Arterial blood gas interpretation

The BAG analysis is also seed for monitoring respiratory therapy (again by evaluating the gas exchange In the lungs). Nursing considerations: Your first look at an BAG result might prove to be confusing. Any patient who is critically ill might be given this test at regular intervals. Arterial blood gas determinations will indicate two basic bodily functions: 1 .

Acid-base balance of the blood 2. Oxygenation status of the blood Bag's will also Indicate other Important facts about a patient's status. However, the two functions above are the most important.

In a clinical situation, most nurses need only to understand these two basic concepts.

When the results of an BAG are abnormal, most hospitals today will have a lab procedure for notification of the MD or to the ICC staff. But if you should be one of those " lucky" nurses who is floated to a critical care area or a respiratory care area, you may have to interpret the results by yourself. If you are able to do this, and fast, It may mean that the patient will get help fast. Hyperemia, accidental, and alkaline are Important concepts which should be understood before beginning.

Hyperemia is a term which refers to a lowered blood oxygen content. This term and the term hypoxia are probably quite familiar to most ruses. They both will be used as meaning exactly the same. Hypoxia is the basis of one part of interpretation process.

From above, we know that oxygenation status of the patient can be critical during certain disease states. Academia or acidosis is a term which refers to excessive amounts of acid In the blood. Acids are produced naturally In the body as a product of metabolism and other specific body processes. If our blood acid levels rise too high, it will interfere with the health of the individual.

This will be in addition to the disease which is already present causing the acidosis.

Alkaloids, or alkaline is the term which refers to the condition of excessive bicarbonate ions (bases) in the blood. As we mentioned above, this imbalance in the blood pH will then cause further problems as the normal body recovery mechanism may also be Interrupted. On the next pages you will find an explanation of what the BAG test is all about. We will also present the nursing considerations surrounding their interpretation. Read each section of the following text in order.

The text builds up from the simpler concepts to the more complex concepts so each nurse will be able to easily follow the interpretation process. When you fully understand one section, then go on to the next section until you finally are able to interpret the BAG with the fullest understanding. Since this course Is very clinically oriented, we will ere clinical uses of BAG studies will be listed on the following pages. BAG studies may be helpful to diagnose and treat the following: (Brenner 1994) 1 .

Unexplained tachyon, dyspepsia (esp.. In patients with cardiopulmonary disease) 2. Unexplained restlessness and anxiety in bed patients 3. Rockiness and confusion in patients receiving oxygen therapy 4.

Assessment of surgical risk 5. Before and during prolonged oxygen therapy and during ventilator support of patients 6. Progression of cardiopulmonary disease Collecting the BAG specimen ere BAG is performed on a sample of arterial blood. The specimen is then obtained in a syringe prepared with heparin so as to prevent coagulation from occurring. The sample is then placed in crushed ice and rushed to the lab for analysis. Each institution will have a slight variation in the method of the collection and in which department the sample will be handled.

The reason for rushing the specimen and or using the ice is to prevent coagulation of the specimen, and specifically, ice slows the clotting of the blood. Be sure you are familiar with that procedure in your facility. Terms used in connection with Bag's Acid-Base Balance – a homeostasis mechanism in the human body that strives to maintain the optimal pH, so that body process may function optimally (normal pH of arterial blood = 7. 35-7. 45) Buffer System – combination of body systems that work to keep optimal acid-base balance Partial Pressure – the amount of pressure exerted by each gas in a mixture of gases POP – partial pressure of oxygen

APPC – partial pressure of carbon dioxide PAPA – partial pressure of alveolar oxygen Papa – partial pressure of arterial oxygen APACE – partial pressure of alveolar carbon dioxide Apace – partial pressure of arterial carbon dioxide Pave – partial pressure of venous oxygen PVC – partial pressure of venous carbon dioxide 250 – oxygen tension at 50% hemoglobin saturation Respiratory Acidosis – condition of lowered pH (acidosis) due to decreased respiratory rate (hyperventilation) Respiratory Alkaloids – condition of increased pH (alkaloids) due to increased respiratory rate (hyperventilation)

Acid/Base Balance H is the measurement used to determine acidity or alkalinity of arterial blood.

