

What to Do When Anesthesia and Surgery Don't Go As Planned

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Discussion points

- **What anesthetic concerns or complications can we plan for?**
 - o preoperative
 - o intraoperative
 - o postoperative
- **Perioperative monitoring essentials**
 - o physical examination
 - o hemodynamic monitoring
 - o maintenance of normal physiological parameters
- **Common interventions and critical thinking skill development case based discussion**
 - o $MAP = CO \text{ (cardiac output)} \times SVR \text{ (systemic vascular resistance)}$
- **Case Examples and Q & A**

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American Society of Anesthesiologists (ASA) Physical Status Scale

ASA I

- Minimal Risk - Normal healthy animal, no underlying disease

ASA II

- Slight risk, minor disease present - Animal with slight to mild systemic disturbance, animal able to compensate; Neonate or geriatric animals, obese

ASA III

- Moderate risk, obvious disease present - Animal with moderate systemic disease or disturbances, mild clinical signs; Anemia, moderate dehydration, fever, low-grade heart murmur or cardiac disease

ASA IV

- High risk, significantly compromised by disease - Animals with preexisting systemic disease or disturbances of a severe nature; Severe dehydration, shock, uremia, or toxemia, high fever, uncompensated heart disease, uncompensated diabetes, pulmonary disease, emaciation

ASA V

- Extreme risk, moribund - Surgery often performed in desperation on animal with life threatening systemic disease; Advanced cases of heart, kidney, liver or endocrine disease, profound shock, severe trauma, pulmonary embolus, terminal malignancy

E denotes emergency

Source: <https://www.avtaa-vts.org/asa-ratings.pml>

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RECOVER - CPR Emergency Drugs and Dosages

DRUG	DOSE	Weight (kg)										
		2.5	5	10	15	20	25	30	35	40	45	50
Epi Low (1:1000, 1mg/ml) every other 30s cycle x3	0.01 mg/kg	0.03	0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5
Epi High (1:1000, 1mg/ml) for prolonged CPR	0.1 mg/kg	0.25	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
Vasopressin (20 U/ml)	0.8 U/kg	0.1	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2
Atropine (0.04 mg/ml)	0.04 mg/kg	0.2	0.4	0.8	1.1	1.5	1.9	2.2	2.6	3	3.3	3.7
Amiodarone (50 mg/ml)	5 mg/kg	0.25	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
Lidocaine (20 mg/ml)	2 mg/kg	0.25	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
Naloxone (0.4 mg/ml)	0.04 mg/kg	0.25	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
Flumazenil (0.1 mg/ml)	0.01 mg/kg	0.25	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
Atipamezole (5 mg/ml)	100 ug/kg	0.06	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
External Defib (J)	4-6 J/kg	10	20	40	60	80	100	120	140	160	180	200
Internal Defib (J)	0.5-1 J/kg	2	3	5	8	10	15	15	20	20	20	25

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STAGES and PLANES of Anesthesia

Anesthetic level	Reaction to surgical stimulation	Muscle tone (jaw)	Palpebral reflex	Eye and pupil position	Ventilatory rate	Heart rate
Stage I	+		+		N	N
Stage II	+		+		↑	↑
Stage III Light	±		+		N ↑	N ↑
Medium	-		-		N ↓ Intercostal lag	N ↓
Deep	-		-		Abdominal slow shallow	↓↓
Stage IV	Ventilatory and cardiac arrest					

Source: <https://veteriankey.com/inhalant-anesthesia-and-inhalant-anesthetics/>

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Planning for perianesthetic complications

- **Comorbidities**
 - Renal, cardiac, liver, respiratory, GI, endocrine, urogenital, neurologic, etc.
 - *Anxiety
 - Create protocol that favors supporting underlying diseases
- **Drug-induced**
 - Inhalants, opioids, sedatives, induction agents, dissociative agents, etc.
 - Create multimodal protocol to minimize adverse effects of drugs
 - Create plan for interventions when adverse effects occur
- **Procedure-induced**
 - Pain, hemorrhage, patient positioning, hypothermia, aspiration
 - Create protocol that prevents procedure-induced complications

**BY FAILING
TO PREPARE,
YOU ARE
PREPARING
TO FAIL.**

BENJAMIN FRANKLIN

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Case Discussions



Case #1
Ovariohysterectomy



Case #2
Small Intestinal Foreign Body



Case #3
Pyometra

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Puppy Spay time

Signalment

- 5-month old, Cavapoo

Vitals

- Weight (Wt): 5 kg
- Temperature (Temp): 100.8 F
- Heart Rate (HR): 140 bpm
- Respiratory Rate (RR): pant
- Mucous Membranes (MM): pink
- Capillary refill time (CRT): <2 sec

Pre-op

- Fasting: 10+ hrs

Intra-op

- OVH

Post-op

- Recovery
- TGH

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Planning for Complications

Signalment

- Pediatric
 - Blood pressure relies on HR - risk for hypotension
 - Minimal glycogen stores, poor gluconeogenesis - risk for hypoglycemia
 - Minimal fat, larger body surface area to mass ratio - risk for hypothermia

Vitals

- Maintain normal physiological parameters

Pre-op

- Fasting: increased risk of hypoglycemia
- Recommended fast 4-6 hours

Intra-op

- Pain
- Monitor glucose
- Hemodynamic monitoring (HR, BP, temperature)

Post-op

- Analgesia
- Normal physiological parameters
- E-collar, continued analgesia, rest

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QUESTION 1

During anesthesia this patient received a pure mu agonist for surgical pain control. The patient is currently bradycardic and hypotensive. Physical assessment reveals a moderate jaw tone, ventromedial eye position, and negative palpebral reflex. Which scenario below is most likely?



