CRITICAL CARE NURSING

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(v) OXYGENATION AND VENTILATION

- examine the patient from a distance, before auscultating the chest to evaluate the pattern, rate · of respiration, and any exaggerated effort in either inspiration or expiration. A **prolonged inspiratory effort** is characteristic of upper airway, laryngeal, or tracheal disease (including obstructive airway disease). A prolonged expiration with or without an expiratory "grunt" or abdominal effort is suggestive of pleural space disease (pneumothorax, chest wall disease, pyo/hemo/chylo - thorax) or lung disease. Any increase in respiratory effort should be reported immediately so that appropriate action can be taken if possible

- rapid, or shallow respirations can be associated with pain from ANY source, or restrictive · pulmonary or pleural diseases, and warrants immediate evaluation

- mucous membrane color is a fair indicator of tissue oxygenation, BUT do not rely on it, because · evidence of cyanosis only occurs when tissue oxygen levels are at or below 50% of normal(!) Pulse oximetry, for all its limitations, is more reliable when used in conjunction with mm color

- special care is required with dyspneic patients, and they should have minimal handling and · restraint to avoid stress-induced respiratory arrest (esp cats, and puppies)

- any patient that has depressed mentation, depressed swallowing reflexes, or is vomiting or · regurgitating is considered at risk for developing aspiration pneumonia, and should be on anti-emetics (metoclopramide) and have appropriate postural support (towel under the scapula allows regurgitated material to flow out the mouth, rather than into the airways) Nasogastric suctioning should also be performed in these patients every two to three hours

- always provide supplemental oxygen

- measure blood gases q 12 hours, pulse oximetry q 4 hours

- failure to maintain SpO2 despite oxygen supplementation is an indication for providing ventilatory · assistance +/- positive inotrope use

ARDS - acute respiratory distress syndrome is a complex respiratory disease which results from systemic inflammation in the body causing leaking capillaries in the lungs. As we mentioned briefly in the section on fluid therapy, one of the side effects of widespread tissue inflammation is the release of the chemicals, or mediators of tissue inflammation into the systemic circulation. When this happens, we see evidence of a severely sick animal. When these inflammatory mediators reach the lung, they cause destruction of the lung capillary membranes. This allows fluid and proteins (including albumin) to leak out of the capillaries, and into the lung tissue. This is BAD - fluid in your lungs decreases the effectiveness of gas exchange.... this impairs the oxygenation of your tissues.

ARDS may also result from direct trauma, fat emboli released from long bone fractures, sudden increase in sympathetic discharge resulting in pulmonary hypertension in head trauma/electric shock, and aspiration pneumonia.

(vi) MENTATION

"There is no delusion more damaging than to get the idea in your head that you understand the functioning of your own brain"
Lewis Thomas

- If patient is, or becomes depressed, they are at an increased risk for regurgitating or vomiting fluid, and, because they may lack the normal reflexes that expel vomitus out through the mouth, they may aspirate, or inhale vomitus and fluid into their lungs - this cause aspiration pneumonia

- seizuring patients should be managed according to the ICU protocol. Beware, these patients can become hyperthermic, and may require cooling with moist skin and a fan (increases convective heat loss). Some seizures can be precipitated by strong light, or loud noises - the solution is obvious (work quietly in the dark!)

- patients recovering from myelography should have their head elevated slightly above the horizontal plane to aid in drainage of myelogram contrast in the cerebrospinal fluid away from the brain as the presence of myelogram contrast in the brain CSF can result in seizures.

- turning of neurologic patients every 4 hours is required to avoid decubital ulcers. In addition, patients with spinal disease should have towels placed between the legs to reduce strain on the spine and joints; and have a urinary catheter placed to prevent urine scalding

- ANY change in the patient level of alertness should be reported immediately, so that the cause may be investigated

(vii) **BLOOD PRESSURE** - Systemic arterial pressure (SAP) which is the blood pressure we measure with our doppler blood pressure monitor, should be maintained between 100-120 mm Hg. A high or low blood pressure reading should be reported immediately so that appropriate intervention can take place to normalize blood pressure

