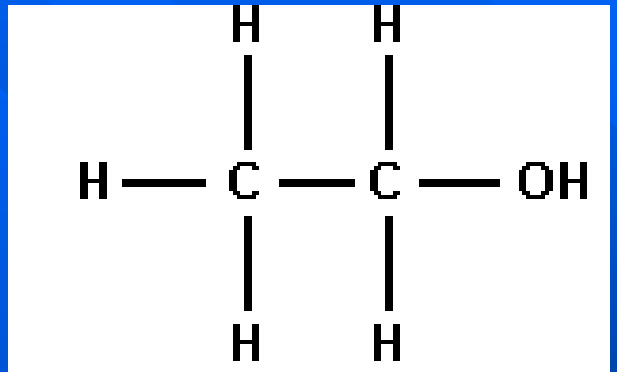
WELCOME TO THE SCIENCE OF ALCOHOL AND ALCOHOLISM

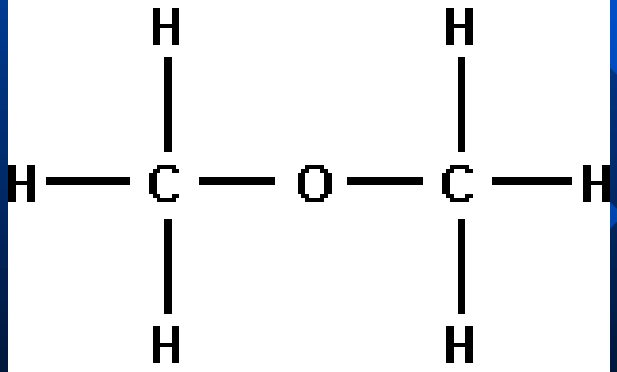
Element- A substance which cannot be decomposed into simpler substances by chemical reactions. Some important biological elements:

- Oxygen (O)
- Carbon (C)
- Phosphorus (P)
- Calcium (Ca)
- Potassium (K)
- Iron (Fe)
- Hydrogen (H)
- Nitrogen (N)
- Sulfur (S)
- Sodium (Na)
- Magnesium (Mg)

CHEMICAL ISOMERS
BOTH CHEMICALS ARE H_6C_2O, BUT THEY ARE NOT THE SAME CHEMICAL!



ethanol



dimethyl ether

Types of Alcohol

- Isopropyl ("rubbing alcohol")
- Methyl ("wood alcohol") (CH_3OH)
- Ethyl (beverage alcohol/ethylene/ethanol) H_6C_2OH

ALCOHOL EQUIVALENTS

12 Oz. Beer @ 6% alcohol =

4 oz wine @ 12% alcohol =

1.25 oz spirits @ 80 proof (40%) alcohol =

1 oz spirits @ 100 proof (50%) alcohol

Absorption of alcohol

- small amounts of alcohol absorbed by the mouth
- most alcohol enters bloodstream from stomach, small intestine and colon
- rate of absorption dependent on gastric emptying time

Absorption of alcohol

- absorption delayed by presence of food in the small intestine

Metabolism of alcohol

- occurs primarily in the liver
- Proportionate to body weight
- A small amount of alcohol is detoxified by the microsomal enzyme oxidation system

Metabolism of alcohol

Alcohol

alcohol dehydrogenase (ADH)

Acetaldehyde-

acetaldehyde dehydrogenase (ALD-H)

Acetic acid (acetate)

CO_2 & H_2O

Metabolism of alcohol

- In heavy alcohol drinkers, liver enzymes will show an increase, especially:
  - SGOT (serum oxaloacetic tranaminase)
  - SGPT (serum glutamic pyruvic tranaminase)

Variations in alcohol metabolism

- 50% of persons of Japanese ancestry have a variant form of ALDH which is less able to metabolize alcohol. Also present in some persons of Chinese ancestry.
- Levels of acetaldehyde may be 10X higher than in persons with normal ALDH

Variations in alcohol metabolism

- Excess acetaldehyde produces “alcohol flush reaction”

Alcohol Flush Reaction

- facial flushing
- vasodilation
- tachycardia
- headache

Alcohol Flush Reaction

- nausea
- vomiting
- edema (fluid build-up/”water weight”)
- hypotension

Alcohol Flush Reaction

- Same reaction occurs when individuals on Antabuse drink
- Presence of ALDH variant seems to lessen tendency to drink alcohol
- The ALDH variant is rare in Japanese alcoholics with liver disease

Blood alcohol level (BAL)/Blood alcohol concentration (BAC) & Behavior

BAL	Behavior
0.05%	Relaxation, decreased inhibitions & alertness, possible personality change
0.08	Legal level in Illinois for DUI

Blood alcohol level (BAL)/Blood alcohol concentration (BAC) & Behavior

BAL	Behavior
0.10	Slowed reaction time, impaired judgment, personality changes
0.15	Large, consistent in reaction time, increasing intoxication, mood/personality changes

Blood alcohol level (BAL)/Blood alcohol concentration (BAC) & Behavior

BAL	Behavior
0.20	Significant impairment of sensory and motor functions, marked intoxication
0.25	Severe motor and sensory disturbance, staggering gait, marked intoxication

Blood alcohol level (BAL)/Blood alcohol concentration (BAC) & Behavior

BAL	Behavior
.30	Semi-stupor, marked decrease in awareness and breathing rate, blackouts
.35	Surgical anesthesia, level of LD_1, minimal level normally required to cause death

Blood alcohol level (BAL)/Blood alcohol concentration (BAC) & Behavior

BAL	Behavior
0.40	LD_{50}

- On average, fifty percent of drinkers with a blood alcohol level of 0.40 will die of alcohol poisoning.

“HE IS……”

WHAT ABOUT “SHE”?

