

## Treatment of Heart Failure

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In order to manage cardiac failure we need to classify cardiac failure into categories:

- a) Acute; history of onset in days or hours.
- b) Chronic or recurrent; history of onset of more than 3 month duration.
- c) Sub acute; onset of symptoms of less than 3 month duration.

Common causes in children are:

- a) Rheumatic valvular heart disease.
- b) Myocarditis (1% of all new Paediatric out patients at the National Institute of Cardiovascular diseases).

Common causes in adults are:

- a) Ischemic heart diseases and its complications.
- b) Hypertensive heart disease.
- c) Rheumatic heart disease.
- d) Cardiomyopathies.

Note:—

Acute heart failure should be managed in the hospital.

Chronic or recurrent cardiac failure, if not severe, can usually be managed in the out-patient department.

Sub-acute group usually needs admission.

Determine the severity of heart failure whether,

- a) Mild heart failure.
- b) Moderate heart failure or
- c) Severe heart failure.

Mild severity heart failure:

1. No respiratory distress is present.
2. Mildly elevated respiratory rate i.e tachypnea (more than 40 breaths per minute in infants and greater than 20 breaths per minute in old children and adults).
3. Mildly elevated heart rate.
4. Peripheral oedema is not present.
5. The heart is mildly enlarged on chest X-Ray film (50% Cardiothoracic ratio (CT) ratio in the older children and adults and 50-60 (CT) ratio in younger children).
6. Liver enlargement is marginal 2-3cm below the costal margin at the mid clavicular line.
7. On auscultation occasional crepitation occasional crepitations are audible over the lungs and jugular venous pulse (JVP) is visible at lower fourth part of the neck in sitting position.

Moderate severity heart failure:

1. There is mild respiratory distress as shown by the intercostal recession in children and thin adults.
2. Mild to moderate elevation of pulse rate (50% increase over the normal basic rate for age).
3. Definite liver enlargement, greater than 2-3cm, and mild oedema of peripheral areas.
4. Top level of the Jugular venous pulse is seen at the mid neck, in sitting position.
5. Chest crepitations; up to mid chest, are present.
6. CT ratio of 60-70% on chest X-Ray film and no Evidence of pulmonary oedema.

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**Severe heart failure:**

1. Marked respiratory distress with intercostal and subcostal recession (and flaring of alae nasi in children).
2. Central cyanosis.
3. Dry cough with or without bloody frothy sputum and or Bronchospasm.
4. Inability to lie flat in bed (Grade IV disability).
5. Generalised pitting edema (Recurrent failure).
6. Gross hepatomegaly greater than 5-6cm at the mid clavicular line, may be absent in acute states such as acute Myocarditis or acute Myocardial Infarction.
7. Markedly elevated Jugular venous pulse up to the angle of jaw in sitting position.
8. Marked venous congestion on X-Ray chest film (CT ratio may be less than 0.5 in some acute forms of failure).
9. Signs of shock:
  - a) Unrecordable or reduced blood pressure, less than 60-70mm Hg systolic in infants and less than 90-80mm Hg in children and adults, feeble or thready radial or brachial pulse.
  - b) Cold peripheral extremities with warm trunk.
  - c) Cold, pale or mottled extremities with peripheral cyanosis.
  - d) Arterial blood gases may show:
    - a) Reduced PH less than 7.3 (normal range, 7.35 - 7.45).
    - b) Reduced  $p_{aO_2}$ , less than 80-60mm Hg; (normal greater than 84mm Hg).
    - c) Increased  $P_{aCO_2}$ , greater than 48mm Hg; (normal 35-48mm Hg).

Diagnostic guide lines for detecting congestive heart failure in the new born (First four weeks of life).

- A. Mild Congestive heart failure (CHF); any three of the following.
  1. Cardiomegaly (Cardiothoracis ratio greater than 0.6).
  2. Tachpnea (greater than 60/min).
  3. Crepitation in the lungs.
- B. Moderate congestive heart failure.
 

Criterion A plus any of the following.

  1. Gallop rhythm; S3 or S4.
  2. Hepatomegaly (Greater than 3cm or more).
  3. Frank pulmonary edema.

## C. Severe congestive heart failure.

Vascular Collapse: Impalpable or markedly diminished feeble and thready peripheral pulses. Cold pale and mottled Extremities. Unrecordable blood pressure.

