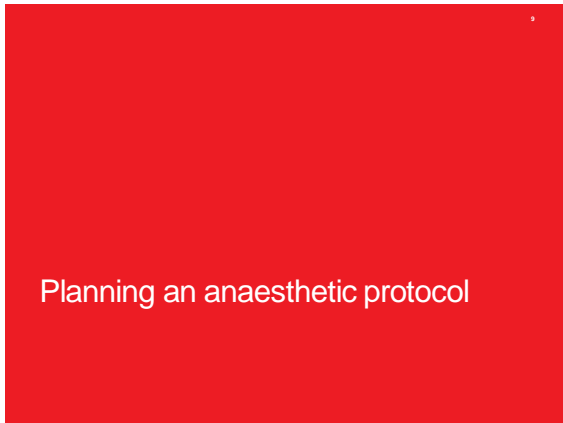


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What type of anaesthesia is most appropriate?

- Recovery abdominal surgery on a mouse?
- Dental rasping procedure on a horse?
- Intranasal dosing into a rat?
- Subcutaneous injection into a rabbit?
- Non-recovery brain surgery on a guinea pig?

7



9

LO: 20.5

11

Planning an anaesthetic protocol: Pre-anaesthetic care and evaluation

- Only healthy, stress free animals should be anaesthetised.
- Consider:
 1. **Acclimatisation**
 2. **Health status**
 3. **Pre-anaesthetic fasting**

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LO: 20.6

8

REMEMBER

- A schedule 1 method of killing is an overdose of anaesthetic agent!
- Careful planning for the proposed procedure is essential!

8

LO: 20.5

10

Choice of anaesthetic protocol

- Species/age of animal
- Duration of procedure
- Depth of anaesthesia required
- Purpose of investigation
- Equipment available
- Experience of staff
- Poor choice of anaesthetic protocol can frustrate the needs of the procedure

10

LO: 20.7

12

Acclimatisation

- Animals take time to recover from stress of transport. Can take > 14 days
- 7 days acclimatisation normally recommended



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LO: 20.5

13

Health

- Health report
- Clinical examination



- Signs of disease
- Respiratory system
- Cardiovascular system
- Phenotype of model
- Bodyweight
- Start record card

13

LO: 20.5

14

To fast or not to fast?

- **Fast overnight:**
 - Dogs, cats, pigs, primates, ferrets,
 - Horses, fish
 - Ruminants - cows, sheep, goats (camelids)
- **Don't fast:**
 - Small mammals - rodents and rabbits
 - Small birds

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LO: 20.8

15

Premedication?

- Definition: Medication that is given in preparation for the administration of an anaesthetic/other treatment
- Not often used in rodent medicine

Advantages:

- Smooth both induction and recovery
- Allay fear and anxiety prior to induction
- Reduce the dose of induction agent required
- Provide pain relief
- Reduce salivary and bronchial secretions



15

LO: 20.8

16

What do we use in a premedication?

- **Dependent on procedure but usually a combination of drugs (eg sedative + analgesic)**

1. Sedatives/tranquilizers

- E.g. benzodiazepines, alpha 2 adrenergic agonists, butyrophenones, phenothiazines, and ketamine.

+

1. Analgesics

- E.g. opioids (buprenorphine, butorphanol, morphine, pethidine, fentanyl)
- NSAIDs (carprofen, ketoprofen, flunixin, or meloxicam)



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17

Analgesia?

- Analgesia = pain relief
- Choice and need depends on the nature/severity/duration of the procedure

Most commonly used analgesics in rodent medicine

- Opioids: eg buprenorphine
- Non-steroidal Anti-inflammatory drug (NSAID) eg Carprofen, Meloxicam
- These drugs are often given in combination to provide balanced analgesia
- Often given after induction in rodents to reduce stress

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18

Type of anaesthesia needed:

1) Local and Regional anaesthesia

- Block sensory nerve endings in tissues (animal remains conscious)
- Rarely used on its own in smaller laboratory animals
- More common in farm species
- Topical e.g. EMLA cream
- Injection (e.g. lignocaine, bupivacaine)
 - Locally (local)
 - Into a nerve trunk e.g. epidural or paravertebral block (regional)



18

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19

Uses

- Local anaesthesia
 - Insertion of IV catheters
 - Microchipping
 - In conjunction with general anaesthesia to provide extra analgesia around surgery site
- Regional anaesthesia
 - Caesarian section
 - Lameness identification in horses
 - Insertion of devices

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20

Type of anaesthesia needed:
2) General Anaesthesia

20

LO: 20.2

21

What is involved in general anaesthesia?