SEX DIFFERENCES AND ALCOHOL INTOXICATION

IN GENERAL, AT THE SAME LEVEL OF ALCOHOL COSUMPTION, WOMEN ACHIEVE A HIGHER BAC THAN MEN

SEX DIFFERENCES AND ALCOHOL INTOXICATION

- Women's body weight is usually less than men's
- Women tend to have less water in their bodies and a higher percent of body fat, so there is less tissue in which alcohol can dissolve
- Women tend to metabolize alcohol less efficiently than men.

PHYSIOLOGICAL EFFECTS OF ACUTE ALCOHOL CONSUMPTION

- Dilation of the peripheral blood vessels = flushing, increased warmth of skin, possibly sweating.
- Small doses produce slight in respiration. Large doses (>.39) can produce respiratory arrest.

PHYSIOLOGICAL EFFECTS OF ACUTE ALCOHOL CONSUMPTION

- Slowing of EEG (brain wave patterns)
- Appearance of nystagmus at ~ 0.10% and above.
- Increase in blood sugar/glucose (hyperglycemia) for ~ one hour

PHYSIOLOGICAL EFFECTS OF ACUTE ALCOHOL CONSUMPTION

- Decrease in glucose levels ~ 3-4 hours after ingestion
- Irritation of the stomach lining
- Decrease in antidiuretic hormones which normally act to retain water in the body

PHYSIOLOGICAL EFFECTS OF ACUTE ALCOHOL CONSUMPTION

- Fluid inside of cells moves outside of cells (cellular dehydration)
- At ~ 0.12 BAL, the vomiting center is stimulated, but only if that BAL is developed rapidly

HANGOVERS

- **Considered by many to be a form of acute alcohol withdrawal.**
  - **upset stomach**
  - **headache**
  - **thirst**
  - **fatigue**
  - **anxiety/depression**
  - **tachycardia**

HANGOVERS

- **Primarily influenced by:**
  - **the maximum BAL level achieved during intoxication**
  - **at the same BAL, the level of congeners is the primarily variable**

HANGOVERS

- highest level of congeners: bourbon, rye, rum (.2%)
- high level of congeners: vodka, gin, grain alcohol (0.1%)
- moderate level: wine (0.04%)
- lowest level: beer (0.01%)

GASTROINTESTINAL (G.I.) SYSTEM: THE G.I. TRACT

- mouth
- esophagus
- stomach
- small intestine
- large intestine (colon)
- rectum
- anus

GATROINTESTINAL (G.I.) SYSTEM : ACCESSORY ORGANS

- salivary glands
- pancreas
- liver
- gallbladder

EFFECT OF ALCOHOL ON THE GASTROINTESTINAL SYSTEM

- Esophagitis
- Peptic Ulcer Disease
- Hemorrhagic pancreatitis
- Uric acid elevation---Gout
- Hyperglycemia
- Alcoholic hepatitis
- Gastritis
- Pancreatitis
- Pancreatic insufficiency
- Hypoglycemia
- Alcoholic fatty liver (hepatosis)
- Cirrhosis

Gastritis

- Presence of alcohol in the stomach initiates release of gastric juices
- If no food is present, the stomach can become irritated

Peptic Ulcer Disease

- Alcohol does not cause ulcers, but if one is already present, both alcohol and unabsorbed gastric juices can make it worse
- If stomach lining is ulcerated enough, bleeding can occur

Pancreatitis

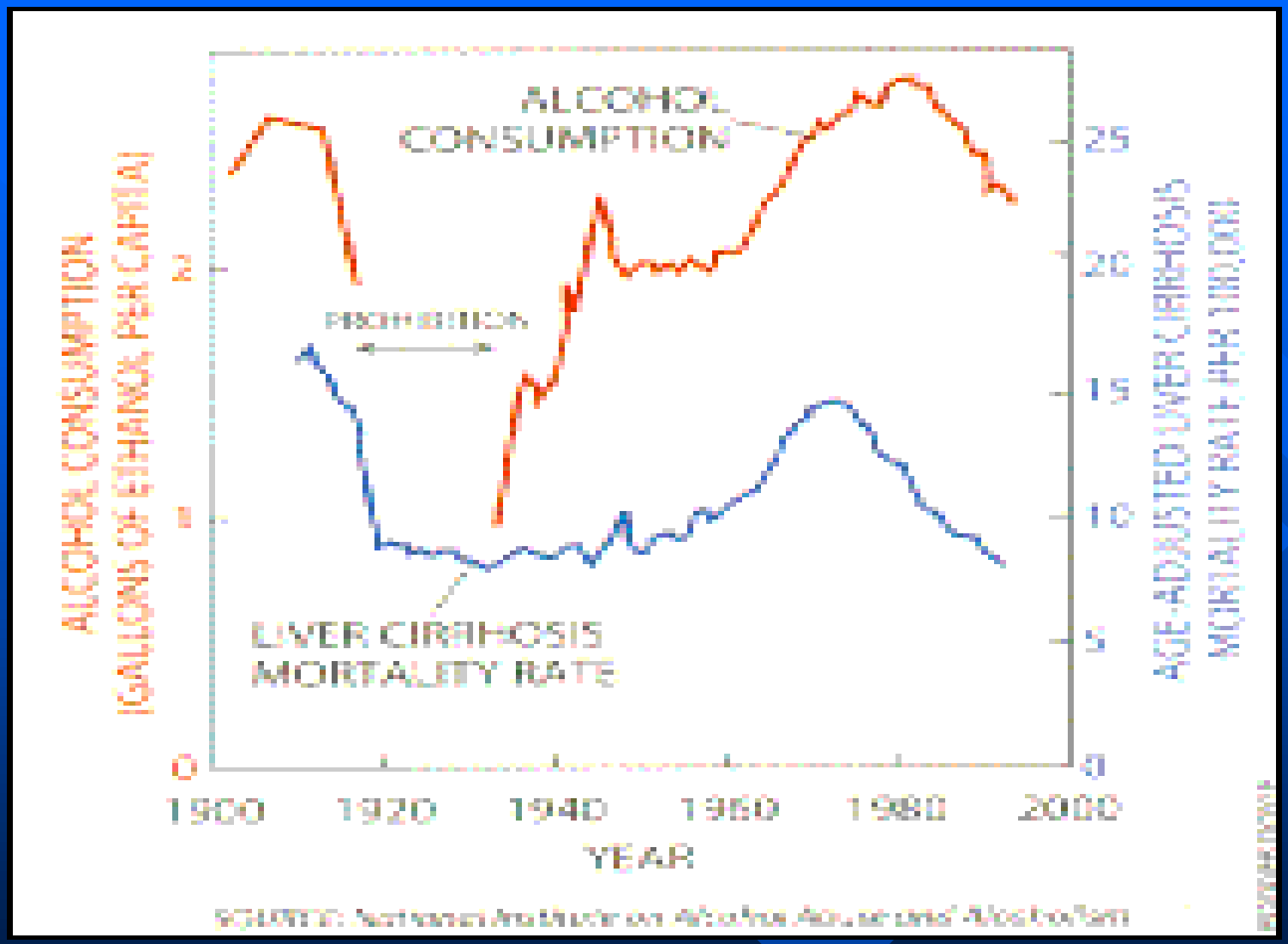
- Pancreas secretes digestive enzymes into the small intestine via the pancreatic duct.
- Alcohol can block the duct by inflaming the small intestine
- Digestive enzymes “stuck” in pancreas; begin to irritate and digest it

