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Original Research Article

Microbial Evaluation of Embalmed Cadavers as a Potential Source of Infection in Anatomy Dissection Laboratory

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Abstract:

Background: Cadaveric dissection is indispensable tool in learning human anatomy. Cadaveric dissection continues to excel despite the development of new and cutting-edge learning modalities for anatomy, such as virtual dissection tables and 3D software, since it allows students to visualize the human body and is the most realistic method of learning anatomy. The microbial evaluation of embalmed cadavers is a critical concern in anatomy laboratories, as it impacts both medical education quality and the safety of students and staff. This study aimed to assess the presence of harmful bacteria and fungi on embalmed cadavers despite the embalming process, focusing on the potential implications for infection risk within the anatomy laboratory environment.

Aim: The goal of this investigation was to see if the anatomy dissection hall's potential source of bacteria that could put students at risk of illness came from the cadavers fixed in formalin.

Materials and Methods: Using a cross-sectional approach, swab samples were collected from various anatomical sites of 25 embalmed cadavers. These samples were cultured on suitable media to facilitate microbial growth, followed by identification through biochemical analyses. The microbiology department received samples from the swabs collected from different sites of cadavers for culture and sensitivity testing.

Results: The research conducted by our team was effective in recovering and identifying a range of organisms from the cadavers using traditional bacteriologic culture and identification techniques. The findings show cadavers treated with 10% diluted formalin have live, potentially contaminating microbes on their surfaces. Given the variety of cultivated species, preserved cadavers were considered as a potential source for the spread of bacterial organisms.

Conclusion: The findings suggest that instructors and students might get infections from cadavers treated with formalin. This study emphasizes the need for protocols to reduce cross contamination.

Keywords: Embalmed Cadavers, Microbial Evaluation, Infection Risk, Anatomy Laboratory, Infection Control.

Introduction

Students learn practical anatomy from a "cadaver" (dead body) through dissection and carefully analyze the structures by dissecting various parts. It enables individuals to recognize the various bodily structures with their own eyes [1]. Then, they can use this knowledge to see these structures under a microscope and put it to use in clinical and surgical procedures [2]. However, students must take great care not to acquire any of the many bacteria that could cause them to get infections while touching the cadaver.

Researchers have concluded that while fixative chemicals like formalin are used to preserve these cadavers, they are not very successful at inactivating or killing all the microorganisms that are present there [1-3]. Faculty and other staff members are also affected, in addition to students [1-3]. Embalming, which aids in the preservation of the cadaver, prevents the formation of microorganisms. In the process of embalming, fixative agents consist of 10% formalin diluted with water, glycerol and some disinfectants [4]. The effectiveness of the fixative agent is crucial since the students', faculties, and other staff's health is in jeopardy. All those who interact with these cadavers, whether directly or indirectly, run the risk of contracting the disease [5]. If necessary, precautions are not taken, the formalin-fixed cadavers contain many living organisms, including fungi (Penicillium, Aspergillus, etc.), bacteria (Staphylococci, Streptococci, etc.) and viruses that can contaminate the dissecting halls and spread various diseases to students [6]. They run the risk of spreading illnesses to those handling cadavers in the dissecting room, including hepatitis, HIV and tuberculosis. To ensure safety, wearing the appropriate protective clothes, maintaining personal hygiene, immunizing everyone who handles cadavers against diseases like hepatitis and tuberculosis, and keeping up with the most recent research in the field are all highly recommended [7].

We emphasized those bacteria because *Staphylococcus* was the primary subject of our study. Gram-positive staphylococci have a diameter of about 1.0 m. They develop as pairs, short chains, clusters, or groups. These cocci's form enables us to distinguish between staphylococci and streptococci. The catalase test is crucial for differentiating between Staphylococcus and streptococci. *Staphylococcus aureus* is the most pathogenic staphylococci member [8]. While *Staphylococcus saprophyticus* is typically linked to UTI in young girls of the reproductive age group, *Staphylococcus epidermidis* is known to cause a variety of hospital acquired infections. Skin is the most common way of entry; however, it can also enter through the respiratory or urinary tracts. Furunculosis, osteomyelitis, endocarditis, boils, and abscesses are all brought on by *Staphylococcus aureus*. Clusters of cocci known as *Staphylococci cohni,* which are typically found on human skin, are one of the primary sources of infections in immunosuppressed hosts. It has not yet been established whether embalming truly kills all diseases from the corpses [8].

Numerous risks and their side effects: Unhygienic practice like unprotected and improper laboratory coats, unsterile gloves and instruments can be carrier for infection that can enter via any route in the body. Improper ventilation can increase the chances of airborne infections. Inadequate preservation of cadavers can be a risk factor for transmission.

This research helps in knowing presence of flora and if there is, so current methods to control standard infections need to improvise. Our study's objective was to identify any dangerous bacteria, particularly staphylococci, in cadavers used for dissection and to determine ways to minimize the spread of these diseases to

students, instructors, and other dissecting hall employees.

