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1 CPD

WEBINAR

Going with the Flow:

Understanding Anaesthesia Breathing Systems

Speaker

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Veterinary anursethesia

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Jurox

- Anaesthesia Machine
  - Oxygen
  - Reservoir Bags
- Breathing Systems
  - Calculating FGF
  - How they work
  - Leak Testing
  - Selection

- Paediatric T-Piece
- Bain
- Mini Lack and Lack
- Circle
- Humphrey ADE

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The Anaesthesia Machine

www.ava.eu.com

Anaesthetic Safety Checklist

ASSOCIATION OF VETERINARY ANAESTHETISTS

Pre-Induction

- ☐ Patient NAME, owner CONSENT & PROCEDURE confirmed
- ☐ IV CANNULA placed & patent
- ☐ AIRWAY EQUIPMENT available & functioning
- ☐ Endotracheal tube CUFFS checked
- ☐ ANAESTHETIC MACHINE checked today
- ☐ Adequate OXYGEN for proposed procedure
- ☐ BREATHING SYSTEM connected, leak free & APL VALVE OPEN
- ☐ Person assigned to MONITOR patient
- ☐ RISKS identified & COMMUNICATED
- ☐ EMERGENCY INTERVENTIONS available

This checklist was written by the AVA with design and distribution support from Jurox

- 13,700kPa > 400kPA > ~10L/min (1-8kPa)
- Oxygen Flush = 30-70L/min

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The Anaesthesia Machine *– Leak Test*

1. Connect oxygen supply
2. Turn oxygen flow to 4L/min
3. Occlude common gas outlet
4. Bobbin should drop in flowmeter
5. The pressure relief valve may open (usually >30kPa of pressure)

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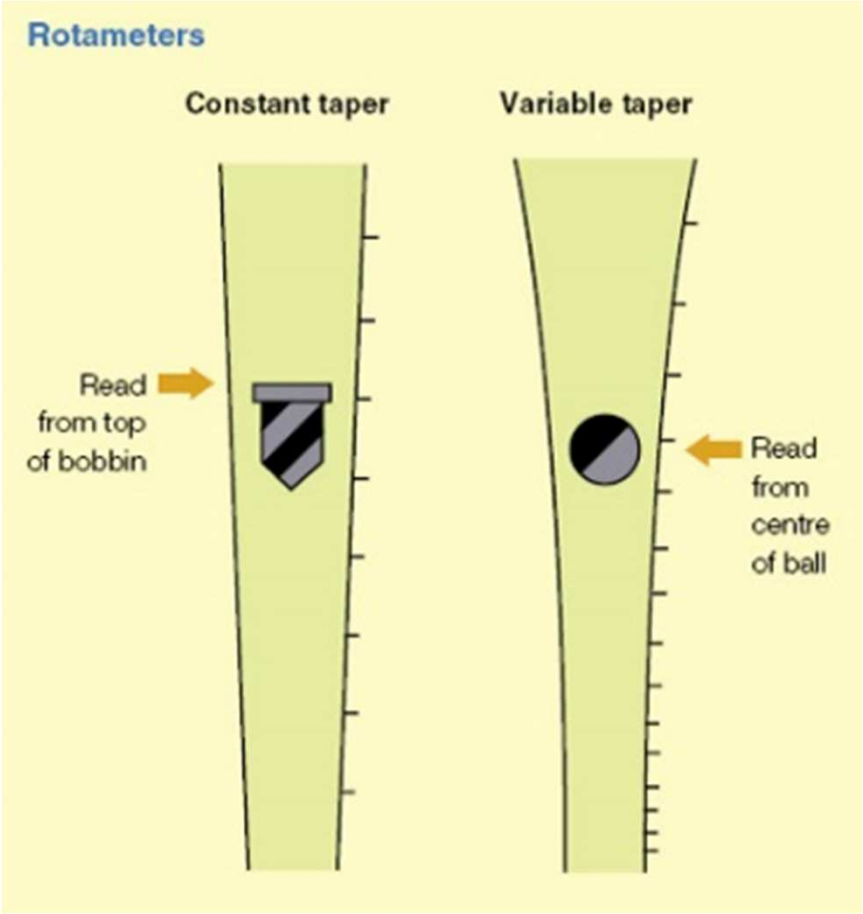
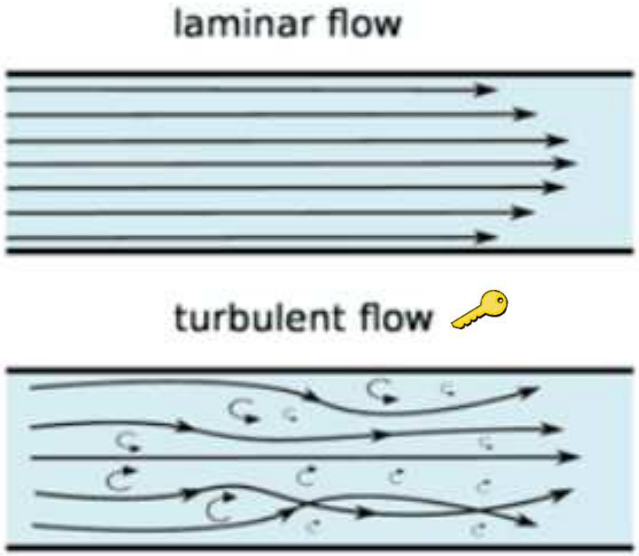
Flow Meters



