Anesthesia of risk patients in small animal practice

ANESTHESIA 4.1 2012

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Subjects

ASA risk classification ↑
(American Society of Anesthetists)

(N)CEPOD urgency of intervention ↑↓
(National Confidential Enquiry into Perioperative Deaths)

Subjects

- Young patients
- Old patients
- Pregnant patients
- Cardiovascular patients
- Respiratory patients
- GI patients
- Liver patients
- Kidney patients
- Endocrine patients
- Septic patients
- Trauma patients

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Young patients

Phys. characteristics 1

- CNS
  - Blood/brain barrier permeable (↓ dose until 4 w)
  - Immature sympathetic regulation (pain → sensitisation → hyperalgesia, allodynia)
- Heart and circulation
  - Vegetative innervation of heart immature
  - Heart min. vol.: frequency dependent (newborn 30%, adult 300% reserve)
  - Weak vasomotoric function, BP ↓
- Respiration
  - Alveolar surface area ↓, surface tension ↑
  - Respiratory rate, tidal minute volume ↑
  - O₂ requirement 2-3 x, but chemoreceptor sens. ↓

Young patients

Phys. characteristics 2

- Fluid homeostasis
  - RBC, Ht, Hb, G, Ca, K, Prot ↓
  - Total water 80% (adult 60%), EC 40% (adult 20%)
  - Overhydration → oed. pulm. (vasomotor func. ↓)
- Kidney, excretion
  - Glom. filtration (2 w), tubular func. (6 w) ↓
  - Sens. to fluid loss (10% olig., 15% anuria)
  - Urine conc. ↓, Na loss ↑
- Liver, metabolism
  - Microsomal enzyme system (4 w) ↓
- Thermoregulation
  - Relatively large body surf., shivering heat prod. ↓
Young patients
Anesthesia

- Fluid therapy (iv., io.), temp. control
- Atropine (not glycopyrrolate!)
- Isoflurane, sevoflurane
- Ketamine (dog: immature liver, cat: immature kidney)
  + midazolam
- Ketamine
  + medetomidine (cat: bradycardia, hypothermia)
- Fentanyl (respiration ↓)
  + midazolam + medetomidine

Young patients
Puppy anesthesia

- Atropine 0.04 mg/bwkg im.
- Isoflurane 2-3 V%, sevoflurane 3-4 V%
- Ketamine 20 mg/bwkg +
  medetomidine 0.05 mg/bwkg im.
  (atipamezole 0.3 mg/bwkg im.)

Young patients
Kitten anesthesia

- Atropine 0.04 mg/bwkg im.
- Isoflurane 2-3 V%, sevoflurane 3-4 V%
- Ketamine 20 mg/bwkg +
  medetomidine 0.05 mg/bwkg im.
  (atipamezole 0.3 mg/bwkg im.)

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Life expectancy

- Dogs
  - 0-10 kg  11.5 y
  - 10-15 kg  10.9 y
  - 15-25 kg  9.9 y
  - 25-45 kg  8.9 y
  - 45 kg+  7.5 y
- ASA: generalisation
Old patients

Phys. characteristics 1

- Heart, circulation
  - Compensation reserve ↓
  - Heart muscle disease, valvular insufficiency
  - Blood volume, heart min. vol., BP, baroreceptor activity ↓, circulation time ↑
  - Vagotonia

- Respiration
  - Anatomical dead space, residual volume ↑
  - Vital capacity, compliance, O₂ diffusion, CO₂ elim., respiratory freq., tidal volume, tidal min. vol., capillary volume, defensive reflexes ↓

Old patients

Phys. characteristics 3

- CNS
  - Neurotransmitter synthesis/degradation ratio ↓
  - Receptor changes
  - Thermoregulation ↓
  - Myelin sheath degeneration, LA effect ↑
  - Muscle relaxant effect longer

- Vegetative nervous system
  - Impulse conduction slows, sensitivity ↑
  - Vagotonia ↑, sensitivity to catecholamines ↑

