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Artículo especial

Document of standardization of enteral nutrition access in adults

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Abstract

The group of standardization and protocols of the Spanish Society of Parenteral and Enteral Nutrition (SENPE) published in 2011 a consensus document SENPE/SEGHNP/ANECIPN/SECP on enteral access for paediatric nutritional support. Along the lines of this document, we have developed another document on adult patients to homogenize the clinical practice and improve the quality of care in enteral access in this age group. The working group included health professionals (nurses, dietitians and doctor) with extensive experience in enteral nutrition and access. We tried to find scientific evidence through a literature review and we used the criteria of the Agency for Health-care Research and Quality (AHRQ) to classify the evidence (Grade of Recommendation A, B or C).

Later the document was reviewed by external experts to the group and requested the endorsement of the Scientific and Educational Committee (CCE) and the group of home artificial nutrition (NADYA) of the SENPE.

The full text will be published as a monograph number in this journal.

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Key words: *Enteral nutrition. Adult. Enteral access. Gastrostomy.*

DOCUMENTO DE ESTANDARIZACIÓN SOBRE LAS VÍAS DE ACCESO EN NUTRICIÓN ENTERAL EN ADULTOS

Resumen

El grupo de estandarización y protocolos de la Sociedad Española de Nutrición Parenteral y Enteral (SENPE) publicó en el año 2011 un Documento de Consenso SENPE/SEGHNP/ANECIPN/SECP sobre vías de acceso en nutrición enteral (NE) pediátrica. Siguiendo las líneas de este documento, hemos querido realizar un documento similar centrado en los pacientes adultos que sirva para homogeneizar la práctica clínica y mejorar la calidad de los cuidados de las vías de acceso en NE en este grupo de edad. El grupo de trabajo incluyó a profesionales (enfermeras, dietistas y médico) con extensa experiencia en NE y vías de acceso Se intentó buscar la evidencia científica mediante una revisión bibliográfica y se utilizaron los criterios de la Agency for Health-care Research and Quality (AHRQ) para clasificar la evidencia (grados de recomendación A-B-C).

Posteriormente el documento fue revisado por expertos externos al grupo y se solicitó el aval del Comité Científico Educacional (CCE) y del Grupo de Nutrición Artificial Domiciliaria y Ambulatoria (NADYA) de la SENPE.

El texto completo se publicará como número monográfico.

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Palabras clave: *Nutrición enteral. Adultos. Acceso enteral. Gastrostomía.*

Introduction

Enteral nutrition (EN) is a safe and effective technique of specialized nutritional support (SNS). Its development has been possible thanks to the advances that have occurred in recent decades, both in the chemical definition of the formula and the different routes for enteral access.

In recent years significant progress has being made to improve the security of the access and materials used in enteral nutrition, to make them incompatible with other routes of administration (essentially the intravenous access, incompatible with Luer-lock systems)[1], hoping these changes will decrease the connection errors for the administration of enteral formulas, which can be lethal to the patient if given IV.

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All this has made it possible for many patients to maintain an adequate nutritional status with the exclusive administration of EN. In addition, this treatment can be provided long term in the patient's home with many advantages to their quality of life and saving hospital costs.

Although EN is the technique of SNS of choice, there are no conclusive prospective randomised studies to demonstrate superior efficacy compared to parenteral nutrition (PN). However, EN offers many advantages over the PN: it is more physiological, is associated with fewer and less severe complications, and costs less. Furthermore, the EN has a trophic effect on the intestinal mucosa, to maintain the structural and functional integrity of the wall and collaborates in the barrier function, preventing the passage of germs and toxins inside the body[2].

Indications for EN

EN is indicated in patients who cannot, should not or do not want to eat by mouth to maintain a functioning intestine.

It is not essential that the digestive tract is fully functioning in order to initiate EN, it is sufficient to maintain a minimal functional activity, with absorptive capacity.

Before starting EN the following should be considered[3,4]:

- The nutritional status of the patient at the time the nutritional support begins.
- What percentage of the recommended intake is met orally.
- Duration of the inadequate intake prior to commencing nutritional support.

The indications and contraindications of EN are summarized in table I.

Gastrointestinal access in EN

EN enables the administration of chemically defined formulas, by mouth or through enteral tubes.

The administration of EN orally is the most physiological route because it respects the normal progression of nutrients through the gastrointestinal tract, although it requires the collaboration of the patient, a stable situation, swallowing reflex and functioning gastrointestinal transit.

The formulas used must have a pleasant taste and smell, to avoid patient rejection. In these cases the EN may be used as complete nutrition or as a supplement. This access can be useful in patients with chronic and stable processes to meet daily nutritional requirements. When the above conditions are not met, we will request EN using a different technique. The techniques used are classified into two groups: non-invasive and invasive.

Non-invasive techniques

Nasogastric tube (NGT)

The NGT is the simplest method for short-term or extended enteral access. Nasogastric feeding should never be started without checking if the distal end is located in the stomach. The most reliable method is the realization of an X-ray covering chest and abdomen before removing the guide wire and initiating nutrition. (B)[5-7].