www.frca.co.uk



www.nuclear-power.net

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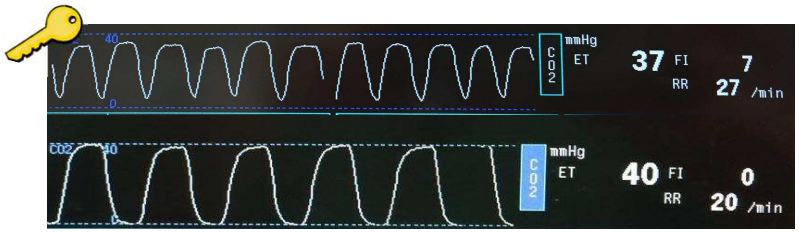
Fresh Gas Flow

- Always provide O_2
- Calculations over estimates – many factors

Minute **V**olume **C**ircuit **F**actor

Tidal **V**olume **R**espiration **R**ate

- Use capnography to reduce flow safely



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Fresh Gas Flow - calculation

Minute **V**olume ✖ **C**ircuit **F**actor

Tidal **V**olume ✖ **R**espiration **R**ate

10-20ml/kg

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Fresh Gas Flow *– shortcut!*

Minute **V**olume

200ml/kg/minute

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Breathing Systems - overview

- Deliver oxygen and volatile agent
- Remove carbon dioxide and waste gases
- Provide ventilation

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Breathing Systems: *types*

- <u>Non-Rebreathing</u> or <u>Rebreathing</u>

NRB
Constant Oxygen Flow

D
T Piece

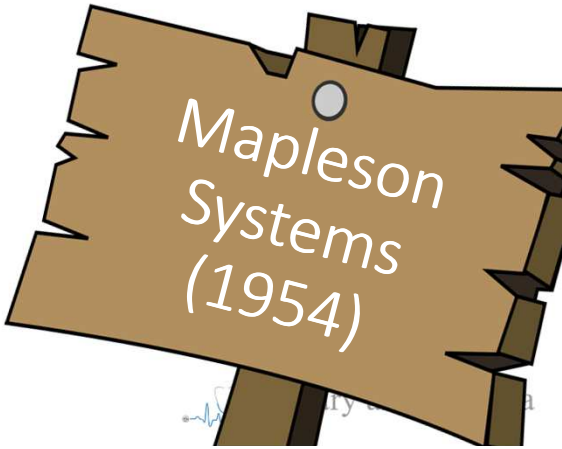
D
Bain

A
Lack

RB
Varied Oxygen Flow

Circle

Humphrey



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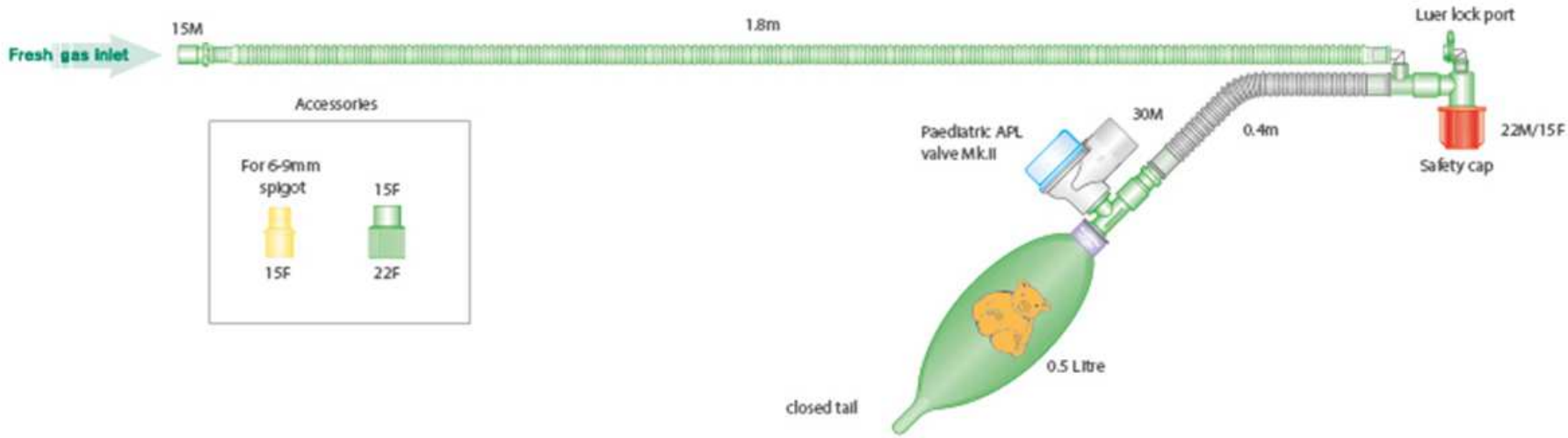
T Piece


15M
1.8m
Luer lock port
Fresh gas inlet
Accessories
For 6-9mm spigot
15F
15F
22F
Paediatric APL valve Mk.II
30M
0.4m
22M/15F
Safety cap
0.5 Litre
closed tail

T Piece

- Paediatric – ~~Ayres~~ or ~~Jackson-Rees~~
- Smaller patients
  - < 10kg
  - Low drag and dead space

✓ IPPV?

