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Respiratory care in local anesthesia

Patients having surgery under local anesthesia are subject to many of the same respiratory and circulatory complications that occur in patients having surgery under general anesthesia. However, there is one essential difference. An anesthetist is usually not available to deal with the crisis.

Except for spinal and caudal blocks, local anesthetics are usually administered by the surgeon and the OR nurse is responsible for monitoring respiratory and circulatory functions. This article points out the importance of respiratory assessment to help detect a condition, which if uncorrected, could lead to intraoperative crisis.

This case study is an example of a situation that could have been prevented with proper respiratory assessment.

At 6 pm Mrs Barnes, 59, was admitted to the hospital for a right penetrating keratoplasty. She had arrived only an hour previously from her home many miles away, anxious about the surgical procedure. Her medical history included bronchitis and emphysema. She requested two pillows upon transfer to the OR stretcher and she coughed several times on the way to the OR suite. She attributed the cough to cigarettes smoked en route to the hospital.

The surgeon used a retrobulbar injection of xylocaine with epinephrine for the local anesthesia, and the nurse administered diazepam to calm Mrs Barnes's anxiety and restlessness. Oxygen was started 6 liters/minute via face mask to facilitate breathing during the procedure. During the first two hours, Mrs Barnes responded coherently and readily to direct questioning. However, as the procedure grew in length, she became unresponsive, lethargic, and her respirations became significantly depressed. The oxygen flow was continuously increased until her respirations ceased due to carbon dioxide (CO_2) narcosis.

The administration of oxygen should be treated with as much caution as the administration of any drug or other chemical agent. The

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patient with normal lungs can safely breathe oxygen via mask at a flow of 5 to 6 liters/minute for a reasonable length of time without lung tissue damage.[1] However, a patient, such as Mrs Barnes, who has a chronic obstructive lung disease (asthma, bronchitis, or emphysema), may not be able to tolerate high percentages of oxygen due to her chronically elevated CO_2 level. In these patients, hypoxia or low oxygen percentage stimulates respiratory drive. In the normal patient, respiration is regulated by CO_2. An increase in pCO_2 (hypoventilation) stimulates the respiratory center to increase respirations; and a decrease in pCO_2 (hyperventilation) stimulates the respiratory center to decrease respirations.[2]

High percentages of oxygen may markedly depress respirations; therefore, oxygen should be given to these patients only if precise calculations are determined by arterial blood gas studies.[3]

The patient with restrictive lung disease (musculo-skeletal deformity, pneumothorax, or obesity) may need increased inspired gas volume. Additional oxygen percentage may be of little benefit to this patient. It is important to distinguish between the need for increased concentration of oxygen or for increased volume only. This knowledge prevents the unnecessary administration of too much oxygen to both the obstructive and the restrictive lung disease patient.

It is neither feasible nor necessary to draw arterial blood gases on all patients receiving local anesthesia. It is feasible, however, for the OR nurse to make certain nursing judgments based on thorough but brief respiratory assessments of all patients.

Ideally, respiratory assessment should be a part of the preoperative visit. Quite often this is not possible, especially for outpatients who arrive at the hospital shortly before their scheduled procedures. This situation presents a tremendous challenge for the OR nurse, for this requires special organization of time to allow for an intraoperative respiratory assessment.

Basic to respiratory assessment is an understanding of normal respiratory physiology and respiratory gas exchange. A brief review of this is summarized in the following paragraphs.

Respiration is the exchange of gases in which the primary goal is to exchange oxygen for carbon dioxide in the body tissue cells. The O_2-CO_2 exchange takes place both at

the alveolar membrane and the tissue cell membrane. This requires the use of two different body systems: the circulatory system to carry oxygen and carbon dioxide to and from tissue cells and the respiratory system to exchange oxygen and carbon dioxide from the blood to the air.[4]

Ventilation is the movement of gas in and out of lungs. This occurs as a result of the difference in the pressure of the gases between the atmosphere and the alveoli. On inspiration, atmospheric pressure is higher than alveolar pressure; when the diaphragm descends, it increases the volume of the thoracic cavity. The pressure in the thoracic cavity falls, creates a gradient, and causes air to move from the atmosphere into the lungs. Gases always move from areas of high pressures to areas of lower pressures. Once the inspired air has filled the thoracic cavity, the pressure increases above that of atmospheric pressure, and on expiration, the air moves out of the lungs back into the atmosphere.[5]

