**DRUG FORMULARY FOR RESEARCH ANIMALS AT UVM**

7/12/25

\* requires DEA registration

**MOUSE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ANALGESICS** | | | | |
| **NSAIDs** - for minor surgery/procedure (e.g., skin/scalp incision, small craniotomy, vascular cut-down); give 1st dose intra-op | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Meloxicam  Extended-Release Meloxicam (Meloxicam-ER) | 5-10  2-4 mg/kg | SC, PO  SC | q 12-24h  q 24h | Should not be diluted |
| Carprofen | 5-10 | SC, PO | q 12-24h |  |
|  | 15-20 | SC, PO | q 24h |  |
| Ketoprofen | 10-20 | SC | q 24h |  |
| Flunixin | 2-5 | SC | q 12h |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **OPIOIDS** - for major surgery (e.g., thoracotomy, laparotomy, osteotomy/fracture, large craniotomy); give 1st dose intra-op | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Buprenorphine\* | 0.05-0.1 | SC, IP | q 4-6h | may cause respiratory depression |
| Extended-release Buprenorphine\*  Buprenorphine in Polymer (sustained-release) \* | 3.25  0.6-1.2 | SC  SC  SC | q 72h  q 72h | Ethiqa-XR® (or generic equivalent)  Buprenorphine SR-LAB®; use only if pharmaceutical grade not available |
| Morphine\* | 2-5 | SC | q 2-4h |  |
| Naloxone | 0.01-0.10 | IP | once | reverses opioids |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **GENERAL ANESTHETICS** | | | | |
| **INHALED** – preferred method for survival surgery, especially ≥30 min; but provides no post-op analgesia | | | | |
| **Drug** | **Dose (%)** | **Route** | **Frequency** | **Notes** |
| Isoflurane or Sevoflurane | 4-5 (induction),  1-3 (maintenance) | inhaled | continuous | requires precision vaporizer;  adjust % to effect;  special vaporizer for sevoflurane |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **INJECTABLE** | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Ketamine\*/Xylazine | 90-120 K/5-10 X  (in one syringe) | IP | lasts 20-30 min | for short (<30 min) procedures; re-dose with ½ ketamine dose only |
| Ketamine\*/Xylazine/  Acepromazine | 80-100 K/5-10 X/  2-3 A (in one syringe) | IP | lasts 30-40 min | for short (<30 min) procedures; re-dose with ½ ketamine dose only |
| Ketamine\*/Dexmedetomidine | 50-75 K/0.25-0.5 D  (in one syringe) | IP | lasts 20-30 min | for short (<30 min) procedures; re-dose with ½ ketamine dose only |
| Atipamezole (reversal agent) | 1.0-2.5 | SC, IP | once | reverses dexmedetomidine |
| Yohimbine (reversal agent) | 1.0-2.0 | SC, IP | once | reverses xylazine |
| Sodium pentobarbital\*  (not euthanasia solution) | 40-60 | IP | lasts 30-40 min | low margin of safety; consider supplementing with NSAID |
| Tribromoethanol | 200-300 | IP | lasts 15-20 min | Previously available as Avertin. For terminal procedure/euthanasia;  use fresh solution (<1wk old) |
| Urethane | 750-1800 | IP | lasts 8-10 h | for non-survival procedure only;  minimal CV/resp depression |
| Alpha-chloralose | 50-120 | IP | lasts up to 8 h | for non-survival procedure only;  hypnosis, poor anesthesia, poor analgesia  (sedative; must be used with an anesthetic) |
| Chloral hydrate\* | 370-400 | IP | lasts ~1 h | for non-survival procedure only;  hypnosis, poor anesthesia, poor analgesia  (sedative; must be used with an anesthetic) |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **HYPOTHERMIA** – for neonates only | | | | | | | | |
| **Drug** | **Dose** | | **Route** | | **Frequency** | | **Notes** | |
| Hypothermia | ice-water slurry | | topical | | once per surgery;  lasts 10-15 min | | only for pups ≤6 days old; avoid direct contact with ice; rewarm gradually | |
| **LOCAL ANESTHETICS** | | | | | | | | |
| **Drug** | | **Dose (mg/kg)** | | **Route** | | **Frequency** | | **Notes** |
| Lidocaine | | 2-4  (≤ 0.1cc of 0.5%) | | intra-incisional | | once, before incision;  lasts <1h | | fast onset (2 min);  max total dose 7mg/kg |
| Bupivacaine  Bupivacaine Liposome Injection (extended release) | | 1-2  (≤ 0.1cc of 0.25%)  1 mg/kg | | intra-incisional  intra-incisional | | once, before incision;  lasts 4-8h  once, before incision, lasts 72 hours | | slow onset (15 min);  max total dose 6mg/kg  Nocita® (or generic equivalent)  vial must be used within 4 days of puncture. |
| Lidocaine/Prilocaine | | 5-10 | | topical | | q 24h | | (EMLA® cream) |

