Microsensors, Implantable Devices and Rodent Surgeries for Biomedical Applications
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Welcome back to the Rodent Neurosurgery Modules. Today's session is crucial for the safety of both the personnel and the lab animals. We will discuss standard safety practices to prevent acquiring infections from the animals and protect yourselves while handling them. Although lab animals are generally clean, they can still harbour diseases that can be transmitted to humans.

Today, we will examine the necessary precautions, how to maintain a sterile field, and how to wear and maintain sterile clothing throughout your time in the lab.

First and foremost, you need to be familiar with the term "zoonotic diseases." These are conditions acquired from handling animals. More broadly, a zoonotic disease is any disease transmitted from an animal to a human.

Specific diseases associated with rodents include rat-bite fever, tularaemia, and hantavirus. There are numerous other diseases you can be susceptible to when handling rodents. It is crucial to take utmost precautions while handling these animals. No matter how clean or hygienic they appear, they can still carry these organisms, and if transmitted to personnel, they can cause various diseases with symptoms such as headaches, vomiting, haemorrhagic manifestations, and meningitis.

How are these diseases transmitted between animals? It can happen through contagion between different species of rats or mice bred in the animal lab. Individual animals can carry these agents and transmit them directly to humans. Animals from different colonies and locations can also be sources of transmission.

There are general guidelines to follow. Essentially, you are creating a barrier between yourself and the rodent you are handling. The goal is to avoid direct contact by following these guidelines.

So, there are two things to consider: one is the protective gear you need to wear while handling the rodents. The second is maintaining a sterile field if you are performing surgery on the rodent. It is crucial to avoid contaminating the field and transmitting microorganisms into the rodent's body, as this can affect your experimental outcomes. The transfer of microorganisms can happen in both directions, and it's vital to prevent transmission from rodent to human, from human to rodent, and even from the environment to the rodent. Contamination during surgery can lead to infection and

disrupt your experiment. So, we also need to discuss how to maintain sterility while handling the animal to prevent any infectious agents from entering its body.

First and foremost, as you can see here, is the lab coat that needs to be worn over your street clothes when entering the animal housing room or handling the animal. Animal hair can stick to your regular clothes and carry microorganisms, potentially transmitting diseases from the rodent. So, the lab coat is essential. There are two options: a sterile apron or a lab coat that acts as a barrier between you and the animal.

The choice depends on the situation. If you're performing surgery, wear a clean gown and gloves until you begin. These aren't completely sterile but are suitable for handling the rodent outside its body, like positioning it or shaving hair. This prevents your body from contacting the rodent's bodily fluids or skin organisms. Eye protection is necessary if you're using fluids or disinfectants to clean the rat or the surgical area. Masks and gowns are also required in such cases.

These are the general lab attire requirements before entering the lab: a cap, face mask, face shield (if possible), respirator mask, gown or apron, and gloves. This is crucial if you're generally handling the animal or conducting behavioral experiments. If you plan to perform surgery, replace these clothes with sterile attire and accessories.

So, it's important to avoid bringing any personal items, such as food, books, combs, or and hats, into the animal room. Leave everything outside and only take essential items into the lab. If you need any accessories, take them in once and leave them there until your experiment or study is completed. This prevents these items, which can harbour microorganisms, from being taken outside. Discard or sterilize any stationery used in the lab with ethanol or formalin at the end of your experiment. Wear the provided uniform, scrub suits, and soft-soled shoes or slippers dedicated to the facility. Any necessary protective clothing must be worn by animal care personnel while in the care room. Avoid bringing personal items into the animal facility and wear the dedicated attire.

Now, let's discuss the situation where you're going to perform surgery. Since this is a surgical module, we'll cover surgical scrubbing, which is crucial. As this is a neural engineering course, many implants will be used. Whenever implants are used, it's natural for them to harbour microorganisms on their surface, which can be carried to the brain and form a biofilm. This biofilm is a colony of microorganisms growing on the implant's surface, which can cause implant failure by preventing proper healing due to infection.

So, it's important to follow specific steps when transitioning from general animal handling to surgical handling. Once you're in the lab with the lab coat on, remove the gowns and gloves used for animal handling. Before changing into the surgical attire, ensure all unsterile steps are completed. It's helpful to have an assistant to aid in the transition from unsterile to sterile.

Once you wear your sterile gowns and gloves, avoid handling anything in an unsterile area. An assistant can help if needed. From this point on, all steps must proceed in one

direction; there's no going back to handle unsterile items. This sequence ensures that the sterile field, once the skin is opened, remains uncontaminated.

By following this sequence, the final gloves you use to handle the surgical area should be free of microorganisms. This is the desired outcome. First, wet your hands. Proper hand scrubbing and duration are crucial, as microorganisms adhere strongly to the skin. Even though some colonized organisms are normal for us, they can cause diseases in animals.

Thoroughly clean your hands with disinfectant, following the World Health Organization's seven steps of handwashing. While these are primarily for human healthcare settings, they provide a gold standard for maintaining sterility before wearing surgical attire. Once you have soap on your hands, rub your palms against each other, focusing on the center. Then, rub the back of each hand with interlaced fingers.

So, it's important to ensure that the wet spaces between your fingers are thoroughly scrubbed and cleaned, as they can harbor many organisms. Start by cleaning the center of your hands, then interlace your fingers and scrub the wet spaces between them, ensuring all areas are covered on both hands. Next, rub the palm and then the back (dorsal side) of each hand with interlaced fingers.