A. The patient is in pain and requires more anesthetics.
 B. The patient is hypovolemic and requires fluid resuscitation.
 C. The patient is experiencing opioid-induced bradycardia and requires an anticholinergic.
 D. The patient is hyperthermic and requires active cooling.

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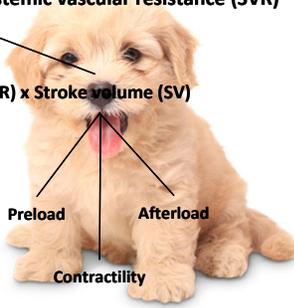
MEAN ARTERIAL PRESSURE

MAP: Mean arterial pressure
 CO: Cardiac output
 SVR: Vascular tone
 HR: Beats per minute
 Stroke volume: Ejected blood volume
 Preload: End diastolic volume (blood volume returned to heart during diastole - "stretch")
 Afterload: Arterial pressure (ventricular muscle pressure required during systole - "squeeze")
 Contractility: Strength of cardiomyocytes to contract during systole

MAP = CO x systemic vascular resistance (SVR)

Heart rate (HR) x Stroke volume (SV)

Preload Afterload
 Contractility



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Bradycardia effects on blood pressure

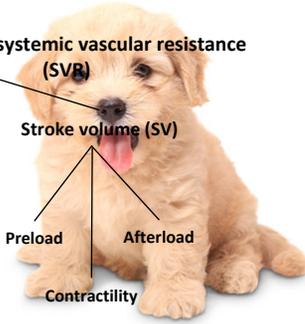
Answer:
 C. The patient is experiencing opioid-induced bradycardia and requires an anticholinergic

Why:
 Decreased HR will decrease the CO, thereby decreasing MAP.

MAP = CO x systemic vascular resistance (SVR)

Heart rate (HR) Stroke volume (SV)

Preload Afterload
 Contractility



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Unplanned Complication

Post-op

- Unresponsive mentation
- HR 200 bpm
- MM pale
- Unable to obtain blood pressure
- Temp 97.2 F

What is happening!?!?!?

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QUESTION 2

This patient is in recovery for 2 hours. Physical examination reveals dull mentation, tachycardic, pale, hypothermic and hypotensive. Which scenario below is most likely occurring?

1. The patient is in pain and requires more analgesics.
2. The patient is hypovolemic and requires fluid resuscitation.
3. The patient is hypothermic and requires rewarming.
4. The patient is too sedate and requires reversals.



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Hypovolemia effects on blood pressure

Answer:
B. The patient is hypovolemic and requires fluid resuscitation.

Why:
Decreased intravascular volume decrease preload (i.e. blood volume returning to the heart), which then decreases stroke volume, thereby decreasing CO and MAP.

Fluid resuscitation options:

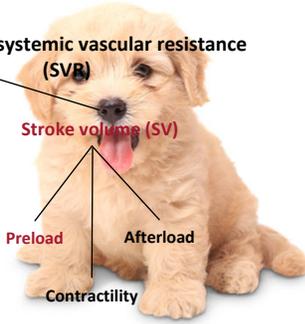
- Crystalloid shock bolus (90ml/kg) administered in increments ¼ - ½ dose.
- PRBC transfusion if blood loss is present dose 10-15ml/kg.

MAP = CO x systemic vascular resistance (SVR)

Heart rate (HR) Stroke volume (SV)

Preload Afterload

Contractility



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Where's the Minion?

Signalment

- 3-year old, Bernese Mountain Dog

Vitals

- Wt: 45 kg
- Temp: 100.8 F
- HR: 160 bpm
- RR: pant
- MM: tacky
- CRT: 2-3 sec

Pre-op

- Fasting: none
- 3-day history of vomiting
- Small intestinal obstruction

Intra-op

- Abdominal explore

Post-op

- Recovery
- TGH



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Planning for Complications

- Signalment
 - ASA III
- Vitals
 - Tachycardia likely compensation due to dehydration and/or pain
- Pre-op
 - No fasting and vomiting increases risk for aspiration
 - Fluid deficits increases risk for hypotension
 - Rapid induction
- Intra-op
 - Pain
 - Hypotension
 - Hemodynamic monitoring (HR, BP, temperature)
- Post-op
 - Analgesia
 - Regurgitation
 - Normal physiological parameters
 - E-collar, continued analgesia, rest

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Following induction



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Transferred to OR



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QUESTION 3

Under anesthesia this patient is tachycardic (with a normal sinus rhythm on ECG) and hypotensive. Physical assessment reveals a loose jaw tone, central eye position, and negative palpebral reflex. Which scenario below is most likely occurring?

