Principles of Rodent Aseptic Surgery & Perioperative Care

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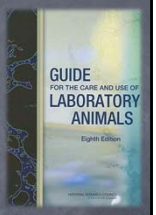
Resources



LARC Training Page
http://goo.gl/rzR0xl

Key resource
Your Veterinarian

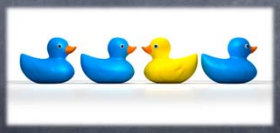
Practicing the art of surgery…

- **Skills are Developed, Practiced and Refined**
- **After that, Practice, Practice and Practice**

Time = Trauma

"In theory, there is no difference between theory and practice... But in practice there is"

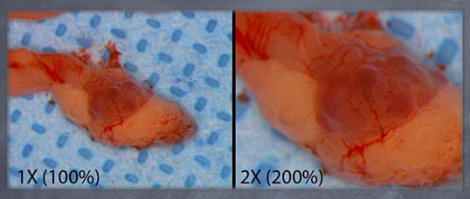
--- Yogi Berra ---

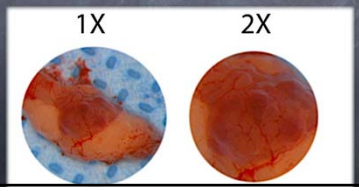


2 + 2 ≠ 4

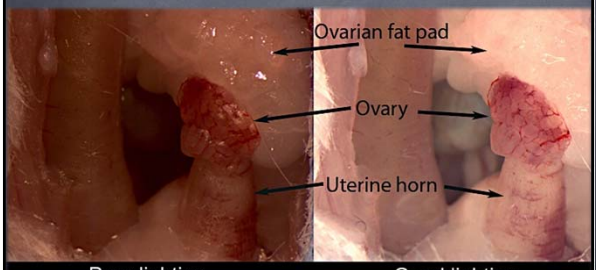
Tips, Tips, Many Tips…

Magnification

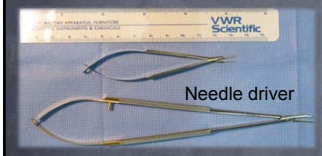




Lighting



Microsurgical instrument selection

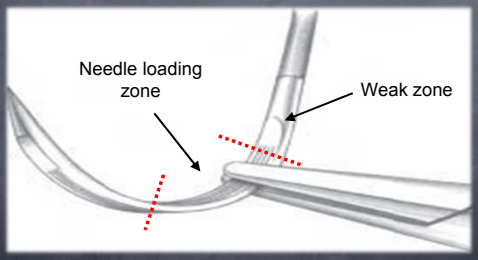


Longer instruments allow handles to rest on hands bet thumb & index (web of the hand) for greater control

Rounded handles (vs. flat) allow rotation around the axis for greater control

Needle & Suture

Needle Anatomy

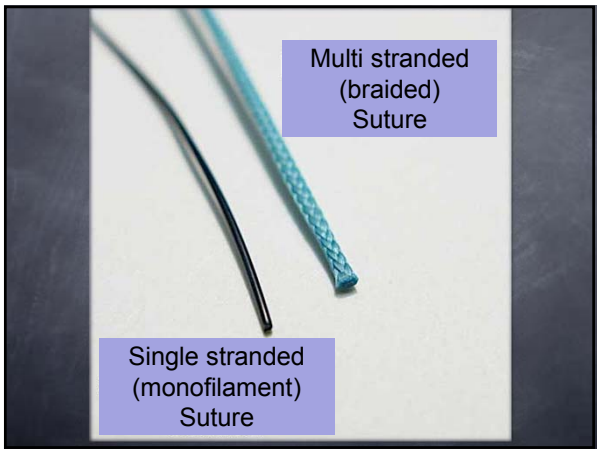


Tissue Drag

Swaged Needle

Eye Needle

Absorbable vs. non-absorbable



Closure with Non-Suture Material

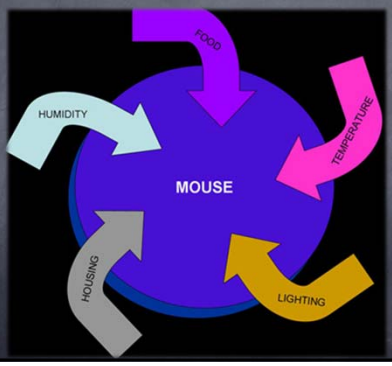
Tissue adhesives cyanoacrylate

Wound clips

Note: Skin tissue *eversion* is OK, *inversion* IS NOT

Clips, applier & remover

Acclimation



The Wonders of Acclimation

The healthy rodent to start with

Aseptic Technique in Rodents

"The Solution to Pollution is Dilution"

Rodents don't get infections?????