**MANAGEMENT OF HEART FAILURE (CHF).**

Laboratory work up: Complete blood picture, including packed cell volume and differential white cell count.

Platelet count and Fibrin split products (In cases of severe CHF).

Blood urea and serum creatinine (In moderate to severe CHF).

Serum calcim (Newborn with CHF).

Blood sugar.

Serum Elctrolytes.

Liver function tests (Moderate to severe cases).

Urine - Routine.

Stool - Routine.

Blood cultures, Sputum and throat cultures. Arrange ECG and X-Ray chest portable in acute cases.

Arrange arterial blood gases analysis by Radial artery puncture.

Treat acute congestive heart failure in the hospital:-

1. Oxygen by mask (4-5l/min flow) or nasal catheter (1-2 l/min flow) or by hood with venturi valves by which oxygen in different concentrations can be given.
2. Place infants in infant seat with elevation at  $45^\circ$  angle. Elevate the bed at  $45^\circ$  for adults.
3. If previously not digitalized, digitalize by using IV digoxin; given equal to 1/2 of the total 24 hours digitalizing doses stat then evaluate remaining amount to be given either intravenously or orally in two 8 hourly doses; remember intravenous does is 70% of the oral dose. Digoxin is the most commonly used preparation of digitalis.

Calculation of 24 hour dose of Digoxin:-

- a) For Infants less than 2 years age, oral dose is 0.03 mg/pound body weight to be given in 3 to 4 doses. In acute emergencies give 1/2 of the amount by intravenous route stat and 1/4 and 1/4 of the remaining amount at 8 hour intervals. After 8 hours of the last

dose, use 1/4 to 1/5 of the total 24 hours dose as maintenance to be given in 2 divided oral doses daily.

Omit further dose of digoxin if heart rate is less than 100/min in infants and less than 80/min in children and less than 60/min in adults.

Children greater than 2 years of age require 0.02 mg/pound body Wt as 24 hour digitalizing dose. Do not exceed adult dose of 1 - 2 mg/ day. Evaluate clinical condition prior to selecting the mode of administration of subsequent doses.

A patient with acute myocardial infarction in cardiac failure is not digitalised unless there is concomittant atrial fibrillation with rapid ventricular rate. As a routine, immediate control of failure is established by IV diuretics and a maintenance dose of Digoxin is started if the patient is in sinus Rhythm.

#### Inotropic and vasodilator therapy :

Oral vasodilator therapy can be given for severe acute CHF with drugs such as Isordil (Isosorbide dinitrate).

Sublingual Isordil 5-10mg can be given at 2 hourly interval.

Acute Emergency situation demands intravenous Inotropic therapy with Isuprel, dopamine or dobutamine or Nitroglycerine.

If blood pressure is greater than 90mm Hg intravenous vasodilator therapy with Nitropruside and Nitroglycerine can be tried (see protocol for shock).

#### Indication for intravenous inotropic support:

Cold peripheral extremities.

Reduced blood pressure, less than 80-90mm Hg.

Continued signs of CHF.

Diminished Urine out put (Less than 1-2ml/Kg/ hour).

Unimproved Pulmonary arterial wedge pressure (CVP) i.e greater than 18mm Hg.

#### Diet:

In infants low salt feeding formula are rarely used. In older children, particularly those with Rheumatic heart disease, restriction of additional salt in the diet should be advised, in severe congestive failure and in adults complete salt restriction may be advised.

#### Fluids:

If an infant has respiratory rate which is greater than 50-60 per min, avoid oral feeding.

Intravenous IV fluids are given at a rate of 50-60 ml/kg/day as 5% DW+0.2% saline and this amount can be increased gradually depending upon the clinical response and urine out put.

Give 1/2 to 3/4 of the maintenance allowance by intravenous drip, depending upon the severity of heart failure.

In adults if inappropriate Antidiuretic Hormone secretion is not present, salt restriction without water restriction may be advised.

#### Diuretics:

Lasix (Frusamide) 1 mg/kg/IV stat, this can be increased to 2-3 mg/kg/IV at 2-4 hourly intervals for all age group; change to oral route after stabilization, check serum potassium and given IV or oral supplements daily (as 10-20 meq/L in IV infusion or 1-4G orally or 2-3 meq/Kg/day in children and infants as K-lyte mixture or Tablets).