  - APL valve 35cmH_2O

500 – 600ml/kg/minute

CF
2.5 – 3
(1.5-2)

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T Piece – FGF Calculation

TV ✕ RR ✕ CF

MV

4.2kg Cat

= 63ml ✕ 18brpm = 1.1L/min (MV)

= 1.1L/min ✕ 2.5 = 2.8L/min

2.1L/min

500 – 600ml/kg/minute

CF
2.5 – 3
(1.5-2)

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T Piece – FGF Calculation

TV ✖ **RR** ✖ **CF**

MV

7.6kg Dachshund

= 114ml ✖ 12brpm = 1.4L/min (MV)

= 1.4L/min ✖ 2.5 = 3.5L/min

3.8L/min

500 – 600ml/kg/minute

CF
2.5 – 3
(1.5-2)

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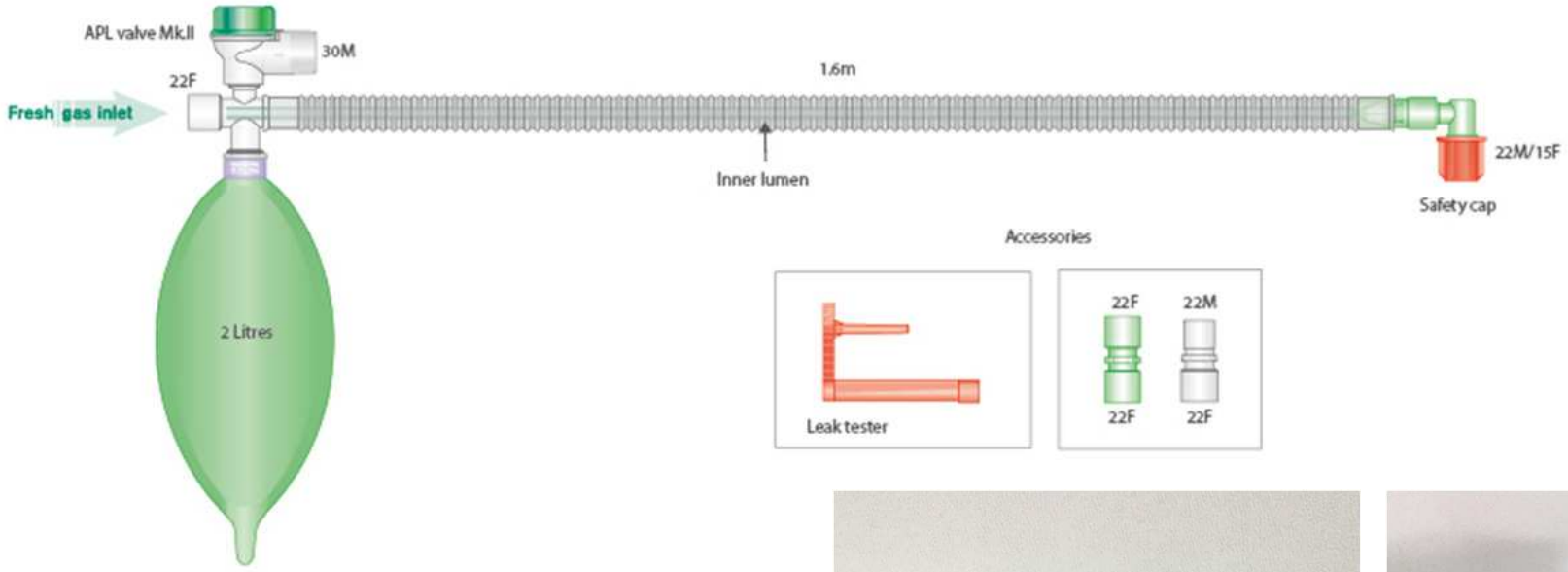
T Piece – Leak Test

1. Close APL valve
2. Occlude patient end with thumb
3. Fill up reservoir bag (with oxygen)
4. Gently squeeze bag to feel resistance
5. Forcefully squeeze to open the safety pressure relief valve
6. Open APL valve

Bain


APL valve Mk.II
30M
22F
Fresh gas inlet
1.6m
Inner lumen
22M/15F
Safety cap
2 Litres
Accessories
Leak tester
22F
22M
22F
22F

Bain

- Co-axial;
  - ➢ inner tube = inspiratory
  - ➢ outer = expiratory
- Any size patient
- ✓ IPPV?
  - ➢ Use lower FGF when doing IPPV

200 – 400ml/kg/minute

CF
2.5 – 3
(1 – 2)

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Bain – FGF Calculation

TV ✕ **RR** ✕ **CF**

MV

9.6kg Jack Russel

= 144ml ✕ 16brpm = 2.3L/min

= 2.3L/min ✕ 1 = 2.3L/min

= 2.3L/min ✕ 2.5 = 5.8L/min

1.9L/min

200 – 400ml/kg/minute

CF
2.5 – 3
(1 – 2)

Bain – FGF Calculation

TV × **RR** × **CF**

MV

34kg Labrador

= 340ml × 10brpm = 3.4L/min

= 3.4L/min × 1 = 3.4L/min

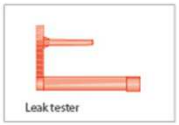
= 3.4L/min × 2.5 = 8.5L/min

2.8L/min

200 – 400ml/kg/minute

CF
2.5 – 3
(1 – 2)

