

# Management of poisoning

- All poisoned patients should be treated as if they have a potentially life-threatening intoxication.
- Treat the patient and not the poison.

# Emergency evaluation

- ABC supportive therapy:-

A = Airway  $\Rightarrow$  Clear

B = Breathing  $\Rightarrow$  Maintain

C = Circulation  $\Rightarrow$  Assist

- Altered mental status

Depression or Excitation

Fever (hyperthermia) or Hypothermia

# Emergency evaluation (cont.)

- **Other complications: e.g. Rhabdomyolysis**
- **Clinical diagnosis:**
  - **Physical examination**
  - **Essential lab tests**
- **Decontamination-----To reduce absorption**
- **Enhanced elimination----Antidote, dialysis.**

# Airway

- **Loss of airway protective reflexes**



- **If reflexes were lost----do endotracheal intubation**



# Endotracheal intubation

- Not easy-----requires expertise
- Nasotracheal intubation:
  - requires local anaesthetic( lidocaine) ----reduces pain
  - + vasoconstrictor (phenylephrine) ----reduces bleeding
- Orotracheal intubation:
  - requires oxygen
  - requires neuromuscular blocker e.g. suxamethonium ( in children suxamethonium induces bradycardia or asystole, so pancuronium is recommended in children)

# BREATHING

- **Breathing difficulties: major cause of morbidity and death.**
- **Complications:**
  1. **Ventilatory failure**
  2. **Hypoxia**
  3. **Bronchospasm**

# 1. Ventilatory failure

- Differentiate poisoning from bacterial or viral diseases.

# CAUSES OF VENTILATORY FAILURE:

- a) Failure of respiratory muscles e.g., by
  - Neuromuscular blockers
  - Organophosphates and carbamates
  - Botulinum toxin
  - Snake bite
- b) Depression of respiratory center e.g. by barbiturates, alcohols, opioids
- c) Severe pneumonia.
- d) Pulmonary oedema



# Treatment

- 1. Assist breathing manually
- 2. Perform endotracheal intubation
- 3. Use oxygen (usually 30—35% to start).

## 2. Hypoxia

**Differential diagnosis:**

Differentiate from pneumonia.

# CAUSES OF HYPOXIA

- 1. Insufficient oxygen in air (e.g., displacement of oxygen by inert gases).
- 2. Disruption of oxygen absorption by the lung (e.g. resulting from pneumonia or pulmonary edema).

# CAUSES OF HYPOXIA (cont.)

- 3. Cellular hypoxia: e.g.
- by carbon monoxide  
(carboxyhemoglobinemia )  
or methemoglobinemia (by nitrates and  
nitrites)  
which limit binding of oxygen to hemoglobin,  
and cyanide, which blocks oxygen utilization.

# Treatment

- **Correct hypoxia e.g.:**
  - **Administer 100% oxygen in carbon monoxide poisoning**
  - **Give cyanide antidote kit for cyanide (or hydroxycobalamine)**

### 3. Bronchospasm

- Differentiate from asthma, hypersensitivity or allergic reactions.
- Severe bronchospasm may result in hypoxia and ventilatory failure.

# Examples of drugs and toxins that cause bronchospasm

- 1. Direct irritant injury from inhaled gases or pulmonary aspiration of petroleum distillates or stomach contents.
- 2. Pharmacologic effects of toxins, e.g. organophosphate or carbamate insecticides or beta-adrenergic blockers.
- 3. Hypersensitivity or allergic reactions may also cause bronchospasm.

# Treatment

- 1. Administer supplemental oxygen.
- 2. Remove the patient from the source of exposure to any irritant gas.
- 3. Administer bronchodilators:
  - a. salbutamol inhaler
  - b. If this is not effective, give aminophylline, 6 mg/kg IV over 30 minutes.
- For patients with bronchospasm and bronchorrhea caused by organophosphate or other anticholinesterase poisoning, give atropine.



