

# Principles of Rodent Aseptic Surgery & Perioperative Care

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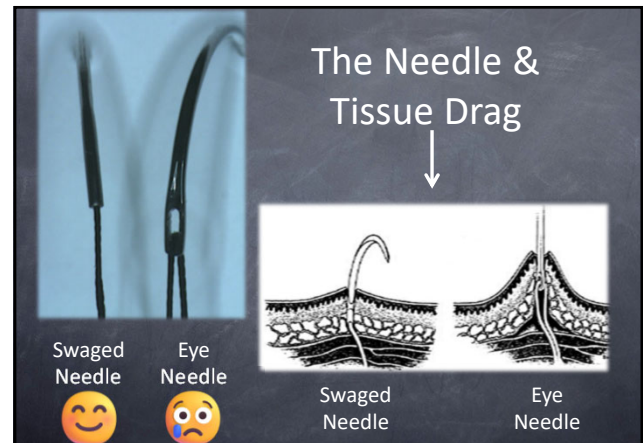


Ms. Rita is 85  
An exemplary nurse  
Just a Little bit out of practice

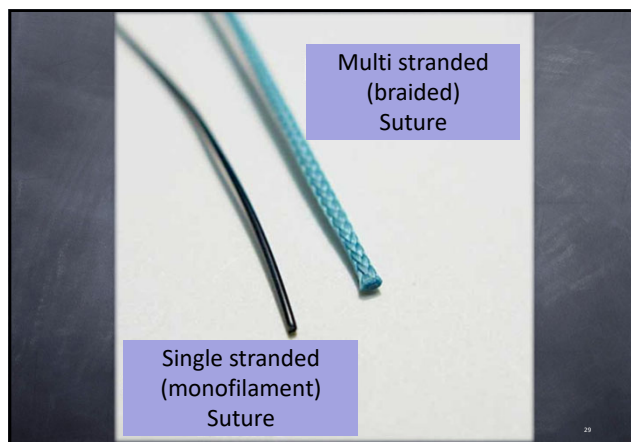
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## Tips, Tips, Many Tips... Practical Tips

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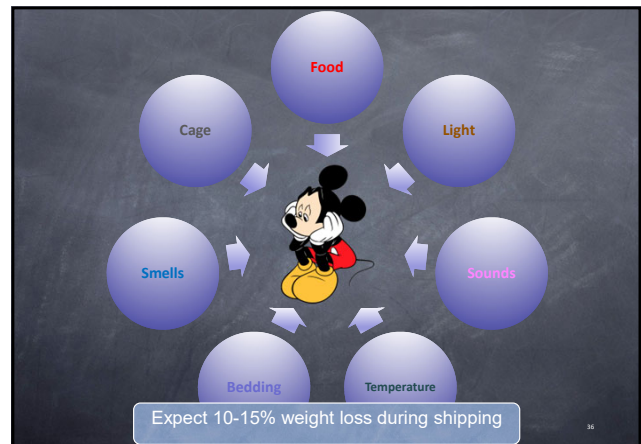
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## Acclimation

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## Wonders of Acclimation



Mice regain weight after acclimating to new facility

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## Aseptic Technique in Rodents

"The Solution to Pollution is Dilution"

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Rodents don't get infections?????



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Why Aseptic  
Rodent Surgery?

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## Survival alone not a valid criterion for success

Success should be based on absence of altered physiological function, immune responses and behavioral changes

(Cunliffe-Beamer, 1993)

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Aseptic technique increases **success of ovarian transplants** in mice & speeds return to post-op normal (Cunliffe-Beamer 1972-73; Cunliffe-Beamer 1990)

Contamination activates **macrophages** (Bancroft, Schreiber et al. 1989), and leads to changes in **cytokines & B cells levels** (Abbas, Lichtman et al. 1991)

SUBCLINICAL infections induce **physiological changes** (Committee on Infectious Diseases of Laboratory Rats and Mice 1992)

Although **NO CLINICAL SIGNS** observed, experimentally inoculated rats ( $10^8$  *S. aureus* or *P. aeruginosa*) had significant alterations in plasma **fibrinogen**, serum **glucose**, total **white blood cell counts**, and wound **histology scores** (Bradfield, John et al. 1992)

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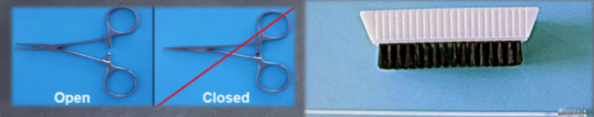
## Summary

Poor rodent aseptic surgery results in:

- Poor experimental results
- Delay to post-op normality
- Physiological changes
- Alterations in fibrinogen, glucose, leukocytes, histology, cytokines, B cells, etc.
- Questionable data

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## Instrument Cleaning & Lubrication



### Cleaning steps:

1. Soak in enzymatic sol (ultrasound if available)
2. Brush/clean
3. Rinse in DI or RO water
4. Lubricate & dry on



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## Surgical area setup

This?



or

This?



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## Surgeon Prep



Impermeable arm sleeves  
Misted with disinfectant

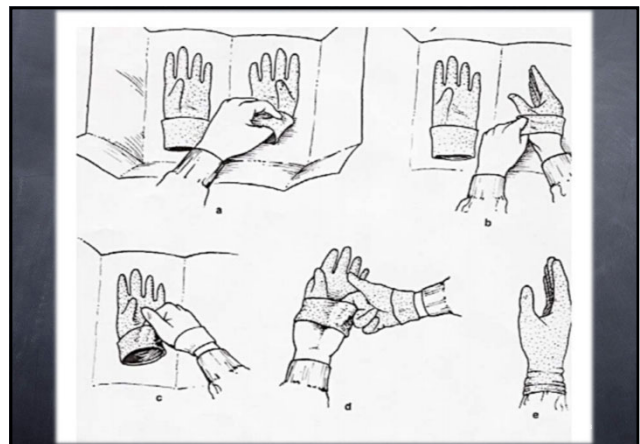
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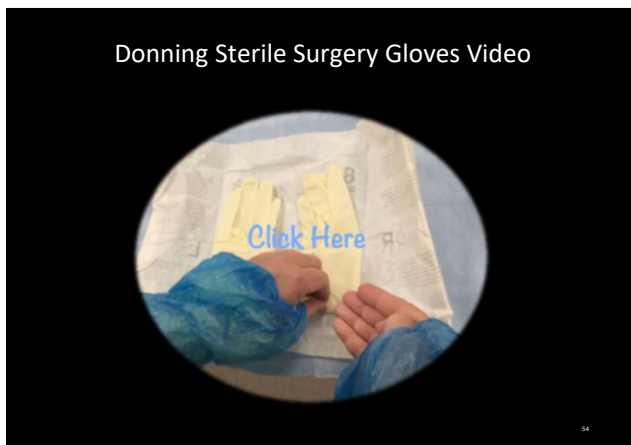




