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Administration of enteral nutrition to adult patients in the prone position

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Summary
Objective: To examine the safety and efficacy of administering enteral nutrition (EN) to patients in the prone position.
Study selection and data extraction: All English-language articles describing human studies identified from data sources were reviewed for inclusion. Included studies had to have at least two groups for comparison, one or all of which had to contain adult patients managed in the prone position.
Data synthesis: Four studies were identified that met our inclusion criteria. Only two of the included studies were specifically designed to compare outcomes associated with EN in the prone versus supine position. The remaining two studies did not specifically compare EN in the prone versus supine position, but did provide some insight on the tolerability of EN in the prone position. Overall, administration of EN to patients in the prone position results in gastric residual volumes similar to those seen in the supine position and does not appear to increase the risk of vomiting or ventilator associated pneumonia.
Conclusions: There is limited evidence proving the safety and tolerability of EN administered to patients in the prone position; however, it does not substantially increase the rate of complications when compared to EN administered in the supine positioning.

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Implications for Clinical Practice

- Most identified studies evaluating EN administered to patients in the prone position did not assess pertinent EN-related outcomes.
- Gastric residual volumes do not appear to differ greatly between the prone and supine position in patients receiving EN.
- The use of EN in the prone position does not appear to substantially increase the risk of vomiting or pneumonia compared to EN administered in the supine position.
- Head-of-bed elevation and use of prokinetic agents may be effective to increase the volume of EN administered to patients in the prone position.

Background

Critical illness is associated with catabolic stress leading to a pro-inflammatory state and many physiologic derangements that may contribute to multi-organ dysfunction, infection and death. Historically, nutrition support in critically ill patients had been thought of as adjunctive therapy to maintain homeostasis and lean body mass. More recently, nutrition support is considered to be therapeutic, in that it decreases the metabolic response to stress, prevents cell injury and has favourable effects on the immune response (McClave et al., 2009). Guidelines for nutrition support in adult critically ill patients recommend enteral nutrition as the preferred route of feeding over parenteral nutrition for patients unable to maintain volitional intake. Furthermore, the guidelines recommend that enteral nutrition be started within the first 24—48 hours of admission provided that the patient is hemodynamically stable and advanced to goal over the next 48—72 hours (McClave et al., 2009). The primary benefit of enteral nutrition over parenteral nutrition is a reduction in infectious morbidity (Braunschweig et al., 2001; Gramlich et al., 2004; Moore et al., 1992; Peter et al., 2005; Simpson and Doig, 2005), including pneumonia, intra-abdominal abscess and line sepsis in one trial of patients with blunt and penetrating abdominal trauma (Kudsk et al., 1992). Enteral nutrition has also been reported to be less costly than parenteral nutrition (Gramlich et al., 2004). Initiation of enteral nutrition early in the course of hospitalisation is also important. Compared to delayed enteral nutrition, early enteral nutrition is associated with a lower incidence of infection and shorter hospital length of stay (Marik and Zaloga, 2001). Therefore, early initiation of enteral nutrition in patients with severe ARDS is an integral aspect of care in critically ill patients.

Acute respiratory distress syndrome (ARDS) is a destructive clinical syndrome of the lungs characterised by hypoxaemia and noncardiogenic pulmonary oedema. The Berlin definition of ARDS includes onset of respiratory failure not fully explained by cardiac failure or fluid overload as evidenced by bilateral opacities on chest imaging and occurring within one week of known clinical insult or new or worsening respiratory symptoms. The severity can be classified as mild, moderate or severe based on the degree of hypoxaemia as assessed by the ratio of partial pressure of oxygen in the blood (PaO_2) to fraction of inspired oxygen (FiO_2) (The ARDS Definition Task Force, 2012).

A number of treatment modalities have been studied in attempts to improve outcomes in patients with ARDS. The most successful approach has been the use of lung-protective mechanical ventilation utilising low tidal volumes (4—8 ml/kg) and permissive hypercapnia. Lung protective mechanical ventilation has been shown to reduce the number of days requiring mechanical ventilation and decrease mortality (Acute Respiratory Distress Syndrome (ARDS) Network, 2000). Other clinical trials evaluating mechanical ventilation variables and strategies, such as positive end expiratory pressure (PEEP) targets (Acute Respiratory Distress Syndrome (ARDS) Network, 2000; Briel et al., 2010; Mercat et al., 2008) and high frequency oscillatory mechanical ventilation (Gallagher et al., 1989; Hurst et al., 1990; Velmahos et al., 1999) have provided inconsistent results, not demonstrated mortality benefit or not thoroughly evaluated clinical endpoints. A number of pharmacologic treatment modalities, including ketoconazole, neuromuscular blocking agents, inhaled nitric oxide, inhaled prostacyclins and corticosteroids have been assessed but have not been consistently associated with improved patient outcomes (Raoof et al., 2010; Shafeeq and Lat, 2012).

Prone positioning is the process of placing a patient in a position such that they are lying flat with their chest down and back up. Prone positioning has been widely evaluated in patients with ARDS since a 1976 study showed that placing patients in the prone position could improve oxygenation (Piehl and Brown, 1976). Early trials evaluating meaningful clinical outcomes with prone positioning in patients with ARDS were conducted prior to lung protective ventilation becoming an accepted practice, which limits their generalisability (Gattinoni et al., 2001; Guerin et al., 2004; Mancebo et al., 2006). These trials and others have demonstrated improved oxygenation in patients rotated to the prone position (Fernandez et al., 2008; Gattinoni et al., 2001; Guerin et al., 2004; Mancebo et al., 2006; Taccone et al., 2009). In a more recent multicentre, prospective, randomised, controlled trial, prone positioning administered in the first 36 hours of ARDS and for at least 16 hours per day was found to be beneficial in patients with severe ARDS (i.e., PaO_2:FiO_2 less than 150) as 28-day mortality was significantly reduced with prone positioning versus supine positioning (16% vs. 32.8%, $p < 0.001$) (Guerin et al., 2013).

A cross-sectional study of anaesthesia and critical care departments found that EN is commonly withheld for a median 6 hours (interquartile range [IQR] 4—8 hours) prior to turning a patient to the prone position (Schneider et al., 2009). Theoretical concerns for administering enteral nutrition to patients in the prone position include the potential for increased residual gastric volumes leading to a decrease