Hemorrhagic Pancreatitis

- Pancreatic enzymes eat through wall of pancreas, causing bleeding in the abdominal cavity

Pancreatic insufficiency

- Pancreas is sufficiently damaged that it stops producing digestive enzymes
- Islands of langerhans are on bottom surface of pancreas. They secrete insulin
- Production and secretion of insulin may slow or stop.
- Tx=Supplemental enzymes and insulins


ALCOHOL CONSUMPTION
PROHIBITION
LIVER CIRRHOSIS MORTALITY RATE
ALCOHOL CONSUMPTION (GALLONS OF ETHANOL PER CAPITA)
AGE-ADJUSTED LIVER CIRRHOSIS MORTALITY RATE PER 100,000
0
1
2
0
5
10
15
20
25
1900
1920
1940
1960
1980
2000
YEAR

ALCOHOL AND LIVER DISEASE

- Alcohol-induced liver disease (ALD) is a major cause of illness and death in the United States.
- Alcoholic fatty liver (hepatosis), the most common form of ALD, is reversible with abstinence.

HEPATOSIS

- At least nine out of ten chronic alcoholics will develop alcoholic fatty liver.
- Placques of fat invade the normal structure of the liver to cause this condition.
- The disease usually has no obvious symptoms. It is detected by physical exam and blood laboratory studies.

HEPATOSIS

- If a person stops drinking, fatty liver will disappear on its own in 4 to 6 weeks without formalized medical treatment.
- If drinking continues, fatty liver may progress to hepatitis.

ALCOHOL AND LIVER DISEASE

- More serious ALD includes
  - alcoholic hepatitis, characterized by persistent inflammation of the liver
  - cirrhosis, characterized by progressive scarring of liver tissue.

ALCOHOLIC HEPATITIS

- Hepatitis" is a general word that refers to swelling or inflammation of the liver.
- Alcoholic hepatitis is caused by the toxic effects of alcohol on the liver after long-term use.
- Alcoholic hepatitis usually occurs after fatty liver but may appear without any previous liver dysfunction.

ALCOHOLIC HEPATITIS

- Ten to thirty percent of all alcoholics will develop hepatitis if they continue to abuse alcohol.
- A person with alcoholic hepatitis feels generally ill.
- Common symptoms:
  - loss of appetite and weight,
  - low grade fever
  - abdominal pain
  - nausea and vomiting

ALCOHOLIC HEPATITIS

- Common symptoms:
  - enlarged, tender liver
  - abnormal laboratory tests of liver function
- Treatment of alcoholic hepatitis involves abstinence from alcohol and provision of adequate nutrition.

CIRRHOSIS

- Five to ten percent of all alcoholics develop cirrhosis of the liver
- It usually develops after a long history of excessive alcohol intake.
- The disease may follow alcoholic hepatitis or may occur without any previous symptoms

ALCOHOL AND LIVER DISEASE

CONSEQUENCES OF LIVER DISEASE

- inability to synthesize protein
- inability to manufacture clotting factors
- inability to eliminate estrogen
- lessened ability to store vitamins
- diminished tolerance

CIRCULATORY SYSTEM

- Transports nutrients and removes wastes from all tissues of the body
  - heart
  - blood
  - blood vessels (capillaries, veins, arteries)

COMPOSITION OF BLOOD

- Platelets
- White blood cells (WBC)
- Red blood cells (RBC)