|  |
| --- |
| **ANTIBIOTICS** |

Treatment is typically directed by veterinary staff, unless specifically approved in protocol

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Ampicillin | 20-100 | PO, SC, IM | q 12h or equivalent 24h dose continuously in drinking water | 0.5 mg/mL drinking water x 14d |
| Clavamox | 50-75 | PO | Continuously in drinking water | Amoxicillin + clavulanic acid |
| Doxycycline | 5-10 | PO | q 12h or equivalent 24h dose continuously in drinking water |  |
| Enrofloxacin | 10-50 | PO, IM | q 12h or equivalent 24h dose continuously in drinking water | 0.05-2.0 mg/mL drinking water x 14d |
| Erythromycin | 20 | PO | q 12h or equivalent 24h dose continuously in drinking water |  |
| Gentamicin | 2-4 | SC, IM | q 8-24h |  |
| Metronidazole | 20-60 | PO | q 8-12h or equivalent 24h dose continuously in drinking water | 2.5 mg/mL drinking water x 5d |
| Trimethoprim/sulfa | 80-160 | PO, IM | q 12h or equivalent 24h dose continuously in drinking water | 1-3.5 mL of 480 mg/mL to 250 mL H2O |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **OPHTHALMIC DRUGS** | | | | |
| **Drug** | **Dose** | **Route** | **Frequency** | **Notes** |
| Gentamicin ophthalmic | 1-2 drops | topical (ophth) | q 12h | ophthalmic antibiotic |
| Proparacaine HCl | 1 drop | topical (ophth) | q 12h | ophthalmic anesthetic |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PARALYTIC DRUGS** | | | | |
| Produce immobility but not unconsciousness. Must be justified in protocol and level of anesthesia well monitored. | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Succinylcholine | 0.05-0.1 | IV | Infusion | must be anesthetized |
| Vecuronium | 0.1-0.5 | IV | Infusion | must be anesthetized |
| Pancuronium | 0.5-1.0 | IP | 1-2 times depending on length of procedure | must be anesthetized |

|  |  |  |  |
| --- | --- | --- | --- |
| **EUTHANASIA AGENTS** | | | |
| Chemical euthanasia agent must be followed by secondary physical method of euthanasia. | | | |
| **Drug** | **Dose** | **Route** | **Notes** |
| Carbon Dioxide (CO2) | 30-70% vol/min | Inhalation | produces death by hypoxia |
| Anesthetic overdose  Isoflurane, sevoflurane  Tribromoethanol  Pentobarbital\*  Urethane | 2-5X anesthetic dose  5%  500 mg/kg  150 mg/kg  3000 mg/kg | inhalation  IP  IP  IP | Beuthanasia®, Euthasol®, Fatal-Plus® |