Old patients

Anesthesia

- Pre-oxygenation, fluid therapy, warming
- Dose reduction 50-70% (!)
- Atropine (vagotony → excess tachycardia)
- ACP small dose! (BP ↓, convulsions ↑)
- Midazolam (paradox reaction rare)
- Opioids (analgesia, Respiration ↓)
- Ketamine (longer duration)
- Propofol (cat: delayed recovery)
- Isoflurane
- Alpha₂-agonists: NO! (hypotension, bradycardia, arrhythmia, respiration depr., insulin ↓, PU)

Old patients

Anesthesia of old dogs

- Atropine 0.02 mg/bwkg im., iv.
- Midazolam 0.5 mg/bwkg iv. or ACP 0.01 mg/bwkg im.
- Propofol 2.0-5.0 mg/bwkg iv.
- Isoflurane 1 V%
- Fentanyl + propofol TIVA dose to effect

Old patients

Anesthesia of old cats

- Atropine 0.02 mg/bwkg im.
- Midazolam 0.5 mg/bwkg iv. or ACP 0.05 mg/bwkg im.
- Propofol 5-7 mg/bwkg iv.
- Isoflurane 1-1.5 V%
- Ketamine 0.5 mg/bwkg iv. or fentanyl 0.003 mg/bwkg iv. (analgesia)
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### Pregnant patients
#### Phys. characteristics 1
- Body mass ratio (fetus/mother)
  - Dog 16.1%, cat 13.1%, human 5.7%
- Circulation
  - Heart capacity ↑, heart min. vol. ↑ (+30-50%)
  - Plasma estrogen ↑, peripheral blood supply ↑
  - During partuition heart freq. ↑, systolic BP ↑ (+10-30 mmHg), central venous pressure ↑ (+4-6 cmH₂O)
  - Heart reserve capacity ↓, compensated heart disease may decompensate

### Pregnant patients
#### Phys. characteristics 2
- Respiration
  - Serum progesterone ↑
    - Resp. center sensitivity (to higher CO₂ level) ↑, hyperventilation, respiratory alkalosis → kidneys compensate, PH remains unchanged
    - Bronchial muscle relaxation, lung resistance ↓
    - Resp. volume ↓ (diaphragm dislocated cranial)
    - During partuition a resp. frequency ↑
    - O₂ requirements ↑ (+20%)
  - Hypoxia and hypercapnia risk at anesthesia
    - Diaphragm position, recumbency, anesthetics

### Pregnant patients
#### Phys. characteristics 3
- Fluid homeostasis
  - Blood volume, plasma volume ↑ (+40%)
  - RBC, Hb, plasma protein conc. relative ↓
- Excretion
  - GFR ↑ (+60%), UREA ↓, CREA ↓
  - „Normal“ UREA and CREA values mean decreased kidney function, NSAID should be avoided
  - Anesthetics excreted faster
- GI system
  - Risk of regurgitation and vomiting

### Pregnant patients
#### Preparation
- Precise body weight measuring
- Calm, warm, dry environment
- Blood sample
  - Blood count, TPP, G, UREA, CREA, ALT
- Vein catheter
- Preparation of surgical area while awake
- Preparation for emergency

### Pregnant patients
#### Anesthesia 1
- Prevention of vomiting or regurgitation
  - Metoclopramide 0.2-0.4 mg/bwkg iv., im.
  - Cimetidine 6-11 mg/bwkg im.
- Infusion therapy
  - 20-60 ml/bwkg/h electrolyte inf.
- Preoxygenation
- Anticholinergics
  - Glycopyrrolate preferred
- Avoid
  - Phenothiazines, barbiturates, alpha₂-agonists
Pregnant patients

Anesthesia 2

- Introduction
  - Propofol, ketamine, steroid anesthetics
  - Rapid intubation, 100% O₂, recumbency (semilateral due to v. cava compression)
- In case of aggressive cat
  - Ketamine 5-10 mg/bwkg im. + benzodiazepines (0.1-0.2 mg/bwkg)

