

1

General anesthesia considerations

- Age
- Species
- Breed
- Sex
- Length of procedure
- Type of procedure

2

Age

- Young
 - Young animals cannot maintain a blood pressure unless their heart is beating strongly
 - More likely to have problems metabolizing drugs
- Old
 - Older pets will more often have complicated medical problems
 - Can be obese and have problems ventilating

3

Species

- “A cat is not a small dog”
 - Cats and Dogs have different approaches and anesthetic protocols
 - Cats cannot often handle opioids
 - Greatly benefit from pre-medication

Not discussing exotics today

4

Breed

- A few pointers.....
- Sighthounds
- Boxers
- Collies/Shelties
 - All of these breeds may be predisposed to drug reactions
 - Anesthesia should follow carefully selected protocols



5

Sex

- Neuter much less risky than a spay
- Often affected by testosterone and have a higher incidence of trauma



6

Length of procedure

- Spay
- Orthopedic procedure
- Abdominal explore
- Cat Neuter
- Dentistry
 - All of the above can have unanticipated complications



7

Type of procedure

- Orthopedic
- Soft-tissue
- Abdominal
- Thoracic
- Will the animal be in Ventral recumbency?
- Dorsal?
- Lateral?

8

Pre-operative assessment/physical

- ◻ Steps:
 - Signalment
 - History
 - SOAP format
 - Subjective
 - Objective
 - Assessment
 - Plan
 - Exam covers all major bodily systems



Physical Exam

- ◻ Nose to tail assessment of bodily function
- ◻ Uses very little "advanced" equipment
- ◻ Tools needed:
 - Ears, Eyes, Hands, Stethoscope

9

10

Physical Exam

- ◻ Start at the head
- ◻ Examine the eyes, face, gums, ears, and cervical lymph nodes
- ◻ Note any abnormalities
 - Abnormal pupils
 - Eye discoloration
 - Swollen lymph nodes
 - Obvious ear infection



11

Physical Exam, cont.

- ◻ Next move to thorax
- ◻ Using stethoscope:
 - Auscult heart and lungs
 - Heart is ausculted:
 - Left side: 5th ICS: Mitral, 4th ICS: Aortic, 3rd ICS: Pulmonic
 - Right side: Tricuspid
 - All lung fields are ausculted



12

Physical Exam, cont.

- Move to abdomen
- Palpate abdomen
- Cranial portion, under last ribs:
 - Liver
- Mid abdomen:
 - Intestines, spleen, kidneys
- Caudal abdomen:
 - Bladder

13

Additional points

- To evaluate orthopedic/neurologic
- Make sure animal can walk
- Seems to have appropriate mentation
- No tremors/seizures
- If all of those are normal, patient probably has normal neurologic/orthopedic function

14

ASA status

- American Society of Anesthesiologists
 - Risk categories
- **ASA Status 1:** Healthy patient, elective procedure
- **ASA Status 2:** Mild systemic disease (dehydration, azotemia)- Not increased risk
- **ASA Status 3:** Systemic disease that is not incapacitating (anemia, renal insufficiency, endocrine disease, mild heart disease)
- **ASA Status 4:** Patients with disease compromising their health and safety
- **ASA Status 5:** Patients who will not live more than 24 hours from their disease

15

Pre-operative blood work/testing

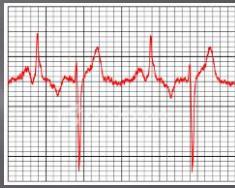
- Typically want full bloodwork/urinalysis done at some point before anesthesia
- Can run a “pre-op” panel before the actual procedure



16

Tests to run

- Blood pressure
- ECG
- Chemistry screen
- Complete blood count
- Electrolyte testing
- Coagulation parameters
- Urinalysis



17

Blood Pressure

- Many factors influence blood pressure:
 - Cardiac output
 - Heart rate
 - Vessel tone
- Patients (especially older) can be hypertensive from disease
- If hypertensive, consider postponing procedure
- Hypotension not a problem, as patient would be "shocky"



18

ECG

- 2-lead strip
- Can often identify any pre-anesthetic arrhythmias
- Important in patients with cardiac disease
- If arrhythmias present, most often refer to cardiologist for anesthetic recommendations



19

Chemistry screen

- Albumin
 - General nutritional health, many disease will cause low albumin
- BUN/Creatinine
 - Elevations in both may point to renal disease
- Calcium
 - Elevations can be indicative of serious disease
- Total Protein
 - Elevations from dehydration, decrease from fluid loss
- Liver enzyme tests (ALT, AST, GGT)
 - Can be elevated with liver diseases



20

Chemistry screen, cont.

