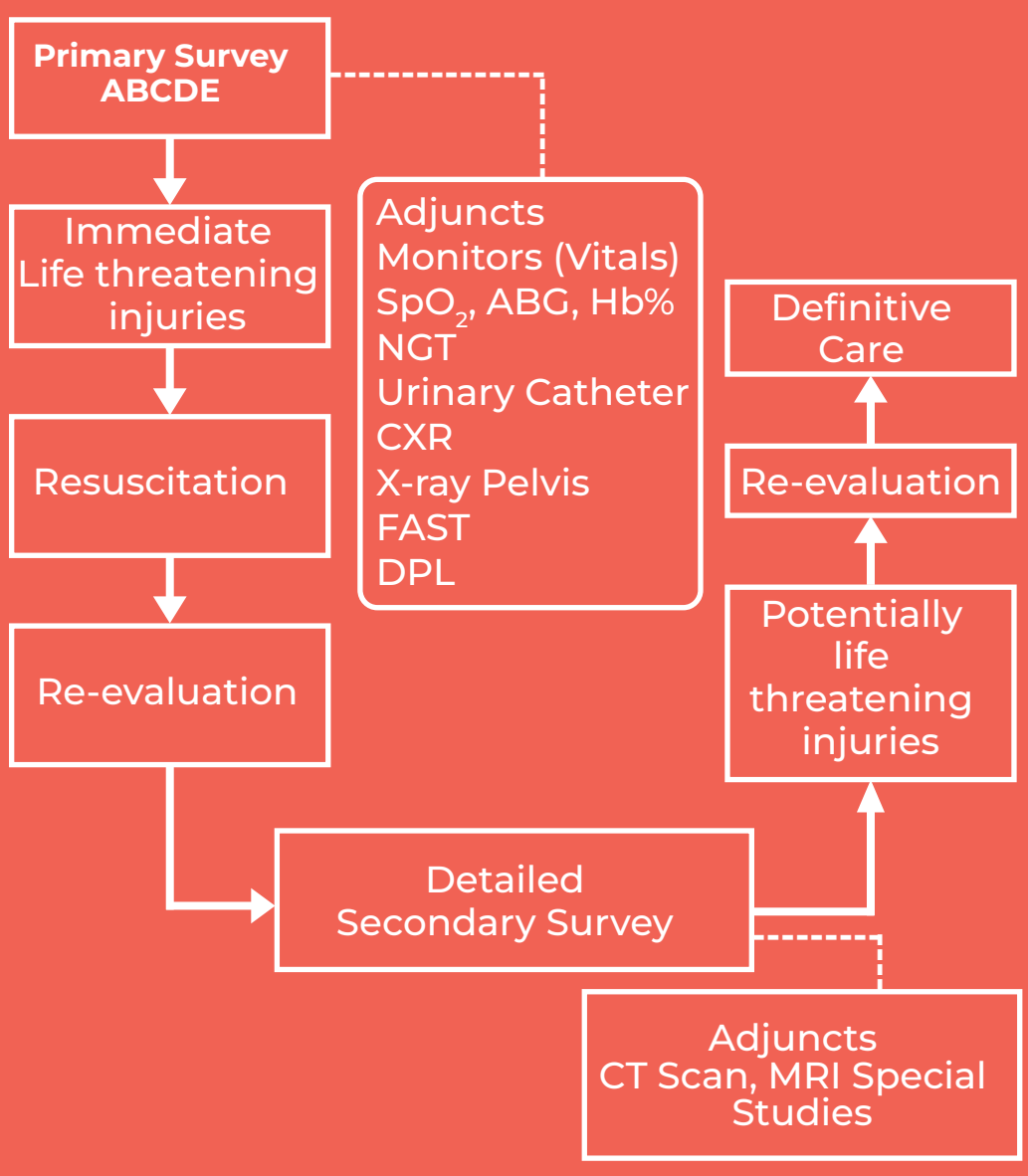
- Pain over the chest
- Shortness of breath
- Cyanosis
- Swelling of chest wall
- Facial/limb puffiness
- Unconsciousness
- Associated blood loss/pallor

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

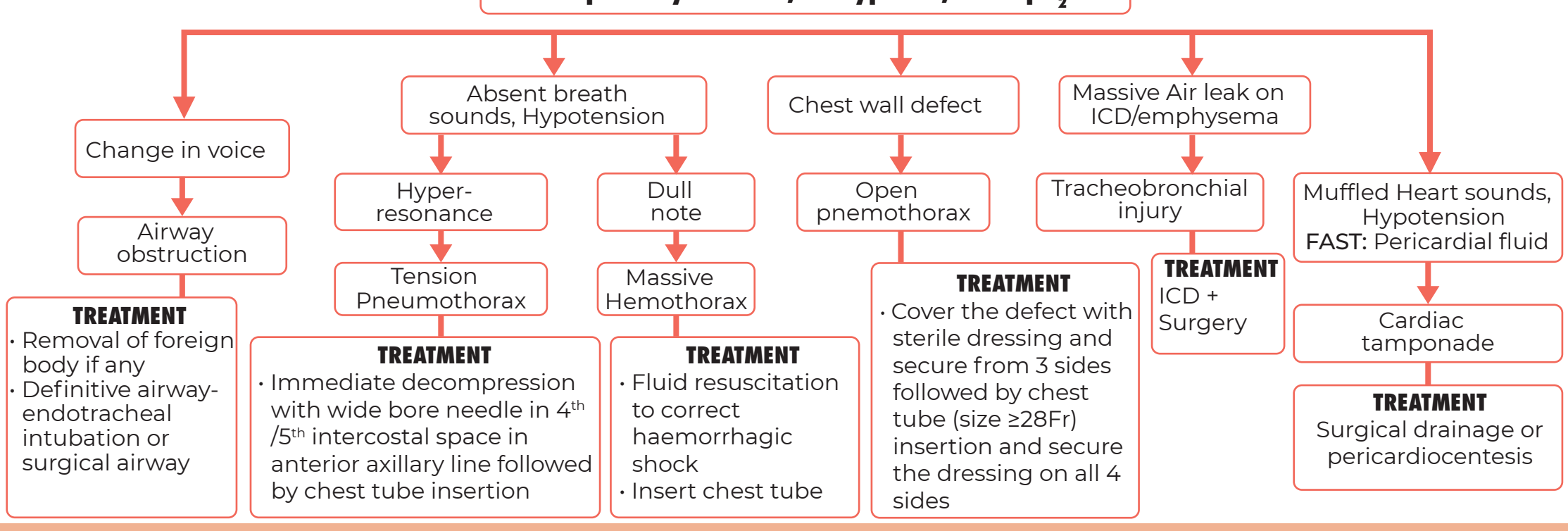
- Blood pressure
- All peripheral pulses
- Altered/Muffled Heart Sounds

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_2



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 4th/5th intercostal space just anterior to midaxillary line

RUPTURED DIAPHRAGM

- Surgery

ABBREVATION

ABG:	Arterial Blood Gas	**ICD:**	Intercostal Drainage Tube
CT:	Computed Tomography	**FAST:**	Focused Assessment with Sonography in Trauma
CXR:	Chest Radiography	**MRI:**	Magnetic Resonance Imaging
DPL:	Diagnostic Peritoneal Lavage	**NGT:**	Nasogastric Tube
ECG:	Electrocardiogram		

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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

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Standard Treatment Workflow
CHRONIC LOWER LIMB ISCHEMIA (CLLI)
ICD-10-M62.262

CLLI is a manifestation of objectively proven Peripheral Arterial Disease (PAD) defined by ankle brachial index of <0.90. These are due to chronic (> 2 week) inadequate tissue perfusion

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
a) Asymptomatic
b) Mild claudication (No life-style limitation)
c) Moderate or severe claudication (Life style limiting)
d) 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

History, Physical Examination
↓
Suspected CLLI
↓
Ankle Brachial Index
- >0.9 → Significant CLLI ruled out
- <0.9 → Duplex Ultrasound/Doppler to confirm obstruction and localization + *Risk factors assessment and management
  ↓
  Co-morbid evaluation: Cardiac, renal and endocrine work up
  - Mild Claudication → No further investigations
  - Moderate/Severe Claudication → CT Angio/MRA/DSA if conservative treatment fails and intervention is planned
  - Critical Limb Ischemia → CT Angio/MRA/DSA

MANAGEMENT OF INTERMITTENT CLAUDICATION

Intermittent Claudication
- Mild Claudication, No lifestyle limitation
  1. ***Antiplatelet therapy
  2. **Exercise Training
  3. *Risk Factor Modification
  4. Annual Follow up
- Moderate/Severe Claudication, Lifestyle limitation
  1. ***Antiplatelet therapy
  2. **Exercise Training
  3. Cilostazol/Naftidrofuryl/Pentoxifylline
  4. *Risk Factor Modification
  5. Follow-up at 1, 3, 6 months and annually

  ↓
  - Symptomatic/functional improvement → Continue Same → Annual follow up
  - No symptomatic improvement or worsening of symptoms → CTA /MRA/DSA for morphological delineation of obstruction
    1. #Revascularization (Endovascular/Surgery)
    2. ***Antiplatelet Therapy
    3. *Risk Factor Management
    4. Follow up at 1, 3, 6 months and annually

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
- Lifestyle modification (graded exercise)
- Control of HTN(BP< 140/90), Control of Diabetes Mellitus (HbA1c< 7.0)
- Low fat diet, exercise
- Atherosclerosis : Start statins, antiplatelets

**EXERCISE REHABILITATION FOR CLAUDICATION
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

#REVASCULARISATION (PREREQUISITES)
- Good distal vessels (run-off)
- Able to walk before critical limb ischemia
- Life expectancy of >1 year
- Satisfactory general condition

MEDICAL MANAGEMENT
- Antiplatelets*** – Aspirin 75-100mg orally/ Clopidogrel 75mg orally OD
- Analgesic – Paracetamol +Opioid

CIRCULATORY MODULATORS
- Cilostazol 100mg orally. (C.I. in CHF, unstable Angina, Recent M.I., Tachyarrythmias)
- Naftidrofuryl 200mg orally TDS
- Pentoxifylline 400mg orally TDS (C.I. in recent cerebral/retinal haemorrhage, intolerance of methyl xanthines)

LOCAL WOUND MANAGEMENT
- Prevention and treatment of infection
- Leg dependency, off-loading, non-adherent dressing, abscess drainage, debridement, digital amputation$

AMPUTATION$
- Non-salvageable limbs, fixed contractures, severe infected/necrosis, failed revascularisation with persistent tissue loss

MANAGEMENT OF CRITICAL LOWER LIMB ISCHEMIA

Critical Lower Limb Ischemia
1. CTA/MRA/DSA for anatomical details aorta and lower limb arterial supply
2. Evaluation of general condition and comorbidities.
3. Antiplatelet Therapy
4. Evaluation of condition of limb: Ulcer, gangrene, abscess, infection
5. Pain Relief ± Antibiotics
6. Cilostazol/Naftidrofuryl/Pentoxifylline
7. *Risk factor management

↓
- Diffuse disease with poor distal vessels, not amenable to intervention or
  2. General condition poor
  → Not a candidate for Revascularization
  - Stable pain and lesion → Medical treatment (non-operative)
  - Not-tolerable pain, spreading infection → 1. Amputation 2. Prosthesis and rehabilitation
- 1. Discrete disease with good distal vessels, suitable for intervention
  2. Satisfactory general condition
  → Candidate for Revascularization#
  1. #Revascularization as appropriate
  2. Antiplatelet Therapy***
  3. Risk factor management*
  4. Follow-up

ABBREVIATIONS

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

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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 REVASCULARIZATION 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

REVASCULARIZATION 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 contraindiacated 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

ABBREVATIONS

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
ECG: Electrocardiogram
LAD: Left Anterior Descending Artery
LIMA: Left Internal Mammary Artery
MI: Myocardial Infarction
OPCAB: Off-Pump Coronary Artery Bypass Surgery
PCI: Percutaneous coronary intervention
RIMA: Right Internal Mammary Artery
STEMI: St Elevation Myocardial Infarction

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INTERVENTIONAL RADIOLOGY

July/ 2024

Department of Health Research
Ministry of Health and Family Welfare, Government of India

Standard Treatment Workflow STW in Interventional Radiology

IMAGE GUIDED DRAINAGE OF INTRA ABDOMINAL ABSCESS

ICD-10-KK65.1,K75.0

CLINICAL PRESENTATION

SIGNS AND SYMPTOMS

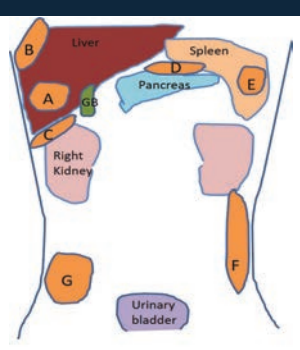
- Pain
- Fever
- Weight loss
- Anorexia
- Local tenderness
- Organomegaly

WHEN TO SUSPECT?

- Patient having unexplained fever especially with chills and rigors
- Local pain: Right hypochondrium (liver abscess), left hypochondrium(splenic abscess, pelvis (post operative status)
- Post operative patient developing fever and increased leucocyte count

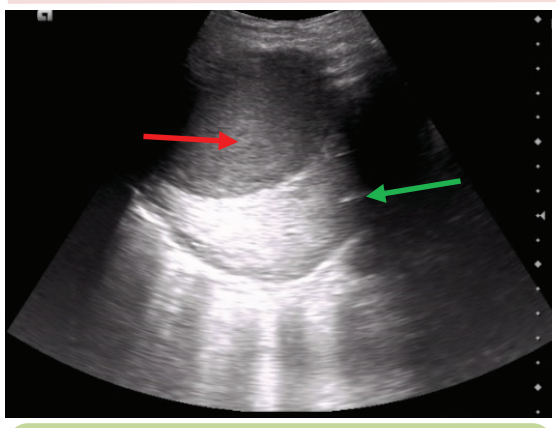
INVESTIGATIONS

	ESSENTIAL	DESIRABLE
HEMATOLOGICAL	CBC CRP ESR	LFTs HIV serology HBs Ag
IMAGING	USG Abdomen	Contrast enhanced CT study of the abdomen

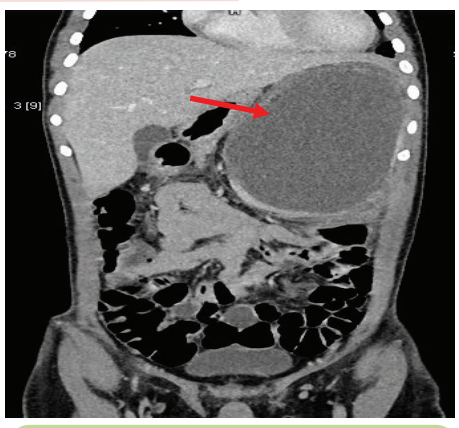


An abscess forms like a round to irregular collection within the liver parenchyma or other abdominal organs/peritoneal cavity

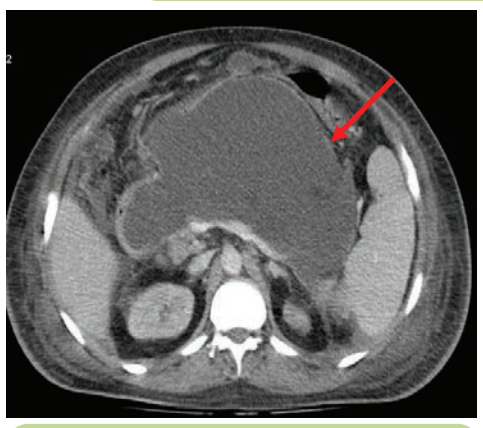
A: Liver abscess
B: Subdiaphragmatic abscess
C: Peri renal abscess
D: Peripancreatic abscess
E: Splenic abscess
F: Paracolic abscess
G: Right iliac fossa/ periappendiceal collection



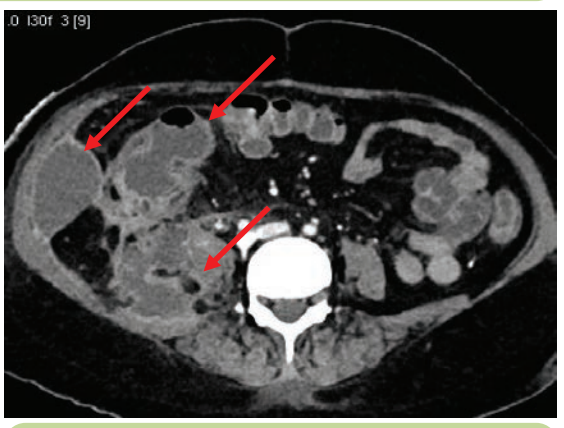
An ultrasound image showing a liver abscess (red arrow) as a well-defined round area appearing less bright than the surrounding liver (green arrow)



A coronal CT scan image of the abdomen showing a large intrasplenic abscess (arrow)



An axial CT scan image of the upper abdomen showing a peripancreatic collection (arrow)



An axial CT scan image of the lower abdomen in a post cholecystectomy patient showing multiple collections (arrows)

MANAGEMENT

Treatment of an abscess depends on its:

- Location
- Size
- Degree of clinical symptoms (patient with septicaemia {tachycardia, hypotension} should be treated aggressively whereas a stable patient can be discharged on oral medical treatment)

- **Medical management**
  - Send the aspirate for microbiological analysis but don't defer treatment for the result of the same
- **Drug dosages:**
  - Inj Metronidazole 500mg IV 6-8 hourly plus inj Ceftriaxone 2gm IV OD for 10-14 days (for liver and splenic abscess)
  - For pancreatic and pelvic/lower abdominal abscesses:
    - Meropenem 1-2gm IV 8 hourly plus Levofloxacin 500-750mg IV daily and Ofloxacin 200 mg for 5-7 days
    - Cefoperazone 1000-2000 mg plus Sulbactam 500-1000 mg (as a combination) IV BD for 5-7 days
- **Surgical management:**
  - To be done in cases of ruptured/impending rupture into the pericardium, peritoneal cavity and pleural cavity
- **Options include:**
  - Laparotomy
  - Chest tube placement/Video-assisted thoracoscopic surgery (VATS)

LIVER ABSCESS

- Right upper quadrant pain
- May present with pleuritic right sided chest pain
- Tender hepatomegaly on examination

RED FLAG SIGNS
- Left lobe abscess
- Segment VIII abscess: can rupture into pleura
- Superficially located abscess
- Abscess volume>100 ml

SPLENIC ABSCESS

- Left upper quadrant pain
- Tender Splenomegaly on examination

PERIPANCREATIC ABSCESS

- Upper abdominal pain
- Patient usually has underlying acute/acute exacerbation of chronic pancreatitis

RED FLAG SIGN
May deteriorate rapidly if splenic vein thrombosis occurs

PELVIC ABSCESS

- Deep seated pelvic abscess
- Common in post operative patients after bowel/ gynaecological surgeries
- Tender lower abdomen/ signs of peritonitis on examination

IMAGE GUIDED DRAINAGE

Consider image guided drainage if the patient has the following despite medical treatment:

- Persistent leucocytosis
- Signs of septicaemia: tachycardia, hypotension
- Impending signs of abscess rupture on imaging

Involves Ultrasound/CT guided placement of catheter in the abscess cavity

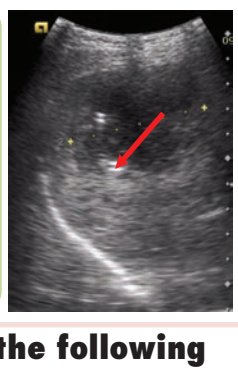
INDICATIONS

- Patient developing tachycardia and hypotension
- Persistent leucocytosis
- Impending signs of rupture of abscess into adjacent cavity(pleural/peritoneal/pericardial)

CONTRAINDICATIONS

- Uncorrectable coagulopathy
- Vital structures in the approach path (large vessel, bowel)

- **Days of required hospitalisation:** 2-5 days
- **Expected outcome:**
  - Relief in pain and tenderness within 6-8 hrs
  - Resolution of fever within 24 hours
- **Associated adverse events that may occur:**
  - Vasovagal syncope (manifested as sweating, hypotension, bradycardia and loss of consciousness)



An ultrasound image showing a drainage catheter (arrow) placed within a liver abscess

How to prevent vasovagal syncope: Ensure the following

- Reassure the patient about the procedure
- Place a large bore(18G/20G) IV cannula in the arm before the procedure
- Keep normal saline infusion bag ready
- Atropine IV to be available for use

How to treat vasovagal syncope

- Raise the legs of the patient to prevent peripheral venous pooling
- Inject Atropine 0.6 mg IV if the heart rate is < 60/min (usually responds to this otherwise the same dose can be repeated after 5 min)

COMPLICATIONS

- Injury to vessels in vicinity of the abscess
- Injury to the pleura in case of liver and splenic abscesses

WHEN TO TAKE OUT THE CATHETER:

- When the output is < 10 ml/24 hours

ALGORITHM FOR IMAGE GUIDED ABSCESS DRAINAGE

Patient with abdominal pain, high grade fever, malaise (suspected intra abdominal abscess)

↓

Laboratory and imaging investigations (Ultrasonography and CT) to confirm the diagnosis

↓ Start medical treatment

Symptoms resolve after 3-5 days

↓

Yes → Follow up imaging ultrasound at 1 month

No improvement/Patient develops signs such as increasing abdominal pain, tachycardia, hypotension → Percutaneous image guided drainage of abscess

Abscess volume > 100ml Superficially located liver abscess at risk of rupture into pericardium/ peritoneum → Percutaneous image guided drainage of abscess

Percutaneous image guided drainage of abscess → Continued medical Treatment

- Immediate step to be taken if warning signs (as shown in red flag) occur: Clamp the drainage catheter (Do not take it out), fast fluid infusion to be started
- Steps to be taken once complication is recognised:
  - Appropriate imaging to look for source of bleeding (CT angiography followed by DSA if necessary)
  - CT thorax if pleural breach is suspected

POST PROCEDURE WARNING SIGNS SIGNIFYING COMPLICATIONS

- Frank blood in the drainage tube (haemorrhage)
- Drop in BP with tachycardia (haemorrhage)
- Patient developing breathlessness/desaturation (pneumothorax)

AFTER CARE IN CASE OF UNCOMPLICATED CASES

Continue with standard medical treatment as mentioned above
Investigation: Ultrasound on day 1 and day 3 post drainage

PATIENT SUITABLE FOR DISCHARGE

Afebrile patient with resolved leucocytosis

FOLLOW UP

Repeat ultrasound at 1 month to look for residual abscess

ABBREVIATIONS

CBC: Complete Blood Count
CRP: C-reactive protein
CT: Computed Tomography
ESR: Erythrocyte Sedimentation Rate
HBs Ag: Hepatitis B surface Antigen
HIV: Human Immunodeficiency Virus
LFT: Liver Function Test
USG: Ultrasonography

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DRAIN THE ABSCESS BEFORE IT DRAINS A LIFE

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**) for more information. ©Indian Council of Medical Research, Ministry of Health & Family Welfare, Government of India.

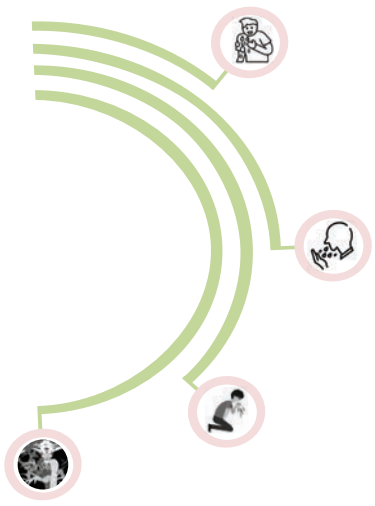
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Standard Treatment Workflow (STW)

IMAGE GUIDED MANAGEMENT OF HAEMOPTYSIS

ICD-10-R04.2



INTRODUCTION

- Haemoptysis refers to the expectoration of blood, originating from the lower respiratory tract
- **LTH - Any haemoptysis that**
  - (1) is > 100 ml in 24 hr
  - (2) causes respiratory failure (SpO2 < 60%) necessitating intubation and mechanical ventilation; or
  - (3) causes haemodynamic instability
- LTH is a respiratory emergency, mortality→50 -100%
- Patient dies because of asphyxiation and not exsanguination
- Optimal diagnosis and treatment→mortality < 20%

ETIOLOGY AND SOURCE OF HAEMOPTYSIS

Pulmonary parenchymal source (65 - 79%)
- Tubercular Pneumonia
- Lung abscess
- Mycetoma ("fungus ball")

Tracheobronchial source (31–57%)
- Bronchiectasis
- Neoplasm

Primary vascular source (1-5%)
- Arteriovenous malformation
- Pulmonary embolism
- Pulmonary artery aneurysm/rupture

Cardiac source (1-5%)
- Mitral Stenosis
- Pulmonary Edema
- CHD with MAPCAS

Miscellaneous and rare causes
- Systemic coagulopathy or thrombolytic agents

Patient with suspected haemoptysis
History & clinical examination
Confirmed hemoptysis
LTH
Chart 2
Non-LTH
Chart 3

Rule out other source of bleeding
- Upper Respiratory tract → alkaline, bright red, foamy blood, breathing difficulty, the sensation of warmth in the thorax
- GIT→hematinized blood, acidic pH, food particles, abdominal pain, nausea

Pseudohaemoptysis
Appropriate supportive care and management

CHART 2

LTH
Resuscitation
Airway, Breathing, Circulation

Consider Intubation in
- Ineffective cough
- Worsening hypoxemia
- Presence of red flag sign

Bad lung down (dependent position-decubitus)
Correct coagulopathy
Reverse anticoagulation
Nebulized Tranexamic acid 1gm f/b 0.5 gm Q8H

Refer to nearest centre having facility of ICU, CT Scan, IR services

RED FLAG SIGNS
- PR > 120/min
- Systolic BP < 100 Mm Hg
- Tachypnoea
- SpO2< 90%
- Deterioration of sensorium

Lab Investigations
BG,CM; CBC; PT-INR; viral markers, KFT, CHEST X-RAY

- PR -60-100/min
- Systolic BP > 100 Mm Hg
- SpO2 > 95%
- Conscious and oriented

Vitals Stable
YES
No
DSA + embolization of BAs/NBSAs/PA/MAPCAS

CTA AORTA +/- CTPA

Normal; No identifiable source	Hypertrophied BAs(90%), NBSAs (5%)	PA aneurysm/PAVM	CHD with MAPCAS	Lung CA
Medical management	BAE by PVA, Embospheres, Glue (Coil and gelfoam for aneurysm/prox occlusion)	PA/PAVM embolization	In consultation with appropriate specialists, plan for MAPCAS embolization	Embolization of supplying artery (PA/BA) as bridge
Fail		Peripheral PA aneurysm →DSA/CT guided glue embolization PAVM→Coil/Plug Embo of feeders (No use of PVA)	Proximal vessel embolization by gelfoam/coil followed by definitive surgery for CHD	
DSA + Embolisation of Bronchial arteries		Fail	Fail	

Fail → Surgery ← Fail

CHART 3

NON LTH
CHEST XRAY

Infiltrate → Antibiotics/sputum C/S
- Resolution → Repeat CXR at 8 weeks
- Non resolution → HRCT/CTA/CECT

Repeat CXR at 8 weeks
- Normal
- Abnormal → HRCT/CTA/CECT

Mass lesion → HRCT/CTA/CECT

Other parenchymal disease → HRCT/CTA/CECT

Suspicion of cardiac disease → ECG+ ECHO → Specific management and treatment

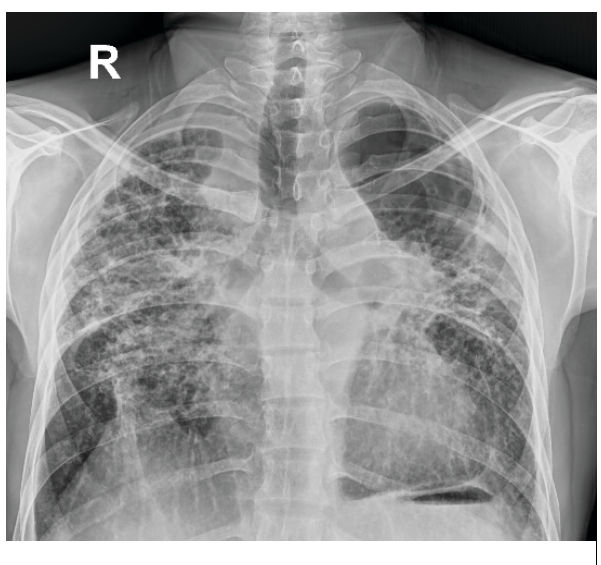
Recurrence/High risk of CA lung

ROLE OF BRONCHOSCOPY

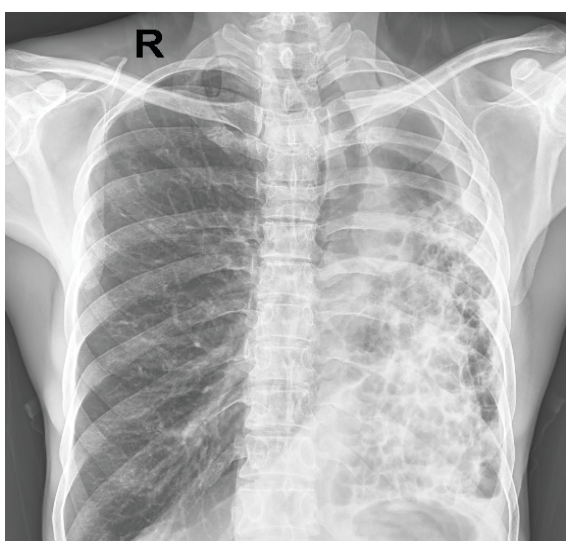
Bronchoscopy may be used for
- Lateralization of bleeding (active haemoptysis within 24-48 hrs)
- Clot extraction
- Balloon tamponade

SURGERY FOR SEVERE/REFRACTORY HAEMOPTYSIS

- Cavitating lesion with fungal ball
- In unsuitable anatomy/not amenable for angioembolization/unsuccessful embolization
- > 600 ml/24 hours
- Surgeries: Lobectomy, Pneumonectomy, Cavernostomy
- Large cavity in a patient with very poor pulmonary functions and massive bleeding→Resection and a cavernostomy with cauterization of the bleeding point and packing of the cavity

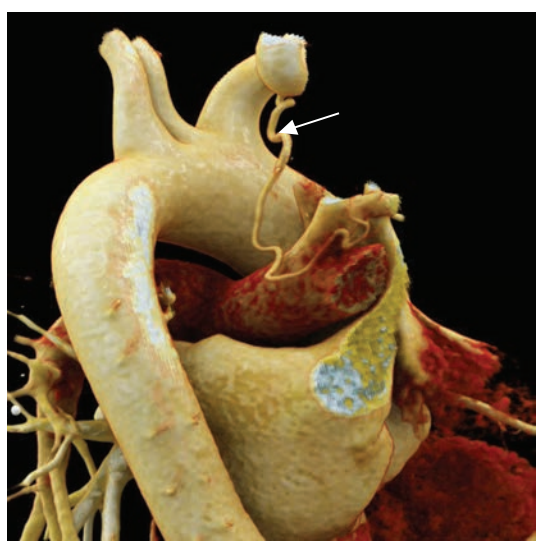


Fibrocalcific lesion



L side-Bronchiectasis





Hypertrophied Bronchial artery in MDCT, MIP and VRT

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Standard Treatment Workflow (STW)

IMAGE GUIDED MANAGEMENT OF HAEMOPTYSIS

(Continued)