EFFECT OF ALCOHOL ON THE CIRCULATORY SYSTEM

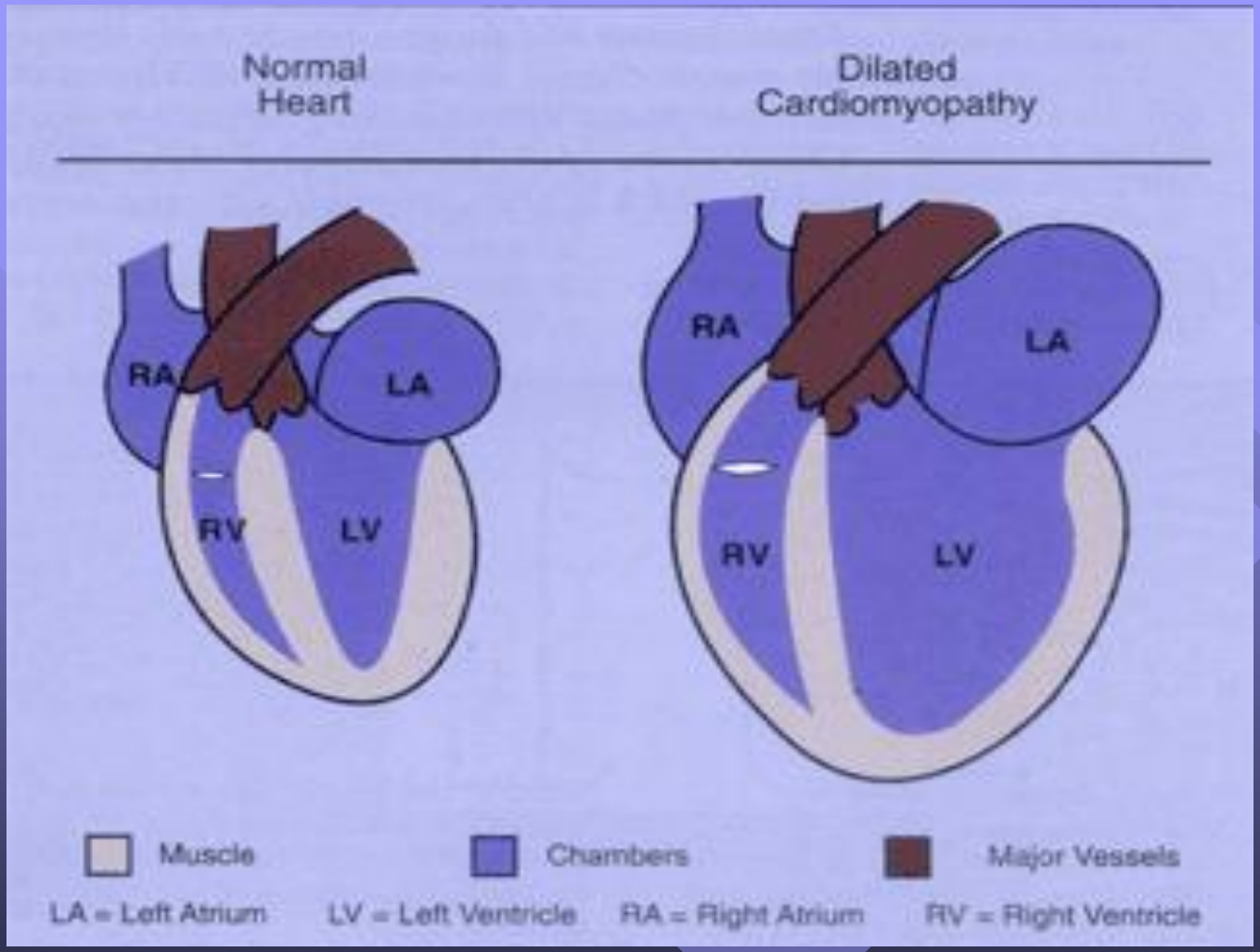
- Small amounts of etoh (~ 1 alcohol equivalent/day) seem to be good for the circulatory system
- Alcohol affects the entire circulatory system as well as the heart.
- Alcohol can produce:
  - High blood pressure
  - An enlarged, weakened heart
  - Irregular heartbeat

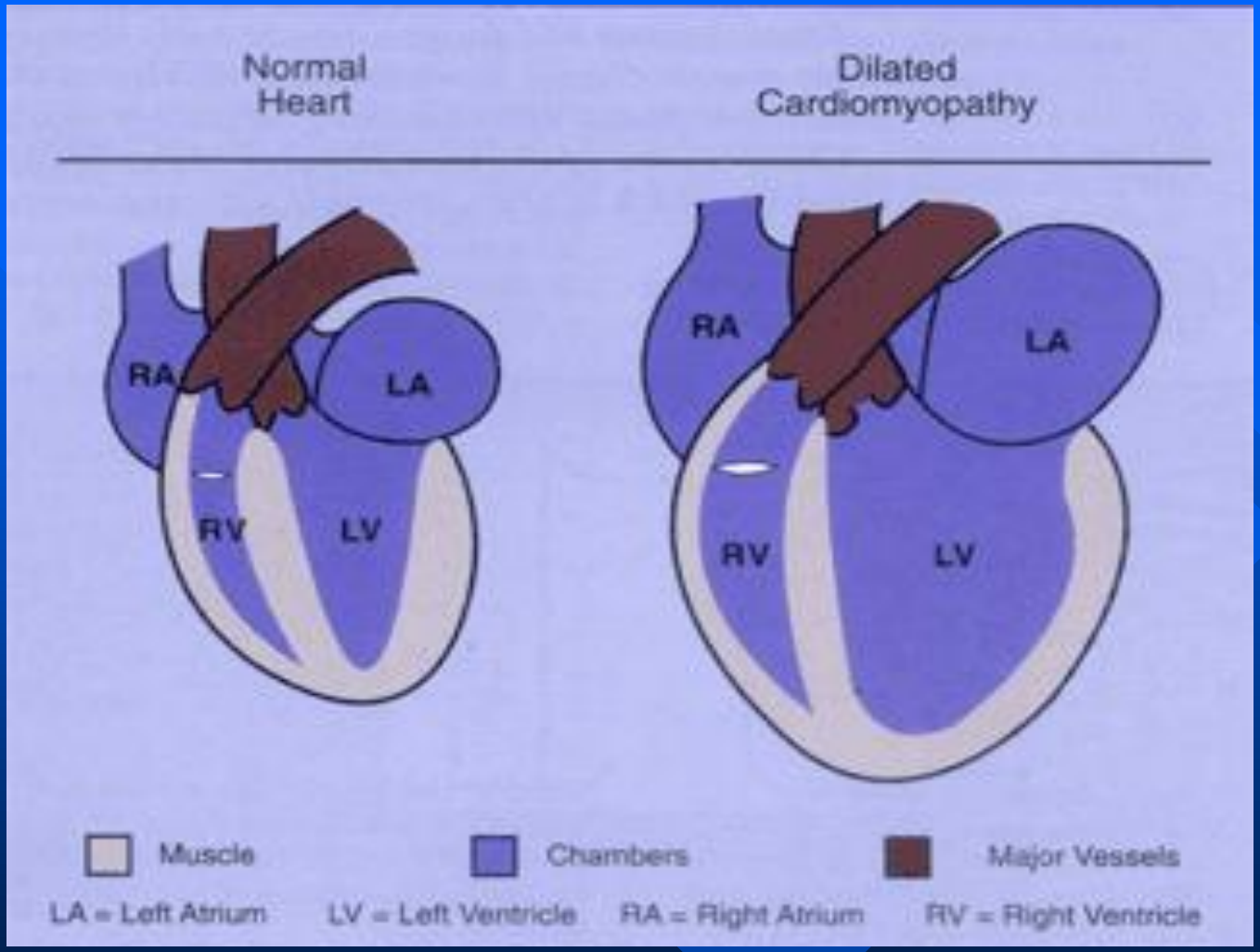
EFFECT OF ALCOHOL ON THE CIRCULATORY SYSTEM

