Dear students, we have discussed in the previous lectures all about death and early postmortem changes. In this lecture we will discuss about putrefaction and modified form of putrefaction.

2ndary relaxation of muscle- After some hrs of stay rigor mortis or rigidity of muscle passes over and body becomes relaxed for 2nd time. This is 2ndary relaxation or flaccidity. In fact 2ndary relaxation occurs only with the onset of **decomposition or putrefaction** of dead body.

During this phase of dead body other signs of putrefaction will be there. At this time muscle reaction will again become alkaline due to break down of protein with liberation and accumulation of ammonia.

Decomposition- can be defined as a process by which the complex organic body tissue breaks down to simpler inorganic compound or element due to action of ferments produced by saprophytic microorganism or due to autolysis.

This process leads to discoloration of dead body, evolution of foul smelling gas, swelling of dead body with gradual and total destruction.

Decomposition is normal fate of an undisposed dead body. Under certain specific environmental conditions modified form of decomposition of dead body occurs in which instead of total destruction of dead body, dead body is preserved for a petty long period.

Microorganism responsible for decomposition- Clostridium wel chii, B coli, staphylococci, nonhemolytic streptococci, diphtheroids and proteus are imp.ones.

Status of autolysis-In absence of any microorganism also there will be decomposition of dead body like aseptic autolysis occurring in dead foetus in uterus.

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- Different gases produced during decomposition- H_2S,Phosphoretted hydrogen, CO,CO_2 and marsh gas.
- External signs of decomposition (in summers)- The first external sign of decomposition appears in right iliac fossa of the abdomen, a greenish discolouration. In this country this first change of greenish discolouration occurs around 12 hours after death in summers. Rigor mortis is still present in different parts of the body.
- In winters this change appears between 36- 48 hours or more after death. The discolouration gradually spreads all over abdomen and then to other parts of body.
- Marbling- Invasion of blood vessels by the organism (clostridium welchii) and production of H_2S gas and formation of sulphmethaemoglobin causes greenish brown staining of the inner wall of the vessels. This makes the superficial veins prominent and colourful. This phenomenon is K/as Marbling and appears by 36-48 hours or much earlier after death in summers.
- Further changes occurs as follows-
- Between 12-24 hrs- Gas accumulates in the abdominal cavity. The abdomen is tense. Blood tinged fluid comes out through the mouth and nostril.
- Between 24-48 hrs- Gas accumulates in the tissue which appears bloated. Subcutaneous tissue becomes emphysematous. Breasts in females and penis and scrotum in males are swollen. Tongue is swollen blackened and protruded. Blisters formed due to presence of gas below the epidermis.
- Between 48-72 hrs-There is prolapse of uterus and anus. Postmortem delivery of foetus occurs from gravid uterus. Both antemortem and postmortem wounds ooze. P M staining get displaced. Eye balls bulged out. Face is extremely swollen, discoloured and subject is not identifiable from facial features. Hairs and nails become loose and may taken easily.

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- **Between 3-5 days-** Abdomen burst open. Swelling of body subsides due to escape of gases from damaged pars of body. Teeth become loose. Skull sutures separate and liquified brain matter comes out specially in infants.
- **Between 5-10 days-** Colliquative (liquefaction) occurs during this period. Soft firm tissues change to thick semisolid black mass.
- **Skeletonisation of body-** This change takes varying time depending on various factors. In buried dead body total skeletonization may take even 1 year. When disposed off on land or water , skeletonization occurs within day, week or months.
- **Destruction of bones** ordinarily takes several years.
- **Prostate in** males and uterus in females decomposes last. Enlarged and diseased prostate decomposes early. Gravid uterus decomposes earlier than non gravid uterus. A parus non gravid uterus decomposes later than a gravid uterus and nulliparous uterus decomposes last.
- The chronology of decomposition mentioned above is not always follows.
- **Factors influencing the process of putrefaction- i) External ii) Internal**
- **External factors-**
- **Atmospheric Temperature-** High atm. Temp. promotes decomposition. Optimum range of temp. for decomposition is 21 – 38 degree Celsius. Beyond this range decomposition occurs at low rate. Decomposition virtually ceases below 0 and above 48 degree Celsius.

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- **Moisture-** Promotes decomposition by promoting growth of microorganism.
- Air- Stagnant air promotes decomposition and air movement retards the process by evaporating body fluid and cooling.
- Clothing- In summers clothings slightly reduce the rate by preventing invasion by airborne organism. In winters clothings helps the process by retaining body heat for longer.
- Environment- If the body is submerged in water then generally speaking decomposition is slow due to early cooling but the rate enhances once the body taken out of water. In buried bodies rate of decomposition varies according to depth of grave.
- Casper's dictum- It is generally presumed that if the rate of putrefaction is considered as 1 unit of time on open ground, it is 2 units in water and 8 units in deeply buried bodies.
- Invasion of dead body by animals and insects on land and in water which enhances the process of decomposition.
- Invasion of dead body by maggots is an imp cause of early decomposition. Forensic entomology studies various aspects of invasion of dead bodies by maggots. By studying the life cycle of various fly laying eggs on dead bodies we can able to estimate the time since death.
- Internal factors (body factors) influencing decomposition-
- Age- In case of intra uterine death decomposition is aseptic and is only by way of autolysis.
- Sex- Sex does not have much to influence the process of decomposition, except that female body due to abundance of fat retain body heat which may enhance the process of decomposition.