EN through NGT is indicated in the short-term in patients whose stomach is anatomically and functionally conserved and with vomiting reflex intact. The main advantages and disadvantages of EN through an NGT are described below:

– *Advantages:*

- Can be used for the administration of medication.

Table I
Indications and contraindications of EN

EN indications	*EN contraindications*
• Undernourished patient that is not going to be able to eat in a period of time > 5-7 days and has a minimal functional absorptive capacity of the small intestine.	• *Absolute:* uncontrollable vomiting, gastrointestinal bleeding, ileus, intestinal obstruction, intestinal perforation.
• Well-nourished patient that is not going to be able to eat in a period of time > 7-9 days and has a minimal functional absorptive capacity of the small intestine.	• *Relative:* high jejunal fistulas, inflammatory bowel disease in acute phase, short < 50 cm bowel syndrome, severe acute pancreatitis.
• Patients in stage adaptation of a short bowel syndrome.	
• Patients after surgery, trauma or severe burn.	

- Low cost.
- Minimum knowledge required for their placement.

– *Disadvantages:*

- Can be unsightly and uncomfortable for the patient.
- Possibility of sores and nasal erosion.
- Frequent involuntary removal.
- The placement can be difficult in patients with mechanical dysphagia.
- Tubes can become blocked.
- Easily misplaced.
- Increases the chances of gastroesophageal reflux (GER) and therefore may increase the risk of aspiration.

Nasoenteric tube:
nasoduodenal (NDT)
and nasojejunal (NJT)

These types of tubes are indicated for short-term nutrition in patients who require a postpyloric approach. NDT feeding is the process of placing a tube through the nose into the duodenum. NJT feeding is placing a tube in the jejunum, through the nostril.

Sometimes the use of endoscopy or fluoroscopy techniques are required for the placement of these tubes[8]. It is mandatory to ensure a radiological control to check its location.

The nasogastric tube-nasojejunal feeding allows you to decompress the stomach while maintaining the nutrient intake in the intestine[5]. These are indicated in patients with gastric ileus of any aetiology, with bowel functioning.

The main advantage of post pyloric nasoenteral tubes is that it decreases the GER and minimizes the risk of aspiration, as well as the incidence of misplacements.

Invasive techniques

Gastrostomy

It involves placing a tube in the stomach through the abdominal wall. The performance of this technique requires the following preconditions:

- Stomach not affected by primary disease
- Gastric emptying and absence of distal obstruction
- Minimal or non-existent GER
- Vomiting reflex intact

It is indicated in patients who need enteral nutrition for more than 4-6 weeks and the digestive system is anatomical and functional (C). Also in patients with severe oesophageal stenosis that impede the placement of a nasogastric tube or in those oesophageal lesions in which the passing of the tube has a high risk of oesophageal perforation.

Contraindications of gastrostomy placement are:

- *General:* expected survival of the patient < 6-8 weeks, serious blood clotting disorders, severe infections or sepsis, heart or respiratory failure.
- *Local:* ascites, portal hypertension, peritonitis, inflammatory process or tumour along the GI tract.
- *Relative:* GER and erosive esophagitis. In patients with oesophageal stricture not dilatable, obesity and important history of gastric or abdominal surgery may be contraindications for a percutaneous endoscopic gastrostomy.

1. Surgical gastrostomy (SG)

The SG consists of the placement of a tube into the stomach through surgery. It is indicated in those patients who require long term nutritional support, when less invasive techniques, such as endoscopic or radiological placement cannot be performed or when it's done during the surgery itself.

2. Percutaneous endoscopic gastrostomy (PEG)

The PEG involves placing a tube into the stomach through the abdominal wall by endoscopy. It is simpler and cheaper than the SG. It offers the possibility of jejunal feeding (J-PEG) and gastric decompression. The most common technique of placement is the so-called "pull-through".

The contraindications of the PEG are[9-11]:

- Gastric tumours.
- Oesophageal obstruction (which prevents the passage of the endoscope).
- Severe obesity.
- Ascites, peritoneal dialysis, portal hypertension, pregnancy (relative).

3. Percutaneous radiological gastrostomy (PRG)

The PRG is the insertion of a feeding tube by direct puncture of the stomach through a guide with fluoroscopic control. This procedure is considered safe, effective and fast, which does not require general anesthesia. In addition, it is a procedure that does not require gastroscopy, and can be performed in patients with an oesophageal stricture. It is contraindicated in patients with hiatus hernia, gastric volvulus or colonic interposition.

Jejunostomy

The jejunostomy is indicated in patients who require long term enteral nutrition and a gastrostomy can not be performed as well as in the early postoperative period after major abdominal surgery. It is contraindicated in cases of complete bowel obstruction, upper GI fistula, morbid obesity, massive ascites and peritoneal dialysis.

Two different techniques can be used:

- Witzell surgical jejunostomy and fine catheter
- Jejunal access through percutaneous endoscopy or radiology

The surgical jejunostomy can be temporary or permanent. Access to the jejunum can be through a PEG or PRG with jejunal extension or directly (direct percutaneous endoscopic jejunostomy or D-PEJ, direct percutaneous radiological jejunostomy or D-PRJ).