- Total bilirubin
 - Gallbladder/Bile duct health
- Amylase/Lipase
 - Pancreatic health

21

Complete Blood Count

- RBC indices
 - Anemia
- WBC indices
 - Cancer, Infection, Inflammation
- Platelets
 - Coagulation disorders



22

Anesthesia machine anatomy

- Parts:
 - Oxygen flowmeter
 - Reservoir bag
 - Anesthetic circuit
 - One-way valves
 - CO₂ absorber
 - Scavenger system
 - Vaporizer
 - Pop-off valve
 - Manometer/Pressure gauge
 - Flush valve

23

Oxygen flowmeter



24

Reservoir bag



Should be 6x
Tidal Volume (10-
15ml/kg)

So 10kg dog:
TV = 150ml
Bag size: 900mL
(or 1L)

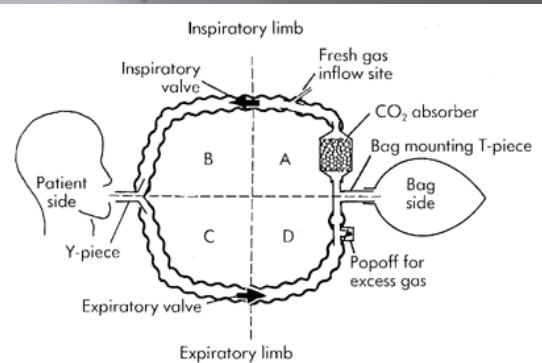
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Anesthetic circuit

- Non-rebreathing systems
 - Bain
 - Jackson-Rees
- Re-breathing/"Circle" systems
 - Y-circuit
 - Universal F-circuit
 - Can be closed, low-flow, or semi-closed
 - Has to do with pop-off valve and O2 flow
 - Most use semi-closed

26

Circle system vs. Non-rebreather



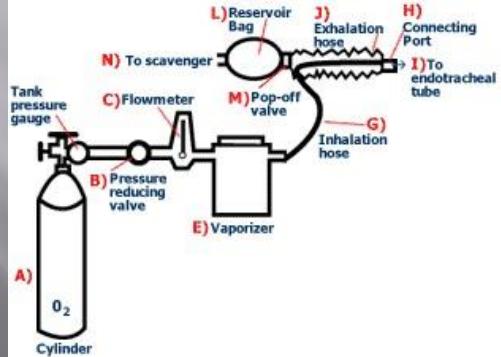
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How does it work?

- Patient inhales
- Gas travels from rebreathing bag, through CO2 absorber
- Travels through flowmeter and across vaporizer
- Travels out inspiratory valve to patient
- Patient exhales, breath goes down expiratory limb
- Passes through expiratory valve and into rebreathing bag

28

Why is it a “non” rebreathing?



29

Types of Non-rebreathers



Bain system



30

Non-Rebreathers

- ◻ Less than 10-15 kg
- ◻ Fresh gas delivered directly to patient
- ◻ Less resistance for smaller patients
- ◻ Relies on higher gas flows to clear CO₂