Bain *– leak test inspiratory tube*

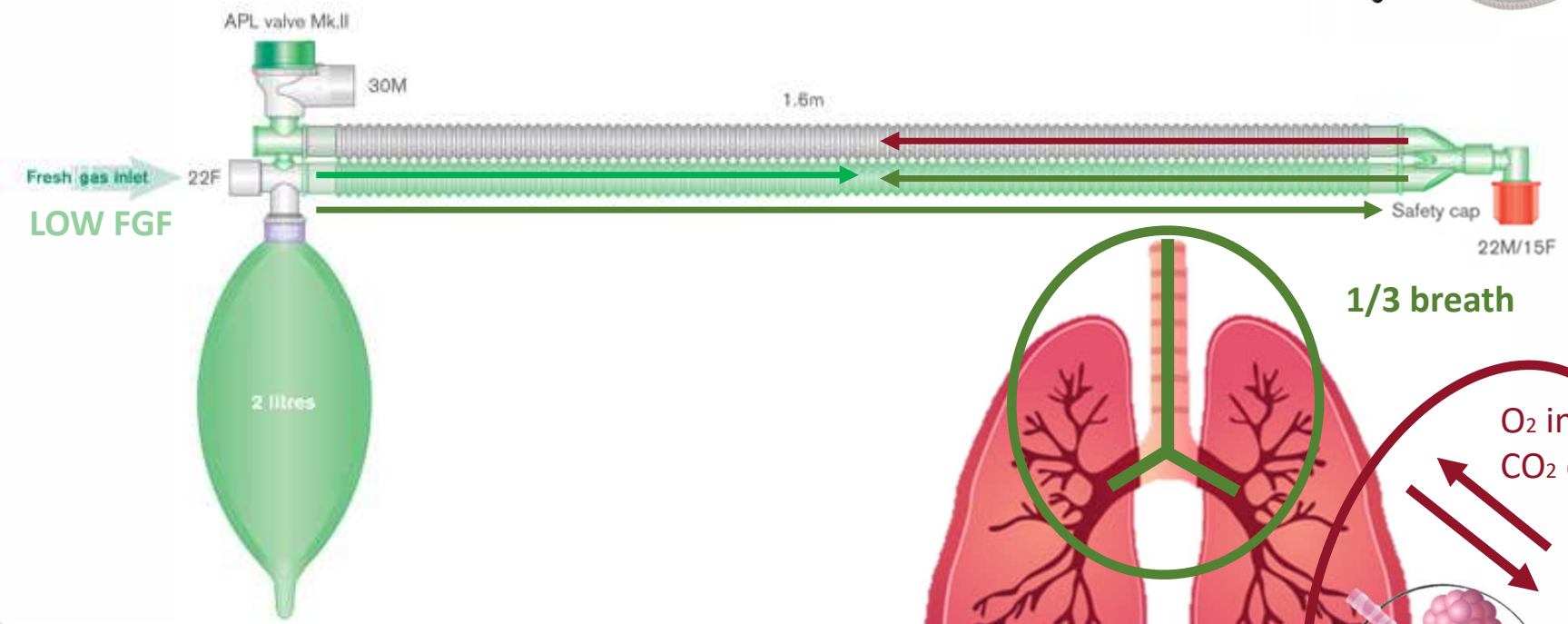


1. Visually inspect patient end that the inner tube is intact
2. Turn on oxygen flow to 4L/min
3. Use red adaptor, finger or 2ml syringe plunger to occlude inner tube
4. Bobbin should drop in flowmeter

Bain *– leak test expiratory tube*

1. Close APL valve
2. Occlude patient end with thumb
3. Fill up reservoir bag (with oxygen)
4. Gently squeeze bag to feel resistance
5. Open APL valve

Lack



1/3 breath

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Lack

- Rebreathing of dead space gases
- Parallel tubing;
  - Mini Lack 2-10kg (inc cats)
  - Lack >10kg
- IPPV
- Increase FGF