Pregnant patients

Anesthesia 3

- Maintenance (balanced)
  - Isoflurane inhalation anesthesia
    MAC value ↓ (in cats -40%)
  - Fentanyl 0.02 mg/bwkg iv. + benzodiazepines 0.1-0.5 mg/bwkg iv. (antagonizable ataralgesia)
  - Epidural anesthesia (combination)
    Lidocaine 1-2%: 1 ml/5 bwkg or 0.5 ml/10 cm

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Cardiovascular patients

Anomalies

- Congenital defects (PDA, PRAA)
- Cardiomyopathy (DCMP, HCMP)
- Heart rhythms (arrhythmias)
- Valvular insufficiency (mitral)
- Pericardial diseases
- Hypotension, hypertension
- Hypovolaemia
- Anaemia
- Heart worms

Cardiovascular patients

Anesthesia 1

- Preoxygenation
- Atropine, glycopyrrrolate (→ tachycardia)
- Midazolam, ACP (↓)
- Opioids (→ bradycardia)
- Propofol
- Dopamine
- No ketamine! (→ tachycardia)
- No inhalants! (neg. inotrop)
Cardiovascular patients

Anesthesia 2

- Atropine dog: 0.02; cat: 0.05 mg/bwkg im.
  glycopyrrrolate dog: 0.01; cat: 0.02 mg/bwkg im.
- Midazolam 0.5 mg/bwkg iv. or
  ACP 0.01-0.02 mg/bwkg im.
- Propofol 2.5-4 mg/bwkg iv.
- Assisted ventilation: O₂, TV 6-8 ml/bwkg,
  PEEP 2-4 mmHg
- Dopamine 2 (-10) µg/bwkg/min iv. (Ringer inf.)
- Propofol (50 ml + 5% G inf. 200 ml) and
  fentanyl (50 ml + Ringer inf. 500 ml) to effect iv.

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Respiratory patients

Anomalies

- Receptors
  - O₂: glomus caroticum; CO₂: medulla oblongata
  - Tension: lung, chest wall
  - Touch: defense mechanisms
- Extrapulmonary
  - Chest movement (rib fracture), diaphragm hernia
  - Pneumo-, haemo-, chylo-, hydrothorax
  - Volume extensions, megaesophagus, foreign bodies
  - Laryngeal paralysis
- Intrapulmonary
  - Inflammation, fibrosis, oedema, tumor, atelectasia

Respiratory patients

Anesthesia 1

- Parasympatholytics
  - Dead space ↑, gland secretion ↓, mucous m. dry
- Phenothiazines (dosis ↓)
  - CO₂ threshold ↑
- Alpha₂-agonists
  - Respiration frequency and TV ↓
- Benzodiazepines
  - CO₂ threshold ↑
- Opioids
  - Respiration depression (drug and dose dep.)
  - CO₂ threshold ↑

Respiratory patients

Anesthesia 2

- Phencyclidines
  - Apneal respiration pattern (blood gas param. ↔)
  - Bronchosecretion ↑ (tube suction), salivation ↑
- Propofol
  - Respiration depression (fast admin, overdose)
- Inhalational anesthetics
  - TV ↓, respiration freq. ↑ (doesn't compensate)
  - CO₂ threshold ↑
Respiratory patients
Intrapulmonary f. - anesthesia

- Glycopyrrolate 0.01 mg/bwkg iv. or atropine 0.02 mg/bwkg im.
- Midazolam 0.5 mg/bwkg iv.
- Propofol 3-5 mg/bwkg iv.
- \( \text{O}_2 \), ventilation (mild hypervent.)
- Fluid therapy (bicarbonate)
- Propofol (50 ml + 5% G inf. 200 ml) and fentanyl (50 ml + Ringer inf. 500 ml) to dose iv.