So Why Aseptic Rodent Surgery?

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)

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)

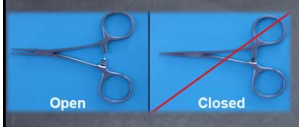
ACLAM Position Statement on Rodent Surgery

Aseptic technique is required for survival surgery since animals can develop either gross or unapparent surgical site infection that may affect research outcomes and animal welfare

JAALAS 55(6):822-823

ACLAM: American College of Lab Animal Medicine

Instrument Cleaning & Lubrication

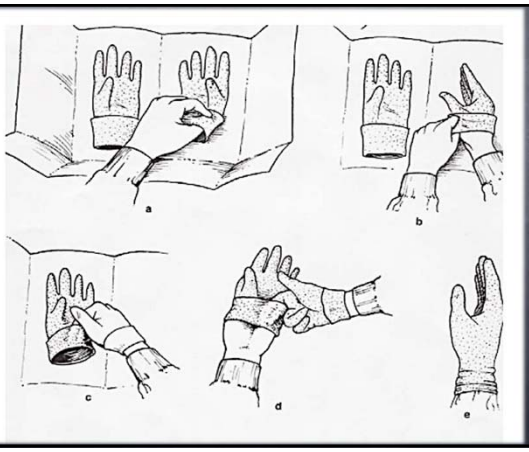


Cleaning steps:
1. Soak in enzymatic sol (ultrasound if available)
2. Brush/clean
3. Rinse
4. Lubricate & dry on

Surgeon Prep

Impermeable arm sleeves not required but highly recommended – disinfectant sprayed

Sterile Surgery Gloves



Donning Sterile Surgery Gloves Video

goo.gl/SEqeSH

Surgical area setup

This?

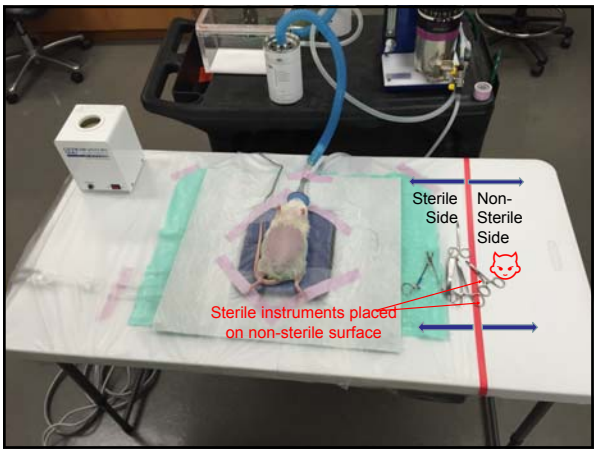
or

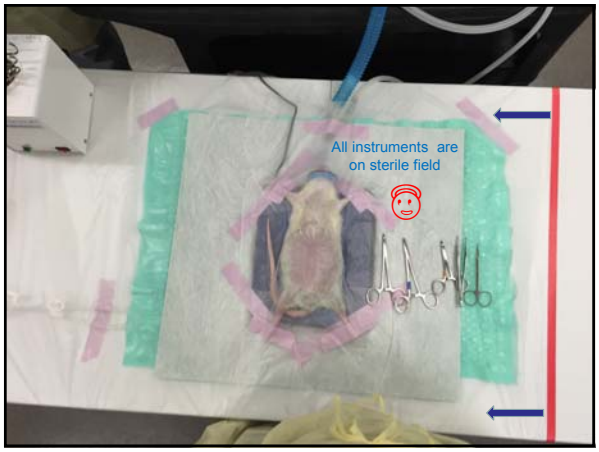
This?