200ml/kg/minute

CF
1

Lack – FGF Calculation

TV ✕ **RR** ✕ **CF**

MV

3.8kg Cat

= 57ml ✕ 22brpm = 1.3L/min

= 1.3L/min ✕ 1 = 1.3L/min

0.8L/min

200ml/kg/minute

CF
1

Lack – FGF Calculation

TV × **RR** × **CF**

MV

19kg Springer Spaniel

= 190ml × 12brpm = 2.3L/min

= 2.3L/min × 1 = 2.3L/min

3.8L/min

200ml/kg/minute

CF
1

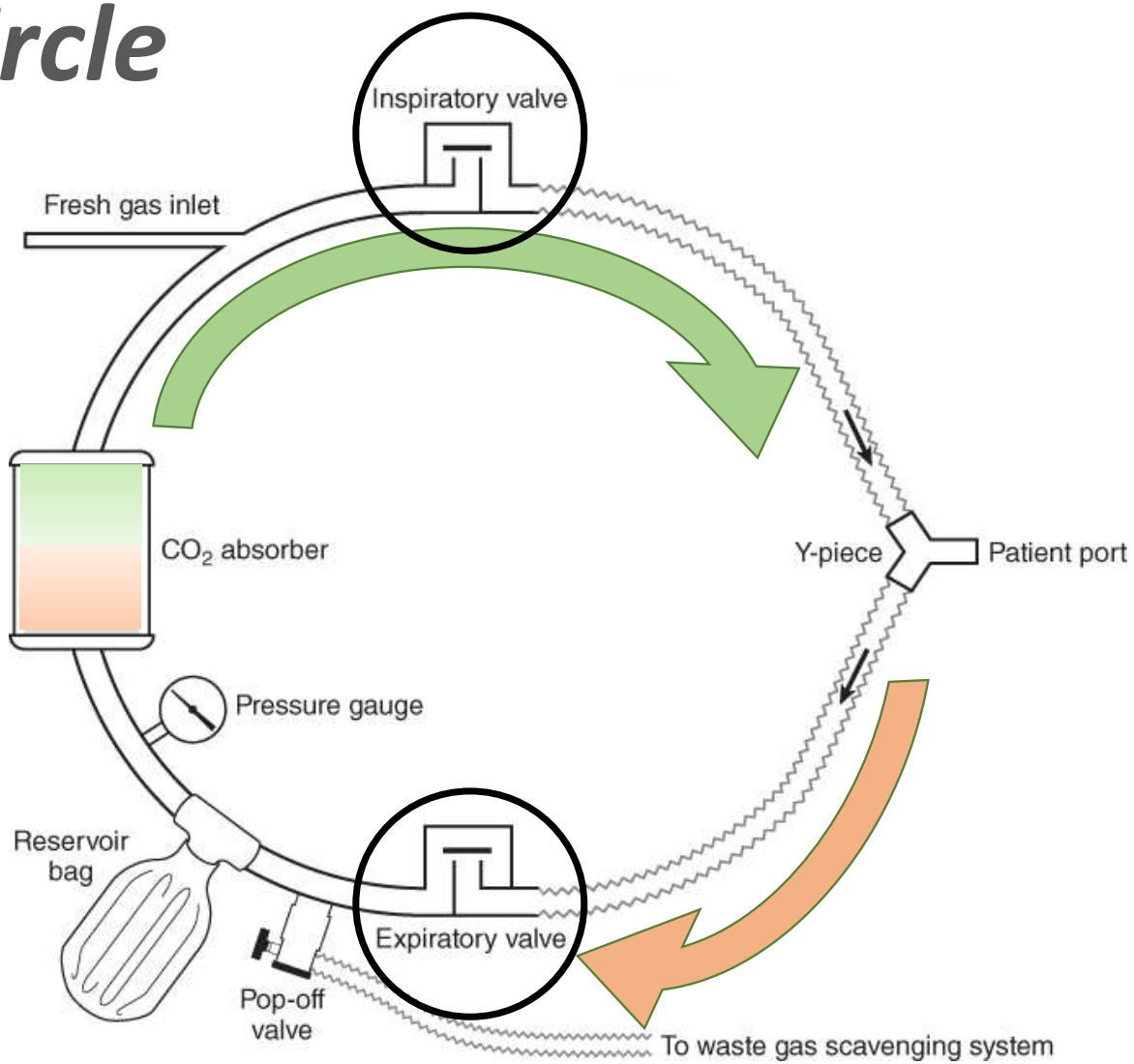
Lack *- leak test*

1. Close APL valve
2. Occlude patient end with thumb
3. Fill up reservoir bag (with oxygen)
4. Gently squeeze bag to feel resistance
5. Open APL valve

Non Rebreathing – summary

Pros	Cons
reliable conc.	gases are dry/cold
range of sizes	↑ O2 flow
↓resistance	↑ inhalant
disposable	↑ pollution

Circle



www.veteriankey.com

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Circle

- Very economical
- Different tubing
  - ➢ F circuit (co-axial) >10kg
  - ➢ Adult parallel >10kg
  - ➢ Paediatric parallel (cats to <10kg)
- ✓ IPPV?
- 🔑 Diluting system

100ml/kg/minute
0.5-1L/min

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Circle - Carbon Dioxide Absorber

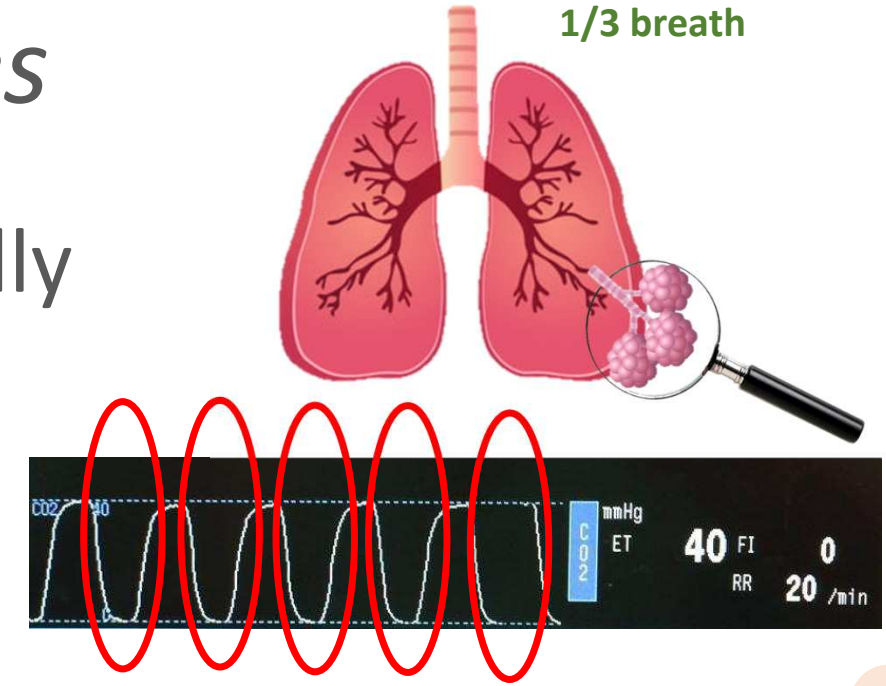
- Sodium hydroxide with calcium hydroxide
- CO_2 is removed by chemical reaction

