Course VCSN630

Neonatology and Intensive Care Medicine

**Clinical Problems**

Instructions: Attached are clinical problems which should be completed by all students taking Course VCSN630. This is an open-book learning exercise. You are allowed to use any resource you can find, except other students. This should reflect your effort only. You may work together in groups studying the material but not in answering these questions. It is often evident when students work in groups to answer these questions since they all have the same incorrect reasoning even though they vary the wording of their answers.

Please type your answers and submit your problems in MS Word or PDF format as an attachment emailed to [jepalmer@vet.upenn.edu](mailto:jepalmer@vet.upenn.edu).

Deadline: The deadline for emailing the completed exercise is *Sunday, July 15th*. The deadline for turning in the take-home clinical problems will be firm. Except under the most unusual circumstances, 1 point will be deducted for each day passed the deadline that the examination reaches Dr. Palmer. If you feel that your summer activities might prevent you from being able to email your completed problems by July 15 you must contact Dr. Palmer by June 15 to request an extended deadline.

Case 1a

You admit a 12 year old multipara mare with a history of several colic episodes during this gestation. She had an episode of undiagnosed colic in May and again in November. It is now March 5 and the mare is on day 305 of gestation. She has been showing signs of colic for 3 hours and has not responded to a dose of flunixin meglumine. On arrival at your hospital she is showing signs consistent with being very painful: pawing, sweating, rolling, heart rate 76, respiratory rate of 68. She also has significant abdominal distension and almost no borborygmi on abdominal auscultation. The mare’s legs are cold and pulses difficult to find. You find 6 liters of gastric reflux.

The farm manager is very concerned with the health of the fetus during this severe colic. Name 2 ways you could try to determine the fetus’ health.

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| 1. |
| 2. |

During your examination you notice that the mare has moderate udder development and is “waxed.” There is dried discharge in her tail hairs and you find a small amount of mucopurulent vaginal discharge. On transrectal ultrasound examination you find that the cervix is soft and open and there is discharge between the chorion and endometrium on the uterus side of the cervix and in the vaginal canal. What do these findings suggest?

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Although your focus is still on the colic you realize this newly discovered problem will need to be dealt with. Name 3 drugs you might use to treat this problem:

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| 1. |
| 2. |
| 3. |

You decide that the mare should have an exploratory celiotomy. In discussing the case with the anesthesiologist, name 2 special considerations related to support of the fetus during the preoperative preparation, operative period and/or early postoperative period.

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| 1. |
| 2. |

At surgery no specific lesions were found except for focal bruising on the large colon consistent with trauma from fetal kicks. During the mare’s initial postoperative hospitalization she continues to have some reflux and so is kept NPO. She is depressed and her legs remain cool. What two additional therapies could you try on the mare which might help the fetus during this period?

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| 1. |
| 2. |

You think the mare may foal early because of her signs and this significant insult. You have lay help who can check the mare hourly for signs of foaling. You wish to write instructions for the lay assistants describing the signs they may see. Name 3 signs that you might ask them to watch for that would indicate that the mare is in stage I labor:

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| 1. |
| 2. |
| 3. |

The mare recovers from the colic and is back on full feed by 1 week. The owner elects to take the mare home to foal despite the risk posed by having a recent abdominal incision during parturition.

Case 1b

The same mare returns on March 25 (gestation day 325) at 6:41 a.m. as a dystocia.

The mare was found at 6:15 a.m. foaling and apparently prolapsing/eviscerating intestine through the vagina. She was immediately sent to your hospital. Attempts were made to relieve the dystocia which were unsuccessful. A terminal C-section was performed with the foal delivered at about 7:20 a.m.

Initial birth resuscitation:

7:20 a.m. – delivered via terminal C-section; diffusely meconium stained; umbilicus teased and ruptured; some umbilical bleeding; umbilicus clamped.

7:22 a.m. – transported to NICU; foal did not have spontaneous respiration for about two minutes after delivery; foal had a bradycardia but an increasing heart rate; apical pulse easily seen; legs cool as transported

7:25 a.m. – arrived NICU; spontaneous respiration; vocalizing; struggling; HR 80; temp 99.2; endotracheal tube placed and assisted ventilation begun with Ambu bag and Fio2 = 1.0.