**RAT**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ANALGESICS** | | | | |
| **NSAIDs** - for minor surgery/procedure (e.g., skin/scalp incision, small craniotomy, vascular cut-down); give 1st dose intra-op | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Meloxicam  Extended-Release Meloxicam (Meloxicam-ER) | 1-2  2-4 mg/kg | SC, PO  SC | q 24h  q 72h | Should not be diluted |
| Carprofen | 5 | SC, PO | q 24h |  |
| Ketoprofen | 2-5 | SC | q 12-24h |  |
| Flunixin | 2-5 | SC | q 12h |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **OPIOIDS** - for major surgery (e.g., thoracotomy, laparotomy, osteotomy/fracture, large craniotomy); give 1st dose intra-op | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Buprenorphine\* | 0.01-0.05 | SC, IP | q 8-12h | may cause pica |
| Extended-Release Buprenorphine\*  Buprenorphine in Polymer (sustained-release) \* | 0.65  0.3-0.12 | SC  SC  SC | q 72h  q 72h | Ethiqa-XR® or generic equivalent  Buprenorphine SR-LAB®; use only if pharmaceutical grade not available |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **GENERAL ANESTHETICS** | | | | |
| **INHALED** – preferred method for survival surgery, especially ≥30 min; but provides no post-op analgesia | | | | |
| **Drug** | **Dose (%)** | **Route** | **Frequency** | **Notes** |
| Isoflurane or Sevoflurane | 4-5 (induction),  1-3 (maintenance) | inhaled | Continuous | requires precision vaporizer;  adjust % to effect;  special vaporizer for sevoflurane |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **INJECTABLE** | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Ketamine\*/Xylazine | 40-80 K/5-10 X  (in one syringe) | IP | lasts 20-30 min | for short (<30 min) procedures;  re-dose with ½ ketamine dose only |
| Ketamine\*/Xylazine/  Acepromazine | 40-80 K/5-10 X/  1-2 A (in one syringe) | IP | lasts 30-40 min | for short (<30 min) procedures;  re-dose with ½ ketamine dose only |
| Ketamine\*/Dexmede-tomidine | 50-75 K/0.2-0.5 D  (in one syringe) | IP | lasts 20-30 min | for short (<30 min) procedures;  re-dose with ½ ketamine dose only |
| Atipamezole (reversal agent) | 0.1-1.0 | SC, IP | Once | reverses dexmedetomidine |
| Yohimbine (reversal agent) | 1.0-2.0 | SC, IP | Once | reverses xylazine |
| Sodium pentobarbital\*  (not euthanasia solution) | 30-50 | IP | lasts 30-40 min | low margin of safety; consider supplementing with NSAID |
| Tribromoethanol | 250-400 | IP | lasts 15-20 min | Previously available as Avertin. For terminal procedure/euthanasia;  use fresh solution (<1wk old) |
| Urethane | 800-900 | IP | lasts 8-10 h | for non-survival procedure only |
| Alpha-chloralose | 35-65 | IP | lasts 8-10 h | for non-survival procedure only;  hypnotic agent, poor analgesia  (must be used with an anesthetic) |
| Chloral hydrate\* | 300-450 | IP | lasts 1h+ | for non-survival procedure only;  hypnotic agent, poor analgesia  (must be used with an anesthetic) |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **HYPOTHERMIA** – for neonates only | | | | |
| **Drug** | **Dose** | **Route** | **Frequency** | **Notes** |
| Hypothermia | ice-water slurry | topical | once per surgery;  lasts 10-15 min | only for pups ≤6 days old; avoid direct contact with ice; rewarm gradually |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **LOCAL ANESTHETICS** | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Lidocaine | 1-4  (≤ 0.1cc of 0.5%) | intra-incisional | once;  lasts <1h | fast onset;  max total dose 7mg/kg |
| Bupivacaine  Bupivacaine Liposome Injection (extended release) | 1-8  {≤ 0.1cc of 0.25%}  1 mg/kg | intra-incisional  Intra-incisional | once;  lasts 4-8h  once before incision, lasts 72 hours | slow onset;  max total dose 8mg/kg  Nocita® (or generic equivalent)  Vial must be used within 4 days of puncture. |
| Lidocaine/Prilocaine | 5-10 | topical | q 24h | (EMLA® cream) |

|  |
| --- |
| **ANTIBIOTICS** |

Treatment is typically directed by veterinary staff, unless specifically approved in protocol

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Ampicillin | 20-100 | PO, SC, IM | q 12h or equivalent 24h dose continuously in drinking water | 0.5 mg/mL drinking water x 14d |
| Doxycycline | 5-10 | PO | q 12h or equivalent 24h dose continuously in drinking water |  |
| Enrofloxacin | 5-10 | PO, IM | q 12h or equivalent 24h dose continuously in drinking water | 0.05-2.0 mg/mL drinking water x 14d |
| Erythromycin | 20 | PO | q 12h or equivalent 24h dose continuously in drinking water |  |
| Gentamicin | 2-5 | SC, IM | q 8-24h |  |
| Metronidazole | 10-40 | PO | q 12-24h or equivalent 24h dose continuously in drinking water | 2.5 mg/mL drinking water x 5d |
| Trimethoprim/sulfa | 20-30 | PO, IM | q 12h or equivalent 24h dose continuously in drinking water | 1-3.5 mL of 480 mg/mL to 250 mL H2O |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **OPHTHALMIC DRUGS** | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Gentamicin ophthalmic | 1-2 drops | topical (ophth) | q 12h | ophthalmic antibiotic |
| Proparacaine HCl | 1 drop | topical (ophth) | q 12h | ophthalmic anesthetic |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PARALYTIC DRUGS** | | | | |
| Produce immobility but not unconsciousness. Must be justified in protocol and level of anesthesia well monitored. | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Succinylcholine | 0.05-0.1 | IV | Infusion | must be anesthetized |
| Vecuronium | 0.1-0.5 | IV | Infusion | must be anesthetized |
| Pancuronium | 1-2 | IP | Once | must be anesthetized |