Three components: the triad of general anaesthesia

1. Narcosis – loss of consciousness
 2. Analgesia – insensitivity to pain
 3. Muscle Relaxation – (NB not muscle paralysis)
- Most common type of anaesthesia used in laboratory medicine

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22

General anaesthesia – 2 phases

- Induction: The animal is reduced from consciousness to a state of unconsciousness
- Maintenance: The animal is maintained in a state of unconsciousness throughout the procedure

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23

How do we administer general anaesthetic drugs?

- 3 main options:
 - **Injectable**
 - **Inhalational (volatile)**
 - **Immersion (fish)**
- In mammals a combination of injectable (for induction) and inhalational (for maintenance) can be used

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24

1 Injectable anaesthesia

24

LO: 20.6

25

Injectable anaesthetic agents

Advantages

- Do not need complicated equipment
- Simple to administer
- Minimal cost
- Can titrate the dose intravenously



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26

Injectable anaesthetic agents

Disadvantages

- Difficult to adjust the level of anaesthesia
- Easier to overdose
- Variable length of anaesthesia
- Variation with animal age, sex, strain etc
- Agents are metabolised by liver - may interfere with study

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27

Injectable anaesthetic agents

Routes of administration:

1) Intravenous

- Method of choice
- More predictable
- Rapid onset
- Titrate dose



May be difficult in neonates and very small animals

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28

Injectable anaesthetic agents

Routes of administration:

2) Intraperitoneal

- Variable rate of absorption
- Painful
- Larger doses needed
- Easy to overdose /underdose

Used predominantly in rodents



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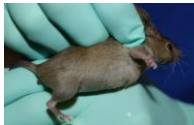
Injectable anaesthetic agents

Routes of administration:

3) Intramuscular

4) Subcutaneous

May be used to induce anaesthesia if handling is a problem (eg ketamine in primates)



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30

Must calculate the dose required

Weigh the animal



If you can



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31

Injectable anaesthetic agents

Calculate the volume to administer

$$= \frac{\text{Weight in kgs} \times \text{Dose in mg/kg}}{\text{Concentration in mg/ml}}$$

Dose 250g (0.25kg) rat, a dose rate of 10mg/kg.
Solution concentration is 50mg/ml.

$$\text{Dose volume} = \frac{0.25 \times 10}{50} = 0.05 \text{ ml}$$

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Examples of Injectable anaesthetic agents

- **Ketamine** (often used in combination with sedative e.g. medetomidine)
- **Hypnorm** (fentanyl/fluanisone) (often used in combination with midazolam)
- **Propofol/Alfaxalone** – short acting, good in most species. Must give IV and generally only used for induction
- **Urethane**, (for terminal anaesthesia only – lasts for 6-8 hours but is carcinogenic)



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33

Ketamine + alpha 2 agonist combinations

Ketamine + xylazine or medetomidine (both sedatives)

NB Ketamine is a Sch 2 controlled drug must store in locked cabinet and record usage

These combinations give approximately 30-40 minutes surgical anaesthesia in rodents
Variable effects in other species

Contact your local vet for advice on the most appropriate anaesthesia protocol for your desired procedure



+



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34

Reversal agents

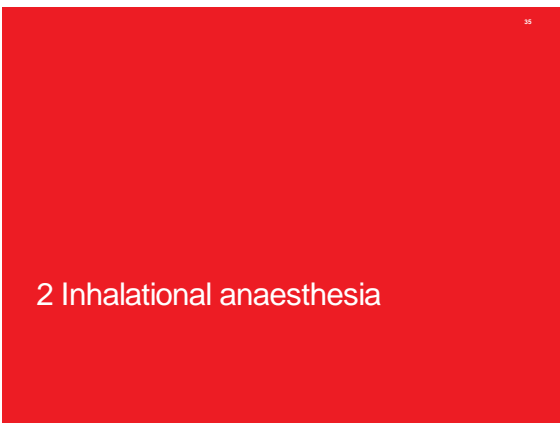
Used once procedure has finished to reverse the effects of the injectable anaesthetic and hasten recovery time

Atipamazole for alpha 2 agonists (xylazine or medetomidine)

Buprenorphine for fentanyl



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35

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36

Inhalation anaesthesia

- Volatile liquids - vaporised by passing oxygen over them.
- Absorbed/excreted via the lung alveoli into the blood stream.
- Anaesthetic depth changed by varying the concentration of inhaled anaesthetic agent.
- Minimal metabolic breakdown occurs, so recovery is rapid (1-10 minutes).
- Recovery can be speeded up by reducing concentration of anaesthetic slightly towards the end of surgery.