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Gastrointestinal patients
Anesthesia 1

- Foreign body removal
  - ASA dependent anesthesia
  - Replace fluid deficiency, electrolyte level correction
  - Circulation support: dopamine 0.002-0.1 mg/bwkg/min cont. drip inf. iv. to effect
  - Induction: propofol 2-4 mg/bwkg iv. to effect + fentanyl 0.02 mg/bwkg iv.
  - Maintenance: propofol 9-15 mg/bwkg/h + fentanyl 0.02 mg/bwkg/h
  - Postoperative: metoclopramide, \( \text{H}_2 \) blocker, pain management

Gastrointestinal patients
Anesthesia 2

- Gastric dilatation and volvulus (GDV)
  - Diaphragm dislocation towards thorax, respiration ↓
  - Venous reflux from abdominal organs ↓, heart min. vol. ↓, arrhythmia, BP ↓, hypoxia, acidosis
  - Fast fluid therapy (first 30 min):
    10 ml/bwkg HAES 6% + 10 ml/bwkg Ringer iv.;
    dopamine 0.005-0.01 mg/bwkg/min iv.

Gastrointestinal patients
Anesthesia 3

- Gastric dilatation and volvulus (GDV)
  - Induction: midazolam 0.5 mg/bwkg iv. + propofol 3-5 mg/bwkg iv. + fentanyl 0.02 mg/bwkg iv., fast intubation, 100% \( \text{O}_2 \)
  - Maintenance: propofol + fentanyl to effect
  - Treatment of arrhythmia: lidocaine 1-2 mg/bwkg iv.
    (then 0.04-0.06 mg/bwkg/min iv. inf.) +/- procaine 6-12 mg/bwkg iv. every 6-8 h
  - In case of shock symptoms consider prednisolone
  - Postoperative: pain management
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### Liver patients

#### Anomalies
- Circulation autoregulation ↓ (HMV 25% !)
  - Isoflurane, sevoflurane: vasodilation (a. hep.)
  - Halothane: vasoconstriction (a. hep.)
  - Inhalational anesthetics: portal circulation ↓
  - Fasting: autoregulation ↓
- Protein metabolism ↓ (TPP 90%, enzymes)
- Carbohydrate metabolism ↓ (GNG, storage, GL)
- Metabolism ↓ (endogenous, exogenous detox.)
- Excretion ↓ (bile)
- Immune system ↓
- Coagulation factors ↓ (I, II, V, VII, IX, X, fibrinolytic activators and inhibitors)

#### Anesthesia 1
- Parasympatholytics
  - Dog: excretion mostly unchanged (kidney)
  - Cat: metabolized by atropine esterase
- Phenothiazines
  - Glucuron conjugation (delayed)
- Benzodiazepines
  - Midazolam (inactive metabolites), no diazepam!
  - Alpha2-agonists
  - Partial biotransformation (vs. unchanged excretion)
- Opioids (fentanyl recommended)
  - Glucuron conjugation (delayed, rebound!)
  - Pylorus and Oddi sphincter spasm; His ↑, perf. ↓

#### Anesthesia 2
- Phencyclidines
  - Dog: demethylation, hydrolysis in the liver; heptonecephalopathic seizure induction
  - Cat: excreted unchanged in kidney
- Propofol
  - Hydroxylation, glucuron or sulfuric conjugation (delayed inactivation)
- Inhalational anesthetics metabolism
  - Isoflurane, desflurane, N2O ~ 0%
  - Sevoflurane, enflurane 8%
  - Halothane 50% (don't use!)
  - Methoxyflurane 70% (don't use!) (renotoxic metabolites)

#### Anesthesia 3
- Clotting examination, preoxygenation
- Atropine 0.02 mg/bwkg im.
- Midazolam 0.5 mg/bwkg iv.
- Propofol 2-5 mg/bwkg iv.
- Ventilation, hypoxia prevention
- Glucose 5% 3 ml/bwkg/h, G ↓ prevention
- Plasmaexp. 20 ml/bwkg iv. (if Alb. 1.5 g/dl ↓)
- Dopamine 2 μg/bwkg/min iv. (if BP ↓)
- Isoflurane max. 1% + N2O 50% + fentanyl (best: remifentanyl) to effect
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### Kidney patients