# CIRCULATION

- I. General assessment and initial treatment
- A. Check blood pressure and pulse rate and rhythm. Perform cardiopulmonary resuscitation (CPR) if there is no pulse .
- B. Begin continuous electrocardiographic (ECG) monitoring. Arrhythmias may complicate a variety of drug overdoses.

## General assessment (cont.)

- **C. Secure venous access.**
  - to draw blood for routine studies.
  - to begin intravenous infusion .
- **D. In seriously ill patients (eg, hypotensive, obtunded, convulsing, or comatose), place a Foley catheter in the bladder, obtain urine for routine and toxicologic testing, and measure hourly urine output.**

## 2. Bradycardia and atrioventricular (AV) block

### Examples of drugs and toxins causing bradycardia or AV block

- 1. Membrane-depressant drugs (eg, cyclic antidepressants, quinidine, beta blockers)
- Cholinergic or vagotonic agents
  - Carbamate insecticides
  - Digitalis glycosides
  - Organophosphates

# Examples of drugs and toxins causing bradycardia or AV block (cont.)

- Sympatholytic agents
  - Beta blockers
  - Clonidine
- Others
  - Opiates
  - Calcium antagonists
  - Lithium

# Complications:

- **Bradycardia and AV block frequently cause hypotension, which may progress to asystolic cardiac arrest.**

## Treatment:

- Do *not* treat bradycardia or AV block unless the patient is symptomatic (e.g. syncope, hypotension).

*Note:* Bradycardia or even AV block may be a protective reflex to lower the blood pressure in a patient with life-threatening hypertension .

# Treatment (cont.)

- 1. Maintain airway and assist breathing. Administer supplemental oxygen.
- 2. Rewarm hypothermic patients.
- 3. Administer atropine. If this is not successful, use isoprenaline or an emergency pacemaker.

## Treatment (cont.)

- 4. Use the following specific antidotes if appropriate:
  - a. For beta-blocker overdose, give glucagon .
  - b. For digitalis intoxication, use Fab fragments .
  - c. For cyclic antidepressant overdose, administer sodium bicarbonate .
  - d. For calcium antagonist overdose, give calcium .



# 3. Tachycardia

## Examples of drugs and toxins causing tachycardia

- Sympathomimetic agents

Amphetamines

Caffeine

Cocaine

- Agents causing cellular hypoxia

Carbon monoxide

Cyanide

Oxidizing agents  
(methemoglobinemia)

- Anticholinergic agents

Antihistamines

Atropine

Cyclic antidepressants

Phenothiazines

- Others

Ethanol or sedative-hypnotic drug withdrawal

Thyroid hormone

# Treatment

If tachycardia is not associated with hypotension

- For sympathomimetic-induced tachycardia, give propranolol, or esmolol,
- For anticholinergic-induced tachycardia, give physostigmine, or neostigmine.
- *Caution: Do not* use these drugs in patients with cyclic antidepressant overdose, because additive depression of conduction may result in asystole.

# 4. Hypotension

## Complications

Severe or prolonged hypotension can cause acute renal tubular necrosis, brain damage, and cardiac ischemia.

Metabolic acidosis is a common finding.

# SELECTED DRUGS AND TOXINS CAUSING HYPOTENSION

## HYPOTENSION WITH RELATIVE BRADYCARDIA

- Sympatholytic agents
  - Beta blockers
  - Hypothermia
- Membrane-depressant drugs
  - Beta blockers (mainly propranolol)
  - Cyclic antidepressants
- Others
  - Barbiturates
  - Calcium antagonists
  - Cyanide
  - Opiates
  - Organophosphates and carbamates
  - Sedative-hypnotic agents

# HYPOTENSION WITH TACHYCARDIA

- Arsenic
- Hyperthermia
- Caffeine
- Theophylline
- Salbutamol

# Treatment

- Fortunately, hypotension usually responds readily to empirical therapy with intravenous fluids and low doses of presser drugs (e.g. dopamine).
- 1. Maintain the airway and assist ventilation if necessary . Administer supplemental oxygen.
- Administer norepinephrine .