ANGIOGRAPHIC AND CT APPEARANCE OF ABNORMAL BRONCHIAL ARTERIES-INDICATIONS FOR BAE

1. Hypervascularity of lung parenchyma (most common)
2. Hypertrophic tortuous bronchial or non-bronchial arteries (common)
3. Neovascularisation (common) or peri-bronchial hypervascularity
4. Enlarged main bronchial artery (diameter > 2.0 mm)
5. Contrast extravasation (variable)
6. Bronchial artery aneurysm, pseudoaneurysm (rare)
7. Bronchial-to-pulmonary vein-shunts
8. Pleural thickening > 3 mm adjacent to a parenchymal abnormality
9. Extrapleural fat hypertrophy including enlarged vascular structures
10. 10% of BA may arise from Brachiocephalic, SCA, IMA or abdominal aorta branches

CONTRAINDICATIONS FOR BRONCHIAL ARTERY EMBOLIZATION

- Documented severe iodinated contrast allergy
- Careful to exclude branches supplying the heart, spinal cord or brain arising from bronchial, intercostal or other non-bronchial vessels
- Congenital PA stenosis (bronchial collateral vessels may provide an essential role in pulmonary parenchymal perfusion)

PROCEDURE DETAILS OF BAE

Pre op CTA/Flush DTA and B/L SCA Aortogram

↓

Locate Hypertrophied BAs, search and hook with diagnostic cobra/simmons catheter

↓

Selective hand-injection angiogram→verification of absence of any branches supplying to critical structures

↓

Advance coaxial microcatheter in target vessel distally and access flow dynamics by angiogram through 2CC luer lock syringe

↓

Embolization by pulsatile injection through 1 cc syringe under active fluoroscopy

↓

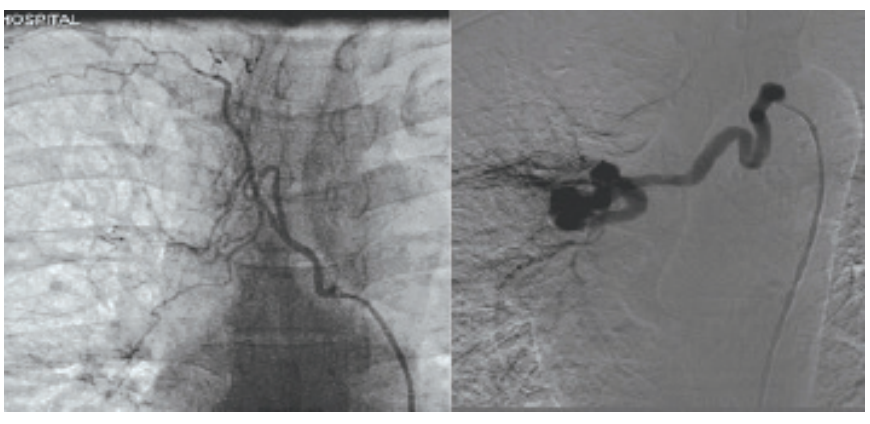
When resistance/reflux develops, new manual contrast angiogram to be done after flushing residual embolic materials

↓

Locate other BAs and NBSAs and embolise all pathological arteries

EXPECTED OUTCOMES

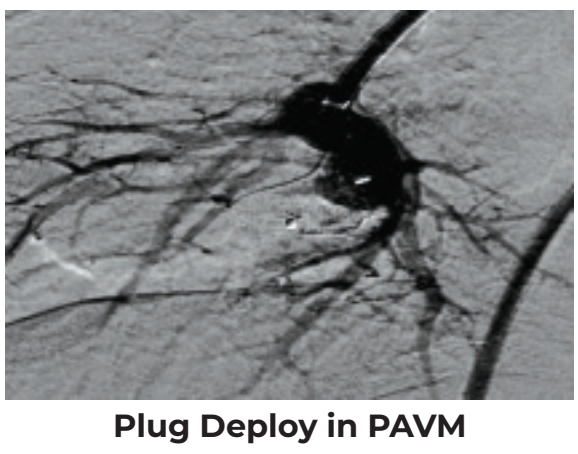
- **Technical success: 90-100%**
- **Clinical success**
  - Within 24 hr- 82-100%; within 30 days-70-92%;
  - 1-yr clinical success- 64-92 %
  - Recurrence: upto 47% [Repeat Embolization to be performed]
- **Predictors of recurrent Haemoptysis are as follows:**
  - Recruitment of non-bronchial systemic collaterals
  - Diabetes
  - Presence of an aspergilloma
  - Feeding vessels from internal mammary artery
  - Multidrug-resistant tuberculosis, co-existent pulmonary interstitial lung disease, patients with malignant diseases
  - Unstable haemodynamics and prolonged coagulation
- **Associated adverse events/complications**
  - Post embolization syndrome-1.7-31%
  - Spinal cord Infarction, bronchial infarction,stroke <1%
- **After care**
  - Pain management: NSAIDS and if required intravenous Narcotics
- **Follow up**:
  - After 1 week; 1, 3, 6, and 12months post-BAE and yearly thereafter
  - Hb
  - Chest Xray



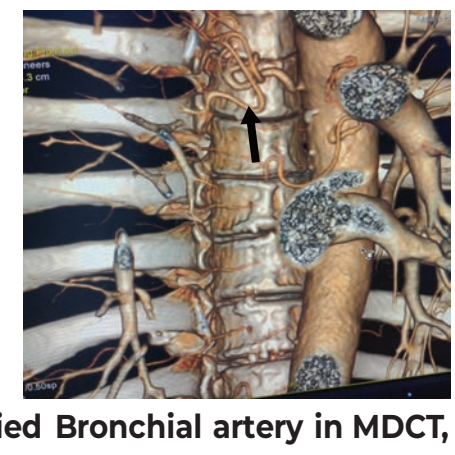
Hypertrophied Bronchial arteries



Non bronchial Systemic Artery



Plug Deploy in PAVM



Hypertrophied Bronchial artery in MDCT, MIP and VRT



MAPCAS

ABBREVIATIONS

BA:	Bronchial Artery	**FB:**	Flexible Bronchoscopy	**NBSA:**	Non Bronchial Systemic Artery
BG:	Blood Grouping	**GA:**	General Anaesthesia	**OT:**	Operation Theatre
CBC:	Complete Blood Count	**HB:**	Hemoglobin	**PA:**	Pulmonary Artery
CE:	Clinical Examination	**ICU:**	Intensive Care Unit	**PAVM:**	Pulmonary Arteriovenous Malformation
CHD:	Congenital Heart Disease	**IMA:**	Internal Mammary Artery		
CM:	Cross Matching	**IR:**	Interventional Radiology	**PT:**	Prothrombin Time
CTA:	Computed Tomogram Angio	**LTH:**	Life threatening Haemoptysis	**PVA:**	Poly vinyl Alcohol
CTPA:	CT Pulmonary Angio	**MAPCAS:**	Major Aorto-Pul Collaterals	**KFT:**	Kidney Function Test
DSA:	Digital Subtraction Angio	**MDCT:**	Multi Detector CT	**SCA:**	Subclavian Artery
ECG:	Electrocardiogram	**MIP:**	Maximum Intensity Projection	**VRT:**	Virtual Reality Technology
ECHO:	Echocardiography	**MS:**	Mitral Stenosis		

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☛ STOP COUGHING OF BLOOD, SAVE LUNGS & SAVE LIFE

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Standard Treatment Workflow (STW)

IMAGE GUIDED THERAPIES FOR PRIMARY LIVER TUMORS

ICD-10-C22.8

PRIMARY LIVER TUMORS

- Primary liver tumors majorly consists of Hepatocellular carcinoma (HCC), Intrahepatic cholangiocarcinoma (IHCC) and combined hepatocellular cholangiocarcinoma (cHCC-CC) HCC being is the most common
- There are no specific signs or symptoms for primary liver tumors
- Radiological and lab investigations are the main tool for the diagnosis

In patients with underlying cirrhosis new onset of ascites, jaundice and/or variceal haemorrhage should prompt investigations to look for HCC

- Patients with pre-existing cirrhosis; are at high risk of developing HCC and should be under surveillance for development
- **Risk Factors**
  - Hepatitis B (33%)
  - Alcoholic liver disease(30%)
  - Hepatitis C (21%)
  - NASH
  - Other causes of cirrhosis
- Serum Alpha fetoprotein: elevated AFP value should prompt imaging work up

DIAGNOSTIC WORK-UP

- LI-RADS classification system should be used for diagnosis
- Multiphasic CT/MRI or contrast enhanced ultrasound is needed for diagnosis
- In patients at risk, if a lesion of size > 2cm with arterial phase hyperenhancement and washout on subsequent phase is diagnostic of HCC
- Biopsy is needed if
  - Equivocal imaging findings
  - Non-cirrhotic liver

INVESTIGATIONS

Essential

Lab investigations
- Liver function tests
- Kidney function tests
- CBC
- PT/INR
- Alpha feto-protein (AFP)

Imaging
- Recent contrast enhanced multiphasic CT/MRI

Desirable
- PIVKA II

Optional
- FDG PET CECT

PATIENT MANAGEMENT

Multiphasic contrast-enhanced CT/MRI
- Tumor characterization staging and presence of extrahepatic disease

IR therapies based on size and number of lesions
- < 3 lesions of < 3 cm: consider ablation
- Lesion > 3cm & < 5cm may consider combination of TACE & Ablation
- Lesion > 5 & < 8 cm consider TACE
- Lesion > 8 cm consider TARE

Portal vein status:
- Portal vein tumoral thrombus: consider TARE/SBRT,
- TACE may be considered for segmental/sub-segmental branch tumoral thrombus

Location of the tumor:
- Tumors at critical location like Perivascular/pericholedochal/exhophytic/subdiaphragmatic lesion
  - Consider TACE
  - Combination of TACE & ablation / MWA in experienced centres

Performance status (ECOG)[ref] PS 0, 1 suitable for IR therapies, PS 2 may consider TARE
Liver function tests: Serum bilirubin >3 mg/dl & AST > five times the upper limit of normal contraindication for TACE
Child-Pugh class: IR therapies should be considered for Child-Pugh class[ref] < B8

ABLATIVE THERAPIES

Chemical ablation
- Ethanol
- Acetic acid

Thermal ablation
- Radiofrequency Ablation
- Microwave ablation
- Cryoablation

Non chemical-non thermal ablation
- Irreversible electroporation

THERMAL ABLATION: INDICATIONS

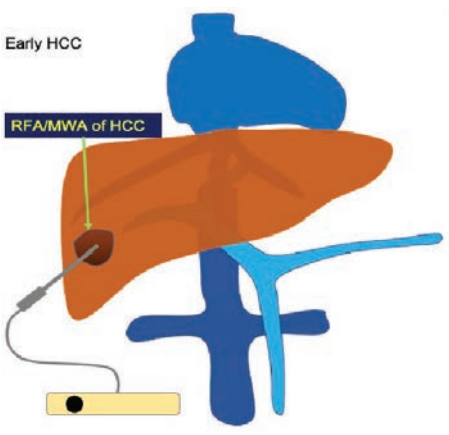
- Very early (single lesion <2 cm) and early HCC single lesion or upto three lesions each less than 3cm
- Ablation may be considered for all primary liver lesions amenable for ablation in following situation
  - Bridging therapy for liver transplantation
  - Residual and recurrent HCC
  - Combination therapy with TACE
  - Repeat ablation should be considered for focal residual lesion < 3 cm along the periphery or within the ablation zone

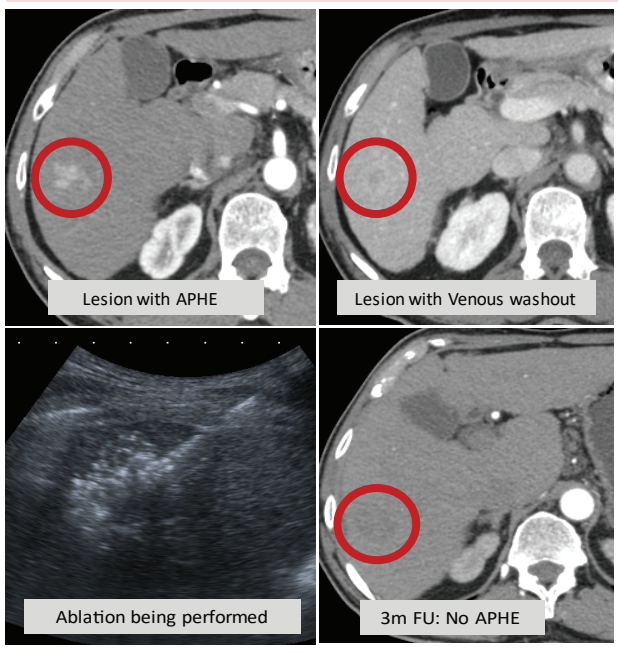
CONTRAINDICATION

- Ascites
- Sepsis and uncorrectable coagulopathy
- Intrahepatic biliary dilatation
- Intravascular invasion or extrahepatic metastatic disease
- Arrhythmias (for IRE)
- Poor PS (>2)
- Severely deranged liver function (CTP class C)

IMAGE GUIDANCE

- USG (contrast optional)
- CT (contrast optional)
- Both CT & USG





POST PROCEDURE COMPLICATIONS

- **Immediate Post procedure:** Bleed/hemoperitoneum

Post procedure appearance of perihepatic hematoma/fluid/ascites suggestive of bleed/hemoperitoneum
If continuous increase in size/volume of hematoma/fluid plan CT angiogram to localize bleeding vessels
If active contrast extravasation noted on CT angiogram plan urgent angio-embolization of the bleeding vessel

- **Post embolization syndrome:** Fever may persist for 2-3 days and pain may persist for 5-7 days
  - Severe/excruciating pain at any point of time should be evaluated with USG and if needed CECT to look for the cause
- **Visceral/diaphragmatic/lung/GB injury:** Rare complications but may be looked for if severe/excruciating pain persists

TRANSARTERIAL CHEMOEMBOLIZATION (TACE)

- TACE: Intra-arterial infusion of cytotoxic agent followed by embolisation of the tumor-feeding blood vessels
- TACE performed in 2 ways
  - **cTACE:** Emulsion of Lipiodol & chemotherapeutic agent is injected into the arteries supplying the tumor
  - **DEB TACE:** Chemotherapy loaded microspheres are selectively injected into the arteries supplying the tumor
- The use of drug-eluting beads has shown similar benefit to conventional TACE (cTACE; gelfoam-Lipiodol particles) and either of the two can be utilized
- TACE is suitable for patients with well-defined nodules and preserved portal flow
- TACE should be performed in a super-selective manner and avoid all possible non-target embolization

TACE INDICATIONS

- Multinodular or single nodule HCC of size > 5 cm with preserved portal flow, preserved liver function and PS=0 (INASL-BCLC/BCLC-2022 stage B)
- In small HCC where ablation is not possible

TACE CONTRAINDICATIONS

- Decompensated cirrhosis (Child-Pugh B ≥8, including jaundice with Serum Bilirubin > 3.0 mg/dl, hepatic encephalopathy, refractory ascites and hepatorenal syndrome)
- Portal vein tumoral thrombus
- Extensive tumor involving both liver lobes
- Untreatable arteriovenous fistula
- Renal insufficiency, including creatinine ≥2 mg/dL or creatinine clearance <30 mL/min

POST TACE COMPLICATIONS

- Immediate post procedure:
  - Arterial injury/dissection (small vessel and minor injury may be left as it is and major vessel injury may require measures like angioplasty and/or stenting)
  - Tumor rupture (Rare) presents as hemoperitoneum/ascites/hemodynamic shock and may be seen in few hours to 24 hours post TACE
- **Post embolization syndrome:** Pain, fever, Nausea/Vomiting – these symptoms are mostly self limiting resolves in 2-3 days and needs symptomatic care (Paracetamol and/or antiemetics)
- If there is deterioration on clinical condition of the patient after TACE (3-7 days) with severe post embolization syndrome then lab investigations (LFT, KFT, CBC and PT/INR) and USG should be done to look for post TACE liver failure
- **Post TACE Liver failure**
  - > 10 times elevation of baseline AST/ALT
  - > 3 times elevation of baseline serum Bilirubin
  - Post procedure hepatic encephalopathy
  - INR elevation > 2.5 of baseline

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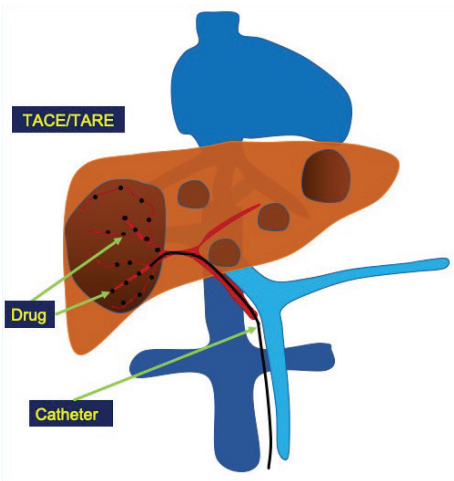
Standard Treatment Workflow (STW)

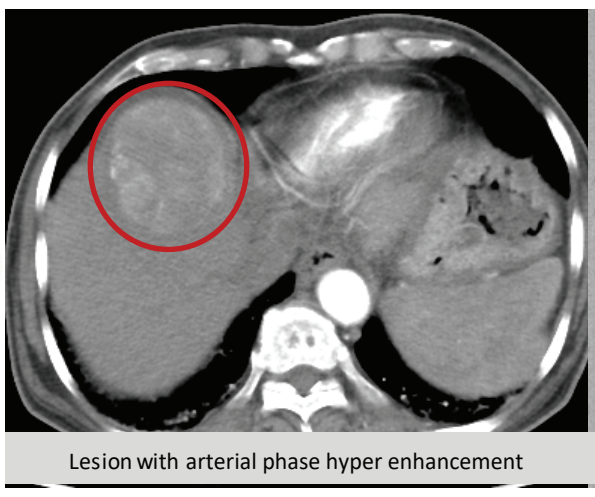
IMAGE GUIDED THERAPIES FOR PRIMARY LIVER TUMORS

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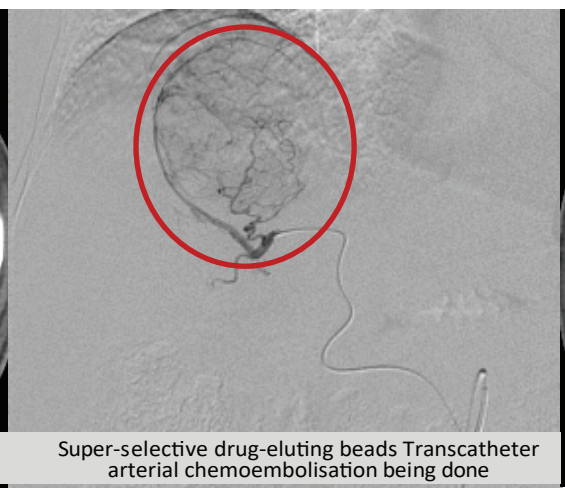
IMAGE GUIDANCE FOR TACE/TARE

- DSA (Cone beam CT optional)

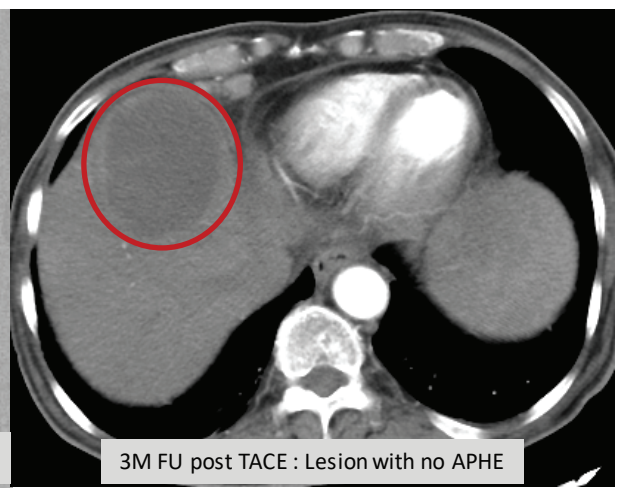




Lesion with arterial phase hyper enhancement



Super-selective drug-eluting beads Transcatheter arterial chemoembolisation being done



3M FU post TACE : Lesion with no APHE

TRANSARTERIAL RADIOEMBOLISATION

- TARE is infusion of radioactive substances or microspheres into the arteries supplying the tumor. It mostly contains yttrium-90 (Y90)
- TARE may be performed in a lobar, sectorial, or segmental approach based on tumor burden and location
- Pre-procedure assessment
  - Assessment of anatomic variant, collateral vessels [prophylactic coil embolisation of gastroduodenal artery, right gastric artery left gastric artery, left gastric artery (optional)]
  - Assessment of degree of shunting to lung.
  - T99m Tc MAA - Macro aggregated albumin- is used for pre-procedure assessment as it has diameter and distribution similar to Y90 microspheres
  - Tc99 (2-5 mCi) microspheres is used in preprocedure assessment - In case of rhenium-188 isotope

TARE INDICATIONS

- Palliation for unresectable HCC with or without PVTT
- Bridge to transplantation
- Neoadjuvant therapy for resection
- Definitive ablative radiotherapy for smaller lesions

TARE CONTRAINDICATIONS

- Lung shunting > 20% or radiation doses to lungs > 30 Gy in single treatment or cumulative dose of 50 Gy
- Severe liver dysfunction (Child – Pugh C), total bilrubin >3mg/dl
- Significant immediate life threatening extrahepatic disease
- Patients with ECOG PS >2

POST TARE COMPLICATIONS

- **Immediate post procedure**
  - Arterial injury/dissection (small vessel and minor injury may be left as it is and major vessel injury may require measures like angioplasty and/or stenting)
- **Post embolization syndrome:** Mild and self limiting resolve in 2-3 days and need symptomatic care (Paracetamol and/or antiemetics)
- Radioembolization-induced liver disease (REILD)
  - It is a rare complications which occurs due to liver injury caused by 90Y microspheres.
  - It develops in 4–8 weeks after treatment and manifests as jaundice and ascites without biliary obstruction or tumor progression.
  - It may be mild or severe
- **Gastrointestinal complications:** Gastroduodenal ulcers and pancreatitis is a rare complication due to non-target reflux of 90Y particles
- **Radiation Pneumonitis:** Rare complication, occurs due to excessive arterio-venous shunting and is seen after 1-6 months of treatment

FOLLOW-UP (Common for all IR therapies)

- Lab investigations (LFT, KFT, CBC) may be repeated after 1-2 weeks of IR therapies to assess infection/liver & kidney dysfunction
- USG abdomen may be done if there is prolonged pain/fever and/or abdominal distension
- Response to evaluation and follow up consists of clinical, biochemical and imaging at 1 month
  - Clinical – General condition, performance status
  - Biochemical – LFT, KFT, CBC, PT/INR, AFP
  - Multiphasic contrast enhanced CT/MRI
    - To assess treatment response as per (mRECIST) criteria at 1 month for Ablation/TACE and 6 or 12 weeks (12 weeks preferable) for TARE

Treatment response should be assessed using mRECIST criteria and should be reported as complete response (CR), partial response (PR), Stable disease (SD) and progressive disease (PD)

OUTCOME MEASURES AND LONG TERM FOLLOW UP

- Treatment response should be assessed using mRECIST criteria and should be reported as complete response (CR), partial response (PR), Stable disease (SD) and progressive disease (PD)
- If complete response achieved, then periodic follow-up at 3, 6, 9, 12 months and 6-12 months thereafter same as above
- Partial response at 1 month: plan repeat session consisting of same or different modality
- Progressive disease at one month: change treatment plan based on advanced HCC as per INASL-BCLC/BCLC-2022 classification

ABBREVIATIONS

AFP:	Alpha Fetoprotein	**MRI:**	Magnetic Resonance Imaging
CBC:	Complete Blood Count	**MWA:**	Microwave Ablation
CT:	Computed Tomography	**PET:**	Positron Emitting Tomography
DSA:	Digital subtraction angiography	**PIVKA II:**	Protein Induced by Vitamin K Absence-II
ECOG:	Eastern Cooperative Oncology Group	**PS:**	Performance Status
HCC:	Hepatocellular Carcinoma	**PT:**	Prothrombin Time
IHCC:	Intrahepatic Cholangiocarcinoma	**PVTt:**	Portal Vein Tumoral Thrombus
INR:	International Normalized Ratio	**mRECIST:**	modified Response Evaluation Criteria in Solid Tumors
IRE:	Irreversible Electroporation	**SBRT:**	Stereotactic Body Radiotherapy
KFT:	Kidney Function Test	**TACE:**	Transarterial Chemoembolization
LFT:	Liver Function Test	**TARE:**	Transarterial Radioembolization
LI-RADS:	Liver Imaging Reporting & Data System	**USG:**	Ultrasonography

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☛ HCC: EARLY DETECTION AND TREATMENT IS ASSOCIATED WITH BEST OUTCOME

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**) for more information. ©Indian Council of Medical Research, Ministry of Health & Family Welfare, Government of India.

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Standard Treatment Workflow (STW)

IMAGE GUIDED MANAGEMENT OF OBSTRUCTIVE JAUNDICE

ICD-10-K83.1

CLINICAL PRESENTATION
- Jaundice
- Pruritus
- Dark coloured urine & Pale stool

COMMON ETIOLOGIES
- **Non obstructive:** Hepatitis related- viral hepatitis (A,B,C,E,NASH, alcohol, auto-immune cirrhosis)
- **Obstructive:** Mechanical obstruction
- **Benign:** stone, sludge, stricture, worm, primary sclerosing cholangitis, bilio-enteric anastomotic stricture (HJ stricture)
- **Malignant:** Carcinoma GB, hepatocellular carcinoma cholangiocarcinoma, hepatic metastasis, pancreatic head carcinoma, extrinsic compression by lymph node/mass, pseudotumor

KEY TO DIAGNOSIS
- In presence of jaundice
  - High AST/ALT + relatively normal SAP/GGT suggests hepatitis
  - Elevated SAP & GGT + relatively normal AST/ALT suggests obstructive etiology
- USG* abdomen would mostly differentiate between obstructive and non-obstructive causes

Do not suspect obstructive jaundice if:
- AST/ALT elevation > 1000 IU
- ALP/GGT normal/mildly elevated (s/o hepatitis)

- If non obstructive jaundice: refer to district hospital/tertiary care to be managed by physician (medicine/gastroenterologist/ hepatologist)

RED FLAGS
- Cholangitis
  - Pain in right hypochondrium
  - Fever
  - Chills
  - Tachycardia & tachypnoea
- Patients should be administered IV fluids & antibiotics- Cefoperazone + Sulbactam in a ratio of 1:1 administered IV 20-40 mg/kg/day in equal doses over duration of 6-12 hrs

INVESTIGATIONS

	ESSENTIAL	DESIRABLE	OPTIONAL
HEMATOLOGICAL	LFT, CBC, PT/INR	KFT, Screen for Hepatitis B/C markers	Hepatitis A/E markers
IMAGING	USG Abdomen	MRCP, CECT Abdomen	

PHC
Patient with clinical features and/or red flag signs

CHC/DISTRICT HOSPITAL
- Clinical examination; hematological investigations – LFT, CBC, PT/INR and Imaging – USG abdomen
- If cholangitis is suspected – Fluid resuscitation and IV antibiotics and refer to tertiary level care for further management

TERTIARY CARE
- Clinical examination, repeat hematological investigations if > 2 weeks. Imaging – MRCP to confirm diagnosis & look for level of obstruction, CECT abdomen to decide for definitive vs palliative care
- Suspected cholangitis – Fluid resuscitation & I/V antibiotics
- Biliary drainage (PTBD/ERCP) to make patient fit for surgery/palliative care (chemotherapy/radiotherapy)
- PTBD preferred for high CBD/hilar obstruction, ERCP preferred in low CBD obstruction

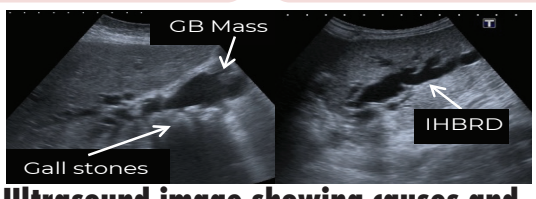
Once the bilirubin starts reducing, the patient can be: taken up for surgery or chemo/radiotherapy or refer back to regional cancer centre

BASIC HEMATOLOGICAL AND USG FINDINGS IN OBSTRUCTIVE JAUNDICE

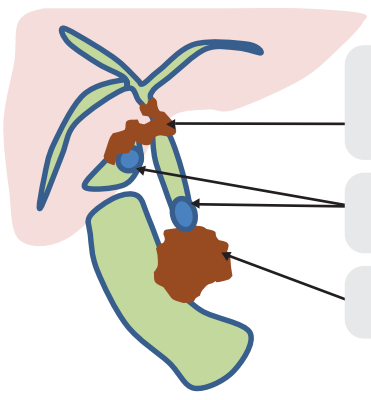
LFT
- Serum bilirubin – Elevated
- AST/ALT – Normal to elevated
- ALP/GGT – Markedly elevated (ALP>GGT)

CBC
- Hb: Normal to low
- TLC: Normal to elevated
- PT/INR: Normal to elevated

***USG ABDOMEN**
- Gall bladder stone/mass
- Dilatation of Common bile duct/intrahepatic biliary radicles



Ultrasound image showing causes and findings in of obstructive jaundice



COMMON CAUSES OF BILIARY OBSTRUCTION

MANAGEMENT

CLINICAL FEATURES

LFT
- Raised serum bilirubin with
- Markedly raised ALP and/ or GGT
- Normal/ mildly raised AST/ALT

If signs of cholangitis: Jaundice with fever, rigor, pain → Urgent referral to higher centre

USG
- CBD/IHBR dilatation
- GB stone/Mass

MEDICAL MANAGEMENT FOLLOWED BY
- USG/MRCP
- Lower CBD obstruction: ERCP
- Higher common bile duct/Hilar Obstruction PTBD#

MRCP
- Ascertain level and cause of obstruction in the biliary tree
  - Lower CBD obstruction: ERCP preferred
  - High CBD obstruction: PTBD# preferred

Choledocholithiasis/other benign cause needing bile drainage
- ERCP
- PTBD# (If ERCP not possible)

Biliary tract malignancy

CECT ABDOMEN
- Identify the malignancy and extent of disease
- Decide for definitive vs palliative care

DEFINITIVE TREATMENT
- PTBD followed by surgery

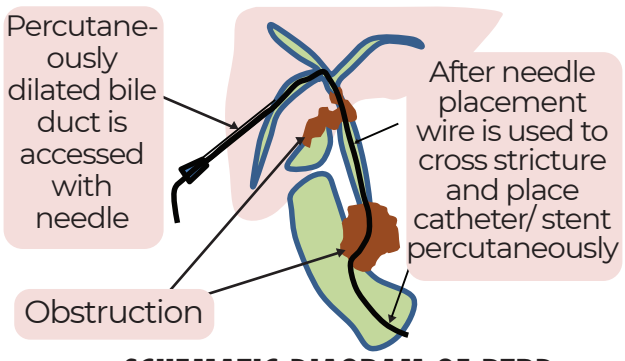
PALLIATIVE TREATMENT
- PTBD# followed by Biliary stenting
- Chemotherapy/Radiotherapy

PERCUTANEOUS TRANSHEPATIC BILIARY DRAINAGE (PTBD)#

INDICATIONS
- Decrease bilirubin to commence appropriate therapy (surgical/palliative)
- Cholangitis (draining infected bile)
- Intense pruritus

DAYS OF HOSPITALISATION
- 1-3 days (non-infected/no cholangitis cases)
- 7-14 days (Cholangitis, can be prolonged in severely septic patients)

CONTRAINDICATIONS
- Deranged coagulation (correct before procedure)
  - Emergent cases: infuse fresh frozen plasma (FFP) - 10ml/kg body weight prior to the procedure
  - Elective cases: I/V vitamin K injection (5-10 mg) - 3 to 5 days
- Ascites (to be dried before therapy)



SCHEMATIC DIAGRAM OF PTBD

PROCEDURAL DETAILS
- **External drainage** for infected cases (aim to establish internal drainage with or without biliary stenting, once the infection is treated. In cases of long-term external drainage – electrolytes should be replaced for ongoing bile salt loss)
- **Internal drainage** using internal external drainage catheter for non infected cases else may be considered for primary biliary stenting