#### Anomalies 1
- Circulation autoregulation (heart min. vol. 25% !)
  - Systemic arterial mean pressure 70-80 mmHg, CVP 0-5 cmH₂O → urine excretion 0.5-1 ml/bwkg/h ↑
- Fluid compartment volume (regulation ↓)
  - Glomerular filtrate → prox. tubules 7/8 resorption → dist. tubules ADH-dependent resorption
  - Opioids: ADH ↑, oliguria
  - Alpha₂-agonists: ADH ↓, polyuria
- Fluid compartment composition (regulation ↓)
  - ADH ↑: water and Na retention, K loss

#### Anomalies 2
- Acid-base state (regulation ↓)
  - Tubular excretion (H⁺, Na-phosphate, ammonium salts)
- Excretion, detoxification (endog. endogen, exogen) ↓
- Renin, erythropoetin, vitamin D conversion, Ca and P homeostasis ↓

### Kidney patients

#### Anesthesia 1
- Prevent hypovolaemia, hypotension, hypoxia, acidosis!
- During anesthesia GFR 100% → 40% !
- Fluid therapy (K⁺ level managed)
- Dopamine
- ACP ↓ (IR: longer and stronger effect)
- Benzodiazepines
- No alpha₂-agonists!
  - Perfusion ↓ + insulin ↓, G ↑ + ADH ↓ → PU
- Opioids (ADH ↑ → oliguria)

#### Anesthesia 2
- Ketamine (not in cats!)
  - Perfusion ↑, but resistance is ↑ → GFR ↔ ↓
- Propofol
- Inhalational anest.
  - Halothane, isoflurane, sevoflurane, enflurane, N₂O: heart min. vol. ↓, perfusion ↓, ADH ↓
  - Desflurane recommended
- FLUTD
  - Dehydration, K⁺ ↑, acidosis, P ↑, hypothermia
  - K⁺ ↑ → bradycardia (1-2 mmol/bwkg Na-bicarb. iv.)
Kidney patients

Anesthesia 3

- Atropine 0.02 mg/bwkg im.
- Dopamine 0.5-2 µg/bwkg/min iv.
- Midazolam 0.5 mg/bwkg iv.
- Propofol 3-5 mg/bwkg iv.
- Ventilation
- Propofol (50 ml + 5% G inf. 200 ml) and fentanyl (50 ml + Ringer inf. 500 ml) to effect iv.
- Isoflurane 0.8-1 V%
- Fluid therapy postop. for 2 days!

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Diabetes mellitus

Preparation 1

- Constantly elevated blood glucose-level
  - 7.5 mmol/l ↑
- IDDM
  - Middle aged and old female dogs
    (poodle, dachshund, spitz, terriers, spaniels)
- NIDDM
  - Old cats

Preparation 2

- Detailed patient exam
  - Blood (blood count, fasting G, Ht, ALT, AST, AP, Urea, Crea, ketone bodies, serum-electrolytes, blood gas values)
  - Urine (density, G, ketone bodies)
  - Consequences: fatty liver → hepatomegaly, cirrhosis, urosepsis, prerenal uraemia, etc
- Metabolic anomalies (praeop. correction!)
  - G ↑, dehydration, blood gas values (K*), serum-electrolytes

Preparation 3

- Insulin (goal: G 11-14 mmol/l ↓)
  - Im.: 0.1 IU/bwkg/h, then 0.5 IU/bwkg every 6-8 h
  - Iv.: 10-15 IU /1000 ml salsol or dextrose 5%, 0.05-0.1 IU/bwkg/h
- Resistance ↓
  - Preop. AB + sterility! (vein catheter sterility!)
- Perioperative stress diabetogen
  - Epinephrine, norepinephrine, cortisol, STH, glucagon ↑
Diabetes mellitus
Anesthesia 1

- **Recommended**
  - Short duration or antagonizable agents
  - Premedication: diazepam + butorphanol
  - Induction and maintenance: propofol or isoflurane

- **Avoid**
  - Xylazine (G ↑)
  - Glucocorticoids (anti-insulin effect, immunosuppression)
  - Hypoxia (catecholamines, G ↑)