7:28 a.m. – RR 60, ETCO2 = 21, HR 70; legs moderately cool, pulses difficult to feel

An arterial blood gas taken at 7:28 a.m. showed the following:

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| pH | 7.074 | lactate | 10.9 |
| Paco2 | 66 |  |  |
| Pao2 | 24 |  |  |
| HCO3 | 19.6 |  |  |
| BE | - 8.2 |  |  |
| O2 Saturation | 37.5 |  |  |
| O2 Content | 3.7 |  |  |

How would you characterize the acid-base abnormality?

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What is the alveolar dead space ventilation? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What does this value mean?

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How would you correct the underlying abnormality causing the alveolar dead space ventilation?

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Considering that you are ventilating with a Fio2 of approximately 1.0, what ventilation perfusion abnormality is causing the hypoxemia?

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What anatomical problem might be causing this ventilation perfusion abnormality?

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How would this relate to the alveolar dead space ventilation?

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What therapy might you use to correct this problem?

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7:28 a.m. – legs cold, pulses difficult to feel

7:30 a.m. – catheter placed right jugular; blood drawn for lab work – PCV 44%, TP 5.5 g/dl, dextrose 9 mg/dl

7:42 a.m. – BP 107/69 (87) 90

What do the cold legs and poor pulses which are difficult to feel tell you?

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Is the blood pressure adequate? How does the blood pressure relate to the perfusion and the clinical signs?

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What 2 therapeutic interventions might you try to correct this problem?

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| 1. |
| 2. |

In light of the low blood glucose level you decide to begin dextrose therapy at a rate that will mimic that produced by the placenta to help support the foal’s birth transition. You estimate that the foal weighs 110 lb. How much 10% dextrose would you give (ml/hr)?

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Is this infusion rate sufficient to meet the foal’s fluid needs?

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The following blood work is taken when the IV catheter was placed:

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| --- | --- | --- | --- |
| WBC | 43,600 | Na | 136 mEq/l |
| Segs | 96 % | K | 3.36 mEq/l |
| Lymphs | 2 % | Cl | 79 mEq/l |
| Monos | 2% |  |  |
| Fibrinogen | 405 mg/dl | Cr | 17.8 mg/dl |
| IgG | 1456 mg/dl |  |  |

What does the hematology and fibrinogen tell you?

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Why is the IgG level increased even though the foal has not nursed? Is this a lab error or is there another explanation?

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What does the high creatinine mean? Is the foal in renal failure?

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After initiating all your therapy you take another arterial blood gas (foal was on intranasal oxygen at 10 lpm):

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| pH | 7.428 | lactate | 1.9 |
| Paco2 | 50 |  |  |
| Pao2 | 381 |  |  |
| HCO3 | 34 |  |  |
| BE | 8.7 |  |  |
| O2 Saturation | 99 |  |  |
| O2 Content | 15.5 |  |  |

What does the Pao2 tell you about the physiology of the lungs now?

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Although initially the foal had no signs of Neonatal Encephalopathy, by 12 hours of age the foal had periods of somnolence, remained weak and needed support and balance standing. By 24 hours of age his suckle began to fade and by 36 hours he developed a head tilt, other vestibular signs, developed hypertonus followed by hypotonus and became hyperresponsive. This was followed by galloping clonic/tonic siezure-like activity. How would you treat the seizures?

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Next you notice that when the foal breaths, the area just behind the ramus of mandible and below the ear is sucked in during inspiration and then balloons out during expiration. This appears to result in a significant upper airway obstruction. An arterial blood gas taken at the time shows the following (the foal is on INO2 = 15 lpm):

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| pH | 7.359 |
| Paco2 | 75 |
| Pao2 | 44 |
| HCO3 | 43 |
| BE | 15.7 |
| O2 Saturation | 79 |
| O2 Content | 8.8 |
| INO2 | 15 lpm |

How would you characterize the acid base status?

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Name 2 aspects of the blood gas which are a direct result of the respiratory obstruction.

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| 1. |
| 2. |

What would you do to try to correct the upper airway obstruction?

