


Pain Management for the Pediatric Cat & Dog



**Analgesia
and Anesthesia**
for the **Ill** or
Injured
Dog and Cat

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The ill or injured Kitten and Puppy



‘Pediatric’ refers to the first six months of life

– due to important physiologic changes which occur during this time frame further demarcation will be defined

- **neonatal** (0-2 weeks)
- **infant** (2-6 weeks)
- **weanling** (6-12 weeks)
- **juvenile** (3-6 months)

Normal Physiological Parameters

- Affected by
 - pain
 - associated illness
 - analgesics
- Frequent assessment/monitoring

PAIN

- **Assessing the degree of pain is very difficult**
 - assume that pain of illness or injury acquired will be as painful, or higher, than adult humans and animals
- **Interpreting crying when no obvious injury is present**
 - **neonates and infants cry when**
 - in pain
 - hungry (failure to nurse)
 - cold
 - loss of contact with mother

PAIN

- **Behavioural - not ill or painful -**
 - duration of crying can last ~ 20 minutes
- **Where injury or illness (pain) is present**
 - crying can be constant
 - depression (facial expression) is difficult to ascertain at this age
 - a limp
 - poorly responsive animal

PAIN

- The weanling and juvenile more demonstrative with respect to pain
- Careful physical exam of the whole patient will localize an area of pain

PHYSIOLOGIC IMPORTANCE OF PREVENTING PAIN

- **The central nervous system is extremely plastic during development**
 - → ↑ **sensitivity to a painful stimulus** applied to the young animal (and human) which →
 - formation of new primary afferents
 - ↑ innervations of wounds
 - hypersensitivity
 - This neural re-organization is permanent → hyperalgesia, potential allodynia, abnormal behaviour

PHYSIOLOGIC IMPORTANCE OF PREVENTING PAIN

- Descending inhibitory pathway not fully developed at birth
- Development of **inhibitory** neurons of descending inhibitory systems from supraspinal centers **occur postnatally** in rats.
- Testing the withdrawal reflex from a painful stimulus
 - infants' spinal cord sensory nerve cells more excitable than adults → greater & prolonged response
 - a larger receptive field

Bottom line.....

- The lack of inhibition by descending spinal cord pathways results in exaggerated and generalized response to all sensory input, both low and high threshold

...there is more

- Young laboratory animals and humans retain '**memory**' of painful experiences
- Inappropriate management of pain results in
 - Hypersensitivity to future painful experience
 - Attention deficit hyperactivity disorders
 - Self-destructive behaviour
 - ↑ anxiety
 - Impaired social skills

• *Anand KJ et al. Biol Neonate 2000;77:69–82*

Licking Proximity of Surgery



-
-
-
-
-

Where is she licking?
Not always the wound
Where is the IM pin?
Where is the screw?
Intra-op nerve injury?

Pain Assessed as Moderate to Severe in Babies

- Venipuncture or phlebotomy
- Insertion peripheral/central intravenous line
- Insertion of urinary catheter or suprapubic aspiration
- Insertion of nasojejunal tube
- Intramuscular injection
- Cleaning or care of excoriated skin
-and more BJ. Stevens CMAJ, April 19, 2011, 183(7)

Gate Control Effect

- Performing a distraction
 - Gentle rubbing
 - Massage
 - → $A\beta$ fibres → activation of
 - Inhibitory neurons in dorsal horn spinal cord
 - Partial block of $A\delta$ and C-fibre sensation

Intraosseous Catheter Placement

Where no IV access

- **Most commonly used sites**
 - Medial surface tibial tuberosity
 - Greater tubercle of humerus
 - Trochanteric fossa of the femur
- Requires local anesthetic

Arrow® EZ-IO® Intraosseous Vascular Access System

- Drug dose = IV dose
- **Infants & weanlings**
 - EZ-IO technique
- **Neonates & small breed infants**
 - 20 to 22ga spinal needle or
 - 18 to 25ga hypodermic needle
 - Refer to notes for details



Puppies & Kittens

- Important to receive appropriate drug & dose of analgesic for the level of pain experienced
- **titration to effect** is advised
 - **initial titration** dose gives assessment of pain level
- requirement to manage this on an **hourly basis**
 - **dose to effect** = **hourly** CRI dose (ketamine & fentanyl)
 - **dose to effect** = **4-hour** CRI dose (hydro, methadone)