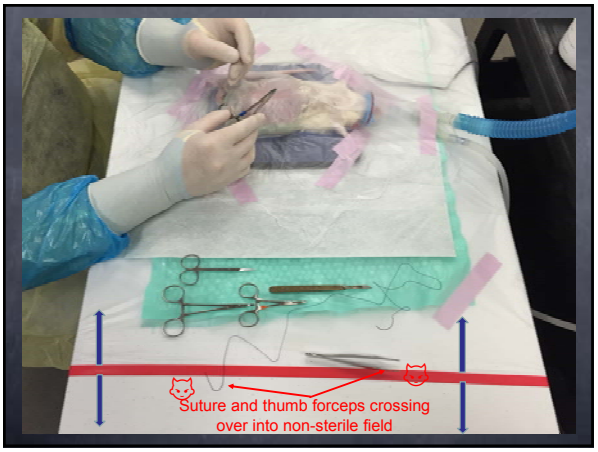
Surgical area setup

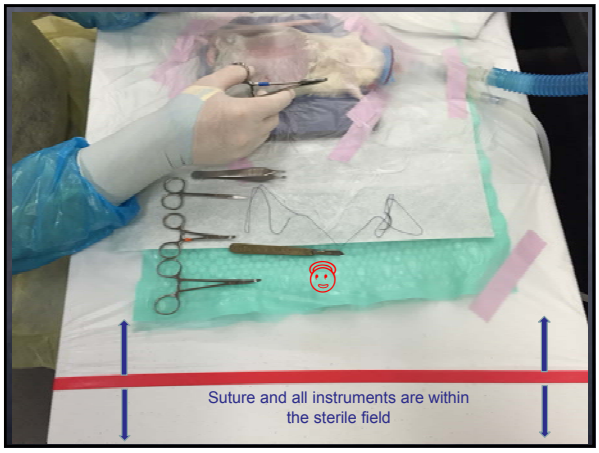
Surgery in animal prep area = Contamination


This is where you clip hair, away from surgery table to avoid debris from falling into the surgical wound
Prep area
Surgery table
Surgery location ≠ Animal prep area


Sterile Side
Non-Sterile Side
Sterile instruments placed on non-sterile surface


All instruments are on sterile field


Suture and thumb forceps crossing over into non-sterile field

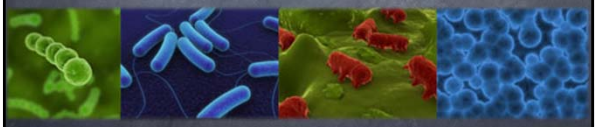

Suture and all instruments are within the sterile field


Post-op recovery cage is dirty

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

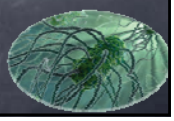
Patient preparation

Antibiotics?



Antibiotic use

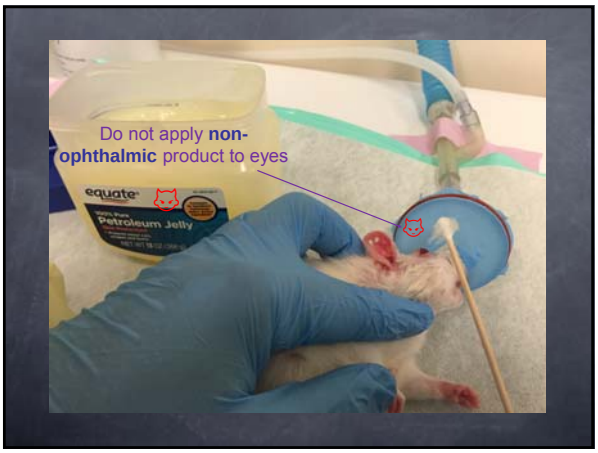
- Not a substitute for proper asepsis (…false sense of security…)
- Use judiciously – resistant strains
- Consider antibiotic rotation (⇓⇓resistant strains)
- Generally not recommended - justify
- Best preemptively
- Once pre op usually enough
- Source of variables???



Assessing antibiotic need

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

Protect the Eyes



Skin Prep

Clipping is better than chemical depilation

Chemical depilation (e.g., Nair) – irritating – remove in 45-60 sec – wipe off

Clip in direction of hair 1st then against it

#40 Clipper Blade

Skin Disinfection

Skin Disinfection

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

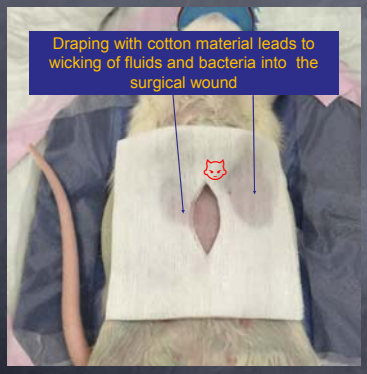
Skin Disinfection Video

http://goo.gl/8FqAPh

Sterile Draping

The ideal draping material

- Adheres to skin
- Impermeable to moisture
- See through
- Traps body heat



Draping the Animal

Adheres to skin
Impermeable to moisture
Transparent
Traps body heat

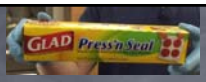
Easy Table & Animal Draping Technique without Sterile Gloves Video