Equipment

Nasoenteric and enterostomy tubes

In the selection of the type of feeding tube it will be necessary to take into account the materials used in its composition, length, size, the use of guide wire, type of connections, characteristics of the proximal end, characteristics of the distal end, existence of positioning marks, lubrication, cost, ease of placement, and security. At present, the two materials that are considered most appropriate are the silicone and polyurethane (PUR) to comply with all the required conditions.

As part of a program of continuous improvement and in response to the demands of the healthcare community, the Medical Nutrition International Industry (MNI) introduced in Europe, a new system of connections for EN in order to avoid incorrect connections between systems of enteral and intravenous access, which are available from September 2012 and that are adapted to the European standard UNE-IN 1615. These new systems of connection ENLock and ENPlus are specific for enteral nutrition and have been designed to be incompatible with the systems of administration with intravenous Luer connection. Some enteral nutrition companies have already incorporated these new systems of secure connection in nasogastric or nasoenteral tubes. There are also feeding tubes on the market with another type of secure connections Superlock, Nutrisafe whose downside is the lack of connectivity between equipment of different companies. Some companies maintain connections less secure (Luer or reverse Luer) that should be avoided.

Table II and III show the different types of nasoenteral and enterostomy feeding tubes respectively.

Containers for the formula

A container is a vesicle in which the formula of EN is decanted. It is recommended to use the "ready-to-use" formula made by the manufacturers.

Original container or package itself

This is the container that comes out of the manufacturing process containing the EN feed. These containers can be glass bottles or plastic airtight packaging.

This packaging of the product has several benefits:

- Reduces the risk of contamination because there is no manipulation.
- Saves costs as it doesn't need preparation.
- It is easily identified and allows the management of accurate volumes.
- The possibility of confusion with the products of PN is minimal.

Empty container

This container is used to decant the feed from the original package. They are made of polyvinyl chloride (PVC) or ethylene-vinyl acetate (EVA) and many of them are latex-free and phthalate and di(2-ethylhexyl) phthalate (DEHP).

The container may be flexible or semi-rigid. It is recommended to change the container every 24 hours.

Enteral infusion giving sets

They are manufactured in plastic and are transparent and flexible. The proximal end is adapted to the container and the distal to the feeding tube. To avoid errors in the connection of the giving sets with the formulas and catheters of intravenous infusion, some manufactures have developed secure connections incompatible with the intravenous route, both in the proximal end of the giving set (ENPlus connection) and in the distal end (connection ENLock, Nutrisafe, Superlock), unsuitable with intravenous connections Luer-lock type. In addition the side ports of these giving sets support only entry of syringes with termination ENLock connections unsuitable for intravenous infusion systems Luer-lock.

At the present time, there are universal enteral giving sets suitable for different EN containers and interchangeable between different commercial manufactures. There are two types of enteral giving sets: for administration by gravity and for administration with feeding pump. In turn, the giving sets consist of the following elements: header, filter, drip chamber, flow regulator and connector.

Table II
Type of nasoenteral feeding tube

	Abbott	*Fresemius*		*Nestlé Health Science*			*Nutricia*		*Grifols*
Brand	FLEXIFLO	FREKA TUBE ENLock	FREKA ENDOLUMINIA	FREKA TRELUMINIA	COMPACT Soft and ENLock	COMPACT STAY PUT	FLOCARE PUR	NASO-INTESTINAL BENGMARK FLOCARE	CORFLO
Material	PUR	PUR	PUR	PUR	PUR	PUR	PUR	PUR	PUR
Radiopaque	YES	YES	YES	YES	YES	YES	YES	YES	YES
Connector	Y-Port	Y-Port 8/10/12 Fr *ENLock:* 15 Fr	ENLock	ENLock jejunal nutrition Gastroic ventilation lumen with funnel connector	ENLock	ENLock jejunal nutrition Funnel connector for aspiration/gastric decompression	ENLock	ENLock	Y-Port
Guarantor (Wire introducer)	With/ Whithout	With	With	Preinstalled	With	Preinstalled	With	With	With/without
Weighted tip	YES/NO	NO	NO	NO	NO	NO	NO	NO	NO
Terminal holes	1 terminal hole 2-4 side holes	2 holes at the distal tip	4 holes for jejunal feed 1 distal hole 4 side holes	2 holes for jejunal feed 5 side holes for aspiration 5 holes for gastric ventilation		3 holes for jejunal feed 4 holes for gastric decompression	3 holes (1distal hole and 2 side holes)	At the distal end (spiral Bengmark)	1 distal hole
Caliber (Fr) Length (cm)	- 8 Fr/91-114 cm with wire introducer and weighted tip - 12 Fr/91-114 cm without wire introducer or weighted tip	8/10/12 FR/120 cm with wire introducer and without weighted tip 15 Fr/100 cm with wire introducer nd without weighted tip	8 Fr/270 cm	9 Fr jejunal feeding lumen with 16 Fr/150 cm gastric decompression lumen The jejunal end protrudes 44cm from the end gastric located 95 cm	8/10/12 Fr/ 120 cm	9Fr jejunal feeding lumen with 18 Fr/150 cm gastric decompression lumen The jejunal end protrudes 35cm from the end gastric located 115 cm	6/8/10/12/ 14 Fr/110 cm	8/10 Fr/145 cm	Guarantor: 10/12 Fr/109 cm Guarantor : 10 Fr/91 cm Guarantor : 8 Fr/91/109 cm Guarantor : 6 Fr/38/56/91 cm Without guarantor : 12 Fr/109 cm
Marking intervals	50 and 76 cm	5 cm	5 cm	5 cm	10 cm	10 cm	2 cm	cm	cm

PUR: Polyurethane; French: Caliber.
Modified from reference[12].

