Intraoperative Anesthetic Management

Module # 3

OBJECTIVE:

On completion of the module the resident should be able to:

1) Describe:

   a. The fluid management plan in this patient and in elders in general receiving spinal anesthesia.

   b. The unique intraoperative complications associated with orthopedic surgery.

   c. The problems associated with spinal anesthesia in the elderly patient.

   d. The pathophysiologic consequences of arterial tourniquets.

   e. Risk factors for the development of bradycardia and cardiac arrest during spinal anesthesia.

(If you have not reviewed Module # 2, please do so before attempting Module #3)

You are asked to develop an intraoperative anesthetic management plan for the following patient:

HISTORY:

78 y.o. EuroAmerican male.

Anticipated Procedure: R total Knee Arthroplasty

PMHx:

1. (R) hemisphere CVA 1998 patient has minimal LUE weakness presently.
2. Hypertension (well controlled)

History of MI, June 1999, Inf. MI, no angina or cardiac symptom since.

Surgical Hx:

1. Appendectomy 1948
2. Cholecystectomy 1977

Allergies: none

Medications: HCTZ/spironolactone 25mg/25mg 1 q day
Metoprolol 25 mg bid

Social Hx: married, nonsmoker stopped 1977, no alcohol

Functional status: Is unable to walk up a flight of stairs due to his knee problems

ROS;
General: negative (no nutritional problems, weight stable)
HEENT: vision and hearing are good, no dental problems, has own teeth
No neck problems.
Cardiac: negative
Pulmonary: negative
GI: mild constipation
GU: negative
MSK: the R Knee has some pain, all other joints are fine.
Skin: negative
Neurological: negative other than above.

PHYSICAL EXAM

VS: 130/76 – 60 – 12 – 98.7 WT. 70 KG
ENT: Teeth in good condition, airway class 1, mild decrease ROM of neck **Cardiac:** RR, no murmur 1+ peripheral edema
Pulm: CTA
Neuro: Motor: UE; symmetrical 4/5
LE; symmetrical 4/5 except proximal 3/5
Sensory: Intact to touch
Cranial nerves: WNL
Mental status; alert, attentive, shows evidence of good short term memory.

To review preoperative testing performed in module # 2 click on TESTING

TESTING

TEST	CORRECT?	RESULTS	RATIONALE
a) CBC	*Optional*	*WBC 6.9, Hgb 12.0, pltlets 180,000*	Pros*: Hgb can screen for anemia and baseline*[1]
			Cons*: Hgb level in healthy elderly who are ASA ≤ II was abnormal in 6.9% and did not affect outcome.*[2]
b) Electrolytes	*Optional*	*Na 139, K 4.1, Cl. 104, CO 28,*	Pros*: Patients with cardiovascular disease or on medications that can alter electrolytes and renal function*[1]
			Cons: *Electrolyte level in healthy elderly who are ASA ≤ II was abnormal in 5.8% and did not affect outcome.*[2]
d) EKG	*Yes*	*NSR, LVH. Non specific ST-T wave changes*	*EKG assist in preoperative risk assessment* [4] *& gives baseline*
f) CXR (PA & LAT)	*Yes*	*Mild cardiomegaly,*	*Pros: Indicated in cardiac or pulmonary dz.* [1],[5]
			Cons: Using guidelines[3] *only 1 in 2765 patients would have benefited from cxr preop.*
h) UA	*Yes*	*Negative except: 2 –5 WBC*	*Screen for infection*[1]
i) Bun/ Creatinine	*Optional*	*Bun 11, Cr. 0.9*	Pros*: Patients with cardiovascular disease or on medications that can alter electrolytes and renal function*[1]
			Cons: *Creatinine level in healthy elderly who are ASA ≤ II was abnormal in 3.2% and did not affect outcome.*[2]
DSE	*Yes*	*Negative for ischemia, EF 50%, no valvular disease, normal LV function*	*Indications for functional cardiac testing are:* *-intermediate risk factors* *-intermediate procedure risk* *-poor functional capacity*

[1]Routine preoperative studies, “Which studies in which patients? Surgical Clinics of North America Vol 76. No 1 Feb 1996

[2]The prevalence and predicative value of abnormal preoperative laboratory test in elderly surgical patients. Dzankic S. et al Anesth. Analg 2001;93:301-8

[3]Prospective assessment of a protocol for selective ordering of preoperative chest x-rays. Can J. Anaesth 35;259, 1988

[4]ACC/AHA Guideline update for perioperative cardiovascular evaluation for noncardiac surgery. Executive summary. J. Am College Cardiology Vol 39, No 3 2002

[5]Practice advisory for preanesthesia evaluation Anesthesiology 2002 96;185-96

return to case

You and the patient have chosen a spinal anesthetic. In preparation for this case you review some critical elements in management with regional anesthesia and encounter the following questions.