(viii) **HEART RATE, RHYTHM, AND CONTRACTILITY**

- why do we measure heart rate? The heart rate is an important indicator of disease. For example, an increasing heart rate can indicate any one of the following conditions

  * sepsis
  * pain
  * hyperthermia
  * hypoxia
  * hypovolemia
  * hypotension

whereas a decreasing heart rate may be suggestive of-

  * hyperkalemia
  * hypothermia
  * increasing intracranial pressure

- cardiac murmurs - they are all significant until proven otherwise. The presence of a previously undetected heart murmur in a patient is potentially a sign of bacterial infection within the heart (bacterial endocarditis), and should be noted immediately, as blood cultures and cardiac ultrasound are generally required to confirm the diagnosis of bacterial endocarditis.

- **ALWAYS** listen to the heart **AND** palpate the femoral pulse at the same time. Do they match each other? If the answer is NO, the presence of an abnormal cardiac rhythm may be the cause, or blood pressure may be low. The detection of these 'pulse deficits' or any abnormal heart rhythm should be noted, and an ECG taken at the earliest opportunity. Nearly all abnormal heart rhythms we encounter in critical patients cause morbidity and can contribute to patient death

- low blood pressure, blood volume loss, and inflammatory mediators can all contribute to the development of cardiac arrhythmias, and depressed heart muscle contractility. Therapy for arrhythmias (incl. tachycardia) is oxygen therapy, analgesia, and fluid therapy, followed by specific antiarrhythmics as indicated

- electrocardiography is useful in evaluating the poorly performing heart - continuous monitoring is advised (but not always tolerated) for patients with systemic illness, as intermittent monitoring results in arrhythmias being overlooked, or their significance to the patient underestimated, (or overestimated)

(ix) **COAGULATION**

- we should all be familiar with the symptoms relating to clotting disorders. All systemically ill pateints are at risk for developing '**DISSEMINATED INTRAVASCULAR COAGULOPATHY**'or DIC which results from widespread tissue inflammation causing activation of blood clotting factors This results in eventual depletion of clotting factors within the body - the patients starts to bleed! In addition, some of our patients arrive with pre-existing clotting disorders (snake bite envenomations, anticoagulant rhodenticides, GDV, pancreatitis etc)

- DIC is expected in patients with Systemic illness until proven otherwise ·

- **Monitor platelet count and Activated Clotting Time** - a decrease in platelet numbers, or a prolonged ACT are indicators of abnormal clotting ability in the patient

- therapy for DIC includes ·

  * oxygen therapy

  * improve tissue perfusion to reduce capillary stasis (fluid therapy)

  * treat the underlying disease

  * support the target organs of DIC - kid neys, heart, lungs, brain, and intestines

  * treat active bleeding with fresh frozen plasma or cryosupernatant to replace clotting factors

There are two broad steps involved in forming a blood clot - the primary clotting (or hemostatic) system, and the secondary clotting system.

PRIMARY HAEMOSTASIS - involves activation of platelets, and the formation of a platelet plug in a damaged blood vessel. The average body experiences about 200,000 damaged blood vessel walls per day! It is not surprising then, that when platelet numbers drop, the patient bleeds. The platelet plug lasts for only 2-3 seconds, during which time it is replaced by a fibrin plug formed by the secondary hemostatic system (see below) The primary clotting system is evaluated by the platelet count and bleeding time in the gum (buccal mucosal bleeding time, or BMBT) A BMBT is indicated if the platelet count is adequate but evidence of platelet dysfunction is present. Typically, this is seen as the presence of multiple small bleeds in the gums, vulva, venipuncture sites, and skin the patient has been lying on.