#PTBD IN CHOLANGITIS: IV antibiotics** and fluids to be started before the procedure: Cefoperazone+Sulbactam in 1:1 ratio, 20-40 mg/kg/day in equal doses after duration of 6-12 hrs; Piperacillin 4 gm +Tazobactam 0.5 gms every 8 hrs
- External drainage till cholangitis subsides (normalization of leucocytosis, and draining bile to become clear – golden brown or light green)
- Establish internal drainage once infection is treated
- Plan for definitive/palliative therapy and manage same as described for non-infected patients

OUTCOME MEASURES
Normal bile drainage through the catheter

COMPLICATION
- Development of cholangitis post PTBD

EXPECTED OUTCOMES
Reduction in bilirubin to make patient fit for required therapy

- **Haemorrhagic output** should prompt an immediate evaluation to **rule out vascular injury**

AFTER CARE
- Appropriate antibiotics** : Ofloxacin/Cefixime 200 mg 12 hrly for 3-5 days
- LFT & CBC
- Clinically stable patient with reducing bilirubin can be planned for biliary stenting/ definitive surgery/discharge as per the requirement and suitability

FOLLOW UP
- Follow-up with IR in case of non-reducing or rise in bilirubin/sign of cholangitis/ stent block
- Patients to follow with respective physician (surgeon/medical or radiation oncologist) after successful biliary drainage and normalization of bilirubin

**Respective contraindications, risks and precautions, pediatric dose of antibiotics to be considered before prescription

Patients with obstructive jaundice having no/ minimal IHBRD with distended GB may be considered for percutaneous cholecystostomy in emergent situations. Similarly, cholecystostomy may be a bridge to surgery in patients with pyocele/mucocele of GB

ABBREVIATIONS

ALP: Alkaline Transferase
ALT: Alanine Aminotransferase
AST: Aspartate Aminotransferase
CBC: Complete Blood Count (Hemogram)
CBD: Common Bile Duct
CECT: Contrast Enhanced Computed Tomography
ERCP: Endoscopic Retrograde Cholangiopancreatography
GB: Gall Bladder
GGT: Gamma Glutamyl Transferase
IHBRD: Intrahepatic Biliary Radicle Dilatation
IR: Interventional Radiology
KFT: Kidney Function Test
LFT: Liver Function Test
MRCP: Magnetic Resonance Cholangiopancreatography
NASH: Non Alcoholic Steatohepatitis
PT/INR: Prothrombin Time/International Normalized Ratio
PTBD: Percutaneous Transhepatic Biliary Drainage
SAP: Serum amyloid P
USG: Ultrasonography

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CHOLANGITIS IN OBSTRUCTIVE JAUNDICE NEEDS AN EARLY BILIARLY DRAINAGE

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July/ 2024

Department of Health Research
Ministry of Health and Family Welfare, Government of India

Standard Treatment Workflow (STW)

IMAGE GUIDED MANAGEMENT OF STROKE

ICD-10- I63.9

WHAT IS STROKE?
An episode of neurological dysfunction caused by focal cerebral, spinal or retinal infarction or haemorrhage

SYMPTOMS

Numbness or weakness especially on one side of the body	Loss of consciousness or altered consciousness	Decreased vision in one or both eyes	Language difficulties either in speaking or understanding	Difficulty in walking, loss of balance or coordination	
Confusion or loss of memory	Swallowing difficulties	Paralysis of any part of the body, including face	Sudden severe headache with no known cause	Neck pain	Nausea and vomiting

WARNING SIGN (BEFAST)

- **BALANCE**: Loss of balance or coordination
- **EYES**: Sudden blurred or double vision, sudden, persistent vision trouble
- **FACE**: Deviation at the angle of the mouth
- **ARM**: Arm drift
- **SPEECH**: Slurred speech or the inability to speak or understand
- **TIME**: Act fast
- Sudden new onset of headache or loss of consciousness
- Sudden giddiness, vomiting and imbalance

WARNING SIGN (FAST)

- **F**: stands for sudden numbness or weakness of FACE, especially on one side of the body
- **A**: stands for sudden numbness or weakness of ARM or LEG especially on one side of the body
- **S**: refers to difficulty in SPEECH and understanding
- **T**: is the TIME to rush to the hospital

TYPES OF STROKE

Ischemic stroke
Focal cerebral, spinal or retinal infarction

Intracerebral haemorrhage
Focal collection of blood within the brain parenchyma or ventricular system that is not caused by trauma

Subarachnoid haemorrhage
Bleeding into the subarachnoid space

Cerebral venous thrombosis of cerebral venous structure

Transient Ischemic Attack (TIA)
Transient episode of neurological dysfunction caused by focal cerebral, spinal cord or retinal ischemia without acute infarction

INVESTIGATIONS

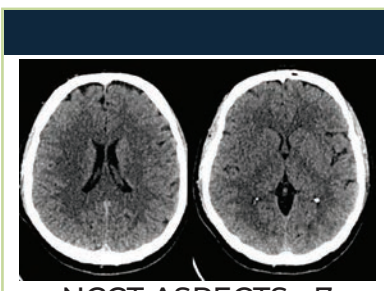
Essential
- CT scan head
- ECG
- Blood Sugar

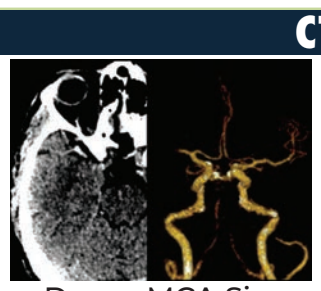
Desirable
- CTA
- Echocardiogram
- Lipids
- Renal Parameter

Optional
- MRI/MRA
- Holter Monitoring

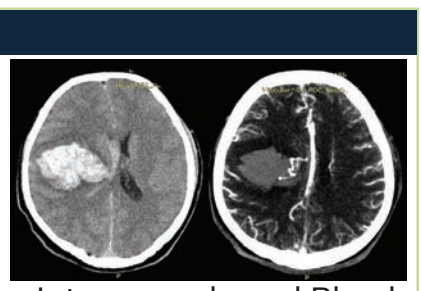
PRELIMINARY MANAGEMENT
- Assess and manage ABCs
- Initiate cardiac monitoring
- Maintain O2 saturation >94%
- Establish IV access
- Determine blood glucose and treat accordingly
- Determine time of symptom onset or last known normal, and obtain family contact information, preferably a cell phone
- Triage and RAPID TRANSFER of patient to nearest district hospital with CT
- Scan facility or Stroke center with facility for thrombolysis
- Referral hospital to be notified to handle the referred patient with stroke

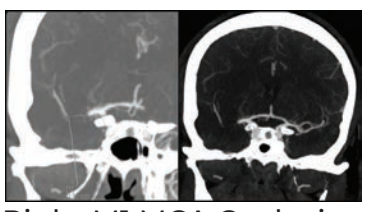
CT SCAN

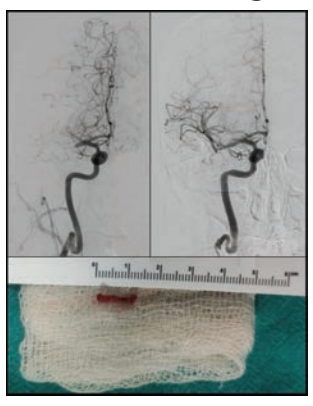

NCCT ASPECTS - 7

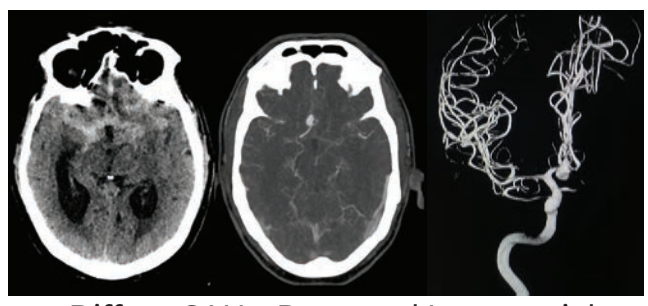

Dense MCA Sign

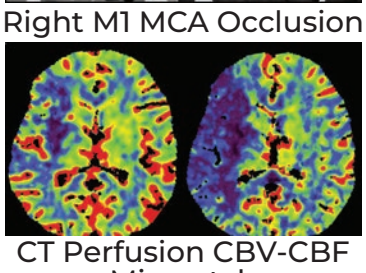

Gangliocapsular Bleed-Likely hypertensive bleed


Intraparenchymal Bleed associated with vascular malformation


Right M1 MCA Occlusion


Mechanical Thrombectomy with removal of clot


Diffuse SAH – Ruptured Intracranial Aneurysm


CT Perfusion CBV-CBF Mismatch

IMAGING- WHAT ALL WE WANT TO KNOW?
- Parenchyma-bleed vs. Ischemia, area involved
- Pipes- Occlusion?, location: 1. Large vessel occlusion vs. Distal branch occlusion
- Perfusion- collaterals? -Multiphase CT angiogram (3rd phase, predicts the outcome)
- Penumbra- Tissue at risk (salvageable tissue)

Assess the 4Ps of stroke as quickly as possible
Time Vs. Information

MANAGEMENT

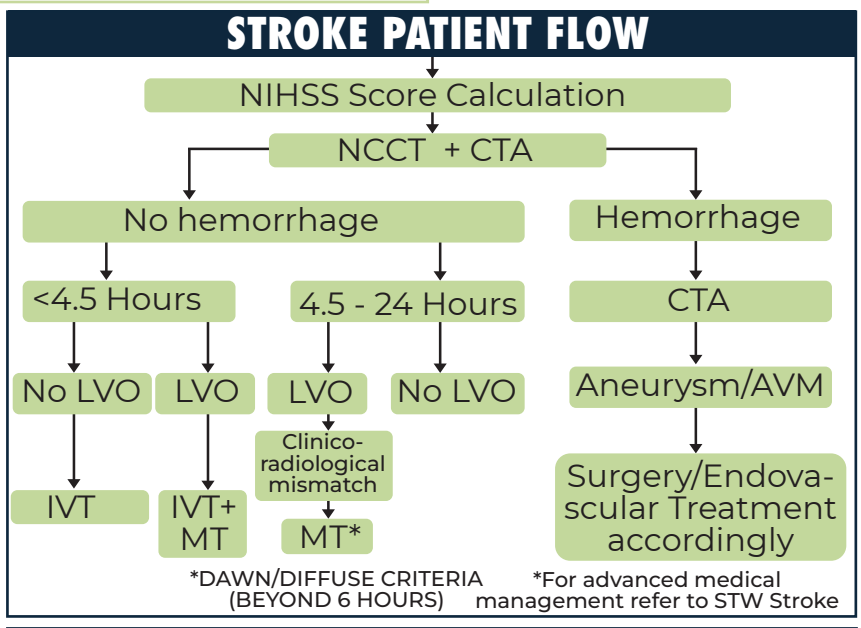
Stroke onset time < 4.5 hrs

ISCHEMIC
- IV tPA (0-4.5 Hrs) or endovascular treatment according to eligibility and availability (.9mg/kg/wt)
- 10% as bolus, remaining 90% as I/V infusion over an hour
- BP maintained below 180/110 mm/Hg

HAEMORRHAGIC
- Dysphagia assessment,
- Blood pressure/blood sugar monitoring and IV fluids.
- Prevention of pneumonia
- Prophylaxis for deep venous thrombosis etc, monitor and record ECG

Stroke onset time > 4.5 hrs
- Rapid Assessment, CODE Stroke, Blood pressure and Blood Sugar monitoring, NIHSS, Intravenous lines
- Endovascular treatment with Mechanical thrombectomy using stent retriever, aspiration, or hybrid techniques (4.5 hrs to 24hrs) according to eligibility

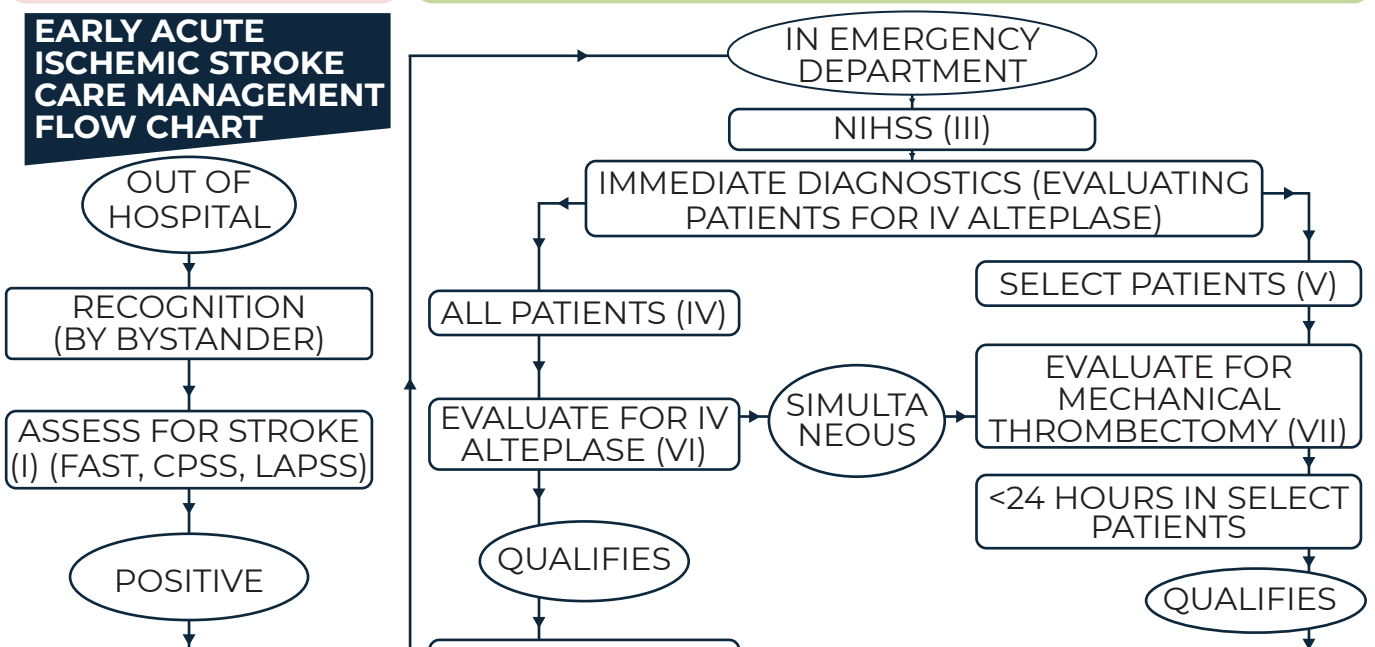
STROKE PATIENT FLOW



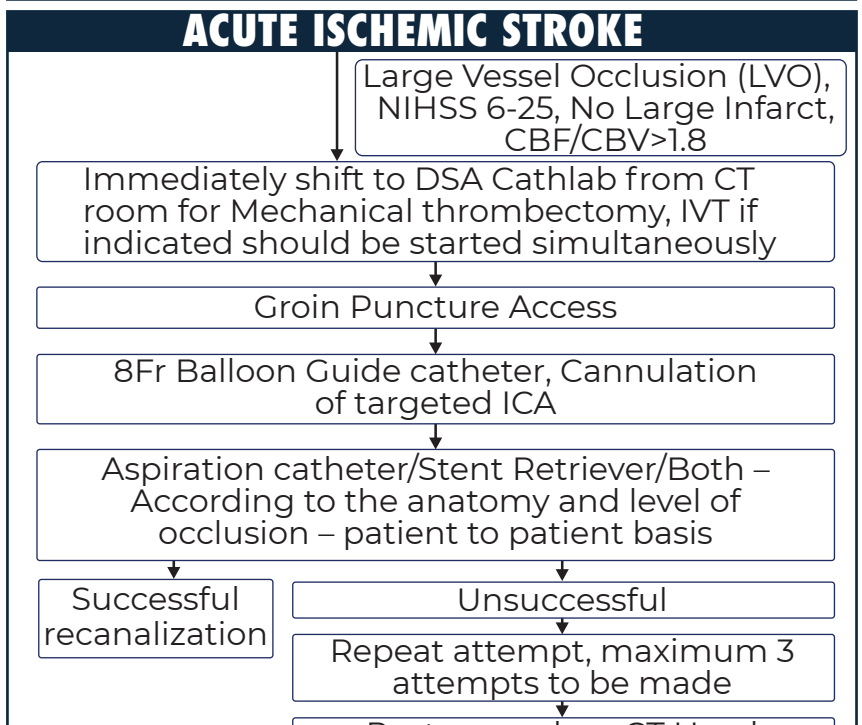
*DAWN/DIFFUSE CRITERIA (BEYOND 6 HOURS)

*For advanced medical management refer to STW Stroke

EARLY ACUTE ISCHEMIC STROKE CARE MANAGEMENT FLOW CHART



ACUTE ISCHEMIC STROKE



ABBREVIATIONS

AVM: Arterio-Venous Malformation
CBF: Cerebral Blood Flow
CBV: Cerebral Blood Volume
CPSS: Cincinnati Prehospital Stroke Scale
CT: Computed Tomography
CTA: CT Angiography
DSA: Digital Subtraction Angiography
ECG: Electrocardiogram
ICA: Internal Carotid Artery
ICU: Intensive Care Unit
IVT: Intravenous Thrombolysis
LAPSS: Los Angeles Prehospital Stroke Screen
MCA: Middle Cerebral Artery
MRA: MR Angiography
MRI: Magnetic Resonance Imaging
MT: Mechanical Thrombectomy
NCCT: Non-Contrast Computerized Tomography
NIHSS: National Institute Of Health Stroke Scale

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TIME IS BRAIN,SAVE NEURONS SAVE A LIFE

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Standard Treatment Workflow (STW)

IMAGE GUIDED MANAGEMENT OF VAGINAL BLEEDING

ICD-10-H90.5, 072,D25



HEAVY MENSTRUAL BLEEDING

Losing 80ml or more in each period, having periods that last longer than 7 days, or both

Uterus preserving treatment for two important causes of vaginal bleeding in women of reproductive age group

POST PARTUM HAEMORRHAGE

500ml after vaginal delivery or 1000ml after Cesarean section



SIGNS AND SYMPTOMS

Look for anaemia

- Primary PPH is within the first 24 hour of delivery and secondary PPH is more than 24 hour after delivery
- Prophylactic IR on patients with an increased risk of massive bleeding at delivery

- Hypotension to haemorrhagic shock and multi-organ failure depending on the quantum of bleeding
- Check for uterine contractility, retained placenta
- Abnormal placenta on imaging

INVESTIGATIONS

	ESSENTIAL	OPTIONAL
HEMATOLOGICAL	Hb, PT, INR, APTT and Platelet count	Thrombo-elastogram (TEG) or Rotational Thromboelastometry (ROTEM)
IMAGING	USG	MRI

MANAGEMENT

FIBROID MANAGEMENT

- **Medical:** NSAIDS, Tranexamic acid, combined oral contraceptive pills, progestogens
- **Interventional Radiology:** Uterine Artery Embolisation
- **Surgical:** Myomectomy or Hysterectomy

FIBROID: IR MANAGEMENT

Indications
- Fibroids with heavy menstrual cycles pain, pressure, and urinary symptoms

Contraindication:
- Suspected infection
- Approximate days of required hospitalisation: 1-3 days

PROCEDURAL DETAILS

- Under conscious sedation or anaesthesia
- Arterial access (femoral/radial)
- Selective internal iliac arterial angiograms and cannulation of hypertrophied (uterine) arteries
- Embolisaton with appropriate agent – PVA particles
- Check angiogram

- **Expected outcomes:** At 12 months, menorrhagia control in 90%–92% of patients and improvement in bulk symptoms in 88%–96%
- Associated adverse events/complications
  - Fibroid expulsion 5%
  - Ovarian failure with amenorrhoea 7.5% of patients, overwhelming majority in women > 45 years of age
  - Uterine sepsis requiring hysterectomy 0.1%
- After care
  - Pain management: NSAIDS and if required intravenous narcotics (Morphine sulfate 30 mg SC /IM/IV), hypogastric nerve block
- **Follow up:** after 3 months; clinical, Hb, USG

- Other image guided minimally invasive treatment for fibroid include HIFU and ablation
- Other gynaecological conditions like adenomyosis also can be managed similarly by UAE

PPH MANAGEMENT

- Medical: Intensive Care Support
  - Uterotonic drugs - Oxytocin infusion: 20 IU in 500 ml RL/NS @ 40-60 drops/ minute
  - Transfusion of blood products
  - Inotropes, ventilation and other organ support
- Interventional Radiology: Uterine Artery Embolisation
- Surgical: Bilateral internal iliac artery ligation or Hysterectomy

PPH: IR MANAGEMENT

Indications
- Uterine atony despite medical treatment
- Vaginal or cervical tear after failed surgical repair
- Persistent hemorrhage after arterial ligation or hysterectomy
- Placenta accreta – including prophylactic treatment

Contraindication:
- Nil; but risk of acute kidney injury to be considered
- Approximate days of required hospitalisation: 2 to 7 days

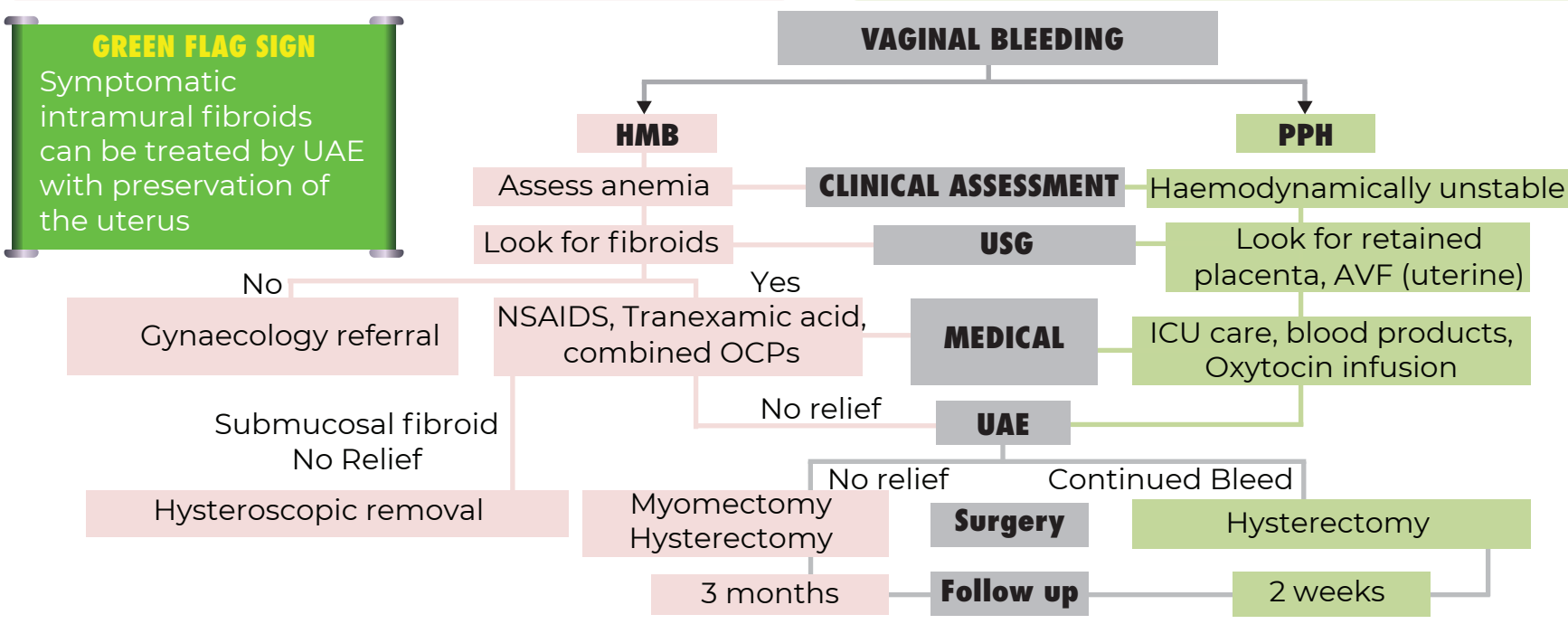
Procedural details
- Under conscious sedation or anaesthesia
- Arterial access (femoral/radial)
- Selective internal iliac arterial angiograms and cannulation of hypertrophied (uterine) arteries
- Embolisaton with appropriate agents – PVA particles, gel foam, histoacryl etc.
- Check angiogram

For patients with placenta accreta
- Prophylactic balloon catheter placement of internal iliac arteries before delivery/caesarean section

- Expected outcomes: successful haemostasis > 95%
- Associated adverse events/complications: ovarian failure, uterine sepsis, uterine infarctions (rare; less than 2%)
- After care
  - **Medical:** ICU care till bleeding arrests and organ failures are reversed
  - **Investigation:** USG
  - **Criteria and timing for safe discharge:** 3 days after the procedure if uneventful
- Follow up: after two weeks; Clinical, Hb, USG

- Other obstetric conditions like post-abortive haemorrhage secondary to uterine artery pseudoaneurysm, complications of molar regnancy, uterine arteriovenous malformation (AVM) can also be treated similarly

GREEN FLAG SIGN
Symptomatic intramural fibroids can be treated by UAE with preservation of the uterus



RED FLAG SIGN
- PR > 120/min
- Systolic BP < 100 Mm Hg
- Tachypnoea >20 breaths per minute
- SpO2 < 95%
- Deterioration of sensorium

Refer to uterine fibroids and polyps ICD-10-D25 & N84
Refer to Postpartum hemorrhage ICD-72

Timely referral to a higher centre must be considered where facilities for ICU, surgical and IR are available

CONCLUSION

- Uterine artery embolization is a minimally invasive image guided procedure which has an important role in management of select cases of obstetric and gynecological conditions
- It is a uterus preserving procedure
- It has evolving role in case of uterine malignancies

ABBREVIATIONS

APTT: Activated Partial Thromboplastin Time
AVF: Arteriovenous Fistula (uterine)
CECT: Contrast Enhanced Computed Tomography
Hb: Haemoglobin
HIFU: High Frequency Focussed Ultrasound
HMB: Heavy Menstrual Bleeding
ICU: Intensive Care Unit
INR: International Normalized Ratio
IR: Interventional Radiology
MRI: Magnetic Resonance Imaging
NSAIDs: Non-steroidal anti-inflammatory Drugs
OCPs: Oral Contraceptive Pills
PPH: Postpartum Haemorrhage
PT: Prothrombin Time
PVA: Poly Vinyl Alcohol
UAE: Uterine Arterial Embolization
USG: Ultrasonography
VB: Vaginal Bleeding

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KEEP A HIGH THRESHOLD FOR INVASIVE PROCEDURES

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Standard Treatment Workflow (STW)

IMAGE GUIDED MANAGEMENT OF VARICOSE VEINS (CHRONIC VENOUS INSUFFICIENCY)

ICD-10-I83. 89



CLINICAL PRESENTATION

SYMPTOMS
- Heaviness/tiredness/aching of the legs
- Itching in legs
- Nocturnal cramps in calf
- Swelling around ankle
- Symptoms worsened after prolonged standing
- Skin discoloration near the ankles
- Abnormal dilated veins in leg
- Bleeding from varicosities in leg
- Non healing leg ulcer

SIGNS (CEAP- CLASSIFICATION)
C1: Telangiectasias or reticular veins
C2: Varicose veins
C3: Edema
C4a: Pigmentation or eczema
C4b: Lipodermatosclerosis or atrophie blanche
C5: Healed venous ulcer
C6: Active venous ulcer

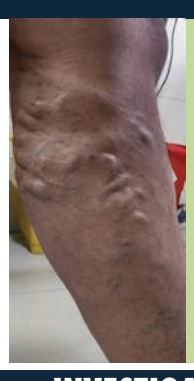
RED FLAGS
- Bleeding from superficial veins
- Venous ulcer
- Recurrent history of superficial vein thrombophlebitis /Cellulitis

CEAP- Classification C1

TELANGIECTASIAS	RETICULAR VEINS
 Intradermal spider veins (web-like), <1mm	 Subdermal reticular veins, <3mm

CEAP- CLASSIFICATION C2


Great Saphenous vein with pronounced chronic venous insufficiency in medial ankle area


Circumflex vein: Lateral branch of the greater saphenous vein


Small saphenous vein varicosis

CEAP- C3	CEAP-C4	CEAP-C6, C5= Healed ulcer
		

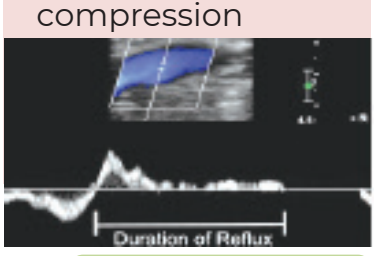
INVESTIGATIONS

ESSENTIAL

Imaging →	USG color doppler
Hematological useful for prior to ablation →	• CBC • PT/INR • APTT • HBs Ag • HIV • KFT • HCV

If there is proximal obstruction in common iliac vein, CTV or MRV is needed

USG COLOR DOPPLER
- Rule out DVT/Deep vein reflux
- Doppler evaluation in standing
- Define and grade reflux at SFJ/SPJ
- Identify segmental intrinsic reflux in GSV/SSV
- Locate incompetent/ pathological perforators
- Diameter of GSV
- Evaluate truncal and superficial vein varicosities and dilated tributaries
- Incompetent SFJ - retrograde reflux venous flow lasting more than 0.5 sec
- Abnormal GSV - ≥ 4 mm on standing
- Incompetent perforator - ≥ 3.5 mm/ reflux on release of distal compression



ALGORITHM FOR DIAGNOSIS, REFERRAL AND MANAGEMENT

PHC
Signs and symptoms of varicose veins

→ Refer to higher centre

CHC/DISTRICT HOSPITAL
- Clinical examination,
- USG Color Doppler
- Exclude DVT/Deep vein reflux

In appropriate imaging setting

Symtomatic patient with Red flag sign (Bleeding, Venous ulcer) →

TERTIARY CARE
- Clinical examination, USG color doppler
- Endovenous thermal ablation
- Adjuvant medical management

MANAGEMENT

MEDICAL/ CONSERVATIVE
- Mostly adjuvant to endovenous thermal ablation.
- Life style modification
- Graded compression stockings
- Limb elevation, Limb massage, calf pumping exercise
- Micronized purified flavonoid fraction (MPFF)
- Wound care – Unna boots, hydrocolloid dressing, silver coated dressing

SURGICAL
- Limited role
- Subfascial Endoscopic Perforator Surgery
- Phlebectomy

IMAGE GUIDED THERAPY
- Primary modality of treating varicose veins
- Percutaneous endovenous Thermal Ablation Therapy: laser/RFA
- Percutaneous endovenous Non-thermal Ablation Therapy: MOCA/Glue/ catheter guided sclerotherapy
- Percutaneous ablation of Perforators – Laser/RFA
- Percutaneous Guided Sclerotherapy .