31

Types of rebreathing circuits

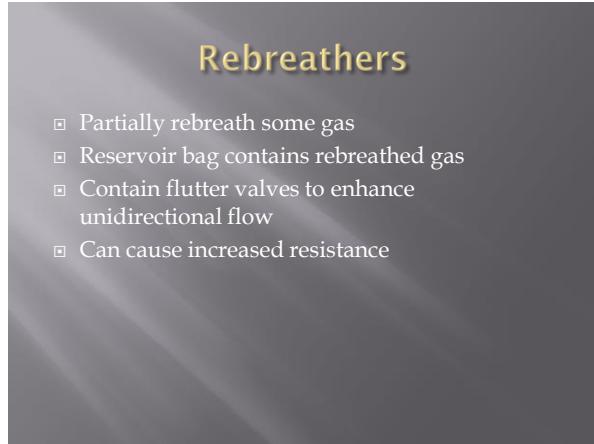
Universal F-Circuit



Adult Y-circuit



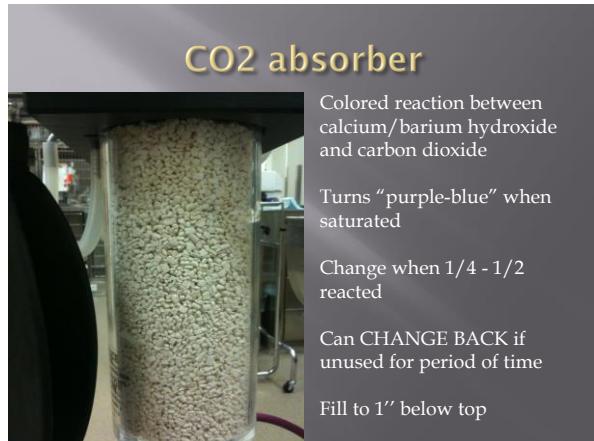
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36

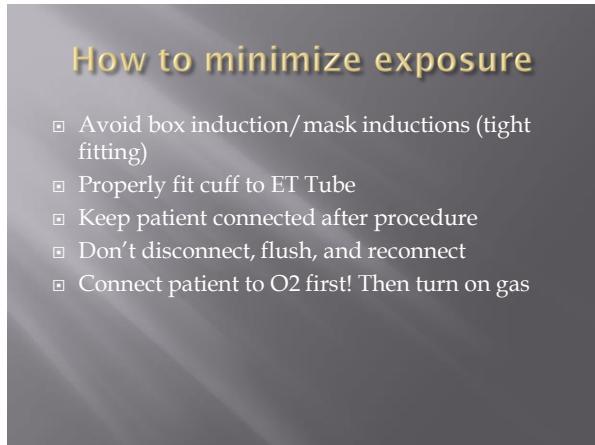


37

Waste Anesthetic Gases

- Most governing authorities suggest exposure be minimized
- Liver/Kidney/Neurologic effects
- Carcinogenic effects debated
- Main causes of excessive exposure:
 - No scavenger- #1 way to prevent WAG exposure
 - Leaky machines

38



39

Pop-off valve

Careful not to LEAVE closed!

Recommendation:
Keep hand on pop-off valve when its closed!

Only relieves pressure when open

40

Oxygen flush valve

- ❑ Delivers pure O₂ and bypasses vaporizer
- ❑ Used to “clear” system in case of emergency
- ❑ Provides flows from 30-70 L/hr
 - Can cause barotrauma
 - Use with caution!
- ❑ Never use when connected to non-rebreather
 - All flow goes into patient (some goes into reservoir bag with re-breather)



41

Manometer



42

Leak Test

- ❑ Close pop-off valve
- ❑ Turn on O₂
- ❑ Put finger over end of breathing tube
- ❑ Watch reservoir bag fill to 20-30 cmH₂O
- ❑ Turn off O₂
- ❑ Should hold for 10-30 seconds

43

After, we've “tested”, PLAN!

- ❑ Develop an anesthetic plan:
 - Understand procedure
 - Perform pre-anesthetic evaluation
 - Identify problems and plan for them
 - Select/calculate ALL drugs (pre-meds, induction)
 - Emergency drugs too!
 - Select monitoring
 - Select/inspect/test equipment first



44

Pre-Meds: Why do we use them?

- Relieve pre-anesthetic anxiety
- Provide sedation
- Begin analgesia
- Reduce amounts of harmful induction/ maintenance drugs
 - Propofol
 - Anesthetic gases
- Anti-cholinergics?????