1. $H_2O + CO_2 \rightarrow H_2CO_3$
2. $2H_2CO_3 + 2NaOH + Ca(OH)_2 \rightarrow CaCO_3 + Na_2CO_3 + 4H_2O$

- Reaction causes heat and moisture
- Change when re-breathing seen
  - ➢ When?

Circle – Flow Rates

- High FGF rate initially
  - ➢ De-nitrogenation
  - ➢ Saturate system
- Lower FGF rate
  - ➢ 10ml/kg/min
  - ➢ Usually 0.5-1L/min



100ml/kg/minute for 10 minutes
0.5-1L/min

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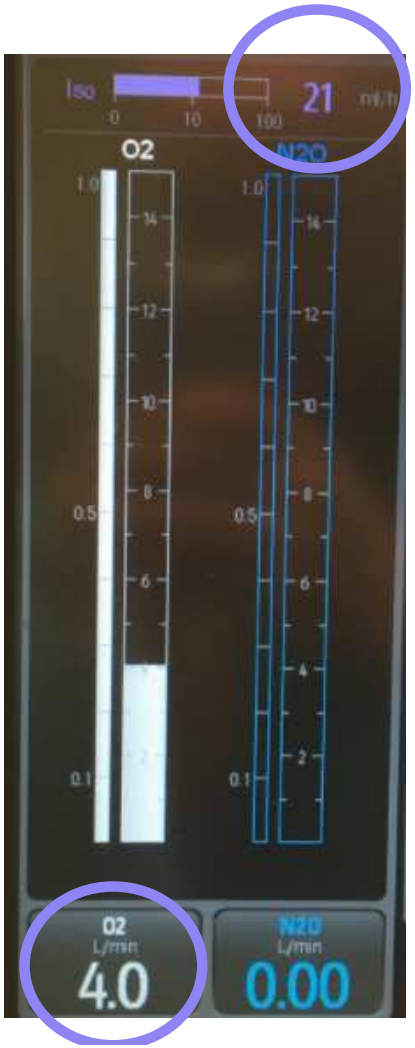
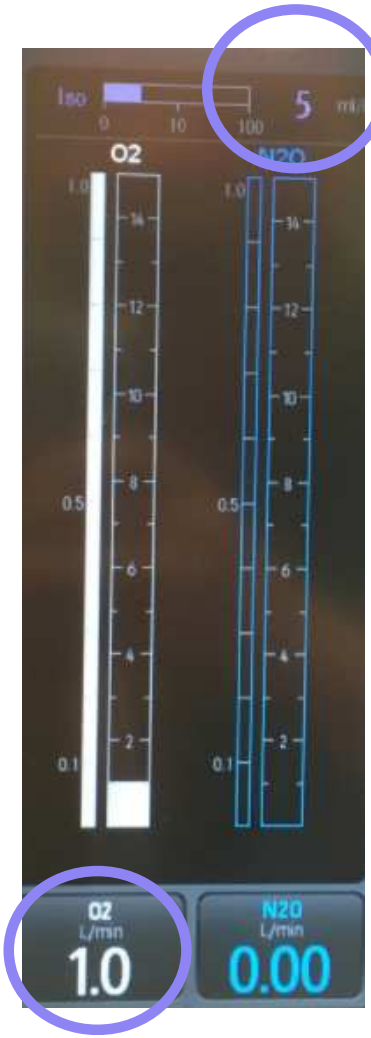
Circle – Flow Rates and volatiles!

11 hours use from a 250ml bottle of isoflurane





50 hours use from a 250ml bottle of isoflurane

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Circle - leak test

1. Close APL valve
2. Occlude patient end with thumb
3. Fill up reservoir bag (with oxygen)
4. Gently squeeze bag to feel resistance
    a. Ensure one-way valves flutter
5. Open APL valve and squeeze bag empty before releasing occlusion at patient end

Humphrey ADE (+ circle)

www.anaequip.com/ade

Humphrey ADE (+ circle)

A CF 0.5

- 15mm smooth bore tubing
- Leaver up – A = Like a Lack 
- Leaver down – D/E = Like a T-Piece (vent)
- ✓ IPPV?
- 1cmH_2O PEEP, pressure relief at 60cmH_20
- Can add carbon dioxide canister (circle)

0.5-1L/min, then
0.3-0.5L/min

T Piece

Bain

Lack

Circle

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Humphrey ADE – changing modes

- Leaver up – A = Like a Lack
- Leaver down – D/E = Like a T-Piece (vent)