- Alcohol can produce:
  - Capillaries surrounding the conjunctiva of the eye to become enlarged
  - Due to peripheral blood vessel dilation, skin appears flushed, and "whiskey nose" may develop
  - Depression of bone marrow function

EFFECT OF ALCOHOL ON THE CIRCULATORY SYSTEM

- Poor diet = blood problems
  - anemias
  - decreased WBC Count
  - "Weak" WBCs
  - decreased platelets
- Alcoholic cardiomyopathy
  - palpitations
  - labored breathing


Normal Heart
Dilated Cardiomyopathy
RA
LA
RV
LV
RA
LA
RV
LV
Muscle
Chambers
Major Vessels
LA = Left Atrium
LV = Left Ventricle
RA = Right Atrium
RV = Right Ventricle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EFFECT OF ALCOHOL ON THE RESPIRATORY SYSTEM

- Paralysis of cilia
- Fluid accumulates in the nose, pharynx, larynx, and vocal chords ("whiskey voice"/hoarseness)
- Lung/esophageal cancer

EFFECT OF ALCOHOL ON THE ENDOCRINE SYSTEM

- decreased testosterone levels
- increased estrogen levels

EFFECT OF ALCOHOLISM ON THE NERVOUS SYSTEM

- Compared to non-alcoholics, the brains of alcoholics:
  - contain fewer nerve cells, fewer connections among cells, less white and grey matter, and larger ventricles.
- This "cerebral atrophy" is associated with impairment of intellect.
- The underlying mechanism of brain damage appears to be a direct toxic action of alcohol on nerve cells

EFFECT OF ALCOHOLISM ON THE NERVOUS SYSTEM

Wernicke Korsakoff Syndrome

- Results from thiamin deficiency
- Disorientation
- Confusion
- Apathy
- Inattentivenss
- Nystagmus
- Gaze paralysis
- Retrobulbar neuropathy
  - transient blindness/spots in visual field

EFFECT OF ALCOHOLISM ON THE NERVOUS SYSTEM

Wernicke Korsakoff Syndrome

- Ataxia
- Korsakoff: Severe memory problems (retrograde and antegrade)
- Confabulation

EFFECT OF ALCOHOLISM ON THE NERVOUS SYSTEM

- **Alcoholic Cerebellar Degeneration**
  - Wide-based gait
  - Leg incoordination
  - Inability to walk heel-to-toe
  - Develops over several weeks, may be relatively mild for some time, suddenly worsens after binge drinking or an unrelated illness.

EFFECT OF ALCOHOLISM ON THE NERVOUS SYSTEM

- Alcoholic Peripheral Neuropathy
  - Due to nutritional deficiencies, especially B1
  - Degeneration of cells in PNS
  - Numbness
  - Tingling/burning sensation in hands/feet
  - Muscle weakness
  - Depressed reflexes

ALCOHOL AND CANCER

- Mechanisms
  - irritation of cells
  - liver damage
  - nutritional deficiencies
  - carcinogenic congeners
  - interaction with tobacco (effect on lungs and inhibition of salivation)

ALCOHOL AND CANCER

- Types of Cancer
  - head/neck
  - esophagus
  - lung
  - liver
  - breast

ALCOHOL AND BREAST CANCER

- Intake of 2-5 drinks/day is associated with increased risk of breast cancer
- After 5 drinks/day, risk did not increase significantly
- "Among women who consume alcohol regularly, reducing alcohol consumption is a potential means to reduce breast cancer risk. "

Source: Smith-Warner, et. al. (1998)

BEER, BEEF AND CANCER

- Some evidence exists that moderate intake of beer may neutralize some of the carcinogens (hetereocyclic amines/HAs) that form when meat is cooked.

ALCOHOL AND PREGNANCY

- **Women who consume two or more drinks per week while pregnant have a higher risk of spontaneous abortion.**
- **Most spontaneous abortions occur during the second trimester.**

Source: Harlap & Shiono (1980)

ALCOHOL AND PREGNANCY

- Drinking while pregnant increases the risk of stillbirth.
- Stillbirths can occur after heavy drinking in the last trimester.

ALCOHOL AND PREGNANCY

- **Drinking alcohol during the last trimester of pregnancy lessens the amount of oxygen delivered to the developing child. This leads to fetal death (stillbirth fetus).**

Source: Herfindal, et. al., 1988

ALCOHOL AND PREGNANCY

- Alcohol decreases the amount of blood flow to the fetus from the mother, thus cutting down on nutrient and oxygen transfer.
- It also inhibits cell division and interferes with replication of RNA.