#### Maintenance Therapy:

After acute episode has been brought under control the following maintenance therapy is instituted.

#### Diet:

Semisolid diet should be started as soon as the patient is able to feed. In case of prolonged ventilatory assist, Naso gastric feeding may have to be given. Only salt in the diet need to be restricted in early phase of recovery.

#### Drugs:

Maintenance dose of Digoxin is calculated as 1/4 of the total 24 hours oral dose and is given in two 12 hourly doses. If heart rate is less than 60 beats per minute in adults, or less than 100 beats per minute in infants then 2 or more doses of digoxin may be omitted and future maintenance amount is reduced.

#### Diuretics:

Oral Lasix (1-2 mg/kg/day) can be started. Intermittent doses of intravenous Lasix can be given if required.

Potassium supplements are added (1-4 G daily) in the form of K-lyte tablets or 2-3 meg/Kg/day or K-lyte mixture.

#### Vasodilators:

If blood pressure is stable oral vasodilators should be considered for long term use in condition such as moderately severe Rheumatic mitral insufficiency or acute myocarditis, oral Isosorbide dinitrate (Isordil), 5-10mg four times a day, should be started and if the blood pressure and heart rate response is appropriate the dose can be gradually increased.

Captopril (Capoten), prazosin (Minipres), or Hydralazine can be administered in appropriate doses.

#### Detection of primary cause:

Search for the primary cause of heart failure should be undertaken by special investigations. Echocardiogram is essential to follow the progress of ventricular function and cardiac catheterization should be considered in selected cases to arrive at the anatomic diagnosis as well as evaluation of the Hemodynamic disturbances.

#### Shock and acute heart failure:

Insert a large IV Cannula and start D5W+0.2% saline infusion at two or more sites.

Take venous blood for:

Serum electrolytes i.e Sodium, Potassium, Chloride and Bicarbonate Concentrations.

Blood urea and serum creatinine.

Hemoglobin, Packed cell volume (PCV) and complete blood picture, including differential white cell count.

Platelet count and fibrin split products.

Liver function test and total serum proteins.

Blood cultures and Urine and throat culture and sputum culture if pertinent.

#### Draw arterial blood: For pa o<sub>2</sub>, PH and Pa Co<sub>2</sub>.

Insert catheter in the bladder and maintain an in-take and out-put chart.

Arrange portable:

E.C.G.

X-Ray chest.

#### Consider mechanical Ventilation if:

The patient is clinically tired, semi conscious, or unconscious or has marked respiratory distress.

Or if Pa o<sub>2</sub> is less than 60 mm Hg. or,

Pa Co<sub>2</sub> is more than 50 mm Hg.

Or PH is less than 7.30 (relative indication)

Insert a central venous pressure line and or swan ganz catheter in the pulmonary artery for pulmonary artery wedge pressure (PAW). Monitor respiratory rate, heart rate and systemic blood pressure at 15 minutes interval till stable and then at 3-4 hourly intervals, repeat arterial blood gases till blood gas values are normalised.

#### Support of Cardiovascular system:

Cold peripheral extremities.

Blood pressure less than 70mm Hg in infants, less than 80 mm Hg in older children and less than 90 mm Hg in adults.

1. Isuprel infusion 0.1 ug/kg/min (add 1mg to 100ml) D5W+0.2% saline; (10ug/ml Concentration), Calculate infusion rate according to the following formula:

$$\text{ML/Hour} = \frac{\text{Wt in Kg} \times [\text{Drugs dose to be given; ug/kg/min}] \times 60}{\text{Concentration of the drug in IV infusion (ug/ml)}}$$

2. Dopamine or dobutrex (Dobutamine) 6-10 ug/kg/min (Add 250mg Dobutrex to 250 ml. of 5% DW+0.2% saline (1000 ug/ml); adjust the rate of intravenous infusion to achieve.
  - a) Warm peripheral extremities.
  - b) Increased blood pressure and cardiac output.
  - c) Reduction in pulmonary arterial wedge pressure (PAW) to less than 18mm Hg.
  - d) Urine output greater than 0.5-1 ml/kg/hour, adults 20-30 ml/hour.
3. Nitroglycerine Intravenous is also a useful pulmonary and systemic vasodilator.

