DIETITIAN PRACTICE AND SKILL

Mechanical Ventilation: Nutritional Needs – Managing

What is Involved in Managing the Nutritional Needs of the Mechanically Ventilated Patient?

› Managing the nutritional needs of the mechanically ventilated patient is a standard of practice that has evolved from being adjunctive therapy used to support the patient (i.e., maintain lean body mass, preserve immune function, avoid metabolic complications) to a more proactive therapy designed to favorably modulate the immune response, prevent oxidative cellular damage, and mitigate the metabolic response to stress. However, to date there are no large prospective, blind randomized trials that provide definitive evidence regarding the optimal methods to use when determining the caloric needs and monitoring the nutritional status of patients who are receiving mechanical ventilation. The best available evidence indicates that, depending on the patient's underlying illness, enteral nutrition (EN; i.e., nutrition that utilizes the gastrointestinal [GI] tract via delivery through a tube into the stomach or small intestine) is preferred over parenteral nutrition (PN; i.e., nutrition that is administered intravenously, bypassing the GI tract) due to its role in maintaining the GI barrier function, reducing risk of infection, reducing risk of sepsis and multiorgan system failure as a result of translocation (i.e., breakdown of mucosal barrier), and lowering cost. At this time, management of nutritional needs for these patients is determined by available evidence and clinical judgment

- *What*: Patients who are intubated and mechanically ventilated cannot consume food orally and are reliant on EN or PN. Typically, the registered dietician's (RD) responsibilities for the management of the nutritional needs for these patients involve
  - collaborating with the treating clinician to assess and administer the necessary calories to meet the patient's energy needs. The individualized energy requirements of a mechanically ventilated patient are estimated based on clinical judgment and the use of standardized formulas (see *Facts and Figures*, below)
  - evaluating and monitoring fluid balance and body weight. Fluid intake is often intentionally reduced in order to avoid fluid shift to the lungs, which can lead to pulmonary edema. Measurement of body weight is used to determine the patient's fluid needs, which will affect the volume of fluid administered enterally or parenterally
  - maintaining the patient in a position to reduce the risk for aspiration (e.g., head of bed [HOB] elevation at a 30–45°angle)
  - monitoring for delayed gastric emptying (e.g., residual 200–500 mL) and intolerance of EN as determined by physical exam, abdominal X-rays, passage of flatus and stool, and complaints of pain and/or distention
  - promoting blood glucose control within prescribed limits
  - monitoring for needed medication
    - to promote gastric motility (e.g., prokinetic drugs such as metoclopramide and erythromycin) or narcotic antagonists (e.g., naloxone and alvimopan)
    - to reduce the risk for development of gastric ulcers (e.g., antacid prophylaxis); (see *Facts and Figures*, below)
  - verifying that appropriate oral care is provided to reduce the risk for ventilator-associated pneumonia (VAP)
- *How*: The nutritional status of the mechanically ventilated patient is addressed by determining the patient's metabolic rate and caloric needs, providing nutrition in

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the form of PN and/or EN, and monitoring body weight and fluid balance (e.g., by measuring daily I & O and assessing laboratory test results)
- *Where*: Mechanical ventilation is used most frequently in the ICU and less frequently in other settings (e.g., long-term care facilities or home settings)
- *Who*: Managing the patient's nutritional needs is a collaborative effort between RDs, physicians, and nurses, who undertake nutritional screening during which nutritional needs and deficits are identified

What is the Desired Outcome of Managing the Nutritional Needs of the Mechanically Ventilated Patient?

› Adequate nutrition is needed to sustain life and is essential for recovery from illness or injury. Nutritional management is especially important following serious illness or injury due to the body's hypermetabolic response to sepsis, multiple trauma, pancreatitis, and other catabolic conditions during which patients commonly demonstrate a systemic inflammatory response

Why is Managing the Nutritional Needs of the Mechanically Ventilated Patient Important?

