Basic concepts and techniques of rodent survival surgeries.
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- General Consideration of Rodent Survival Surgery
- Aseptic Techniques
- Perioperative Care
- Surgical Techniques
General Consideration of Rodent Survival Surgery
General Consideration of Rodent Survival Surgery

- Training basic surgical concepts and techniques should be undertaken before performing surgery.
  
  Scientific and animal welfare reasons

- Surgery itself is a technical skill and one that will improve with practice.

- Training the principles of asepsis and surgical technique at the same time however, often remain unexplained or untaught.

- Perioperative care = Pre and post operative care

- Good Technique of surgery
  - Asepsis.
  - Gentle tissue handling.
  - Minimal dissection of tissue.
  - Appropriate use of instruments.
  - Effective hemostasis.
  - Correct use of suture materials and patterns

- Anatomy
TECHNIQUES IN ASEPTIC RODENT SURGERY

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Abstract

Performing aseptic survival surgery in rodents can be challenging. This unit describes some basic principles to assist clinicians, researchers, and technicians in becoming proficient in performing aseptic rodent surgery.

Key Terms

aseptic surgery; technique; rodent; surgical preparation; instrument preparation; suture material; anesthesia; analgesia; surgical gloves
General Consideration of Rodent Survival Surgery

The principles described in the Guide (NAS, 1996) apply to rodent surgery:

1. **Appropriate pre-operative and post-operative care** of animals in accordance with established veterinary medical and nursing practices is required.

2. All survival surgery will be performed by using **aseptic procedures**, including sterile gloves, masks, sterile instruments, and aseptic techniques.

3. **A dedicated surgical facility** is not required for rodents but surgery must be performed using aseptic techniques.

4. Research personnel will be **appropriately qualified and trained in all procedures** to ensure that good surgical technique is practiced.
General Consideration of Rodent Survival Surgery

SURGICAL RESEARCH GUIDELINES

Guidelines for Rodent Survival Surgery

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Keywords: Rodent Surgery, survival, guidelines
General Consideration of Rodent Survival Surgery

1. Rats and mice have a high surface area to body volume ratio and rapid metabolism. Pharmacological doses are usually higher than in larger species.

2. Dehydration can occur faster per unit of time than in larger species.

3. Rats and mice lose body heat rapidly through hairless areas and hypothermia during surgery is a frequent cause of intra-operative mortality.

4. Rodents have limited fat storage and energy reserves, which may contribute to hypothermia.

5. Changes in protein metabolism can occur postoperatively leading to negative nitrogen balance lasting for several days.

6. Minimizing tissue trauma, preventing infection, controlling post-surgical pain and discomfort, and supporting animals’ nutritional needs will reduce the magnitude of metabolic response to surgery.
Aseptic Techniques for Rodent Survival Surgery
무균술 - 물품과 공간에 미생물이 없는 상태를 만들고 유지하고자 고안된 술기

pectral Technique for Rodent Survival Surgery

무균술의 기본 개념
1) 미생물은 동물 또는 인간에게 질병을 일으킬 수 있음
2) 생명체에게 해로운 미생물은 간접 또는 직접 접촉을 통해 전파될 수 있음
3) 미생물에 의한 질병 발생은 미생물이 감수성 있는 숙주로 전파되는 것을 차단함으로서 예방이 가능함

Major Consideration
- Preparation of your surgical space
- Surgeon preparation
- Animal preparation
- Handling of instruments
Aseptic Technique for Rodent Survival Surgery

✔ 무균술 기본 원칙 및 술기

➢ 손 씻기 또는 세척을 통해 피부의 미생물 수를 감소 -> 수술전이 중요

  ▪ 술자의 손과 팔 : 세제와 소독제 이용 / 스크럽 브러쉬나 거즈를 이용 실시
  ▪ 환자의 피부 : 필요시 제모 시행 / 2가지 이상의 소독액으로 소독 (알코올, 포비돈)

➢ 처치실 또는 수술실 이용 실시

  ▪ 살균세제로 환경 표면을 주기적으로 청소 / 주기적인 멸균 필요
  ▪ 헤파필터 장착 공조기, 양압유지
  ▪ 출입 인원의 최소화 : 술자, 보조술자, 간호사