During inspiration and expiration, oxygen from the atmosphere that enters the alveoli is higher in pressure than the oxygen in venous blood which returns from the body. At the alveolar-capillary membrane, there is a high to low pressure gradient, and oxygen flows from the alveoli into capillaries. Oxygen which is carried primarily on the hemoglobin molecule is then transported to the tissue cells and used to sustain cell life.[6]

At the cellular membrane, carbon dioxide, a by-product of cellular metabolism, crosses the cell membrane and enters the venous blood. When the venous blood returns to the lungs to be oxygenated, the carbon dioxide encounters a high to low pressure gradient. It then crosses the alveolar cell membrane and is blown off by exhalations from the lungs.[7]

Alveolar ventilation, the amount of gas moved in and out of alveoli, is controlled by both chemical and neural regulatory mechanisms. The brain stem, primarily the medulla, contains sensitive areas which repond to chemical changes in pCO_2, pO_2, and pH. Changes in pO_2 are sensed primarily by peripheral chemoreceptors in the carotid body and aortic arch. Changes in pCO_2 and hydrogen ion concentration are sensed primarily by the medulla; however, changes in these chemicals do exert some influence on the peripheral chemoreceptors.

A brief interview, inspection, and auscultation of the chest should be a part of the respiratory assessment for each patient who is to receive

Abnormal respiratory rhythm can lead to inadequate alveolar ventilation.

a local anesthetic. A suggestion for organization of time might include the following: the patient interview can be conducted when the nurse is admitting the patient to the OR suite; the nurse can inspect the patient when transferring to and positioning him on the OR table; and auscultation could accompany the routine check of vital signs, placement of monitor leads, and application of the oxygen mask or cannula. The interview can be continued during the time of inspection and, therefore, complement the physical care given by the nurse who should discuss with the patient his feelings, anxieties, and any significant health history. The nurse should ask the patient to describe past respiratory infections, the presence of cough and sputum, smoking habits, and any history of shortness of breath. Inquiries should be made about the existence of allergic reactions to drugs and of any positions which are of particular discomfort to him. This gives the nurse the opportunity to tell the patient that if he gets too warm or short of breath under the drapes during the procedure, he should inform her at the first signs of any discomfort.

The history serves two purposes: it provides information to answer questions that may arise on inspection and auscultation and talking with the patient prior to surgery can significantly reduce his anxiety. Apprehensive patients usually take rapid shallow breaths which, in a patient with normal lungs, can lead to respiratory alkalosis. In a patient with lung disease, however, rapid, shallow breaths can lead to hypoxia.

When assessing the patient, the nurse should watch carefully the movement of the thorax, diaphragm, and the use of the accessory muscles for breathing. Normally, the diaphragm contracts on inspiration and the anteroposterior diameter of the chest cavity increases. On expiration, the diaphragm relaxes and the muscles of the chest cavity return to normal. The use of abdominal or accessory muscles for breathing instead of the diaphragm is a sign that abnormal or labored breathing is occurring and indicates respiratory impairment. The nurse should continue both verbal and physical assessment to determine the cause of the impairment and relieve it if possible. For example, if secretions are causing labored breathing, the nurse instructs the patient to cough up his secretions. If the patient cannot effectively cough, the nurse initiates nasotracheal or pharyngeal suctioning.

When inspecting the patient, the nurse notes the rate, depth, rhythm,

amplitude, and symmetry of the thorax. Normal adult respiratory rate is 12 to 18 breaths per minute. Less than 12 breaths per minute can be the result of chronic obstructive lung disease or central nervous system depression from drugs. More than 18 breaths per minute can occur with conditions such as anxiety, pain, and hypoxia.[8] If anxiety exists, the nurse should talk with the patient to help relieve it and coax the patient to take slow, deep breaths. This allows for more effective filling of alveoli with oxygen. If pain is present, the nurse should assess its source and initiate measures such as repositioning to facilitate comfort for the patient. Hypoxia can be detected by an increase in respirations and pulse or the sudden appearance of restlessness or labored breathing. The nurse should assess its cause and intervene to relieve it.

Depth of respiration refers to filling the alveoli with enough gas to provide for adequate pO_2-CO_2 gas exchange. An estimate of respiratory depth can be made by an evaluation of tidal volume, the amount of air inhaled and exhaled with normal breathing. Tidal volume may be assessed by observing chest excursions and by developing a sensitivity to feeling the amount of exhaled air by hand. Inadequate depth of respirations can lead to a decrease in pO_2 and an increase in pCO_2.[9]

If obstructive lung disease is present, the patient should be encouraged to take slow, deep breaths. Use of the abdominal muscles and exhaling through the mouth will facilitate adequate emptying of the alveoli at the end of expiration. Secretions should be removed if they obstruct the airway.