Diabetes mellitus
Anesthesia 2

- **Perioperative G-control protocols**
  - Tight control: continuous insulin and glucose-infusion (continuous monitoring, small variance)
  - Loose control: no food, no glucose, no insulin on day of surgery (progressive G ↑)

Diabetes mellitus
Anesthesia 3

- **Compromise**
  - Perform usual routine until midnight of day before surgery
  - Fasting after midnight, and early morning
  - G measuring 1 h before; then every hour
  - In the morning 50% of normal insulin + 10 ml/bwkg/h dextrose 5% inf.
  - If G ↑: 0.25-0.5 IU/bwkg im. insulin
  - If G ↓: dextrose intake ↑

- **Postop. fasting**
  - Minimal time (gen. 0-3 days)
  - Iv. dextrose + im. insulin every 6 h

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Cushing Syndrome
Preparation 1

- **Hyperadrenocorticism (cortisol ↑)**
  - Hypophysis (85-95%) → hypophysectomy
  - Unilateral adrenal gland tumor (5-15%) → adrenalectomy
  - Iatrogen

- **Disposition**
  - Middle aged and old small body dogs (beagle, miniature schnauzer, boxer)
**Cushing Syndrome**

**Preparation 2**
- Multisystemic changes = risk factors
- Circulation exam (physical, RTG, ECG, US)
  - Fluid retention, hypertension, valvular insufficiency, left ventricular hypertrophy, chronic heart failure
- Respiration exam (respiration, blood gas)
  - Weak respiratory muscles, thoracic and abd. fat depot, hepatomegaly, decreased diaphragm movements
  - Consider IPPV

**Cushing Syndrome**

**Preparation 3**
- Increased mineralocorticoid-level
  - Na⁺- and water retention (↑ level)
  - Increased K⁺- and H⁺-excretion (↓ level)
- Following mitothane therapy
  (50 mg/bwkg/day o.p. DDD, Lysodren for 25 days)
  - may be mineralcort. deficiency
  - Hypovolaemia, hyperkalaemia, acidosis
  - Fluid replacement, balanced electrolytes, glucocorticoid-, mineralocorticoid-repl. iv.

**Cushing Syndrome**

**Preparation 4**
- Cushing-syndrome → diabetes mellitus
  - Cortisol level ↑ → insulin requirement ↑
- Cortisol level ↓ → relative hyperinsulinaemia
  - Preoperative mitothane therapy
  - Adrenocortical inhibitors (metyrapone, aminoglutethimide)
  - Adrenocortical-tumor resection

**Cushing Syndrome**

**Anesthesia 1**
- Anesthetic-selection
  - Endocrine disease limits minimally
- Avoid: etomidate, metomidate
  - During unilateral adrenal-tumor-resection suppresses contralateral function as well
- Perioperative stability
  - Fluid-, electrolyte-, acid-base homeostasis and G
  - IPPV: resp. min. vol. 150 ml/bwkg/min ↑, PaCO₂ 60 mmHg ↓

**Cushing Syndrome**

**Anesthesia 2**
- Substitution therapy after radical surgery
  - Until stabilization after unilateral adrenalectomy
    (remaining adrenal gland maintains function)
  - Until the end of animal’s life after bilateral adrenalectomy and hypophysectomy
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# Hypothyreosis

## Preparation 1

- Most common endocrinopathy in dogs
  - Middle aged and old dogs
    (dobermann, boxer, retriever, beagle, schnauzer)
  - 95% primary idiopathic or autoimmune

## Preparation 2

- Anesthesiological aspect:
  - Metabolic rate ↓ → drug metabolism ↓
  - Myocardium contractility ↓, bradycardia
  - Anaemia (consider transfusion)
  - Obesity, decreased diaphragm movement
  - Thermoregulation disturbances (hypothermia)

## Preparation 3

- Pre-treatment for elective surgery:
  - L-thyroxine 20 µg/bwkg/day at least 2 weeks po.
    (reach the normal “euthyroid risk”)
  - L-thyroxine 1x 20-40 µg/bwkg iv.
    (or L-triiodothyronine 4x 6 µg/bwkg po.)
  - Thyreotoxicosis may happen

- Anesthetic selection:
  - In small part metabolizable drugs
  - Dose ↓

## Anesthesia 1

- Premedication (not always)
  - 0.05-0.1 mg/bwkg butorphanol im.
    (sedation, potentiation, analgetic)
  - Bradycardia: 0.02-0.06 mg/bwkg atropine im.