45

Drugs

- Acepromazine
- Benzodiazepines
- Opioids
- Alpha-2 agonist
 - Dexmedetomidine
- Ketamine



46

Acepromazine

- Profound sedative/tranquilizers
- Can cause vasodilation/hypotension (dose-dependent)
- 15-30 min onset
- Can last 4-12 hours
- NO analgesia
- Not really correlated to increasing seizure risk
- Decreases PCV (Splenic sequestration)
- Not for use in critical care



Benzodiazepines

- Sedatives
- Can cause excitement if given alone
- Good with opioids
- Diazepam
 - Not compatible with other drugs
 - No IM use
- Midazolam
 - Compatible and IM ok
- Reversible
- No analgesia



47

48

Opioids-Pure mu

- ◻ Various classes:
 - Pure mu, Antagonist/Agonist, Antagonist
- ◻ Pure mu: Fentanyl, Hydro, Oxy, Morphine
 - Good analgesia
 - May cause excitement in cats if alone
 - Can cause panting/hypothermia/vomiting
 - Morphine NOT IV
 - Fentanyl too short acting



49

Opioids- Partial agonists

- ◻ Buprenorphine
 - Takes 30-45 min to kick in
 - Binds tightly with receptor
 - Not recognized for severe pain
- ◻ Butorphanol
 - Mild analgesia
 - Good sedation
 - Short acting (30 mins only)
- ◻ Butorphanol an option to reverse opioid dysphoria

50

Alpha-2 agonists

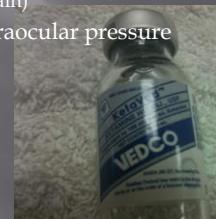
- ◻ Low-doses seem to provide good effects and LESS bad effects
- ◻ Hypertension (Bradycardia reflexive)
 - Not to treat with anticholinergics
- ◻ Peripheral vasoconstriction
- ◻ Some analgesia
- ◻ Reversible



51

Ketamine

- ◻ Short acting dissociative
- ◻ Muscle rigidity
- ◻ Some analgesia (not primary)
 - Not visceral (organ pain)
- ◻ Increase ICP and intraocular pressure
- ◻ Sympathomimetic:
 - Increased HR and BP



52

Atropine vs. Glyco

- ❑ Reasons to use:
 - Prevents vagal tachycardia
 - Decreases "secretions"
 - Pediatrics
 - Brachycephalics
- ❑ Reasons not to use:
 - May not work on non-vagal tachycardias
 - Shock, Hypothermia, hypovolemia
 - Decreases GI motility
 - Can cause reflex tachycardia
- ❑ Atropine for emergencies
- ❑ Glyco: Slower onset/Longer duration of action
 - Less arrhythmogenic

53

54

"Kitty Magic"

- ❑ Combo of Opioid, Ketamine, Alpha-2
 - Hydromorphone/Ketamine/Dexdomitor
 - DKT = Domitor, Ketamine, Torb
- ❑ Great sedation, Great analgesia
 - Profound cardiovascular effects
 - ONLY for healthy patients!



Induction period

- ❑ Gather appropriate induction drugs
- ❑ Gather appropriate airway device
- ❑ Gather ancillary equipment
 - Laryngoscope
 - Stylette



55

56

Induction period

- ❑ Pre-oxygenate
 - Apnea, hypoventilation, arrhythmias, difficult/prolonged intubation
 - Multiple sources cite easy and safety
- ❑ Administer drugs/drug cocktail
- ❑ Assess depth/readiness for intubation

Induction drugs

- ❑ Benzodiazepines (Diazepam, Midazolam, Zolazepam)
- ❑ Cyclohexamines (Ketamine, Tiletamine)
- ❑ Propofol
- ❑ Etomidate
- ❑ Barbiturates
- ❑ Opioids

57

Cyclohexamines

- ❑ CNS stimulants
- ❑ Dissociative state ("trance")
- ❑ Muscle rigidity
- ❑ HR/BP increase
- ❑ Apneustic breathing
- ❑ Increase in intraocular pressure/ICP
- ❑ Hypersensitive recovery



58

Propofol

- ❑ Own class: Rapid onset, metabolism
- ❑ CV/RR depressant (vasodilation, decreased contractility)
- ❑ Anemia in cats (repeated use)
- ❑ Decreases ICP and intraocular pressure
- ❑ Susceptible to microbial growth-d
- ❑ Extra/intrahepatic metabolism



59

Opioids

- ❑ Opioids + Sedative = Neuroleptanalgesia
- ❑ Can provide adequate sedation in critical animals
- ❑ Minimal CV effects
- ❑ Analgesia effects als