Materials and Methods

The study was conducted in the Department of Anatomy, Rajendra Institute of Medical Sciences (RIMS), Ranchi, Jharkhand, India, after the Institutional Ethics Committee (IEC) of RIMS, Ranchi having approval number 01 Dated 20/02/2018. A cross-sectional descriptive study was carried out over 24 months on 25 (15 male and 10 female) formalin embalmed adult human cadavers of north Indian ethnicity aged between 25 to 75 years.

Sample Collection:

Selection of Cadavers: A total of 24 embalmed cadavers were selected for microbial evaluation in this study. Cadavers from diverse age groups and medical backgrounds were included to ensure a representative sample.

Preparation of Equipment: Prior to sample collection, all necessary equipment was prepared and sterilized. This included sterile cotton-tipped swabs, sterile transport tubes, disposable gloves, and appropriate personal protective equipment (PPE) for the researchers.

Sample Collection Procedure: Sample collection was performed under aseptic conditions to prevent contamination. Each cadaver was properly positioned to access different anatomical regions. Researchers put on disposable gloves and used a sterile cotton-tipped swab for sample collection.

Sampling Sites: Sample collection sites included areas prone to microbial colonization, such as oral and nasal cavities, axillae, perineum, and areas with skin folds. Additionally, samples were taken from incision sites made during embalming.

Swabbing Technique: A sterile cotton-tipped swab was gently inserted into the selected site and rotated in a circular motion to ensure adequate contact with the tissue. Care was taken to avoid excessive pressure that might disrupt the tissue.

Sample Labeling and Transport: After swabbing, each swab was immediately placed into a sterile transport tube, labeled with a unique identifier corresponding to the cadaver and sampling site. Transport tubes were sealed to prevent any contamination during transportation to the laboratory.

Microbiological Analysis:

Preparation of Culture Media: In the laboratory, suitable culture media were prepared based on the type of microorganisms likely to be present. These included nutrient agar, blood agar, MacConkey agar, and Sabouraud agar for bacteria, fungi, and yeasts.

Inoculation of Culture Media: Using sterile techniques, researchers transferred the microbial samples from the swabs onto the appropriate culture media. For each sample, multiple types of media were used to support the growth of different microorganisms.

Incubation: Inoculated culture media were incubated at appropriate temperatures (ranging from 30°C to 37°C) for a specified period. Incubation times varied depending on the expected growth rates of different microorganisms.

Microbial Identification: After incubation, the cultured plates were examined for microbial growth. Colonies with distinct morphologies were further subjected to biochemical and microscopic analyses to identify the specific microorganisms present.

Quality Control Measures:

Negative Controls: To ensure the reliability of results, negative controls (sterile swabs swiped across sterile surfaces) were included during both sample collection and culture media inoculation.

Cross-Contamination Prevention: Strict measures were taken to prevent cross-

contamination between samples. Disposable gloves were changed between each sample collection, and sterile techniques were followed throughout the process.

Laboratory Safety: All laboratory procedures were performed in accordance with biosafety guidelines to minimize the risk of exposure to potential pathogens.

Preparation of samples: All tubes with swabs in them were incubated for 24 hours at 37°C before being placed on blood agar and MacConkey agar plates. After that, any observable growth on the culture plates was examined. Gram staining and a study of the colony features were conducted. To distinguish between various forms of cocci, many common tests like clumping factor, catalase and tube coagulase test were conducted. Tube coagulase, DNase, and mannitol fermentation tests were used to identify Staphylococcus aureus. According to the procedure outlined by IORIO [9], coagulase negative Staphylococcus species were identified.

Results

Quantitative Analysis:

Our research team was effective in recovering and identifying a range of organisms from different sites (total 60 sample of swabs) of the embalmed cadavers using traditional bacteriological culture and identification techniques. The organisms found in the are listed in a table (Table 1). The findings show that cadavers treated with 10% buffered formalin have live, potentially contaminating microbes on their surfaces.

Table 1: Types of isolated organisms

Isolated micro-organism	Number
Non-typeable	16
Staphylococcus epidermidis	2
Staphylococcus aureus	2
Staphylococcus lugdunensis	1
Staphylococcus saprophyticus	0
Staphylococcus cohni	1
Staphylococcus capitis	1
Staphylococcus warneri	3
Staphylococcus hominis	1
Total isolates	27
Total sample	60

Statistical analysis

The data obtained was organized on Microsoft Excel systemically. Isolated organisms were classified based on protocol mentioned by IORIO and then calculated as Colony forming units. Unclassified microorganisms were mentioned in the non-typeable category. Total isolations in occurrence from sample swabbed from 60 swabs were determined.

