

Design and Implementation of a Comprehensive Four-Week RAAPM Curriculum for Medical Students in a Subspecialty Orthopedic Hospital

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INTRODUCTION

-The practice of anesthesiology continues to grow and become more subspecialized at a rapid pace, especially in the academic setting.

-Hospital for Special Surgery (HSS) offers highly specialized orthopedic anesthesia for patients undergoing spine, trauma, joint, and sport surgical procedures.

-There has been a recent push for enhancing the experience for rotating medical students; an experience that can be standardized and uniform, and with purposeful measurable objectivity. Historically at the national level, active and effective teaching or training approaches have been used less frequently during anesthesia rotations leaving students dissatisfied with their competencies at the end of their rotations.¹

-Many curricula covering the regional anesthesiology and acute pain medicine (RAAPM) subspecialty exist; institutions often create experiences geared to their practice, but these curricula often only cover the subspecialty contents.

-Here we have designed and are currently implementing a robust and rigorous 4-week medical student curriculum that not only challenges students in the practice of regional anesthesia and acute pain medicine, but that encompasses broad foundational concepts in general anesthesiology needed to provide the highest standard of care in a fast-paced environment.

CURRICULUM LEARNING OBJECTIVES

- 1.**Identify** the potential benefits of regional anesthetics and determine which patient populations are strong candidates for blocks over general anesthesia.
- 2.**Delineate** the differences between spinal and epidural anesthesia, including their different indications, techniques, and complications.
- 3.**Assess** and **determine** appropriate ventilator settings based on the clinical environment and mechanical ventilation strategy.
- 4.**List** common brachial plexus and lower extremity blocks, including their indications, techniques, and complications.
- 5.**Perform** and **interpret** basic lung, cardiac, and gastric point-of-care ultrasound.

References

1 Shawahna R, Jaber M, Maqboul I, Khaleel M, Abo-Mokh J, Sabbah H, Assi S, Zuhd J. Teaching approaches and satisfaction of medical students during anesthesia rotations: a multicenter crosssectional study. BMC Med Educ. 2023 Sep 7;23(1):641. doi: 10.1186/s12909-023-04603-8. PMID: 37679731; PMCID: PMC10486086.

2 Galway UA. Designing an Optimally Educational Anesthesia Clerkship for Medical Students - Survey Results of a New Curriculum. J Educ Perioper Med. 2014 Jan 1;12(1):E054. PMID: 27175386; PMCID: PMC4719530.

Day 7 - Tuesday:

Fundamentals of Anesthesia, Topic #7: PA catheters and basics of mixed venous O₂

Most medical students have heard the terms "Swan-Ganz catheter" and "mixed venous O₂ saturation", and these topics even come up on their USMLE exam, but I have found that students often lack context for these topics. A review of basic information regarding PA catheters and SvO₂ can be interesting, and ties in nicely with a short discussion of different shock states (which medical students are usually very familiar with).

-What do we use **pulmonary artery catheters (PACs)** for and why?

-What are the different pressures encountered in the right heart as you progress the tip of your catheter from the **right atrium to the right ventricle to the pulmonary artery?** (common question on USMLE).

-Are there any risks with PA catheter placement?

-What is mixed venous O₂ saturation (SvO₂)? What do you think is a normal SvO₂?

-See the **modified Fick equation** below and note the main variables that affect SvO₂. Would cardiogenic shock increase or decrease mixed venous O₂ sat? How about anemia? How about hypoxia?

$$SvO_2 = SaO_2 - \frac{VO_2}{1.36 \times Hb \times Q}$$

SvO₂= mixed venous O₂; VO₂= oxygen consumption; Q= cardiac output

-What are the different types of shock?

-What pathologic states do you think would cause a high SvO₂? What states do you think would cause a low SvO₂?

Day 16 – Monday:

Fundamentals of Anesthesia, Topic #16: Pre-Op Cardiac Clearance for Non-Cardiac Surgery

-What are the goals for a pre-op cardiac clearance workout?

-Does every patient need a basic ECG before proceeding to the OR for anesthesia/surgery?

-What are some examples of patients who absolutely need an ECG before proceeding to the OR? Who might or might not **need**? Who **do not need**?

-What are examples of high risk surgeries? Intermediate risk? Low risk?

-Name components to the Revised Cardiac Risk Index (RCRI) and correlate these with risk of major Adverse Cardiac Events (MACE)

-Describe the concept of METS and determine who classifies (IE: what amount of METS) as functionally capable of proceeding safely with anesthesia/surgery.

-If a patient needs further cardiac workup before elective surgery, can you think of additional tests/studies/imaging that would yield important, actionable information?