# Treatment (cont.)

- 2. Treat cardiac arrhythmias that may contribute to hypotension (heart rate  $<40-50/\text{min}$  or  $> 180-200/\text{min}$ ).
- 3. Hypotension associated with hypothermia often will not improve with routine fluid therapy but will rapidly normalize upon rewarming of the patient.

# Treatment (cont.)

- 4. Consider specific antidotes:
  - a. Sodium bicarbonate for cyclic antidepressant
  - b. Glucagon for beta-blocker overdose.
  - c. Calcium for calcium antagonist overdose.
  - d. If the systemic vascular resistance is low, administer norepinephrine



# 5. Hypertension

- **Complications:**

**Severe hypertension can result in intracranial hemorrhage, aortic dissection, myocardial infarction, and congestive heart failure.**

# SELECTED DRUGS AND TOXINS CAUSING HYPERTENSION

## ■ HYPERTENSION WITH TACHYCARDIA

### Generalized sympathomimetic agents

Amphetamines and derivatives

Cocaine

Epinephrine

Levodopa

LSD (lysergic acid diethylamide)

Marihuana

Monoamine oxidase inhibitors

Phencyclidine

### Anticholinergic agents

Antihistamines

Atropine

Cyclic antidepressants

Phenothiazines

### Others

Ethanol and sedative-hypnotic  
drug withdrawal

Nicotine (early stage)

Organophosphates

# SELECTED DRUGS AND TOXINS CAUSING HYPERTENSION (cont.)

## ■ HYPERTENSION WITH BRADYCARDIA OR ATRIOVENTRICULAR BLOCK

Clonidine

Norepinephrine

Ergot derivatives

Phenylephrine

Phenylpropanolamine

# Treatment

- **Rapid lowering of the blood pressure is desirable .**
- **For hypertension with little or no tachycardia, use phentolamine, nifedipine chewable capsule or liquid form, or nitroprusside.**
- **For hypertension with tachycardia, add to the above treatment propranolol, or esmolol , or labetalol.**
- ***Caution: Do not* use propranolol or esmolol alone to treat hypertensive crisis; beta blockers may paradoxically worsen hypertension if it is caused primarily by alpha stimulation.**

# ALTERED MENTAL STATUS

- 1. COMA AND STUPOR

- a) Causes:

- Drugs and toxins that depress brain reticular activating system(RAS)
- After seizures
- Brain injury associated with infarction or intracranial bleeding.

## **b) Complications:**

- **Respiratory depression (cause of death)**
- **Hypotension, hypothermia, hyperthermia and rhabdomyolysis**

## **c) Treatment:**

- **-AB supportive + Oxygen**
- **-50% dextrose + thiamine( thiamine prevents Wernicke's syndrome in persons deficient in thiamine)**
- **Normalize body temperature**
- **Naloxone is routinely given in respiratory depression (may ppt. opioid withdrawal)**
- **Flumazenil may be considered**

## 11. Hypothermia:

- Serious when temp.  $< 32\text{ }^{\circ}\text{C}$  ( $90\text{ }^{\circ}\text{F}$  )

### Treatment:

- AB supportive +  $\text{O}_2$
- Rewarm slowly (to avoid rewarming arrhythmia)

( this arrhythmia does not respond to the usual treatment of v. arrhythmia – bretylium may be effective)



- Open cardiac massage with direct warm irrigation of ventricles may be needed in hypothermic patients in cardiac arrest.

# III. Hyperthermia

- Serious when temp.  $> 40\text{ }^{\circ}\text{C}$  ( $104\text{ }^{\circ}\text{F}$ )

- A) Causes

1. Drugs and toxins:

- antipsychotics(chronic use)  $\longrightarrow$  neuroleptic malignant syndrome

- halothane and suxamethonium  $\longrightarrow$  malignant hyperthermia (inherited disorder)

- amphetamines and cocaine  $\longrightarrow$  excessive muscular activity

- aspirin (toxic doses) —▶ uncoupling of oxidative phosphorylation
- serotonergic drugs e.g. fluoxetine —▶ serotonin syndrome
- withdrawal from alcohol and sedative hypnotics

## 2. Other causes:

heat stroke, infections, meningitis,  
thyrotoxicosis..... etc.