Discussion

Human skin serves as the body's primary line of immunity against toxins and infections. The biggest organ in the body, the skin, is continuously impacted internally and externally both by environmental variables. The presence of organisms on skin might alter depending on these internal and external conditions. Up until recently, skin microbiology was confined to culture-dependent research, mostly coming from pathological specimens [10]. Non-pathogenic bacteria, on the other hand, are found everywhere on people, with up to $1*10^7$ bacteria per cm^2 of skin [11]. Although culture-dependent methods are still widely used, many bacteria are highly challenging to grow and

frequently go unnoticed as a result. Numerous studies on human infections to date have concentrated on oral and gut bacteria. Numerous investigations have been conducted on skin microorganisms, however sampling from hands has not been considered [12]. In high-risk locations including hospitals, labs, and food handling facilities, hands may carry a variety of dangerous bacteria, such as methicillin-resistant Staphylococcus aureus or Escherichia coli [13].

The risk of infectious pathogens like the hepatitis B and C viruses, HIV, *M. tuberculosis*, and prions that cause transmissible encephalopathies is present in the cadavers [14]. In anatomy departments, disinfectants, salts, glycerol, fixatives, and water is all present in the embalming fluid. The effectiveness of regularly used embalming fluids is not well-documented. One of the major dangers of infection for anatomy students is exposure to cadavers. A special effort must be made to minimize dangers. By receiving the right training, using protective gear, and following hygiene precautions, safe working circumstances can be created when handling corpses.

We attempted to document the presence of germs, particularly staphylococci, in the corpse utilized in our study. Some studies additionally highlight the risk of manipulating fixed cadavers and the spread of harmful microbes during anatomical education, research, and dissection operations [15]. In addition, *Enterococcus faecalis*, *Staphylococcus aureus* and *Streptococcus pyogenes* were discovered by Kabadi et al. by analyzing the scrubs of students who handled corpses [16].

Conclusion

Our study's conclusion is that samples taken from embalmed cadavers contained live germs. Students, teachers, and anybody else who uses human cadavers as a teaching tool, as well as anatomists & other cadaver handlers worldwide, may be at risk. It is determined that current embalming practices are insufficient for cleaning bodies, hence all care should be taken to avoid infection and cross contamination. Dissection lab directors must stay current on the latest research in the field and design protocols for the safe use of human cadavers in medical education to assure safety of all researchers, educators and students.

References

1. Ramesh G, et al. Detection of microorganisms on formalin-fixed and stored pathology tissues: A microbiological study. J Oral Maxillofac Pathol. 2017; 21(1):64.
2. Tabaac B, et al. Bacteria detected on surfaces of formalin-fixed anatomy cadavers. Ital J Anat Embryol. 2013; 118(1-5).
3. Morgan DJ, et al. Transfer of multidrug-resistant bacteria to healthcare workers' gloves and gowns after patient contact increases with environmental contamination. Crit Care Med. 2012;40(4):1045-1051.
4. O'Sullivan E, Mitchell BS. An improved composition for embalming fluid to preserve cadavers for anatomy teaching in the UK. J Anat. 1993;182(2):295.
5. Watson R. General and medical microbiology: summary of biochemical tests. University of Wyoming; 2013.
6. Nikolaou P, Papoutsis I, Dona A, Spiliopoulou C, Athanaselis S. Toxicological analysis of formalin-fixed or embalmed tissues: a review. Forensic Sci Int. 2013; 233:312–319.
7. Musiał A, Gryglewski RW, Kielczewski S, Loukas M, Wajda J. Formalin use in anatomical and histological science in the 19th and 20th centuries. Folia Med Cracov. 2016; 56:31–40.
8. Morgan O. Infectious disease risk from the dead following natural disasters. Rev Panam Salud Publica. 2004;15(5):307-312.

9. Iorio NL, et al. Methicillin-resistant Staphylococcus epidermis carrying biofilm formation genes: detection of clinical isolates by multiplex PCR. Int Microbiol. 2011;14(1):13-17.
10. Zeeuwen PL, et al. Microbiome and skin diseases. Curr Opin Allergy Clin Immunol. 2013;13(5):514-520.
11. Mathieu A, et al. Life on human surfaces: skin metagenomics. PLoS One. 2013;8(6): e65288.
12. Fredricks DN. Microbial ecology of human skin in health and disease. J Invest Dermatol Symp Proc. 2001;6(3):167-169.
13. Tomic-Canic M, Perez-Perez GI, Blumenberg M. Cutaneous microbiome studies in the times of affordable sequencing. J Dermatol Sci. 2014;75(2):82-87.
14. Grice E, Segre J. The human microbiome: our second genome. Annu Rev Genomics Hum Genet. 2012; 13:151-170.
15. Weed LA, Baggenstoss AH. The isolation of pathogens from tissues of embalmed human bodies. Am J Clin Pathol. 1951;21(12):1114-1120.
16. Kabadi CJ, et al. Potential pathogen transmission on medical student anatomy laboratory clothing. Med Student Res J. 2013;30-35.