CONTRAINDICATION
- Absolute contraindication-
  - Reflux in deep veins
- Relative contraindications-
  - Severe peripheral artery disease
  - Severe hypercoagulability syndromes
  - Advanced liver disease
  - Serious systemic disease

VARICOSE VEINS: IR MANAGEMENT
Procedural details:
- Performed in IR suite
- Under conscious sedation or spinal anaesthesia or local anaesthesia
- Sterile precautions
- Percutaneous GSV access
- Perivenular anaesthesia
- Thermal ablation about 2 cm from SFJ unction
- Management of pathological perforator, SSV, accessory GSV, tributaries and superficial vein as and when required

RECOMMENDATION
- For treatment of GSV reflux in patient with symptoms and sign of chronic venous disease endovenous thermal ablation technique is recommended in preference to surgery and foam sclerotherapy
- For treatment of SSV reflux in patient with symptoms and sign of chronic venous disease endovenous thermal ablation technique should be considered. Access to SSV should be gained no lower than midcalf
- Foam sclerotherapy should be considered as primary treatment in patient with recurrent varicose veins
- When performing endovenous thermal ablation for saphenous reflux trunk, adding concomitant phlebectomy should be considered

MANAGEMENT ALGORITHM: VARICOSE VEINS

C1-C2 GRADE VARICOSE VEINS	C1-C2 GRADE VARICOSE VEINS	C3=-C6 GRADE VARICOSE VEINS
USG COLOR DOPPLER - Competent SFJ - Mild reflux grade I	**USG COLOR DOPPLER** - Grade II/III/IV reflux - Saphenous incompetence	**USG COLOR DOPPLER** - Grade II/III/IV reflux - Saphenous/ Tributary incompetence
Medical Management/ Conservative treatment	Endovenous thermal/ Non-thermal ablation	Endovenous thermal/ non-thermal ablation plus management of perforator, Sclerotherapy, phlebectomy whenever needed

MANAGEMENT OF RED FLAG SIGN
Bleeding from superficial varicose veins: Leg elevation higher than the heart. Application of pressure over the bleeding site followed by a pressure dressing
Referred to tertiary centre for endovenous ablation treatment

VENOUS ULCER
- Wound care/Dressing
- Compression Therapy
- Leg elevation

Referred to tertiary centre for endovenous ablation treatment

ABBREVIATIONS

APTT: Activated Partial Thromboplastin Time
CTV: Computed Tomography Venography
DVT: Deep Vein Thrombosis
GSV: Great Sephanous Vein
Hb: Haemoglobin
HCV: Hepatitis c Virus
INR: International Normalized Ratio
IR: Interventional Radiology
KFT: Kidney Function Test
MOCA: Mechanical Occlusion Chemically Assisted Ablation
MRV: Magnetic Resonance Venography
PT: Prothrombin Time
RFA: Radio-frequency Ablation
SPJ: Sapheno-popliteal junction
SFJ: Sapheno-Femoral Junction
SSV: Short Sephanous Vein
USG: ULTrasonography

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SAVE LIMBS SAVE LIFE

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NEUROSURGERY

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Standard Treatment Workflow

SUSPECTED BRAIN TUMORS

ICD-C71, D33

DEMOGRAPHICS

Brain tumors are seen with equal frequency in males and females

Astrocytoma is the commonest brain tumor in children followed by embryonal tumor

Meningioma is the commonest tumor in adults followed by glioma

CLINICAL PRESENTATION OF BRAIN TUMORS

SYMPTOMS

- Recent onset headache, with or without vomiting
- Gradual vision loss (unilateral/ bilateral)
- Seizures
- Cranial nerve deficits (eg. hearing loss)
- Focal deficit like monoparesis, hemiparesis
- Increasing head-size (children with open fontanalle)

HIGH INDEX OF SUSPICION FOR BRAIN TUMOR WHEN PATIENT HAS:

- Adult onset seizures
- Progressive symptoms
- Focal neurological deficits
- Severe headache
- Recurrent vomitings
- Blurring of vision
- Drowsy or altered sensorium
- Recurrent seizures
- Pupillary asymmetry – Anisocoria
- Abnormal posturing
- Respiratory distress , abnormal breathing patterns
- Bradycardia and hypertension

IF RED FLAG SIGNS PRESENT

- Give Inj Dexa 4mg IV
- Loading dose of antiepileptic to prevent seizure
- 200ml (to adult patients or as per weight to children) 20% mannitol IV over 30 minutes (only if systolic BP > 90 mmHg) and refer to higher centre immediately after stabilisation of ABC

AT PHC LEVEL

Seizures → Metabolic workup (including Serum sodium, Blood sugar)

Headache, vomiting → Metabolic workup (including Serum sodium, Blood sugar)

- Focal deficit (monoparesis/ hemiparesis)
- Vision loss
- Cranial nerve deficit → Metabolic workup (including Serum sodium, Blood sugar)

Metabolic workup (including Serum sodium, Blood sugar) → Refer to higher centre for CT Scan

- Phenytoinization (if seizures are present),
- Airway protection (If patient has altered sensorium)

AT CENTRE WITH MRI SCAN FACILITY & NEUROSURGERY

MRI SCAN

- Negative → Medical management
- Positive → Refer to higher centre for further workup (Medical College / Cancer Hospital, with neurosurgery and MRI Scan facility



MRI image of Meningioma



MRI image of Glioblastoma

MEDICAL COLLEGE/CANCER HOSPITAL WITH NEUROSURGERY AND MRI SCAN FACILITY

GENERAL PRINCIPLES OF MANAGEMENT

- No surgery needed → Follow-up
- Surgery → Possible here
- Surgery → Not possible here → Higher centre
- Radiosurgery → Available
- Radiosurgery → Not Available → Higher centre

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Standard Treatment Workflow

HEAD INJURY

ICD-S09.90XA

CLINICAL PRESENTATION

SYMPTOMS

Headache/vomiting	Seizures
Brief or persistent loss of consciousness (LOC)	Local signs of scalp hematoma/ laceration
Confusion/amnesia/ inability to remember events related to trauma	Blood/ blood stained/ clear watery fluid leak from nose/ear

RED FLAG SIGNS:
- Unconscious
- Irregular respiration
- Pupil size asymmetric

IF RED FLAG SIGNS PRESENT:
- Give 200ml (to adult patients or as per weight to children) 20% mannitol IV over 30 minutes (only if systolic BP > 90 mmHg) and refer to higher centre immediately after stabilisation of ABC

PREHOSPITAL CARE OF HEAD INJURY
- Golden hour of head injury management: ABC as in trauma guidelines
- Look for associated injuries to pelvis/long bones/chest/abdomen
- Any external bleeding controlled with local pressure
- All suspected head injury cases: shift to higher centre (where CT SCAN and neurosurgeon are available)
- Transfer only when ABC are stable

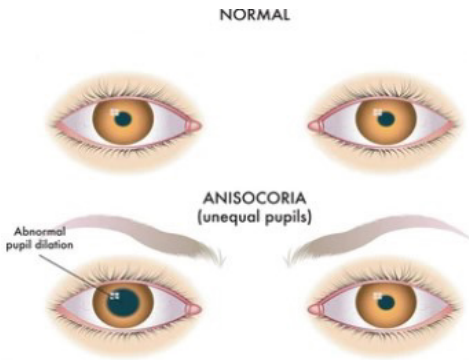
NEUROLOGICAL ASSESSMENT

GLASGOW COMA SCORE (GCS) TO QUANTIFY SEVERITY OF HEAD INJURY

ASSESSMENT DOMAIN	SCORE
Eye opening (E)	
Spontaneous	4
To speech	3
To pain	2
None	1
Verbal response (V)	
Oriented	5
Confused conversation	4
Inappropriate words	3
Incomprehensible sounds	2
None	1
Best motor response (M)	
Obeys commands	6
Localizes pain	5
Flexion withdrawal to pain	4
Abnormal flexion (decorticate)	3
Extension (decerebrate)	2
None (flaccid)	1

SCORING & INTERPRETATION OF SEVERITY
- GCS Score = (E[4] + V[5] + M[6])
- Score range: 3 to 15
- Mild = GCS 13-15, Moderate = GCS 9-12, Severe = GCS 3-8

NOTE PUPILS: SIZE / SHAPE / REACTION / SYMMETRY
LOOK FOR SYMMETRY OF MOTOR RESPONSE



ELICITING MOTOR RESPONSE TO PAINFUL STIMULI

IRREGULAR RESPIRATION
- Labored breathing
- Accessory muscles of respiration active

INVESTIGATIONS

ESSENTIAL
- Chest X ray
- Ultrasound abdomen and chest to rule out abdominal free fluid/hemothorax
- NCCT Head with Cervical Spine as soon as possible in all head injury patients
- Definite indication for CT SCAN if any of the following are present
  - GCS <15
  - Transient loss of consciousness
  - Suspected skull fracture
  - Post traumatic seizure
  - Focal neurological deficit
  - Persistent vomiting
  - Amnesia

DESIRABLE:
- X rays long bone and pelvis (if indicated)

OPTIONAL:
- Blood alcohol levels
- Plain MRI brain for prognostication (not in acute cases)
- Biomarkers like serum S100b

MANAGEMENT AT HIGHER CENTRE WITH CT SCAN & NEUROSURGEON

MILD HEAD INJURY (GCS: 13 - 15)

- History
- General examination
- Neurological examination
- Skull X-Ray
- Cervical spine X-Ray
- Blood alcohol levels

CT HEAD- Ideally in all except completely asymptomatic pts

ADMIT
- Amnesia
- H/o LOC
- Deteriorating consciousness
- Moderate-severe headache
- Alcohol/drug intoxication
- Skull fracture
- Associated injury
- Abnormal CT SCAN

DISCHARGE
- Does not meet criterion for admission
- Discuss need to return if problem persists

MODERATE HEAD INJURY (GCS: 9 - 12)

- Initial Assessment
- CT SCAN IN ALL CASES

Admit even if CT is normal

Frequent neurological examinations
Follow up
CT SCAN if deteriorates/before discharge

If patient Improves
Discharge when stable

If patient deteriorates
Repeat CT SCAN
Manage as per severe HI

SEVERE HEAD INJURY (GCS: 3 - 8)

Intubate, Sedate, Resuscitate

CT SCAN → Not available → Refer to higher centre if < 2 hrs

Diffuse lesion → ICU

Surgical Lesion (decompressive craniectomy)

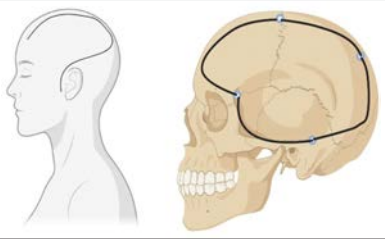
- Monitor ICP
- Elevate Head end
- Sedate
- Maintain PaO_2 100 mmHg
- Maintain $PaCO_2$ 30-32 mmHg

ICP still high → Treat ICP

MEDICAL MANAGEMENT
- **Treatment of high intracranial pressure**
  - Sedation, analgesia and mild to moderate hyperventilation ($PaCO_2$ 30–35 mmHg)
  - Osmotic therapy: mannitol: 0.25 - 1.00 g/kg IV bolus or 3ml/kg 3% hypertonic saline 8 hourly
- **Antiepileptic drugs**
  - Phenytoin (20mg/kg over 30 min IV, followed by 5mg/kg in 2-3 divided doses)
  - Levetiracetam (500 mg BD, continue for 1-3 months)
  - Prophylaxis - if seizure free for 6 months
  - Therapeutic - if seizure free for 2 years after receiving drug therapy, consider tapering/ discontinue antiepileptic
  - Consult neurosurgeon/neurologist before stopping
- **Steroids NOT useful in Head Injury**

SURGICAL MANAGEMENT IN HEAD INJURY IF
- Extradural hematoma > 30cc in volume
- Subdural hematoma > 10mm thick with midline shift > 5 mm and evidence of deterioration in clinical neurology/change in pupillary size
- Most common operation done is decompressive craniotomy with hematoma evacuation and/ or removal of large bone flap (15x12cm). To be done by neurosurgeon only

REMOVAL OF LARGE BONE FLAP (15CM X12 CM) BY A NEUROSURGEON (DECOMPRESSIVE CRANIECTOMY) IS THE MOST COMMON SURGICAL PROCEDURE DONE



COMPLICATIONS TO WATCH FOR
- Deterioration of GCS score
- New onset or worsening focal neurological deficit
- Persistent headache, vomiting, or restlessness
- Bradycardia, hypertension
- Abnormal initial CT SCAN (repeat at 24 hours or earlier if indicated)

ABBREVIATIONS

CT : Computed Tomography
ICP : Intracranial Pressure
ICU : Intensive Care Unit
MRI : Magnetic Resonance Imaging
NCCT : Non-contrast Computerized Tomography

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KEEP A HIGH THRESHOLD FOR INVASIVE PROCEDURES

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July/ 2024

Department of Health Research
Ministry of Health and Family Welfare, Government of India

Standard Treatment Workflow

SPINAL INJURY

ICD-S14.109A

DEFINITION

- **Injury to any of the following**
  -Vertebral Column and it's adnexae (disc, ligaments, facets etc)
  -Spinal cord (Partial/ Complete)
  -Cauda Equina and nerve roots
- **Acute <3 weeks**
- **Subacute 3 weeks - 3 months**
- **Chronic >3 months**

WHEN TO SUSPECT

- Always rule out spine injury in patients with poly-trauma, especially if unconscious
- Ascertain pain in the neck, back or limbs
- Rapid sensorimotor examination- ability to move fingers, hands, elbows, shoulders, hips, knees, ankles, toes
- Priapism (in unconscious/unresponsive)

CLINICAL PRESENTATION

SYMPTOMS:
- Pain (neck or back)
- Inability to move the limbs
- Numbness
- Breathing difficulty
- Inability to void and defecate

SIGNS:

Local-
- Deformity (swelling, gibbus)
- Bruising
- Open wound over spine
- Tenderness over spine

Systemic-
- Bradycardia with hypotension
- Sensorimotor deficit in arms, legs
- Labored breathing
- Priapism

PRIMARY CARE	SECONDARY CARE	TERTIARY CARE
GOALS	**GOALS**	**GOALS**
• Identify/suspect • Immobilise • Refer to higher center	Where General/Orthopaedic surgeon or Neuro surgeon {trained in spine} available • Imaging: X ray/ CT SCAN • Determine neurological status • Develop treatment plan	• Imaging: x-ray/CT SCAN/MRI • Surgery/ Conservative management • Rehabilitation
MANAGEMENT	**MANAGEMENT**	**MANAGEMENT**
• ATLS protocol (Airway-breathing-circulation-disability-exposure) • Intubate/ventilate with C spine control • IV Line Ringer Lactate; collect blood for grouping and cross matching; catheterise • Log roll and inspect neck and back for bruise, deformity, tenderness • Immobilise with ambulance man's collar/ philadelphia collar/spine board/sand bags • Manage pain with morphine/pethidine or unless contraindicated • Transfer to higher centre	• Secondary survey as per ATLS protocol • Conscious/ unconscious • Log roll and examine cervical, thoracic, lumbar, sacral spine • Detailed neurological examination (Frankel scale) and document (Appendix I) • Associated injuries • Imaging (appropriate X rays, CT whole spine scans/MRI if available) • TLICS/SLIC scoring (Appendix II/ III) – • surgery: indicated/doubtful – refer; • conservative: brace • MPSS in selected cases (Appendix IV) • Apply collar/skull traction/halo vest, brace or spine board to transfer	• Detailed neurological evaluation (ASIA scale) • Imaging (X Ray, CT, MRI) • Classify spinal injury and score • TLICS/SLIC <4 conservative management; >5 surgery; 4-case based • MPSS as indicated • DVT prophylaxis as indicated (Appendix V) • Surgery as indicated (decompression/ stabilisation) • Conservative care-skull traction, halo vest, SOMI brace, TLSO brace • Rehabilitation

APPENDIX 1: FRANKEL SCALE

- Grade A: Complete neurological injury - No motor or sensory function detected below level of lesion
- Grade B: Preserved sensation only - No motor function detected below level of lesion, some sensory function below level of lesion preserved
- Grade C: Preserved motor, nonfunctional - Some voluntary motor function preserved below level of lesion but too weak to serve any useful purpose
- Grade D: Preserved motor, Functionally useful voluntary motor function below level of injury
- Grade E: Normal motor function - Normal motor and sensory function below level of lesion, abnormal reflexes may persist

APPENDIX II: TLICS SCORE

Table 1
The TLICS with its subcategories and scoring

Injury Category	Point Value
Injury Morphology	
Compression fracture	1
Burst fracture	2
Translation or rotation	3
Distraction	4
PLC Status posterior ligamentous complex	
Intact	0
Injury suspected or indeterminate	2
Injured	3
Neurological Status	
Intact	0
Nerve root involvement	2
Spinal cord or conus medullaris injury	
Incomplete cord injury	3
Complete cord injury	2
Cauda equina syndrome	3
Non operative	<4
Equivocal	4
Operative	>4

APPENDIX III: SLIC SCORE

Characteristics	Points
Injury Morphology	
No abnormality	0
Compression fracture	1
Burst fracture	2
Distraction	3
Translation/rotation	4
Integrity of the disco-ligamentous complex	
Intact	0
Indeterminate	1
Disrupted	2
Neurological Status	
Intact	0
Nerve root injury	1
Complete cord injury	2
Incomplete cord injury	3
Persistent cord compression	+1
Non operative	<4
Equivocal	4
Operative	>4

APPENDIX IV: MPSS GUIDELINES (MODERATE EVIDENCE AND WEAK RECOMMENDATION)

- Methyl Prednisolone Sodium Succinate: 30mg/kg bolus and 5.4mg/Kg/hr x 23 hours
- Role of MPSS:
  - May consider but be aware of the complications of high dose of steroids
  - Acute spinal cord injury less than 8 hours, incomplete neurology: consider
  - Acute spinal cord injury more than 8 hours, incomplete/complete cord injury neurology : no role
  - Acute spinal cord injury less than 8 hours, complete neurology: no role
  - Acute spinal cord injury with thoracic/abdominal visceral injury: contraindicated

APPENDIX V: DVT PROPHYLAXIS

- All neurologically compromised (non-ambulatory) patients within 72 hours must receive DVT prophylaxis.
- Subcutaneous LMW Heparin/ fixed low dose unfractionated heparin
- No adjusted dose unfractionated heparin
- Duration 8-12 weeks depending on risk factors

ANCILLARY PROCEDURES

- Goal MAP ≥ 85 mmHg for blunt/incomplete penetrating injury
- Goal MAP ≥ 65 mmHg for complete penetrating injury
- Nor-epinephrine IV infusion (0.1- 0.5 mcg/kg/min)
- Early neurosurgical decompression of acute spinal cord compression (< 72 hours) is recommended
- Consider early tracheostomy (< 7 days) in high cervical injury (C1-C5) patients

ABBREVIATIONS

ATLS : Advanced Trauma Life Support
CT : Computed Tomography
DVT : Deep Vein Thrombosis
LMW : Low Molecular Weight Heparin
MAP : Mean Arterial Pressure
MRI : Magnetic Resonance Imaging
SLIC : Subaxial Injury Classification
SOMI : Sternal Occipital Mandibular Immobilizer
TLICS : Thoracolumbar Injury Classification and Severity
TLSO : Thoracic-Lumbar-Sacral Orthosis

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ORTHOPAEDICS

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Standard Treatment Workflow (STW)

ANKLE FRACTURES

ICD-10-S82



DEFINITION

Classically called the 'Malleolar fractures', these are fractures of distal tibia/fibula or both

MECHANISM OF INJURY

- High-energy trauma in young patients (RTA)
- Low-energy twisting injuries in elderly

Management of patient as per ATLS protocols

Presentation:

- Pain, swelling, deformity at the ankle

PHYSICAL EXAM

Inspect

- Look circumferentially to rule-out an open fracture

Palpate

- Tenderness at the ankle
- Rule out compartment syndrome when pain + on passive stretching of toes

Assess

- Any differences in pulse examination between extremities – Suspected vascular injury
- Inability to move toes actively – Suspected Tendon injury/nerve injury
- Dislocated ankle

→ A. Airway and cervical spine
B. Breathing and ventilation
C. Circulation and haemmorhage control
D. Disability and neurological status
E. Exposure and environment control

→ Open fracture STW

→ Fasciotomy and external fixator application

→ Urgent reduction and immobilization

INVESTIGATIONS

RADIOGRAPHS

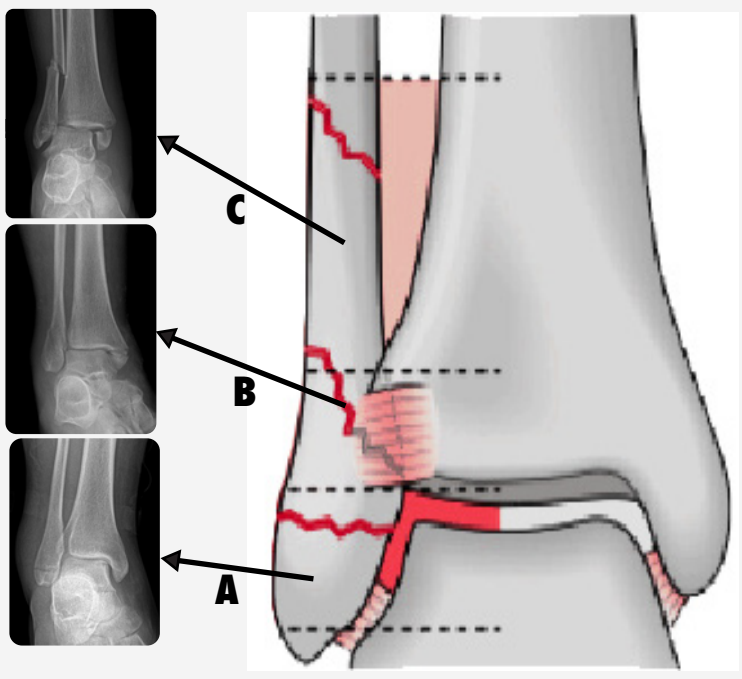
- AP View (up to knee joint to look for high fibula fractures)
- Lateral View
- Mortise view
- Stress views - Weight-bearing and external rotation stress views in suspected syndesmotic injuries

CT SCAN (DESIRABLE)

- Detailed assessment of fracture patho-anatomy
  - To look for suspected posterior malleolar fracture
  - To look for impaction
- Preoperative planning for operative approaches and fixation techniques

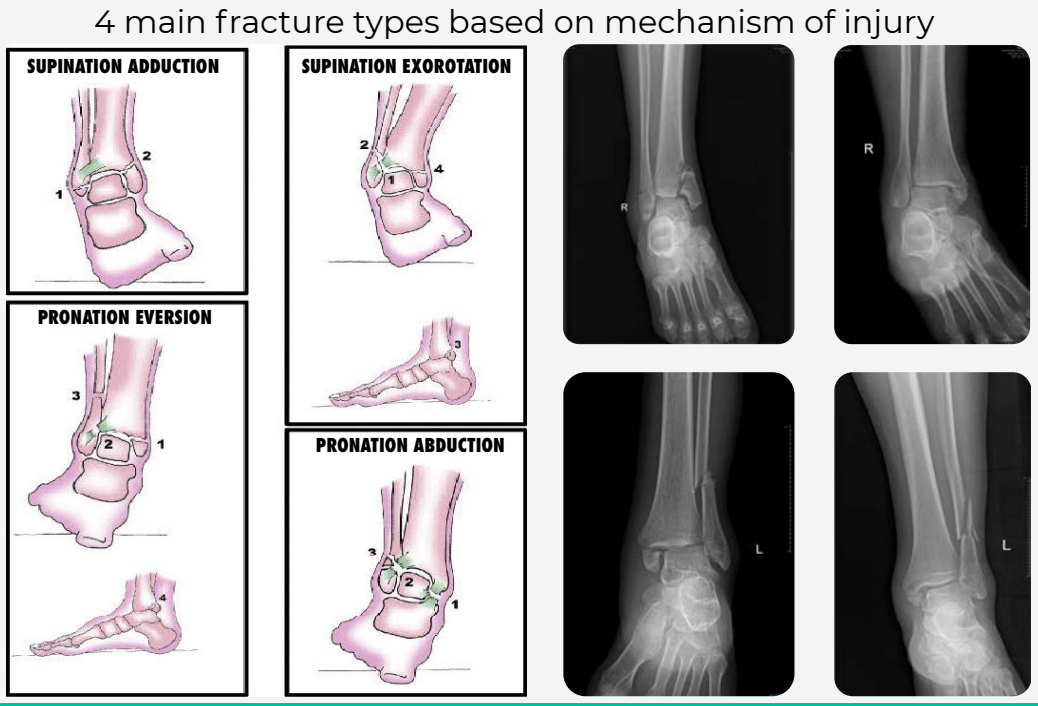
CLASSIFICATION

WEBERS CLASSIFICATION



LAUGE HANSEN CLASSIFICATION

4 main fracture types based on mechanism of injury



MANAGEMENT

GOALS OF TREATMENT

Restoration of joint stability

- Anatomical reduction of the articular surface
- Maintenance of ankle joint and medial clear space
- Assess and manage the syndesmotic joint

IMPLANT OPTIONS

Choice of implant is related to

- Fracture pattern
- Degree of displacement
- Familiarity of surgeon

Fibula (Lateral malleolus)

- Anti-glide plating
- Anatomical locking plates
- Screw/K-wire/TENS

Medial Malleolus

- Screws – ensure proximity to strong bone tibia plafond
- Tension band wiring
- Anti-glide plating (SAD injury)

Posterior malleolus

- Cancellous cannulated screws
- Buttress plating

Syndesmosis

- Screws
- Tightrope

Ankle spanning Ex-fix – for temporary splintage

Open fractures

Waiting for soft tissues to settle until definitive surgery

Ankle fracture → **At primary centre** → ATLS management
Limb elevation/ice packs/splintage

At secondary centre

- Active bleed
- Suspected compartment syndrome
- Open fracture
- Simple fracture

→ **Refer to secondary centre**

- Stop the bleed
- Debride for open fracture
- Fasciotomy if warranted for impending compartment syndrome
- External fixator application
- CT scan for detailed assessment

- Vascular injury
- Complex fracture dislocation
- Multi system injury
- Tendon injury

→ **Refer to tertiary centre**

At tertiary centre

- B/K Slab/Cast for stable syndesmotic/infrasyndesmotic injuries
- Open reduction internal fixation for simple fractures

- If final fixation not possible
- Complex fracture dislocation
- Vascular repair warranted
- Multi-system injury
- Tendon injury

→ **Refer to tertiary centre**

- HDU/ICU management for multi-system injury
- Fasciotomy if required
- Vascular repair

Final fixation once swelling subsides/ blisters resolve/patient physiologically fit

Ankle fracture
→ X-Ray

Ankle dislocated → Closed Reduction, check X-ray → Assess need for external fixator – Skin condition/ swelling/blisters/compartment syndrome

No dislocation → Unstable fracture → Assess need for external fixator – Skin condition/ swelling/blisters/compartment syndrome

Open reduction internal fixation should be performed only after appearance of "wrinkle sign"

Open reduction & internal fixation after CT scan

- Isolated Medial/Lateral malleolar fractures → Single approach MM-Antero-medial with screws LM - Lateral approach with antiglide plate/anatomical plate
- Bimalleolar fractures → Dual approach Fix simple fracture first (Usually fibula) Fix the second fracture (MM) **check syndesmotic stability** If unstable – Fix with screws (2 preferable)/tightrope
- Trimalleolar fracture

Plan approach after CT assessment
Dual approach
Try to fix – 2 malleoli (LM + PM/MM + PM) from a single approach as per surgeon comfort, third malleolus by another approach

Non weight bearing mobilisation and exercises should be initiated early. Hip, knee, toes ROM during cast application and ankle ROM after removal of plaster

Stable fracture (Syndesmosis intact Medial joint space maintained in stress views) → B/K Slab

Review in out patient department at 5-7 days

Re-assess the fracture reduction whether satisfactory
- No → Open reduction & internal fixation after CT scan
- Yes → Convert to cast and keep for 6 weeks

ABBREVIATIONS

AP: Antero-posterior
ATLS: Advanced Trauma Life Support
HDU: High Dependency Unit
ICU: Intensive Care Unit
LM: Lateral malleolus
MM: Medial Malleolar
PM: Posterior Malleolus
ROM: Range of Motion
RTA: Road Traffic Accident
SAD: Supination Addiction
TENS: Titanium Elastic Nail System

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☛ TIMELY REFERRAL AS PER RESOURCE SETTING

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Standard Treatment Workflow (STW)

DISTAL FEMUR FRACTURES

ICD-10-S72.402A

DEFINITION

A break in the metaphyseal-diaphyseal junction of the femur and/or involving articular surface of the knee

MECHANISM OF INJURY

- High-energy trauma in young patients (RTA)
- Low-energy fragility fracture in elderly

Management of patient as per ATLS protocols

Presentation:

- Pain, swelling, deformity above the knee joint

Physical Exam

- Inspect
  - Look circumferentially to rule-out an open fracture
- Palpate
  - Tenderness at the distal thigh
  - Rule out compartment syndrome when pain on passive stretching of toes
- Assess
  - Any differences in pulse between extremities - vascular injury
  - Look for associated injuries (especially floating knee)

A. Airway and cervical spine
B. Breathing and ventilation
C. Circulation and Hemmorhage control
D. Disability and Neurological status
E. Exposure and Environment control

Open fracture STW

Fasciotomy and external fixator application

INVESTIGATIONS

RADIOGRAPHS

- AP View
- Lateral View - Look for coronal plane fractures (Hoffa's fracture)

CT SCANS

- Detailed assessment of fracture pathoanatomy - intra-articular and Hoffa component especially(Type B & C).Desirable -3D Reconstruction.
- Preoperative planning for operative approaches and fixation techniques

CLASSIFICATION

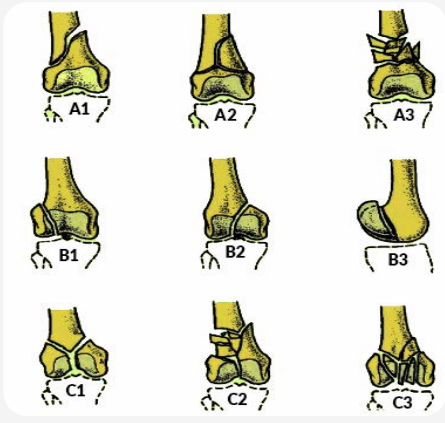
AO/OTA Classification of Distal Femur Fractures

Type A: extra-articular fracture

- **A1:** Simple
- **A2:** Metaphyseal wedge and/or fragmented wedge
- **A3:** Metaphyseal complex

Type B: partial articular fracture

- **B1:** Lateral condyle, sagittal
- **B2:** Medial condyle, sagittal
- **B3:** Frontal



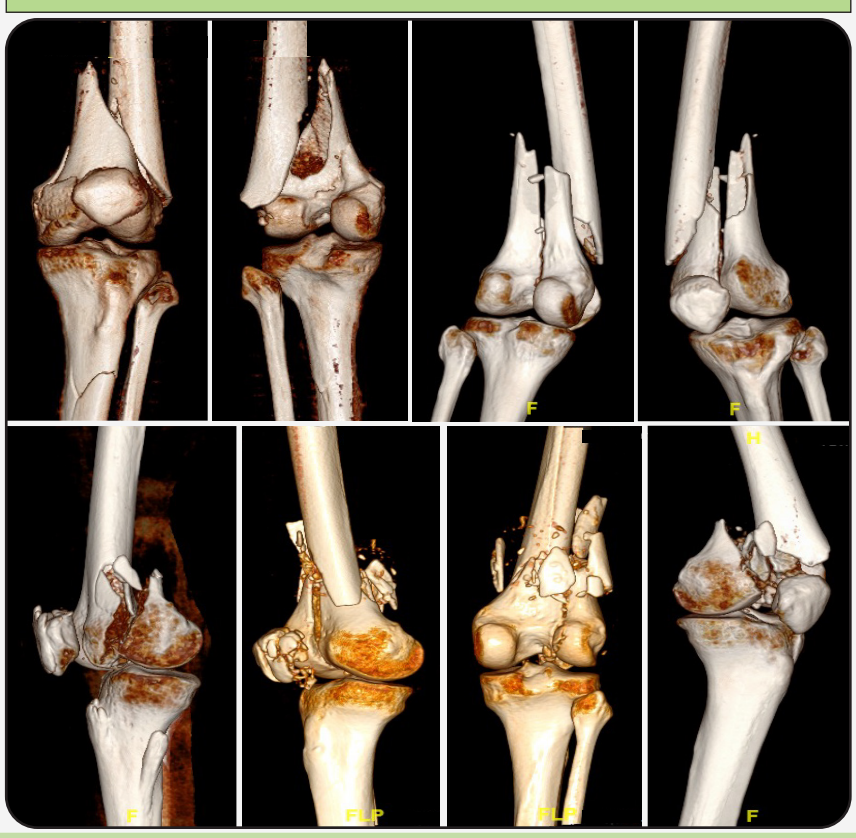
Type C: complete articular fracture

- **C1:** Articular simple, metaphyseal simple
- **C2:** Articular simple, metaphyseal multi-fragmentary
- **C3:** Articular multi-fragmentary