60

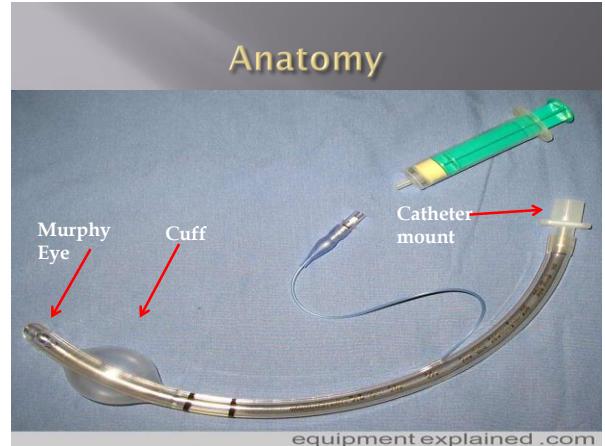
Intubation

- ❑ ET Tubes come in various sizes/styles/shapes
- ❑ Parts:
 - ❑ Tube, Cuff, Murphy Eye
- ❑ Tube, Cuff, Murphy Eye

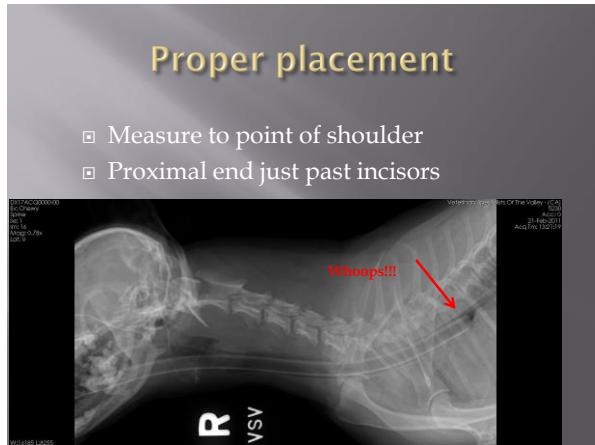


www.tigerhomes.org

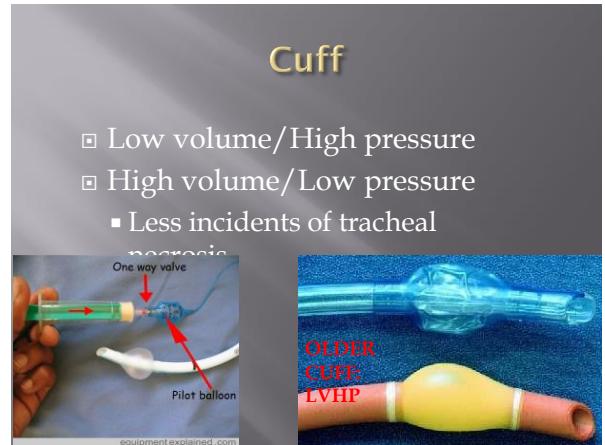
61



62



63



64

Filling cuff

- ❑ Procedure:
- ❑ Turn on O₂ and connect to patient circuit
- ❑ Close pop off valve
- ❑ Slowly inflate cuff and check for seal
- ❑ If any leak heard, slowly administer more air
- ❑ Inflate until NO leak

65

After drugs....

- ❑ Hook up to machine
- ❑ Proper way:
 - Turn O₂ on first
 - Connect to patient circuit
 - Then turn vaporizer on!
 - Minimize waste gas exposure



66

Flowrates, review

- ❑ Non-rebreathing:
 - 100-300ml/kg/min
 - 6kg cat: 6kg × 300 = 1.8L/min
- ❑ Rebreathing:
 - Semi-closed:
 - 22-44ml/kg/min
 - 35kg dog: 35 × 44 = 1.5L/min

67

Anesthetic planes

- ❑ Stage 1: Induction to unconsciousness
- ❑ Stage 2: Unconsciousness but not surgical plane
- ❑ Stage 3: Surgical planes
 - Plane 1: Too light
 - Plane 2: Surgical plane
 - Plane 3: Too deep
- ❑ Stage 4: Too deep/anesthetic emergency