› For the mechanically ventilated patient, some degree of alteration in nutritional status is expected due to the underlying illness or injury which increases metabolic demand, presence of the endotracheal tube (ETT) which prevents feeding by mouth, and impairment in GI functioning (e.g., gastroparesis, development of gastric ulcer) due to sedation and physiologic stress. Early detection and correction of nutritional abnormalities in a patient who is mechanically ventilated can facilitate earlier recovery and prevent further physiologic deterioration

› Nutrition must be individualized to the patient's needs—underfeeding or overfeeding can cause serious complications in the mechanically ventilated patient. Underfeeding can prevent adequate regeneration of the respiratory epithelium and can lead to respiratory muscular weakness, which can delay successful weaning and prolong mechanical ventilation. Overfeeding, especially with excessive carbohydrates (e.g., > 5 mg/kg per minute), can increase physiological stress and lead to hypercapnia (i.e., excessive production of carbon dioxide), which alters the arterial blood gasses beyond the acceptable range required to permit extubation

Facts and Figures

› Experts maintain that EN is more beneficial to patients than PN because it facilitates normal GI functioning, limits proliferation of harmful intestinal bacteria, and, when initiated within 24–48 hours of admission, is associated with shorter duration of time spent in the ICU and lower mortality rates. Evidence is mixed regarding the superiority of either gastric or intestinal feeding, but experts maintain that nasogastric tube feeding is associated with a greater risk for aspiration than other routes of enteral feeding (Academy of Nutrition and Dietetics [AND], 2012; Woo et al., 2010)

› In a study that examined the impact of how an RD makes nutritional recommendations on the timeliness of nutritional interventions for mechanically ventilated patients, researchers, researchers determined that nutrition support was most likely to be ordered the same day when the RD made the recommendation to the clinical team during medical rounds. Making a recommendation directly to the physician or via a nurse to the physician delayed the order for nutrition support (Snyder & Zabel, 2013)

› **Indirect calorimetry** (IC) is the measurement of energy requirements based on oxygen consumption, carbon dioxide production, and nitrogen release. Indirect calorimetry is the preferred method for estimating caloric requirements, but equipment required for IC measurement is not available in all facilities
- **Note:** High ventilator settings, such as those required for treatment of acute respiratory distress syndrome (ARDS), can make IC unfeasible. As an alternative measure, the patient's oxygen consumption (and, therefore, energy requirements) can be measured if the patient's hemodynamic status is monitored via pulmonary catheter

› The most commonly utilized mathematical formula is the Harris-BenedictEquation (HBE), which is a calculation (see below) that determines the basal metabolic rate (BMR; i.e., calories used for normal metabolic function while the body is completely at rest and under normal room temperature). It indirectly measures the calories required for physiologic functioning, based on an individual's gender, weight, height, and age. The Harris-BenedictEquationis as follows for
- females: BMR = 655 + (4.35 x weight in pounds) + (4.7 x height in inches) – (4.7 x age in years)
- males: BMR = 66 + (6.23 x weight in pounds) + (12.7 x height in inches) – (6.8 x age in years)

› Although the HBE does not determine the active metabolic rate (i.e., the calories necessary for various levels of activity or the calories metabolized during fever or illness, which can increase the BMR by as much as 100%), it can be adjusted by multiplying the BMR by a number that represents estimated activity levels. Penn State Equation is recommended for use in determining the caloric needs of critically ill mechanically ventilated adults with obesity. Different formats (e.g.,

PSU[2003b] or PSU[2010]) are used for patients depending on whether the patient is younger than 60 years of age or 60 years or older. Note: The AND also recommends PSU(2003b) for nonobese, critically ill mechanically ventilated adults because research indicates this equation has the best predictive accuracy in nonobese patients

Level of Activity	Multiply BMR by this Factor
Extra active (very hard exercise/work 6–7 days a week)	x 1.9
Very active (hard exercise/work 6–7 days a week	x 1.725
Moderately active (moderate exercise/work 3–5 days per week)	x 1.55
Lightly active (light exercise/work 1-3 days per week)	x 1.325
Sedentary (little or no exercise)	x 1.2