Table III
Type of enterostomy feeding tube

	Model	*G/PEG/J-PEG/J*	*Material*	*Connector*	*Internal retention*	*Caliber (fr) Length (cm)*	*Placement technique*	*Endoscopical removal*	*Maximum recommended usage*
Fresenius Kiabi	Freka PEG	PEG	PUR	ENLock	Bumper	9-15-20 Fr	Endoscopical	Yes	6 months
	Freka PEXACT	B	SIL	Funnel	Ballon	15 Fr	Direct puncture method with gastropexy	No	6 months
	Freka GASTROTUBE	G	SIL	Funnel	Ballon	15 Fr / 13 cm	Replacement for PEG	No	6 months
	Freka INTESTINAL TUBE	J- PEG	PUR	ENLock	Bumper	9-12 Fr/ 120 cm	Endoscopical	Yes	6 months
	Freka FCJ	JeJunostomy	PUR	ENLock	Surgical fixation plate	9 Fr/ 70 cm	Surgical	No	6 months
Nestlé Health Science	Compat NUPORT PEG	PEG	SIL	Y-Port	3-leaf internal bolster	22 Fr	Endoscopical	No	3-6 months
	Compat PEG	PEG	PUR	Y-Port	Bumper	15 Fr	Endoscopical	No	3-6 months
	Compact GASTROTUBE	Replacement for PEG	SIL	Funnel	Balloon	14-20-22 Fr	Replacement for PEG	No	3 months
	Compat Jejunalcath	Surgical jejunostomy	PUR	Luer-Lock	–	9 Fr / 70 cm	Surgical	No	90 days
	Compat J-Line	PEG	PUR	Funnel with luer-lock adaptor	–	9 Fr / 120 cm	Mediante Compat GEP 15 Fr	No	3-6 months
Nutricia	PEG Flocare	PEG	PUR+SIL	ENLock	Bumper	10-14-18 Fr/ 40 cm	Endoscopical	Yes	6 months
	J-PEG Flocare (Sonda Bengmark)	PEG-J	PUR	ENLock/Luer-Lock / Y-Port	Retention ring	9 Fr / 105 cm	Endoscopical	Yes	6 months
Grifols	MIC-Key Gastrostomy	B	SIL	Funnel / Y-Port	Balloon	12-14-16-18-20-24 Fr (0,8 to 4,5 cm)	Replacement for PEG	No	4-6 weeks
	MIC-PEG Gastrostomy	PEG	SIL	Y-Port	Bumper	14-20-24 Fr	Endoscopical	No	6 months
	MIC-G Gastrostomy	G	SIL	Y-Port	Balloon	12-14-16-18-20-22-24-26-28-30 Fr	Replacement for PEG	No	3-6 months
	MIC-B Gastrostomy (Bolus)	G	SIL	Y-Port	Balloon	12-14-16-18-20-22-24 Fr	Replacement for PEG	No	3-6 months
	MIC-KEY transgastric-jejunal	B	SIL	Funnel / Y-Port	Balloon	16/18/22 Fr/Stoma length 1 to 3,5 cm Jejunal length (15,22, 30 and 45 cm)	Endoscopical/Radiological	No	6 months
	MIC transgastric-jejunal	Jejunostomy	SIL	Y-Port	Balloon	16-18-22 Fr/ Jejunal length (15,.22, 30 and 45 cm)	Endoscopical/Radiological/ Surgical	No	6 months
	MIC Gastro-enteric	Jejunostomy	SIL	Y-Port	Balloon	16-18-20-22-24-26-28-30 Fr Jejunal length (25, 56,5 cm)	Endoscopical/Radiológical	No	6 months
	MIC Jejunal	JeJunostomy	SIL	Y-Port	–	14 Fr	Surgical	No	6 months

G: Gastrostomy tube; PEG: Percutaneous endoscopical gastrostomy; J: JeJunostomy tube; B: Button or Low profile system; SIL: Silicone; PUR: Polyurethan; FR: French (Caliber); J-PEG: Percutaneous endoscopical gastrostomy with jejunal extensión; NS: non-specified by the manufacturer. Modified from reference[12].

It is recommended that enteral giving sets are changed every 24 hours in the hospital to decrease the risk of contamination (B)[7], but in reality with good hygiene and conservation of the giving set, in our experience in the home care setting, it is possible to extend its use for a period of time greater than that[12].

