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Blood IS Thicker Than Water: Anesthetic Concerns of Hypercoagulability

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Stem Case and Key Questions Content

Your patient is a 60 year old, 90 kilogram white male who is to undergo a laparoscopic nephrectomy. His medical history is significant for having chronic renal failure secondary to polycystic kidney disease, and is status post a renal transplant 5 years ago. At that time, one polycystic kidney was removed due to its large size possibly interfering with placement of the grafted kidney. The patient's nephrologist feels the remaining polycystic kidney should be removed because of frequent urinary tract infections in light of the patient's immunosuppression. His renal function has been good since. In addition, he has Factor V Leiden; he has a history of frequent deep venous thromboses, and is on coumadin therapy. The urologist has told you he has arranged for the patient to receive an inferior vena cava filter in the operating room today, done before the laparoscopy.

1. Are there any anesthetic implications of polycystic kidney disease?
2. What are the anesthetic implications specific to laparoscopic nephrectomy?
3. Are there any anesthetic implications specific to inferior vena cava filter placement?
4. What is Factor V Leiden? How does it influence hypercoagulability?
5. How is Factor V Leiden managed?
6. What, if any, preoperative lab tests would you order?
7. What measures to prevent perioperative deep venous thrombosis are used perioperatively?
8. What is an acceptable PT/INR for this patient preoperatively?
9. When should the patient discontinue his coumadin use preoperatively?
10. Will you check a PT/INR preoperatively or assume that the PT/INR has normalized within a certain time frame? The remainder of his history is unremarkable; except he takes metoprolol 25 milligrams daily for hypertension. His vital signs are normal, including a blood pressure of 140/70. His physical exam is also unremarkable, including his airway exam.

When you review the patient's recent lab test, you see his BUN is 9, and his creatinine is 1.2. What surprises you is that his hematocrit is 59% (normal range at your institution is 41-50%).

9. What are some causes of a hematocrit of 59%?
10. What is primary Polycythemia vera? What is secondary polycythemia?
11. What are the implications perioperatively for a hematocrit that high?
12. What options do you have when faced with a preoperative hematocrit that high?
13. How does the patient's Factor V Leiden influence your concerns of his high hematocrit? You decide the patient needs to be phlebotomized preoperatively. You inform the patient that in addition to his Factor V Leiden risk, he is at risk for DVT because of his polycythemia vera.
14. How should the patient be phlebotomized? When, where, and by whom? (Preoperatively or

intraoperatively?) You are able to obtain blood transfusion bags from the blood bank, and prepare to phlebotomize the patient.
15. Describe the process of phlebotomy in this situation. How long will it take?
16. How will you monitor the patient during this procedure?
17. How much blood will you take?
18. Will you replace intravascular volume? How, and with what fluid?
19. Are there any contraindications to phlebotomizing a patient with polycythemia?
20. What will you do with the blood that is taken from the patient?
21. What precautions will you take with these units? The patient has been phlebotomized three bags worth of blood, and the volume has been replaced with 3:1 crystalloid solution. His vital signs are similar to those before the phlebotomy. He is taken to the operating room, and general anesthesia is induced. He has an IVC filter placed and undergoes the nephrectomy. Estimated blood loss is 300 milliliters. Intraoperative intravenous fluids amount to 1,200 milliliters of Ringer's Lactate. A hematocrit in the recovery room is 42%.
22. Should any of the blood be given back to the patient?
23. Can the blood be sent to the blood bank for use on other patients?
24. How should his Factor V Leiden be treated postoperatively?