H is measure of an acid or base solution and the relative strength of that solution. Below is the pH scale, 7 being the arbitrary center point indicting a neutral solution. An example of an acid is carbonic acid. Carbonic Acid is formed when carbon dioxide CICS) chemically combines with water (H2O) to form carbonic acid (WHICH). The “ H” at the beginning of a chemical formula usually designates and acid. Neutral 4 5 6 7 8 9 10 7.

45 normal ere further away from 7 in either direction indicates the strength of the acid or base. An acid can donate the hydrogen ion (H+) and the base is a substance which can accept the ion. The pH then is the concentration of the ion in solution.

Normal blood pH ranges from 7. 35 to 7.

45 this is slightly to the alkaline side of the scale. If the pH is at the low end of the scale or if it is actually below 7. 35, the condition is academia. Rush if it above 7.

45 it is described as alkaline. The body is in a state of constant Change. Thus, the pH is constantly changing within this range of values. This of course is called the homeostasis process. Body waste products are constantly being reduced, and affecting the pH of the blood. As food is metabolize, these wastes are dumped into the blood and affect the PH.

There are also concurrent processes which act to balance these actions. They are known as buffers.

If the body pH should start to became too acid, the buffers work to neutralize them and balance the pH at normal levels. The exact opposite occurs in an alkaline pH situation. This buffer pair of acid-base work to maintain pH at an optimum 7. 40.

Carbonic acid and the ion bicarbonate is the buffer pair we refer to. The buffer systems ere lungs, kidneys, and the buffer system are the primary considerations in the monastic process. The lungs can control certain small amounts of carbon dioxide n the blood. Carbon dioxide in the blood chemically produces carbonic acid. Thus, in cases where the lungs do not function properly, CA builds up, causing increased carbonic acid.

This increase in acid can affect the blood pH, leading to acidosis.

The main function of kidneys is retaining or excreting of the bicarbonate ion (HCI). This is the ion which neutralizes the excess acid in the blood. If both organs are working properly, the natural build? Up of acids can be neutralized effectively by the buffer system. The buffer system in the body is able to work very quickly to maintain proper pH of the blood and body tissues.

The prime buffer system is the system of carbonic acid and bicarbonate. Bicarbonate will neutralize the correct numbers of carbonic acid molecules to maintain the correct ratio of 20: 1 acid molecules. This 20: 1 ratio will preserve the blood pH at the normal range of 7. 35 to 7. 45.

Bicarbonate ions and carbonic acid are constantly being produced and combined in order to keep the optimal PH.

The respiratory system also works to maintain the proper blood PH. En the bicarbonate/carbonic acid buffer system cannot work fast enough to insensate for pH disturbances, the respiratory system has a mechanism for buffering the blood. Hyperventilation and hyperventilation can be used by the body to control the amount of carbonic acid in the blood. The respiratory center in the brain responds to changing levels of carbonic acid in the blood. When the acid level of blood increases, and is not controlled by the first buffer system, the respiratory system responds.

Hyperventilation causes the body to exhale and " get rid of" CA from the blood, through the lungs. This reduction of CA causes the blood pH to become less acid. Reduce the CA and the acid level of the blood is reduced. This is how the body responds to excess acid in the blood. The opposite mechanism occurs Ninth hyperventilation. Hyperventilation will cause the retention of CA in the blood.

As En discussed earlier, this CA becomes carbonic acid when it remains in the blood increased acid could " buffer" any excess base that is present in the blood. If the blood becomes alkaline, then hyperventilation may be another way to neutralize it and get the blood pH back to normal.

These respiratory conditions will be discussed in more detail later in this text. In the lab, pH is measured directly using an electrode placed in the blood sample.

The " p" of pH is actually defined as " percent Hydride" or called the negative logarithm of the hydrogen concentration. The concentrations can be expressed as 10-7, for example; this means: 0. 0000001. This negative logarithm can also be expressed as the inverse ratio (Cooper 1987).