Question #1: The elderly may be at increased risk of developing hypotension following regional (central neuraxial) anesthesia due to which of the following?

(Choose as many answers as indicated)

- [ ] a) Pre-existing hypertension
- [ ] b) Reduced baroreceptor responsiveness
- [ ] c) Sympathetic blockade
- [ ] d) Pre-existing hypovolemia

Answers: a, b, c, d (all of the above)

Discussion:

Answer	Correct?	Rationale
a. Pre-existing hypertension	Yes	The loss of elasticity in the arterial tree often leads to hypertension in the elderly. This leads to a contracted blood volume. This relative hypovolemia becomes apparent with the onset of sympathetic blockade and vasodilation.
b. Reduced baroreceptor responsiveness	Yes	The baroreceptor response of increasing heart rate in response to hypotension is reduced in the elderly so they compensate poorly to the vasodilation caused by regional anesthesia. Elderly demonstrate less tachycardia in response to hypotension or hemodilution
c. Sympathetic blockade	Yes	Sympathetic blockade results in a decreased afterload which is poorly tolerated in the elderly. Reflex vasoconstriction in the upper extremities often does not adequately maintain preload and therefore cardiac output. Supplementing with vasopressors (ephedrine) or atropine may prevent spinal anesthesia-induced hypotension. *ASA Refesher Course Lecture: General vs regional anesthesia for the elderly patient. Raymond Roy, MD 1997 (#143). See Geriatric Resource Binder.*
d. Pre-existing hypovolemia	Yes	The elderly are at an increased risk of experiencing hypovolemia due to impaired thirst, laxative abuse, less reserve volume storage (reduced muscle mass), aggressive bowel preps, NPO status or an inability to concentrate the urine.

Continue the case

Q#2 After choosing regional (spinal) anesthesia for this case, which of the following are goals in fluid management? (Only one right answer)

- a) Maintaining a urine output of at least 1 cc/kg/hr during the case.
- b) Maintaining mean arterial pressure (MAP) within 20-30% of baseline.
- c) Preloading the patient with a minimum of 1000cc of crystalloid before placing the block.
- d) Avoiding postoperative fluid overload as the block wears off by prophylactically administering a diuretic such as lasix, even if the patient is asymptomatic.

Answer: b

Answer	Correct?	Rationale
a. Maintaining a urine output of at least 1 cc/kg/hr.	No	The goal should be a urine output of 0.5cc/kg/hr to prevent acute renal failure/acute tubular necrosis.
b. Maintaining mean arterial pressure (MAP) within 20-30% of baseline	Yes	Maintaining MAP within 20-30% of baseline ensures perfusion to the heart and brain. It is important to remember having an awake patient who is able to communicate also allows the ability to monitor for confusion or chest pain.
c. Preloading the patient with a minimum of 1000cc of crystalloid before placing the block.	No	It has been recommended that preloading the patient with <500cc of crystalloid (3cc/kg) and treating with vasopressors as needed prevents fluid overload in those at increased risk. *ASA Refresher Course Lecture: General vs regional anesthesia for the elderly patient. Raymond Roy, MD 1997 (#143) See Geriatric Resource Binder.*
d. Avoiding postoperative fluid overload as the block wears off by administering a diuretic such as lasix.	No	Although hypervolemia with recovery is associated with increased congestive heart failure or angina, prophylactic diuretic administration without monitoring of central venous volumes may result in hypovolemia/hypotension/electrolyte disturbances.

Continue the case

Question # 3: An arterial (thigh) tourniquet is used to reduce blood loss and provide good operating conditions for the surgeon. Which of the following statements about the systemic effects of deflation of arterial (thigh) tourniquets used during total knee arthroplasty are most likely true? (Choose as many answers as indicated)

- [ ] a) Deflation is associated with an increase in thrombolytic activity.

- [ ] b) Immediately after tourniquet release, oxygen consumption and carbon dioxide production are decreased.

- [ ] c) Deflation results in a temporary reduction in cerebral blood volume.

- [ ] d) Deflation causes a transient decrease in core temperature.