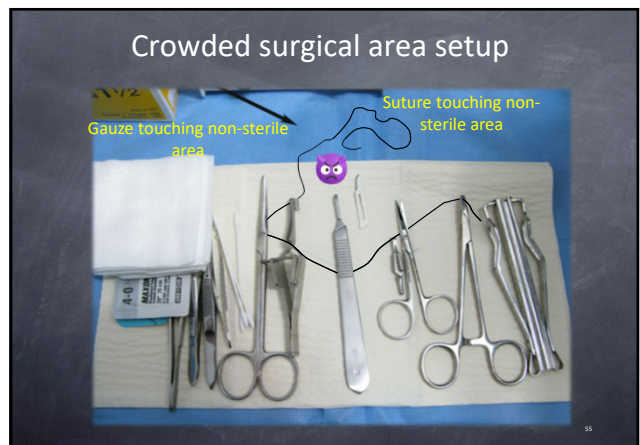
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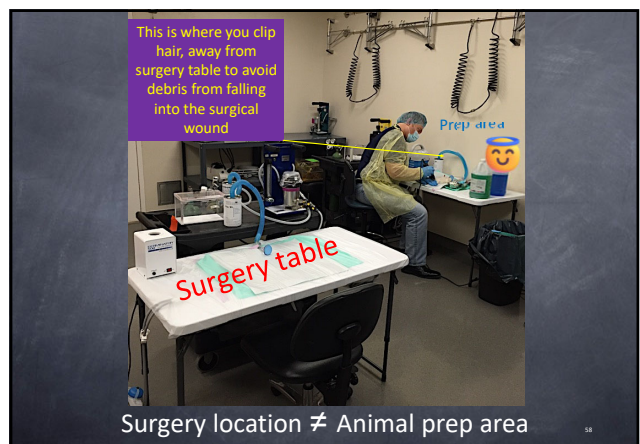
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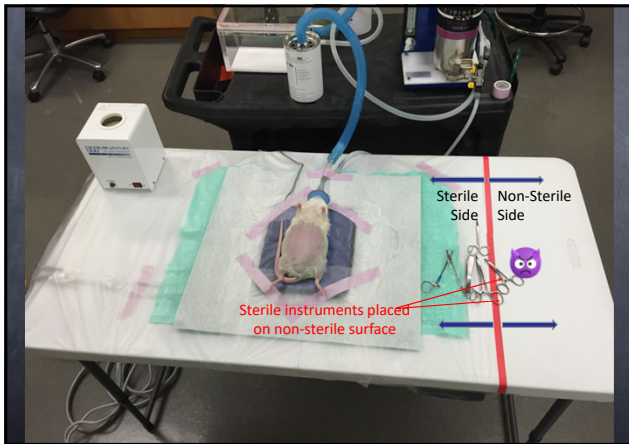
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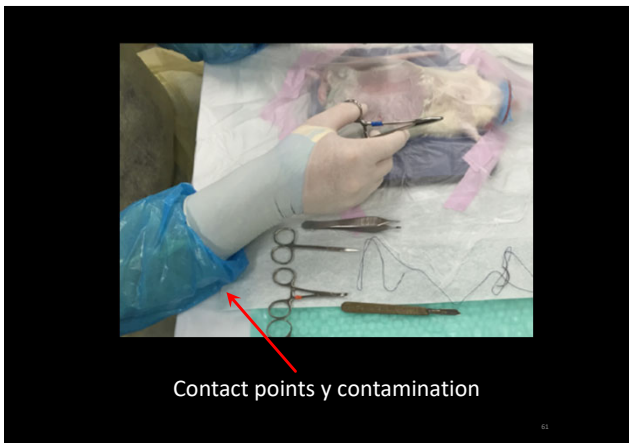
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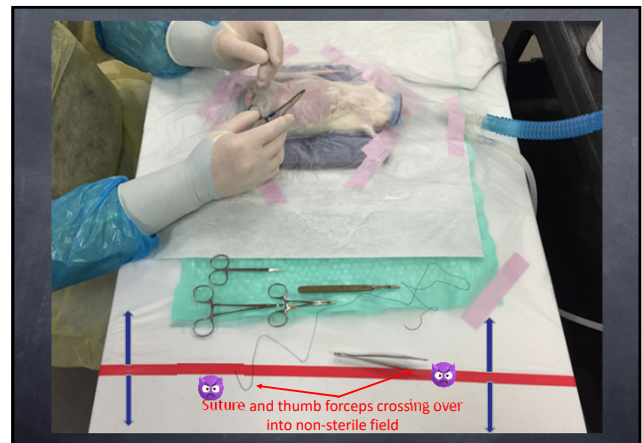
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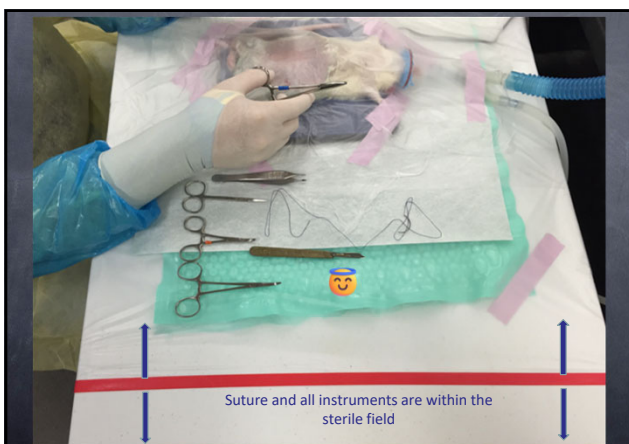
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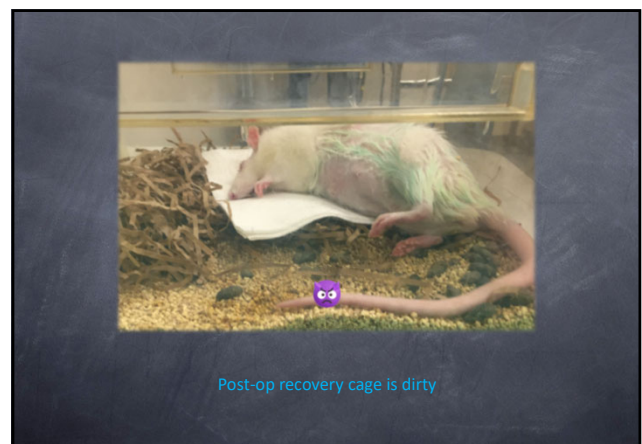
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Post-op recovery cage is clean, to minimize post-op infections