Feeding pumps

Current feeding pumps are accurate, reliable and allow the management of exact volumes of feed within a given time.

There are two types of feeding pumps (table IV): peristaltic and volumetric.

In adults, it is recommended that feeding pumps have an accuracy of 10% of the volume administered (B) and it needs to be calibrated periodically (B). In the homecare setting the feeding pumps should be used safely and should not interfere with the patient`s night rest (B)[7].

Forms of administration of the EN

Place of infusion

The enteral feeding route determines the starting rate of the nutritional feeding regimen and the progression. When the infusion is in the stomach, the capacity for tolerance of the volume is much greater, allowing use of intermittent or cyclic infusion regimes delivered with a syringe or by gravity. In contrast to this, if the infusion is into the duodenum or jejunum then the volume of the nutrition administered and the infusion rate should be limited since high rate of infusion may increase the risk of feed intolerance with diarrhoea and dumping syndrome.

Initiation of enteral nutrition

The initiation of enteral nutrition will progress by following the guidelines as per-protocol according to the place of infusion and the technique of the feeding tube used. *In the non-invasive techniques EN may be start immediately* after verifying the proper placement of the feeding tube. *In the surgical techniques* (gastrostomy or jejunostomy) EN may be started between 24-48 h following the intervention (A)[7]. *In endoscopic and radiological techniques,* it is usual to start the enteral nutrition at 6 h after the technique. In the endoscopic technique recent studies indicate that it is possible to advance the start without increasing the risk of complications (B)[7].

It is not recommended to dilute the formula with water to avoid contamination and to reach as soon as possible the nutritional goals (C)[4,7].

Infusion regime

Once the correct tolerance of the EN is verified, the regime of infusion will help us to optimize the tolerance and the compliance.

The infusion regime depends on the place of infusion (gastric or intestinal), on the pattern prescribed (full or mixed), individual tolerance (diarrhoea, abdominal distension, nausea) and the needs of each patient (nutritional requirements, timetables, treatments and individual preferences).

There are different feeding regimes [9,13,14]:

- *Continuous EN:* The EN is administered continuously throughout the day at a consistent rate with a feeding pump.
- *Cycled EN:* The EN is administered on a continuous basis in a period of 8-12 hours with a feeding pump.
- *Intermittent EN:* The EN is administered not administered continuously but in short periods of time (usually according to the mealtimes), the administration can be with feeding pump, gravity or by bolus.

Monitoring

In general, during nutritional support with EN, it is recommended to monitor:

- The NGT site.
- The insertion site in case of ostomy.
- The daily amount given of EN.
- Oral intake (if any).
- Hydration status.
- Fluid balance in some cases.
- Gastric residual volume.

Method of infusion

There are three methods of infusion to deliver the EN:

1. *Syringe:* it is used for bolus enteral feeding.
2. *Gravity:* is administered through a giving set that allows regulating the infusion rate of the EN.
3. *Feeding pump:* indicated for patients who require a constant infusion rate over an established number of hours during the day and/or at night. Continuous feeding are often well tolerated and is commonly used for duodenal or jejunal infusion.

Transition of EN

1. *From EN to oral feeding:* the swallowing capacity of the patient needs to be taken into

Table IV
EN feeding pumps

Brand	*Model*	*Type of pump*	*Portable*	*Flow rate (ml/h)*	*Accuracy of flow rate*	*Size (cm) = height × length × depth*	*Battery runtime*	*Weight*
ABBOTT	Flexiflo Companion	Volumetric	Yes	5-300 ml/h 1 by 1 ml	± 10%	Only pump 10.92 × 15.24 × 4.32 Only charger 15.24 × 17.02 × 8.38	8 h to 150 ml/h	675 g Charger: 1,125 g
	Flexiflo Companion Clear Star	Volumetric	Yes	1-300 ml/h 1 by 1 ml	± 10% ± 0.5 ml/h	Only pump 10.92 × 15.24 × 4.32 Only charger 15.24 × 17.02 × 8.38	24 h	Pump: 600 g Charger: 1,125 g
	Flexiflo Quantum	Volumetric with automatic flush set	No	1-300 ml/h 1 by 1 ml Automatic flush set 25 ml of water every hour	± 10% ± 0.5 ml/h	20.96 × 19.05 × 15.24	8 h to 125 ml/h	3,270 g
	Flexiflo Patrol	Peristaltic	No	1-300 ml/h 1 by 1 ml	± 10% ± 0.5 ml/h	21.59 × 16.51 × 12.19	8 h to 125 ml/h	3,000 g
NESTLE NUTRITION	Compat Standard	Peristaltic	No	1-295 ml/h 1 by 1 ml	± 10% ± 0.5 ml/h	14 × 18 × 10	8 h to 100 ml/h	2,500 g
	Compat Go	Peristaltic	Yes	1-600 ml/h 1 by 1 ml If < 100 ml 10 by 10 ml Si > 100 ml	± 10% ± 0.5 ml/h	12.8 × 11.4 × 4.3	24 h to 125 ml/h	480 g
GRIFOLS	Nutriflow II	Peristaltic	No	1-300 ml/h 1 by 1 ml	± 10%	17 × 26 × 14	10 h to 150 ml/h	2,750 g
	Nubo	Peristaltic	Yes	1-400 ml/h 1 by 1 m	± 10%	15.5 × 10.5 × 4.5	24 h to 125 ml/h	530 g
NUTRICIA	Flocare Infinity	Peristaltic	Yes	1-400 ml/h 1 by 1 m	± 5%	9.5 × 14 × 3.5	24 h to 125 ml/h	392 g
COVIDIEN	Kangaroo cPump	Peristaltic	Yes	1-300 ml/h 1 by 1 m	± 10%	16.8 × 16.3 × 11.7	15 h to 125 ml/h	1,100 g
FRESENIUS KABI	Applix Smart	Peristaltic	Yes	1- 600 ml/h 1 by 1 ml	± 10%	12.8 × 11.4 × 4.3	24 h to 125 ml/h	480 g