Step 1: Risk stratify

- Emergency Surgery: Clinical assessment and proceed to surgery
- Non-emergent Surgery: Proceed to Step 2

Step 2: ACS

- If patient has ACS: treat according to published guidelines
- If patient has no ACS: proceed to Step 3

Step 3: Assess Risk

- Low risk with MACE < 1%: Proceed to surgery with no further testing
- Intermediate risk with MACE > 1%: Proceed to Step 4

Step 4: Assess functional capacity

- Moderate to excellent exercise capacity (METS > 4-10): Proceed to surgery with no further testing
- Poor functional capacity (METS < 4): AND further testing will impact perioperative management/outcomes: Proceed to Step 5

Step 5: Stress Testing

- Cardiac stress test is normal: Proceed to surgery with no further testing
- Cardiac stress test is abnormal: Perform coronary angiography and revascularization. Proceed to surgery according to established guidelines in patients with revascularization or noninvasive surgical alternatives

Sample Daily Curriculum Topics

Day 9 - Thursday:

Fundamentals of Anesthesia Topic #9: Mechanical Ventilation 101

-Have you taken care of someone who required mechanical ventilation?

-Do you remember what mode(s) of ventilation they were on?

-Where was this patient? An OR, an ICU, a **stepdown** unit? What are some key differences between these environments that might impact our ventilation strategy?

-Discuss the indications for intubation and mechanical ventilation.

-What is the difference between Controlled and Spontaneous modes of ventilation?

-What are vent parameters that affect oxygenation? What are vent parameters that affect ventilation?

-What is PEEP? What would prompt us to turn PEEP up or down?

-What is auto-PEEP or breath stacking?

-How can we identify it?

-What are some strategies we use to correct it?

-What does SIMV stand for? Why and how do we use it?

-Why do we sometimes "rest" patients on the vent overnight in the ICU?

-Do we ever leave the OR with our patient still intubated? Why would we choose to do so?

-Can patients leave the hospital if they require mechanical ventilation?

-Discuss extubation criteria. Can keep it to general OR extubation criteria, or you can get into a short discussion about RSBI, NIF, vital capacity, etc.

-What are some complications of prolonged intubation and mechanical ventilation?

Day 20 – Friday:

Point-of-Care Ultrasound Series, Topic #20: Gastric Exam

-Describe when a gastric ultrasound exam might help an anesthesiologist? What might be a few indications for performing this exam?

-State how you will position your patient to perform a gastric ultrasound exam. What type of ultrasound probe might you choose and why?

-Which portion of the stomach provides the most reliable quantitative information for gastric volume?

-When might a gastric ultrasound exam be difficult to perform or interpret? (IE: what special patient populations)

-Identify and describe various gastric ultrasound image findings including those of:

- Empty stomach
- Thick fluid/solid food
- Clear fluid

DESIGN

-Our challenge was to design a curriculum geared to the practice of orthopedic anesthesia in order to enhance student learning while functioning in a fast-paced, private-practice / academic hybrid setting; we wanted to ensure that the principles of general anesthesiology were not lost.

-The curriculum targets fourth year medical students who are already applying into the field.

-To make the curriculum more dynamic, each day of the first week is dedicated to a regional subspecialty topic; the remainder of the rotation continues with daily didactics in fundamental topics that would be useful for any soon-to-be intern in anesthesiology.

-We added a 3-day POCUS series to give rotating students a foundation in lung, cardiac, and gastric ultrasound. Each of these talks take approximately 20-30 minutes to review depending on the level of the learner, leaving plenty of time throughout the clinical day to cover the didactic topic.

-The talks are given in the operating room during active cases by current fellows in the Department of Anesthesiology, Critical Care, and Pain Medicine at HSS.

-The fellows each receive the full curriculum but have different students working with them each day. Each day is assigned a particular didactic, and each day is dedicated to the same didactic among all fellows/learners.

-Most students think the job of an anesthesiologist is to simply ‘put people to sleep,’ but at HSS we’d like to highlight how in the regional subspecialty sometimes the exact goal is to keep a patient awake.

DISCUSSION

-The general anesthesiologist is board certified to care for all patients in all settings.

-The development of subspecialty practice often tracks physicians into particular niches.

-Creating subspecialty curriculum for trainees can provide early exposure and unique clinical experience while enticing students to continue applying into anesthesiology.

-When creating a curriculum in anesthesiology, it is important to remember the foundation - the basics - as keeping up-to-date will allow a physician to provide the highest standard of care.

-This poses a challenge as the field is so broad; creating well-defined objectives for trainees to learn and demonstrate can help maintain objectivity when standardization of learners is desired.

-The ultimate goal is to measure outcomes to continue enhancing and improving the curriculum.

-Fellows, residents, and medical students have been training at HSS for decades and perform neuraxial and regional anesthesia techniques in high numbers, leading to expertise and mastery in a private practice/academic hybrid setting.

-While many institutions have designed clerkships in anesthesiology ranging in length from 2-4 weeks, these experiences are often variable with regard to learning opportunities and are designed to introduce one to all aspects of practice, which can be broad.

-Future directions which are currently in design include administering pre-rotation and post-rotation exams covering the comprehensive list of topics to assess mastery of RAAPM and basic foundation concepts.