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What do you think the cause of the obstruction is?

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Despite your efforts to relieve the obstruction, the foal becomes fatigued and you decide to place the foal on positive pressure ventilation. You begin with a tidal volume of 400, respiratory rate of 38, PEEP of 4 cm H2O and Fio2 = 0.35. After 20 minutes of ventilation you run an arterial blood gas:

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| --- | --- |
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| pH | 7.470 |
| Paco2 | 48 |
| Pao2 | 62 |
| HCO3 | 35.5 |
| BE | 11.2 |
| O2 Saturation | 92 |
| O2 Content | 12.3 |
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How would you characterize the acid base status?

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What 2 ventilation parameters could you change to help correct the pH (name the parameter and how you would change it):

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| --- |
| 1. |
| 2. |

You would also like to improve the Pao2 . Name 2 ventilation parameters could you change to accomplish this (name the parameter and how you would change it):

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| --- |
| 1. |
| 2. |

Before you change any of the ventilator settings you note that the peak airway pressure is 20 cmH2O and the plateau pressure is also 20 cmH2O.

What is the effective static compliance? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What is the effective dynamic compliance? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Did ventilation correct the upper airway obstruction? YES/NO Why?

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You find that your patient has moderately severe contracture of both front fetlocks. Name 2 ways you could treat the forelimb fetlock contracture.

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| 1. |
| 2. |

Eventually the foal fully recovered and was discharged on a nurse mare. The foal did well for at least the next year but after that was lost to followup.

Case 2

The second case is a foal born on day 290 of gestation. The mare had precocious lactation and had been dripping milk for at least 2 weeks. She had been treated with ReguMate® but nothing else. The mare’s water broke at 11:30 pm, the foal was born at 11:40 pm and the placenta past at 12:05 am.

Does the timing of the stages of parturition sound normal?

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As you place an IV catheter, you collect venous and arterial blood for analysis:

Arterial:

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| --- | --- | --- | --- |
| pH | 7.410 |  |  |
| Paco2 | 54.5 |  |  |
| Pao2 | 42 |  |  |
| HCO3 | 34.9 |  |  |
| BE | + 9.0 |  |  |
| O2 Saturation | 89 |  |  |
| O2 Content | 13 |  |  |

Venous:

|  |  |  |  |
| --- | --- | --- | --- |
| WBC | 6,800 | PCV | 32% |
| Segs | 73 | TP | 4.2 gm/dl |
| Bands |  | Glucose | < 12 mg/dl |
| Lymphs | 23 | Na | 136 |
| Monos | 4 | K | 3.51 |
| Fibrinogen | 744 | Cl | 97 |
|  |  | Cr | 1.08 |

What 2 abnormalities noted in the blood work are most critical?

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| 1. |
| 2. |

How would you treat the hypoglycemia?

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Name 3 things you could do to treat the hypoxemia short of ventilation:

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| 1. |
| 2. |
| 3. |

You decide to start the foal on intranasal oxygen insufflation. After 10 minutes, you take another ABG and find:

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| --- | --- |
| pH | 7.396 |
| Paco2 | 57.1 torr |
| Pao2 | 240 torr |
| HCO3 | 35.3 |
| BE | + 9.1 |
| O2 Saturation | 100.0 |
| O2 Content | 15.2 |

How would you adjust the intranasal oxygen flow at this point?

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What does this tell you about the origin on the hypoxemia?

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You finally get a chance to do a careful physical examination. The temperature is 93.5 F, heart rate 78 bpm and respiratory rate 32 bpm. He has no borborygmi or evidence of passing meconium (and no history of meconium passage). You find the foal has fully developed ear cartilages, aural petechia, scleral hemorrhages, excessive flexor tendon laxity, umbilical bleeding, a fine haircoat, hyperemic coronary bands, and loose joint ligaments. He is also hyperresponsive to stimuli but generally has poor body tone and does not stay sternal without a lot of help. He has no suckle and often holds his tongue out to one side of this mouth. Although he has somnolent periods, when he is awake he appears aware and appropriately objects to your examination. You also note that he is much smaller than expected, weighing 44 lbs.

