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Review of the cadaver infectious diseases from past to present

Geçmişten günümüze kadavra enfeksiyon hastalıklarının gözden geçirilmesi

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ABSTRACT

Background: The target of this study is to identify the infectious microbial organisms that may encountered from during handling the cadaver and find the various methods of protection for the anatomists and the students in the dissection room.

Materials and Methods: This study is a historical review of the previous studies between the years 2002 and 2022 taken from the database of Pubmed and Google Scholar by using the following keywords (infectious diseases, cadaver diseases, anatomists hazards, Cadavers; risk of disease transmission, anatomical dissection).

Results: As a result of the literature review, it was concluded that every cadaver should be considered infectious material until proven otherwise.

Conclusions: As a result of this article, it was concluded that the fixation of the cadaver does not prevent infectivity. And the only method to reduce morbidity and mortality resulted from handling cadavers is by following protective measures according to the guidelines. Both the proper preparation of the cadaver and the knowledge of the medical history of the cadaver play an important role in minimizing the risks associated with the procedure.

Keywords: Cadaver Diseases, Anatomist Hazards, Infectious Diseases

ÖZET

Amaç: Bu çalışmanın amacı, kadavranın işlenmesi sırasında karşılaşılabilecek enfeksiyöz mikrobiyal organizmaları tespit etmek ve diseksiyon odasında anatomistler ve öğrenciler için çeşitli korunma yöntemlerini bulmaktır.

Materyal ve Metot: Bu çalışma, Pubmed ve Google Scholar veri tabanından alınan 2002-2022 yılları arasındaki önceki çalışmaların ilgili anahtar kelimeler (bulaşıcı hastalıklar, kadavra hastalıkları, anatomist tehlikeleri, Kadavralar; hastalık bulaşma riski, anatomik diseksiyon) kullanılarak tarihsel bir derlemesidir.

Bulgular: Literatür taraması sonucunda, aksi ispatlanana kadar her kadavranın enfeksiyöz materyal olarak kabul edilmesi gerektiği sonucuna varıldı.

Sonuç: Bu yazı sonucunda kadavranın fiksasyonunun enfektiviteye engel olmadığı sonucuna varılmıştır. Kadavraların işlenmesinden kaynaklanan hastalık ve ölüm oranlarını azaltmanın tek yolu da kılavuzlara göre koruyucu önlemlerin alınmasıdır. Hem kadavranın uygun şekilde hazırlanması hem de kadavranın tıbbi geçmişine sahip olunması, işlemle ilgili risklerini en aza indirilmesinde önemli bir rol oynar.

Anahtar Kelimeler: Kadavra Hastalıkları, Anatomist Tehlikeleri, Bulaşıcı Hastalıklar

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INTRODUCTION

The cadaver is the most important study material for the student's studying anatomy. Anatomical dissections don't just enhance the cognitive domain of learning or knowledge but also help the student of the subject to accumulating exploratory skills that might be further enhanced and applied to the fields of anatomical sciences and surgical sciences (Owolabi, Tijani & Ihunwo, 2022; Shoja, Benninger, Agutter, Loukas & Tubbs, 2013). As with many professions, working in anatomy has risks. One of these risks is that cadavers, which are anatomy training materials, have an infection risk. Cadavers, which are indispensable educational material for anatomists and medical students, pose a risk of infection during embalming procedures and dissection. Infectious microorganisms that pose a risk are mycobacteria, hepatitis B and C viruses, HIV and prions that cause infectious spongy encephalopathies (Demiryürek, Bayramoğlu & Ustaçelebi, 2002).

Throughout history, cadaver dissectors have witnessed many fatal accidents due to contamination from human cadavers. Well-known physicians and anatomists whose work has shaped the recent knowledge about the human anatomy and pathology were also not immune to the hazardous contamination from cadavers. Fear of cadaveric infections delayed progress in anatomical sciences (Shoja et al., 2013).