Restrictive lung disease is characterized by restriction of alveolar or chest wall expansion. Abnormalities underlying this problem include pain, excessive anxiety, musculoskeletal deformities, obesity, pregnancy, pneumonia, pneumothorax, sarcoidosis, and fibrosis.[10] Patients with these diseases usually breathe rapidly and shallowly. If restrictive lung disease is present, nursing intervention to facilitate the patient to increase his tidal volume includes talking with the patient concerning his anxiety, relieving his pain, positioning him for better chest wall expansion, and encouraging him to take slower and deeper breaths.

Respiratory rhythm should be regular with a ratio of 1 inspiration to 1.5 expiration. Abnormal respiratory rhythm can lead to inadequate alveolar ventilation and will result in hypoxia and hypoxemia.[11] If abnormal or asynchronous (opposing move-

Wheezes, crowing, rales, and rhonchi are abnormal breath sounds.

ments of the chest and abdomen) respiratory rhythm is assessed, the nurse should explore the cause and consult with the physician.

Normal chest amplitude during inspiration is about two to three inches. Chest excursions should be equal and bilateral. Unequal chest excursions indicate respiratory impairment and may be due to obstruction, atelectasis, pneumothorax, pulmonary embolus, fractured ribs, or excessive pain.[13] The trachea should be in the midline. A shift to either side of the thorax may indicate tracheal obstruction or obstruction inside the thoracic cavity. A shift may also indicate atelectasis or pneumothorax.[13] Abnormalities in each of these mentioned areas should be reported to the physician prior to the surgical incision.

When inspecting the patient, the nurse should also assess facial expressions, the flaring of nostrils, cyanosis in the lips and nail beds, and labored breathing. Any observed restlessness, anxiety, and pain should be noted. Throughout the surgical procedure the patient's pulse, blood pressure, and EKG should be compared to base line readings and significant changes reported to the surgeon.

The objective of the OR nurse during auscultation prior to a surgical procedure is to evaluate the adequacy of the patient's breathing and presence or absence of secretions.

Auscultation involves the ability to hear and distinguish normal from abnormal breath sounds. Ideally, the patient should be in the sitting position but the supine position is acceptable, however, when sitting is not possible. The nurse should use the diaphragm portion of the stethoscope and ask the patient to exhale through his mouth. Exhaling through the mouth increases the ease with which breath sounds can be heard. The chest should be divided into upper, middle, and lower thirds. Each third should be compared to the third of the opposite side of the chest. The stethoscope should be moved to various sites across the lung field in each of these thirds and a thorough assessment made of both the front and back of the chest.[14]

There are three principle types of breath sounds which are heard over the lungs. Bronchial breath sounds are loud and high pitched and are heard mainly over the large airways. Vesicular breath sounds are soft and low pitched and are heard over the entire lung surface. Bronchovesicular breath sounds, which exhibit characteristics of both bronchial and vesicular sounds, are heard at the bifurcations of the large airways. If

these sounds are heard in abnormal locations, the presence of disease or obstruction is indicated. For example, if bronchial breath sounds are heard in the lung periphery, the lung is consolidated with fluid and sound is transferred with greater magnitude to the periphery. A primary cause of consolidation in the lungs is pneumonia.[15]

Abnormal sounds include wheezes, rhonchi, and crowing. Wheezes are high pitched whistling sounds indicative of narrowed or obstructed airways.[16] Wheezes are usually heard on expiration, and the nurse should be aware that if they are heard, the patient is working to ventilate his lungs. He will tire easily, and should be offered support during the transfer from stretcher to the OR table. The patient will need oxygen so the nurse should be sure a functional tank or an outlet is available. She should also have access to bronchodilating drugs. These dilate the bronchi and allow passage of gases from areas of higher to lower pressures.

Rales and rhonchi are breath sounds which occur as a result of fluid or secretions in the airways. Rales are indicative of fluid in the small airways and cannot be removed by suctioning. The nurse should be aware that the presence of fluid indicates conditions such as congestive heart failure, pulmonary edema, and pneumonia.[17] The patient with any of these diseases has less difficulty breathing if his head is elevated about 30 degrees. Many operative procedures will lend themselves to this position if the result is adequate ventilation for the patient.