68

Anesthesia monitoring

- ❑ Ears, Eyes, Hands
- ❑ Stethoscope
- ❑ Feel pulses
- ❑ Check MM's/CRT/Tongue color
- ❑ Look at respiration effort/rate
- ❑ Touch: Reflexes



69

Reflexes

- ❑ Toe pinch
- ❑ Jaw tone
 - Positive- Light anesthesia
 - Negative- Surgical and Deep
- ❑ Eyeball position
 - Central-light
 - Ventromedial-Adequate
 - Central-Deep
 - May not change if use Ketamine

70

Gas anesthesia

- ❑ How do they work?
- ❑ Inhaled
- ❑ Pass into alveolus/capillaries
- ❑ Blood levels achieved
- ❑ CNS effects debated



71

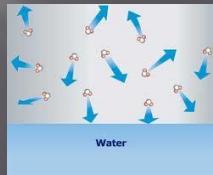
Factors that influence

- ❑ MAC:
 - Minimum alveolar concentration
 - Concentration produces anesthesia in 50% of patients
 - Measure of potency...
 - Low MAC = Higher potency
 - Iso more potent than sevo

72

Factors that influence

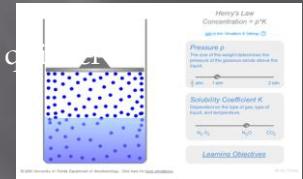
- Vapor pressure:
 - Rate at which liquid turns to gas
- “Quickness of delivery”
- Sevo > Iso



73

Factors that influence

- Solubility co-efficient
 - Lower the number, quicker dissolves into bloodstream
- Sevo < Iso
- Sevo dissolves quickly



74

Isoflurane

- MAC:
- Canine: 1.28
- Feline: 1.63
- Vapor pressure: 240
- Twice as soluble as Sevo



75

Sevoflurane

- MAC:
 - Canine: 2.1
 - Feline: 2.6
- Vapor pressure: 157
- Half as soluble as Iso



76

Sevo vs. Iso

- ❑ Sevo will dissolve quicker, be metabolized quicker
- ❑ Will take more % of Sevo to anesthetize a patient

77

Gas anesthetic risks

- ❑ All cause dose-dependent:
- ❑ Vasodilation
- ❑ Cardiovascular depression
- ❑ Most potent vasodilators in your arsenal!!!!

78

Vaporizer setting

- ❑ Combination of MAC and patient depth
- ❑ Depending on protocol used, can lower vaporizer to less than MAC
- ❑ Often 1.5 to 2x MAC
- ❑ Sevo: 2.5-4% for maintenance
- ❑ Iso: 1.5-2.5% for maintenance
- ❑ Premed, induction, epidural?...Iso at 0.8 for THR!!!

79

Quick tip

- ❑ Don't set vaporizer and walk away
- ❑ Take cues from patient/vitals to adjust as needed
- ❑ If need to lower depth....
 - Turn up flow rate!
- ❑ Flow rate decides "delivery" rate of gas

80

Monitoring

- ❑ ECG
- ❑ BP
- ❑ SPO₂
- ❑ ETCO₂
- ❑ Temperature



81

IV Fluids

- ❑ Important to maintain organ perfusion
- ❑ Drug carrier
- ❑ Counteract vasodilation from anesthetic drugs
- ❑ Standard of care
- ❑ 10ml/kg/hr surgical rate
- ❑ Can lower with heart disease



82

Recovery

- ❑ In literature, most critical time is during recovery
- ❑ Constant monitoring of vitals should occur
- ❑ Recommended to keep connected to 100% O₂ for few minutes after procedure
- ❑ Do not extubate until REALLY swallowing

83

Recovery procedure

- ❑ 1- Turn off inhalant
 - 5 minutes of 100% O₂
- ❑ 2- Turn off flowmeter
- ❑ 3- Place patient in warm dry bed
 - Continue non-invasive monitoring (spo₂, vitals, etc)
- ❑ 4- Monitor vitals at regular intervals, increase if sick
- ❑ 5- Delay extubation as long as possible
- ❑ 6-Observe/treat emergence delirium (breakthrough pain)
- ❑ 7-Remove IV catheter once fully alert

84

This is why we do this!

□ EMD



85