## **B. Complications:**

- Rhabdomyolysis
- Renal failure
- Cardiac failure
- Brain damage
- Death

## C. Treatment:

- Immediate rapid cooling
- - AB supportive + oxygen
  - I.V. glucose
  - control seizures, agitation or muscular rigidity
  - continue cooling with tepid sponging, fanning, or iced gastric or colonic lavage, or ice water immersion

# Treatment (cont.):

- To prevent shivering give:  
diazepam or midazolam( central muscle relaxants)  
or neuromuscular blockers (pancuronium)
- For persistent hyperthermia use:  
dantrolene (peripherally, prevents calcium release from sarcoplasmic reticulum of skeletal muscle)

# Treatment (cont.):

- For neuroleptic malignant syndrome use:  
bromocriptine (dopamine agonist)
- for serotonin syndrome use:  
methysergide (serotonin antagonist)

# IV. Seizures

## A) Causative drugs and toxins:

- amphetamines and cocaine
- propranolol (but not atenolol)
- camphor
- organophosphates
- CO or cyanide (cellular hypoxia)
- tricyclics
- haloperidol
- lead and other heavy metals
- methanol
- salicylates
- withdrawal from ethanol or sedatives



## **b) Complications:**

-apnoea

-pulmonary aspiration

-hyperthermia

-rhabdomyolysis

-brain damage

## **C) Treatment:**

1. AB supportive + oxygen
2. Naloxone
3. If hypoglycemic, give 50% glucose + thiamine
4. Use anticonvulsants e.g.  
diazepam, phenytoin, phenobarbitone

Anticonvulsants should be administered slowly ( if given rapidly, can cause hypotension, cardiac arrest or respiratory arrest)

# Treatment (cont.):

- If hyperthermic: cooling; pancuronium
- Use specific antidotes if possible e.g. pralidoxime  
+ atropine for organophosphates

## V. Agitation, delirium and psychosis

Agitation = continuous and excessive restlessness

Delirium = a state of mental confusion and excitement

Psychosis = delusions (false beliefs) + hallucinations (false sensation) + indifference + excitement

## **a) Causative drugs and toxins:**

- Lead and other heavy metals
- Carbon monoxide
- L-dopa
- Salicylates
- Withdrawal from ethanol or sedatives
- Amphetamines and cocaine
- L.S.D. and marihuana

## **b) Complications:**

- Hyperthermia
- Rhabdomyolysis

## **c) Treatment:**

- Rapid cooling, if hyperthermic
- Treat hypoglycemia
- Give a sedative ( midazolam or diazepam) or a an antipsychotic (haloperidol)
- Administer pancuronium (intubation may be needed)

# Diagnosis of poisoning

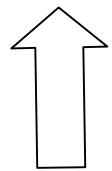
- Correct diagnosis is through data from history, physical examination and lab. tests.
- 1. History
  - Collect history of ingestion from the patient, family, friends pharmacy.....etc.
  - Collect any drugs or drug remnants for later testing  
( Rescuer should avoid skin contact or needle stick).

# Diagnosis of poisoning (cont.)

## 2. Physical examination:

Look for general signs that may lead to the poison (B.P., pulse, eye, skin, ....etc.)

♠  $\alpha$ -adrenergic syndrome (e.g. with phenylpropanolamines)



B.P. + reflex bradycardia + dilated pupil



♠  $\beta$ -adrenergic syndrome (e.g. with salbutamol)

↓ B.P. ( $\beta_2$  vasodilatation) + tachycardia

♠ Mixed  $\alpha$  – and  $\beta$  adrenergic syndrome  
(e.g. amphetamines and cocaine )

↑ B.P + tachycardia + dilated pupil

♠ Sympatholytic syndrome ( e.g. Clonidine,  
methyldopa, also opioids )