In the early days of the anatomical sciences, predissection antiseptic applications to cadavers were not common. Gloves were also not worn during dissection until the late 1800s. In the anatomical cadaver studies carried out from the 18th century to the end of the 19th century, many medical students and anatomists were infected and some even died (Kaufman, 2005; Lassek AM., 1959; Shoja et al., 2013).

The agents of infectious diseases

Tuberculosis

Tuberculosis is a slowly progressive disease caused by the beaded bacillus of mycobacterium tuberculosis. It is transmitted by inhalation of the bacteria Mycobacterium tuberculosis. It also affects other organs in our body, especially the lungs. Mycobacterium tuberculosis is a bacterium that can be cultured in L.J. and it gives various colony shapes. Although tuberculosis disease varies according to many professions, it has also been a disease that has affected scientists and medical students working in the anatomy department. Due to the increase in drug resistance, especially in bacteria, the risk of this infection is even increased. The number of cases has increased with the emergence of HIV infections in this disease, which has a risk of death (Demiryürek et al., 2002).

The estimation of the risk of TB among workers handling cadavers is done by the tuberculin skin test. It was thought was the by fixing the cadaver the risk of transmission is lower, some authors agree to the thought that formalin is tuberculocidal. Although it has been reported that TB bacilli in the cadaver is not infectious however, the clinical signs, culturing the bacilli showed it is still alive and infectious and its infectivity remains for 24-28 hours after being embalmed. Moreover, the reported case that led to the discovery of the infectivity of the T.B bacilli during embalming process the case developed active T.B. Judging by the conflicting data published, the ability of fixatives to act as a disinfectant for TB infection is uncertain. (Demiryürek et al., 2002).

Creutzfeldt-Jacob Disease (CJD)

Prions; are infectious particles with small proteins and are defined as the microorganism that causes CJD. It can be transmitted after medical procedures such as surgery, cadaveric dural grafts, cadaveric somatotrophic hormone injections and corneal transplantation (Billette de Villemeur et al., 1994).

Prion diseases have been collectively defined in the last 100 years and classified according to a certain number of criteria. In the 1920s, two German neuropathologists, A.M. Jacob and H.G. Creutzfeldt discovered a prion disease with a neurodegenerative effect and described it as Creutzfeldt-Jacob Disease. They detected progressive neurodegeneration in the patient groups they examined. Because prions continue to live in hosts after death, there is a risk of transmission of prion diseases to humans during cadaveric dissection in anatomy (Bradford, Piccardo, Ironside & Mabbott, 2014).

There is not enough information in the literature about the efficacy of liquids used for cadaver embalming. The target of this review is to identify infectious microorganisms that can be transmitted from cadavers and to recommend safety measures to protect scientists and medical students working with cadavers (Shoja et al., 2013).

HIV infection and viral hepatitis

The methods of transmission of hepatitis B and HIV nevertheless are the same, and measures to prevent transmission of hepatitis should be sufficient to prevent transmission of HIV.

Comparing the infectivity of the HIV and Heptitis B agent the HIV is less infectious. Which lead to less liability of having the infection during handling cadaver. HIV can survive in laboratory conditions for as long as many days in post-mortum tissues. We

should be careful when handling non-fixed HIV infected materials from cadavers or while conducting examination on them. The handling of an HIV infected cadaver is not recommended. Most of these cadavers are infested with other pathogens such as TB bacilli, which in some cases these pathogens are much infectious than the HIV itself (Perre, 2018).

A cadaver population's incidence of HIV and hepatitis C indicators was investigated, and the cases showed an excessive incidence of serologic markers for infection of the viruses. It has been claimed that cadaver organ transplantation can spread hepatitis. Also, there is a risk of contamination for morbid anatomy workers, raising severe concerns about the infectious potential of cadavers and the efficacy of fixatives in preventing hepatitis viruses (Demiryürek et al., 2002).