|  |  |  |  |
| --- | --- | --- | --- |
| **EUTHANASIA AGENTS** | | | |
| Chemical euthanasia agent must be followed by secondary physical method of euthanasia. | | | |
| **Drug** | **Dose** | **Route** | **Notes** |
| Carbon Dioxide (CO2) | 30-70% vol/min | inhalation | produces death by hypoxia |
| Anesthetic overdose  Isoflurane  Tribromoethanol  Pentobarbital\*  Urethane | 5-10X anesthetic dose  5%  800 mg/kg  100 mg/kg  2000 mg/kg | inhalation  IP  IP  IP | Previously available as Avertin  Beuthanasia®, Euthasol®, Fatal-Plus® |

**GUINEA PIG**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ANALGESICS** | | | | |
| **NSAIDs** - for minor surgery/procedure (e.g., skin/scalp incision, small craniotomy, vascular cut-down); give 1st dose intra-op | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Meloxicam | 1-2 | SC, PO | q 24h | Limit to 3 days |
| Carprofen | 1-2 | SC, PO | q 24h |  |
| Ketoprofen | 1-2 | SC | q 24h |  |
| Flunixin | 2-5 | IM | q 12-24h |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **OPIOIDS** - for major surgery (e.g., thoracotomy, laparotomy, osteotomy/fracture, large craniotomy); give 1st dose intra-op | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Buprenorphine\* | 0.05-0.1 | SC, IM | q 8-12h |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **GENERAL ANESTHETICS** | | | | |
| **INHALED** – preferred method for survival surgery, especially ≥30 min; but provides no post-op analgesia | | | | |
| **Drug** | **Dose (%)** | **Route** | **Frequency** | **Notes** |
| Isoflurane | 4-5 (induction),  1-3 (maintenance) | inhaled | continuous | requires precision vaporizer;  adjust % to effect; |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **INJECTABLE** | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Ketamine\*/Xylazine | 20-40 K/3-5 X  (in one syringe) | IM |  |  |
| Ketamine\*/Diazepam\* | 60-100 K/5-8 D  (in one syringe) | IM |  |  |
| Chloral hydrate\* | 400 | IP | once; lasts 1h+ | for non-survival procedure only;  hypnotic agent, poor analgesia  (must be used with an anesthetic) |
| Urethane | 1500 | IP, IV | once; lasts 8-10h | for non-survival procedure only |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **LOCAL ANESTHETICS** | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Lidocaine | 1-4  (≤ 0.1cc of 0.5%) | intra-incisional | once;  lasts <1h | fast onset;  max total dose 7mg/kg |
| Bupivacaine | 1 max  (≤ 0.1cc of 0.25%) | intra-incisional | once;  lasts 3-4h | slow onset;  max total dose 1mg/kg |
| Lidocaine/Prilocaine | 5-10 | topical | q 24h | (EMLA® cream) |

|  |
| --- |
| **ANTIBIOTICS** |

Treatment is typically directed by veterinary staff, unless specifically approved in protocol

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Doxycycline | 2-5 | PO | q 12h or equivalent 24h dose continuously in drinking water |  |
| Enrofloxacin | 5-10 | PO, IM | q 12h or equivalent 24h dose continuously in drinking water | 0.05-0.2 mg/mL drinking water x 14d |
| Gentamicin | 2-4 | SC, IM | q 8-24h |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **OPHTHALMIC DRUGS** | | | | | |
| **Drug** | **Dose (mg/kg)** | | **Route** | **Frequency** | **Notes** |
| Gentamicin ophthalmic | | 1-2 drops | topical (ophth) | q 12h | ophthalmic antibiotic |
| Proparacaine HCl | | 1 drop | topical (ophth) | q 12h | ophthalmic anesthetic |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PARALYTIC DRUGS** | | | | |
| Produce immobility but not unconsciousness. Must be justified in protocol and level of anesthesia well monitored. | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Succinylcholine | 0.05-0.1 | IV | infusion | must be anesthetized |
| Vecuronium | 0.1-0.5 | IV | infusion | must be anesthetized |
| Pancuronium | 2 mg/kg | IP | 1-2 times depending on length of procedure | must be anesthetized |

