Central Sterile Service Department – Part 1

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Content of the Presentation

Content

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History of Sterilisation

History of Sterilisation

- Early concepts
  - Disinfection and hygiene are concepts that have been applied by humans for thousands of years
  - Aristotle recommended to Alexander the Great the practice of boiling water to be drunk by his armies
  - It may be inferred that there was awareness that something more than mechanical cleanness was required
  - Chemical disinfection of a sort was practiced at he time of Persian Imperial expansion, c. 450 BC
    - Water used to be stored in vessels of copper or silver to keep it potable

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History of Sterilisation

- Wine, vinegar, and honey were used on dressings and as cleansing agents for wounds
  - It is interesting to note that diluted acetic acid has been recommended comparatively recently for the topical treatment of wounds and surgical lesions infected by *Pseudomonas aeruginosa*
  - The art of mummification used a variety of balsams containing natural preservatives
  - Practical procedures involving chemical agents were also applied in the field of food preservation
  - An early account of procedures to try and combat episodic plague are found in the writings of 14th century

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History of Sterilisation

- Joseph of Burgundy recommended burning of juniper branches in rooms where plague patients stayed
  - Sulphur was also used
- Perhaps, rats were eliminated because of these and reduced the incidences of the disease
- Next, the discovery of a simple microscope (X300) by Antnie van Leewenhoek heralded beginning of new era
  - Some small creatures could be found under the microscope from various items that were examined
  - This was the discovery of bacteria
  - Bacteria in colony form, however, was found since the existence of human being

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History of Sterilisation

- Chemical disinfection
  - With the development of science of chemistry, newer and purer chemical disinfectants began to be used
  - Mercuric chloride was used by Arab physicians for wound dressing since the middle ages
  - In 1798 bleaching powder was used as a deodorant and disinfectant
  - Chlorine water was introduced in 1843
  - In 1839 iodine was suggested for wound dressing
  - Semmelweis used chlorine water in childbed fever occurring in the maternity division of Vienna General hospital
    - A sensational reduction in infection was achieved by this method after his insistence on use of this method of hand sanitization

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History of Sterilisation

- Since these early attempts for sterilisation and disinfection, present understanding about causation of infection, transmission and control has evolved
- Knowledge of Bacteria, virus, fungus, their susceptibility and resistance to various physical and chemical agents are now known
- This knowledge has been translated into application of food preservation, treatment of wounds
- Antibiotics was one of the greatest discovery which helped eliminate many diseases and improve longevity
- Misuse of antibiotics has led to development of bacterial resistance and we are soon reverting back to the pre-antibiotic era
- Sterilisation and disinfection which is an insurance against infection have gained more importance

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Sterilisation Concepts

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Sterilisation

- Definition
  - Sterilisation involves killing all forms of microbial life, including bacteria, viruses, and spores
  - To be effective sterilization must be preceded by meticulous cleaning all foreign material from objects prior to undergoing sterilization
- Spaulding's classification
  - The level of terminal reprocessing required by medical devices is based on the classification system developed by Spaulding in 1970
  - It divides medical devices into three categories

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Sterilisation

- The classification is based on patient's risk of infection when they come in contact with a medical device
- The classification is as under:
  - Critical Device
    - Device that enters sterile tissue, including the vascular system
    - Level of processing required:
      - Cleaning followed by sterilisation
    - Examples:
      - Surgical instruments
      - Biopsy instruments
      - Foot care equipment
      - Cystoscopes

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Sterilisation

- Semi-critical Device
  - Level of processing
    - Cleaning followed by high-level disinfection
    - Sterilisation is preferred
  - Example
    - Respiratory therapy equipment
    - Anaesthesia equipment
    - Tonometer
    - Cystoscopes

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Sterilisation

- Noncritical devices
  - Devices that touches only intact skin and not mucous membrane
  - They may not directly touch the patient
  - Processing required
    - Cleaning followed by low level disinfection (sometimes only cleaning is acceptable)
  - Example:
    - ECG machine
    - Oximeters
    - Bedpans, urinals, commodes

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Classical Sterilisation Practices

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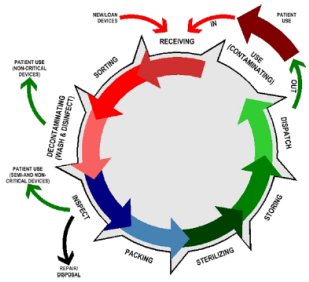

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Decentralised Sterile Processing

- Some years back, in India, each user department practiced sterilising instruments and syriges department wise
- For OT instruments, there used to be Theatre Sterile Supply Unit (TSSU)
- In wards, sterilisation of instruments and syringes was done by boiling.
- Operation theatres used very simple steam sterilizers
- Obviously, this was an inefficient system
- No standards of sterilisation could be maintained
- With improved technology and knowledge, the sterilisation tasks in hospitals were centralised in one department, the CSSD