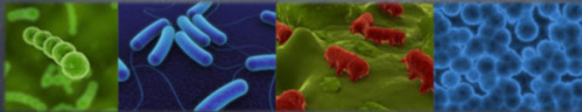
Consider placing in clean cage the day before

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## Patient preparation

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## Antibiotics?



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## Antibiotic use

- Not a substitute for proper asepsis (...false sense of security...)
- Use judiciously – resistant strains
- Consider antibiotic rotation (↓ resistant strains)
- Generally, not recommended - justify
- Best preemptively
- Once pre op usually enough
- Adds one more variable???



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## Assessing antibiotic need

- Immune deficiency
- Organs with high contamination potential (gut, bladder, lungs...)
- Extensive tissue dissection & blood loss
- Inadvertent contamination
- Biomaterial implantation
- Lengthy procedure
- Stressed, aged or ill
- Inexperienced surgeon
  - ↑↑ experience = ↓↓ antibiotic

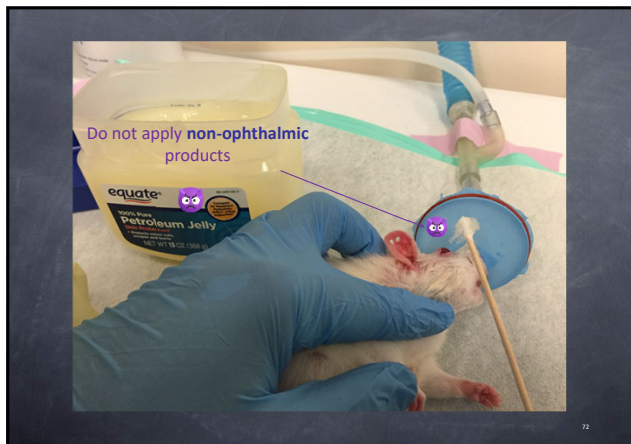


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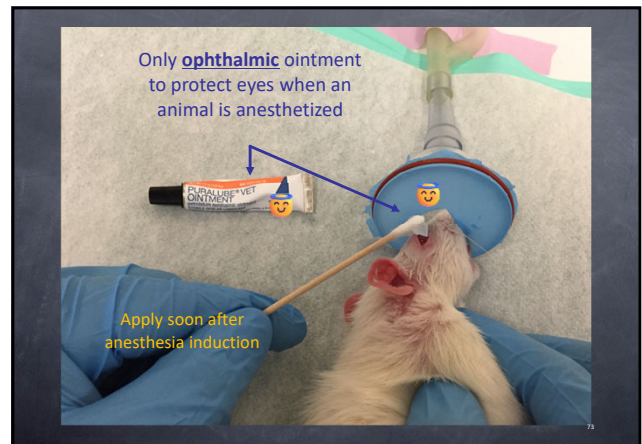
## Protect the Eyes



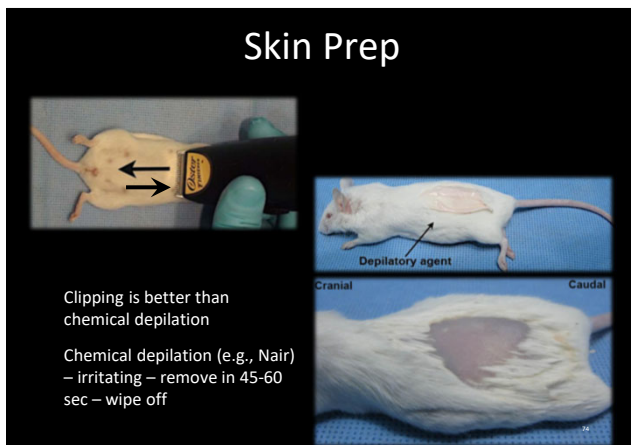
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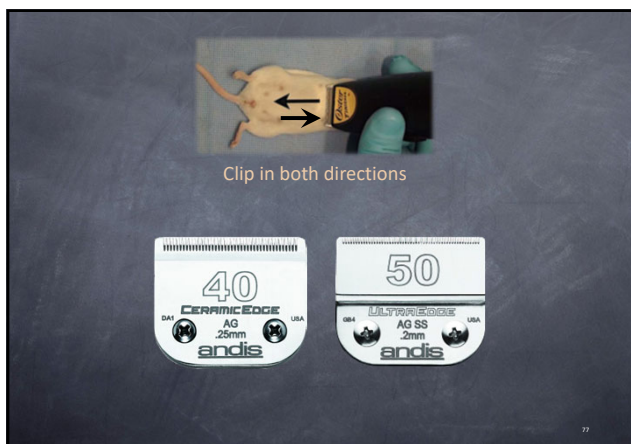
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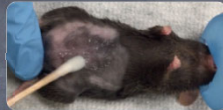
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## Skin Disinfection



1. Remove hair
2. Wipe with alcohol to remove excess hair & debris
3. Chlorhexidine or povidone iodine SCRUB followed by 70% alcohol
4. Repeat previous SCRUB & alcohol step 2 more times
5. After last alcohol, paint area with chlorhexidine or povidone iodine SOLUTION (NOT scrub)
6. Allow SOLUTION to dry on – lethal effects on bacteria maximized by combination of chemical + desiccating activity

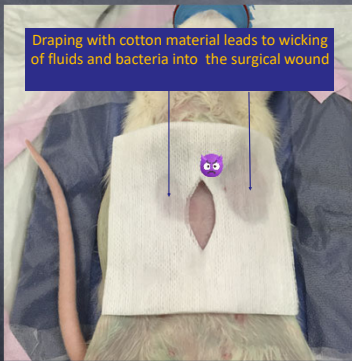
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## Skin Disinfection Video



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Draping with cotton material leads to wicking of fluids and bacteria into the surgical wound



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## Rodent Surgical Draping

The 5 properties of the ideal rodent draping material...