› Note: The RD should select the correct factor to be multiplied by the BMR in order to determine the energy requirements for a mechanically ventilated patient based on the specific disease process and the anticipated level of patient activity
› Researchers studying ICU patients in Malaysia found that about 79% of patients experienced multiple feeding interruptions, mainly for procedures, high GRV, diarrhea, difficulty in nasogastric tube placement, and vomiting. They suggested that since mechanically ventilated patients are at risk for nutritional inadequacy, care should be taken with ICU patients to make sure they receive adequate nutrition (Yip et al., 2014)
› Investigators in a study assessing oral intake of 50 patients in the first 7 days after extubation found that patients continued to have inadequate oral intake, with most patients consuming less than 75% of their daily caloric needs and less than 50% of their estimated protein needs during this time. Barriers to eating after extubation included nausea and anorexia. The investigators concluded that continued nutritional supplementation may be needed following extubation (Peterson et al., 2010)
› Physiologic stress leading to the development of gastric ulcers is a frequent problem in critically ill, mechanically ventilated patients. A systematic review and meta-analysis of 14 trials on the use of histamine-2 receptor antagonists and protein pump inhibitors in critically ill patients revealed that the latter drug class seems more effective in preventing upper GI ulceration or bleeding, but that there were no observable differences in length of ICU stay or incidence of pneumonia or death between the two groups (Alhazzani et al., 2013)
› Investigators in China examined resting energy expenditure (REE) as it relates to EN type in mechanically ventilated patients with COPD and concluded that low energy (hypocaloric) EN during mechanical ventilation may have better effects on improving protein nutritional status than high energy (hypercaloric) formulas in these patients. The researchers also found that measured or actual REE was significantly higher than estimated REE in both patient groups (Rao et al., 2012)
› Researchers have found that initiating either EN or PN immediately has benefits for the extremely immature newborn (EIN). With regard to PN, amino acid solutions administered at a minimum of 1 g/kg/day of protein can prevent catabolism, and are generally well tolerated by the infant. EINs receiving EN should receive trophic feedings initially, and advanced as tolerated with a goal of increasing the EN by up to 30 ml/kg/day (Barrington, 2014)
› Researchers found that using indirect calorimetry instead of Penn State equations 2010 and 2003b showed mechanically ventilated patients needing more calories than the Penn State equations indicated (Ratzlaff et al., 2016)

What You Need to Know Before Managing the Nutritional Needs of the Mechanically Ventilated Patient

› Prior to managing the nutritional needs of patients receiving mechanical ventilation, the RD should be familiar with the following:
  • The anatomy involved in endotracheal intubation that eliminates the possibility of oral nutrition. In endotracheal intubation, the ETT is passed through the oral cavity, to the oropharynx, behind the epiglottis, into the larynx, and finally into the trachea. The patient must remain NPO during endotracheal intubation because the epiglottis must remain open, leaving the

trachea unprotected. Note: The endotracheal balloon used to seal the pulmonary cavity is designed to create a closed system for respiratory support and is not primarily intended to protect the lungs from aspiration