➢ 미생물 전파를 감소시키도록 환경을 관리

  ▪ 수술실 환경 유지
  ▪ 수술탑장 : 멸균 장갑, 수술가운, 모자, 마스크 착용
  ▪ 방포를 이용하여 멸균 영역 유지

➢ 침습적인 시술을 하게 되는 물품의 경우 멸균 처리된 1회용을 사용

➢ 멸균 물품을 다룰 때에는 사용전 멸균되지 않은 부분에 접촉되는 일이 없도록 주의함 / 만약 사용 전 오염되는 경우 폐기처분 또는 재멸균

➢ 오염이 의심스러운 의약품이나 소독제 등의 폐기
Aseptic Technique for Rodent Survival Surgery
Aseptic Technique for Rodent Survival Surgery
Aseptic Technique for Rodent Survival Surgery

Figure 1.12.7.
Simple peel pack.

Figure 1.12.8.
Complex surgical pack.
Aseptic Technique for Rodent Survival Surgery

Figure 1.12.9.
Hot bead sterilizer.

Figure 1.12.10.
Flash dry heat sterilizer.
Aseptic Technique for Rodent Survival Surgery

Figure 1.12.12.
Between surgeries, the tips of the instruments should be covered.
Aseptic Technique for Rodent Survival Surgery

Figure 1.12.13.
Paper surgical drape

Figure 1.12.14.
Plastic adhesive surgical drape.

Figure 1.12.15.
Sterile gauze pads used for surgical drapes.
### Aseptic Technique for Rodent Survival Surgery

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<th>그람(-) 세균</th>
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<td>크로로 환산민</td>
<td>세포벽 파괴</td>
<td>매우 우수</td>
<td>우수</td>
<td>부적절</td>
<td>양호</td>
<td>우수</td>
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<td>요오드/요오드 합성물</td>
<td>산화/Free iodine 대치</td>
<td>매우 우수</td>
<td>우수</td>
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<td>양호</td>
<td>우수</td>
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<th>지속효과</th>
<th>통상 사용농도</th>
<th>유기물질에 받는 영향</th>
<th>안전성</th>
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<tr>
<td>알코올</td>
<td>가장 빠름</td>
<td>없음</td>
<td>70%</td>
<td>자료없음</td>
<td>피부건조, 휴발성</td>
</tr>
<tr>
<td>크로로 환산민</td>
<td>보통</td>
<td>매우 우수</td>
<td>2%,4%, 0.5% in alcohol</td>
<td>적음</td>
<td>독성, 각막염</td>
</tr>
<tr>
<td>요오드/요오드 합성물</td>
<td>보통</td>
<td>적음</td>
<td>10,7,5,2, 0.50%</td>
<td>받음</td>
<td>피부에서 홍수: 독성, 피부자극</td>
</tr>
</tbody>
</table>
Perioperative Care for
Rodent Survival Surgery
Preoperative fasting
not usually practiced on rodent
do not vomit, predisposed to hypoglycemia.

Anesthesia
Zoletil (40~80mg/kg) + Xylazine (10~20mg/kg)
Ketamine (50~100mg/kg) + Xylazine (10~20mg/kg)
Alfaxan (40~80mg/kg) + Xylazine (10~20mg/kg)

Endotracheal intubation is ideal
Most rodent species have a small thoracic cavity
relative to their abdomen, and a small tidal volume.
Perioperative Care for Rodent Survival Surgery

Endotracheal Intubation

- Neck can be transilluminated
- Open mouth with gag
- Pull tongue forward
- See bright flashing light
  - Opening and closing of larynx
Perioperative Care for Rodent Survival Surgery

Prevention of hyperthermia

적외선 등, HYPER-HYPOTHERMIA SYSTEM (blanketrol)

Large surface/volume ratio of rodents predisposes to hypothermia provided extracorporeal heat and their body temperature monitored. Hair removed through shaving should be isolated to the surgical site only. All solutions should be properly warmed, whereas alcohol should be avoided.
Perioperative Care for Rodent Survival Surgery

Drapes

A severe disadvantage for the anesthetist monitoring rodent patients.

Plastic transparent (or slightly semitransparent) drapes view the animal while still providing a sterile surgical field. Help maintain body heat, and keep the patient dry from irrigation and flushing procedures.
Perioperative Care for Rodent Survival Surgery

Hemostasis and Suture

Blood volume of small mammals is approximately 8 to 10 mL/100 g. Blood loss of 10% is considered safe in relatively healthy animals.