MANAGEMENT

GOALS OF TREATMENT

1. Restore articular congruity in intra-articular fractures
2. Reconstruction of extra-articular component
3. Length, alignment and rotation should be clinically and flouroscopically confirmed before final fixation



Distal femur fracture

At primary centre → ATLS Management
Limb Splintage/Ice packs/elevation
X-Ray if possible

At secondary centre

- Active bleed - sterile dressing and compression bandage
- Suspected compartment syndrome
- Open fracture- sterile dressing

Refer to secondary centre

- Stop the bleed
- Debride for open fracture
- Fasciotomy if warranted for impending compartment syndrome
- External fixator application
- Open reduction internal fixation for simple fractures

At tertiary centre

- If final fixation not possible
- Geriatric patient/Osteoporotic
- Periprosthetic fracture
- Multi-system/Vascular injury

Refer to tertiary centre

- HDU/ICU management for multi-system injury
- Fasciotomy if required
- Vascular repair

Refer to tertiary centre

- Vascular injury
- Geriatric patient/ Osteoporotic
- Periprosthetic fracture
- Multi-system/ Vascular injury

Final fixation once swelling subsides/blisters resolve/patient physiologically fit

Distal femur fracture → X-Ray

Type A

A1 and >7cm from joint → Antegrade nailing

Type A within 4cm from joint → Retrograde nailing/ ORIF with Locking plate, Blade plate and Sliding barrel condylar plate → Anterolateral approach

Geriatric patients/ Osteoporotic bone → Nail Plate or Dual plate constructs needed

Type B

B1 and B2 fractures → ORIF with locked plate/Condylar Buttress Plating → Anterolateral/ Medial approach

Type C

B3 fractures → ORIF with buttress Plate +/- Screws (Anterior to posterior/ Posterior to anterior)

Lateral/medial approach based on condyle involved
OR
Midline parapatellar approach for visualisation and fixation with A to P screws

Assess need for external fixator – Skin condition/swelling/blisters/compartment syndrome

Rigid anatomic fixation of intra-articular fractures

Single approach- anterolateral, medial/ lateral parapatellar, Swashbuckler, Gerdy's tubercle osteotomy approach

Placement of void filler – bone graft substitute

ABBREVIATIONS

AP: Antero-posterior
ATLS: Advanced Trauma Life Support
HDU: High Dependency Unit
ICU: Intensive Care Unit
ORIF: Open Reduction and Internal Fixation
OTA: Orthopaedic Trauma Association
RTA: Road Traffic Accident

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☛ TIMELY INTERVENTION AS PER RESOURCE SETTING

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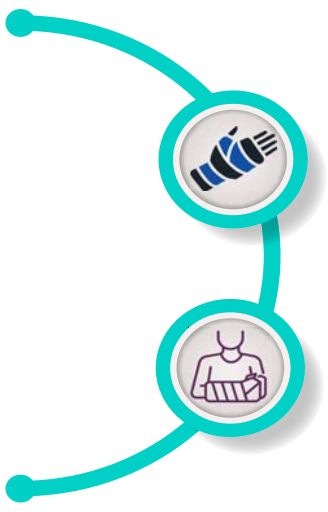
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Standard Treatment Workflow (STW)

FRACTURE DISTAL END RADIUS

ICD-10-S62



RISK FACTORS

- Old age
- Osteoporosis
- Female
- Post menopause

PRESENTATION

- Pain over distal radius
- Swelling and ecchymosis
- Deformity - commonly Dinner fork or spade
- Painful restriction of wrist motion

EXAMINATION

- Swelling and ecchymosis
- Deformity
- Tenderness
- Limited active and passive wrist motion

INVESTIGATIONS

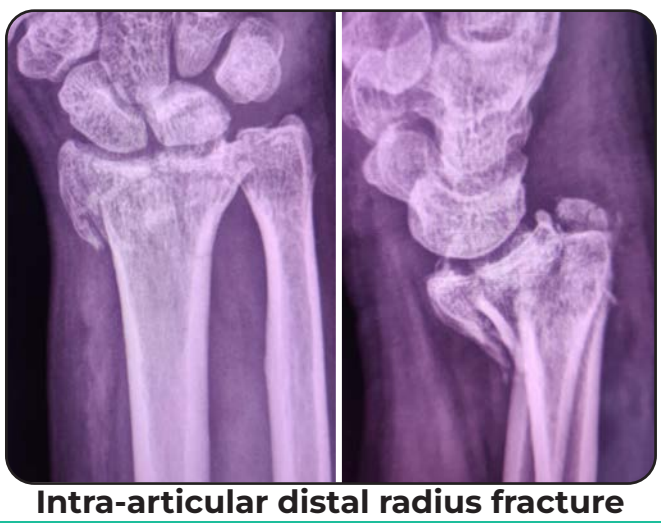
Essential: Radiographs of wrist AP, lateral and oblique views

Desirable (In patients with trivial trauma):

Distal radial fractures may be the first opportunity to evaluate and treat osteoporosis to reduce the risk of future fragility fractures

- Serum calcium, Serum phosphorous, Serum alkaline phosphates
- Serum vitamin D levels, Serum Parathyroid Hormone (PTH)
- BMD all three sites

Optional: CT scan for comminuted fractures and for planning surgery



Intra-articular distal radius fracture

MANAGEMENT

PRIMARY CARE

Simple fracture

Refer to higher centre after:

1. Adequate analgesia
2. Immobilisation of the limb

Open fracture

1. Refer to open fracture STW

Emergent referral:

Open fractures
Neurovascular Deficit
Concomitant trauma requiring immediate admission

SECONDARY/TERTIARY CENTRE

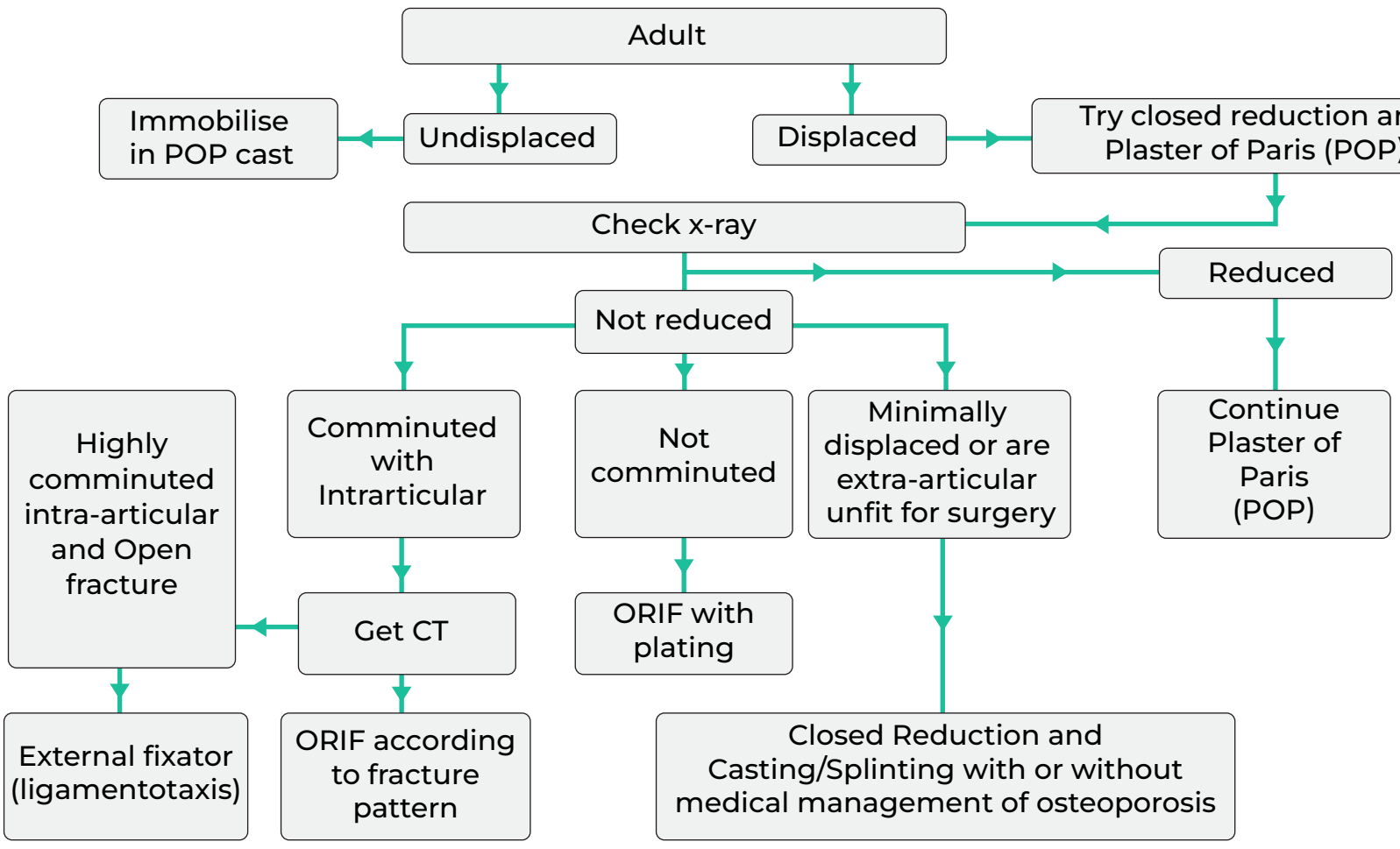
Simple fracture

1. Adequate analgesia
2. Immobilisation of the part

Open fracture

1. Look for Median nerve function, dysfunction/compartment syndrome
2. Distal radial and ulnar pulses
3. Rule out compartment syndrome

TRY INITIAL CLOSED REDUCTION IN ALL DISPLACED RADIUS FRACTURES



Guidelines for operative intervention

- Radial shortening of >3 mm
- Dorsal tilt of >10 [degrees]
- Intra-articular step-off of >2 mm

A majority of pediatric distal radius fractures are inherently stable and can be treated with a short period of immobilization with a cast or splint



Extra-articular distal radius fracture

FOLLOW UP

- Conservatively treated fractures are managed for 4-6 weeks in cast
- To check for fracture displacement, angulation subsidence and fracture healing, serial images are necessary at 1 week and 2 weeks follow up
- If fracture displaces in follow up, may require re-reduction/surgery
- Exercises should be initiated early (Shoulder, elbow and finger ROM during cast application and wrist ROM after removal of plaster)

ABBREVATIONS

AP: Antero-posterior
CT: Computed Tomography
ORIF: Open Reduction and Internal Fixation
ROM: Range of Motion

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KEEP A HIGH THRESHOLD FOR INVASIVE PROCEDURES

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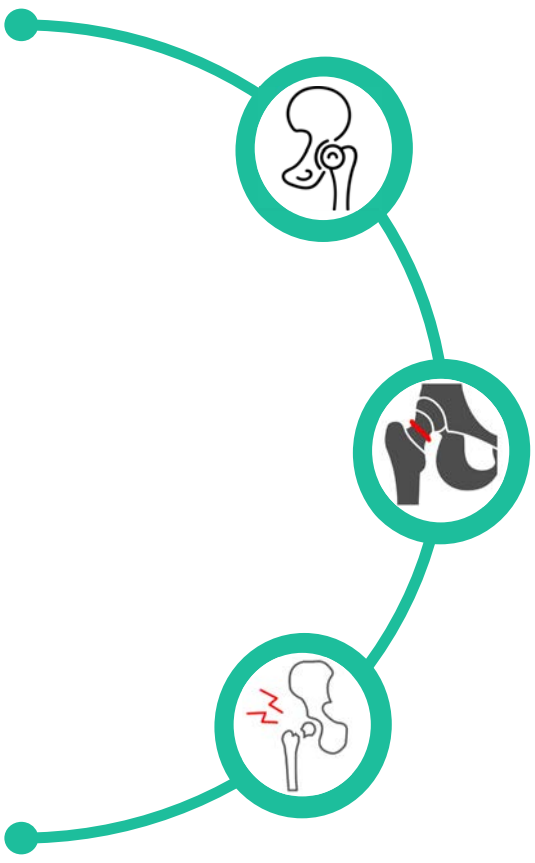
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Standard Treatment Workflow (STW)

FRACTURE NECK OF FEMUR

ICD-10-S72.0



FEMORAL NECK FRACTURES

- Femoral neck fractures are intracapsular fractures

RISK FACTORS

- Osteoporosis
- Advancing age
- Increased number of comorbidities
- Increased dependency with Activities of Daily Living (ADL)

SYMPTOMS

- Severe pain in the hip after fall/ Road Traffic Accident (RTA)
- Limb in a deformed position (usually external rotation) and shortening
- Unable to move and stand on the injured limb
- Bruising and swelling around the hip

SIGNS

- Limb is short and externally rotated
- Patient unable to stand or do active straight leg raising
- Marked tenderness at hip joint

FIRST AID

- Pain relief
- Immobilisation of (Splintage including hip, knee & ankle to minimize movements at fracture site during transport)

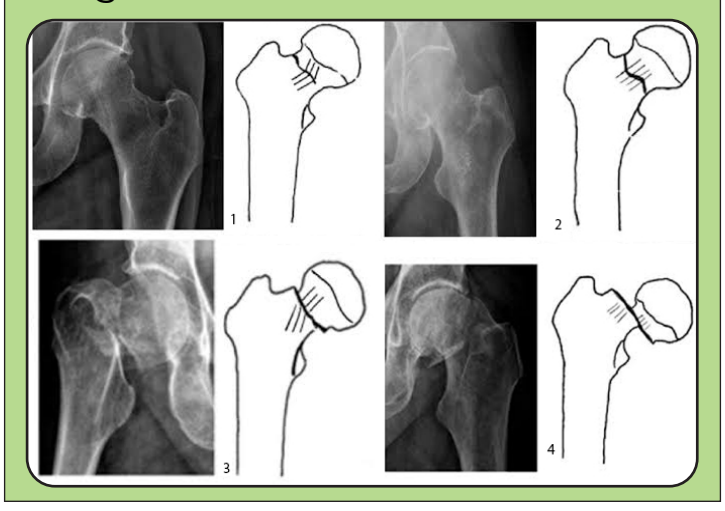
RADIOGRAPHS

- X ray Pelvis with bilateral hips- AP
- Involved hip with thigh – AP (with hips in internal rotation to see the entire neck properly) and lateral view

MANAGEMENT

GARDEN CLASSIFICATION

- **Type I:** Incomplete fracture/Valgus impacted
- **Type II:** Complete fracture without displacement of the fracture fragments
- **Type III:** Complete fracture with partial displacement of the fracture fragments
- **Type IV:** Fracture is complete with total displacement of the fracture fragments



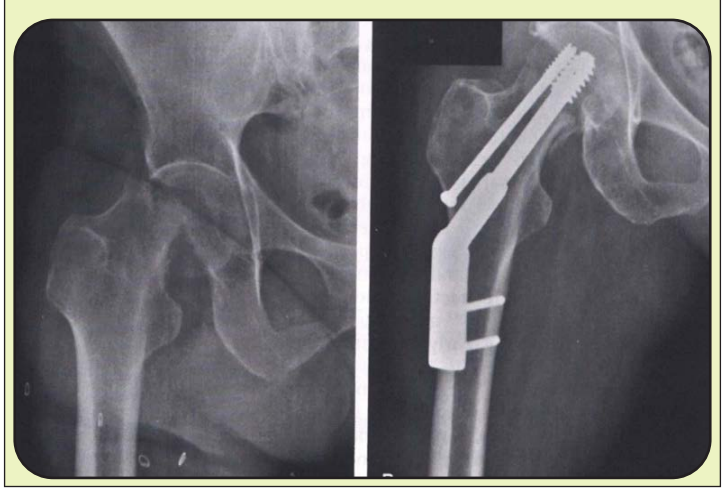
VALGUS/UNDISPLACED (TYPE I & TYPE II)

- In situ internal fixation at the earliest possible
- Three 6.5 cancellous screws (Threads crossing fracture site) should be placed in inverted triangle or triangular configuration



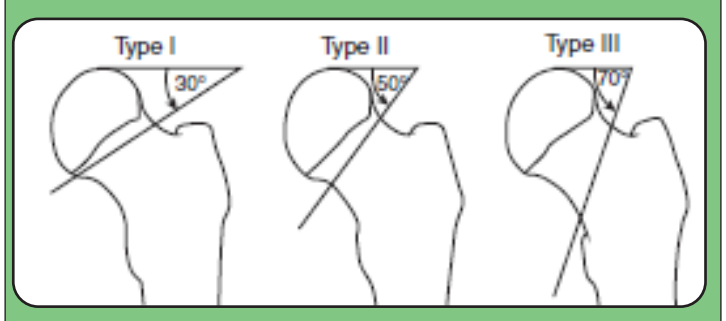
DISPLACED (TYPE III & TYPE IV) UPTO AGE 60 YEARS

- Closed reduction in anatomical position
- If closed reduction is not possible then open reduction should be done
- Fracture fixation is performed by either multiple screw fixation or by Dynamic Hip Screw (DHS) with de-rotation screw



DHS WITH DE-ROTATION SCREW

- Cervicotrochanteric basal neck femur
- Pauwel's type III fracture



MORE THAN 60 YEARS

- Displaced femoral neck fractures require arthroplasty
  - Unipolar (Austin Moore prosthesis)
  - Modular bipolar prosthesis
  - Total Hip Replacement (THR)



INDICATIONS OF THR

- Intracapsular fracture associated with marked arthritis of the hip
- Pathological fractures in patients more than 60 years

ABBREVATIONS

ADL: Activities of Daily Living

AP: Antero-posterior

DHS: Dynamic Hip Screw

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☛ EARLY SURGICAL TREATMENT IS DESIRABLE

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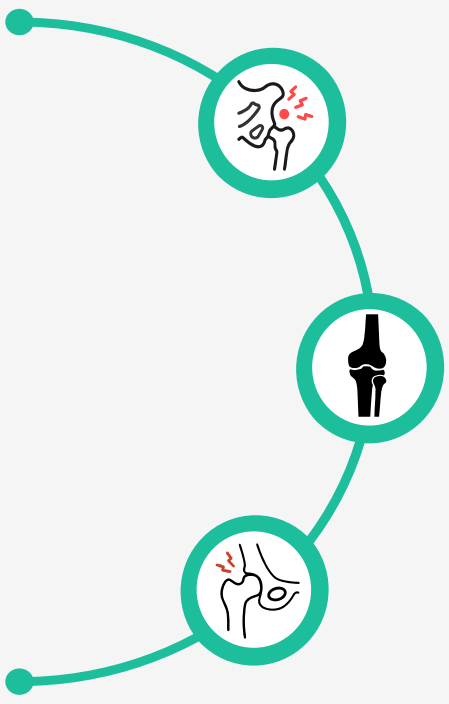
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Standard Treatment Workflow (STW)

HIP OSTEOARTHRITIS

ICD-10-M16. 9



SYMPTOMS & SIGNS

Pain

- During or after movement
- Joint stiffness
- Tenderness
- Loss of flexibility & restricted range of hip movement
- Grating sensation
- Deformity

PRIMARY

- Very rare

SECONDARY

- Developmental dysplasia of hip
- Osteonecrosis
- Failed reconstruction
- Post-traumatic
- Tuberculosis
- Coxa plana (Legg-Calvé-Perthes disease)
- Slipped capital femoral epiphysis
- Paget's disease
- Hemophilia

MANAGEMENT

CONSERVATIVE MEASURES

- Weight loss
- Non-opioid analgesics (as per need)
- Reasonable activity modification
- Avoid standing for long hours, climbing stairs, squatting, sitting cross legged
- Hip abductor and extensor muscle strengthening exercises and quadriceps exercises
- Ambulatory aids like walking stick

KELLGREN (1963) DESCRIBED 4 GRADES OF HIP OA

- **Grade 1 (doubtful OA)**, Possible narrowing of the joint space medially and possible osteophytes around femoral head
- **Grade 2 (mild OA),** Definite narrowing of the joint space inferiorly, definite osteophytes and slight sclerosis
- **Grade 3 (moderate OA),** Marked narrowing of the joint space, slight osteophytes, some sclerosis and cyst formation, and deformity of the femoral head and acetabulum
- **Grade 4 (severe OA),** Gross loss of joint space with sclerosis and cysts, marked deformity of the femoral head and acetabulum, and large osteophytes

INDICATIONS OF TOTAL HIP REPLACEMENT (THR)

- Patients with osteoarthritis of hip, Kellgren & Lawrence Grade-IV with following clinical features may require surgery after appropriate conservative treatment has failed
- Deformity & pain that significantly limits the activities of daily living
- Disabling hip pains that continues even at rest
- Daily requirements of analgesic
- Bilateral ankylosis of hip joints





ABBREVIATIONS

OA: Osteoarthritis

THR: Total Hip Replacement

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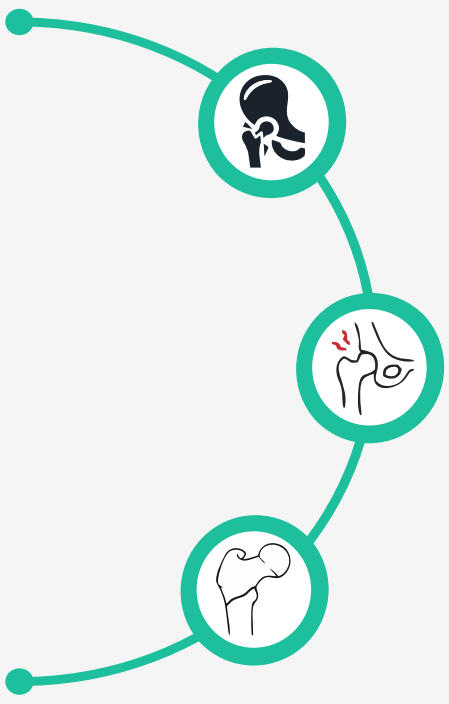
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Standard Treatment Workflow (STW)

INTERTROCHANTERIC FEMORAL FRACTURES

ICD-10-S72. 14



DEFINITION

- Extracapsular fractures of the proximal femur that occur between the greater and lesser trochanter

RISK FACTORS

- Osteoporosis
- Advancing age
- Increased number of comorbidities
- Increased dependency with Activities of Daily Living (ADL)

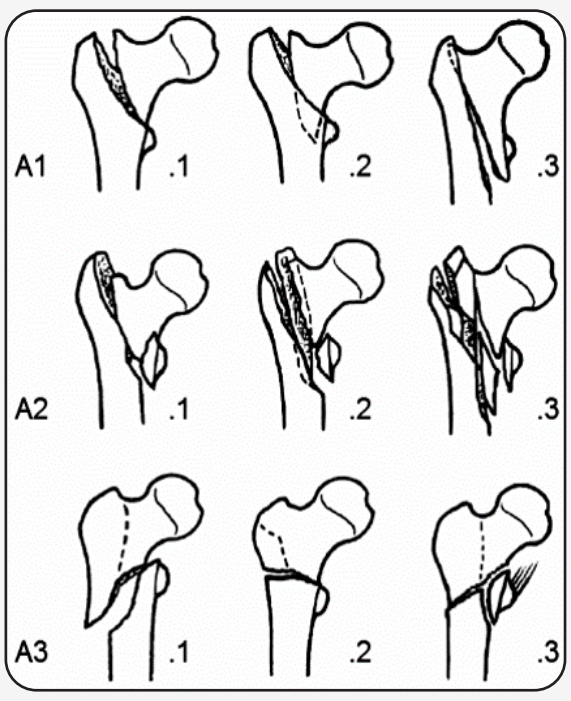
SYMPTOMS AND SIGNS

- Severe pain in the hip after fall/Road Traffic Accident (RTA)
- Limb in a deformed position (usually external rotation)
- Unable to move and stand on the injured limb
- Bruising and swelling around the hip
- Tenderness at trochanteric level

MANAGEMENT

AO CLASSIFICATION

- AO/OTA type-31-A pertrochanteric fractures:
  31-A1 fractures - simple
- 31-A2 fractures - multifragmentary -
  - A2.1: detachment of the lesser trochanter
  - A2.2: several intermediate fragments including the lesser trochanter
  - A2.3: several intermediate fragments extending more than 1 cm distal to the lesser trochanter
- 31-A3: fractures - fracture line through the lateral femoral wall, anatomically defined as the lateral femoral cortex distal to the greater trochanter



AO CLASSIFICATION

FIRST AID

- Pain relief
- Immobilisation of limb (splintage including hip, knee and ankle to minimize movements at fracture site during transport)

RADIOGRAPHS

- X ray pelvis with bilateral hips- AP
- Involved hip with thigh – AP and lateral

OPERATIVE MANAGEMENT

- The mainstay of treatment is fixation with a dynamic hip screw (DHS) or proximal femoral Intramedullary nail
- Stable FRACTURE -intact posteromedial cortex- Association of osteosynthesis (Ao) type A1 and A2.1 -DHS
- Unstable FRACTURE - broken posteromedial cortex- Association of osteosynthesis (Ao) type A3 & A2.2 & A2.3 - Proximal femoral Intramedullary nail



31-A2



Dynamic Hip screw with plating post operative Xray



31-A3



Proximal femoral nail A2 Post operative Xray

ARTHROPLASTY - INDICATIONS (RARE)

- Revision for failed internal fixation
- Associated pre-existing severe hip arthritis
- Severely osteoporotic bone that is unlikely to hold internal fixation

Red flag signs
Excessive Bruising/hematoma or any distal neurovascular deficit

Nonoperative treatment to be considered in patients with severe comorbidities not fit for surgery understanding high risks of pneumonia, urinary tract infection, decubitus ulcers, deep vein thrombosis and mortality

ABBREVIATIONS

ADL: Activities of Daily Living **AP:** Antero - posterior **DHS:** Dynamic Hip Screw **RTA:** Road Traffic Accident

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☛ EARLY SURGERY DECREASE COMPLICATIONS AND MORTALITY

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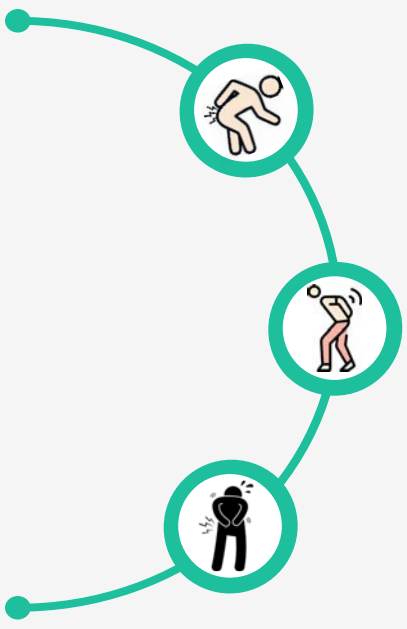
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Standard Treatment Workflow (STW)

LOWER BACK PAIN

ICD-10-M54. 2



HISTORY

- Lower back pain-acute or chronic
- Severity of pain
- Site and onset of pain
- Radiation of pain
- Associated features such as fever, trauma, weight lifting, associated tingling or numbness
- History related to Pelvic Inflammatory disease (PID)- if positive-refer to Gynecologist
- Anticonvulsants and steroids intake

RED FLAG SIGNS

- Features of Cauda Equina Syndrome including sudden onset of loss of bladder/ bowel control, saddle anesthesia and weakness of lower limbs
- Severe worsening pain, especially at night or when lying down
- Significant history of trauma
- Weight loss, history of cancer, fever
- Use of prolonged steroids or intravenous drugs
- First episode of severe pain in patient over 50 years of age

Conduct a full assessment including
- History taking
- Physical and neurological examination
- Evaluation of red flags
- Psychosocial risk factors

Red Flag Signs → Yes → Consider referral to higher center for evaluation

No

Acute and Sub acute-duration less than 12 weeks

- **Consider analgesics for short duration**
  - Acetaminophen
  - NSAIDs
  - Short course muscle relaxants
  - Use opioids (short duration) if not responding to above analgesics
- Recommend back strengthening exercises and/ or physical activity (when pain becomes bearable), avoid heavy weight lifting activities
- **Prescribe self-care strategies**
  - Alternating cold and heat therapy
  - Continuation of Activities of Daily Living as tolerated
- **Encourage early return to work**
- **Educate patient that low back pain usually resolves with time**

↓

Re-assess at 2-6 weeks (including Red Flags) if patient is not returning to normal function or symptoms are worsening

↓

Consider lab test and imaging*
Consider Referral
- Physical therapist
- Orthopeadic surgeon (for unresolving radicular symptoms)
- Multidisciplinary pain program (if not returning to work)

Chronic-duration greater than 12 weeks

- **Consider lab test and imaging (X -rays)**
- **Prescribe back strengthening exercises or therapeutic exercise**
- **Analgesic options**
  - Acetaminophen
  - NSAIDs
  - Short term muscle relaxant for flare-ups
- **Pain not responding to above**
  - Opioids for short term in severe pain
  - Low dose antidepressants for short duration
- **Other modalities**
  - Physiotherapy
  - TENS as adjunct to active therapy etc
- If pain still does not subside then consider Referral
- **Modalities at Referral centre**
  - Multidisciplinary chronic pain program/ clinic
  - Epidural steroids (for short-term relief of radicular pain)
  - Surgery in carefully selected patients after expert opinion and based on indications

***Based on provisional diagnosis - Lab and imaging Test**
- Lab tests
  - Hemogram with ESR and CRP
- Imaging
  - X rays LS Spine- Anteroposterior (AP) and lateral
  - MRI LS spine
  - DEXA Scan- suspected osteoporosis

ABBREVIATIONS

CRP: C-reactive Protein
DEXA: Dual-energy X-ray Absorptiometry
LS: Lumbo-Sacral
ESR: Erythrocyte Sedimentation Rate
MRI: Magnetic Resonance Imaging
NSAIDs: Non-Steroidal Anti-inflammatory Drugs
PID: Pelvic Inflammatory Disease
TENS: Transcutaneous Electrical Nerve Stimulation

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KEEP A HIGH THRESHOLD FOR INVASIVE PROCEDURES

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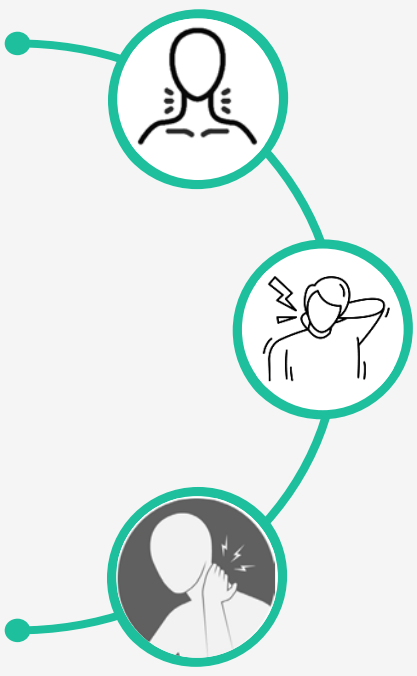
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Standard Treatment Workflow (STW)

NECK PAIN

ICD-10-M54. 2



HISTORY

- Acute or chronic
- Severity of pain
- Site and onset of pain
- Radiation of pain
- Associated features such as fever, trauma, weight lifting, associated tingling or numbness
- Anticonvulsants and steroids intake

RED FLAG SIGNS

- Features of neurological deficit including sudden onset of loss of bladder/ bowel control, numbness/paresthesias/weakness of upper limbs or lower limbs
- Severe worsening pain, especially at night or when moving the neck
- Significant history of trauma
- Weight loss, fever, history of cancer
- Use of prolonged steroids or intravenous drugs
- First episode of severe pain in patient over 50 years of age

Conduct a full assessment including
- History taking
- Physical and neurological examination
- Evaluation of red flags
- Psychosocial risk factors

Red Flag Signs → Yes → Referral to higher center for evaluation

No

Acute and Sub acute (Duration - less than 12 weeks)

- **Consider analgesics for short duration**
  - Acetaminophen/PCM and NSAIDs
  - Short course muscle relaxants
  - Use opioids (short duration) if not responding to above analgesics
- Immobilize neck in acute stage. Once pain subsides - start neck strengthening exercises and/or physical activity
- Recommend neck strengthening exercises and/or physical activity (when pain becomes bearable)
- Avoid lifting heavy weights
- **Prescribe self-care strategies**
  - Alternating cold and heat therapy
  - Continuation of Activities of Daily Living as tolerated
- **Encourage early return to work**
- **Educate patient that neck pain usually resolves with time**

Re-assess at 2-6 weeks (including Red Flags) if patient is not returning to normal function or symptoms are worsening

*Based on provisional diagnosis - Lab and imaging Test

- Lab tests
  - Hemogram with ESR and CRP
- Imaging
  - X rays Cervical Spine- AP and lateral
  - MRI Cervical spine

Chronic (Duration - greater than 12 weeks)

- **Consider lab test and imaging (X -rays)**
- **Prescribe neck strengthening exercises or therapeutic exercises**
- **Analgesic options**
  - Acetaminophen/Paracetamol (PCM)
  - NSAIDs
  - Short term muscle relaxant for flare-ups
- **Pain not responding to above**
  - Opioids for short term in severe pain
  - Low dose antidepressants for short duration
- **Other modalities**
  - Physiotherapy
  - TENS as adjunct to active therapy etc
- If pain still does not subside then consider Referral

Consider lab test and imaging*

Consider Referral
- Physical therapist
- Orthopaedic surgeon (for unresolving radicular symptoms)
- Multidisciplinary pain program (if not returning to work)

- **Modalities at Referral centre**
  - Multidisciplinary chronic pain program/clinic
  - Surgery in carefully selected patients after expert opinion and based on indications

ABBREVIATIONS

AP: Antero-Posterior
CRP: C-reactive Protein
NSAIDs: Non-Steroidal Anti-Inflammatory Drugs
ESR: Erythrocyte Sedimentation Rate
MRI: Magnetic Resonance Imaging
TENS: Transcutaneous Electrical Nerve Stimulation

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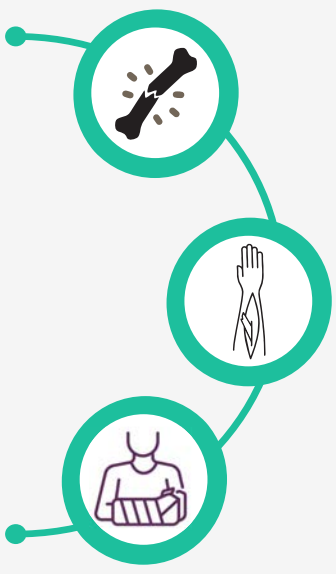
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Standard Treatment Workflow (STW)

OPEN FRACTURES

ICD-10-S82.891B



A fracture is considered open when there is communication between the fracture and/or the fracture hematoma and the external environment

CLINICAL EXAMINATION

Management of patient as per ATLS protocols
Systematic inspection of each limb is critical
Expose the entire extremity
- Size of skin wounds
- Muscle crush or loss
- Periosteal stripping or bone loss
- Contamination
- Clinical photography of wound is a must
- Neurovascular status assessment

GOALS OF TREATMENT

First Preserve life
↓
Preserve limb
↓
Preserve function
Prevention of infection
Fracture stabilization
Soft tissue coverage

MANAGEMENT

*ANTIBIOTIC - WHICH, WHEN AND FOR HOW LONG?