- The importance of adequate nutrition in sustaining life and promoting recovery from illness or injury, especially the physiologic mechanisms that contribute to altered nutritional needs in mechanically ventilated patients such as
  - ↑ metabolism (i.e., energy expenditure) due to ↑ release of stress hormones in response to injury or illness
  - ↑ catabolism (i.e., muscle breakdown), which occurs following injury and which can lead to a significant ↑ in protein needs
  - ↑ risk for aspiration, if administering EN
    - Closely monitor patients with an increased risk for delayed gastric emptying (e.g., due to sepsis, sedative and/or narcotic use, head trauma, diabetes mellitus)
  - physical activity of the patient during routine nursing care, which increases the patient's energy expenditure
  - sedatives and physical inactivity/immobility, which increases the risk for gastroparesis
  - the specific changes in nutritional requirements resulting from the patient's disease state (e.g., sepsis, surgery, respiratory failure, immobilization)
  - ↑ risk for gastric ulcers related to increased physiologic stress
- The methods and components used to assess nutritional and fluid volume status in the mechanically ventilated patient
  - Metabolic energy expenditure is affected by age, gender, height, weight, and lean body mass, in addition to individualized factors such as medications, severity of injury, and physical activity level. RDs, along with physicians and nurse clinicians, collaboratively estimate the patient's daily energy requirements in order to determine the amount of nutrition that should be administered parenterally and/or enterally
  - Body weight is assessed daily in order to determine if the patient is being under- or over-fed, or is being administered the appropriate fluid volume. Patients who are mechanically ventilated and receiving PN or EN can expect to lose a small amount of weight (e.g., 0.5 lb/0.22 kg) per day due in part to insensible fluid loss, which averages 400 mL/day in an unstressed adult
  - Strict I & O is crucial in patients who are critically ill and mechanically ventilated because they are at increased risk for fluid accumulation in the lungs and pulmonary edema. Fluid accumulation is indicated by positive fluid balance (i.e., greater fluid intake than output, and weight gain)
- Mechanisms (e.g., EN, PN) of providing nutrition to the mechanically ventilated patient
  - Patients who have underlying metabolic diseases (e.g., hypertension, diabetes mellitus, renal insufficiency) may require certain dietary restrictions (e.g., low sodium, low potassium, fluid restriction). The RD will take into account the presence of these metabolic diseases before initiating EN or PN
- Components of the current guidelines published by AND, the American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.), and the Society for Critical Care Medicine as they relate to patients who are receiving mechanical ventilation. Note: The guidelines are primarily focused on critically ill patients
  - Recognition that EN is the preferred method of nutritional support therapy, as compared with PN. Repeated efforts should be made to initiate EN for patients who were stabilized with PN
    - Contraindications for EN include hemodynamic instability, bowel obstruction, high output fistula, and severe ileus
  - Early initiation of EN (i.e., within the first 24–48 hours following admission)
    - The A.S.P.E.N. guidelines recommend that EN be withheld from patients with hemodynamic compromise who require high doses of catecholamine agents, alone or in combination with large volume fluid or blood product resuscitation, until the patient is fully resuscitated and/or stable
    - Evidence of bowel function (e.g., presence/absence of bowel sounds, evidence of passage of flatus/stool) is not required to initiate EN
    - No nutritional support therapy should be provided if EN is not feasible or available during the first 7 days following ICU admission
    - Critically ill patients who require EN and who are receiving mechanical ventilation should be fed through a small-bowel feeding tube instead of a gastric tube due to the reduced risk for gastroesophageal reflux and evidence that links small-bowel feeding with a reduced risk for VAP
  - Adherence to a protocol that promotes moderately strict control of serum glucose (e.g., 110–150 mg/dL recommended by A.S.P.E.N. and 140–180 mg/dL recommended by AND)
  - Formulation recommendations:
    - Patients with severe acute lung injury and ARDS should receive an EN formulation characterized by an anti-inflammatory lipid profile (i.e., omega-3 fish oils, borage oil [e.g., γ–linolenic acid]) and antioxidants that are designed to manipulate respiratory quotient and reduce carbon dioxide production. However, specialty

high-lipidlow-carbohydrate formulations are not recommended for routine use in patients with other forms of acute respiratory failure—fluid-restrictedcalorically dense formulations should be administered to these patients
- Antioxidant vitamins and trace minerals (specifically selenium) should be administered to all critically ill patients who receive specialized nutrition
- Enteral glutamine should be administered to burn and trauma patients, if feasible. Parenteral glutamine should be considered for all patients in the critical care setting who require PN
- No recommendation was made for the addition of probiotic agents; however, their use has been shown to improve outcome (by decreasing the overall rate of infection) in certain patient groups (e.g., those who received transplanted organs, who underwent major abdominal surgery, and who experienced severe trauma)

– Monitor laboratory test results
- Serum phosphate levels should be monitored closely. Note: Phosphate is necessary for normal diaphragmatic contractility and optimal pulmonary function
- Additional test results to monitor include
  - albumin
  - magnesium, a micronutrient that has a reciprocal relationship with phosphorous. Hypomagnesemia can result from diuretic use, concurrent with hypophosphatemia and/or hypokalemia. Magnesium is necessary for cellular metabolism and muscle contraction
  - antioxidants (e.g., vitamins E and C, β-carotene, and selenium), which prevent and/or treat the cellular damage induced by free radicals

– Use of chlorhexidine gluconate mouthwash twice daily should be performed to reduce the risk of VAP

– The surrogate markers for aspiration (e.g., blue food coloring and glucose oxidase strips [used to detect glucose-containing feeding in tracheal secretions]) should not be used in the critical care setting due to their poor sensitivity/specificity