account. If any alterations, a swallowing test should be performed to assess the volume and texture suitable for starting oral feeding.

2. *From PN to EN:* Rates for initiating enteral feeding after bowel rest should be slow and progressive. The current clinical situation of the patient and the progressive tolerance will establish the time from PN to EN.
3. *Trophic feeding:* Minimal quantities of enteral nutrition can have beneficial effects on the preservation of the intestinal epithelium, improves immune function and prevents the bacterial translocation in spite of not covering the daily nutritional requirements[15].

Care of enteral feeding access in adults

Common care guidelines for EN

Hand hygiene

Is the most effective method for the prevention and control of infections. The caregiver or patient should wash their hands with running water, liquid soap and dried with disposable paper towels when preparing the nutrition or when handling any part of the set.

At the hospital, after the washing of hands, it is recommended to use disposable gloves during the administration (A)[7].

Patient position during the administration of EN

The patient must be seated or at an angle of 30-45 degrees during the administration of the EN (A)[7] and between half an hour to an hour after the administration, except when it is delivered into the jejunum[16].

Oral hygiene

Although there is no oral intake, the patients must maintain a good oral hygiene: brushing with fluoride toothpaste twice a day[16] (B) and mouthwash without alcohol The toothpaste must be washed out and it is preferable not to rinse the mouth with water (B).

The consumption of foods, drinks or drugs rich in refined sugars should be avoided (C). The lips should be hydrated[17].

Water administration

Institutionalized patients must use sterile water for irrigation of the feeding tube before and after the administration of EN or medications (B)[7], while in the home setting the type of water will depend on the patient's environment. If there is an increased risk of infection or GI barrier disorder, sterile water must be used since it loses the bactericidal effect of the gastric barrier (C)[16].

Care of the EN formula

Should be stored in a clean dark place, between 15-25 degrees, avoiding extreme temperatures[18] (B).

Handling should be avoided. It is recommended that, whenever possible, use products ready to use and not powdered formulations to reconstitute (A)[7]. Handling should be done in a clean environment, using aseptic techniques and by trained personnel (A)[18] and reconstituted with sterile or purified water (B).

Hang time of enteral feeds needs to be closely monitored and depends on the type of formula presentation[3,17,19,20]:

- Airtight Packaging of plastic (semi-rigid or packs): 24 hours.
- Glass bottle: 8 hours.
- Powdered formula in a container: 4 hours.

Blockage prevention of the feeding tubes

The tube size depends on the site of the GI tract that EN will be delivered. Viscosity and drug interactions need to be taken into account[16].

Feeding tubes for intermittent feeds should be flushed with 20-30 ml of warm water before and after delivering the enteral feed. In continuous feeds water should be flushed every 4-6 hours[7] or when the formula is replaced. Maximise prevention of blockage in naso-jejunal or jejunostomy tubes. It is necessary to flush the feeding tubes before and after every medication (C)[16] even if not used.

Administering medications

Enteral guidelines should be followed to minimize complications of the enteral nutrition and medication. Medication should never be mixed directly with the enteral formula (B) or mixing different drugs together (B). The drugs should be administered separately crushed into fine powder and mixed with sterile water (B). Medication given via a feeding tube should be in liquid form whenever possible. Before the administration of the medication, EN should be stopped and the feeding tube should be flushed with 15 ml of water before and after the administration (A). In some cases, it is necessary to wait over 30 minutes to avoid the reduction of the bioavailability of the drug (A). Only syringes of oral/enteral administration (> 30 ml) should be used for the administration of medications (B).

Care of nasogastric and nasointestinal feeding tube

Silicone or polyurethane feeding tubes are flexible and have a duration of 4-6 weeks[16] (C). PVC tubes should only be used for gastric aspiration and must be changed every 3-4 days. Once the tube is placed, the guide wire should not be reintroduced[17].

Tube fixation

The nostril should be rotated, use hypoallergenic tape, change the area of the skin where it is fixed and maintain good hygiene and hydration of the skin and the nostrils at least once a day with a cotton swab or moistened gauze [17].