Name 3 findings from the physical examination which are characteristic of prematurity:

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| 1. |
| 2. |
| 3. |

Name 3 findings from the physical examination which are characteristic of neonatal encephalopathy:

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| 1. |
| 2. |
| 3. |

Name 3 findings from the physical examination which are characteristic of sepsis:

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| --- |
| 1. |
| 2. |
| 3. |

What could you do to try to prove that the foal is septic?

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He urinates during the exam. His legs are warm, his pulses easily felt and strong, he has good arterial fill and good arterial tone. His blood pressure is systolic 74, diastolic 43, mean 53.

Is his blood pressure too low?

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 Why shouldn’t this foal be fed colostrum?

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Since this foal can’t be fed colostrum, what would you do to insure passive transfer?

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Since the foal can’t be fed enterally, you decide to place the foal on TPN. You choose to start him on 10 gm/kg glucose + 2 gm/kg amino acids + 1 gm/kg lipids. In the pharmacy you find 50% glucose solution, 10% amino acid solution, 10% lipid solution and a large (3 liter) empty IV bag. How much of each solution should you place in the bag for a 24 hour supply?

|  |  |
| --- | --- |
| 50% glucose: | mls |
| 10% amino acids: | mls |
| 10% lipids: | mls |

This mix should run at \_\_\_\_\_\_ mls/hr. It will deliver \_\_\_\_\_\_\_kcal/kg/day. The normal growing foal should receive \_\_\_\_\_\_ kcal/kg/day.

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Over the next 10 days the foal survives the trials and tribulations of multiple problems including Neonatal Encephalopathy, Neonatal Gastroenteropathy with persistent dysmotility and recurrent colic, Neonatal Nephropathy, sepsis, hypoglycemia, hyperglycemia, omphalophlebitis, aerophagia and aspiration pneumonia secondary to dysphagia. The now 54 lb. foal is finally ready for oral feeding.

You decide to begin by giving 10% of his body weight in milk. How much should you feed the foal every 2 hours to reach this goal?

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How many kcal/kg/day will this provide?

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The foal had a prolonged NICU stay recovering from his aspiration pneumonia and incomplete ossification but finally returned home. On last contact with the owner the foal was reported to have had an unsuccessful racing career but is currently a very successful show hunter.

Normal Laboratory Values

(only for the purpose of these clinical problems)

Normal Values at Birth

|  |  |  |  |
| --- | --- | --- | --- |
| WBC | 6-10,000 | Na | 130-142 meq/l |
| Segs | 60-80% | K | 3.6 – 4.2 meq/l |
| Lymphs | 40-20% | Cl | 98 – 104 meq/l |
| Monos | 0-5% | Cr | 2.0-3.9 mg/dl |
| Fibrinogen | 100-150 mg/dl | Glucose | 55-110 mg/dl |
|  |  |  |  |
| pH | 7.35 – 7.40 |  |  |
| Paco2 | 48 – 60 torr |  |  |
| Pao2 | 70 – 98 torr |  |  |
| HCO3 | 24 – 29 |  |  |
| BE | - 2.0 – +2.0 |  |  |
| O2 Saturation | 92 – 99% |  |  |
| O2 Content | 12.5 – 15.5 ml/dl |  |  |

Normal Laboratory Values

48hrs to 1 week

|  |  |  |  |
| --- | --- | --- | --- |
| WBC | 6-10,000 | Na | 130-142 meq/l |
| Segs | 60-80% | K | 3.6 – 4.2 meq/l |
| Lymphs | 40-20% | Cl | 98 – 104 meq/l |
| Monos | 0-5% | Cr | 0.80 – 1.1 mg/dl |
| Fibrinogen | 200 – 360 mg/dl | Glucose | 80 - 110 mg/dl |
|  |  |  |  |
| pH | 7.35 – 7.40 |  |  |
| Paco2 | 45 – 55 torr |  |  |
| Pao2 | 80 – 98 torr |  |  |
| HCO3 | 24 – 29 |  |  |
| BE | -2.0 – +2.0 |  |  |
| O2 Saturation | 92 – 99% |  |  |
| O2 Content | 12.5 – 15.5 ml/dl |  |  |