– Diarrhea associated with EN should be investigated for etiology—infectious diarrhea vs. osmotic diarrhea. Common causes of diarrhea include excessive intake of hyperosmolar medications such as sorbitol, use of broad spectrum antibiotics, or infectious etiologies such as *Clostridium difficile*. Peptide or soluble-fiber-containing formulations can be added in the presence of osmotic diarrhea

• Indications for PN, when EN is not feasible or available

– For patients who, prior to hospitalization, were previously healthy with no evidence of protein-calorie malnutrition, PN (without soy-based lipids) should be initiated only after the first 7 days of hospitalization

– For patients who, prior to hospitalization, were not previously healthy or have evidence of protein-caloriemalnutrition, PN should be initiated as soon as possible following adequate resuscitation, if applicable

– For patients who anticipate major upper GI surgery and EN is not feasible, PN should be initiated only if the duration of the therapy is anticipated to be ≥ 7 days
- If the patient is malnourished prior to hospitalization, PN should begin within 5–7 days preoperatively and continued postoperatively
- If the patient is not malnourished prior to hospitalization, PN should be withheld in the immediate postoperative period but not delayed beyond >7 days postoperatively

– For patients who are unable to meet their energy requirements (i.e., 100% of target goal calories) after 7–10 days via EN, PN may be added as a supplement to enteral feedings

› Preliminary steps that should be performed before managing nutritional needs in a patient who is mechanically ventilated include the following:

• Review the facility/unit specific protocol regarding mechanical ventilation, including information specific to nutritional management, if one is available

• Review the treating clinician's order for

– nutritional therapy

– laboratory tests, medications, and/or other treatments or procedures to be completed/administered in conjunction with nutritional support therapy

• Review the manufacturer's instructions for all equipment to be used and verify that the equipment is in good working order

• Verify completion of facility informed-consent documents. Typically, the general consent for treatment executed by patients at the outset of admission to a medical facility includes standard provisions that encompass nutritional support therapy

• Review the patient's medical history/medical record for

– any allergies (e.g., to latex or other substances); use alternative materials, as appropriate. **Be especially alert to egg-relatedallergies because the base for lipids can include egg phospholipids**

  - laboratory tests related to EN/PN administration for abnormal values; advise the treating clinician if unexpected values are present
  - social and medical history, which will contain data regarding the patient's baseline nutritional status, presence of metabolic diseases (e.g., diabetes mellitus, renal disease), and normal dietary habits. Review the patient's record for fluid balance and history of bowel movements
- Gather supplies necessary for the procedure, which typically include the following:
  - Nonsterile gloves (several pairs of nonsterile gloves and a pair of sterile gloves are needed if dressing change is necessary). Other personal protective equipment (PPE; e.g., eye protection, gown, and mask) may be needed if exposure to body fluids is anticipated. Note: Some facility/unit specific protocols require that the clinician wear a mask when opening the closed system (e.g., connecting or disconnecting PN-related administration sets)
  - Device for weighing the patient (e.g., bed scale)
  - Calculator
  - Facility-approved pain assessment tool appropriate for use in mechanically ventilated patients
  - Physical assessment equipment (e.g., thermometer and other devices for obtaining vital signs, stethoscope for auscultating bowel sounds, tape measure for obtaining abdominal girth)
  - Blood glucose monitoring device
  - Supplies and equipment for administering EN or PN (e.g., prescribed formula, tubing, feeding pump, syringes, prescribed flush)
  - Dressing supplies, if dressing change is required
  - Materials to permit communication with the mechanically ventilated patient (e.g., writing pad/board)

How to Manage the Nutritional Needs of the Mechanically-Ventilated Patient

The RD is responsible for assessing the nutritional needs of the patient; selecting the appropriate formula, route, and method of administration; and determining volume, frequency/duration, and requirement for formula delivery (over a set number of hours), as well as flush volume and frequency. Nurse clinicians are generally responsible for administration and patient care-related management of EN/PN. RDs should be familiar with the administration process and collaborate with nurse clinicians where appropriate