Fine hemostats - may be too big or traumatic in very small patients.

Standard ligation - might be expensive or time consuming.

Compression hemostasis is more appropriate.

It can be performed with sterile cotton tipped applicators.

Cotton swabs provide 3 adjunct functions:

- handle and bluntly dissect small and delicate tissue
- moistened with epinephrine for additional hemostasis
- they help to evaluate blood loss.
Perioperative Care for Rodent Survival Surgery

Gelatin sponge and oxidized regenerated cellulose enhance hemostasis, providing clot formation, biologically inert, and adapt well to very small surgical sites.
Perioperative Care for Rodent Survival Surgery

Post-operative Care

If possible, administration of reverse anaesthesia
   Ex) atipamezole hydrochloride (Antisedan).- Medetomidine
House animals individually and keep under close observation
   until they fully recover from anaesthesia.
Following recovery period (approximately 24 h after surgery),
   the animals can be grouped together as normal.
Delay administration of experimental treatments for at least 24 h after surgery.
Depending on species, the use of Elizabethan collars is difficult, impossible
   Ex) increased stress, risk of entrapment, limited visual field,
   inability to carry out coprophagy

the risk of postoperative self-trauma can be minimized
   proper incision and handling of tissues, surgeon skill,
   adequate size and type of suture material, and effective analgesia.
Perioperative Care for Rodent Survival Surgery

Analgesia

Ketoprofen: 2~5mg/Kg, SC
Ketorolac: 5~7.5mg/Kg, SC or PO
Carprofen: 5~10mg/Kg, SC
Meloxicam: 5~10mg/Kg, SC or PO or IM

NSAIDS

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Contraindication</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Long duration of effect</td>
<td>• Impaired renal or hepatic function</td>
</tr>
<tr>
<td>• Anti-inflammatory properties</td>
<td>• Dehydration of hypovolemia</td>
</tr>
<tr>
<td>• No behavior modifying effects</td>
<td>• Coagulopathies</td>
</tr>
<tr>
<td>• Lack of respiratory and cardiovascular side</td>
<td>• receiving other NSAIDs or corticosteroids</td>
</tr>
<tr>
<td>effects</td>
<td>• Gastrointestinal ulcer or erosions</td>
</tr>
<tr>
<td>• Availability in oral formulation</td>
<td>• Pregnant, lactating or breeding animals</td>
</tr>
<tr>
<td>• Lack of abuse Potential</td>
<td></td>
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</tbody>
</table>
Surgical Techniques for Rodent Survival Surgery
1. Undermining

피부를 피하 결합조직과 분리하는 과정
수술시 피부의 이동을 용이하게 하고 술부의 tension을 감소함
Surgical Techniques for Rodent Survival Surgery
Surgical Techniques for Rodent Survival Surgery

2. Simple interrupted suture

3. Simple continuous suture
4. Suture patterns and Skin closure

- Over and over sutures (interrupted and continuous)
- Subcuticular suture (interrupted and continuous)
- Horizontal mattress sutures (interrupted and continuous)
- Vertical mattress sutures (interrupted and continuous)
- Lembert sutures (interrupted and continuous)
- Cushing suture
Surgical Techniques for Rodent Survival Surgery

Tissue glue, in combination with subcuticular suture
1. 흡수성 VS 비흡수성 and Monofilament VS Multifilament

- 표피에는 비흡수성, Monofilament suture를 쓰는 것이 바람직함
  일반적으로 피부조직이 질기므로 각침을 이용
- 내피에는 흡수성 suture를 이용, Monofilament가 바람직하나
  모양 유지가 쉽지 않으므로 Multifilament 이용도 가능함
  감염우려가 큰 수술에는 Multifilament를 이용하지 않음.
  조직손상을 최소화하기 위해 round needle을 주로 이용함

<table>
<thead>
<tr>
<th>Absorbable suture</th>
<th>Non-absorbable suture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyglactin (Vicryl) , Dexon(Polyglycolic acid), Polytrimethylene carbonate (Maxon) Polydioxanone suture (PDS)</td>
<td>Nylon(Ethilon), Silk, Polypropylene (Prolene), Polyester (Dacron), stainless steel wire</td>
</tr>
</tbody>
</table>
2. 수술사의 두께