The presence of rhonchi means fluid or secretions in the large airways.[18] If rhonchi are heard, the nurse should instruct the patient to cough up his secretions before the procedure begins. If the patient is unable to cough, the nurse should initiate nasotracheal or pharyngeal suctioning. Immobilization, caused by lengthy operative procedures, predispose to the accumulation of secretions in the tracheobronchial tree. By suctioning the patient prior to surgery, the nurse prevents hypoxia, tachypnea, and excessive movement from coughing by the patient during the surgical procedure. Excessive movement by the patient, especially during ophthalmic procedures, can result in permanent postoperative damage.

If rhonchi are heard, the surgeon may elect to give atropine preoperatively to dry mucous membranes and prevent accumulation of excess secretions in the tracheobronchial tree.[19]

Crowing sounds occur in the upper

Responsibility for respiratory care during local anesthesia is no mean task.

airways and indicate laryngospasm. These require immediate attention from the physician, for upper airway obstruction causes complete cessation of breathing.

The absence of breath sounds may indicate atelectasis, pneumothorax, pleural effusion, or the absence of a lung from a past pneumonectomy.[20]

It is important that the OR nurse learn to auscultate breath sounds, for the presence of secretions or airway obstruction become extremely significant in planning therapeutic intraoperative care. Two important aspects of this intraoperative care include the use of the Ambu bag and the administration of an adequate flow of oxygen.

An Ambu bag is a self-inflating manual mechanical ventilator. It is used to assist the patient to take deep breaths, to control the patient's breathing for short periods of time, and to support the patient with adequate oxygen or volume until a respirator can be connected. An Ambu bag should be available at all times and the nurse should familiarize herself with the techniques of its inflation and deflation.

Oxygen is most commonly given for hypoxia. A hypoxic patient is not usually subjected to surgery, but there are factors which may predispose to hypoxia during the procedure.

Narcotics, sedatives, and local anesthetics combined with epinephrine are primary causes of decreased ventilation and decreased coughing. A decrease in hemoglobin means a decrease in the amount of oxygen carried to the tissues; and a decrease in blood pressure means a decrease in the amount of blood circulated throughout the body.

At high altitudes, the decrease in normal barometric pressure causes a decrease in the pressure of the inspired oxygen which reaches the alveoli.[21] Normally, the blood compensates for this by increasing the cardiac output or hemoglobin concentration; but, if heart or lung disease is present, compensatory mechanisms are inadequate and supplementary oxygen concentrations must be calculated and applied.

Since hypoxia is the primary reason for giving oxygen, the following are clinical findings to guide the nurse in its administration: significant changes in vital signs (hypertension, hypotension, increased pulse, irregular pulse; a change in respiratory rate); a change in the patient's level of consciousness; the onset of anxiety or irritability; or cyanosis.[22]

Having a knowledge of these clinical findings, the OR nurse would use

the following guidelines for the administration of oxygen during the intraoperative period. A flow of 5 to 6 liters of oxygen from a humidified wall oxygen outlet is sufficient and over an extended period of time will not result in injury to the lung tissue.[23] A flow rate of 1 to 3 liters of oxygen should be given to a patient with chronic obstructive lung disease until arterial blood gas studies can be evaluated by a physician.[24] Higher flow rates of oxygen should not be administered to the chronic obstructed pulmonary disease patient because over an extended period of time, the high oxygen concentration will destroy the patient's hypoxic respiratory drive. The hypoxic respiratory drive refers to the stimulation of respiration by the chemoreceptor stimulus of a low arterial oxygen concentration.[25]

Two common methods of administering humidified oxygen in the operating room is by the face mask or nasal cannula. The face mask provides the greater flow of oxygen, but is more uncomfortable to the patient if applied for long periods of time. The nasal cannula, because of the narrow bore tubing, provides lower concentrations of oxygen and less humidity. To increase the flow of oxygen through a nasal cannula would increase the force at which oxygen flows through the nasal passages. This increased flow through the nasal passages of low humidified oxygen would result in injury to the respiratory passages.[26]

The responsibility of the respiratory care of the patient receiving local anesthesia is no mean task. The OR nurse must develop confidence in abilities to assess, communicate, and apply scientifically based nursing skills to patients. The nurse must use knowledge of patient care to complement the skills of the surgeon and anesthesiologist. □

Notes

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