The more hydrogen ions there are, the lower the pH, or acid. On the other hand, as the hydrogen ion concentration decreases in the blood, the pH increases (alkalinity). A third buffer system exists that will react if the first two methods fail to correct an abnormal blood PH.

This third and powerful buffer system is the kidney. The kidneys will react to sustained and/or high levels of acid and/or alkalinity. The kidney buffer system responds to these dangerous levels, called “ metabolic” conditions.

These conditions are metabolic acidosis and alkaloids, and will be discussed later. CA + H2O WHICH HCI- + H+ Normal HCI- is: 24 to 28 Rene/L) NORMAL vs.. ABNORMAL BAG VALUES or continue the discussion from the previous section, we must now look at the value of the carbon dioxide in the blood. CA levels are reported on the BAG test as the partial pressure of carbon dioxide. APPC levels will directly affect the levels of acid in the blood.

APPC normal – 35 to 45 mm Hag Increases above the levels indicated, could possibly mean that the CA is building due to hyperventilation or respiratory failure of some kind. Decreased levels of CA can indicate the opposite type of problem, hyperventilation, as discussed earlier. Analysis of respiratory status First: examine pH value; if HIGH (above 7. 45), ALKALOIDS is present THEN: examine CA LEVELS, If below 35 raring, RESPIRATORY ALKALOIDS present IF: PH was low Below 7. 35) and CA levels are High (above 45 mm Hag), RESPIRATORY ACIDOSIS present As you see, the conditions of respiratory acidosis or respiratory alkaloids can be determined by examining Just the pH and the carbon dioxide levels in the blood.

In fact, there are two ways that the pH values can be affected.

Earlier we demonstrated that the respiratory system will increase or decrease breathing when the acid levels are too high or too low. The reverse condition can also occur. If some other factor(s) directly causes either hyperventilation or hyperventilation, then the acid content of the blood will be forced to go up or down.

Examples of these conditions are described below. So remember that respirations can be considered a buffer to help he body; or, if there is a primary respiratory problem, it can adversely affect the blood PH. In most cases, the respiratory conditions of acidosis or alkaloids can be corrected quite simply, by merely improving the patient’s respiratory status.

Respiratory alkaloids can be reversed in most cases by merely stopping the hyperventilation. Nursing Considerations: As we look at the medical conditions which can produce pH imbalances, we will first symptom, can lead to either previously mentioned condition.

Respiratory Acid-Base Disorders Respiratory Acidosis Findings: excess CA retention H <7. 35 HC03- > 28 meg/L (if compensating) ace > 45 mm Hag Possible Causes: CONS depression from drugs, injury, or disease asphyxia hyperventilation due to pulmonary, cardiac, musculoskeletal, or neuromuscular disease Signs and Symptoms: depression headache tachycardia confusion restlessness apprehension Respiratory Alkaloids excess CA excretion pH > 7. 5 HCI- < 24 mEq/L (if compensating) pac02 < 35 mm Hg hyperventilation due to anxiety, pain, or improper ventilator settings respiratory stimulation caused by drugs, disease, hypoxia, fever, or high room temperature gram- negative bacteremia Signs and symptoms: rapid, deep breathing parasthesia light-headedness witching anxiety fear Recognition of these conditions can be the key to prevention. When administering pain meds, remember possible respiratory problems which can occur. With fever, remember hyperventilation can happen, quite subtly. METABOLIC CONDITIONS: Now we will discuss metabolic situations.