- The patient is in pain and requires more anesthetics.
- The patient is hypovolemic and requires fluid resuscitation.
- The patient is hypothermic and requires rewarming.
- The patient is in a deep anesthetic plane and requires less anesthetics.



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Deep anesthetic plane effects on blood pressure

Answer:
D. The patient is in a deep anesthetic plane and requires less anesthetics.

Why:
Adverse effects of inhalants include decreased HR, SV (preload, afterload and contractility), and SVR.

MAP = CO x systemic vascular resistance (SVR)

Heart rate (HR) Stroke volume (SV)

Preload Afterload

Contractility

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Bolus finished

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Start of surgery

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QUESTION 4

Under anesthesia this patient is tachycardic (normal sinus rhythm on ECG) and hypertensive. Physical assessment reveals a tight jaw tone, ventromedial eye position, and positive palpebral reflex. Which scenario below is most likely occurring?

1. The patient is in pain and requires more anesthetics.
2. The patient is hypovolemic and requires fluid resuscitation.
3. The patient is hypothermic and requires rewarming.
4. The patient is in a deep anesthetic plane and requires less anesthetics.

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Hypovolemia effects on blood pressure

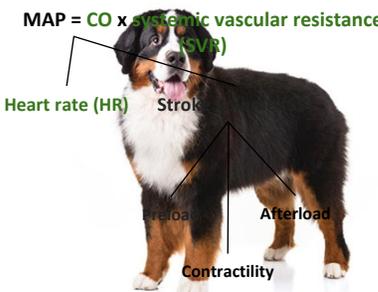
Answer:
B. The patient is in pain and requires more anesthetics.

Why:
Noxious stimulation causes increases in circulating catecholamines and adrenaline. This, in turn, increases HR and SVR, among other things.

MAP = CO x systemic vascular resistance (SVR)

Heart rate (HR) Stroke volume

Contractility Afterload



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The Minion has been found!



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The Emergency Spay

Signalment

- 6-year old, intact female, Pitbull mix

Vitals

- Wt: 35 kg
- Temp: 104.8 F
- HR: 165 bpm
- RR: 25 brpm
- MM: tacky, injected
- CRT: 2-3 sec
- Blood pressure: 100/55 (70) mmHg
- QAR mentation

Pre-op

- Fasting: none
- 3-day history of decreased appetite and lethargy
- 4hr history of vomiting
- Vaginal discharge

Intra-op

- OVH

Post-op

- Recovery
- TGH



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Planning for Complications

Signalment

- ASA IV
- Systemic inflammatory response syndrome (SIRS)

Vitals

- Tachycardia likely compensation due to dehydration, fluid shift due poor vascular tone, and/or pain
- Hyperthermia likely due to underlying infection/inflammation
- Borderline hypotension
- Check BG
- Injected MM - vasodilation

Pre-op

- No fasting and vomiting increases risk for aspiration
- Fluid deficits increases risk for hypotension
- Poor vascular tone increases risk for hypotension

Intra-op

- Pain
- Hypotension - positive inotrope, vasopressor, fluids
- Monitor BGs - dextrose for hypoglycemia
- Hemodynamic monitoring (HR, BP, temperature)

Post-op

- Analgesia
- Regurgitation
- Normal physiological parameters
- E-collar, continued analgesia, rest



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Infection/Trauma
e.g. due to perforation of intestinal tract by foreign body

SIRS
Inflammatory response
HR >160 bpm
RR >20 rpm
Temp <37.8°C / >39.7°C
White blood cell count: <4 000 or >12 000

Sepsis
SIRS and infection

Severe sepsis
Sepsis and organ damage

Septic shock
Severe sepsis and persistent hypotension

Source: <https://www.theveterinarynurse.com/patient-care/article/nursing-a-canine-in-septic-shock-a-patient-care-report>

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QUESTION 5

Under anesthesia this patient's HR is 100 bpm (normal sinus rhythm on ECG) and hypotensive. Physical assessment reveals a tight jaw tone, ventromedial eye position, and positive palpebral reflex. Which scenario below is most likely occurring?

- The patient is in a light anesthetic plane (based on physical assessment) and requires more anesthetics.
- The patient requires less inhalant agent (based on hypotension) to increase blood pressure.
- The patient requires a vasopressor or other injectable anesthetic (based on hypotension) to reduce inhalant requirement and increase SVR.
- All of the above

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Pain effects on blood pressure

Answer:
D. All of the above.

Why:
Inhalant agents cause dose-dependent vasodilation. When a patient is in a light anesthetic plane and hypotensive, the inhalant must be decreased and another agent must be added.
In the case of sepsis, reducing the inhalant may not be enough. Cytokines (proteins) released in response to systemic inflammation result in vasodilation, decreased systemic vascular resistance, and low BP.
A vasopressor such as norepinephrine or dopamine may be required to treat hypotension.

MAP = CO x systemic vascular resistance (SVR)

Heart rate (HR) → Stroke volume (SV) → Contractility

Prefload → Afterload

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Patient Planning: "Every patient, every time."

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QUESTIONS?



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Thank you!!!



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