- Sterile
- Adheres to skin
- Impermeable
- Transparent
- Traps body heat...

Bonus property: Cheap!

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## Draping the Animal



Sterile  
Adheres to skin  
Impermeable  
Transparent  
Traps body heat  
Cheap!

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## Draping other parts



Reynolds Aluminum Foil

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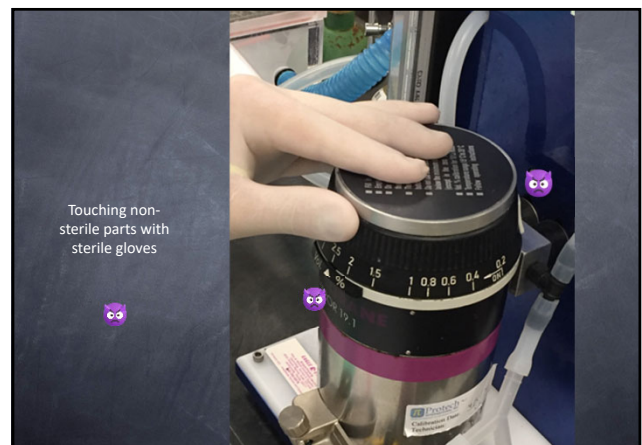


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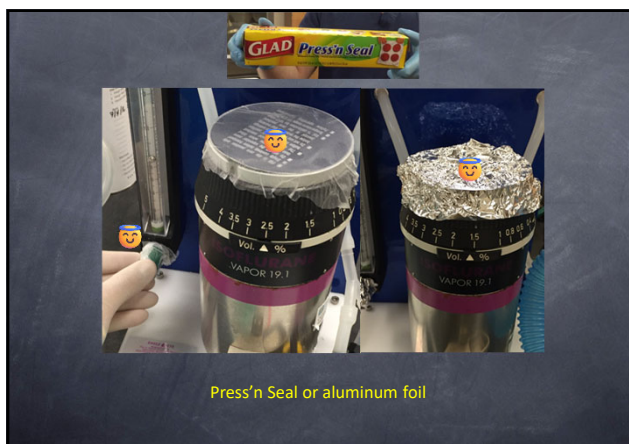
## The Solo Surgeon

- Typical lab: One does it all
- What happens if non-sterile items such as the anesthesia dials, stereotaxic apparatus knobs, light handles and microscope dials have to be manipulated during surgery?
- The next slides provide practical solutions to the "Solo Surgeon" problem