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Inhalation anaesthesia - advantages

- Rapid induction and recovery
- Easy to adjust the depth and duration – safer
- Agents minimally metabolised so less likely to interfere with the experiment
- Good for rapid procedures and for high frequency anaesthesia
- Generally regarded as the most refined method of anaesthesia for laboratory animals

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Inhalation anaesthesia - disadvantages

- Expensive equipment
- Bulky equipment
- Disposal of waste gases
- More operator skill required
- Induction can be stressful



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Volatile agents

Isoflurane – most commonly used
Rapid induction and recovery

Sevoflurane – rapid induction and recovery but very expensive

Desflurane



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Inhalation anaesthesia

The Vaporiser

Oxygen is passed over isoflurane held in a calibrated vaporiser.

The oxygen collects a small amount of anaesthetic vapour (0-5%)

The vaporiser compensates for variations in temperature and flow rate, to always deliver the selected % of anaesthetic vapour



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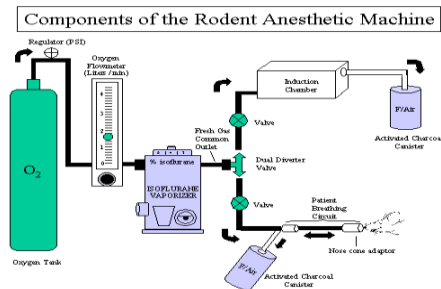
Administration of volatile agents

Equipment needed:

- Source of oxygen
- Flowmeter
- Anaesthetic vaporiser
- Delivery system from vaporiser to animal
- Mechanism to deal with waste gases



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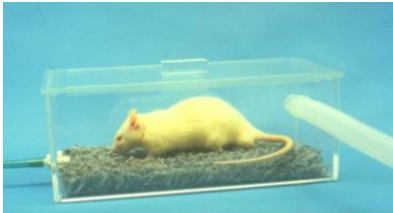
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43

Delivery from vaporiser to animal

- Induction chamber (small rodents)



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LO: 20.9

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Delivery from vaporiser to animal

- Face mask – usually used for maintenance
- Not normally used for induction (stressful)

- Some masks incorporate a scavenging system

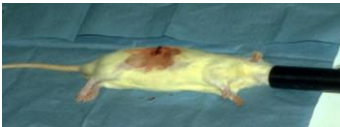


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45

Maintenance on a face mask



45

LO: 20.9

46

Delivery from vaporiser to animal

- Endotracheal tube



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LO: 20.3

47

Combining injectable and inhalation anaesthesia

- **Clinically, induce using intra-venous injection, maintain using inhalation.**
- Used in large animals
 - difficult to restrain for induction by inhalation.
- Not used often in rodents
 - intra-venous injection is difficult, usual to induce in an inhalation chamber.
- If using an inhalation agent for anaesthesia, can reduce concentration needed by administering injectable analgesic (e.g. fentanyl).

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LO: 20.6

48

Non-recovery anaesthesia

- Some experiments require terminal or prolonged anaesthesia.
- Same degree of animal care needed.
- Invasive techniques more likely if non-recovery procedure.
- Some anaesthetic agents are used solely for non-recovery anaesthesia.
 - Alpha-chloralose - very prolonged recovery
 - Urethane - severe peritoneal irritation and carcinogenic.
 - Chloral hydrate - poorly analgesic, can cause paralytic ileus in rats

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LO: 20.11

49

Considerations once anaesthetised

1. **Position** - place animal with head and neck extended
2. **Provide oxygen** to prevent hypoxia (with injectable and inhalational anaesthesia)
3. **Protect eyes from drying** – place lubricant
4. **Keep warm** – place on heat matt
5. **Maintain fluid balance** – inject saline
6. **Monitoring**

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50

Anaesthesia monitoring

- **VERY IMPORTANT!**
- Poor care during anaesthesia can result in prolonged recovery or death.
- Must monitor the animal during anaesthesia to ensure animal is physiologically stable and correct depth of anaesthesia is maintained.

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LO: 20.10

51

Depth of anaesthesia

- Voluntary excitement
- Involuntary excitement
- Surgical anaesthesia
 - light
 - medium
 - deep
- Death!

The most effective depth is the one that removes the animal's response to noxious stimuli without reducing circulatory or respiratory systems

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LO: 20.10

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What can be assessed?