A person who has died due to HIV infection may still be contagious after coming to the anatomy department as a cadaver. The HIV agent has been isolated from pleural fluid, pericardial fluid, and blood samples of such deceased patients after being stored at 2°C for as much as 16.5 days after death intact infectious HIV had been isolated from bone fragments, spleen, brain, bone marrow, and lymph nodes from an affected person with AIDS at 6 days postmortem. Although in suspension tests, 25% ethanol and 0.5% formaldehyde had been proven to be powerful towards HIV, it isn't always clear whether or not those concentrations also are powerful in cadavers (Demiryürek et al., 2002).

MATERIALS AND METHODS

This study is a review of the previous studies between the years 2002 and 2022 taken from the database of and Google Scholar by using the following keywords (infectious diseases, cadaver diseases, anatomist hazards, Cadavers; risk of disease transmission, anatomical dissection).

RESULTS

As a result of the literature review concluded that every cadaver should be considered infectious material until proven otherwise (Demiryürek et al., 2002).

According to the information above, a cadaver may still be infectious when it arrives in an anatomy department for later instructional purposes. Because of this, safety precautions must be taken as soon as the cadaver arrives at the facility.

As encountered in

1.French – The Frenchman, Marie- Francois Xavier Bichat (1771–1802) was one of the most well-known anatomists to pass away from an infection they encountered while dissecting a human cadaver.

2.United Kingdom – William Hewson (1739-1774), a surgeon and anatomist known as the "father of hematology," passed away in England at the age of 35 from an infection he contracted from a dissecting wound.

3.Austria – The Hungarian Ignaz Philipp Semmelweis (1818–1865) recorded that one of his students; Jakob Kolletschka (1803–1847) accidently pricked on the finger while dissecting a cadaver while he was a resident at the obstetrics Hospital of Vienna General Hospital in Austria. Kolletschka's upper limb experienced phlebitis in a short amount of time, which then led to peritonitis, pleuritis, and meningitis. Soon after, he had eyesight loss and ultimately passed away because of the infection.

4.United States – The Philadelphia School of Anatomy has left a significant historical legacy in the US that is important to this subject. The founder of the Philadelphia School of Anatomy, Jason Valentine O'Brien Lawrance (1791–1823), dissected a number of yellow fever patients before passing away from the rickettsiosis pandemic. John Davison Godman (1794–1830), who took over the school after Lawrance passed away, occasionally used cadavers in various stages of decay. To prevent this, he injected the bodies injection of whiskey for preservation purposes.

Nevertheless, during a dissection session, Godman's janitor accidentally pricked his thumb on a cadaver and nearly passed away, as did other of Godman's students over time. Godman was at least three times infected. Sadly, Godman (1828) noted that one of his students had passed away in 1827 as a result of an infection he had acquired during dissecting. Despite Godman's advice to wash his hands, the student continued his dissection cadaver. The student awoke the next morning emetic, queasy, and with a terrible headache. He was given medication and leech bleeds, despite that passed away (Shoja et al., 2013).

The fixation of cadavers is not always efficient and the growth of bacteria is available as shown in a study by Burton Tabaac which indicated the presence of bacteria after fixation. In the experiment, it was stated that there were live microorganisms in the areas where the cadavers were examined. Isolated seven bacteria from fixed cadavers; eight cadavers had in the perineum, three cadavers in the oronasal region and seven cadavers showed the presence of microorganisms in the axilla (Tabaac et al., 2013).

DISCUSSION

The goal of this study was to list the risks of handling cadavers and the potential risk of infectious agents and provide the recommended protective measures according to the literature starting with:

Preparation for dissection

Information including the cadaver's health records must be obtained. It is very important to know what diseases and infectious microorganisms he was exposed to while he was alive. We must consider that the cadaver always has infectious microorganisms and respect the cadaver. We need to be protected against M. tuberculosis, hepatitis B, HIV, and prions.