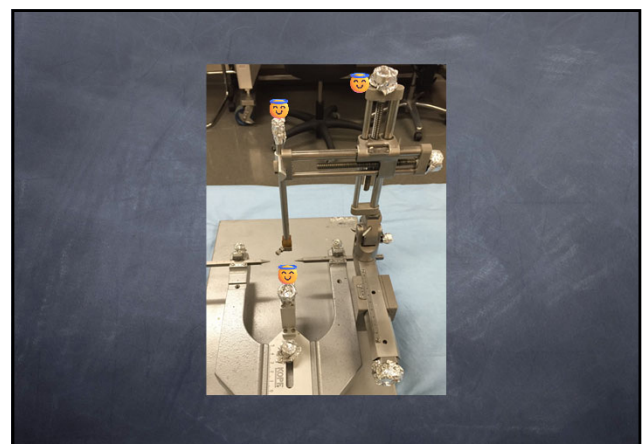
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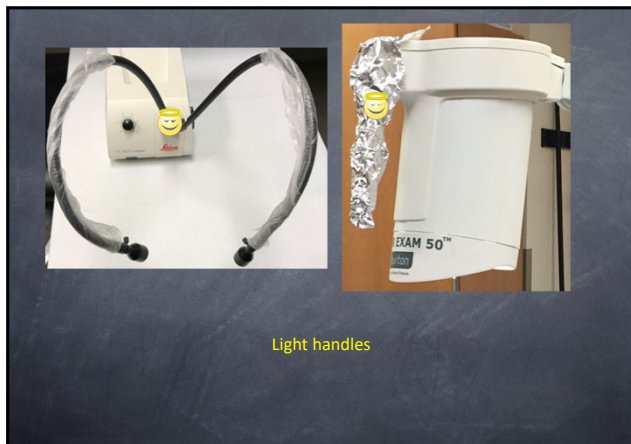
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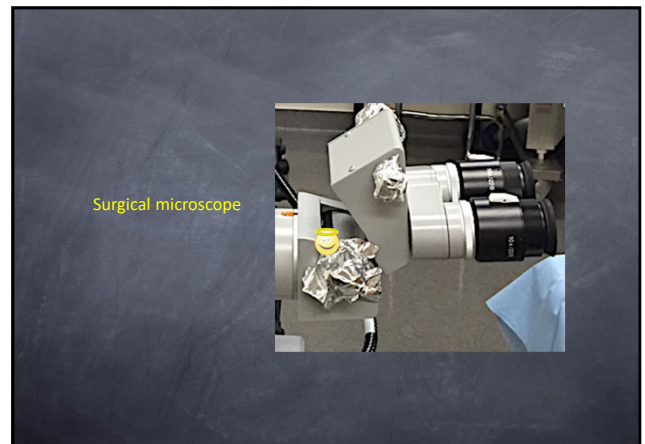
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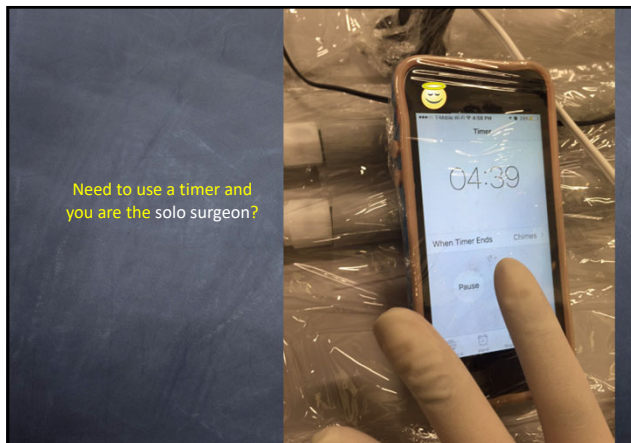
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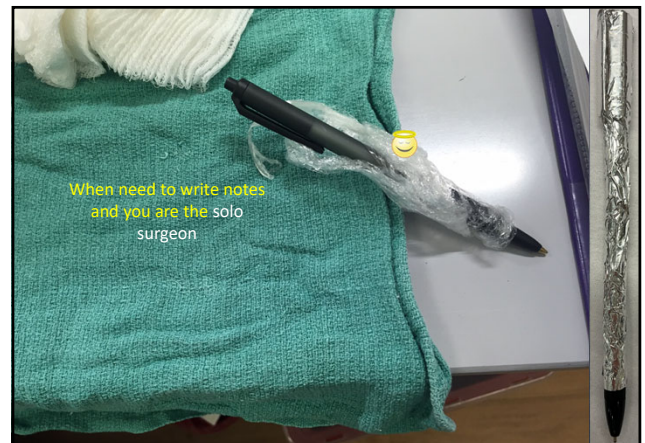
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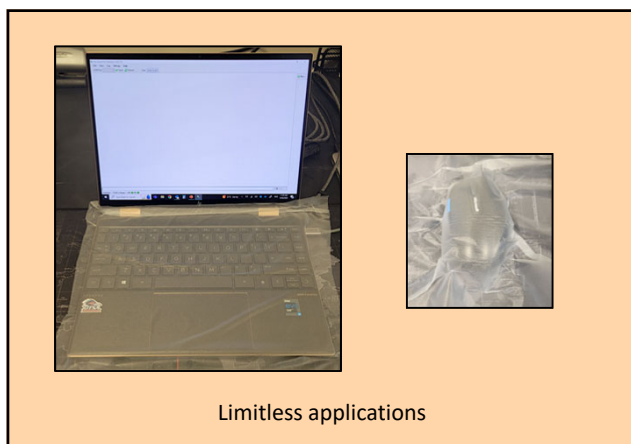
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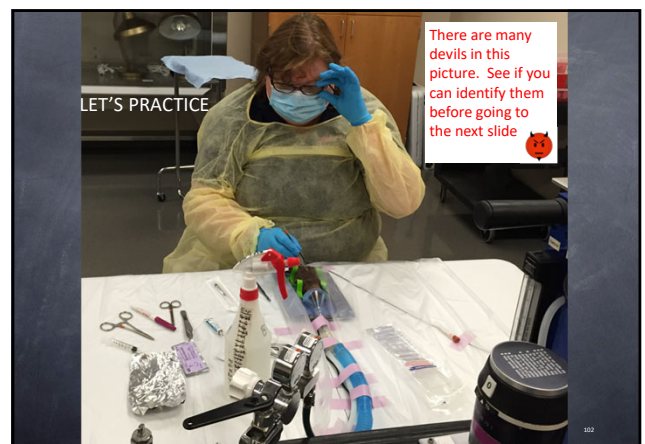
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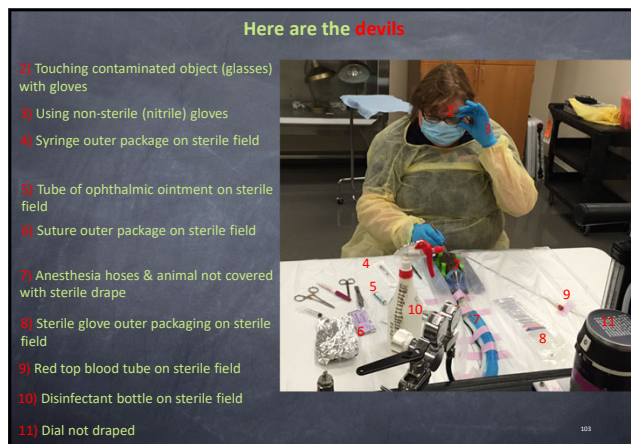


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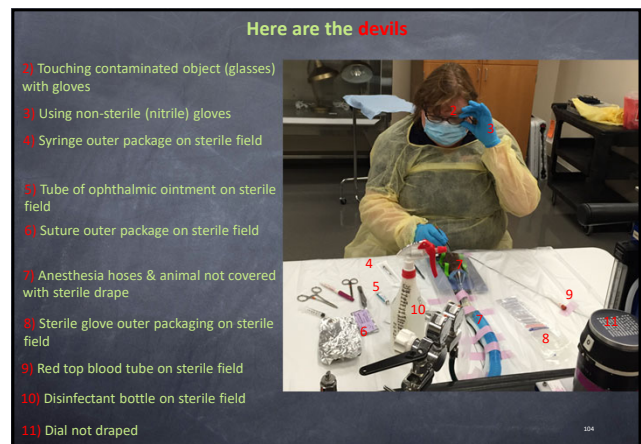


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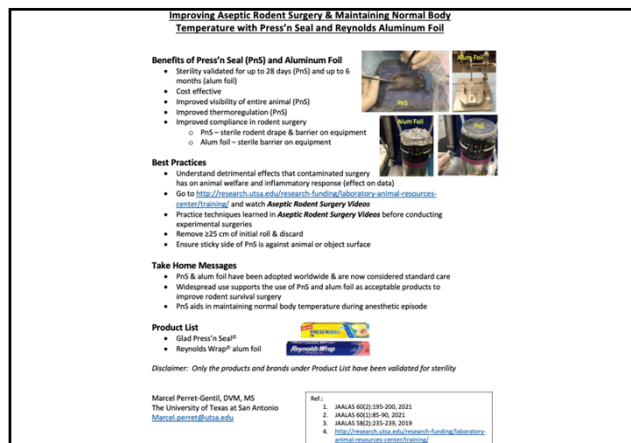