OPIOIDS

- Reversal agent available for opioids
 - Naloxone (0.4mg/mL) 0.1mL + 5mLs saline
 - 0.5mL/min SLOW TITRATION ESSENTIAL
 - Neonates 1 drop naloxone under the tongue
- Liver and kidney maturation is incomplete until > 3 weeks of age
 - duration of drug action will be longer
 - CRI dosing may have to be reduced

Buprenorphine

- **Cats & Dogs**

- 0.02–0.04 mg/kg OTM q4-8h for 3–5 day
- Careful dosing is essential as there is no reversal agent
- If inadequate pain relief a higher mu opioid dose will be required due to partial mu-receptor block

NEONATES

- Neonates 0-2 weeks
 - Lower opioid & local anesthetic requirements
 - $\frac{1}{2}$ adult dose for similar degree of pain titrate to effect
 - **Fentanyl & methadone** < sedation & respiratory depression than morphine
 - Sensitive to sedatives/sedative effects of opioids



INFANTS

- Infant 2-6 weeks
 - Nervous & hepato-renal systems still not fully developed
 - ? lower dosage of opioids
 - **½+ adult dose** for similar degree of pain
 - titrate to effect
 - Sedatives CAUTION
 - **do not admin prior to opioid**
 - **assess requirement after**
 - Local anesthetics
 - **½+ adult dose**
 - **> 6 weeks may require up to adult dose**
 - Do not admin NSAIDs



Neonates and Infants

- Suckling is analgesic
 - casomorphine in milk
- Following any stressful procedure
 - allow contact with the mother as soon as possible
- **Analgesia still required for painful procedures**



WEANLINGS

- Weanlings 6-12 weeks
 - Titrate between infant and juvenile dose
 - May require higher opioid dosages mg/kg than adults
- **Some NSAIDs OK** - Confirm by reading package insert/consult for individual NSAIDs
 - Recommended dose may be based on age of study dogs, not always pharmacologic adverse effects
 - e.g. Metacam



JUVENILE

- 3-6 months
 - Usually requires adult dosages
 - May require higher opioid dosages than adults
 - liver size and function relative to body size is ↑
 - NSAIDs OK – Confirm by reading package insert/consult for individual NSAIDs



Ketamine

- Widely used anesthetic & analgesic in neonates and children due to its
 - rapid onset of action
 - short duration of action
 - effective anesthetic and analgesic properties
 - relatively safe respiratory and hemodynamic profile
- No veterinary studies with analgesic focus

Ketamine

- Low doses prevent wind-up
- May abolish opioid hypersensitivity once established
- Adjunct to opioids usually where opioids are inadequate in controlling severe pain

Ketamine

- Single drug patient dependent
- Administer by
 - **Intramuscular** 0.05-0.25mg/kg as high as **1mg/kg IM human neontes**
 - **Oral transmucosal** 0.25mg/kg q4h
 - Bad taste