- Induction and maintenance
  - Propofol to effect iv.
  - Isoflurane (even during myocardial depression)
  - Halothane (milder peripheral vasodilation than isoflurane → BP ↓, temp ↓)

## Anesthesia 2

- Avoid
  - Respiration depressing drugs (decreased diaphragm movement)
  - ACP and other phenothiazines (longer effect, hypotermia, hypotension)

- Monitoring
  - Respiration- and blood gas-parameters (IPPV)
  - Fluid homeostasis
  - Temperature (warm inf., heating pad)
<table>
<thead>
<tr>
<th>Subject Category</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young patients</td>
<td></td>
</tr>
<tr>
<td>Old patients</td>
<td></td>
</tr>
<tr>
<td>Pregnant patients</td>
<td></td>
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<tr>
<td>Trauma patients</td>
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### Hyperthyreosis

#### Preparation 1
- Hypermetabolic state → multisyst. consequences
- Middle aged and old animals
  - Cats (adenoma), dogs rarely (carcinoma)
- Metabolic rate ↑
  - O₂- and G-requirement ↑, drug-metabolism ↑
- Cardiac consequences
  - Tachycardia
  - Myocardial sensitivity to hypoxia, dysrhythmia
  - CMP (HCMP), chronic heart failure (15%)

#### Preparation 2
- Detailed patient exam
  - Auscultation, RTG, ECG, US
  - Laboratory: ALT, AST, AP
- Goal
  - Reach a euthyreoid state

#### Preparation 3
- Methimazole
  - 1 (-1.5) mg/bwkg 3x daily, for 2 weeks
  - 2-3 weeks euthyreoid state: symptoms normalize
  - Stop in case of agranulocytosis, thrombocytopenia
- Propranolol
  - 0.5-1 mg/bwkg 3x daily, for 7-14 days
  - β-blocker (tachyarrhythmias, hypersensitivity ↓)
  - Carefully in chronic heart failure cases (neg. inotrope)

#### Anesthesia 1
- Most general protocols are safe
  - After 2 weeks maintaining a euthyreoid state
- In untreated animals avoid
  - Ketamine, tiletamine (→ catecholamine level ↑)
  - Atropine (→ vagal tone decreases)
  - Xylazine, halothane (→ myocardial sensitivity)
Hyperthyreosis
Anesthesia 2

- Premedication
  - 0.05-1 mg/bwkg ACP im. (stress ↓, dysrhythmia ↓, 8-blocker → BP ↓)
  - Opioids (myocardial O₂-demand ↓, bradycardia)
- Induction
  - I.v.: propofol, thiobarbituate, alphaxalone and alphadoline (dysrhythmias ↓)
  - Inhalational: stress in awake patient → catecholamine ↑

Hyperthyreosis
Anesthesia 3

- Intubation: smaller tube or tracheotomy
- Maintenance
  - Isoflurane (easy regulation, don’t causes heart muscle sensitization, minimal myocardial depression)
- Monitoring
  - ECG: ventricular dysrhythmias
    0.01-0.05 mg/bwkg iv. propranolol,
    0.1-1 mg/bwkg iv. lidocaine
  - Body temperature
  - Oxygen consumption ↑ (sensitive to hypoxia)

Hyperthyreosis
Anesthesia 4

- Complications of bilat. thyreoidectomy
  - Iatrogen hypoparathyreoidism may be: blood exam. over 3 days: Ca ↓ (convulsions) → Ca and D vit.
- Total thyreoidectomy
  - Total hormonal replacement after 24-48 h

Subjects

- Young patients
- Old patients
- Pregnant patients
- Cardiovascular patients
- Respiratory patients
- GI patients
- Liver patients
- Kidney patients
- Endocrine patients
- Septic patients
- Trauma patients