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- Condition of body- Thin emaciated body decomposes late in comparison to well nourished bulky body due to less fluid content in former.
- Cause of death- When death is due to infection, septicemia decomposition is rapid.
- Surface injury on the body- Having external injury will decompose earlier.
- Decomposition in water and floatation of dead body- Process of decomposition in water is slow due to early cooling. But once the body taken out of water the process is very rapid.
- Factors influencing decomposition in water- i) Water Temp. ii) Stagnancy of water iii) Quality of water iv) Aquatic animals.
- Floatation of dead body on water- In our country floatation of dead body on water occurs usually by 24 hrs after death in summers and it takes 2-3 days in winters.
- Medicolegal Importance of Decomposition- i) To estimate TSD ii) Advance decomposition obliterate identity and cause of death.

Mummification

In mummification there is rapid drying of dead body due to environmental factors, when the soft tissue becomes dark, hard and stay preserved. The dry hard skin get adhered to underlying bones.

In mummification skin becomes somewhat transparent due to absorption of liquified subcutaneous fat. Due to mummification internal organs reduce in size so much that they may not remain identifiable. Destruction of such a body occurs late. Depending on extent of availability of favourable condition time required for mummification varies between 3 weeks to 3 months roughly.

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- Factors favouring mummification- i) Hot Atmosphere ii) Dry atmosphere iii) Free air movement iv) Contact of body with absorbing surface.
- Medicolegal Importance- i) It gives rough idea about time since death. Ii) Identification of dead body is possible even after long period because features were preserved. Iii) Cause of death iv) Place of disposal of dead body can be guessed.

Adepocere Formation

It is formation of soft, whitish, crumbly, waxy and greasy material occurring in fat containing tissues of dead body. Adepocere also K/ac corpse wax, grave wax and mortuary wax.

Time required for adipocere formation- In hot and humid environment it is seen to occur by the end of 1st week (earliest recorded time -3 days). In cold environment change takes 3 weeks to occur. Completion of process may take 3 months.

Mechanism of adipocere formation- Adepocere consists mainly of fatty acids formed due to postmortem chemical reaction of hydrolysis and hydrogenation of body fats. Process needs water and at initial phase it utilises body fluid and hence other tissues being mummified.

Normally body fat contains only about 0.5% free fatty acid but in adipocere this may rise to 70% or more.

Chemical reaction essentially involves change of fat to higher fatty acids like palmitic acid, stearic and oleic acid.

Appearance, physical and chemical properties- Change is whitish or greyish white in colour has sweet rancid smell soft waxy in consistency when fresh but brittle when old. It burns with yellowish flame, after this change body buoyancy increased and body floats on water.

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- It dissolves in ether and alcohol. When treated with KOH liberates little ammonia.
- Distribution- At first it forms in patches and gradually increase in size. Change is well marked over those parts where there is excess of fatty tissue like cheeks, female breast and buttocks.
- In case of female body this change will be seen all over the body due to presence of good amount of subcutaneous fat.
- Fate of body- Usual decomposition is prevented due to i) adipocere change is rather chemically stable. Ii) the process utilizes most of body fluid and thus other tissue become dessicated and hence not invaded by organism.
- Factors influencing adipocere formation- 1. Heat favours and cold retards the process. High atm. Temp. helps in two ways a) Directly promotes the chemical reaction required for the change b) High atm. Temp. helps invasion of fatty tissue by *claustridium welchii* which liberates lecithinase that helps breakdown of fat cells.

2. Moisture- Moisture is essential for chemical reaction to occur. Body fluid utilised initially but completion of adipocere needs water.

3. Air movement- This retards the process i) by evaporation of body fluids ii) by reducing the body temp.

4 Running water- Retards the process.

Medicolegal Importance- i) Gives rough idea about TSD. Ii)Body is well preserved identification of subject is possible even after long period. Iii) Similarly body is preserved injuries over the body can be recognized even after long period. Iv) Here also some idea about the place of disposal of body can be made.

Preservation of Dead bodies-

- Preservation of dead bodies may occur naturally if disposed off in favourable environmental condition. Dead body may also be preserved artificially.
- Natural preservation of dead bodies- 1) When dead body lies in arctic region or a person dies at very high altitude where temp.is very low throughout year dead body get preserved for a long period.

2) In case of mummification and adipocere body preserved for long period.

3) When dead body buried in grave where there is high concentration of lime or arsenic in soil dead body may stay preserved for a long.

Artificial preservation of dead body- 1) By freezing below 0 degree Celsius, at -17 / -18 degree Celsius dead body may be preserved for unlimited period. 2) By embalming- content of intestine is syringed out by some means then formalin injected in system through some major veins and body is dipped into formalin solution. 3) By treating dead body with certain other chemical agent like arsenical preparation. 4) By mummification and use of chemicals- This was the old Egyptian method of preservation of dead body.