Once that's done, cover the back of your fingers, including the nails. These seven steps ensure thorough cleaning of all hand areas. Clean the base of the thumb and fingers individually, then focus on the fingertips to clean the nail bed. A good manicure is recommended to ensure proper cleaning. Finally, rinse and dry your hands.

For a surgical scrub, ensure the water drips down your elbow when rinsing and drying. Keep your hands elevated to prevent dirty water from flowing towards your fingertips when handling sterile gloves. The flow should be away from your hands.

To recap:

1. Clean the palms.
2. Interlace fingers and clean the palmar and dorsal surfaces, covering the web spaces.
3. Clean the back of your fingers.
4. Clean the base of the thumb and its web space
5. Clean the fingertips and nail bed
6. Rinse and dry, ensuring water flows away from your hands.

These are the standard seven steps of handwashing.

Now, let's see how to wear personal protective equipment (PPE), specifically the scrub suit, before surgery. The sequence is important to keep your gloves sterile until you touch the rodent's sterile field.

Start with shoe covers, then wash your hands, followed by the mask and cap. Eye protection is also crucial, as drilling can generate bone dust and blood particles that may come into contact with your eyes.

Once these are on, perform the thorough surgical scrub as just mentioned. Afterward, you'll touch the sterile gown. We'll cover how to wear it in the next slide, followed by sterile surgical gloves.

It's preferable to use double surgical gloves, even though it might slightly reduce tactile perception. Double gloves provide an extra layer of protection. If the outer glove gets torn or punctured during surgery, you can easily remove it and still have a sterile inner glove. Otherwise, your assistant would need to help you remove the glove, and you'd have to repeat the entire gloving sequence.

This is the entire sequence to follow, ensuring your hands are sterile and clean before proceeding with surgery. It's best not to skip any steps to guarantee sterility.

So, now let's discuss how to don, or wear, a sterile gown. This is crucial because when you approach the surgical field wearing a sterile gown, your body is close to the sterile area. Wearing an unsterile gown can contaminate the field. It's recommended to wear a sterile gown depending on the procedure's sterility requirements. For a brief procedure like a small injection, you might skip the gown, although it's still strongly recommended. However, for longer procedures involving implants or chronic studies, comprehensive sterile attire is necessary.

Regardless, it's good to know how to wear a sterile gown. After scrubbing, gowns are folded to expose the inner and outer surfaces. Handling is always done with the inner surface, not the outer one, which will directly contact the sterile field. Avoid touching the outer surface with bare hands before wearing gloves, as gloving comes after gowning.

Exit the hand scrubbing area with clean, dry hands, holding the gown with the inner surface in contact with your hand. Drop the gown to open it fully, exposing more inner surface for handling. Locate the sleeves, which usually open when dropped, and insert your hands into them, keeping the inner surface in contact with your skin. Your assistant can help pull the gown up until your hands reach the end of the sleeves. Tie the gown behind your back.

One variation is to avoid fully removing your hands from the sleeves and use them to handle the gloves. Gowns are the most sterile part of the attire, so this helps keep the gloves completely sterile. Hold the cuffs of your sleeves in place and use your hands to put on one glove.

Once one sterile glove is on, the other can be handled easily. However, I suggest wearing the sleeves completely, provided you handle the gloves in a specific way, as shown here.

I missed mentioning the scrubbing time. The initial scrub should always be 10 to 15 minutes. For rodents, 10 minutes is sufficient. Then, wipe your hands clean and wear the gloves as demonstrated.

Again, there are inner and outer surfaces. The gloves are folded so the inner surface is accessible, just like the gown. To maintain sterility, handle only the inner surface. Pick up the glove, insert your hand, and pull it over your wrist. Avoid touching the outer surface. Keep it folded, pull it up to the wrist crease, and leave it there. Now, with your sterile hand, insert it into the outer surface of the other glove.

Once the other hand is fully gloved, unfold the pre-folded glove and cover your entire wrist up to the sleeve of your gown. The glove will snap onto the outer surface of the gown, ensuring your entire upper limb is sterile. This gloving method keeps your fingertips and hands completely sterile.

You're now ready to start surgery, provided all your equipment is sterile and arranged beforehand. An assistant can help arrange the equipment, or you can do it yourself while wearing sterile gloves before scrubbing. Once you're in surgical attire, you can't handle unsterile items outside the tray. So, have the entire surgical setup ready before scrubbing if you don't have assistance.

Once gloved, you can proceed with surgery. Remember to maintain safety measures and wear gloves whenever there's direct contact with animals, especially during blood collection or if you suspect an infection.

It's crucial to change gloves between different procedures or steps. For example, if you're handling the skin but need to draw blood, switch from handling gloves to sterile gloves. After surgery, remove the surgical gloves and put on another pair for handling. These measures are essential to maintain sterility.

Remember to discard the entire scrub suit when leaving the lab and dispose of all accessories and the scrub suit properly.

This concludes our session on safety measures, which are extremely important. To summarize, there are two sets of safety measures: one for animal handling and another for maintaining the sterility of the surgical field. We've covered both in this session, encompassing all the necessary surgical aspects and best safety practices.

In the next session, we will discuss how to perform euthanasia correctly and harvest organs for various lab studies. Thank you all.