Ketamine Administration

- **Intravenous** - titrate bolus & CRI
0.1 – 0.5 mg/kg/hr

- **Taper infusion to prevent rebound hyperalgesia**

Local Anesthetics

- **To Reduce Pain**

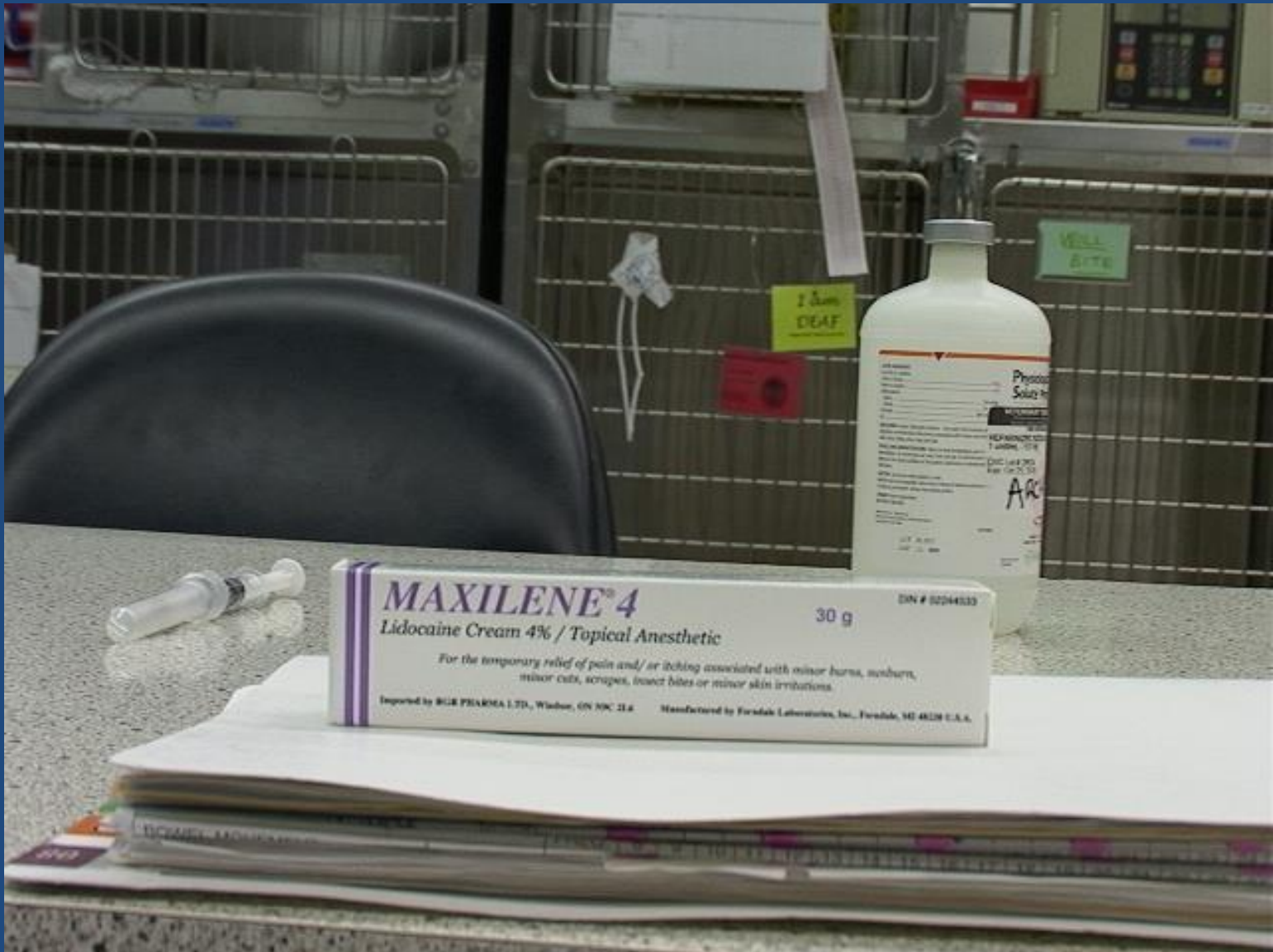
- Warm (37° to 40°C)

- Slow administration with 25 ga needle is recommended

- Mepivacaine does not induce pain on injection

Surgical procedures

- Local analgesia/anesthesia
- Apply a VERY small amount of EMLA cream to the surgical site 20 – 30 mins prior to injection of lidocaine in conscious patients



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Nursing care

- Warm, clean, dry environment
- Appropriate nutritional support
- Physiotherapy & massage therapy for chronic debilitating problems







Keep ambient noise & lights low



A LOT OF TLC



Complementary

- Cold compress during acute injury can reduce swelling and provide analgesia
 - Cold compress generally needs to be in place for 15–20 minutes to be effective
 - Caution → hypothermia
- Warm compress is more comfortable after the acute phase has passed
 - can aid tissue relaxation
 - a precursor to massage or stretching
 - warm compress needs to be in place for 10–15 minutes

Acupuncture

- Must be trained in this
- Specific acupuncture points can relieve pain through
 - ↓ muscle spasm
 - release of a variety of neurotransmitters
- **Juveniles only**
- **Caution** with neonates, infants, weanlings
- Veterinary Clinics N. Amer: Sm Anim Pract July 2000;30(4)



WHY **APPROPRIATE** PAIN & SURGICAL MANAGEMENT IS SO IMPORTANT

Painful Traumatic Neuroma After a Finger Stick

Kahraman S Anesth Analg 2005;100:1414–5

...what about tail and ear amputation??

- Infants with ulnar polydactyly removed with string ligation can produce an unsightly incomplete amputation, a tender neuroma, or both. Mullick S, Pediatric Dermatology 2010;27(1):39–42
- A Review. Safi KH, Fischer H. Consultant for Pediatricians 2010;9(10)
- 16 year old patient's experience- Hartzell TL. Pediatric Dermatology. 2009;26(1):100-102