Septic patients
Anomalies 1

- SIRS (Systemic Inflammatory Response Syndrome of noninfectious origin)
  - Trauma, steril inflammation, burns etc.
- Sepsis (like SIRS but infections origin)
  - Pyometra, pyothorax, prostate-, liver-, kidney-abcess, mastitis, wound inf., GI perforation, - arrodation etc.
- MODS (Multiple Organ Dysfunction Syndrome: consequence of SIRS or sepsis)
  - Organ systems affected in following order: dog: GI, liver, kidney, lung; cat: lung
**Septic patients**

**Anomalies 2**

- Signs of septic state
  - Core body temperature
    - $<38^\circ C$: hypovolaemic shock, bacteriaemia
    - $>40^\circ C$: bacteriaemia
  - Peripheral body temp. min. $6^\circ C \downarrow$
  - Pulse freq. $\uparrow$ (150-200/min)
  - Respiration freq. $\uparrow$
    (metabolic acidosis, thromboembolism, respiratory insufficiency)

**Septic patients**

**Anomalies 3**

- Signs of septic state
  - CRT $>2$ sec
  - Mucous membr.: pale, anemic, gray
  - Systolic arterial pressure $<90$ mmHg
  - Central venous pressure
    - $<1-2$ cmH$_2$O: hypovolaemia
    - $>15$ cmH$_2$O: right sided heart failure, inf. $\uparrow$
  - Urine filtration $<0.5$ ml/bwkg/h
  - Ht $<20\%$: bleeding, overinfusion
  - Ht $>50\%$: fluid loss
  - G $<3.9$ mg/dl (70 mg/dl): sepsis

**Septic patients**

**Preparation**

- Eliminate infection source
  - Drain
  - Antibiosis (based on hemoculture)
- Circulation support
  - Volume support, acidosis correction
  - Increase of systemic central pressure
  - Optimize pressure of right and left ventricle
  - Optimize heart index
- Support tissue perfusion
  - Preoxygenation

**Septic patients**

**Anesthesia**

- Fast induction
  - Etomidate 0.5-1.5 mg/bwkg iv.
  - Midazolam + ketamine
  - Intubation
- Maintenance (balance)
  - Fentanyl 0.01 mg/bwkg/20 min iv.
  - Vecuronium 0.08-0.1 mg/bwkg/20 min iv.
  - Can be increased with inhalational anesthetics
    (isoflurane, sevoflurane)
  - Artificial ventilation!

**Subjects**

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- Trauma patients
# Trauma patients

## Anomalies 1

- **Common changes**
  - Thoracic changes in 70% of cases (oedema, thoracic bleeding, PTX, diaphragmatic hernia, rib fracture)
  - Spleen-, liver rupture, urinary bladder rupture
  - CNS injuries

- **Emergency cases**
  - Processes constricting upper respiratory tract
  - Open chest wounds, tension PTX
  - Open abdomen, eventration of abdominal organs
  - Life threatening bleeding

## Preparation

- **Stabilization** (respiration, circulation, homeostasis)
- **Analgesia**
  - Butorphanol 0.4 mg/bwkg im.
  - Carprofen 4 mg/bwkg iv.
  - Meloxicam in dog: 0.2 mg/bwkg iv. (in cat 0.3 mg/bwkg iv.)

## Premedication

- Midazolam 0.5 mg/bwkg im., iv. or diazepam 0.5 mg/bwkg iv. + butorphanol 0.1-0.4 mg/bwkg im., iv.

## Anesthesia

- **Induction**
  - Propofol 1.5 (-10) mg/bwkg iv. to effect
- **Maintenance**
  - Isoflurane, sevoflurane: 2-3 V% + O₂ (contraindicated in CNS, increases intracranial pressure)
  - Propofol 15 mg/kg/h (Dextrose 5% inf.)
    + fentanyl 0.02 mg/kg/h iv. (Ringer-lactate inf.)
  - Midazolam 0.5 mg/bwkg im., iv.
    + fentanyl 0.02 mg/bwkg im., iv.