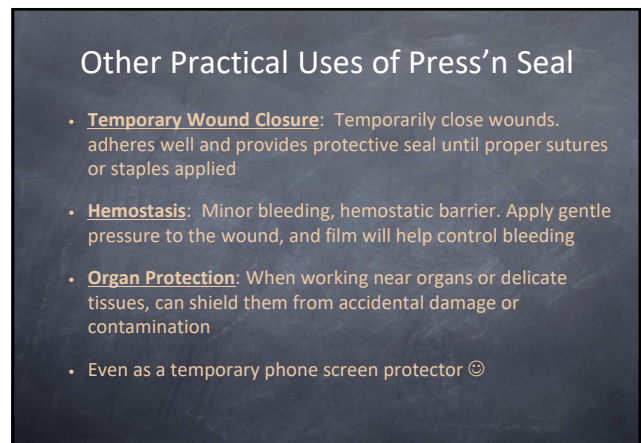
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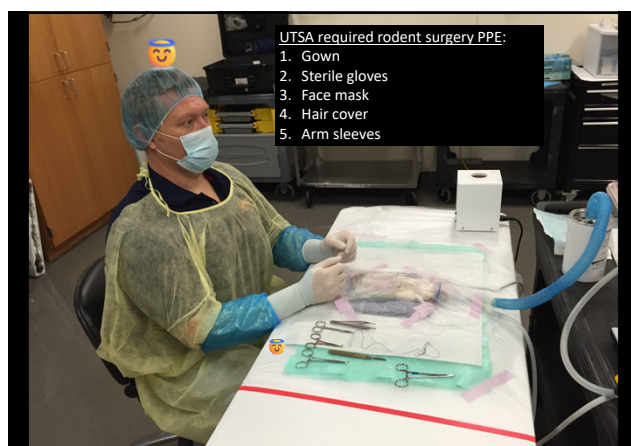
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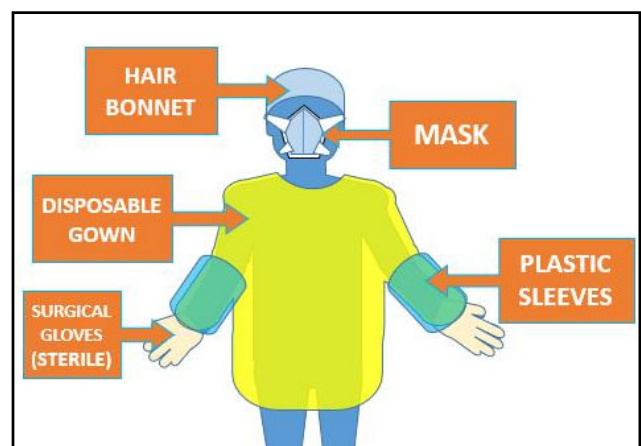
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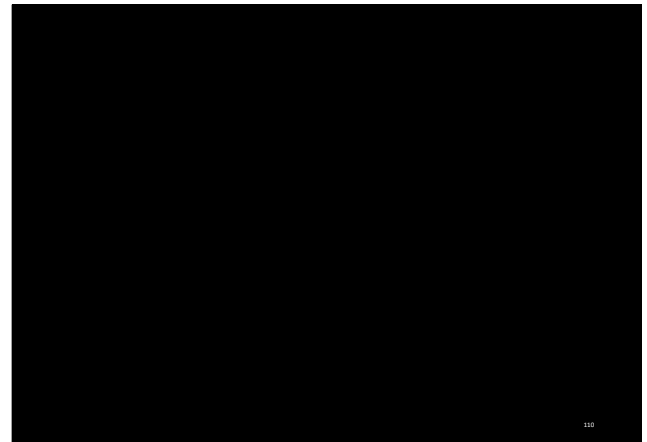
## Let's critique



Survival Surgery

Video MCAO fast mode

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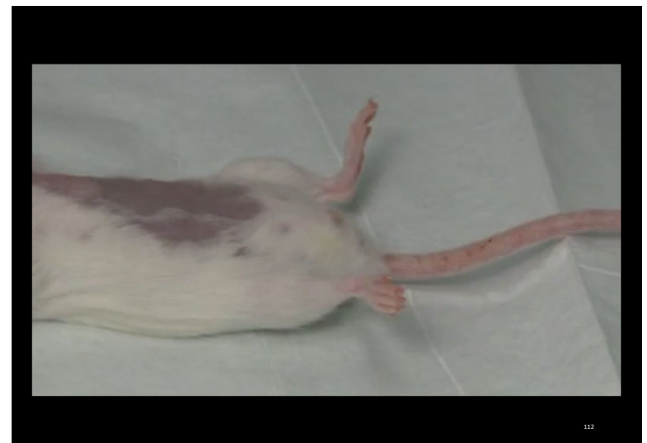
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## Let's Critique Again



Survival Surgery

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## More Tips...

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## Glass Bead Sterilizer – Tips Only Technique

### Recommendations\*:

- Use only when light contamination - Not for gross contamination (such as gut surgery)
- Autoclave instruments on first animal & use for up to 5 serial surgeries only
- Clean instruments between surgeries (alcohol)
- Do not overload sterilizer (not too many instruments)
- Dip at  $500 \pm 50$  °F ( $260 \pm 10$  °C) x 60 sec



15s (manufacturer's recommendation) sterilizes 82.5% of instruments\*

\*Holdridge et.al. 2021

\*Skiles et.al., JAALAS 2022

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## Monitoring, thermoregulation, recovery & fluid maintenance



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## Anesthetics & Hypothermia

- All anesthetics depress thermoregulation
- Vasodilation makes it worse



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## Fear Hypothermia



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## Fear Hypothermia

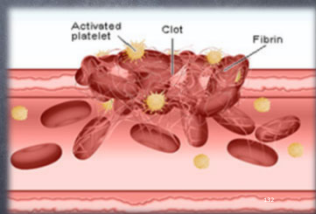
- Rodents lose heat rapidly (high surface area/body wt ratio)
- Starts at induction
- Exacerbated by cold, dry gases, shaving, skin prep solutions & admin of cold fluids



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## Fear Hypothermia

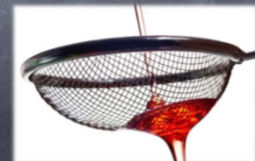
- Prolongs recovery
- ↑ potency of gas anesthetics
- Leads to hypoventilation
- ↓ platelet function