Answers: a, d

Answer	Correct?	Rationale
a. Deflation is associated with an increase in thrombolytic activity	**Yes**	**Tissue ischemia promotes the release of tissue plasminogen activator (TPA), activating the antithrombin III and thrombomodulin-protein C anticoagulant systems in the occluded limb. This causes a short-lived (30 min) systemic thrombolysis when the tourniquet is released.**
b.Immediately after tourniquet release, oxygen consumption and carbon dioxide production are decreased.	No	After 1-2 hours of ischemia, there is an increase in arterial plasma potassium and lactate and a transient decrease in arterial pH with deflation. Oxygen consumption and carbon dioxide production are increased by 55 and 80% respectively, 2 minutes after deflation, returning to baseline within 8 min.
c. Deflation results in a temporary reduction in cerebral blood volume.	No	The rapid increase in end-tidal carbon dioxide tension after deflation is associated with an increase in cerebral blood volume. This may contribute to brain injury in patients with increased ICP (can be prevented by hyperventilation in patients under general anesthesia).
d. Deflation causes a transient decrease in core temperature.	**Yes**	**The transient decrease in core temperature with deflation is a result of the redistribution of body heat and the return of hypothermic venous blood into the systemic circulation. *Review Article: The arterial tourniquet: pathophysiologic consequences and anaesthetic implications. Anaesthesia, 2001: 56; 534-545*.**

Continue the case

Question # 4: 20 minutes into the case, your patient complains of nausea and becomes less responsive. Bradycardia worsens and hypotension develops requiring treatment. Which of the following have been reported to be risk factors for the development of bradycardia (pulse < 50 bpm) and cardiac arrest during spinal anesthesia?

- [ ] a) Baseline heart rate <60 bpm.
- [ ] b) ASA physical status III or IV (vs I).
- [ ] c) Sensory level above T4.
- [ ] d) Age > 50.
- [ ] e) Use of beta-blocking drugs.

Answer; a, c, e.

Answer	Correct?	Rationale
a. Baseline heart rate <60 bpm.	**Yes**	**Because a high degree of cardiac vagal activity can occur during spinal anesthesia (SAB), patients with strong resting vagal tone should be at an increased risk for cardiac arrest during SAB. It has been reported that a baseline pulse of <60 bpm was associated with a fivefold increase in the odds of developing moderate bradycardia during SAB.**
b. ASA physical status III or IV (vs I).	No	Typically, young patients have strong vagal tone and it has been reported that ASA I patients have a threefold increased risk for developing moderate bradycardia during SAB compared to ASA III and IV.
c. Sensory level above T4.	**Yes**	**Block height >T6 has been found to be a risk factor for the development of bradycardia during SAB. It has been observed that 40% of patients with spinal levels above T4 develop moderate bradycardia. Bradycardia can serve as a surrogate marker for extensive sympathetic blockade. Cardiac accelerator fibers originate from T1-T4.**
d. Age > 50.	No	Age less than 50 has been found to be a risk factor in that younger patients have strong vagal tone. In a closed claims analysis, half of all cardiac arrests in the OR during spinal anesthesia were in patients less than 30 years old and in minor surgical procedures.
e. Use of beta-blocking drugs.	**Yes**	**Beta-blocking drugs also predispose to "vagotonia".**

The other risk factor in this study was a prolonged PR interval. When two or more of these risk factors are present, the patient may be considered high risk for bradycardia and cardiac arrest during spinal anesthesia.

Reference: Pollard JB, Cardiac arrest during spinal anesthesia: Common mechanisms and strategies for prevention. Anesth Anal 2001; 92: 252-6.

Continue the case

Question # 5: Your patient is feeling much better now and asks you what is the chance of getting a “spinal headache” over the next few days? Your response includes which of the following statements? (Choose all that apply).

☐ a) The elderly may have a less elastic dura and therefore a smaller hole size results after needle placement resulting in a lower risk of PDPH.

☐ b) The presence of osteophytes may prevent leakage of CSF through intervertebral foramina resulting in a lower risk of PDPH in the elderly.

☐ c) The incidence of PDPH decreases with increasing age.

☐ d) The incidence of PDPH with a 24 gauge sprotte (small diameter, noncutting tip) is less than or equal to 0.05% in those >65 yrs

Answer: a, b, c, d (all of the above)

Answer	Correct?	Rationale
a. The elderly may have a less elastic dura and therefore a smaller hole size results after needle placement resulting in a lower risk of PDPH.	Yes	A smaller hole size allows less leakage of CSF which normally cushions the brain. Loss of CSF results in traction and pulling on pain sensitive structures in the brain (meninges).
b. The presence of osteophytes may prevent leakage of CSF through intervertebral foramina resulting in a lower risk of PDPH in the elderly.	Yes	The arthritis associated with aging also occurs in the vertebral column with formation of osteophytes that prevent loss of CSF through the intervertebral foramina.
c. The incidence of PDPH decreases with increasing age.	Yes	The incidence in 20 year olds is approximately 0.25% compared to 0.05% in those >65 years old. (five-fold difference)
d. The incidence of PDPH with a 24 gauge sprotte (small diameter, noncutting tip) is less than or equal to 0.05% in those >65 yrs.	Yes	The incidence in 20 year olds is approximately 0.25% compared to 0.05% in those >65 years old. (five-fold difference)