FETAL ALCOHOL SYNDROME & FETAL ALCOHOL EFFECT

- Prenatal alcohol exposure is one of the leading known causes of mental retardation in the Western World
- Prenatal and/or postnatal growth retardation (weight and/or length below the 10th percentile);

FETAL ALCOHOL SYNDROME & FETAL ALCOHOL EFFECT

- Lessened ability in many body functions
- Poor coordination or clumsiness
- Low muscle tone
- Irritability,
- Jitteriness,
- Hyperactivity

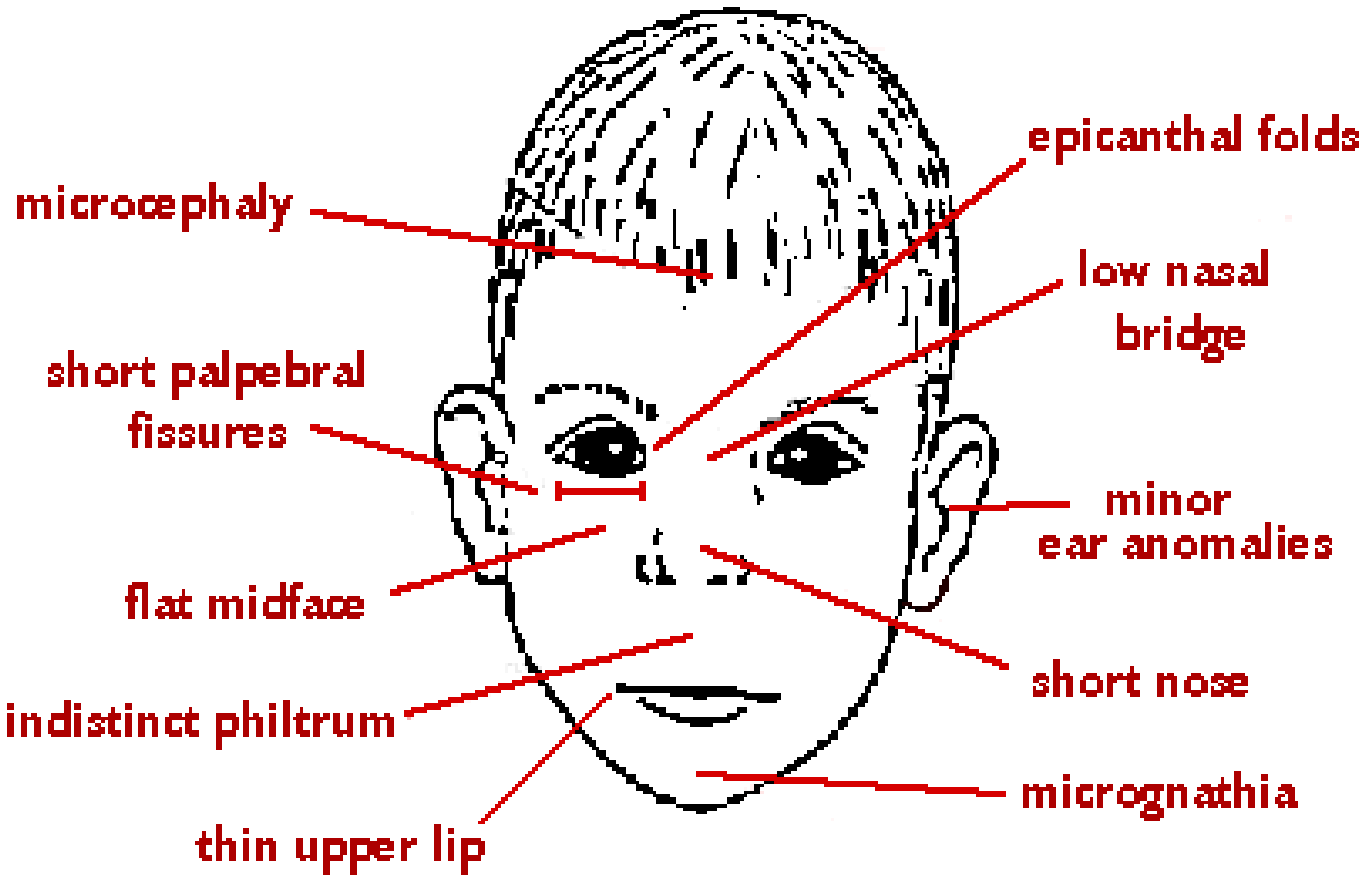
FETAL ALCOHOL SYNDROME & FETAL ALCOHOL EFFECT

- Central nervous system involvement, including:
  - neurological abnormalities
  - developmental delays
  - behavioral dysfunction
  - intellectual impairment
  - skull or brain malformations