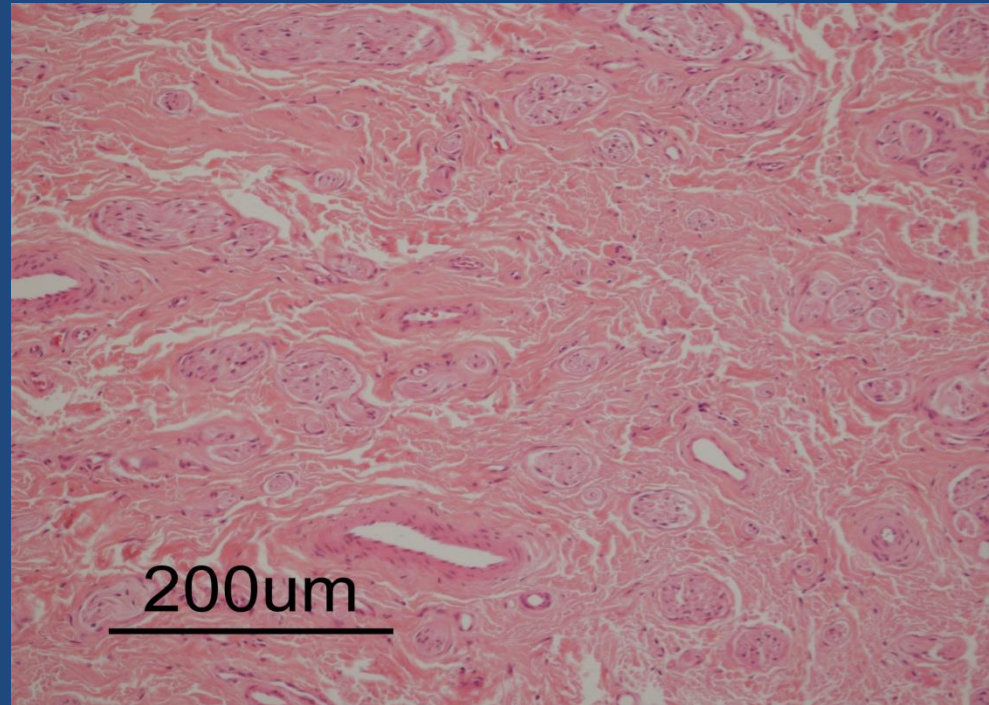


Figure – The postaxial supernumerary digit on this infant's left hand was removed via surgical excision at age 9 months. (Courtesy of John W. Harrington, MD)

Proliferation of nervous tissue

- When nerve tissue is cut the Schwann cell-endoneural barrier is disrupted, allowing the axons to regenerate in a disorganized fashion. The regenerating axons are often surrounded by connective tissue, further disorganizing the regenerate. If a nerve lies too near the end of the stump it is subject to repeated trauma from pressure, [and] friction. This leads to increased edema and fibrosis of the nerve, leading to increased sensitivity."

LeberGE. Pediatric
Dermatology. 2003;20(2):108-112





and this is WHY

- UNNECESSARY (eg. COSMETIC SURGERY) PROCEDURES SHOULD NOT BE PERFORMED
- ABOVE ALL ELSE

DO NO HARM!

Physical Exam

- Observe
 - attitude
 - alert, depressed, distressed etc.
 - respiratory pattern - rate, rhythm, character
 - normal RR 15-35/min
 - high oxygen demand → increased respiratory rate
 - ~ 4 weeks of age, tidal volume similar to an adult
 - indicators of respiratory pathology similar to adults

CAUTION

- Due to the compliance of the thoracic wall, collapses rather than expands on inspiration
- End-expiratory pressure does not go below zero
 - caution is required when manually ventilating these patients to avoid barotrauma

Physical Exam

- Heart sounds
 - can be difficult to auscultate
 - pediatric stethoscope chest piece (2cm bell, 3cm diaphragm) at the left 5th-6th intercostal space
 - rate and rhythm
 - presence or absence of a heart murmur, location if present
 - normal HR ~ 200/min in the very young

Physical Exam

- Body temperature for
 - < 2 weeks of age is 35.5-36C (96-97F)
 - \geq 4 weeks is 37.7C (100F)
 - gradual increase to 38.5C during the juvenile phase
- Due to large surface area to body weight ratio
 - \uparrow evaporative heat loss & poor thermoregulation
→ hypothermia given the right conditions
- At a young age they cannot shiver contributing to hypothermia.