- Perform hand hygiene
- Assess the EN/PN solution and prepare it for infusion
  - If refrigerated, remove the solution from the refrigerator 30 minutes to 1 hour before administration to let the solution warm to room temperature. Cover the container to prevent the degradation of vitamins due to exposure to light if the solution does not include lipids
  - Using the facility policy for administering high-alert medication, check the
    - EN/PN order from the treating clinician against the label placed on the solution container by the pharmacy (or the dietary office if EN is a commercial preparation)
    - name on the solution container to confirm that it matches the patient's name
    - the solution container to confirm that the expiration date and time have not passed
  - Observe the solution for abnormalities (e.g., clarity vs. cloudiness; absence of discoloration, sediment, or floating particulate matter)
  - Gently squeeze the bag to check for leaks
  - If any abnormality is observed, return the PN solution to the pharmacy or dietary office, as appropriate
- Identify the patient according to facility protocol
- Establish privacy by closing the door to the patient's room and/or drawing the curtain surrounding the patient's bed
- Introduce yourself to the patient and family member(s), if present; explain your clinical role; assess the coping ability of the patient and the family and for knowledge deficits and anxiety regarding EN/PN administration
  - Follow facility protocols for using a professional certified medical interpreter, either in person or via phone, when a language barrier exists
  - Explain the procedure for administration of EN/PN and its purpose; answer any questions and provide emotional support as needed
- Don mask if indicated by facility/unit protocol; don other PPE if exposure to body fluids is anticipated
- Raise the bed to a height that offers optimal access to the patient. Position the patient
  - so that risk of contamination from oral or pharyngeal bacteria is reduced; ask the patient to turn his or her head away from the catheter insertion site (if PN is being administered) or the naso/oro/gastric/intestinal tube (if EN is being administered)

- to minimize aspiration risk (e.g., HOB elevation at a 30–45ºangle)

› Don nonsterile gloves

› Assess the patient's general health status, including his/her level of pain, using a facility-approved pain assessment tool, and the catheter/tube insertion site for other signs and symptoms of infection, such as fever (i.e., > 100.4 ºF/38 ºC [oral] or 101.4 ºF/38.5 ºC [rectal]), pain/tenderness, redness, swelling, and exudate

- Assess for the presence of signs and symptoms that indicate poor nutrition (e.g., poor dentition, dry skin and hair, presence of poorly healing wounds)
- If EN is being administered to the stomach, assess for delayed emptying (e.g., < 200–500 mL) and EN tolerance (e.g., by physical examination, abdominal X-rays, passage of flatus and stool, and complaints of pain and/or distention)

› In accordance with the facility/unit specific protocols regarding the role of the RD during management of EN/PN, perform the following responsibilities:

- Collaborating with the physician and nurse clinician to gather information related to the patient's physical characteristics and baseline nutritional status
  - Completing the calculations necessary to determine the patient's energy requirements. Note: Some facilities require the initial request for nutritional support be completed by the RD based on prescribed formulas (see *Facts and Figures*, above) and the patient's BMI (i.e., weight-to-height ratio, calculated as kg/m^2)
  - If this is the initial assessment, obtain the patient's weight and height
  - The RD may request information related to the patient's daily care or that which is gathered during the nursing assessment to estimate/calculate the patient's energy requirements
- Administration of EN, as prescribed, and monitoring for associated complications
  - Assist with insertion of a nasogastric or nasoduodenal feeding tube, or with preparation for insertion of a gastrostomy or jejunostomy tube
  - Confirm correct placement of the tube per facility protocol
  - Administer enteral feeding, as prescribed, and in accordance with facility/unit specific protocol (e.g., flushing tube at prescribed intervals)
  - Monitor blood glucose levels every 4–6 hours or per clinician order/facility protocol
  - Strictly monitor enteral intake and amount of residual gastric contents (if indicated)
  - Monitor bowel sounds
  - Appropriately hold feedings for patient repositioning, hygiene care, feeding intolerance (e.g., vomiting), absence of bowel sounds, or signs of gastric/intestinal distention
- Administration of PN, as prescribed, and monitoring for associated complications
  - Assist with placement and periodic assessment of central venous access (for total parenteral nutrition) or peripheral venous access (for partial parenteral nutrition)
  - Administer PN, as prescribed, and in accordance with facility/unit specific protocol (e.g., flushing IV line at prescribed intervals)
  - Monitor blood glucose levels every 4–6 hours or per clinician order/facility protocol
  - Maintain sterility of the venous access site and parenteral solution
  - Change the PN solution and administration set in accordance with facility protocol
- Confirming that the infusion pump remains programmed to deliver the EN/PN solution at the prescribed rate
- Assisting the patient to a comfortable and safe position throughout the procedure
- Preparing the sterile field and maintaining sterility throughout the procedure
- Verifying that appropriate aseptic technique is maintained throughout the procedure to reduce the patient's risk of developing **bloodstream infections such as bacteremia or sepsis**
- Performing bedside serum glucose checks per facility/unit specific protocol or as indicated
- Administering medication to promote gastric motility (e.g., prokinetic drugs such as metoclopramide and erythromycin) or narcotic antagonists (e.g., naloxone and alvimopan)
- Providing appropriate oral care to reduce the risk of VAP
- Monitoring laboratory test results, and collecting and arranging for transport of ordered laboratory specimens
- Weighing the patient prior to and after EN/PN administration
- Updating daily I & O records