|  |  |  |  |
| --- | --- | --- | --- |
| **EUTHANASIA AGENTS** | | | |
| Chemical euthanasia agent must be followed by secondary physical method of euthanasia. | | | |
| **Drug** | **Dose** | **Route** | **Notes** |
| Carbon Dioxide (CO2) | 30-70% vol/min | inhalation | produces death by hypoxia |
| Anesthetic overdose  Isoflurane  Pentobarbital\*  Urethane | 5-10X anesthetic dose  5%  150  3000 | inhalation  IP  IP | Beuthanasia®, Euthasol®, Fatal-Plus® |

**PIG**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ANALGESICS** | | | | |
| **NSAIDs** - for minor surgery/procedure (e.g., skin/scalp incision, small craniotomy, vascular cut-down); give 1st dose intra-op | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Meloxicam | 0.4 | PO, IM | q 24h |  |
| Carprofen | 2-3 | PO | q 12-24h |  |
| Ketoprofen | 1-3 | IM | q 12-24h |  |
| Flunixin | 1-4 | IM | q 24h |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **OPIOIDS** - for major surgery (e.g., thoracotomy, laparotomy, osteotomy/fracture, large craniotomy); give 1st dose intra-op | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Buprenorphine\* | 0.01-0.05 | IM | q 8-12h |  |
| Extended-release Buprenorphine\*  Buprenorphine in Polymer (sustained-release) \* | 0.2-0.4  0.12-0.24 | SC  IM | q 72h  q72h | Ethiqa-XR® (or generic equivalent)  Buprenorphine SR-LAB®; use only if pharmaceutical grade not available |
| Fentanyl\*  Fentanyl transdermal patch\* | 0.02-0.05  25-50 µg/h | IV  TD | q 6h  Lasts 3-4 days | Apply at time of anesthetic induction. Requires single housing until patch is removed. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **GENERAL ANESTHETICS** | | | | |
| **INHALED** – preferred method for survival surgery, especially ≥30 min; but provides no post-op analgesia | | | | |
| **Drug** | **Dose (%)** | **Route** | **Frequency** | **Notes** |
| Isoflurane or Sevoflurane | 4-5 (induction),  1-3 (maintenance) | inhaled | continuous | requires precision vaporizer;  adjust % to effect;  special vaporizer for sevoflurane |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **INJECTABLE** | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Ketamine\*/Xylazine | 20 K/1-2 X  (in one syringe) | IM | lasts 20-30 min |  |
| Ketamine\*/Acepromazine | 22-33 K/1.1 A | IM |  | sedation, pre-anesthesia |
| Ketamine\*/Dexmede-tomidine | 1 K/0.1 D  (in one syringe) | IM | lasts 20-30 min | sedation, pre-anesthesia |
| Ketamine\*/Midazolam\* | 33 K/0.5 M | IM | lasts 45-60 min | sedation, pre-anesthesia |
| Atipamezole | 1 | IM, IV | once | reverses dexmedetomidine |
| Yohimbine | 1.0-2.0 | IV | once | reverses xylazine |
| Fentanyl\* | 0.003-0.005 per hr | IV | infusion | often given w/ propofol/midazolam |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **LOCAL ANESTHETICS** | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Lidocaine | 1-4  (≤ 0.1cc of 0.5%) | intra-incisional | once;  lasts <1h | fast onset;  max total dose 7mg/kg |
| Bupivacaine | 1 max  (≤ 0.1cc of 0.25%) | intra-incisional | once;  lasts 3-4h | slow onset;  max total dose 1mg/kg |
| Lidocaine/Prilocaine | 5-10 | topical | q 24h | (EMLA® cream) |

|  |
| --- |
| **ANTIBIOTICS** |

Treatment is typically directed by veterinary staff, unless specifically approved in protocol