SECONDARY HAEMOSTASIS - fibrin formation is the result of the secondary hemostatic system. Deficits in this system are likely to cause hematomas, or bleeding into joints or body cavities. An activated clotting time should be carried out - the ACT evaluates the contact phase of coagulation, and much of the secondary clotting (hemostatic) system. Occasionally, severe decreases of platelet numbers can prolong this test, due to a decreased degree of activation of clotting factors Coagulation factors must be reduced to less than 30% of normal to cause a prolongation of the other clotting tests run at the laboratory (APTT and PT) Fibrin degradation products (FDP's) are the result of clot lysis, and elevated FDP's are associated with the clinical finding of DIC

(x) **RED BLOOD C ELL AND HAEMOGLOBIN CONCENTRATION**

- why do we measure PCV? The PCV as we all know is a measure of the percentage of red blood cells in blood. Red blood cells contain hemoglobin, which is the principle oxygen transport protein in blood. It is not surprising then, that a drop in PCV may result in decreased oxygen supply to body tissues. Decreased oxygen supply to tissues can result in tissue hypoxia, organ damage, and activation of the inflammatory cascade. When the PCV drops below 25%, tissue oxygenation in a normal patient can become compromised, so in most patients, we will aim for a PCV of above 25%. With occasional exceptions, a patient with a PCV below 20% will often require a red cell transfusion to ensure adequate tissue oxygenation

- maintain PCV above 20%, and preferably above 25%

- hemoglobin and red blood cells must be structurally normal, and in sufficient concentration to provide adequate oxygen transport. Optimum levels of PCV and Hemoglobin are 25-30 and 10g/l respectively

NB - microhematocrit method is preferred for serial PCV measurements, as the hematocrit measurement from automated counters is a calculated measurement based on MCHC and RBC count

(xi) **RENAL FUNCTION**

- measure urine output - aim for 2-4 ml/kg/hr. In patients with a urinary catheter in place, the urine output should be calculated every 2-4 hours, in ml/kg/hr. If urine output drops below 2 ml/kg/hr, the duty vet should be notified **IMMEDIATELY** - low urine output is an emergency!

(xii) IMMUNE STATUS, ANTIBIOTIC DOSAGE AND SELECTION, WBC COUNT

- measure total WBC count with differential, as this gives an indicator of the patient's ability to fight infection review antibiotic selection, dosage, and route of administration **DAILY.**

- if you notice abnormal tissue, urine, sputum, or other discharge in a patient, take a sample for microbiological culture and sensitivity - this should be done for any new focus of infection

  persistent pyrexia, or high or low WBC counts in sick animals on apparently appropriate antibiotic therapy suggests anaerobic bacterial, viral, or fungal infections. Always consider anaerobes in git, liver and biliary disease

  initial choice of antibiotic may be made on the basis of a gram smear and rod or cocci identification from exudates, urine, sputum, aspirates we try to restrict empirical choices for initial antibiotic therapy to minimize development of · antibiotic resistance.

  Good choices are

  urinary system
  amoxicillin/clavulanate, cephalexin

  respiratory tract
  amoxicillin/clavulanate, cephalexin

  oral cavity
  amoxicillin, metronidazole, clin damycin

  gastrointestinal tract—culture and sen sitivity preferred,
  cephalexin, metronidazole

  skin
  amoxicillin/clavulanate, enro floxacin, cephalexin

  septicemia
  amoxicillin OR cephalexin PLUS amikicin OR gentamicin OR enrofloxacin PLUS metroni dazole

(xiii) GASTROOINTESTINAL MOTILITY AND MUCOSAL INTEGRITY

- auscultate the abdomen at least twice daily for the presence of bowel sounds. The normal gut will have 1-2 propulsive contractions per minute. In patients that have been anorexic, the intestine may contract only once every 2 minutes. Therefore, when you listen to the abdomen, you need to do it for **AT LEAST 2-3 minutes**. Intestinal ileus and gastroparesis are terms used to describe the absence of normal bowel sounds and movement, and indicate an abnormally functioning gastrointestinal tract. Gastroparesis and intestinal ileus predispose the gut to ulceration, and causes vomiting, abdominal discomfort, and pain.

- Borborrhygmus is a term used to describe a gut with greater than normal sounds, and is not uncommon in patients with gastroenteritis - the so-called "rumbling stomach"

- oral glucose and electrolyte solutions aid in protection against gastric ulceration by providing microenteral nutrition

- placing a nasogastric tube for suctioning stomach contents in vomiting patients will decrease the sensation of having a full stomach, make the patient feel better, and will reduce the frequency of vomiting

- metoclopramide 0.2-0.5 mg/kg SC q 4 hours promotes gastric and duodenal motility, and blocks the chemoreceptor trigger zone. A constant rate infusion is preferred in most critically ill patients

- **Anti-emetics are indicated in ALL critical vomiting patients that are recumbent, have a slow heart rate, have compromised breathing or depressed gag reflex**. If you see a patient with this description that is not on an antiemetic, ask the vet on duty why.