↓ B.P + bradycardia + pin-point pupil

♠ Nicotinic cholinergic syndrome

(autonomic ganglia)

e.g. nicotine

- Initial tachycardia followed by bradycardia
- Muscle fasciculation followed by paralysis

♠ Muscarinic cholinergic syndrome :

(muscarine)

bradycardia + miosis + sweating + SLUD

♠ Mixed cholinergic syndrome :

(e.g. organophosphates)

- Pin-point pupil + SLUD syndrome
- Muscle fasciculation followed by paralysis

♠ Anticholinergic syndrome :

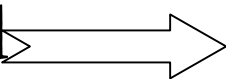
(e.g. atropine, cyclic antidepressants, antihistamines)


- Tachycardia
- Hot dry skin
- Urinary retention

# Characteristic odours:

## ■ Examples:

Acetone  acetone, chloroform

Bitter almond  cyanide

Garlic  arsenic, organophosphates

# Essential clinical lab tests

## ■ Routine tests:

### 1. Serum osmolality:

Measure Na, glucose and BUN serum concentration.

$$1- \text{Calculate osmolality (calculated osmolality)} = 2[\text{Na}] + [\text{glucose}] / 18 + [\text{BUN}] / 2.8$$

(Normal osmolality value = 290 mosmol / L)

2- Measure serum osmolality by an Osmometer (measured osmolality )

3- Osmolar gap = measured osmolality – calculated osmolality

Increased osmolar gap is seen with alcohol, ethylene glycol or mannitol poisoning

## 2. Anion gap:

Measure Na, chloride and bicarbonate serum concentration.

Calculate anion gap:

$$\text{anion gap} = [\text{Na}^+] - [\text{Cl}^-] - [\text{HCO}_3^-]$$

Normal anion gap value = 6-12 meq / L

**Increased anion gap is seen with alcohol, ethylene glycol, CO, cyanide, iron poisoning.**

**Decreased anion gap is seen with bromide and iodide poisoning**

## Other tests:

- 3. Measurement of serum potassium
- 4. Renal function tests:
  - measure serum creatinine and BUN levels
- 5. Liver function tests:
  - measure liver transaminases levels



# Elimination of the poison from the GI tract, skin and eyes

- A. Gastric emptying
  - **Syrup of Ipecac** - usually used at home, rarely used after presenting to medical facility.
    - Dose - < 1 year = 1 cc/kg; 1 to 12 years = 15 ml; > 12 years = 30 ml
    - Follow with water or juice (induction of emesis will be delayed if given with milk) - may repeat once if no emesis in 30 minutes-keep emesis for analysis

# Contraindications of ipecac:

- lost gag reflex, decreased level of consciousness, seizures
- ingestion of agent that rapidly depresses mental status (cyclic antidepressants, hypnotics, strychnine)
- ingestion of caustic agent
- petroleum distillate/hydrocarbon ingestion
- < 6 months of age

# Gastric lavage

- Usually used for extremely toxic substances, in cases of unknown ingestions or when loss of consciousness is present
  - When patient is unable to protect his own airway, intubate before proceeding
  - Warm saline is instilled in aliquots until stomach contents are clear.
- Contraindicated - alkalis, sharp objects, pills larger than lavage hose

# Activated Charcoal

- Almost irreversibly absorbs drugs and chemicals, preventing absorption.
- Consider for all significant toxic ingestions; poorly binds Fe and Lithium, not to be used in caustic ingestions because of poor binding and makes endoscopy difficult.
- Dose = 1 gm/kg or 30-60 gm for children and 60-100 gm in adults. Prepared as a slurry with a ratio 1:4 charcoal to water. Goal is to have a charcoal to toxin ratio > 10:1 .

# Activated Charcoal (cont.)

- Repetitive doses of charcoal (1 gm/kg q 4-6<sup>o</sup>) will help clear enterohepatic circulation of some drugs (carbamazepine, digoxin, phenobarb, salicylates, theophylline).
- Cathartics such as sorbitol (5 ml/kg) can be used with first dose of charcoal to prevent constipation.
- Cathartics should not be used repetitively as it will cause fluid and electrolyte disturbances.