goo.gl/Bn1UvT

The Solo Surgeon

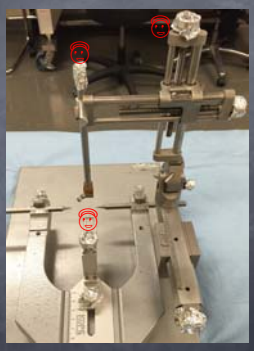
- Frequently investigators assign surgery duties to a member of their lab without additional help from another person. The lab member ends up performing every aspect of the surgery alone
- So what happens if non-sterile items such as the anesthesia dials, stereotaxic apparatus knobs, light handles and microscope dials have to be manipulated during surgery?
- The next slides provide practical solutions to the "Solo Surgeon" problem

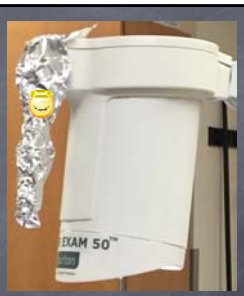
Touching non-sterile parts with sterile gloves



Covering the anesthesia machine dials with Press'n Seal or autoclaved aluminum foil prevents cross-contamination of the surgical wound

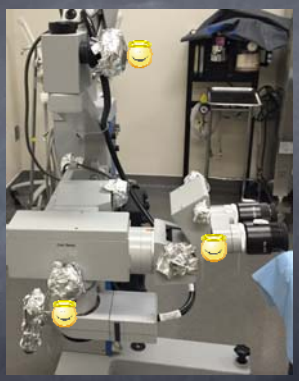
Covering parts of the stereotaxic apparatus with Press'n Seal or autoclaved aluminum foil



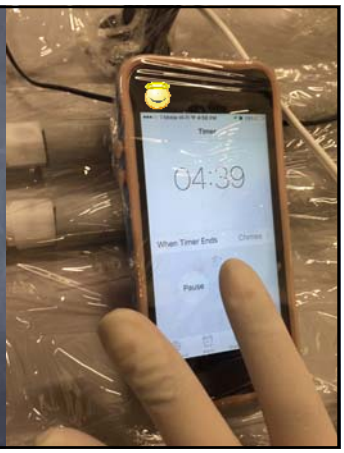


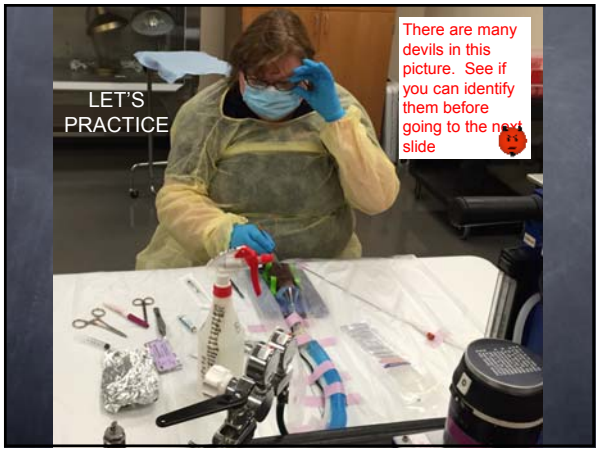
Covering light handles with Press'n Seal or autoclaved aluminum foil

Covering knobs of the surgical microscope with Press'n Seal or autoclaved aluminum foil



Need to use a timer and you are the solo surgeon?