It is necessary to use disposable body packs should be used during the transportation process of the cadaver. Even from the one exhalation of air that occurs when the body is first transferred, the risk of respiratory tract pathogens from the deceased to division staff is most likely remote. During the transfer, the personnel must use disposable latex gloves and wear clothing that protects against anything that may be transmitted from cadavers.

The clothes of the person who will study cadaveric dissection are also important. On top of that, he can wear a normal lab apron and then a disposable apron. High-safety gloves (Teflon or metallic gloves) should be worn on disposable gloves to protect against chemicals and not to penetrate any wounds. A filter face mask should be used to protect from particles, mist concentrates or dust in the environment. Thus, the respiratory system is protected. In addition, glasses or face shields should be used to protect the eye and nose from any splashes or particles. Finally, disinfection of the dissection table should be used for disposable plastic sheets or any protective material (Demiryürek et al., 2002).

Protecting anatomists who dissect

1. The history of the cadaver to be dissected should be well known and the fixation of the cadaver should be carried out in accordance with the procedures.

2. The presence of protective equipment against chemical substances should be ensured.

3. There should be a suitable working environment for anatomists mentally, psychologically and also physically.

4. Immunization of anatomists working for cadaveric dissection is very important. In particular, immunization against hepatitis should be carried out.

5. Protections- The welfare levels of cadaver dissectors should be positively ensured and protected (Owolabi et al., 2022).

Embalming chemicals

Despite the belief that says cadaver preservation reduces the risk of hazardous transmission from it, the data about the fixative and disinfection fluid properties used in embalming is not enough. In the process of embalming fluids used contains buffers, disinfectants, fixatives, surfactants, glycerol, water, and salts. The foremost commonly used fluid material are ethanol, formalin, and phenol. The formalin deactivates the infectious agents by forming covalent links with the functional natural protein groups. The powerful effects of formaldehyde against most of the micro-pathogens unfortunately not effective against the CJD agent.

The most commonly used alcohol to control microbial growth is ethanol. The mechanism of action of ethanol is lipid disintegration and protein denaturation. Ethanol can be used at a high concentration of about 60-95% on its own or at a lower concentration in combination with other antimicrobial agents. The spectrum of action of ethanol includes parasites and micro-organisms but doesn't affect prions, endospores, and non-enveloped infections.

Phenol and its subtypes of it act by inactivating the vital cell chemical reactions and damaging lipid contains cellular membranes leading to the destruction of cellular materials.

The level at which phenols are effective is 1% at the concentration it shows a wide spectrum of actions against micro pathogens but ineffective against prions.

CONCLUSIONS

The steps to prevent risks to the anatomists who handles the cadaver.

1. After the cadaver is supplied safely then the cadaver must be fixed in accordance with the procedures. Thus, the infectious microorganisms that can be present in the cadaver are reduced.

2. To use the best methods for the protection of cadavers and to restrict the use and exposure as far as possible to hazardous chemical agents.

3. Anatomists and medical students need to properly apply cadaveric dissection methods and gathering the cadavers and materials in a planned manner at the end of dissection.

4. The materials used during dissection must be well sterilized. Thus, the possibility of infection is reduced. In addition, optimal working conditions must be provided to prevent injuries (Owolabi et al., 2022).

Decontamination process following dissection;

After the dismemberment, the discarded items and leftover residues from dissection should be thrown away in the hazardous medical bin.

All materials used in dissection must be decontaminated. The disinfection and sterilization

methods used are effective against many microorganisms. But this does not apply to prions. So it can not decontaminate prions. For this reason, extreme caution should be taken during dissection and special precautions for prions should be applied.

Every day the laboratory should be disinfected with phenolic solution (containing 3–5% dynamic fixing). This method is favored to hypochlorite for several reasons: hypochlorite may be a corrosive chemical and may harm surfaces or rebellious; cleaning expansive areas with hypochlorite may free unacceptable amounts of chlorine; and formaldehyde reacts with hypochlorite to form bischloromethyl ether, a potent strong carcinogen (Demiryürek et al., 2002).

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Author Contributions

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