› Dispose of used procedure materials and PPE; perform hand hygiene

› Update the patient's plan of care, as appropriate, and document administration of EN/PN in the patient's medical record and medication administration record, including the following information:

- Date and time of EN/PN administration, dressing change, and catheter flush, if applicable
- EN/PN formulation, including additives, volume, and rate
- Patient assessment information and assessment information, including information about the catheter's integrity and placement and insertion site
- Patient's response to the therapy, including recording daily weights and I & O values
- Any unexpected patient events or outcomes (e.g., signs of feeding intolerance or aspiration), interventions performed, and whether or not the treating clinician was notified
- Patient/family education, including topics presented, response to education provided/discussed, plan for follow-up education, and details regarding any barriers to communication and/or techniques that promoted successful communication

Other Tests, Treatments, or Procedures That May be Necessary Before or After Managing the Nutritional Needs of the Mechanically Ventilated Patient

› Laboratory testing to identify preexisting malnutrition (e.g., indicated by low albumin and prealbumin levels), infection (e.g., indicated by elevated WBCs), inflammation (e.g., indicated by elevated erythrocyte sedimentation rate), or other physiologic abnormalities that can contribute to poor nutrition

› The patient's fluid volume status should be evaluated with each patient assessment; signs of fluctuations in fluid level (e.g., edema, rhonchi) should be reported to the treating clinician for appropriate management

› The patient's nutritional status will be reassessed on a continual basis to permit adjustment of the type, volume, and/or rate of EN/PN

› The need for supplemental nutrition may continue after the patient has been extubated. Administer supplemental oral EN or PN as prescribed until the patient can consume adequate calories orally

What to Expect After Managing the Nutritional Needs of the Mechanically Ventilated Patient

› The patient's caloric requirements, fluid balance, and body weight will be evaluated and continually monitored

› EN and/or PN will be administered, as prescribed, without complications

› The patient's nutritional status will be maintained or improved while mechanically ventilated

Red Flags

› Enteral feeding is preferred over parenteral feeding in mechanically ventilated patients, but is associated with greater risk for pneumonia due to aspiration. Signs and symptoms of aspiration include decreased oxygen saturation, cyanosis, and excessive pulmonary secretions. Periodically assessing for residual contents in patients receiving gastric feedings and holding enteral feeding during repositioning and patient care can reduce risk for aspiration. Aspiration risk is also reduced by elevating the patient's upper body to at least a 30º angle, as tolerated, during and for 30 minutes after feedings

› PN may increase risk for patient infection (especially catheter-relatedbloodstream infection) to a greater degree than enteral feeding. Clinicians must maintain sterility of the venous catheter, parenteral solution, and tubing to prevent contamination, which could lead to patient infection

What Do I Need to Tell the Patient/Patient's Family?

› Reinforce the treating clinician's explanation of the steps that will be taken to provide adequate nutrition while the patient is mechanically ventilated. Explain why performing laboratory testing and other diagnostic evaluations is necessary to obtain information about the patient's nutritional needs. Answer questions and address concerns of the patient/family

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