#### Note:—

- A. If there is marked tachycardia and very much reduced blood pressure then the best drug

drug would be either:

- a) Dopamine or Dobutamine (Dobutrex). Nitro prusside can be added later as the blood pressure improves.
- b) When blood pressure has increased with inotropic support consider using peripheral vasodilators such as Nitroprusside or Intravenous Nitroglycerine or another: Nitrate. Sublingual Isordil can be used as an effective vasodilator in acute situation; 5-10mg doses at q2 hourly interval. Watch carefully all the Monitored parameters. If the pulmonary arterial wedge pressure is more than 18mm Hg and Urine put is not adequate and initial blood pressure response is not sustained, consider continued use of oral vasodilators as maintenance therapy.
- c) After acute phase has been effectively treated, try and determine the cause of cardiac failure, consider special investigations such as echocardiography and or cardiac catheterization. Surgical treatment of the primary cause should be attempted.

B. If blood pressure more than 90mm Hg use Nipride (Nitroprusside), dose required is 0.6-6 ug/kg/min (Add 50mg (1 ampule) in 150ml 5% DW+0.2% saline solution. Keep ncreasing the dose by 1 ug/kg/min increments till desired effect is obtained. Watch peripheral extremities for in-creasing warmth.

Increased Urine put suggest adequate response. If CVP or PAW pressures are available, these should be kept at 15-18mm Hg use additional volume such as plasma, Hemaccel, or 5% salt free albumin to maintain the blood pressure and PAW pressure at the desired level.

#### Correction of acidosis:

Correct acidosis if PH is less than 7.3, and Hco<sub>3</sub> less than 18 meq/L, use sodium bicarbonate 1 meq/kg as bolus which can be repeated at 20 min to achieve PH greater than 7.3, consider mechanical ventilation if Pa Co<sub>2</sub> is greater than 56mm Hg and Pa o<sub>2</sub> less than 60mm Hg. Do not wait for the results of blood gases in those cases where clinical deterioration continues; do not wait for ventilation to cease, act at an earlier stage.

#### Treatment of actue pulmonary oedema:

1. Keep head and trunk elevated at 45° angle.
2. Rotating pressure cuffs in 3 out of 4 limbs at an inflation pressure of less than systemic; rotate at 15 minutes interval.
3. Give 100 % O<sub>2</sub>, consider ventilation if indication are present.
4. Give Digoxin IV ½ of the total 24 hour dose stat (if previously not taking digoxin) repeat times two at 8 hour intervals.
5. Morphine 0.1mg/kg q4-6 hours (watch for respiratory depression).
6. Lasix IV 1-2mg/kg stat repeat at 45 min to 60 min interval.
7. Consider oral Isosorbide dinitrate 5-10mg S/L at 2 hourly interval.

In resistant cases when CVP or PAW pressure monitoring is available consider using IV Nitroprusside.

#### Mild to moderate acute heart failure management.

If onset is acute the patient should be hospitalised, so that while therapy for cardiac failure is being given, the cause of the failure can be ellucidated.

#### Management:—

Most patient with mild to moderate acute congestive cardiac failure can be managed with oral medications. Bed rest is for a short period till signs of failure have subsided.

No restrictions are placed on the diet. Digoxin is given orally in calculated amount. Complete digitalization should be done over 24 hour period in four equal doses at 8 hourly interval. Maintenance digoxin is ¼ to 1/5th of the 24 hour oral dose. Its given in 2 daily doses. In small infants because of the unavailability of liquid preparation of Digoxin, one daily dose in tablet form can be given. The previous note about digitalization in adults especially with ischemic heart disease should be noted.

#### Diuretics:—

Intially one or two doses of Lasix are given intravenously in acute heart failure, otherwise oral diuretic therapy can be given. Starting intravenous dose of Lasix is 1 mg/kg. Future needs are determined according to the response.

Most patients with mild congestive heart failure may not require diuretics and can be managed with digoxin alone. Maintenance with intermittent diuretic therapy can be achieved in most cases.