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Amoxicillin | 7-10 | PO | q 12h |  |
| Ampicillin | 2-5 | IM | q 12h |  |
| Ceftiofur | 3-5 | IM | q 24h |  |
| Enrofloxacin | 2.5-5 | IM, PO | q 12-24h |  |
| Erythromycin | 2-5 | IM, IV | q 12h |  |
| Gentamicin | 2 | PO | q 24h |  |
| Trimethoprim/sulfa | 5 | IM | q 24h |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **OPHTHALMIC DRUGS** | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Gentamicin ophthalmic | 1-2 drops | topical (ophth) | q 12h | ophthalmic antibiotic |
| Proparacaine HCl | 1 drop | topical (ophth) | q 12h | ophthalmic anesthetic |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PARALYTIC DRUGS** | | | | |
| Produce immobility but not unconsciousness. Must be justified in protocol and level of anesthesia well monitored. | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Succinylcholine | 0.05-0.1 | IV | infusion | must be anesthetized |
| Vecuronium | 0.12-0.18 | IV | infusion | must be anesthetized |

|  |  |  |  |
| --- | --- | --- | --- |
| **EUTHANASIA AGENTS** | | | |
| Chemical euthanasia agent must be followed by secondary physical method of euthanasia. | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Notes** |
| Sodium pentobarbital\* | 150 | IV | Beuthanasia®, Euthasol®, Fatal-Plus® |
| KCl | 75-150 | intra-cardiac, IV | must be under deep anesthesia |

**SHEEP**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ANALGESICS** | | | | |
| **NSAIDs** - for minor surgery/procedure (e.g., skin/scalp incision, small craniotomy, vascular cut-down); give 1st dose intra-op | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Meloxicam | 1-2 | PO, IM | q 24h |  |
| Carprofen | 2-4 | IM, IV | q 24h |  |
| Ketoprofen | 1-4 | IM, IV | q 24h |  |
| Flunixin | 1.1-2.2 | IM, IV | q 24h |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **OPIOIDS** - for major surgery (e.g., thoracotomy, laparotomy, osteotomy/fracture, large craniotomy); give 1st dose intra-op | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Buprenorphine\* | 0.005-0.01 | IV | q 4-8h |  |
| Buprenorphine in Polymer (sustained release)\* | 0.12-0.24 | IM | q 3-5d | Buprenorphine SR-LAB®; use only if pharmaceutical grade not available |
| Fentanyl\* | 0.02-0.05 | IV | q 6h |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **GENERAL ANESTHETICS** | | | | |
| **INHALED** – preferred method for survival surgery, especially ≥30 min; but provides no post-op analgesia | | | | |
| **Drug** | **Dose (%)** | **Route** | **Frequency** | **Notes** |
| Isoflurane or Sevoflurane | 4-5 (induction),  1-3 (maintenance) | inhaled | continuous | requires precision vaporizer;  adjust % to effect;  special vaporizer for sevoflurane |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **INJECTABLE** | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Ketamine\*/Xylazine | 5 K/0.03-0.05 X  10-15 K/0.1 X  (in one syringe) | IV  IM | lasts 15-20 min | don’t use in late pregnancy |
| Ketamine\*/Acepromazine | 22-33 K/1.1 A | IM |  | sedation, pre-anesthesia |
| Ketamine\*/Dexmede-tomidine | 1 K/0.015 D  (in one syringe) | IM | lasts 20-30 min | anesthesia |
| Ketamine\*/Diazepam\* | 3-7.5 K/0.5-1 D | IV | lasts 45-60 min | sedation, pre-anesthesia |
| Atipamezole | 0.1-0.2 | IM, IV | once | reverses dexmedetomidine |
| Yohimbine | 0.12-0.2 | IM, slow IV | once | reverses xylazine |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **LOCAL ANESTHETICS** | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Lidocaine | 1-4  (<3 ml/kg of 2%) | intra-incisional | once;  lasts <1h | fast onset; |
| Bupivacaine | 1-2  (<0.8 ml/kg of 0.25%) | intra-incisional | once;  lasts 4-8h | slow onset; |

|  |
| --- |
| **ANTIBIOTICS** |

Treatment is typically directed by veterinary staff, unless specifically approved in protocol