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## Fear Hypothermia

- Bradycardia, fatal arrhythmias, myocardial infarction
- ↑ blood viscosity = ↓ gas exchange



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## Fear Hypothermia

- ↑ stress response to surgery
- ↑ risk of infection
- Impaired wound healing
- CNS depression



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## Fear Hypothermia

- Interferes with metabolism of some drugs
- Special concern with hairless strains and neonates

May be difference bet life & death,  
reliable & unreliable data, success  
& failure



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## Preventing Hypothermia



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- Monitor temp – otherwise how will you know?
- Cutaneous warming (lamps, warming blanket) – Preheat prep (scrub) solutions
- Administer pre-warmed fluids

Fluid bag kept warm on  
heating blanket



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Heat pad under induction  
chamber

Insulate with Press'n Seal,



Press'n Seal

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## Post-op Recovery



Heat pad under 1/2 of cage  
allows rodent to escape excess  
heat

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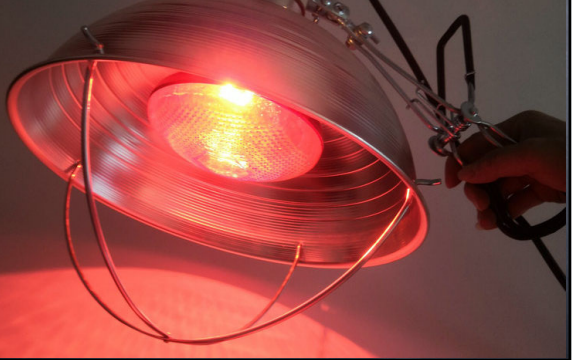


## Warming Systems in Order of Preference



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😬😬😬 **Heat Lamp:** difficult to judge distance  
(burns), some institutions have banned it



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😊😊😬 **Electric Pad**  
focused warming areas,  
elements may burn



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## Electric Pad Warning!



**Electric Pad Burn - Rat**

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😊😊😊😊 **Circulating Water Heating Pad**

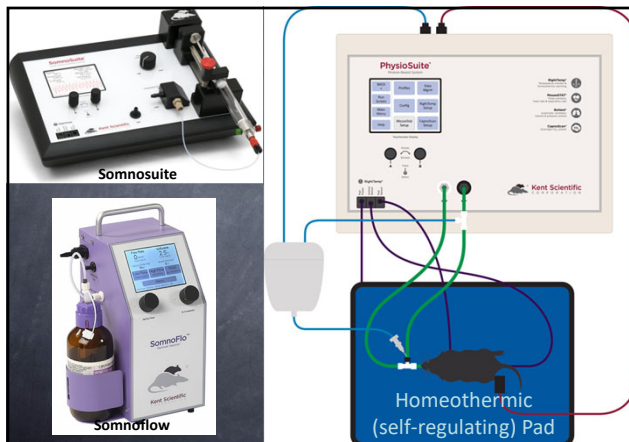


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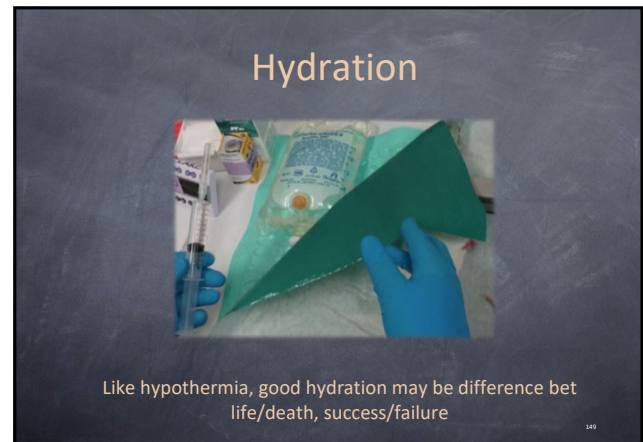
😊😊😊😊😊😊 **Far Infrared Homeothermic Pad**  
(self regulating)  
Kent Scientific



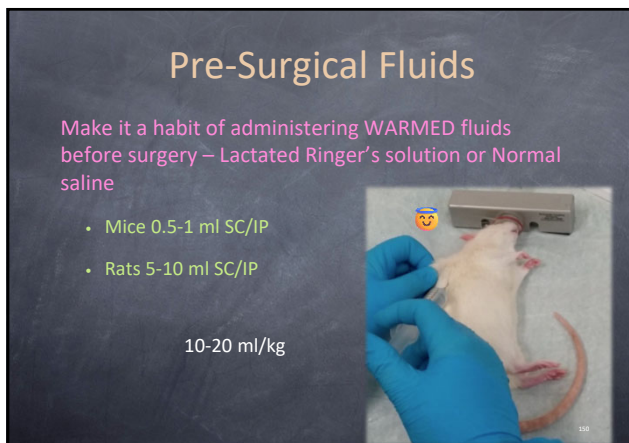
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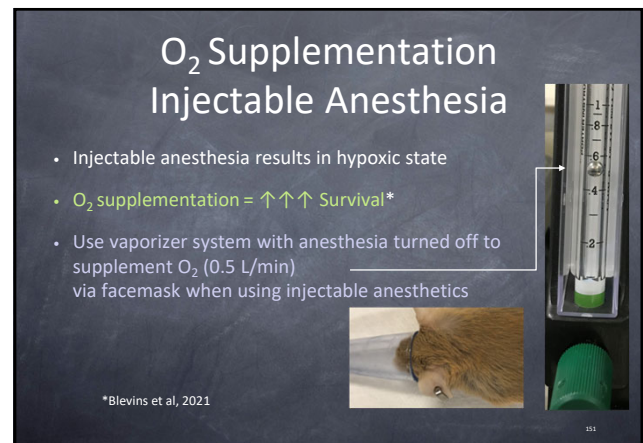
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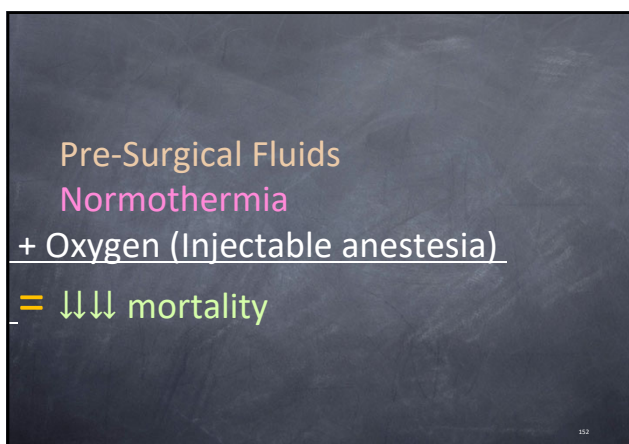
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Preemptive analgesia (before surgery) can reduce post-op hypersensitivity and pain\*