Single most important factor in reducing the infection rate - early administration of antibiotics - ideally within 1 hour of injury
- Cephalosporin (cefuroxime 1.5 gm) 3 doses 8 hours apart
- **Type III** - Add aminoglycoside (gentamycin 5mg/kg every 24 hours)
- **Duration** - 3 days after wound closure
- **Potential soil contamination** - Add metronidazole 500 mg IV every 8 hours

- Consider Aspirin in case of prolonged immobilisation
- Look for signs of DVT and embolism

REFERRAL

Ensure Splintage is done, Analgesic IV/IM Diclofenac single dose is given. Patient is kept NPO and IV fluid (RL) is started

At primary centre after initial management is done
- GA Type I to III A → Refer to secondary centre
- GA Type III B → Refer to tertiary centre

SURGICAL WOUND DECONTAMINATION

- Prior to formal debridement the wound should be handled only to remove gross contamination
- 'Mini-washouts' outside the operating theatre environment are not indicated
- Debride all devitalized structures – skin, muscle, bones ('When in doubt, take it out)
- Irrigation: Low to medium pressure; normal saline
- **Rule of 3 (Type 1 – 3L; Type 2 – 6L; Type 3 – 9L)**
- Send cultures
- Fracture stabilization with fresh instruments once debridement is complete
- **Grade I to IIIA** - Early internal fixation – With definitive skin cover
- **Grade IIIA and IIIB** - Provisional stabilization of fracture with wound management when definitive skin cover is not possible

GA TYPE III B/III C

Managed at tertiary centre
Multidisciplinary approach - **'Orthoplastic'**
III C injuries may require CT angiogram/doppler study

WOUND CLOSURE

- Recommendation is primary closure of Type I, Type II and a few selected Type IIIA fracture – but avoid tension at closure site
- Coverage of III A and III B - after proper debridement and cleaning. May require one or two or more formal debridements
- Definitive soft tissue closure or coverage should be aimed within 72 hours of injury if it cannot be performed at the time of debridement

INITIAL EMERGENCY TREATMENT

OBVIOUS BLEED → Apply local pressure
- Controlled → No obvious bleed
- Does not stop → Pack the wound

→ Antibiotics* and Tetanus prophylaxis
→ Remove gross contamination with gentle saline wash
→ Cover with saline gauze
→ Do not debride/suture in ED
→ Assess Neurovascular status
→ Reduction, realignment, splintage
→ Reassess Neurovascular status

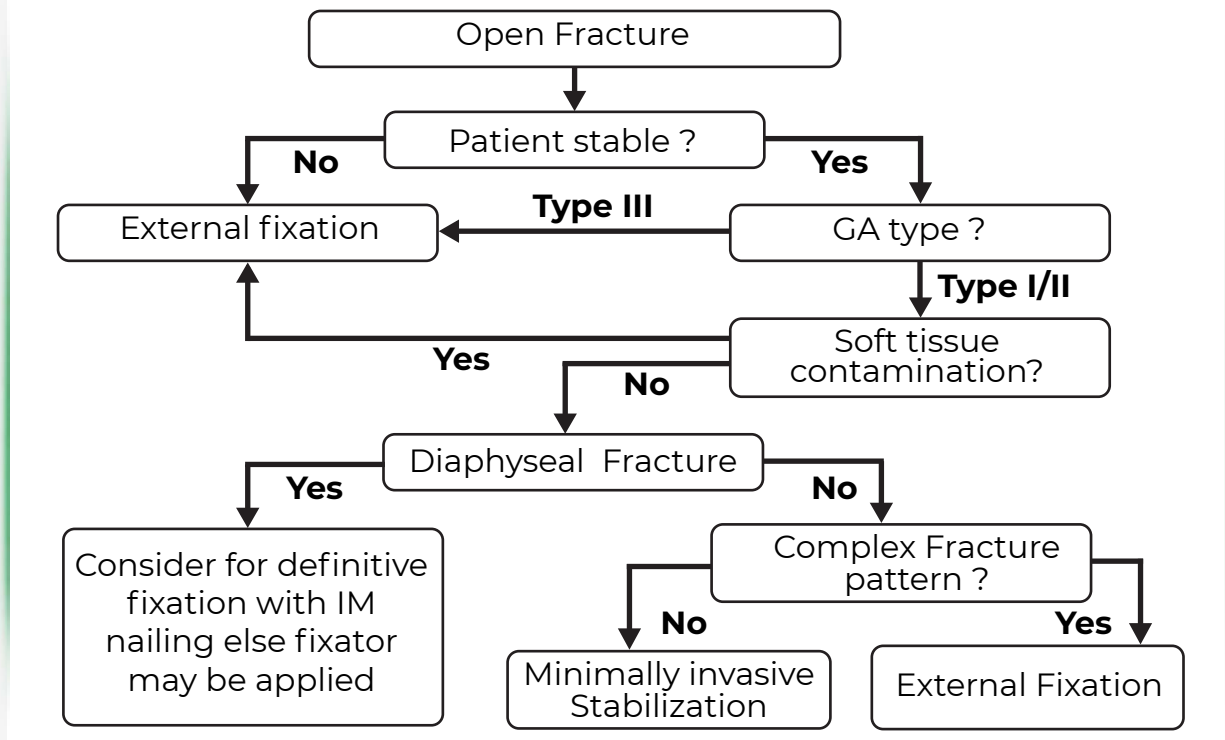
Look for Compartment syndrome
Pain on passive stretching
Pallor
Paraesthesia
Paralysis
Pulselessness
→ If suspected urgent referral to higher centre for immediate fasciotomy

GET X-RAY TO ASSESS UNDERLYING FRACTURE (IF POSSIBLE)

GUSTILO-ANDERSON CLASSIFICATION

	I	II	III-A	III-B	III-C
Energy of mechanism	Low	Moderate	High	High	High
Wound size	<1 cm	1 to 10 cm	>10 cm	>10 cm	>10 cm
Soft tissue injury	Low	Moderate	Extensive	Extensive	Extensive
Contamination	No	Low	Severe	Variable	Variable
Fracture pattern/ comminution	Simple /no	Simple/ Some	Complex /Severe	Complex /Severe	Complex /Severe
Soft tissue coverage	Yes	Yes	Yes	No	Variable
Vascular injury	No	No	No	No	Yes





ABBREVIATIONS

ATLS: Advanced Trauma Life Support
CT: Computed Tomography
ED: Emergency Department
GA: Gustilo Anderson
IM Nail: Intramedullary Nail
IV/IM: Intravenous/Intramuscular
NPO: Nil Per Oral
RL: Ringer's Lactate

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☛ EARLY ADMINISTRATION OF ANTIBIOTICS AND REFERRAL AS PER RESOURCE SETTING

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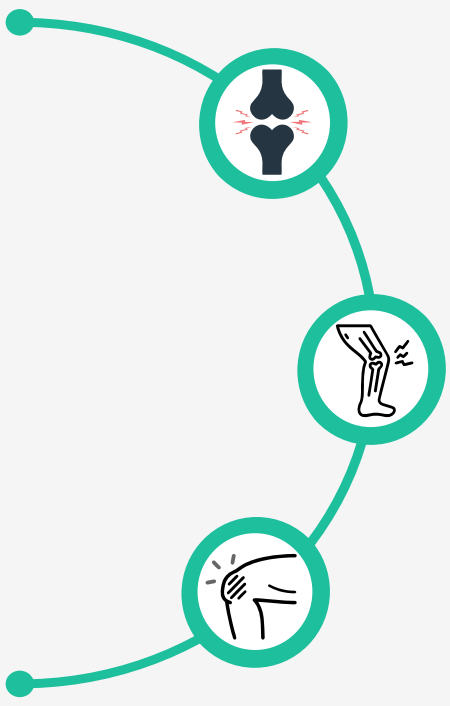
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Standard Treatment Workflow (STW)

OSTEOARTHRITIS OF KNEE JOINT

ICD-10-M19. 9



SYMPTOMS

- Pain that increases with activity & relieves with rest
- Joint stiffness especially in the morning or after a period of rest for short duration
- Decrease in Range of Motion (ROM) of the knee, making it difficult to stand from sitting position, get in and out of chair or car, stair climbing, or walk
- Creaking, crackling sounds on movement of knee
- Swelling and feeling of warmth in the joint may be present

SIGNS

- Joint line tenderness
- Patello-femoral crepitus
- Decreased ROM
- Deformity (commonly flexion and varus)
- Joint effusion and synovial thickening may be present

INVESTIGATION

- X-rays
- Bilateral Knee - AP (standing) and lateral views

MANAGEMENT

KELLGREN AND LAWRENCE (RADIOLOGICAL) CLASSIFICATION OSTEOARTHRITIS OF KNEE

Classification

- **Grade 0:** No radiographic features of OA are present
- **Grade 1:** Doubtful Joint Space Narrowing (JSN) and possible osteophytic lipping
- **Grade 2:** Definite osteophytes and possible JSN on anteroposterior weight-bearing radiograph
- **Grade 3:** Multiple osteophytes, definite JSN, sclerosis, possible bony deformity
- **Grade 4:** Large osteophytes, marked JSN, severe sclerosis and definite bony deformity

- High tibial osteotomy may be considered in younger patients with significant varus deformity

Indications of surgery for total knee replacement

Patients with osteoarthritis Kellgren and Lawrence grade 4 with following features may require surgery after appropriate conservative treatment has failed

- Severe knee pain or stiffness that limits activities of daily living including walking, climbing stairs, and getting in and out of chairs
- Patient unable to walk short distances (due to significant knee pain) and requires use of a cane/walker
- Regular analgesic requirement over a long period
- Moderate or severe knee pain while on rest either day or night
- Severe deformity

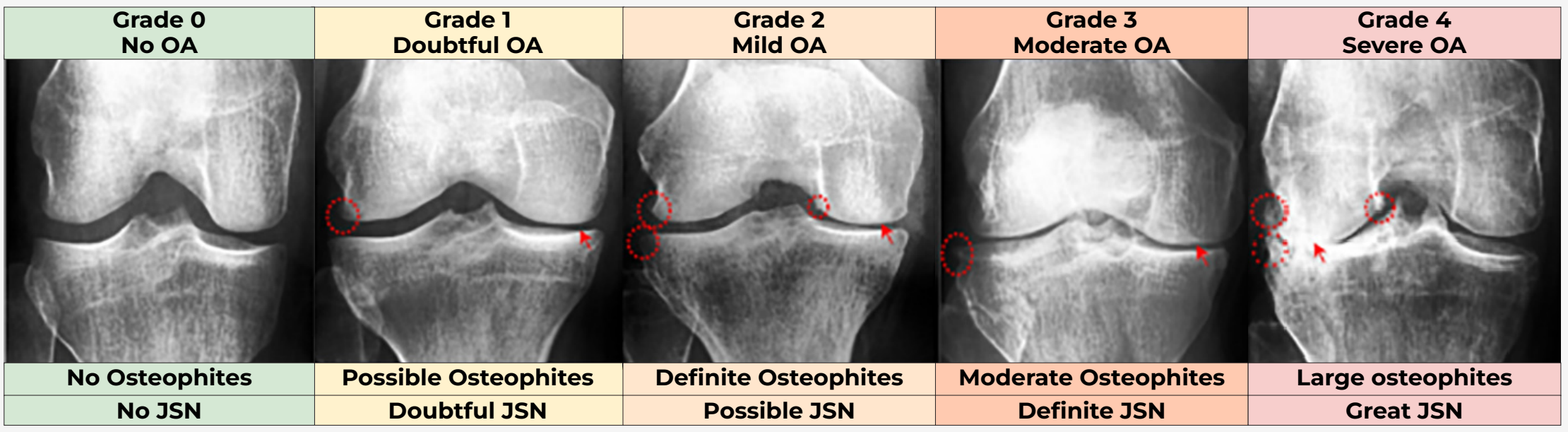
CONSERVATIVE TREATMENT

- Topical NSAIDs
- Oral Acetaminophen
- Oral NSAIDs (If not contraindicated) as and when required

- Quadriceps strengthening and Hamstring stretching exercises
- Lifestyle modifications such as avoid cross legged sitting and squatting and stair climbing wherever possible
- Weight loss

CONTRAINDICATIONS FOR KNEE REPLACEMENT

- Recent or current knee sepsis
- Remote source of ongoing infection
- Extensor mechanism discontinuity or severe dysfunction
- Recurvatum deformity secondary to neuromuscular weakness
- Presence of a painless, well-functioning knee arthrodesis



ABBREVIATIONS

AP: Antero-posterior

NSAIDs: Non-steroidal Anti-inflammatory Drugs

OA: Osteoarthritis

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Standard Treatment Workflow (STW)

TIBIAL PLATEAU FRACTURES

ICD-10-S82.109A

DEFINITION

A fracture involving the proximal end of the tibia which may or may not extend to the articular surface and/or diaphyseal region

MECHANISM OF INJURY

- High-energy trauma in young patients (RTA)
- Low-energy falls in elderly

Management of patient as per ATLS protocols

Presentation:

- Pain, swelling, deformity at or below the knee

PHYSICAL EXAM

- Look circumferentially to rule-out an open injury
- Tenderness below the knee
- Rule out compartment syndrome (blisters, ecchymosis, swelling, pain out of proportion)
- Look for distal neurovascular deficit

A. Airway and cervical spine
B. Breathing and ventilation
C. Circulation and haemorrhage control
D. Disability and neurological status
E. Exposure and environment control

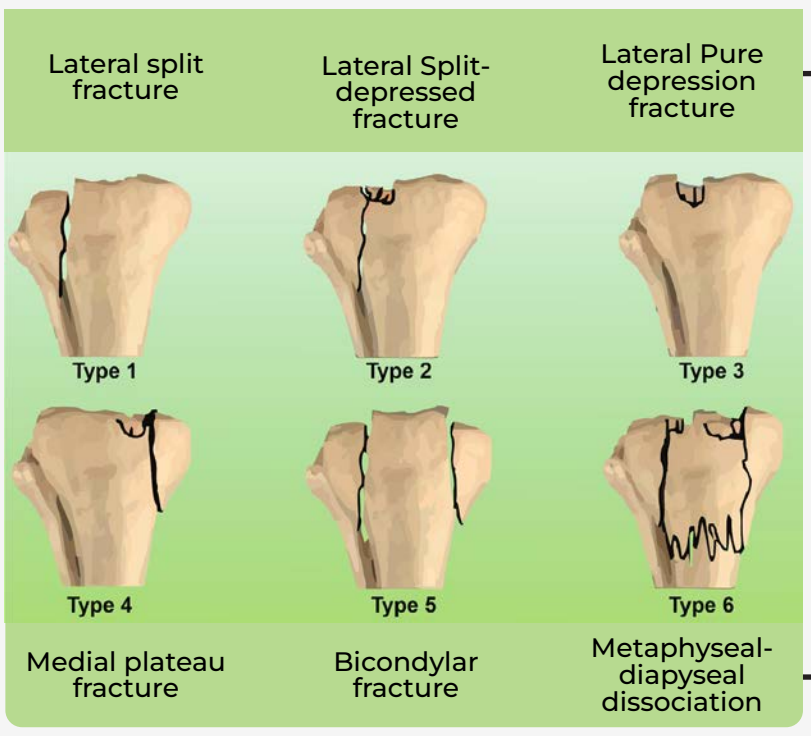
Open Fractures - STW

Urgent referral to higher centre for consideration for Fasciotomy and External Fixator application

INVESTIGATIONS

RADIOGRAPHS

- AP View – Schatzker classification
- Lateral View – Posterior fracture component



CT SCANS REQUIRED FOR

- Detailed assessment of fracture pathoanatomy & Preoperative planning
- Column classification – Luo

LOW ENERGY INJURY

Preferable to get a CT scan

HIGH ENERGY INJURY

Medial fracture dislocations

Open fracture (IIIA/B)

Compartment syndrome

Severe displacement/ Axial shortening

May consider for knee spanning External fixator prior to CT scan

Span → Scan → Plan

THREE COLUMN CLASSIFICATION (LUO)

- One column fracture is defined as an independent articular depression with a break in the column
- Zero-column fracture = purely articular

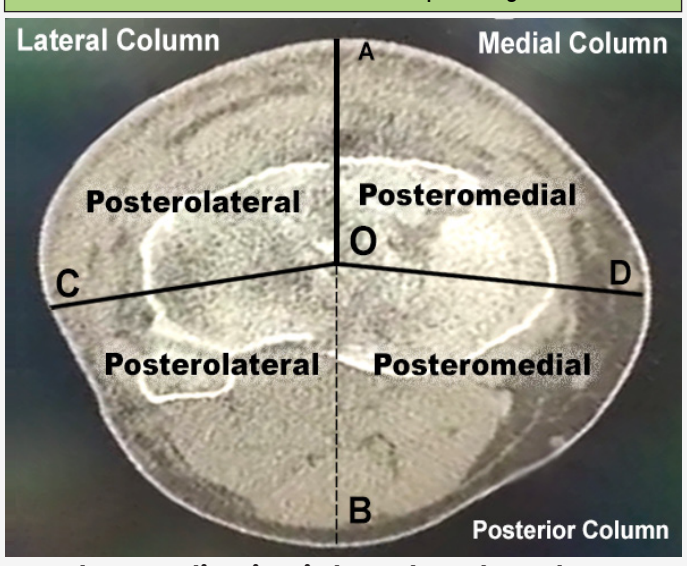


Plate application is based on the column concept.
Attempt to reduce and fix each column individually

MANAGEMENT

GOALS OF TREATMENT

Restoration of joint stability

- Anatomical reduction of the articular surface
- Restoration of the mechanical axis of the lower limb

IMPLANT OPTIONS

Screws alone

- Simple split
- Depressed fracture elevated percutaneously

Hybrid External fixator/Ilizarov: Poor skin condition, post fasciotomy

Anatomical locking plates

- Buttressing against shear forces or Neutralizing rotational forces

- **Additionally** – Rim plates/fragment specific small plates/bone graft substitutes may be used on case to case basis

Tibial Plateau Fracture

ATLS Management
X-Ray if possible
Limb elevation/ice packs/splintage
Analgesics

At secondary centre

- Active bleed
- Suspected compartment syndrome
- Open fracture
- Simple fracture

Refer to secondary centre

- Stop the bleed
- Refer- STW for open fracture
- Fasciotomy if warranted for impending compartment syndrome
- External fixator application

Open reduction internal fixation for simple fractures

- If final fixation not possible
- Complex fracture dislocation
- Vascular repair warranted
- Multi-system injury

At tertiary centre

- High Dependency Unit/Intensive Care Unit management for multi-system injury
- External Fixator
- Fasciotomy if required
- Vascular repair

Refer to tertiary centre

- Vascular injury
- Complex Fracture dislocation
- Multi-system injury

Final fixation once swelling subsides/ blisters resolve/patient physiologically fit

Tibial Plateau Fracture

X-Ray

Assess need for external fixator-Skin condition/ swelling/blisters/compartment syndrome

Open reduction internal fixation should be performed only after appearance of "wrinkle sign"

Schatzker 1 to 3	Schatzker 4	Schatzker 5 & 6
Anterolateral approach	Medial or posteromedial approach based on column involved	Based on the column concept- approach to each column must be made and all columns to be fixed
Articular surface reconstruction by elevating depression using bone punch via lateral fracture split/medial window (Type 2 and 3 fractures)	Fracture reduction	First fix one fragment anatomically (usually posteromedial)
Placement of raft screws and/or plate	Fixation with Antiglide plate	Elevate the articular depression if present
		Fix each fragment with anatomical locking plates

ABBREVIATIONS

ATLS: Advancd Trauma Life Support
CT: Computed Tomography
RTA: Road Traffic Accident

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☛ LOOK FOR RED FLAGS AND ACT TIMELY

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PEDIATRIC CARDIOLOGY

July/ 2024

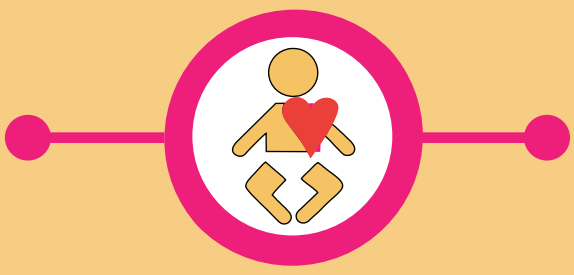
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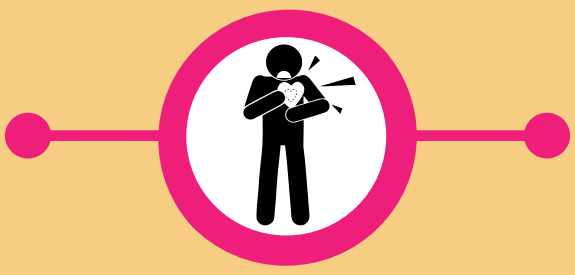
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Standard Treatment Workflow (STW)

ACUTE RHEUMATIC FEVER

ICD-10-I01.9





Rheumatic fever (RF) is an acute, nonsuppurative inflammatory disease complicating untreated or partially treated Group A Streptococcus (GAS) pharyngitis

PATHOPHYSIOLOGY

Risk factors:
Overcrowding
Poor orodental & personal hygiene limited access to healthcare

Precipitating event:
Group A Streptococcal pharyngitis

Susceptible host:
School going children (5-15 years age)

Repeated group A Streptococcus infections

Priming of immune response

First episode of ARF

Repeated or ongoing infections

RHD

Molecular mimicry between group A Streptococcus antigens and host tissues

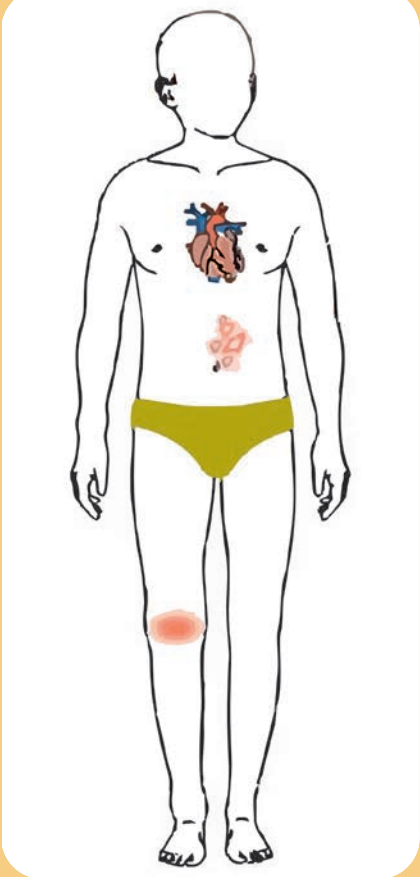
Exaggerated T-cell mediated immune response

CLINICAL PRESENTATION

Arthritis (80%) – Most common manifestation
- Multiple joints
- Migratory – lasts <1 week in a joint
- Large joints – ankles, knees & wrist
- Exquisite tenderness with redness & swelling
- Prompt response to NSAIDs
- Leaves no deformity

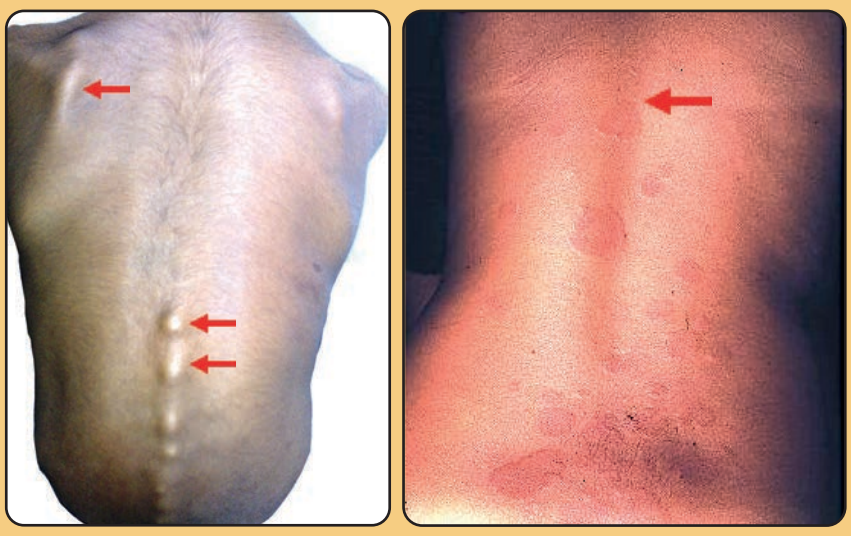
Carditis (50%) – Most devastating manifestation
- Tachycardia
- Dyspnoea
- Heart Failure
- Murmur on auscultation

Chorea (10%) - 2-6 months after streptococcal sore throat
- Quasipurposive, involuntary movements with emotional lability
- Best seen in hands, arms, tongue and face
- Affects fine motor movement like handwriting



Subcutaneous nodules – rare
Painless, pea-sized, hard nodules
On extensor surfaces of limbs, skull and back

Erythema marginatum (5%)
Transient pink macule with fading centre
Mostly located on the trunk and limbs



DIAGNOSIS BASED ON JONES CRITERIA

For all patient populations with evidence of preceding group A streptococcal infection

Diagnosis:		
	Initial ARF	2 major or 1 major plus 2 minor Criteria
	Recurrent ARF	2 major or 1 major and 2 minor or 3 minor Criteria
	Recurrent ARF in RHD	2 minor (No major criteria needed)
Criteria		
Major		
	Low-risk populations[a]	***Moderate and high-risk populations***[a]
	Carditis (Clinical and/or subclinical)[b]	Carditis (Clinical and/or subclinical)[b]
	Arthritis (Polyarthritis only)	Arthritis (Monoarthritis or polyarthritis or polyarthralgia)[c]
	Chorea	Chorea
	Erythema marginatum	Erythema marginatum
	Subcutaneous nodules	Subcutaneous nodules
Minor		
	Polyarthralgia[c]	Monoarthralgia
	Fever (≥38.5°C)	Fever (≥38°C)
	ESR >60 mm/h and/or CRP ≥3 mg/dL	ESR >30 mm/h and/or CRP ≥3 mg/dL
	Prolonged PR on ECG (for age) (unless carditis is a major criterion)	Prolonged PR on ECG (for age) (unless carditis is a major criterion)
Essential		
	Throat culture or antigen positive for streptococcal sore throat OR elevated ASO titers (>320 U)	

[a]Low-risk populations ARF incidence ≤2/ per 100 000 school-aged children or all-age RHD prevalence of ≤1/per 1000 population per year

[b]Subclinical carditis is pathological echocardiographic valvulitis

[c]Polyarthralgia should only be considered as a major manifestation in moderate-to high-risk populations after exclusion of other conditions. Joint manifestations can only be considered in either the major or minor categories but not both in the same patient

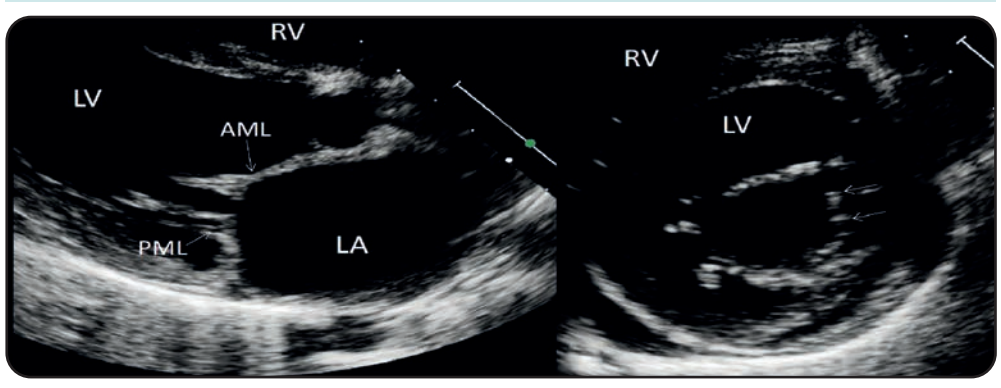
Erythema marginatum and subcutaneous nodules are 'stand-alone major criteria