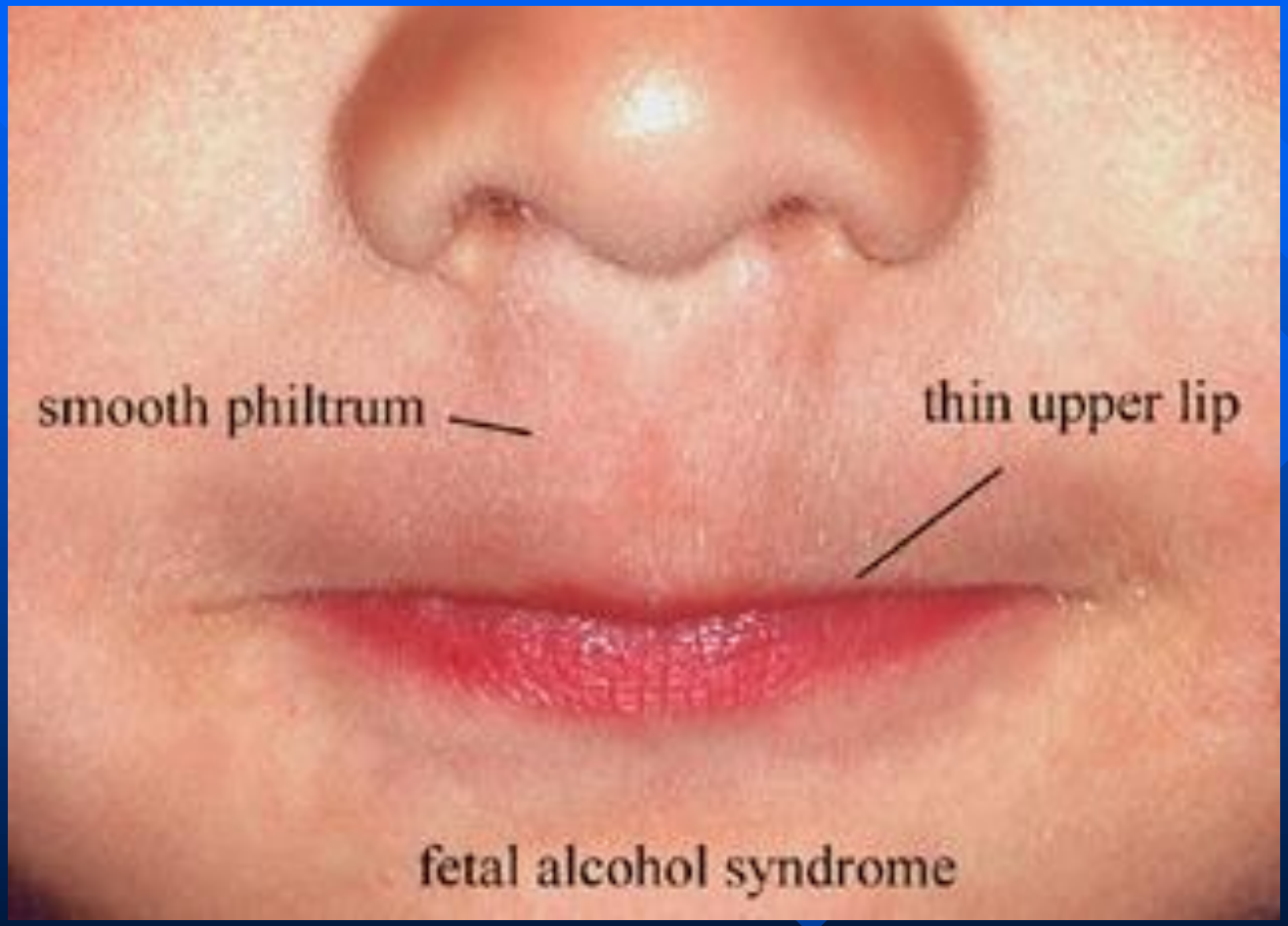
FETAL ALCOHOL SYNDROME & FETAL ALCOHOL EFFECT

- A characteristic face with
  - short palpebral fissures (eye openings)
  - a thin upper lip
  - an elongated, flattened midface and philtrum

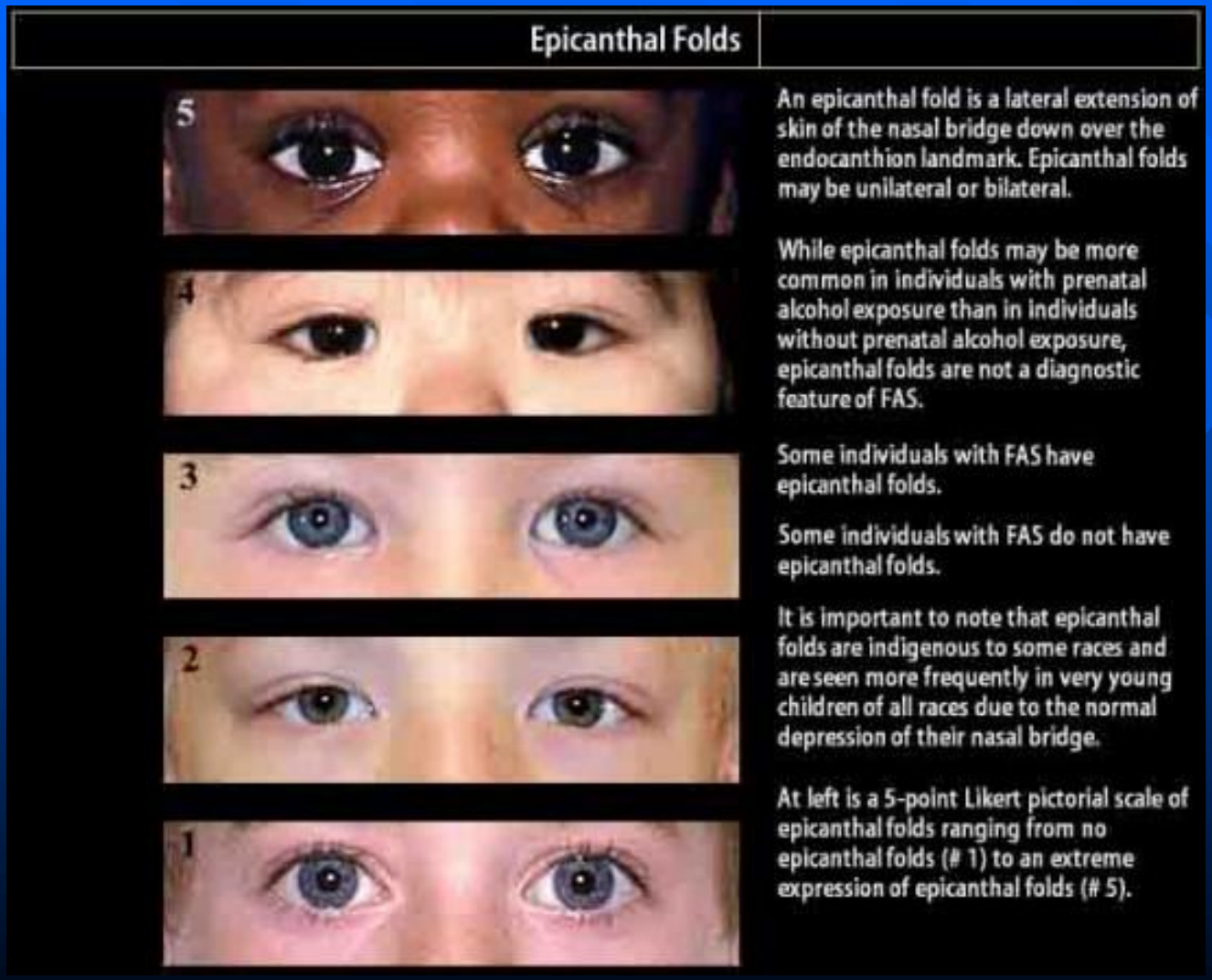
Typical Physical Features of Fetal Alcohol Syndrome