- Rate, depth and pattern of breathing
- Response to noxious stimulus
 - Pedal reflex
 - Ear pinch
 - Palpebral and Corneal reflexes
- Cardiovascular function: MM colour, Heart rate, oxygen saturation etc
- Body temperature

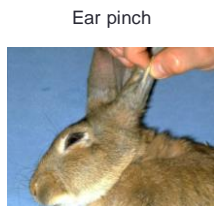
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53

Response to noxious stimuli:

Surgical anaesthesia



Eye rotation and blink reflex

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Respiratory function

- Ensure airway is patent – head and neck extended
- Assess Rate, depth and pattern of breathing
- **Rapid breathing indicates lightening of anaesthesia**
- **Slow laboured breathing indicates anaesthesia plane is too deep**
- Tip: count resps in 15 seconds and x 4
- If respiratory rate < 40% of resting, then treat promptly
- Breathing stops completely – **EMERGENCY**
- **If in doubt give oxygen**

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55

Cardiovascular function

- Requires specialist equipment in rodents
- Heart rate and rhythm
 - Pulse ox and ECG
- Mucous membrane colour
 - Blue = cyanotic
- Capillary refill time
 - Larger animals < 2secs
- Evaluate blood loss –
 - <10% of TBV
- Replace fluids
 - Subcut saline



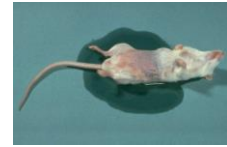
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Body temperature

- Falls rapidly in small animals due to their high surface area to body weight ratio
- Exacerbated if placed on cold surface, anaesthetic gases cold, or skin cleansing solutions cold



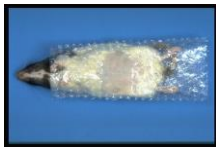
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Body temperature

- Monitor rectal temperature
- Use supplementary heat
- Minimize heat loss – insulate
- Warm any fluids given



- Cotton wool/bubble wrap
- Aluminium foil
- Heated blankets
- Heat lamps
- Hot water bottles
- Thermostatically controlled heat boxes

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LO: 20.12

58

Care following anaesthesia

- Continue monitoring in post anaesthetic period
- Separate recovery area to allow for special attention to be given, depending on species
 - Appropriate environment
 - Special housing
 - Emergency drugs and equipment available
 - Record observations and treatments given
- Warmth – until can maintain own temperature
- Bedding – comfortable and absorbent
- Fluids – animals may be dehydrated
- Urine/faecal output – can indicate hydration status
- Feeding/Body weight - convalescent diet/floor feeding?

58

LO: 20.12

59

Post surgical analgesia

- Choice and need depends on the nature/severity/duration of the procedure

Most commonly used analgesics in rodent medicine

- Opioids (buprenorphine)
- Non-steroidal Anti-inflammatory drug (NSAID) eg Carprofen, Meloxicam
- These drugs can be given in water/jelly to reduce stress post procedurally.

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LO: 20.12

60

Anaesthetic emergencies

- In an emergency situation consider...
- Will the animal still be suitable as a research model if it is recovered after crashing under anaesthesia?
- If not, what should you do?
 - for this animal? Euthanasia
 - before the next anaesthetic? Review protocols

60

LO: 20.12

61

Anaesthetic emergencies

- **Remember** **A** **B** **C** **D**
- **AIRWAY** - Check the airway is unobstructed
- **BREATHING** –
 - Switch off vaporiser (or stop continuous infusions)
 - Supply 100% oxygen
 - Assist ventilation – 20-30 breaths/minute
- **CIRCULATION**
 - Give fluids to maintain blood pressure
- **DRUGS**
 - Anaesthetic antagonist if available
 - Respiratory stimulants



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LO: 20.13

62

Safety

- Keep anaesthetic agents locked away
 - Some are controlled drugs – risk of abuse
- Inhalation agents
 - Use scavenging systems/key fillers to avoid exposure
 - Dangers with compressed gases
 - Check equipment regularly
- Immersion
 - Dispose of waste water appropriately
- Injectable agents
 - Follow procedures to avoid accidental self-injection
 - Good animal handling
 - Label syringes
- Inadequately anaesthetised animals may be dangerous

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LO: 5.6

63

HO Anaesthetic Codes

- | | |
|--------|---|
| AA | - No anaesthesia |
| AB(L) | - Local anaesthesia |
| AB (R) | - Regional anaesthesia |
| AB (G) | - General anaesthesia |
| AC | - Non-recovery anaesthesia |
| AD | - General anaesthesia with a neuromuscular blocking agent |

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Any Questions?



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