A	D
Lack	T Piece

Humphrey ADE - leak test

1. Close APL valve
2. Occlude patient end with thumb
3. Fill up reservoir bag (with oxygen)
4. Gently squeeze bag to feel resistance
5. Open APL valve

Humphrey "Circle" - leak test

1. Close APL valve
2. Occlude patient end with thumb
3. Fill up reservoir bag (with oxygen)
4. Gently squeeze bag to feel resistance
5. Open APL valve and squeeze bag empty before releasing occlusion at patient end

Circle – Summary

Pros	Cons
↓waste gas	↑ resistance
↓ inhalant cost	slow conc. change
warms, humidifies	many parts
2 tube sizes	monitoring

Breathing Systems *- selection*

- Patient weight
- Patient breed
- Length of Procedure
- ?IPPV

Breathing Systems *- storage*

- Hang up at the end of the day
- Dispose of often
- Clean often - weekly

An investigation of the bacterial contamination of small animal breathing systems during routine use

May 2007 · Veterinary Anaesthesia and Analgesia 34(3):190-9

DOI: 10.1111/j.1467-2995.2006.00320.x

Source · PubMed

Ludovic Pelligand · Richard Hammond · Andrew N Rycroft

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Reservoir Bags

- <u>Reservoir</u>
  - ➢ Accommodates changes of airflow
  - ➢ Accommodates excessive pressure
- Hold at least two TVs
- Visualise breathing
- IPPV
- Hang to dry

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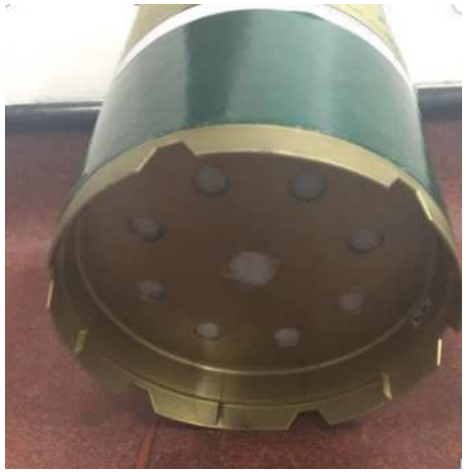
Scavenging

- Passive (absorbers)
  - ➢ Weigh daily
  - ➢ Below APL/patient level
  - ➢ Keep away from heat
  - ➢ Sit on flat surface
- Passive (out of building)
- Active (powered)



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Oxygen *- Concentrators*

1. Pulls room air
2. Removes nitrogen
3. Concentrates oxygen

- Zeolite sieve
- Filter
- Oxygen backup

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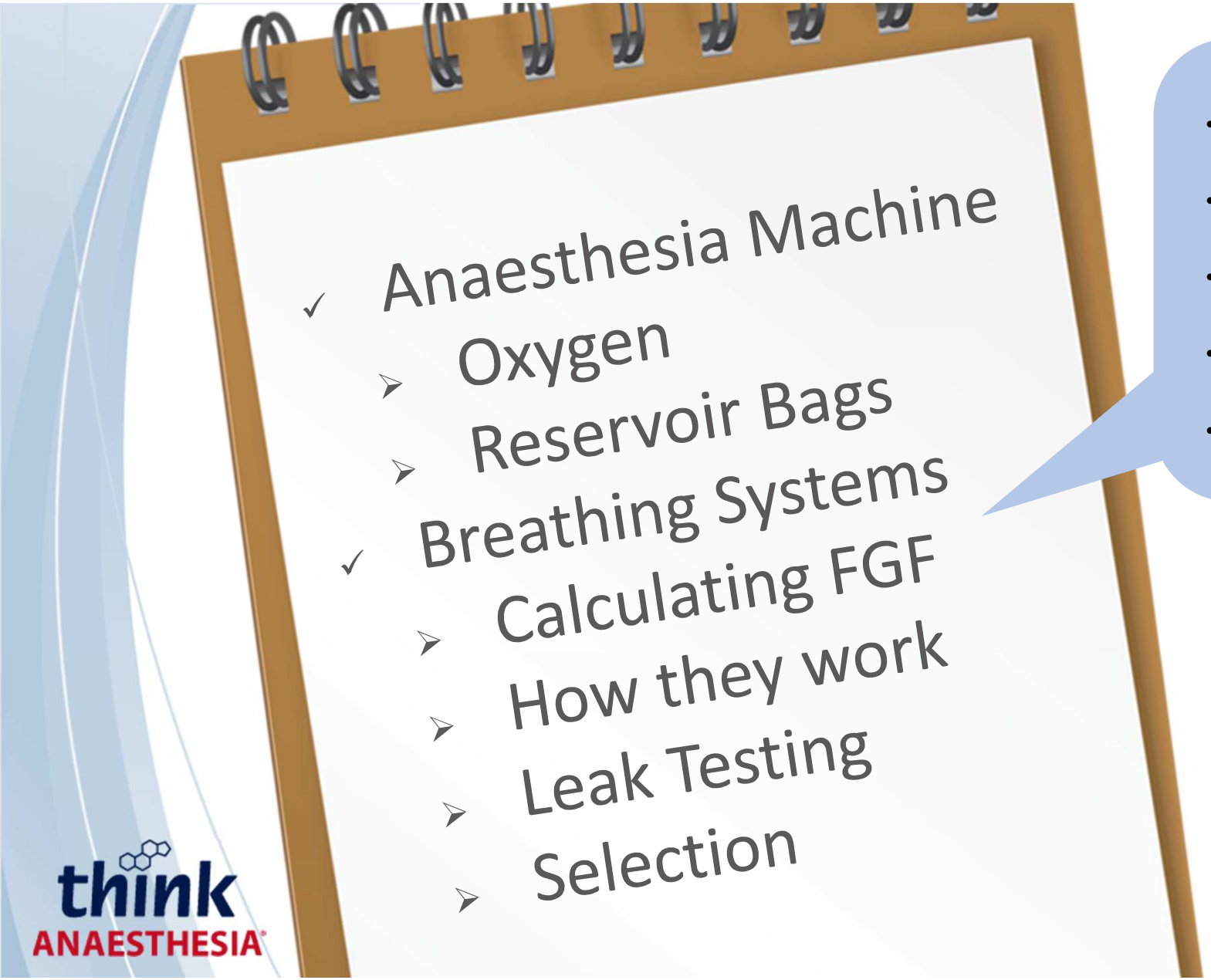