Control of the position of the feeding tube

Before starting the EN, the location of the feeding tube should be with abdominal X Ray. For subsequent tests, in addition to the location mark in the feeding tube, the measurement of gastric pH can be used (less than 5.5)[19,21]. This method most closely matches the effectiveness of radiation test, it is important to bear in mind those patients who are receiving treatment with antacids or continuous EN.

Care of gastrostomy and jejunostomy tubes

The replacement of the gastrostomy and jejunostomy tubes shall be carried out once a year, and in the balloon button tube every 3- 6 months.

Gastrocutaneous fistula

Accidental removal of the gastrostomy tube before the 3-4 weeks is an emergency because gastrocutaneous fistula has not formed and there is a high risk of peritonitis. If the removal is later in time, the stoma can close in 1-2 hours, so a replacement feeding tube must be introduced or a Foley catheter and return quickly to the reference hospital[21]. The caregivers and the patient must have an action plan and enough training to address this complication. At this stage you should never use a balloon button, gastrostomy or jejunostomy tube at home unless you are sure of the correct position.

Skin care stoma

The care will aimed to prevent infections, excoriations, wounds and granulomas[17]. Daily cleaning with a sterile gauze, during the first two weeks with a gauze soaked in saline water or hydrogen peroxide. From the third week the skin stoma should be clean with soap and water, rinse and dry the stoma and the surrounding area with another gauze and apply an antiseptic solution[21]. The skin of the stoma needs to kept clean, dry and hydrated[17]. It must be cleaned once a day, but if there are secretions it should be cleaned more often.

Control of feeding tube positioning

There will be daily checking reference marks, fixing systems and external length of the tube. In case of doubt the position will be confirmed by radiography, ultrasound, or measuring the gastric or intestinal pH with a colorimetric strip[17].

Specific care of button gastrostomy

Monitor the volume of the balloon at least once a month or if there are signs that it had ripped. Replacement of the button is performed every 6 months.

Specific care of the percutaneous radiologic gastrostomy (PRG)

The three anchor buttons[22,23] (three points of gastropexy and the surrounding area) must be cleaned daily with saline. To do this, the retaining plate need to be lifted carefully and cleaned with cotton swab, dried and an antiseptic solution applied. Finally a sterile gauze can be placed to cover the area.

The buttons of the gastropexy will fall between one week and three months. It is recommended to keep one for at least three weeks.

Specific care of the surgical gastrostomy and jejunostomy feeding tubes

Daily cleaning with saline in the periostomal area and attachment points is needed. Subsequently the stoma needs to be dry, apply an antiseptic and cover with a dressing[23]. It is essential to monitor presence of exudates, bleeding, or irrigation[22].

Care after enterostomy feeding tube removal

The most common complication after enterostomy feeding tube removal is the persistence of the fistula that depends on the time that it has been inserted[23].

If the duration was less than 11 months, the fistula will close spontaneously.

When a PEG or gastrostomy balloon is removed it is sufficient to make an approach with Steri-Strips® to close the stoma. If after 7-15 days has not been closed, we can cauterize the area with silver nitrate,

return to bring the ends with Steri-Strips® and treat the patient with antacids. If after 3-4 weeks of the cauterizing is not closed, it is a convenient surgical closure or by endoscopy combining cauterization and metal clips[9,24].

EN complications

Classically they are classified as mechanical, infectious, gastrointestinal, metabolic and psychological (table V).

Table V
Potential complications associated with EN

Mechanical complications	*Action*
Type of feeding tube: **Nasoentetic**	
• Nasofaringeal discomfort	➪ Mouth higiene. ➪ Use of analgesia.
• Nasal irritation or erosion	➪ Tape tube securely to avoid pressure on nose. ➪ Use smaller tube.
Type of feeding tube: **Ostomy**	
• Leakage around tube and skin scoriation	➪ Replace the feeding tube to adapt it to the stoma. ➪ Pull back on tube gently until resistance felt to ensure intestinal securing device is flush to stomach wall. ➪ Tape tube securely to abdomen ➪ Consider changing the feeding tube. . ➪ Use creams/ointments only as indicated if skin is irritated or infected.
• Buried bumper syndrome	➪ Consult with endoscopist or surgeon.
• Granulation tissue	➪ Carefully mobilise the feeding tube. ➪ Stabilize the tube. ➪ Prescribe silver nitrate, if necessary.
Type of feeding tube: **Nasoenteric / Ostomy**	
• Tube displacement	➪ Tape tube securely after position verified. . ➪ Mark with fixed marker the right position of the tube.
• Internal digestive erosions	➪ Mobilise the tube with rotary movements. ➪ Check the position of the fixation.
• Involuntary tube removal	➪ Assess changing the Access. ➪ Secure and properly protect the tube. ➪ Replaced the PEG with a replacement kit or for another PEG as soon as possible.
• Blocked tube	➪ Flush with water every 4-6 hrs with continuous feeding and after each intermittent feeding.. ➪ Dilute medication according to pharmacy, in liquid form if possible. ➪ Flush with warm water or carbonated beverage.
Mechanical complications	*Action*
Type of feeding tube: **Nasoenteric**	
• Nasal septal abscess • Sinusitis • Otitis	➪ Careful and regular mobilization. ➪ With fever and pain, remove the tube and treat. ➪ Evaluate the placement of a gastrostomy.
• Infections	➪ Daily care and cleaning stoma. ➪ Avoid placing post trauma. ➪ Use appropriate hygiene measures (hand washing, use of disposable gloves) to prevent skin infections.
• Aspiration pneumonia	➪ Check the position of the tube prior to administration. ➪ Position the patient at more than 30 º or upright even once the enteral feed is finished. ➪ Evaluate a transpiloric access. ➪ Evaluate the placement of jejunostomy.