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Amoxicillin | 7-10 | PO | q 12h |  |
| Cephalexin | 10 | SC | q 24h |  |
| Enrofloxacin | 2.5-5 | IM, PO | q 12-24h |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **OPHTHALMIC DRUGS** | | | | | |
| **Drug** | **Dose (mg/kg)** | | **Route** | **Frequency** | **Notes** |
| Gentamicin ophthalmic | | 1-2 drops | topical (ophth) | q 12h | ophthalmic antibiotic |
| Proparacaine HCl | | 1 drop | topical (ophth) | q 12h | ophthalmic anesthetic |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PARALYTIC DRUGS** | | | | |
| Produce immobility but not unconsciousness. Must be justified in protocol and level of anesthesia well monitored. | | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Frequency** | **Notes** |
| Succinylcholine | 0.01-0.02 | IV | infusion | must be anesthetized |
| Vecuronium | 0.01-0.05 | IV | infusion | must be anesthetized |

|  |  |  |  |
| --- | --- | --- | --- |
| **EUTHANASIA AGENTS** | | | |
| Follow with secondary method. Death must be confirmed. | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Notes** |
| Sodium pentobarbital\* | 150 | IV | Beuthanasia®, Euthasol®, Fatal-Plus® |
| KCl | 75-150 | intra-cardiac, IV | must be under deep anesthesia |

**FISH**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **GENERAL ANESTHETICS** | | | | |
| **Drug** | **Dose (mg/L)** | **Route** | **Frequency** | **Notes** |
| Benzocaine | 25-100 | immersion | once | Dissolve powder in ethanol;  Buffer with NaCO3 |
| Tricaine Methane Sulfonate (MS-222) | 75-125 | immersion | lasts 5-20 min | Buffer with NaCO3 to pH7 |
| Eugenol | 2 mg/L  7.5-15 mg/L | immersion,  up to 15 min | once  once | For light sedation  For handling procedures/Anesthesia  (Aqui-s® 20E or generic equivalent. Calculate eugenol dose based on 10% eugenol stock solution) |

|  |
| --- |
| **EUTHANASIA AGENTS** |

|  |  |  |  |
| --- | --- | --- | --- |
| **IMMERSION** – often 1-step method; leave fish in solution ≥30 min after last opercular movement | | | |
| **Drug** | **Dose** | **Route** | **Notes** |
| Tricaine Methane Sulfonate (MS-222) | 250-500 mg/L | immersion | Buffer with NaCO3 to pH7 |
| Benzocaine | ≥250 mg/L | immersion | Buffer with NaCO3 |
| CO2 | CO2-saturated water | immersion | only from gas cylinder |
| ethanol | 10-30 mL 95% EtOH / L | immersion | produces anesthesia, then death |
| Eugenol/isoeugenol/clove oil | ≥20 mg/L | immersion | poor water solubility; potential carcinogens |
| Isoflurane/sevoflurane | 5-20 mL/L | immersion | poor water solubility; human hazard |
| Quinaldine sulfate | ≥100 mg/L | immersion | Buffer with NaCO3 |
| 2-phenoxyethanol | 0.3-0.4 mg/L | immersion |  |
| lidocaine | 400 mg/L | immersion | Effective in adult zebrafish |

|  |  |  |  |
| --- | --- | --- | --- |
| **INJECTION** – usually part of 2-step method | | | |
| **Drug** | **Dose (mg/kg)** | **Route** | **Notes** |
| Sodium pentobarbital\* | 60-100 | IV, intracardiac, intracoelomic | Death in 30 min |
| Ketamine\* | 66-88 | IM | usually followed with pentobarbital |
| Ketamine\*/Medetomidine | 1-2 K / 0.05-0.1 M | IM | usually followed with pentobarbital |
| propofol | 1.5-2.5 | IV | usually followed with pentobarbital |

|  |  |
| --- | --- |
| **PHYSICAL** – usually 2-step method; requires training and verification of proficiency | |
| **Method** | **Notes** |
| Decapitation, then pithing | Decapitation alone unacceptable |
| Cervical transection, then pithing | Use sharp knife or instrument |
| Cranial concussion, then pithing or exsanguination | Blunt force trauma to head |
| Maceration | Macerator designed for size of fish |
| Rapid chilling (2-4°C) | Acceptable for zebrafish and other small (<3.8cm) tropical fish; conditionally acceptable for other tropical fish; not appropriate for cold-water fish or any large-bodied fish. No direct contact of fish with ice.  Slow chilling or freezing of unanesthetized fish is unacceptable. |