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CSSD

- Advantages
  - Cleaning, disinfection, inspection, packing, sterilisation, storing and distribution are carried out by specialised, experienced personnel
  - Ensures better control and more reliable results
    - These reduced risk of hospital associated infections
  - Centralised resources require less personnel and equipment
  - More time was now available to Nursing staff
    - This available time could be utilised for patient care

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Classical Sterilisation Methods

- Sterilisation methods:
  - Heat sterilisation
    - Steam and dry heat
  - Chemical (gaseous) sterilisation (EtO, Formaldehyde)
  - Sterilisation by filtration
  - Radiation (UV light, radium, X-rays)
  - Combination of radiation and chemicals: UV & β- Propiolactone
  - Combination of steam and formaldehyde – work synergistically

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Classical Sterilisation Methods

- Liquid sterilisation
  - Acid in alcohol,
  - Aqueous formaldehyde with isopropylealcohol,
  - Halogens,
  - H_2O_2,
  - Hypochlorites,
  - Ozone,
  - Phenolic compounds (e.g. phenol and a mercury agent, thymol, and so on) - may be high level disinfectants or partial sterilisation

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Heat Sterilisation

- Moist heat is used (> 100^0C liquid or saturated steam)
- Dry heat without moisture
- Heat is the oldest form of sterilisation
  - Both dry and moist heat have many similarities
  - They have the ability to sterilise practically all organisms
  - There is no toxic residue or waste
- Differences between these two forms of heat:
  - Steam sterilisation can distort, corrode or wet materials
  - Dry heat can degrade and melt many heat sensitive materials and devices

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Heat Sterilisation

- Dry heat has excellent penetration properties
- Typically sterilisation by steam or moist heat sterilisation process is described as denaturation of protein
- Dry heat has been described as an oxidative process
  - More recently also described as extreme dehydration
- Heat in general can improve and enhance the microbial effectiveness of other methods of sterilisation
- Determining which sterilisation method is most fitting in any given situation
  - requires identification and discussion of their sterilising principles, qualities, uses, and prospects of the different techniques

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Sterilisation Process

- There are various methods of sterilization
  - Heat sterilisation
    - Heat is now the major sterilization method in use worldwide employing pressurized steam
  - Types of heat
    - Dry heat – less efficient
    - Moist heat
      - Sterilisation in an autoclave using moist heat is optimal in saturated steam at the phase boundary between the steam and condensate at the same temperature
      - Steam at any point on the phase boundary has the same temperature as the boiling water from which it was produced
      - But, it holds an extra load of latent heat
      - This latent heat is transferred without drop in temperature when it condenses on a cooler surface

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Sterilisation Process

- When air is present in a space with steam, the air will carry part of the load
  - In this case partial pressure of steam is reduced
- The temperature achieved in the presence of air will be less than that associated with the total pressure recorded
- Large volume of air trapped in an autoclave load may not be associated with lower temperature
  - Heating up period will be prolonged
- Such times are considerably reduced when an efficient air removal system is used
  - Removal of air is important in ensuring efficient autoclaving

Russel, Hugo & Ayliffe's Principle and Practice of Disinfection

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Moist Heat Sterilisation

- Some classical points of steam sterilisation are:
  - It is inexpensive compared to most other methods
  - Virtually there are no consumables
  - Steam could corrode metal and distort some polymers
    - Therefore, right metal or right polymers need to be selected
    - Metals can be treated prior to sterilisation – the process of passivation can be done
  - Tyndalization was sometimes used,
    - Sometimes it is still used now
  - Moist heat sterilisation process is not complex

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Moist Heat Sterilisation

- Can sterilise many liquids, drugs, fabrics, procedure trays that other methods cannot
- Could sterilise many reusable instruments
- Typically lower temperature and shorter times required than dry heat
  - Koch had shown that it is more effective than dry heat
- Relatively inexpensive
- Can sterilise all microbes, including prions except if they are occluded in some crystals such as calcium carbonate that are not water soluble

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Tyndalization

- Tyndallization
  - It is a form of sterilization.
    - This is also called fractional sterilization and discontinuous heating
  - A wide range of items could be sterilised using this process
  - In practice, tyndallization was used mostly for food storage.
  - The process is named after its inventor, John Tyndal
- The Process
  - Tyndall's method is relatively simple but somewhat time-consuming.
  - Food is placed in a can or heat-proof storage container,
  - This is boiled for about 15 to 20 minutes each day, for three days

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Tyndalization

- The rest of the time, it is kept as such without any other interference
- The boiling temperature must be at least at 100 degrees Centigrade
- The idea behind this is that
  - Some microorganisms may not get killed by the first day's boiling session
  - They will germinate from the warmth and get released from their spore coatings
  - They will get killed in the next day's boiling session, or,
    - If they survive that one, they will be killed on the third day's boiling session
- It is not considered today as a suitable sterilisation method

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CSSD Functional Zones and Work Flow

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Thank you

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