FAS:
Upper Lip Features



Variations in Epicanthal Folds



STAGES OF ALCOHOL WITHDRAWAL: Stage 1:

- Anxiety
- Agitation
- Hypertension
- Eating Disturbances (e.g., anorexia)
- Hallucinations
- Quality of contact (awareness of examiner and people around him/her)
- Paroxysmal Sweats
- Tachycardia
- Hyperreflexia

STAGES OF ALCOHOL WITHDRAWAL: Stage 1:

- Seizures/Convulsions
- Sleep Disturbances (e.g., insomnia/poor quality of sleep)
- Sensorium clouded (disorientation)
- Hyperthermia/Hyperpyrexia
- Tremor ("the shakes")

STAGES OF ALCOHOL WITHDRAWAL: Stage 2

- All of the signs of stage 1, but increased severity
- Begins within 48 hours of last drink
- Distinguishing feature is appearance of hallucinations
  - **Auditory, but may be visual**
  - **Usually non threatening**
  - **Patient/client usually has insight into their benign nature**

STAGES OF ALCOHOL WITHDRAWAL:
Stage 3: Delirium Tremens ("DT's")

- An acute, reversible organic psychosis
- Usually begins after ~72 hours after the last drink
- Duration: two to six days
- All signs and symptoms listed in Stage 1, but greatly increased severity
- Hallucinations: may now include olfactory and/or tactile manifestations
  - **Hallucinations may be fused**
  - **Patient/client lacks insight into benign nature of hallucinations**

STAGES OF ALCOHOL WITHDRAWAL:
Stage 3: Delirium Tremens ("DT's")

- Disorientation (person, place, time)
- Misidentification common
- Emotional Lability
- Anxious, fearful
- Depressed, apathetic
- Angry
- Euphoric
- Agitation often becomes more pronounced after sunset

STAGES OF ALCOHOL WITHDRAWAL:
Stage 3: Delirium Tremens ("DT's")

- (CAUTION: DARKENED ROOMS MAY TRIGGER THIS REACTION DURING DAYTIME HOURS)

USE OF MEDICATION TO TREAT WITHDRAWAL

- Administration of thiamin (100 mg/day) to avoid Wernicke Korsakoff syndrome
- Many patients/clients will need little or no additional medication during withdrawal
- Medication of withdrawal should not begin while the patient is at 0.15 BAL or above

USE OF MEDICATION TO TREAT WITHDRAWAL: Pharmaceutical Agents

- Alcohol is cross-reactive and cross tolerant with most commonly used, non-neuroleptic sedatives (tranquilizers and hypnotics). These include:
  - All of the benzodiazepines (Ativan, Xanax, Valium, etc.)
  - All barbiturates (phenobarbital, secobarbital/Seconal, etc.)
  - Most non barbiturate hypnotics (Dalmane, Placidyl, Doriden)
-

USE OF MEDICATION TO TREAT WITHDRAWAL: Pharmaceutical Agents

- Long acting benzodiazepines (chlordiazepoxide/Librium) are drug of choice
- Depends on patient characteristics:
  - Liver disease
  - Nausea and vomiting
  - Known potential for seizures
  - Pregnancy
  - Advanced age

The Genetics of Alcoholism

Rates of alcoholism among the relatives of alcoholics are significantly higher than among the relatives of non-alcoholics, with children of alcoholics showing a 3-4X greater risk of developing the disorder.

Genetic Influences Operate in:

- Choice to Drink
- Level of Response
- Reinforcement
- Consequences
- Dependence
- Wernicke - Korsakoff
- Cirrhosis
- Pancreatitis
- Withdrawal seizures
- Alcohol Metabolism
- Disinhibition / Impulsivity
- Independent Psychiatric Disorders

The Genetics of Alcoholism

The evaluation of family, twin and adoption studies all indicate that genetics plays an important part in the development of some forms of alcoholism

The Genetics of Alcoholism

- Cloninger and his associates have identified two types of alcoholism based on:
  - the biological parents' pattern of alcohol abuse
  - the degree to which postnatal environmental factors affect the inheritance of a susceptibility to alcoholism

Cloninger's Typology: Milieu-Limited (Type 1)

- predominates among female alcoholics and their male relatives
- characterized by:
  - loss of control over drinking after the age of 25
  - pronounced environmental reactivity to drinking

Cloninger's Typology: Milieu-Limited (Type 1)

- minimal criminality
- "passive-aggressive" traits
- high degrees of harm avoidance, reward dependence;
- low levels of novelty-seeking

Cloninger's Typology: Male-Limited (Type 2)

- predominates among male alcoholics and their male relatives
- less dependency on environmental factors
- more associated criminality
- personality traits are the opposite of the milieu-limited alcoholic