- Paediatric T-Piece
- Bain
- Mini Lack and Lack
- Circle
- Humphrey ADE

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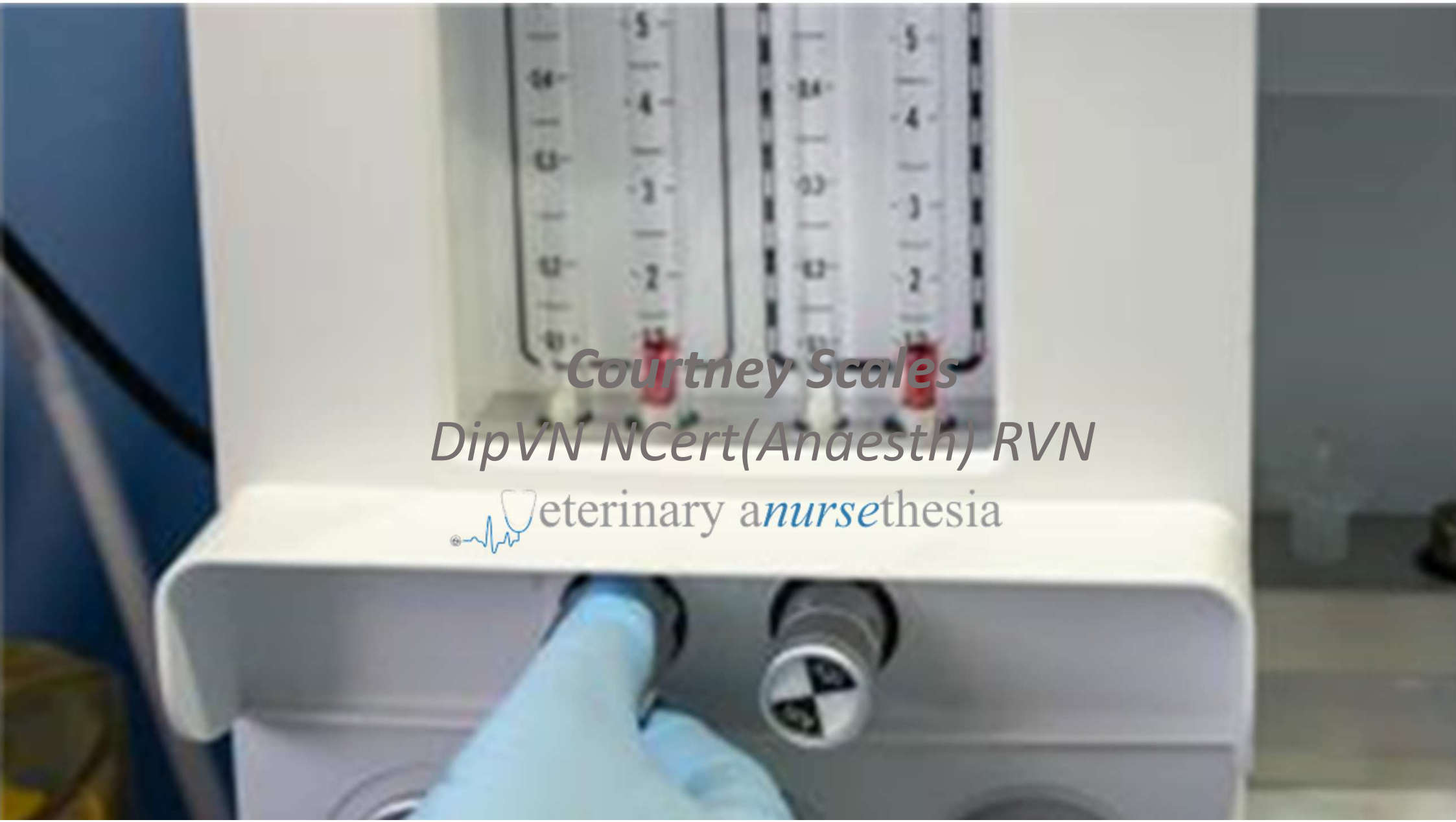
Courtney Scales
DipVN NCert(Anaesth) RVN
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