Model Discussion Content

Factor V Leiden was first described in 1994. It is a variant of Factor V, which is a cofactor allowing Factor X to activate thrombin. Factor V Leiden is not inhibited by Activated Protein C, the usual inactivator of normal Factor V. Since Factor V Leiden is not inhibited, a hypercoagulable state exists in patients with Factor V Leiden. Factor V Leiden is an autosomal dominant trait with incomplete dominance. It is seen in 5% of Caucasians, and is the most common thrombophilic condition in that group[1, 2]. Polycystic kidney disease is a major cause of chronic renal failure. 50% of patients with this disorder will require dialysis or renal transplantation. It occurs in around 1:500 and is autosomal dominant. A rarer autosomal recessive type also exists. Patients with polycystic kidneys are at an increased risk of having cerebral aneurysms[3]. This condition can also cause secondary polycythemia vera through production of erythropoietin by the polycystic kidneys. Polycythemia vera (PCV) is a condition in which the blood has an excess of erythrocytes. It can be primary, i.e. from overproduction of cells from bone marrow, or secondary, which is from an increase in erythropoietin. Secondary polycythemia is related to several conditions, such as exogenous erythropoietin treatment, neoplasms, smoking, chronic hypoxemia, obstructive sleep apnea, and polycystic kidney disease[4.] In a study from 2010, men whose hematocrit was in the upper 20th percentile had a risk of DVT 1.5 times that of the general population[5]. A retrospective study from JAMA in 2007, looking at Veterans' Affairs patients, showed a 1.6% increase in postoperative mortality for every point increase above high normal hematocrit, which in this study was a hematocrit of 54% or higher[6]. In another study, the rate of DVT for patients with polycythemia was 5 times more than the normal rate of postoperative DVT even after preoperative phlebotomy and perioperative treatment with low-molecular weight heparin or antiplatelet drugs[7]. Patients with PCV are at risk of deep venous thrombosis not only perioperatively, but in non-operative settings. Other sequelae include stroke[8], Budd-Chiari Syndrome[9], cognitive dysfunction[10], and even vision loss. The usual treatment for polycythemia is phlebotomy on a

semi regular basis. This is usually done at a blood bank in order for the blood to be processed for donation. In a perioperative situation, the polycythemic patient can self-donate (preoperative autologous donation) in advance of the scheduled operation. Alternatively, the patient can be phlebotomized immediately preoperatively or intraoperatively so the blood is readily available for use during the procedure if need be. The usual precautions for standard normovolemic emodilution should be considered in polycythemia patients needing phlebotomy preoperatively; caution in the presence of cardiac disease, renal impairment, and severe hypertension. If systemic disease accompanies polycythemia, the patient should be closely monitored during the phlebotomy. Blood is usually replaced with crystalloid in a 3:1 ratio, or with colloid in a 1:1 ratio. The ideal replacement fluid for normovolemic hemodilution is not known. Intravascular replacement fluids should be administered through a fluid warmer, and should be done simultaneously with the phlebotomy. The amount of blood removed can be calculated by the following equation: V =EBV x Hi -Hf ÷ Hav Where *V* is volume of blood removed; *EBV* is Estimated Blood Volume; *Hi* is initial Hct; *Hf* is desired Hct at end of hemodilution; *Hav* is average Hct during hemodilution (average of *Hi* plus *Hf*). Special blood bags are available from different sources, such as the hospital blood bank or the community blood bank. The blood can be removed under aseptic techniques from large bore intravenous lines or an arterial line, drained to gravity. The bags should be labeled with the patient's name and hospital number, and accompany him or her to the operating room. Normally, blood banks will not accept blood obtained in this manner. If the patient is normovolemic and not symptomatically anemic (or with risk factors where anemic could be detrimental, e.g. coronary artery disease), there is no pressing need to administer the blood back to the patient. If the normovolemic hemodilution is performed during the anesthetic, the blood can contain enough muscle relaxant to potentially cause recurarization if given back to the patient. Postoperative care of ypercoagulable patients should include intermittent compression stockings whenever the patient is not ambulatory, early ambulation when possible, and low molecular weight heparin therapy. Those patients with Factor V Leiden who were on Coumadin therapy preoperatively should have the medication restarted when risk of bleeding has decreased[11].

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