## Enhanced elimination of the Absorbed Substance

- Forced diuresis (falling out of favor)
- Alkalinization
  - Ingestions of phenobarbital, salicylate.
  - Use 0.5-2 mEq/kg/hour IV NaHCO<sub>3</sub> to alkalinize urine - titrate to keep urine pH 7.5-8.0.

### Acidification

- Used for ingestions of amphetamine, chloroquine, lidocaine, quinidine
- Use ammonium chloride 75 mg/kg/day p.o. to acidify urine (contraindication --hepatic insufficiency)
- Keep urine pH 5.5 -6.0

Haemodialysis and hemoperfusion:  
Dialysis has been used for many substances, **some** of which are: ammonia, amphetamines, anilines, antibiotics, barbiturates, boric acid, bromides, calcium, chloral hydrate, ethylene glycol, fluorides, iodides, isoniazid, meprobamate, methanol, paraldehyde, potassium, quinidine, quinine, salicylates, strychnine, thiocyanates.

Haemodialysis but not hemoperfusion, causes fluid and electrolyte balances.

# Antidotes

- Use of specific antidotes is invaluable; unfortunately few poisons have antidotes
- SUMMARY OF ANTIDOTES
  - #Acetaminophen —▶ N-Acetylcysteine  
Initial dose of 140 mg/kg PO in water, cola, juice or soda: then, 70 mg/kg q 4 hr for 68 hrs (17 doses, 18 total doses).
- Methionine is also a useful antidote



- **Anticholinergics** —▶ **Physostigmine**  
(CAUTION: may cause seizures, asystole, cholinergic crisis)
- **Anticholinesterases** —▶ **Atropine IM or IV**
- **Organophosphates** —▶ **Pralidoxime + atropine**
- **Carbamates** —▶ **Atropine; pralidoxime for severe cases**

- **Benzodiazepines —▶ Flumazenil 0.01 mg/kg IV, max. dose 3 mg (estimated pediatric dose)**
- **Beta-adrenergic blockers —▶ Glucagon**
- **Calcium channel blockers —▶ Calcium chloride 10%, or Calcium gluconate 10%**

- **Carbon monoxide —▶ Oxygen 100% inhalation, consider hyperbaric oxygen for severe cases**
- **Cyanide —▶ Cyanide antidotal kit**

**Adult: 1. Amyl nitrate inhalation (inhale for 15-30 sec every 60 sec)**

**2. Sodium nitrite (10 ml of a 3% solution) IV slowly over 2-4 min.**

**3. Follow immediately with sodium thiosulfate (2.5-5 ml/min of 25 % solution) IV**

**Children: Na nitrite should not exceed recommended dose because fatal methemoglobinemia may result.**

Hydroxycobalamine is also a useful antidote for cyanides.

- Ethylene glycol —▶ (similar to methanol)
- Fluoride —▶ Calcium gluconate 10%, IV slowly
- Digitalis —▶ Fab antibodies (Digibind)

# Heavy metals:

- Heavy metals/usual chelators
- Arsenic —▶ BAL (dimercaprol), IM for up to 7 days
- Lead —▶ BAL, EDTA (IM or slow IV ), ( $\pm$  penicillamine, PO in divided doses for up to 5 days), DMSA (succimer)
- Mercury —▶ BAL, DMSA (PO every 8 hours for 5 days )

- Iron —▶ Deferoxamine IV
- Isoniazid —▶ Pyridoxine 5-10%, IV slowly.
- Methanol and Ethylene Glycol —▶ Ethanol

**ALSO:**

- Folate 50 -100 mg IV every 6 hours (methanol)
- Thiamine 0.5 mg/kg and pyridoxine 2 mg/kg for ethylene glycol

- **Methemoglobinemia —▶ Methylene blue**  
1%, 1-2 mg/kg (0.1-0.2 ml/kg) IV slowly
- **Opioids —▶ Naloxone 0.1 mg/kg IV, IM**
- **Warfarin (and superwarfarin rat poisons)**  
—▶ **Vitamin K**