CAUTION

- The potential for hypothermia must always be considered
 - ‘liquid’ & antiseptics
 - warm to a temperature equal to that of the palmar surface of the human wrist
 - heat loss enhanced when placed on cool surfaces
- Hypothermia → bradycardia → low cardiac output & hypotension
 - which may be potentiated with opioid admin

CAUTION

- Re-warming the puppy or kitten is a priority along with administration of fluids as appropriate
- Body temperature may also influence GFR

Hydration

- Kittens and puppies dehydrate rapidly
 - difficult to detect by skin turgor when younger than 6 weeks of age
 - more advanced dehydration
 - the skin will lose turgor
 - remain tented
 - spontaneously wrinkle
 - best examined on the ventral abdomen
 - a useful region to look for evidence of anemia, hemorrhage, cyanosis, edema and umbilical disorders

Dehydration

- Urine colour a good indicator of dehydration
 - normally colourless in dogs in this age group
 - even slight colour is indicative of dehydration
 - kittens may have some colour
 - Should colour disappear with fluid admin the patient was dehydrated
 - a small amount of glucose and protein is normally present in urine of neonates
- Constipation may be a sign of dehydration

Dehydration

- Objective assessments can be made through
 - the recent history of intake and losses
 - vomiting
 - diarrhea
 - polyuria
 - heart rate and peripheral pulse character
 - mucous membrane moistness, colour and capillary refill time
 - eyes sunken within the orbit

Total Body Water

- Neonates, infants, and weanlings have an ~80% TBW volume when extrapolated from human babies
 - ~ one-half being extracellular
 - ↑ potential for evap loss, ↓ reserve of intracellular water, ↑ relative fluid & energy requirement
 - requires careful attention to fluid intake when healthy
 - constant assessment during illness and fever
- Gradual ↓ to 60% TBW occurs after weaning

Cardiovascular : Perfusion

- Blood pressure, peripheral vascular resistance & stroke volume
 - lower than adults
- Plasma volume, heart rate and CVP
 - higher than adults
- Hearts of puppies and kittens generate less force (stroke volume) than the adult, relying on **heart rate** primarily for cardiac output

Cardiovascular: Perfusion

- ~ 6 weeks of age, mean arterial pressure gradually \uparrow to normal adult values when several months of age
- The parasympathetic innervation to the pediatric heart is dominant
 - more vulnerable to bradycardia and hypotension
 - keep in mind with opioid admin

Laboratory Evaluation

- Obtain the smallest volume of blood for
 - PCV
 - high during first few days of life
 - ↓ to ~ 27% by 7 weeks of age
 - ↑ towards normal thereafter
 - TS
 - Blood glucose
 - BUN (reagent strip for whole blood)

Laboratory Evaluation

- WBC count higher than adults during the first few days of life
 - tends to ↓ by the 3rd week
 - ↑ by week 7
- Urine, test for
 - sp gravity (refractometer < adults)
 - glucose, ketones, protein, bilirubin (urine stick)
- Coagulation parameters
 - normal values not reported for <8 weeks of age
 - the same as adults at 8 weeks of age

FLUIDS

- Most ill puppies and kittens are hypoglycemic
 - 2.5-5% dextrose balanced electrolyte solution should be administered
- Volume to be administered must be guided by
 - physical findings
 - response to fluid administration
 - (see Table 1 Suggested Fluid Requirements)
- The enteral route for fluids/feedings should be used where possible for maintenance



Venous Access

- Jugular
 - 22ga peripheral IV cath
 - 18ga peripheral IV cath
- Intraosseous
 - Spinal needle
 - 20 or 22 ga hypodermic needle

HISTORY

Embryological research - In 1872, Paul Flechsig stated that “the myelination of nerve fibers occurred at different rates of development, and although both myelinated and unmyelinated nerve fibers were present in newborns, only the myelinated fibres were believed to be functional.”

Based on this, it was believed that newborns were not sufficiently developed to experience pain. This belief continues as a reason/excuse by some not to administer analgesics to the neonates (0-2 weeks of age) and infants (2-6 weeks)

HISTORY

- In 1986 Jeffrey Lawson changed the attitude of pain perception in the newborn
- “Pain pathways, as well as cortical and subcortical centres necessary for pain perception, are well developed late in gestation, and neurological systems well known to be associated with pain transmission and modulation are also intact and functional.”

– Anand KJ, Hickey PR. *N Engl J Med* 1987;317:1321–1329

- In a prospective study of 87 infants aged 4 or 6 months, pain scores measured by a blinded observer during vaccinations revealed
 - uncircumcised boys had the lowest pain scores
 - boys who received EMLA cream for their circumcision scored lower than the placebo group *Taddio A et al. Lancet 1997;349:599–603*
- A big O U C H for the placebo circumcision group
- Various degrees of iatrogenic injury is also reported with circumcision – no longer routinely performed