Metabolic acidosis and metabolic alkalosis conditions are determined by the levels of bicarbonate ion in blood. The kidneys excrete these ions into the urine and out of the body when not needed. As the body demands the bicarbonates to neutralize acids, the kidneys conserve bicarb ions to products of metabolism). To detect metabolic conditions: FIRST: examine pH values——High pH (above 7. 5) SECOND: examine C02 levels (assumed to be normal) THIRD: examine bicarb levels—–high bicarbonate (above 22 to 26 mEq/L) Condition: METABOLIC ALKALOSIS *opposite conditions indicate METABOLIC ACIDOSIS FIRST: LOW PH (below 7. 35) SECOND: Normal C02 levels THIRD: Low Bicarb levels Nursing Considerations in Metabolic Conditions: Metabolic Acidosis can be caused by many conditions: renal failure, shock, severe diarrhea, dehydration , diabetic acidosis, salicylate poisoning, paraldehyde The above conditions can all lead to metabolic acidosis.

Patients who have had pancreatic drainage and have had a ureterosigmoidostomy are also prone to develop a metabolic acidosis.

The nurse should observe for any of the signs or symptoms of dehydration, shock or diabetic acidosis. Mental confusion, disorientation, and other neurological signs should not be overlooked, especially if the patient is an unstable diabetic. Remember, the kidneys will work to relieve the acidosis, but it may not be enough to fully compensate such as in the case of aspirin overdose. With silicate poisoning, initially there is a respiratory alkaloids due to the stimulant effect of aspirin on the respiratory system. However, later Bag’s will show the true danger of silicate poisoning, in the fact that metabolic acidosis will shortly follow.

Metabolic Alkaloids can be caused by many disease conditions as well as by iatrogenic causes.

The following are the most frequently seen causes of metabolic alkaloids: severe and/or prolonged vomiting, Cunning’s disease, administration of large amounts of sodium bicarbonate, diuretic therapy (long-term), steroid therapy Along-term), prolonged GIG (gastrointestinal) suctioning Every nurse should be aware of the great imbalances which might be brought on by suctioning of any kind. Especially long? Term instigators suctioning can induce fluid and electrolyte imbalances and can lead to alkaloids. A common cause of alkaloids is hyperventilation.

This respiratory condition can lead to metabolic alkaloids especially if another of the above disorders is present. One of the first symptoms seen in these cases is dizziness. Other symptoms of increased alkaline include numbness and tingling in extremities, weakness, twitching of the muscles, and some arrhythmias may be seen. Metabolic Acid-Base Disorders Metabolic Acidosis HCI- loss (acid retention) pH < 7. 35 HC03- < 24 rnECl/L

Apace > 35 mm Hag (if compensating) HCI- depletion due to renal disease, diarrhea, or small-bowel fistulas excessive diabetes mellitus, hypoxia, shock, and drug intoxication Signs and Symptoms fatigue fruity breath drowsiness lethargy nausea ‘ omitting coma (if severe) Metabolic Alkaloids HCI- retention (acid loss) HCI- > 28 Renee/L Inadequate excretion of acids due to renal disease Loss of hydrochloric acid from prolonged vomiting or gastric suctioning 0 Loss of potassium due to increased renal excretion (as in diuretic therapy) or steroid overdose 0 excessive alkali ingestion Signs and Symptoms: low, shallow breathing hypersonic muscles apathy irritability tenant seizures Oxygenation status In the previous section, acid? Base balance concepts were presented. Those simple respiratory and metabolic disease conditions can be determined by analysis of the results of the BAG.

We also discussed the many clinical applications of this knowledge. Next, we will present the oxygenation concepts involved with Interpretation of the BAG. Oxygen as a gas in our atmosphere is in the concentration of about 21%. It is important to know that the patient was breathing room air when the BAG sample was obtained.

As with all gases, oxygen is also measured in its partial pressure. Partial pressure of a gas refers to the pressure a gas exerts as a result of its molecular activity in a mixture of gases.

The lab results of the Bag’s are reported as percentages and partial pressures of these gases. For our purposes as nurses, these percentages and partial pressures should only be used as a normal POP (partial pressure of oxygen) is 80? 100 meg. All this should really mean to us is that in arterial blood, 80 to 100 meg represents the “ amount” of oxygen that is dissolved in each 100 ml of the arterial blood. If a patient’s POP results are 70, hen we know there is an insufficient amount of dissolved oxygen present.