Potassium supplements (1-4 G daily in three doses or 2 meq/kg/day) can be added with the oral Lasix if Lasix is required daily. Hydrochlorothiazide in 2-4 mg/kg/day can be substituted for Lasix. Aldactone-A (1-4 mg/kg) in one or two doses can be added in situations where alternate day therapy is required. If twice a week or 5 days a week diuretic therapy is required addition of aldactone-A obviates the need for potassium supplements. Daily diuretic therapy requires addition of oral K-lyte solution or tablets (1-4 G K-lyte tablets in three daily doses or 2-3 meq/kg/day K-lyte mixture in two doses).

#### Vasodilator therapy:—

If signs of cardiac failure do not settle, vasodilators should be added. These may be required in moderate to severe degree of heart failure (see vasodilator therapy).

#### Management of chronic or recurrent heart failure

Classify severity of recurrence into mild, moderate or severe. The problem of recurrent heart failure is a vexing one for patients with Rheumatic valvulitis, Myocarditis, and Cardiomyopathy. The cause may be progression of the cardiac damage, Myocarditis or non compliance of drug therapy or recurrent acute Rheumatic fever. The medical management follows the lines out-lined for acute cardiac failure of various grades. Treatment of Chronic cardiac failure on the out-patient basis is possible in majority of patients. Most are due to Rheumatic fever and some have Myocarditis or dilated form of cardiomyopathy.

#### MANAGEMENT OF CHRONIC HEART FAILURE ON OUT-PATIENT BASIS

1. Rest periods during the day are advisable.
2. While signs of cardiac enlargement or liver enlargement persist the child and adult should be kept away from school or work respectively.

3. Those children, in whom no signs of heart failure are present, should be sent to school but not allowed participation in games.
4. Drugs such as Digoxin in maintenance dose is given in 2 daily doses as 1/4 to 1/5th of the total 24 hours digitalizing dose. Example; one tablet (0.25mg) for adolescent and Adult. Half tab (0.125mg) daily for an older child, 1/3 tab daily (0.08mg) for 1-2 year old child, One fourth (0.06mg) for infant less than 1 year age.  
Digoxin must be given on daily basis, Intermittent therapy with Digoxin is not appropriate.
5. Daily or alternate day or twice or thrice weekly diuretic therapy should be instituted. The principle of Potassium supplements (1 to 4 G/day orally or 2 to 3 meq/kg/day) have already been described.
3. Prophylaxis with penicillin (penidure) injection should be stressed for children with Rheumatic heart disease.
4. Attempt should be made for not restricting any element of the diet, salt or fluid restriction are generally not required at his stage.
5. Cardiovascular assesment of the type of lesion and the hemodynamic disturbances should be elucidated by specialised tests so that primary anatomic abnormality can be treated, generally by cardiac surgery.
6. Regular 3 monthly or more frequent follow up visits are advised.

#### Oral Vasodilator therapy

1. Isordil (Isosorbide dinitrate); start with 0.5-1 mg/kg/day in two to three doses, increase to 20-40 mg/q 6 hours after 2-3 days increments. Watch the heart rate which should not increase by more than 10mm Hg. Headaches, dizziness, weakness or Hypotension are trouble some side effects and may necessitate withdrawal of the drug.
2. Hydralazine 2-3 mg/kg/day in three doses (25-100mg tid or Qid to 200mg Qid), do not use if pulmonary edema is present. Start with 12.5mg tds and gradually increase the amount.
3. Prazosin (Minipress) 1/2mg stat. If no unwaranted Hypotension, give 1/2mg twice a day upto 10mg twice a day. Increments should be gradual at each 2-3 day intervals.

4. Captopril (Capoten) 25mg 8 hourly, start with 12.5mg 8 hourly watch for Azotemia and Nephrotic syndrome.

**Indication of vasodilator therapy:—**

1. In acute condition use IV drugs like Nitroprusside, Dobutrex, Dopamine or Nitroglycerine.
2. In chronic or subacute failure the most common lesion which responds well to

vasodilators is mitral regurgitation or dilated form of cardiomyopathy.

3. Vasodilators are contra-indicated in aortic or mitral valve stenosis.

Vigorous investigatory effort is to be made to find the primary cause of the cardiac failure.

Echocardiography and cardiac Catheterization should be undertaken and effort should be made to treat the primary cause medically and or by cardiac surgery.

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