\*Bromley 2006; Gonzalez et al. 2000; Lascelles et al. 1995, 1997; Reichert et al. 2001

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Multimodal approach provides superior analgesia compared to use of a single analgesic\*

Combinations of:

- NSAIDs – nonsteroidal antiinflammatory drugs
- Opioids
- Local anesthesia

\*Recognition & Alleviation of Pain in Laboratory Animals, NRC 2009

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## Local Anesthesia

- Can reduce required overall dose of analgesics
- Prevents hyperalgesia (amplification of pain signal)

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## Local Anesthesia – Part of Multimodal Strategy

Local Anesthetic	Onset	Duration	Do not exceed (toxic dose)
Lidocaine	1-3 min	~40 min	10 mg/kg
Bupivacaine	~20 min	~4-6 hours	5 mg/kg

- Mix: ½ and ½ volume of each solution
- Administer under incision and surrounding area

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## Non-Pharmacological Methods of Pain Control

Treating the mind...  
& other parts

Simkin & O'hara, 2002; Chia et al, 2017

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## Fear & Anxiety Enhance Pain Response (Hyperalgesia)

Providing a stress-free environment must be included in the pain management program

Linton 2000; Morley et al. 1999; Munro et al. 2007; Panksepp 1980; Perkins and Kehlet 2000; Ploghaus et al. 2001

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## Minimizing Environmental Stress

Minimizes stress-induced hyperalgesia\*



\*Mogil, 2017

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## Delicious Calories

- Tasty, energy dense food supplements
- If necessary, place at floor level



DietGel  
clearh2o.com



Bacon Softies  
bio-Serv.com

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## Social Housing

*Single housing – The post op norm, however...*

- Rats spinal cord injury – 20% less chance of survival when housed individually
- Telemetric implant surgery, female mice - When housed socially needed less time to fully recover

(Van Loo et al., 2007)

Single-housed mice tend to lose more weight than group-housed

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## Post Op Social Housing\*

- Pair housing improves animal wellbeing
- Pair housing does not increase cage mate trauma to the surgical incision

\*Tirado-Muñiz et al 2023

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## The sick & painful rodent



Both mouse and rat have starey (piloerection of guard hairs) coats and a poor body condition

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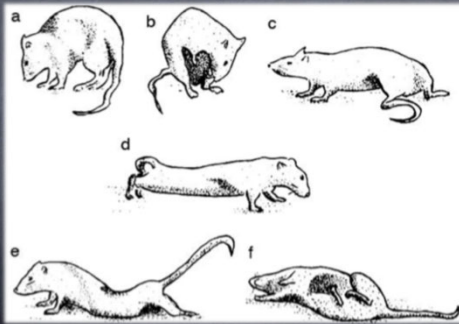
## The sick, stressed & painful rodent



Red tears (chromodacryorrhea) – Porphyrin, red-brown pigment secreted from Harderian glands in rats. Occasional low levels of staining may be normal. Overproduction indicates stress, sickness, poor nutrition or pain. Porphyrin drains through nasolacrimal duct. Rat may smear around nose and fur with paws during grooming

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## The painful rodent



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## The painful rodent



Abdominal presses and extension of the hind-limbs indicative of abdominal pain

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## Mouse in Pain



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## Rat in Pain (Laparotomy)



Back arching & squinted eyes

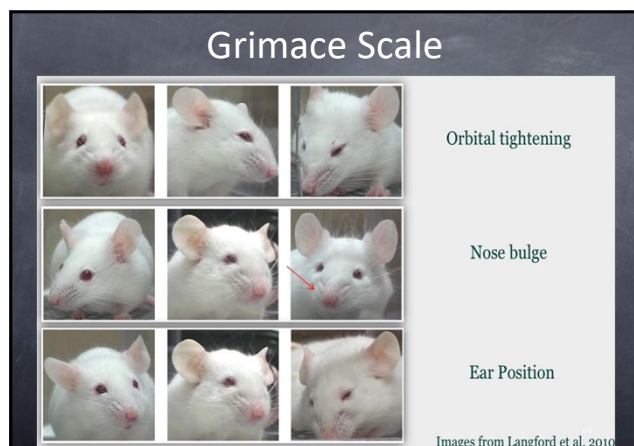
Courtesy of Paul Flecknell

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## Pain Assessment in the Rat

-  
Behaviour following Laparotomy  
for Bladder Tumour Implant

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### Training

The LARC is pleased to offer instruction in the various techniques used in studies involving laboratory animals. The LARC provides the hands-on and instructor-led portions of the UTSA Animal User Training Program Checklist (PDF). Please feel free to contact the LARC at [larc@utsa.edu](mailto:larc@utsa.edu) to see how we can assist you with your animal research.

### Handouts & Videos

Rodent Aseptic Surgery Techniques and Videos	
<a href="#">Dos and Don'ts of Rodent Aseptic Surgery (PDF)</a>	+
<a href="#">Crating Technique for Stereotaxic Surgery (PDF)</a>	+
<a href="#">Crating a Rodent for an Orthopedic Procedure (PDF)</a>	+
<a href="#">Survival Rodent Surgery Checklist (PDF)</a>	+
<a href="#">Survival Rodent Surgery Policy (PDF)</a>	+
Personal Protective Equipment (PPE)	+
Aseptic Rodent Surgery Videos	+
Surgery Handouts	+
Anesthesia Handouts	+
Analgesia Handouts	+
Rodent Biotechnology Handouts	+
Breeding Handouts	+
Animal Worker Protection Program	+
Spanish Handouts (Láminas en Español)	+

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