Clinically, there can be many different reasons for this. The patient may be anemic, or may have decreased respirations, or may have pneumonia. All or any of these conditions may lead to low POP. Oxygen Content of the Blood: Another term with which nurses should be familiar is FIEF. This term refers to fractional inspired oxygen (FIEF).

If a patient is breathing other than 21% room air, the FIEF is said to be higher or at a greater percentage. In some cases, Bag’s are analyzed simply for the results of the oxygen content. Perhaps it might already be now that the patient does not have an acid-base imbalance, but the physician is more interested in the amount of oxygen in the blood.

Remember that many COOP patients will almost always have a slight imbalance in the pH of the blood due to a Chronically high CA level. In these cases the POP is critically important for diagnosis. Oxygen Saturation of the Blood: Next we will present saturation of hemoglobin in determining BAG results.

The SIS ‘ alee is defined as the extent to which oxygen saturates the hemoglobin molecules in the Orb’s. It is expressed in a percentage, compared to the full potential of the blood to be saturated. Therefore, at full saturation the normal SIS is 95% to 100%. As you can then see, the SIS and POP are directly related to each other.

As one increases, so does the other, usually.

This holds true in the upper level numbers. However, when the relationship between these two numbers changes, it also indicates that saturation is affected by other factors not Just the amount of oxygen present. Remember that oxygen is present in the blood in two forms.

Oxygen is dissolved in the blood and oxygen is combined with hemoglobin. The solubility of oxygen depends upon the pressure of oxygen and its solubility as a gas. Oxygen dissolved in he blood represents only a very small part of the total oxygen in the blood. Most oxygen is carried on the hemoglobin.

Arterial oxygen pressure values (Papa) are used to calculate the hemoglobin saturation.

These values are also used to estimate the availability of oxygen for the vital organs of the body. The Papa is also used with the Apace, arterial carbon dioxide pressure, can be used to estimate the alveolar-arterial oxygen gradient (Gradient). Calculation of the Gradient serves as an index of lung effectiveness in gas exchange.

The wider the difference, the greater the severity of the lung dysfunction. As an example, even if the POP reaches as low as 50 to 60 meg, the oxygen saturation can remain at 85% – 90%. That is an indication that even though the oxygen levels are quite low, the saturation will be nearly normal. Clinically, this means that the patient has very little oxygen in reserve.

The kidneys respond by excreting HCI, to try to restore the normal PH. The BAG’S math be: PH 7. 5 CA-36 HCI-22 As you see, the pH is high normal, indicating that the patient is borderline alkaloid. ere low normal is trying to compensate. Another BAG will be needed soon to see if the patient has stabilized or if they are now in full blown alkaloids. If it was recognized that the patient was in compensation, the patient would be watched very carefully and probably have frequent BAG determinations to see if they were able to handle the mild hyperventilation which lead to the alkaloids.

As another example, if En are dealing with a serious metabolic problem, the condition can be much more unstable.

For example, with renal failure, the kidneys will not be able to excrete even normal amounts of HCI. This renal failure will cause alkaloids as bicarbonate builds up in the blood. The body’s initial response will be hyperventilation, in an effort to build up CA and thus neutralize the vicars with acid. The Bag’s might be: pH–7.

45 CA-45 HCI-25 Kook can see that the patient is in compensation now, but if the kidneys continue to fail, the situation will become worse, rapidly. Compensation is a delicate situation. ere patient can easily go into acidosis or alkaloids with little or no reserve power to get the situation. Also, compensatory situations can last for only a short time.

When the lungs or the kidneys respond to a pH change, they have limits to what they can do to correct the situation.

If the person is already sick, and then they also develop a pH be able to compensate for a short time, due to low body reserves. In completing our discussion on compensation, we also have to remember the patient. He/she will need to be treated as soon as possible. Since the body's own defense mechanism will last lust a short time, the nurse must look for and accurately report symptoms.

The susceptible patient must be identified and observed for life-threatening complications in the acid-base balance. However, do not forget the patient's oxygenation status. Up to this point, we have primarily been concerned with pH of the blood.