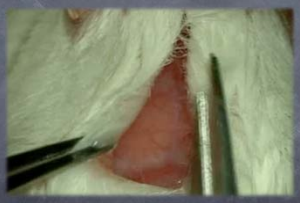




Here are the devils

1) Not hair cover
2) Touching contaminated object (glasses) with gloves
3) Using non-sterile (nitrile) gloves
4) Syringe outer package on sterile field
5) Tube of ophthalmic ointment on sterile field
6) Suture outer package on sterile field
7) Anesthesia hoses & animal not covered with sterile drape
8) Sterile glove outer packaging on sterile field
9) Red top blood tube on sterile field
10) Disinfectant bottle on sterile field

Let's Critique This



Survival Surgery

Video MCAO fast mode

More Tips…

Tissue protection

"Wet tissues = Happy tissues"

Monitoring, thermoregulation, recovery & fluid maintenance

Normal Temperature

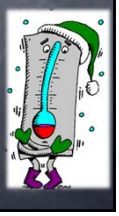
	°F	°C
MOUSE	99	37
RAT	99.5	37.5

Anesthetics & Hypothermia

- All anesthetics depress thermoregulation
- Vasodilation makes it worse

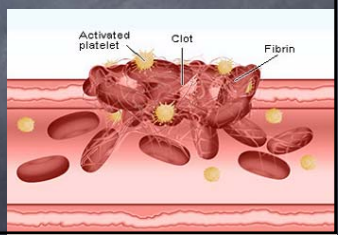
Fear Hypothermia

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



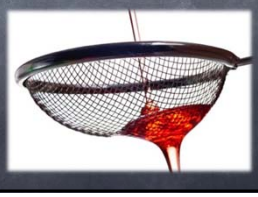
Fear Hypothermia

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



Fear Hypothermia

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



Fear Hypothermia

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

Fear Hypothermia

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

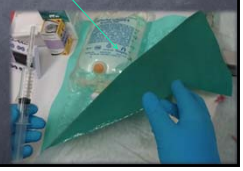
May be difference bet life & death, reliable & unreliable data, success & failure

Preventing Hypothermia

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

Fluid bag kept warm on heating blanket

Temperature monitoring



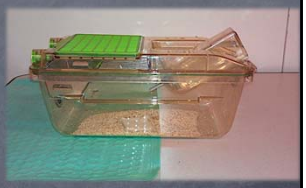
Heat pad under induction chamber

Insulate with bubble wrap, Press'n Seal

Press'n Seal

Bubble wrap

Post-op Recovery



☹

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Heat pad under ½ of cage allows rodent to escape excess heat

Warming systems in order of preference

- ☺☺☺☺☺☺ ***Far Infrared Homeothermic Pad*** (self regulating)
- ☺☺☺☺ ***Circulating Water Heating Pad***
- ☺☺☺ **Isothermal Pads**
- ☺☺😐 ***Electric Pad***: focused warming areas, elements may burn
- ☺😣😐 ***Heat Lamp***: difficult to judge distance (burns), some institutions have banned it

☺☺☺☺☺☺

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Electric Pad Warning!

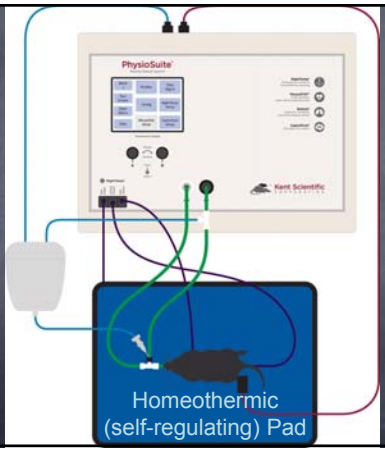
Electric Pad Burn – Rat

Homeothermic (self-regulating) Pad

Physiosuite
kentscientific.com

Physiosuite (Kent Scientific)

- Homeothermic pad (warms rodent at exact temp through far infrared arming that goes beyond cutaneous warming by heating deep into rodent's body with temp feedback)
- Pulse oximeter and heart rate
- Automatic ventilator (enter animal weight & press run)
- End tidal CO_2 monitor



Hydration

Like hypothermia, good hydration may be difference bet life/death, success/failure

Hydration

- Make it a habit of administering WARMED fluids before surgery – Lactated Ringer's solution or Normal saline
  - Mice 0.5-1 ml SC/IP
  - Rats 5-10 ml SC/IP

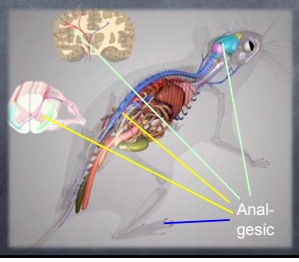
Hydration + Normothermia

=

⬇ Mortality & Morbidity

Pharmacological Pain Control

- Best when administered before insult (a.k.a. preemptive analgesia)
- Multimodal superior to single analgesic