Table V *(cont.)*
Potential complications associated with EN

Gastrointestinal complications	*Action*
Type of feeding tube: **Nasoenteric / Ostomy**	
• Nausea, vomiting, regurgitation and abdominal distension	➪ Check gastric residuals ➪ Decrease the flow rate or change to continuous feeding. ➪ Room temperature of the enteral feed. ➪ Evaluate antiemetics. ➪ Decrease the fluid intake (< 30-40% of the total calories). ➪ Isotonic formula administration.
• Constipation	➪ Regular fluid intake. ➪ Fibre-containing formula. ➪ Increase physical activity when possible. ➪ Assess all the medication. Consult pharmacy for alternative. Use of laxatives if possible.
• Diarrhoea	➪ Increase higiene measurements. Check the time of infusion and the temperature. ➪ Decrease osmolality of the formula and evaluate the need of alternative medication. ➪ Use isotonic formula. . ➪ Decrease or modify the type of fibre used. . ➪ Decrease the flow rate of the enteral feed. ➪ Remove dietary components not tolerated. ➪ Room temperature enteral feed to be administrated. ➪ Check or modify the position of the tube.
Gastrointestinal complications	*Action*
Type of feeding tube: **Nasoenteric/ Ostomy**	
• Difficulties in adapting to the new situation	➪ Psycological support. ➪ Evaluate an individual suitable enteral access. ➪ Allow to remain in certain patients food in their mouth to taste it.
Metabolic complications	*Action*
Type of feeding tube: **Nasoenteric/ Ostomy**	
• Hyperglycemia	➪ Adjust the input according to glycemia. Assess specific formula. ➪ Assess hypoglycemic agents. ➪ Blood sugar control until stabilization.
• Hypoglycemia	➪ Gradual withdrawal of the enteral feed. ➪ Keep glucose infusion or intake.
• Dehydration	➪ Replace fluids as indicated. Check electrolites, fluid balance, osmolality and renal function. ➪ Provide an adequate amount of liquid and control the abnormal fluid losses. ➪ Evaluate the use of isotonic formula.
• Inadequate serum electrolites	➪ Check blood levels and adequate the composition of the feed if possible. ➪ Treat the cause of excess losses.

Criteria of care at discharge

The possibility to administer enteral nutrition in the patient's home (HEN), has great advantages as it allows the patient to remain in their family and social environment, and reduces health care costs associated with hospitalization.

But for greater safety and effectiveness for patients with HEN, an appropriate training program for both the patient and the primary caregivers with periodic follow-up is necessary.

HEN indications

Not all patients may be candidates to receive HEN support, to ensure the effectiveness of this treatment the patient must meet a number of requirements[25,26]:

- The patient's clinical condition should allow their discharge.
- Expectations should be made for improvement of quality of life.
- The family and/or caregivers must accept nutritional therapy.
- The patient should not be discharged until enteral nutritional tolerance is assured with the same HEN regimen that will be at home.
- The patient and/or caregivers must follow a training program that includes demonstration of their ability in handling the administration of enteral nutrition and action on the most frequent complications.
- The family and social environment of the patient should be favorable, the family of the patient must be willing to collaborate and help the patient in the administration of the enteral nutrition.

Program of education and training of the patient and /or caregivers[25,27,28]

When the need for HEN is established it is necessary to carry out a program of education and training for both the patient and primary caregivers to provide management of the nutritional support at home minimizing complications and ensuring the patient's maximum independence

The staff responsible for the education in this program at discharge should assess the acquirement of knowledge necessary for the administration of the HEN.

Contents of the education and training program

- What is HEN and the objectives to be achieved with this support.
- Enteral access: should include the most common complications and how to avoid them. In the case of the nasogastric tube, it should describe the length of the tube visible to assess possible mobilizations.
- Equipment required for the administration of the enteral nutrition.
- Characteristics and management of the prescribed formula: the conditions of conservation, storage and handling (hygiene, temperature, expiration...), as well as knowledge about how to detect possible alterations of the preparation.
- Method of administration: shall state the amount and timing of administration of prescribed formula and water, as well as time of administration.
- Nursing care: frequency and how to perform oral and nasal hygiene as well as care both of the feeding tube and the stoma.

Conflict of interest

The authors declare that they have participated in activities funded by the pharmaceutical industry for the marketing of nutritional products (clinical studies, educational programmes and attendance to scientific events). No pharmaceutical industry has participated in the preparation, discussion, writing, and establishing of evidences in any phase of this article.

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