- All vomiting, and bowel motions should be recorded on the ICU chart, together with a description of the vomitus or feces if they are abnormal

- liver dysfunction may be a primary or secondary problem in critically ill patients. The

presence of icterus should be noted, but is not specific for liver disease.

(xiv) **NUTRITION**

- inanition causes the following to occur

  * delayed gastric emptying, and pro longed gastrointestinal tract transit times

  * decreased surface are in the gut avail able for absorbtion of food and nutri ents

  * decreased activity of intestinal diges tive enzymes

  * decreased immune response, and de creased ability to mount an effective response against infection

  * decreased effectiveness of mucosal barrier systems, git, urinary tract, pul monary tract etc

  * decreased inflammatory response

  * decreased pulmonary response to hy poxia, reduced lung elasticity, de creased surfactant production

  * loss of cardiac mass, reduced ability of the heart to use lactic acid as a fuel

  * mediators of inflammation depress cardiac performance

  * depressed synthesis and increased degradation of skeletal muscle i.e. mus cle wasting

- **Determine Patient nutritional requirements on admission**

- BER (kcal/day) = (30 x BWt(kg)) + 70 for patients weighing > 2 kg

- feed 0.5 - 2 ml/kg q 2 hrs glucose/.5 - 2 ml/kg q 2 hrs glucose/electrolyte solution Per Os to ALL patients

- give 1/4 - 1/3 patient feed requirements via liquid diet diluted 1:1 with water on day 1 ·

- provide 2/3 - 1 x daily feed requirements of non-diluted diet on day 3

- consider metoclopramide, cisapride, and/or decreasing concentration and volume of feed if · vomiting occurs following feeding

- perform suctioning of tubes used for feeding prior to the next scheduled feed - continue feeding if less than one third of the volume of the previous feed is suctioned

(xv) **ANALGESIA**

- pain is manifested by tachycardia, restlessness, mental depression, poor attitude (demeanor) ·

- pain control is important to the reduce cardiovascular stress, and patient suffering ·

- opioids (buprenorphine, butorphanol) are preferred ·

(xvi) **NURSING CARE, WOUND CARAE, BANDAGE CARE, TLC**

- recumbancy - manage by turning patient every 4 hours

- urinary catheters avoid urine scalding ·

- manual evacuation of feces, enema application reduces fecal soiling of the patient ·

- gentle manipulation, flexing/extending limbs every 4 hours is essential to reduce muscle and joint stiffness

- bandage care/wound care - examine ANY puncture site DAILY to ensure appropriate healing is taking place. Outline ANY areas of ecchymosis or swelling with a marker pen (non-toxic!) so that the size of the lesion may be monitored

- bandages should be changed whenever they become soiled OR moist

- TLC - speak to, and handle the patients in a quiet manner, grooming

NB - Elimination of any septic focus is essential, and should be carried out at the earliest time possible. If an anesthetic is required, placement of a feeding tube is advised in anticipation of post operative anorexia.

CONCLUSION

While the therapeutic measures outlined above may look daunting (and expensive and time consuming) at first glance, the bulk of what is outlined may be achieved by the following

Initial Database

- PCV/TP, ACT ·
- CBC, biochemistry, electrolytes ·
- blood pressure, pulse oximetry, ECG
- urinalysis ·
- +/- DPL, chest/abdominal radiography as indicated by the patients' disease ·

Essential Daily Monitoring

- PCV/TP ·
- ACT ·
- Platelet count ·
- urinalysis/urine volume monitoring ·
- blood pressure measurements (Doppler), ECG ·
- pulse oximetry
- nutritional assessment and weighing patient·
- chest auscultation, abdominal auscultation ·
- clinical examination as often as possible ·
- coma score evaluation ·

Additional Measurements every 2-3 days

- CBC, biochemistry ·
- chest radiography/abdominal radiography as indicated

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