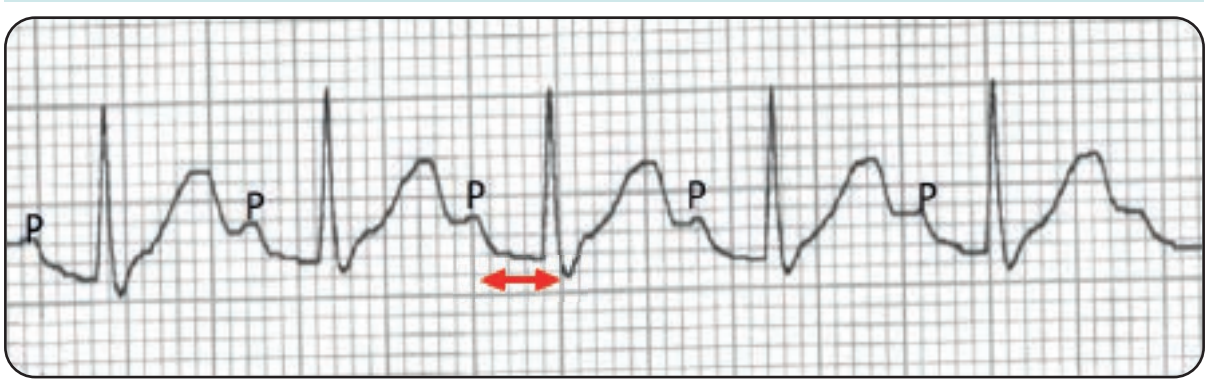
LABORATORY INVESTIGATIONS

Essential		*Optional*
• TLC, DLC	• Chest X ray	• Throat swab antigen
• ESR, CRP	• Anti-streptolysin O	• Throat swab culture
• ECG (12 lead)	• Echocardiogram	• Anti DNAse-B

DIFFERENTIAL DIAGNOSIS

1. Pediatric autoimmune neuropsychiatric disorders (PANDAS)- autoimmune disorder
2. Post streptococcal reactive arthritis (PSRA)- small joint arthritis, poor response to NSAIDs
3. Juvenile rheumatoid arthritis
4. Infective endocarditis





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Standard Treatment Workflow (STW)

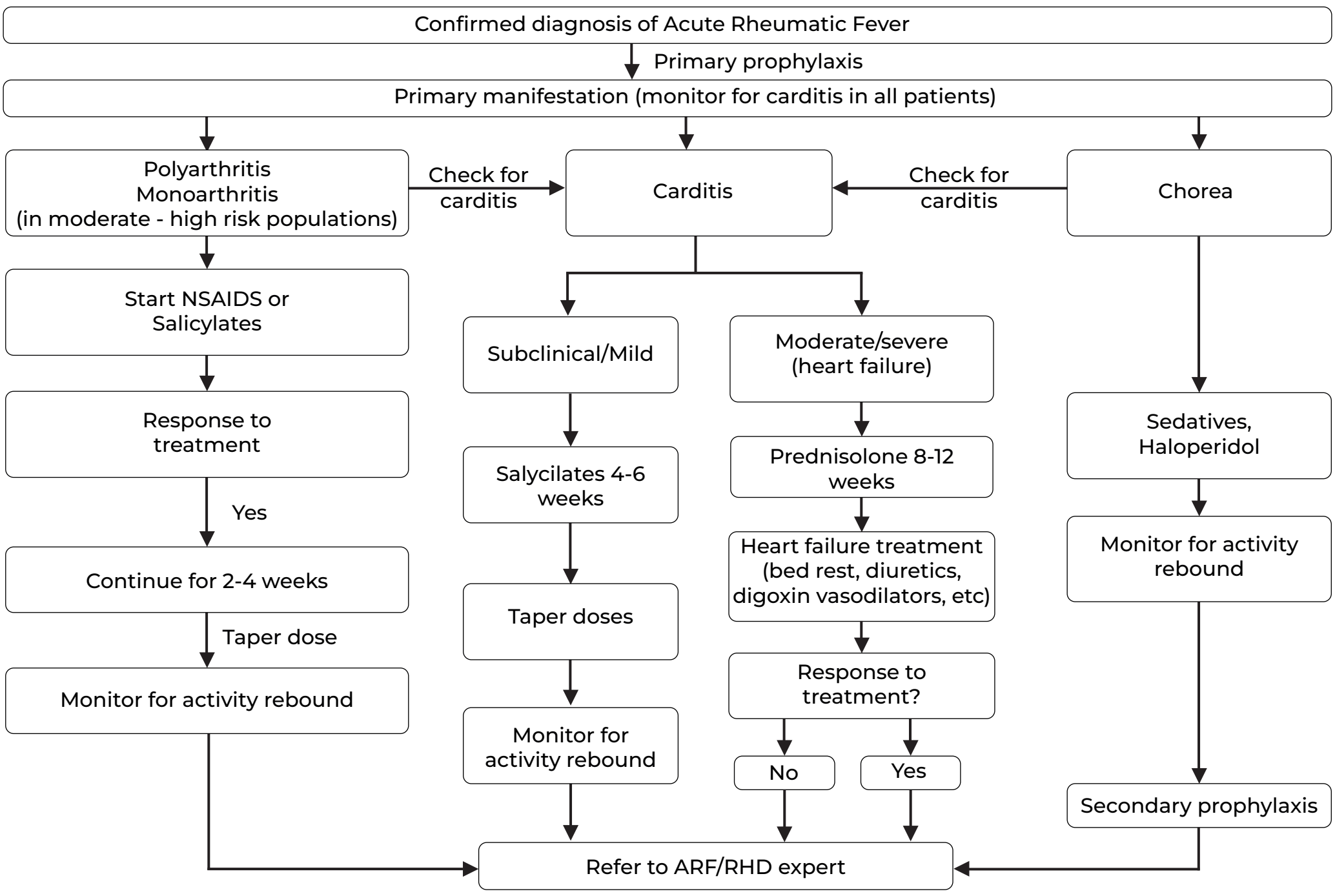
ACUTE RHEUMATIC FEVER

(Continued)

MANAGEMENT

Primary prophylaxis (to Eradicate streptococcus)		
Agent	**Dose**	**Duration**
Benzathine penicillin (Penicillin G)	≤27kg 6,00,000U >27kg 12,00,000U	Once
or		
Phenoxymethyl penicillin(Penicillin V)	≤27kg 250mg/dose <27kg 500mg/dose	10 days
For individuals allergic to penicillin		
Amoxicillin Erythromycin	25-50mg/kg/day divided into 3 doses (maximum 1g/day) 20-40mg/kg/day divided into 2-4 doses (maximum 1g/day)	10 days

Anti-inflammatory therapy & supportive care



Clinical Manifestation	Treatment Schedule	Duration
Moderate/Severe carditis	Prednisolone 2mg/kg/day once daily (Aspirin while tapering Prednisolone)	8-12 WKS
Mild carditis	Aspirin 75-100mg/day divided into 4 doses	2-4 WKS
Polyarthritis	Aspirin 75-100mg/day divided into 4 doses or Naproxen 10-20mg/kg/day	2-4 WKS
Chorea	Carbamazepine 4-10mg/kg/day or Valproic acid 20-30mg/kg/day or Haloperidol 2-6mg/day	Variable depending upon the need of the patient

Secondary prophylaxis

Category of Patient	Duration
Patients without carditis	5 years after the last ARF episode or until 21 years age (whichever is longer)
Patients with carditis but no RHD	10 years after the last acute episode or until 25 years age (whichever is longer)
Patients with RHD who have undergone valve surgery (repair or replacement)	At least until 40 years age (preferably lifelong)

Agent	Dose	Route
Benzathine penicillin (Penicillin G)	≤27kg 6,00,000U >27kg 12,00,000U	Intramuscular
or		
Phenoxymethyl penicillin(penicillin V)	250mg twice daily	Oral
For individuals allergic to penicillin		
Erythromycin	250mg twice daily	Oral

ABBREVATIONS

ARF: Acute Rheumatic Fever
ASO: Antistreptolysin O
CRP: C-reactive protein
DLC: Differential Leukocyte Count
ECG: Electrocardiogram
ESR: Erythrocyte Sedimentation Rate
NSAIDs: Non-Steroidal Anti-Inflammatory Drugs
PANDAS: Pediatric Autoimmune Neuropsychiatric Disorders Associated with Streptococcal Infections
RHD: Rheumatic Heart Disease
TLC: Total Leukocyte Count

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3. Handbook on prevention and control of rheumatic fever and rheumatic heart diseases. Directorate General of Health Services. Government of India 2015. accessed online on July 18, 2023.

☛ INJECTABLE PENICILLIN IS SAFE; ALLERGY IS UNCOMMON

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**) for more information. ©Indian Council of Medical Research, Ministry of Health & Family Welfare, Government of India.

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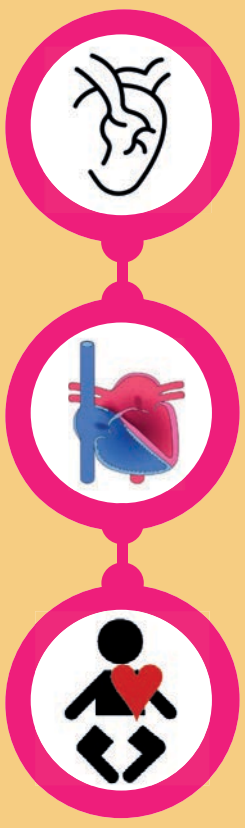
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Standard Treatment Workflow (STW)

CRITICAL HEART DISEASE IN THE NEWBORN

ICD-10-P09.5



UNIVERSAL PULSE OXIMETRY SCREENING IS RECOMMENDED (REF 2)

Measurement 1
Pulse oximetry on right arm and 1 foot around 24 hours of age (or earlier, if being discharged)

Fail
Pulse oximetry of 89% or less in either the right arm or foot
Action: Do not repeat pulse oximetry screening, refer for immediate assessment

Retest
a) Pulse oximetry of 90% to 94% in either the right arm or foot or
b) A difference of 4% or more between the right arm and foot
Action: Repeat pulse oximetry measurements

Pass
Pulse oximetry of 95% or more in right arm and foot and a difference of 3% or less between the 2
Action: Do not repeat pulse oximetry screening, provide normal newborn care

Measurement 2
Pulse oximetry on right arm and 1 foot 1 hour after measurement 1

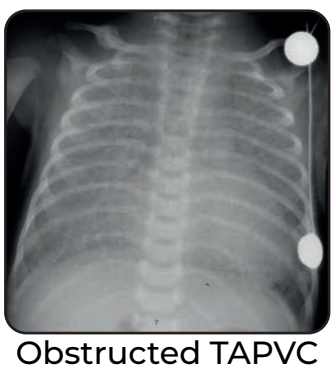
Fail
a) Pulse oximetry of 94% or less in either the right arm or foot or
b) A difference of 4% or more between the right arm and foot
Action: Do not repeat pulse oximetry screening, refer for immediate assessment

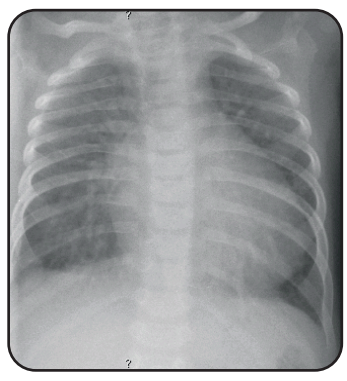
Pass
Pulse oximetry of 95% or more in right arm and foot and a difference of 3% or less between the 2
Action: Do not repeat pulse oximetry screening, provide normal newborn care

Onset of cyanosis	Possible CHD
1st week (Day 1 to 7)	dTGA with intact ventricular septum Hypoplastic left heart or right heart Tricuspid atresia/critical stenosis of PV, MV, AV TOF (severe) or pulmonary atresia TAPVC Truncus arteriosus Ebstein's anomaly
7 days to 1 month	Hypoplastic left heart dextro-Transposition of the Great Arteries (dTGA) TOF Severe PS Truncus arteriosus
Late onset cyanosis	TOF Double outlet right ventricle (DORV) with VSD - PS, dTGA with VSD -PS, Tricuspid atresia with VSD -PS

Hemodynamic approach to CHDs	
Hypotension/shock	Duct dependent systemic circulation (Critical AS, HLHS Severe Interrupted aortic arch) Ventricular dysfunction Arrhythmia with hemodynamic compromise
Severe desaturation	Decreased pulmonary blood flow (duct dependent pulmonary circulation): Pulmonary Atresia, Critical PS TOF with severe PS Ebstein's anomaly Increased PBF & high PA pressure: Transposition
Heart failure	Pulmonary plethora: L -> R shunt With cyanosis/desaturation - CCHD with increased pulmonary blood flow (PBF) With severe desaturation and pulmonary venous hypertension: Obstructed TAPVC

ASK/LOOK/FEEL	CATEGORY	INTERPRETATION
Does the baby have decreased activity and feeds poorly?	Activity and feeding	Decreased activity is a common presentation of heart failure/shock in neonates
Is the baby cyanotic? Pulse Oximetry screen	Cyanosis/Desaturation	Look for bluish discolouration of fingers and tongue. If extremities are blue, to rule out peripheral cyanosis- warm the baby and re check
Is there any evident respiratory distress or Tachypnoea?	Respiration	Chest indrawing/grunting/use of accessory muscles/RR more than 60 per minute
Does the baby have Inappropriate Tachycardia/Bradycardia	Heart Rate	Normal awake new born 100-180 normal sleeping new born 80-160
Is the baby in shock? peripheral temperature	Perfusion	Peripheries cold and clammy OR Cardiac resynchronization therapy(CRT) > 3 seconds, core - difference more than 2 degrees even after warming/external temperature is controlled/ appropriate correction of ambient temperature is done
Is the baby in heart failure?	Heart Failure	Look for Tachypnoea, Tachycardia, Tender Hepatomegaly
Is the baby sucking from the breast normally?	Feeding	Normal: sucking vigorously, no suck rest suck breast cycle, no breathlessness/ forehead sweating while feeding, no prolonged feeding times


Obstructed TAPVC


TGA

APPROACH TO SHOCK

Start PG E1 and refer if:

- Identifiable that femoral pulses are distinctly feeble compared to upper body
- Right arm - Any foot SpO_2 difference more than 3%

Shock
↓
Intravenous/Intraosseous access and fluid resuscitation 10 ml per kg of isotonic fluid, (max 40 ml per kg until perfusion improves or hepatomegaly develops).
Manage Hypothermia, Hypoglycemia, hypocalcemia
Appropriate antibiotic
Monitoring to assess response
↓
Manage shock as per Neonatal shock guidelines
↓
Low threshold for Paediatric Cardiology Evaluation
↓
Refractory Shock, Unlikely to be sepsis - Urgent referral to Pediatric Cardiologist

Septic shock likely if:

- Predisposing maternal and neonatal factors
- Core peripheral temperature difference > 3
- Sepsis Screen Positive

APPROACH TO CYANOSIS

Cyanosis ($<SpO_2<95\%$)
↓
Rule out TAPVC
↓
Chest X-ray S/O whiteout lung/ Ground glass appearance /pulmonary venous hypertension
↓ Yes
If clinical setting makes it unlikely to be Respiratory distress syndrome, Likely obstructed TAPVC -Immediate referral

Significant congenital heart disease likely →

SpO_2 < 80%?
No → Early Paediatric Cardiology Consultation & Echo
Late discharge once diagnosis confirmed
Close SpO_2 monitoring through first week of life (for decrease in SpO_2 on ductal closure)
Heart Failure Management (if only clinical features of CHF) Iron supplementation

Yes → Start PGE1 infusion refer for urgent paediatric cardiology evaluation (within hours)
↑
$SpO_2<80\%$ On serial monitoring

Duct dependent pulmonary circulation (All forms of Pulmonary Atresia/Critical PS) TGA with intact septum

ABBREVATIONS

AS: Aortic Stenosis
AV: Aortic Valve
CCHD: Cyanotic Congenital Heart Disease
CHD: Congenital Heart Disease
HLHS: Hypoplastic Left Heart Syndrome
L->R: Left to Right
MV: Mitral Valve
PA: Pulmonary Artery
PG E1: Prostaglandin E1
PS: Pulmonary Stenosis
PV: Pulmonary Valve
TAPVC: Total anomalous pulmonary Venous Connection
TGA: Transposition of Great Arteries
TOF: Tetralogy of Fallot
TV: Tricuspid Valve
VSD: Ventricular Septal Defect

REFERENCES

1. Gupta SK. Congenital heart disease. In Agarwal R, Deorari A, Paul V, Sankar MJ, Sachdeva A (Eds), AIIMS protocols in Neonatology. Noble Vision Medical Books Publishers, New Delhi 2019. Page 150-164
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INVOLVE A PAEDIATRIC CARDIOLOGIST AS SOON AS CRITICAL CHD IS SUSPECTED

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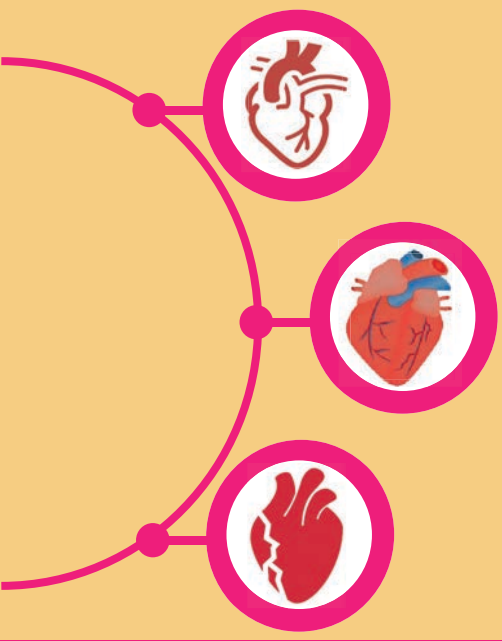
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Standard Treatment Workflow (STW)

PEDIATRIC HEART FAILURE

ICD-10-I50.9



DEFINITION

Clinical and pathophysiological syndrome that results from inability of the heart to function adequately to meet the metabolic demands of the body

CLINICAL SPECTRUM

- Acute decompensated HF
- Chronic compensated HF
- Acute exacerbation of chronic HF

MODIFIED ROSS CLASSIFICATION OF HEART FAILURE

- **Class I:** No symptoms/limitations
- **Class II:** Mild tachypnea/sweating during feeds in infants/ dyspnoea on exertion in older children but no growth failure
- **Class III:** Significant tachypnea or sweating during feeds/marked dyspnoea on exertion/prolonged feeding time with growth failure
- **Class IV:** Symptoms (tachypnoea, retractions, grunting and sweating) even at rest with growth failure

HEART FAILURE OFTEN HAS A TREATABLE CAUSE IN MOST CHILDREN. IDENTIFYING AND TREATING THE CAUSE IS THEREFORE THE MOST IMPORTANT PRIORITY

Category	Specific Conditions
Shunt lesions	VSD, PDA, AP window, AVCD, TGA, Truncus, TAPVC
Obstructive lesions	Critical AS, PS, coarctation/aortic interruption
Regurgitant lesions	Congenital- AV canal defect, Ebsteins anomaly Acquired- RHD, IE, post-operative
Primary Myocardial dysfunction	Dilated cardiomyopathy, Inborn errors of metabolism, muscular dystrophy, drug induced

Category	Specific Conditions
Inflammatory	Myocarditis and other immunoinflammatory conditions
Abnormal rate/rhythm	Tachycardiomyopathy, bradycardia, AV dyssynchrony
Ischemic	Anomalous coronary artery from pulmonary artery, Coronary artery occlusion from other causes
Post- cardiac surgery	Variety of causes (cardiopulmonary bypass, Myocardial preservation etc.)
Abnormal homeostasis	Hypoxia, hypocalcemia, hypoglycemia, sepsis, hypothermia

First Week	7-30 Days	3-6 Months	6 Months - 1 Years	1-10 Years
• Duct dependent systemic circulation ◦ HLHS ◦ Critical AS ◦ Critical Co A ◦ Interrupted arch • Severe Tricuspid regurgitation • Vein of Galen malformation • Fetal/Neonatal myocarditis • Congenital MR	• VSD with Coarctation • Large AP window • Persistent truncus arteriosus • Single ventricle physiology with no PS • TGA-VSD/PDA • Large VSD or PDA especially in preterm infants • All cases listed for the first week	• Large post tricuspid L-R shunts ◦ VSD ◦ PDA ◦ AV canal defects • ALCAPA • Myocarditis/DCM • All examples listed for the 7-30 days category	• Large post tricuspid L-R shunts ◦ VSD ◦ PDA ◦ AV canal defect • Myocarditis/DCM • ALCAPA	• Heart valve disease (RHD) • Myocarditis/DCM • Aortoarteritis • Palliated CHD • Post KD coronary arteriopathy • Idiopathic PAH

SYMPTOMS

Neonate	Infant	Older children
• Lethargy • Fast breathing • Poor suck • Reduced urine output • Cold extremities	• Rapid and labored breathing • Excessive sweating • Feeding difficulties (suck-rest-suck cycles) • Poor growth • Frequent chest infections	• Breathlessness • Effort intolerance • Growth retardation • Puffiness of face, extremities • Abdominal distension

SIGNS

- Tachypnea and labored respiratory efforts with intercostal and subcostal recession (RR>60/min in less than 1 year old and >50/min in 1-2 year old)
- Tachycardia (HR>160/min in less than 1 year old, >140/min between 1-2 year old)
- Hepatomegaly
- Auscultation-Crackles at lung bases (limited sensitivity and specificity)
- S3 gallop, murmurs
- Raised JVP (not useful in infants)
- Peripheral edema

RED FLAGS

- Reduced peripheral perfusion
- Reduced urine output
- Elevated lactate levels
- Altered sensorium

INVESTIGATIONS

HEART FAILURE MIMICS

- Sepsis
- Respiratory distress syndrome
- Inborn errors of metabolism
- Bronchiolitis (infants)

ESSENTIAL INVESTIGATIONS

Chest x-ray

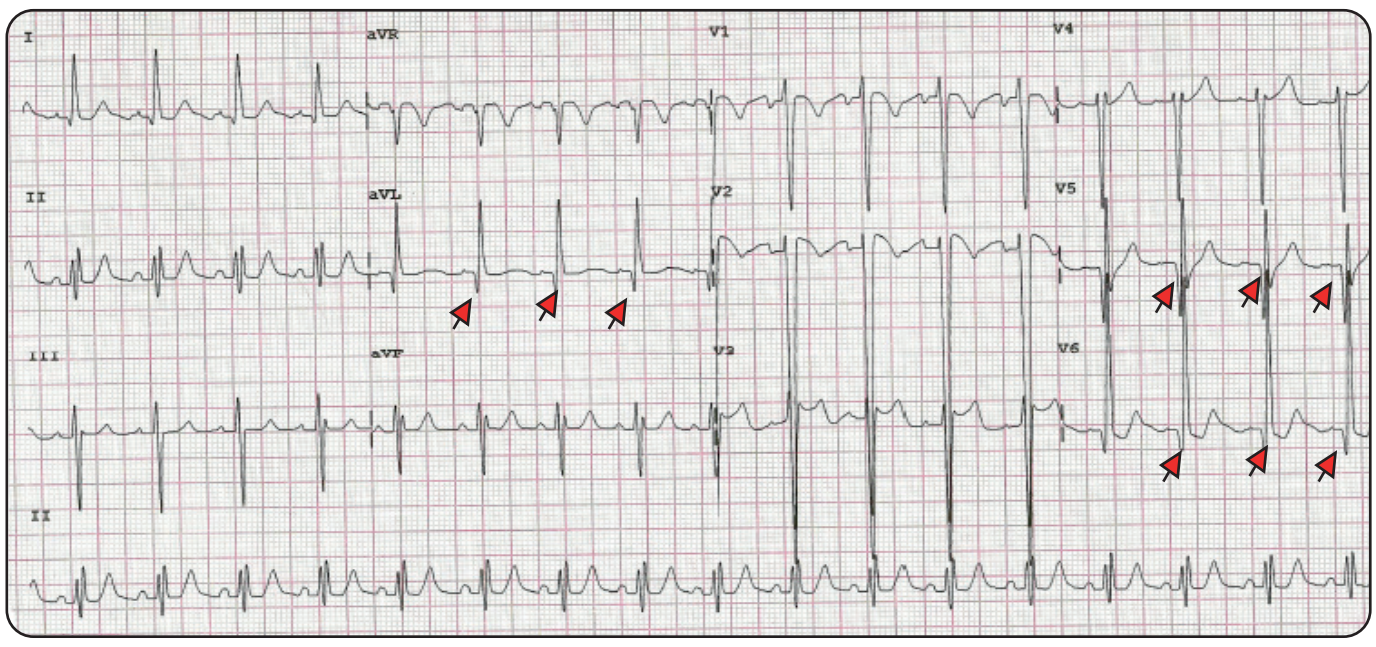
Information on cardiac silhouette, pulmonary vasculature, pulmonary artery dilatation and associated skeletal abnormalities

ECG

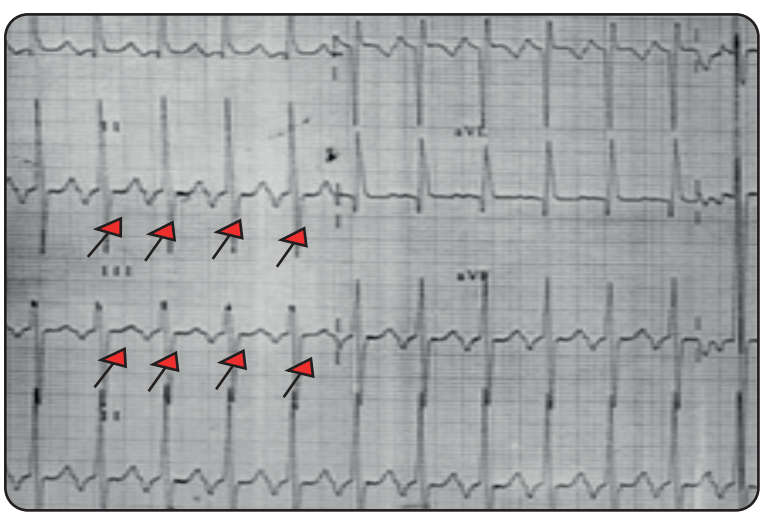
Diagnosis of treatable causes of heart failure such as persistent tachyarrhythmia, ALCAPA and, hypocalcemia. Other specific causes such as Pompe's disease, specific forms of cardiac muscle involvement in muscular dystrophy have ECG manifestations

Echocardiogram

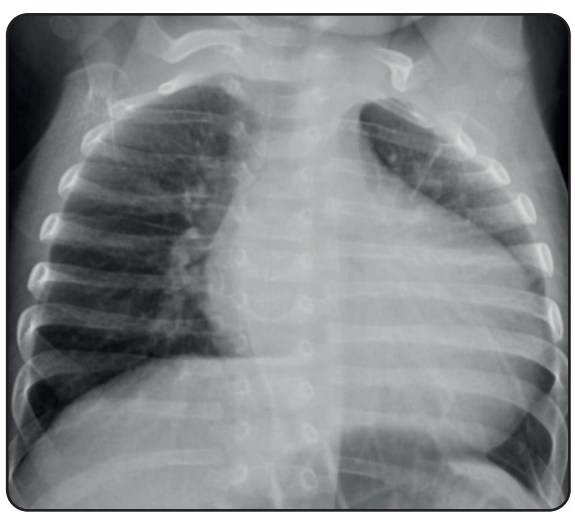
Critically important to accurate diagnosis and tailoring response to therapy



12 lead ECG showing classical pattern of q 1, aVL,V5-6 , a case of ALCAPA



Tachycardiomyopathy is suggested by abnormal P waves (inverted in II, III and aVF) additional clues are fixed and rapid heart rates



CXR showing cardiomegaly, a case of dilated cardiomyopathy

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PEDIATRIC HEART FAILURE

(Continued)

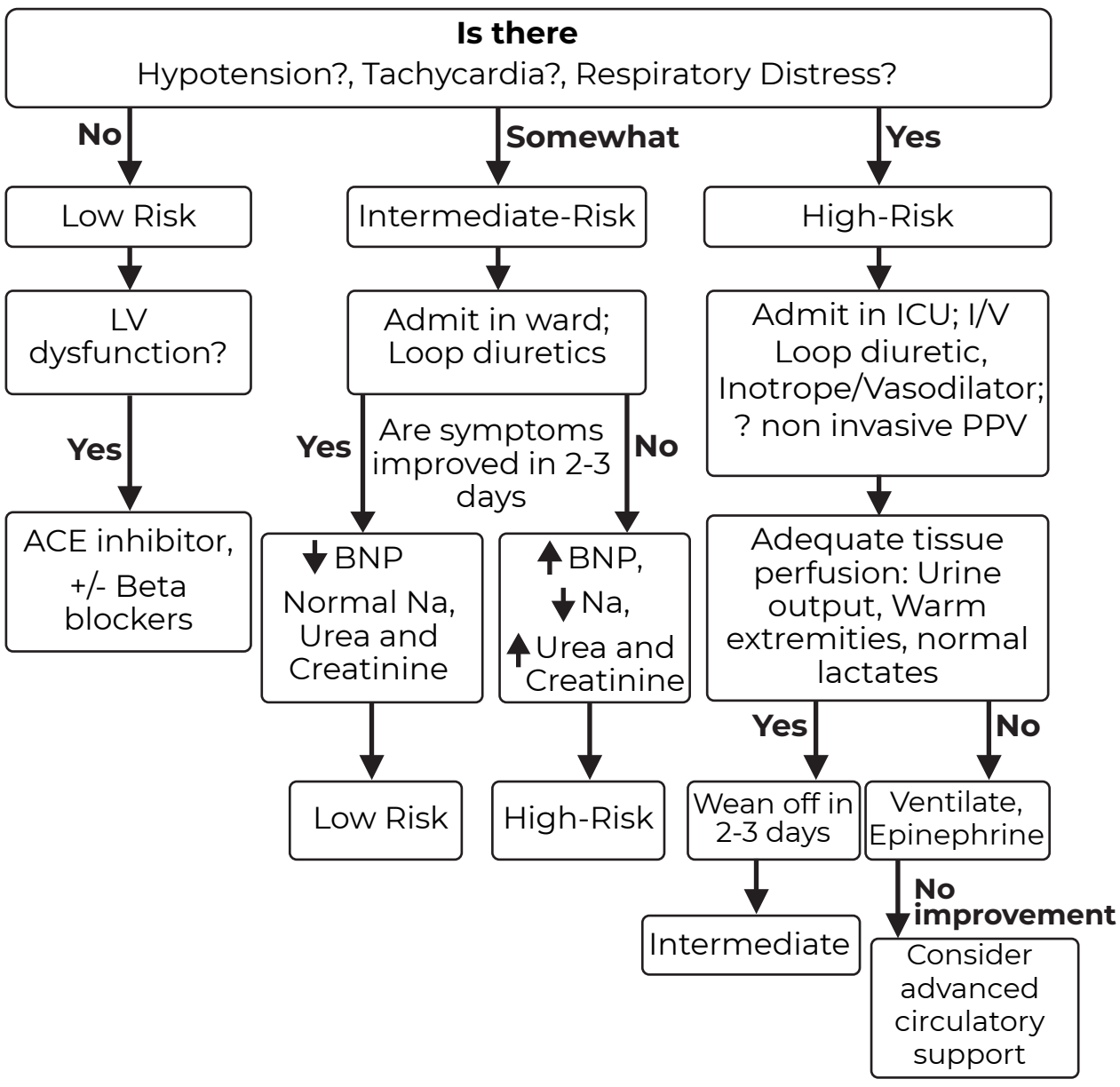
Essential blood tests to be performed in all	Utility
Complete blood count; CRP	Identifying Sepsis, Anemia
Electrolytes and urea, creatinine	Elevated urea, creatinine may indicate decompensated HF or may result from medication side effects. Electrolyte imbalance is a common association of HF and diuretic use. Hypocalcemia can cause ventricular dysfunction leading to HF
Liver function test	Elevated bilirubin, liver enzymes and prolonged prothrombin time points towards congestive hepatopathy. Hypoalbuminemia points to chronic HF and poor nutrition
Optional tests to be decided based on clinical situation	
Arterial blood gas with lactate	Lactic acidosis- as a marker of tissue perfusion and helps monitor response to treatment; It is also elevated in specific inborn errors of metabolism
Thyroid function test	Thyroid hormone imbalance could be a primary cause or may lead to worsening of symptoms
Brain Natriuretic Peptide (BNP)	It helps differentiate HF from respiratory disease. Useful in monitoring response to therapy
Cardiac enzymes (troponin I, T, CKMB) and Viral Panel	In suspected cases of myocarditis

