Historical Highlights of the Development of Enteral Nutrition

Stanley J. Dudrick, MD[a,b,*], J. Alexander Palesty, MD[b,c]

KEYWORDS

• Enteral nutrition history • Normoglycemia • Immunonutrition
• Early ICU feeding • Glycemic control • Oral nutrition

The past 5 decades have seen great progress in the multitude of approaches to enteral feeding that are rather unique, creative, and increasingly sophisticated, and indeed, especially in more recent years, have included life-maintaining and life-saving methodologies designed and proved to sustain the provision of adequate nutritional support and therapy for a large number and variety of patients. Historically, the application, advancement, and success of enteral nutrition as a safe and effective feeding method has depended on the development of (1) enteral access devices and techniques and (2) enteral nutrient mixtures and defined formulations (**Box 1**). In the broadest sense, enteral nutritional support has been defined as any method of provision of nutrients by tube into the gastrointestinal tract, which would include a portal of entry into the alimentary tract anywhere from the esophagus to the rectum. However, from a practical modern clinical point of view, enteral nutrition is generally understood to imply a technique or method of delivering nutrients to a patient by a tube having its terminus in the stomach, duodenum, or upper jejunum.

Attempts at enteral nutritional therapy are certainly not new and can be documented for more than 3500 years to 1500 BC, when the ancient Egyptians, according to Herodotus, tied animal bladders to small clay or ceramic pipes to deliver nutrients and medications by rectal enemas.[1] More than a millennium later, in 400 BC, Greek physicians, including Hippocrates, used apparatus similar to that of the Egyptians to administer clysters of wine, milk, whey, wheat, and barley broth by rectum.[2] Relatively more recently, but still more than 500 years ago, in 1500 AD Arculanus, Ryff, and Scultetus

The authors have nothing to disclose.

[a] Department of Surgery, Yale University School of Medicine, 333 Cedar Street, New Haven, CT 06510, USA
[b] Department of Surgery, Saint Mary's Hospital/Yale Affiliate, 56 Franklin Street, Waterbury, CT 06706, USA
[c] Department of Surgery, University of Connecticut School of Medicine, 263 Farmington Avenue, Farmington, CT 06030, USA
* Corresponding author. Department of Surgery, Saint Mary's Hospital/Yale Affiliate, 56 Franklin Street, Waterbury, CT 06706.
E-mail address: sdudrick@stmh.org

Surg Clin N Am 91 (2011) 945–964
doi:10.1016/j.suc.2011.05.002 **surgical.theclinics.com**
0039-6109/11/$ – see front matter

Box 1
Development phases of enteral feeding

1. Rectal feeding 1500 BC to 1950 AD
2. Upper alimentary tract feeding (pharyngeal, esophageal, gastric)
   a. Description: twelfth century
   b. Use: sixteenth century
3. Oroduodenal and orojejunal feeding: 1910
4. Enteral tube feeding techniques: 1939
5. Chemically defined nutrient formulation: 1949
6. Disease- and disorder-specific nutrient formulations: 1970

used silver and lead tubes having several small side-holes to retrieve fish bones and other foreign bodies from the esophagus.[3] In 1598, Capivacceus, of Venice, attached a tube to an animal bladder to deliver nutrients through the mouth into the upper esophagus, and in 1617, Fabricius ab Aquapendente poured nutrient solutions into the buccal pouch, or introduced them into the pharynx or upper esophagus by a small silver tube placed through the nose in tetanus patients, saving some lives as a result.[3,4] Flexible leather catheters that were long enough to be advanced into the esophagus were first constructed and introduced by Van Helmont in 1646, and in 1776, John Hunter described the use of a syringe connected with a hollow bougie or flexible catheter of sufficient length to traverse the esophagus and enter the stomach to convey stimulating matter into the stomach without adversely affecting the lungs in treating a nearly drowned patient.[3,4] Later, in 1790, John Hunter reported the ingenious innovation of using a small eelskin, drawn over a flexible whalebone as an obdurator, and advanced through the esophagus into the stomach.[5] The proximal end was attached to a hollow wooden tube connected to a bladder he dissected from an animal. With this hybrid apparatus, he fed a 50-year-old stroke patient with eggs, sugar, milk, wine, and jellies until his paralyzed pharynx regained swallowing function and he could eat safely and effectively.

In the nineteenth century, stomach tubes and pumps for aspiration of gastric contents and for feeding were described in France by Dupuytren in 1803 and by Renault in 1823 and, during this same time period, in Philadelphia by Philip Syng Physick and in London by Sir Astley Cooper.[6,7] In 1878, Brown-Sequard described feeding patients with "esophageal spasm" by rectum with a finely ground mixture of two-thirds beef and one-third hog pancreas for 5 to 8 days.[8] Rectal feeding gained brief notoriety when United States President James Garfield was fed in this manner for 79 days with peptonized beef, broth, whiskey, and defibrinated blood.[9] In the early twentieth century, in 1910, Max Einhorn used his "duodenal pump," a tube with a metal capsule on the end (which was usually used for sampling duodenal content) to introduce milk, eggs, sugar, and water directly into the duodenum in patients who could not be fed by mouth or stomach.[10] He also vigorously condemned rectal feeding because of the high incidence of rectal irritation and the poor absorption of the nutrients. In 1918, Andresen introduced the concept of early postoperative feeding by starting jejunal administration of peptonized milk, dextrose, and alcohol through a Rehfuss tube, which he inserted and advanced well into the jejunum during a gastrojejunostomy operation for pyloric obstruction.[11] This concept was based on his observations that following operation, small bowel peristalsis is preserved despite the stomach