- 숯자가 클수록 얇은 수술사
- 일반적인 설치류 수술 : 3-0  ∼  5-0 suture 이용
Surgical Techniques for Rodent Survival Surgery
Surgical Techniques for Rodent Survival Surgery

Wrong instrument holding

Correct holding: Pencil grip technique for holding thumb forceps

Holding hemostats or scissors

Thumb & Ring finger

Holding the needle driver

Thumb & Ring finger

Palming the needle driver
Surgical Techniques for Rodent Survival Surgery
Surgical Techniques for Rodent Survival Surgery

Orchiectomy (Castration, 정소 절제술, 거세술)

Definition

하나 또는 양쪽의 정소를 제거하는 외과술

Objects

testosterone 호르몬 효과의 제거
호르몬 관련 행동 연구
수컷 생식기능의 제거
수정란 이식시 대리모 암컷과 mating 용 (Vasectomy)

-> 암컷의 위임신 유도후 대리모 역할 수행 (수정란 이식)
Orchiectomy_Scrotal approach

1) Scrotum (음낭) 끝 부분을 Dressing 후 절개
2) 정소를 둘러싸는 막의 제거
3) Testis(정소), cauda epididymis(정소상체), spermatic cord(정삭)를 노출시킨다.
※ testis와 연결된 cremaster m.을 분리해야 노출이 용이함
Surgical Techniques for Rodent Survival Surgery

A) the exposed testicle  
B) the spermatic cord surrounded by fat  
C) the epididymis  
D) the deferens duct  
E) the everted hemiscrotal sac.
Surgical Techniques for Rodent Survival Surgery

5) Spermatic cord (정삭) 을 묶어 준다
   ※ Spermatic cord : 정관, 정소 관련 혈관 등이 지나감
6) Ligation 윗 부분을 잘라 testis와 epididymis를 제거한다.
7) 잔여 조직을 내부로 밀어 넣는다.
8) 반대쪽 testis도 동일하게 실시한다.
9) 피부봉합을 실시한다 - simple interrupted suture.
Surgical Techniques for Rodent Survival Surgery

Abdominal Approach

1) 복부 아래쪽 피부를 중앙에서 절개한다 - 1 cm 정도 피부 절개 후 안쪽의 백선을 절개한 후 방광과 정소를 확인한다.
2) the testis, cauda epididymis, vas deferens, and the spermatic blood vessels 을 노출
3) Spermatic cord (정삭) 을 묶어 준다
Surgical Techniques for Rodent Survival Surgery

4) Ligation 윗 부분을 잘라 testis와 epididymis를 제거한다
   반대쪽 정소도 동일하게 제거한 후 잔여 조직을 복강 안으로 넣는다

5) 복벽을 봉합한다. – simple interrupted
   피부를 봉합한다. - simple interrupted or continuous
Surgical Techniques for Rodent Survival Surgery

Ovariectomy — 난소절제술, 적출술

Definition
한쪽 또는 양쪽 난소의 외과적 제거

Objects

Estrogen effects의 제거

- 비뇨생식기 질병, 골다공증, 기억 등의 모델동물 제작
종양모델 제작시 일정한 Estrogen 농도 유지를 위한 제거
번식기능의 제거
Surgical Techniques for Rodent Survival Surgery
Surgical Techniques for Rodent Survival Surgery

1) 등 부분의 털을 제거하고 dressing 한다.

2) 등의 중앙 조금 아랫부분의 피부를 1cm 정도 절개한다

3) 절개부 옆쪽을 충분히 Undermining 한다
Surgical Techniques for Rodent Survival Surgery

4) 갈비뼈 뒤쪽의 엽쪽 복벽을 노출시킨 후 5mm 정도 절개한다.
5) 복강내의 지방조직을 꺼내 난소 위치를 확인한다.
6) The bladder is pulled from the abdominal cavity. - Simple interrupted
7) The bladder is removed.
8) The wound is placed in the abdominal cavity, and the abdominal wall is sutured. - simple interrupted
9) The skin is sutured. - Simple continuous
THANK YOU!!

THANK YOU FOR LISTENING TO OUR PRESENTATION