*Jirkof, 2017

Local Anesthesia

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

Local Anesthesia

- 1% lidocaine/0.25% bupivacaine (50/50 mix by volume)
- Infuse incision site and underlying tissues
- May need to dilute, esp. for mice – dilution reduces duration of effect*
- Epinephrine prolongs action

*Grant et al, 2000, J.Pharm and Tox Methods, 43, 69-72

Local Anesthesia – Part of Multimodal Mix

Local Anesthetic	Onset	Duration	Do not exceed (toxic dose)
Lidocaine (xylocaine)	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

Non-Pharmacological Methods of Pain Control

Conformtable Environment

Provide comfort & stress free environment

Nestlets, Enviro-dri, huts)

Tasty Calories

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

DietGel
clearh2o.com

Bacon Softies
bio-Serv.com

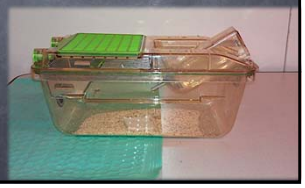
Social Housing

- *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)

Other Non-Pharmacological Methods of Pain Control

- Habituation to procedures
- Fluid therapy
- Thermal support



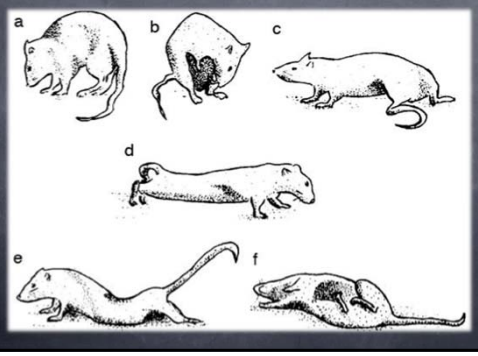
The sick & painful rodent

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

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

The painful rodent



The painful rodent


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

Mouse in Pain

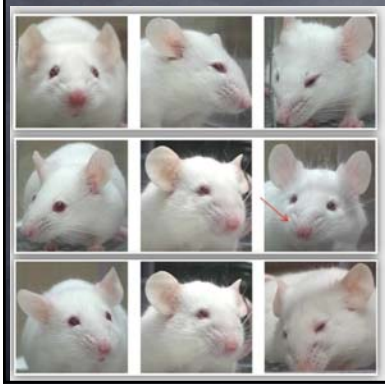
Rat in Pain

Back arching & squinted eyes

Courtesy of Paul Flecknell

Pain Assessment
in the Rat
-
Behaviour following Laparotomy
for Bladder Tumour Implant

Grimace Scale



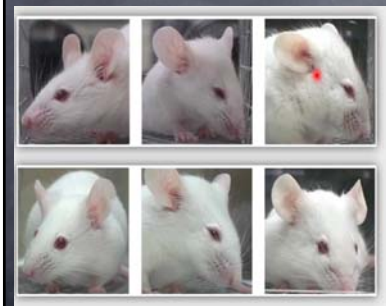
Orbital tightening

Nose bulge

Ear Position

Images from Langford et al, 2010

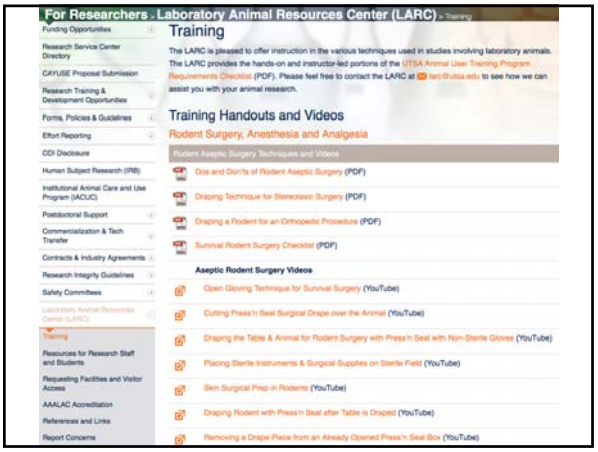
Grimace Scale



Cheek bulge

Whisker position

Images from Langford et al, 2010



Resources

Presentations, References & Useful Notes

http://goo.gl/r4R3sl

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