Management Goals

Correct the underlying cause

Reduce associated morbidity and mortality

Improve functional status and quality of life



General Measures

- **Fluid restriction**
  - In acute HF with lung congestion, peripheral edema despite diuretics and in presence of hyponatremia
- **Rest and restriction of activity**
  - Activity as tolerated for older children with chronic compensated HF
- **Correction of Anaemia**
  - Hematinics; Blood transfusion only for severe anemia (Hb < 7gm/dl)
- **Nutrition**
  - NG feeds for infants in acute severe HF.
  - In infants calorie intake of 120-150kcal/kg/with a fluid intake of 100 ml/kg/day. (thickening of feeds or by adding coconut oil/medium chain triglyceride). In older children increase protein content of diet while optimizing the fat and carbohydrate intake. Supplement Ca and Vit D3;
  - Dietary restriction of sodium is generally not recommended in children unless there is severe edema unresponsive to diuretic therapy
- **Supplementary oxygen**
  - May be necessary when there is respiratory distress but must be used with caution in L-R shunts and avoided in neonates with duct dependent lesions

Inotropes should be physiologically appropriate:

- Avoid vasodilators in presence of fixed outflow obstruction (AS); use vasodilators for regurgitant lesions, pump failure and large shunts
- Avoid using very high doses for sustained periods (Preferably adrenaline < 0.1; dopamine or dobutamine < 15 mcg/g/min)

ABBREVATIONS

ACEI: Angiotensin Converting Enzyme Inhibitor

ALCAPA: Anomalous Origin of Left Coronary Artery from Pulmonary Artery

AP Window: Aorto-Pulmonary Window

AS: Aortic Stenosis

AVCD: Atrio-Ventricular Canal Defect

AVCD: Atrio-Ventricular Canal Defect

CoA: Coarctation of the Aorta

CKMB: Creatine Kinase Myoglobin Binding

CRP: C-reactive Protein

DCM: Dilated Cardiomyopathy

HF: Heart Failure

HLH: Hypoplastic Left Heart

HR: Heart Rate

IE: Infective Endocarditis

JVP: Jugular Venous Pressure

KD: Kawasaki Disease

LV: Left Ventricle

MR: Mitral Regurgitation

NG: Naso-Gastric

PAH: Pulmonary Arterial Hypertension

TAPVC: Total Anomalous Pulmonary Venous Connection

PDA: Patent Ductus Arteriosus

PPV: Positive Pressure Ventilation

PS: Pulmonary Stenosis

RHD: Rheumatic Heart Disease

RR: Respiratory Rate

TGA: Transposition of Great Arteries

VSD: Ventricular Septal Defect

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PEDIATRIC HEART FAILURE IS BEST MANAGED IN CONSULTATION WITH A PEDIATRIC CARDIOLOGIST

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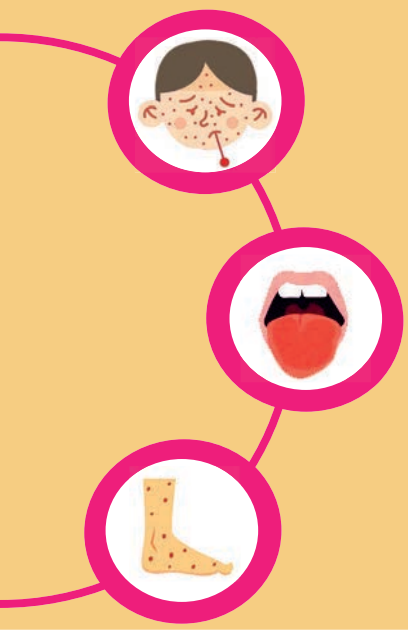
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Standard Treatment Workflow (STW)

KAWASAKI DISEASE

ICD-10-M30.3

Any child with fever for more than 5 days should be evaluated for KD



SPECIFIC SIGNS

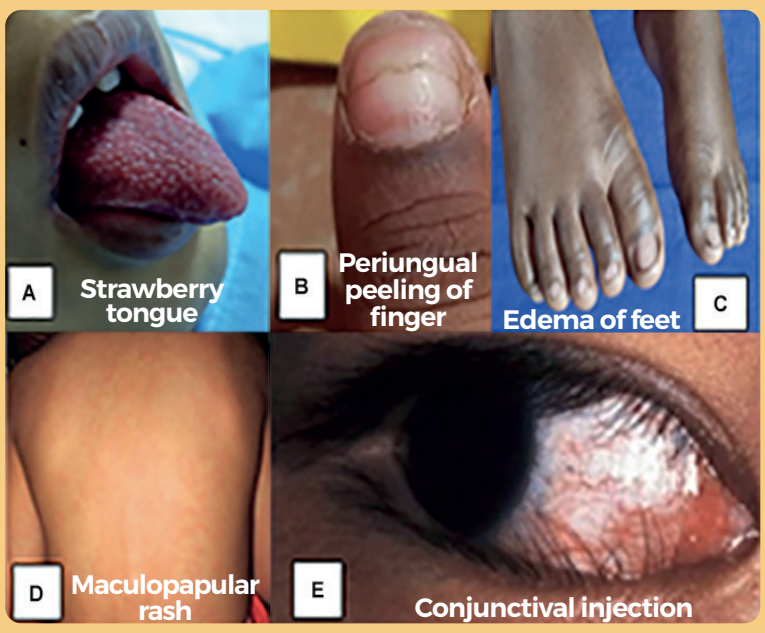
A. Lips and oral cavity:
Erythema & Lip cracking
Strawberry tongue and/or Diffuse erythema of oral & pharyngeal mucosa

B. Changes in extremities:
Erythema of palms, soles
Dorsal edema of hands & feet
Periungual peeling of fingers, toes (2nd & 3rd week)

C. Polymorphous exanthem:
Rash – maculopapular or erythema multiforme-like

D. Eyes: Bilateral conjunctival injection without exudate

E. Cervical lymphadenopathy (>1.5cm diameter) - mostly unilateral



OTHER CLINICAL FINDINGS

GIT: Diarrhea, vomiting, abdominal pain

RS: Cough, rhinorrhea

CVS: Signs of CCF, new onset murmur, gallop

MUSCULOSKELETAL: Arthritis, arthralgia

CNS: Extreme Irritability

OTHERS: Induration at BCG scar site

EXCLUDE OTHER COMMON DISEASES WITH SIMILAR FINDINGS

INFECTIONS
Viral: Measles, Adenovirus, Enterovirus, EBV, CMV
Bacterial: Scarlet fever, Bacterial cervical lymphadenitis, Meningococcemia, leptospirosis

RHEUMATOLOGICAL DISEASE
Systemic onset juvenile idiopathic arthritis

OTHERS
TSS, SSSS, Drug hypersensitivity reaction, SJS

≥ 4 signs: **CLASSICAL KD** → Investigations → Treatment

Fever (≥ 5 days) & < 4 signs: OR Infants with fever (≥ 7 days) → Consider **INCOMPLETE KD** → Refer to a District Hospital/ Tertiary Pediatric Hospital

Reassess Patient characteristics

- CRP < 3 mg/dL ESR< 40 mm/hr → Serial clinical and lab re-evaluation if fever persists; ECHO if peeling develops under nailbeds
- Investigations
- CRP≥ 3 mg/dL and/ or ESR≥ 40 mm/hr → ≥ 3 lab findings:
  - Anemia for age
  - Platelet count ≥ 4.5 lakhs (> 7 days of fever)
  - Albumin ≤ 3 g/dL
  - Elevated SGPT
  - WBC ≥ 15,000/mm³
  - Urine > 10 WBC/hpf

  or
  - Positive Echocardiogram

  → Yes → **INCOMPLETE KD** → Treatment

  → No

CONSIDER KD IN DIFFERENTIAL DIAGNOSIS IF PROLONGED FEVER OCCURS IN:

- Infants < 6 months with irritability
- Infants with unexplained aseptic meningitis
- Infants or children with unexplained or culture –negative shock
- Infants or children with cervical lymphadenitis unresponsive to antibiotics
- Infants or children with retropharyngeal phlegmon unresponsive to antibiotics

WHEN NOT TO CONSIDER KD?

- Bullous/vesicular rash
- Exudative conjunctivitis
- Exudative pharyngitis
- Ulcerative oral lesions
- Generalized lymphadenopathy
- Splenomegaly

DISCUSS WITH RHEUMATOLOGIST

- Infants with KD
- Children with coronary dilatation at time of diagnosis
- Children with shock and myocarditis
- Children who have features of secondary MAS

May need primary intensification of therapy in addition to IVIG (Infliximab, Steroids, Cyclosporine, etc.)

MANAGEMENT

INVESTIGATIONS

- CBC
- CRP
- ESR
- Serum electrolytes
- LFT
- Urine microscopy
- Echocardio-gram

WHAT TO LOOK FOR?

- **CBC:** Leukocytosis –Neutrophilia, Anemia, Thrombocytosis (in 2nd week)
- **CRP-** ↑
- **ESR-** ↑
- **LFT:** SGOT, SGPT - ↑, Albumin ↓
- **Serum electrolytes** – Sodium ↓
- **Urine microscopy-** Sterile pyuria
- **ECHO-** Coronary artery dimensions, perivascular brightness, lack of tapering, LV dysfunction, mitral regurgitation, pericardial effusion

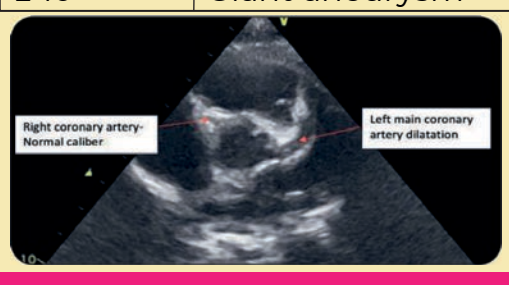
ECHOCARDIOGRAPHY - TO BE DONE BY A PAEDIATRIC CARDIOLOGIST

Positive ECHOCARDIOGRAM:
Any one of the below-

- RCA or LAD Z score: ≥ 2.5
- Coronary artery aneurysm
- ≥ 3 of the following:

LV dysfunction, Mitral regurgitation, pericardial effusion, RCA or LAD Z score: 2 - 2.5

Z-SCORE CLASSIFICATION	
< 2	Normal
2-2.5	Only dilatation
≥ 2.5 to < 5	Small aneurysm
≥ 5 to < 10	Medium aneurysm
≥ 10	Giant aneurysm



2-D ECHO imaging:
Aim for highest resolution & frame rate possible
Phased array transducer with highest frequency possible

- Narrow sector width
- Adjust focus to region of interest
- Reduce depth
- Zooming in
- Optimize gain

TREATMENT

WHEN TO START IVIG?

- In children who meet diagnostic criteria as soon as possible (ideally within 10 days of fever onset)
- Even after 10 days of illness if evidence of systemic inflammation is present (elevated ESR/ CRP) with fever
- Recurrent KD (repeat episode after complete resolution of previous episode)

Unavailability of ECHO should not delay IVIG if diagnostic criteria are met

- Intravenous Immunoglobulin-IVIG (2g/kg) as a single infusion over 10-12 hours
- Aspirin 80-100 mg/kg/day in 4 divided doses –till child is afebrile or 48 to 72 hrs after cessation of fever

↓

Aspirin: 3-5 mg/kg/day for 6 to 8 weeks

LONG TERM THROMBOPROPHYLAXIS FOR CORONARY ARTERY INVOLVEMENT

CORONARY ARTERY	DRUG	DURATION
No involvement	Aspirin* 3-5 mg/kg/day	6-8 weeks
Only dilatation	Aspirin* 3-5 mg/kg/day	6-8 weeks
Small aneurysm	Aspirin* 3-5 mg/kg/day	Till aneurysm resolves (Consult pediatric cardiologist)
Medium aneurysm	Aspirin* 3-5 mg/kg/day + Clopidogrel 0.2-1mg/kg/day	
Giant aneurysm	Aspirin* 3-5 mg/kg/day + Anticoagulation (Warfarin: 0.2 mg/kg/day loading, then 0.1mg/kg/day or LMWH 1mg/kg/day)	

*If patient is intolerant/resistant to Aspirin - use Clopidogrel

TREATMENT OPTIONS FOR IVIG RESISTANCE (PERSISTENT OR RECRUDESCENT FEVER 36 HOURS AFTER THERAPY WITH IVIG)

DRUGS	DOSE	DURATION
IVIG (second infusion)	2g/kg IV	Single dose
Pulse methyl prednisolone followed by Oral prednisolone in tapering doses	Intravenously (10-30 mg/kg/day) 2mg/kg	3-5 days Till CRP is normal, then taper over 2-3 weeks
Infliximab	5mg/kg IV over 3-4 hours	Single dose

ABBREVATIONS

CBC: Complete Blood Count
CMV: Cytomegalovirus
CRP: C-reactive Protein
EBV: Epstein-Barr Virus
ESR: Erythrocyte Sedimentation Rate
KD: Kawasaki Disease
LAD: Left anterior Descending Artery
LFT: Liver Function Test
LMWH: Low Molecular Weight Heparin
LV: Left Ventricle
MAS: Macrophage Activation Syndrome
RCA: Right coronary Artery
SGOT: Serum Glutamic Oxaloacetic Transaminase
SGPT: Serum Glutamic-Pyruvic Transaminase
SJS: Stevens-Johnson Syndrome
SSSS: Staphylococcal Scalded Skin Syndrome
TSS: Toxic Shock Syndrome
WBC: White Blood Cell

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DELAY IN DIAGNOSING KAWASAKI DISEASE CAN RESULT IN ADVERSE CLINICAL OUTCOMES

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Standard Treatment Workflow (STW)

LEFT TO RIGHT SHUNT LESIONS

ICD-10-Q21.8

INTRODUCTION

- Most common type of congenital heart defects
- One of the common causes of infant morbidity and mortality
- Majority of the lesions are easily correctable if detected on time

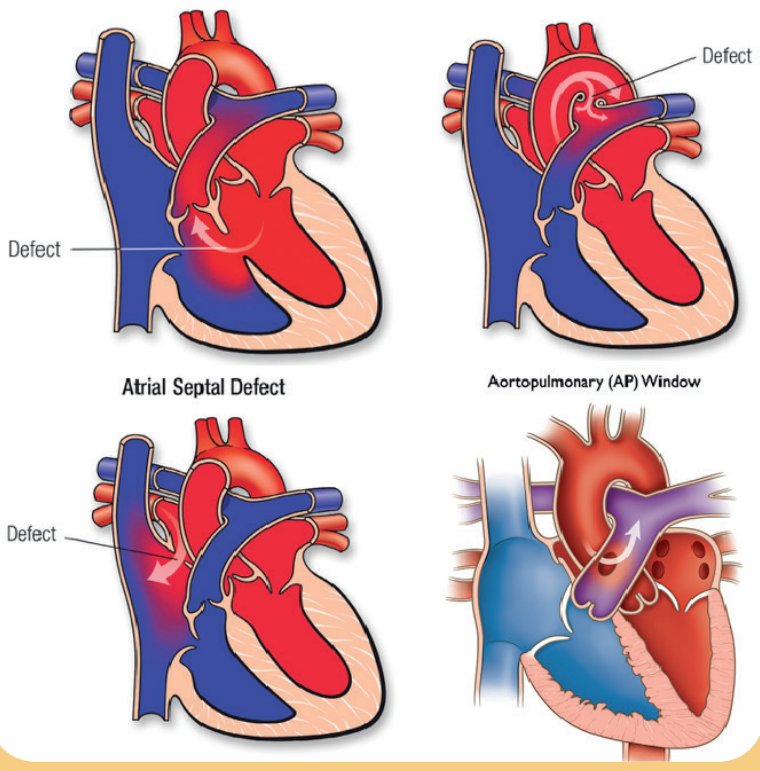
PHYSIOLOGY

- Left to right shunt lesions lead to passage of oxygenated blood from left side of heart to right side and into the lungs
- As a result there is increased flow to the lungs and over circulation of blood within the lungs and left side of the heart
- Majority of symptoms of shunt lesions are due to this over circulation

COMMON LEFT TO RIGHT SHUNT LESIONS

- **Pre-tricuspid shunts:**
  - Atrial septal defect (ASD): Usually asymptomatic. Presents commonly as incidentally detected murmur
- **Post-tricuspid shunts:**
  - Ventricular septal defect (VSD)
  - Patent ductus arteriosus (PDA)
  - Aorto-pulmonary window (APW)

Large post-tricuspid shunts present early (usually by 1.5-2 months of age) with signs of cardiac failure like feeding and breathing difficulty along with failure to thrive



MANAGEMENT

WHEN TO SUSPECT?

1. Failure to thrive (weight less than 3rd centile for age, drop in weight by more than 2 major centile lines)
2. Feeding difficulty (suck-rest-suck cycle) with forehead sweating (cold sweats)
3. Repeated chest infections/one life threatening infection
4. Baseline tachypnea with subcostal and intercostal retractions:
   - Rate > 60/min in less than 1 year old
   - Rate > 50/min between 1-2 year old
5. Tachycardia:
   - Rate > 160/min in less than 1 year old
   - Rate >140/min between 1-2 year old
6. Bounding (high volume) pulse (in PDA and APW)
7. Precordial bulge with active precordium
8. Loud second heart sound, gallop rhythm, ejection systolic murmur, mid-diastolic murmur (Large shunts may not have loud murmurs)
9. Hepatomegaly
10. Dysmorphic features: Down syndrome are known to be associated with Atrioventricular septal defect(AVSD)
11. Abnormal peripheral pulses especially feeble lower limb pulses

Timely referral to higher centre with pediatric cardiac facility

- Shunt lesions are confirmed by echocardiography
- Large post tricuspid shunts require early referral

Drugs

- Furosemide: 1-2 mg/kg/dose twice or thrice daily (reduce or temporarily stop during diarrhea or vomiting). Oral suspension contains 10 mg/ml. So can be given as 0.1 ml/kg/dose twice or thrice daily
- Add Spironolactone if Furosemide is administered more frequently than once daily
- Digoxin: 5 microgram/kg/dose twice daily. Oral preparation contains 50 microgram/ml. So can be given as 0.1 ml/kg/dose twice daily

General Advice

- Educating parents about importance of maintaining hygiene to prevent infections
- Promoting breastfeeding if tolerated. If breastfeeding is difficult then teach gavage/spoon feeding, preferably with expressed breast milk
- Use top milk in case of reduced breastmilk output. Average volume intake should be approximately 120 mL/kg/day
- Include energy dense weaning foods in those beyond 6 months of age
- Continue vaccination as per Indian Academy of Pediatrics (IAP) schedule
- Vitamin D3, calcium and iron supplementation to be continued as per IAP recommendations and clinical requirement



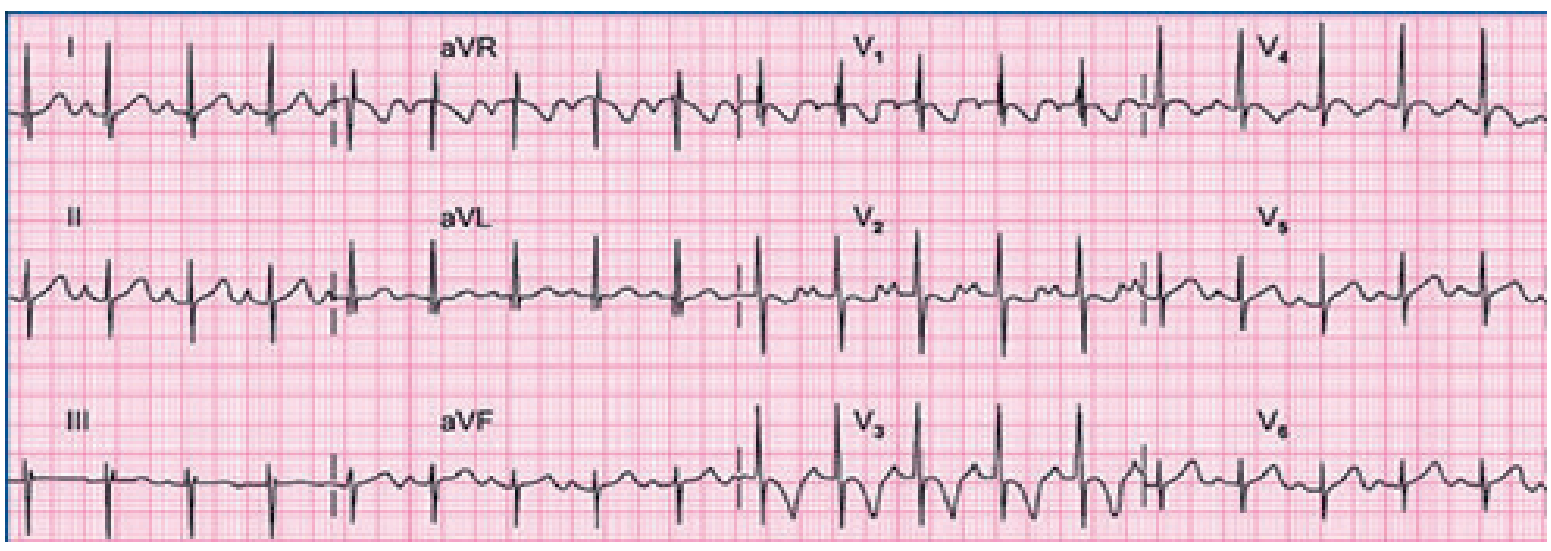
Cardiomegaly & increased vascular markings in shunt lesion



Harrison sulcus



Precordial bulge (left side)



12-lead ECG showing left axis deviation in a patient with AV septal defect

INVESTIGATIONS

Essential

- X-ray Chest, Echo
- ECG - To watch for unexpected abnormal axis, rate, rhythm and QRS complex
- CBC, Electrolytes - Depending on clinical conditions and specific clinical circumstances

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TIMELY CORRECTION OF SHUNT LESION ENABLES NEAR NORMAL QUALITY OF LIFE

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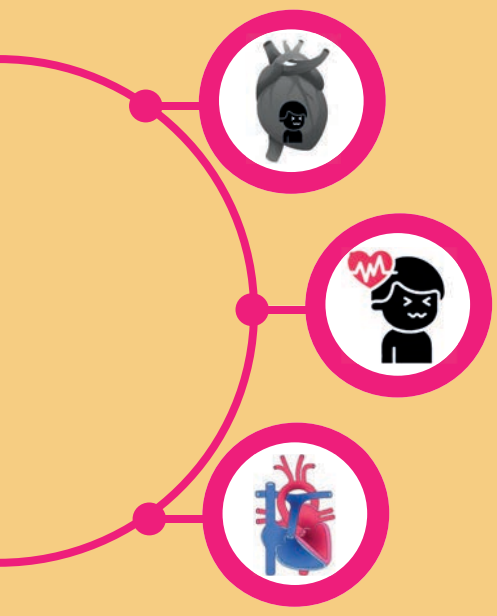
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Standard Treatment Workflow (STW)

TACHYARRHYTHMIA

ICD-10-P29.11



SUSPECTING TACHYARRHYTHMIA SYMPTOMS

- Palpitations/chest discomfort
- Parents may report increased precordial activity or observe neck pulsations
- Unexplained lethargy
- Syncope/presyncope: Relatively rare in children but potentially serious

SIGNS

- Tachycardia out of proportion to clinical condition
- Irregular heart rate
- Unexplained heart failure

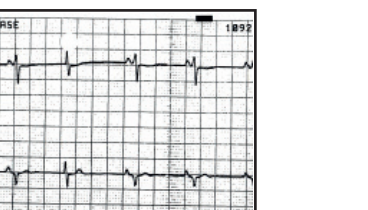
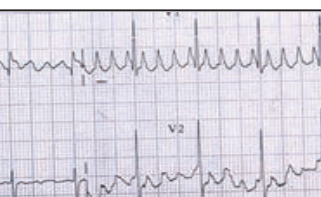
KEY QUESTIONS

- Is there hemodynamic instability?
- Can the heart rate be explained by clinical condition (Fever etc.)
- Is the arrhythmia incessant or episodic?
- Is there an underlying structural heart disease?
- Is this a re-entrant arrhythmia or does it involve an automatic focus?

MANAGEMENT

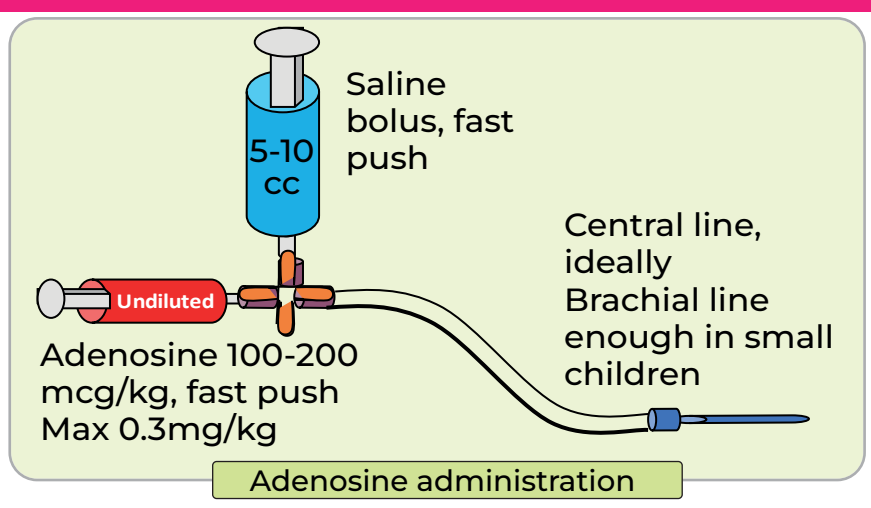
Hemodynamic Stability

Stable	Unstable
Common Stable/minimally distressed Good perfusion	Uncommon Distressed In shock Poor perfusion; pulse not felt
	Connect to Defibrillator paddles

Narrow QRS tachycardia	Regular Wide QRS tachycardia	Irregular Wide QRS tachycardia
		
Synchronized Cardioversion 1J/Kg		Defibrillation 2 J./Kg

Obtain

1. 12 lead ECG; Limb leads alone if child does not cooperate (If ECG machine is unavailable, a video recording of the monitor must be obtained)
2. Reliable I/V access; Proximal sites preferred



Adenosine administration

REGULAR TACHYCARDIA

Sinus tachycardia suggested by:

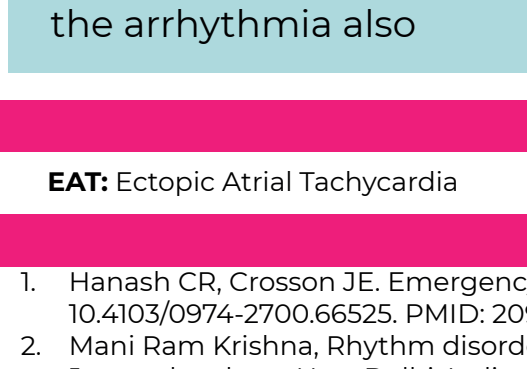
- Heart rates <220 -age
- Subtle variations in rates
- Associated fever/systemic illness other conditions
- Bronchodilators/ Adrenaline nebulization
- Normal p prior to every QRS

Tachyarrhythmia suggested by:

- Fixed rates often >220 -age
- Tachycardia not explained by clinical condition
- Abnormal ECG (p waves not clearly seen or different from sinus rhythm or dissociated)
- Adenosine administration with ECG record is often diagnostic

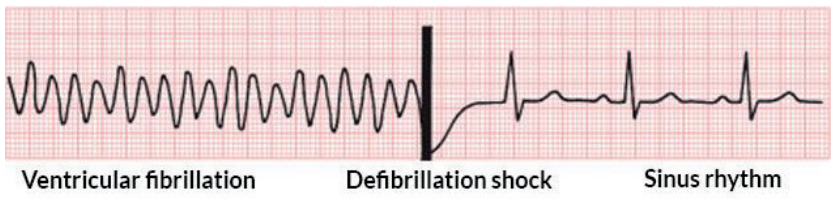
Obtaining ECG during arrhythmia is of great value as it enables precise diagnosis and treatment. All efforts must be made to document the tachyarrhythmia and it's response to treatment

Adenosine

Sudden termination	No effect	Slow and unmask
		
Re-entrant supraventricular tachycardia	Sinus tachycardia, Junctional ectopic tachycardia, EAT	Atrial Flutter, ectopic atrial tachycardia (EAT)

Defibrillation

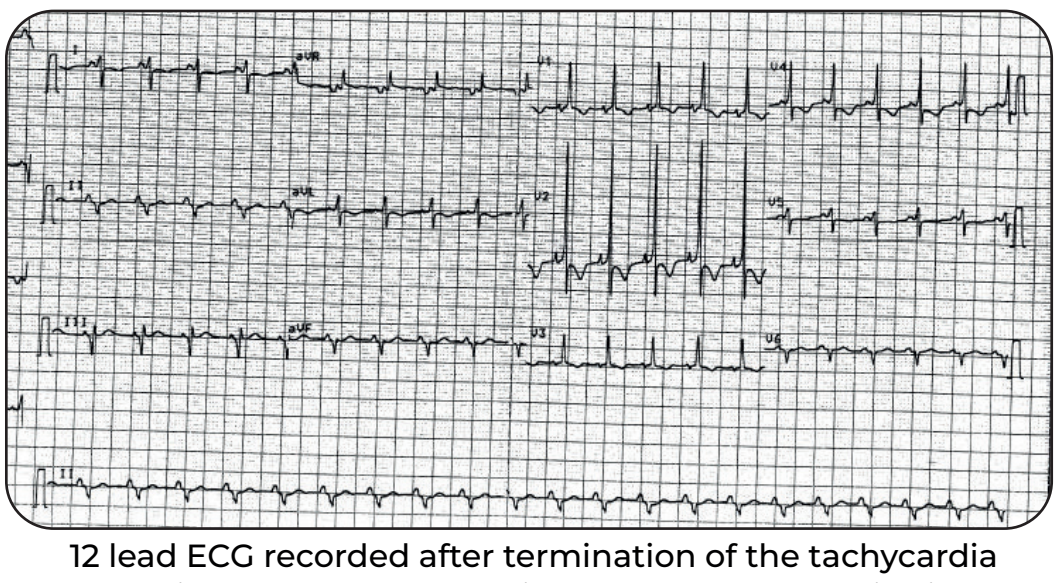




0.5-2 J/Kg synchronized for suspected SVT/VT
2-4 J/Kg for VF; should not be synchronized

Adenosine

- Proximal access
- Connect three-way to I/V port
- Adenosine 100-200 mcg/Kg rapid I/V push followed immediately by 5-10 ml saline bolus
- Always record Electrocardiogram (ECG) during administration
- Always record Electrocardiogram (ECG) after treating the arrhythmia also



12 lead ECG recorded after termination of the tachycardia showing a clear substrate in the form of pre-excitation

ABBREVATIONS

EAT: Ectopic Atrial Tachycardia **SVT:** Supraventricular Tachycardia **VT:** Ventricular Tachycardia

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ALWAYS TRY IDENTIFY AND DOCUMENT THE ARRHYTHMIA PRIOR TO TREATMENT

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2024 EDITION
VOLUME IV