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ADVERSE EVENTS INVOLVING ENTERAL TUBES: AN INTEGRATIVE REVIEW

EVENTOS ADVERSOS RELACIONADOS À SONDA ENTERAL: REVISÃO INTEGRATIVA

EVENTOS ADVERSOS RELACIONADOS A LAS SONDAS ENTERALES: REVISIÓN INTEGRATIVA

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Objective: know the adverse events related to the insertion, maintenance and removal of enteral tube described in the literature. Method: this is an integrative literature review. The PICO strategy was used to elaborate the guiding question. This research reviewed articles published from June 2009 to July 2019 in Portuguese, Spanish and English, in the databases PubMed, Embase and Scopus. Results: 45 studies were included and categorized as adverse events involving enteral tubes related to the insertion of the tube (n=22), which caused damage such as epistaxis caused by lesion and insertion of the tube in the right-side atrium; events related to the maintenance of the tube and/or administration of the diet (n=14), such as infusing the diet into the lungs; and those related to tube removal (n=9), such as entanglements in the distal end. Conclusion: different adverse events described in literature can take place during the insertion, maintenance, diet administration, and removal of the enteral tube.

Descriptors: Intubation, Gastrointestinal. Nursing Care. Enteral Nutrition. Patient Safety. Near Miss, Healthcare.

Objetivo: conhecer os eventos adversos relacionados à inserção, manutenção e remoção de sonda enteral descritos na literatura. Método: trata-se de uma revisão integrativa de literatura. A estratégia PICO foi utilizada para formulação da questão norteadora. Foram selecionados artigos das bases PubMed, Embase e Scopus, publicados entre junho de 2009 e junho de 2019, nas línguas portuguesa, espanhola e inglesa. Resultados: foram incluídos 45 estudos, categorizados em eventos adversos relacionados à inserção da sonda enteral (n=22) que promoveram danos como epistaxe por lesão até a inserção de sonda no átrio direito; eventos relativos à manutenção da sonda e/ou administração de dieta (n=14), como a infusão de dieta em sítio pulmonar; e aqueles ocorridos na remoção (n=9), como emaranhado na ponta distal. Conclusão: diferentes eventos adversos descritos na literatura podem ocorrer na inserção, manutenção, administração de dieta e remoção da sonda enteral.

Descritores: Intubação Gastrointestinal. Cuidados de Enfermagem. Nutrição Enteral. Segurança do Paciente. Potencial Evento Adverso na Assistência à Saúde.

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Objetivo: conocer los eventos adversos relacionados a la inserción, manutención y remoción de una sonda enteral descritos en la literatura. Método: esa es una revisión integrativa de la literatura. Se utilizó a la estrategia PICO para formular la pregunta rectora. Se seleccionó artículos de las bases PubMed, Embase y Scopus publicados de junio de 2009 hasta julio de 2019 en portugués, español e inglés. Resultados: se incluyó 45 estudios y se les categorizó como eventos adversos relacionados a la inserción de la sonda enteral (n=22) y que causaron daños como epistaxis por lesión e inserción de la sonda en la aurícula derecha; eventos relacionados a la manutención de la sonda y/o la administración de dieta (n=14), como la infusión de la dieta en sitio pulmonar; y eventos relacionados a la remoción de la sonda (n=9), como el enmarañamiento del extremo distal de la sonda. Conclusión: diversos eventos adversos descritos en la literatura pueden ocurrir en la inserción, manutención, administración de dieta y remoción de la sonda enteral.

Descriptores: Intubación Gastrointestinal. Atención de Enfermería. Nutrición Enteral. Seguridad del Paciente. Near Miss Salud.

Introduction

Nasal inserted Enteral Tubes (ET) are used for patients who cannot be fed orally, but whose Gastrointestinal Tract (GIT) is still intact[1]. In clinical practice, Dobbhoff® ETs with guide wires are the most used. Their distal end can be placed before or after the pylorus, according to the characteristics of the patient[2].

Despite the lack of official data on the use of ETs, they are frequently used in hospitalized patients and even after discharge, in Long Permanence Institutions or at patient's houses[1-2]. In these environments, the nurse is the professional responsible for the different stages of care of the users of these devices, from its insertion and maintenance until its removal[3-4].

The processes involved in the assistance to patients who need to be fed via tube have their own risks of complications and Adverse Events (AE)[1]. Complications are defined by the Ministry of Health as any "Event or circumstance that could have led, or which led, to unnecessary damage to the patient"[5:7], while AE are any "Complications that lead to damage to the patient"[5:7]. In this context, one of the most feared and known AEs is the bronchopneumonia resulting from wrongly placing the ET in the respiratory tract or from the reflux of gastric content due to the esophageal positioning of the distal end of the tube[6-7].

A review[6] that involved 9.931 ET insertions found a 1.9% (n=187) proportion of cases in which the distal end was in the bronchi or in the lungs. From these, 18.7% (n=35) presented with pneumothorax associated to the bad positioning, and at least five resulted in the death of the patient. A lower proportion of wrong ET positioning was reported in a Brazilian study[7]. From the 150 insertions made in clinical patients monitored in emergency situations, 1.3% had the distal end placed in a position considered to offer risk for the administration of therapies, according to image exams. One death was associated to diet bronchoaspiration[7].

Other ET related events with high potential for harm were described by literature, usually through case reports. Among them, the Nasogastric Tube Syndrome stands out, which includes lesions to the larynx mucosa and vocal fold paresis[8-9], esophageal lacerations due to the removal of a tube which was entangled with itself[10], gastric perforations[11], insertion of the tube into the brain[12-14], hypertensive pneumothorax[15], second degree burns resulting from a tube that was disconnected from the gastric juice reflux[16], among others.

Therefore, considering these incidents or AE resulting from practices inherent to the stages of assistance to the user of ETs, the dissemination of studies that synthesize these findings seem to be of relevance. The disinformation among teams of assistance, patients and caretakers about the subject, as well as its effective magnitude and possible clinical outcomes related to the insertion, maintenance, and removal of the ETC[1], may lead them to carry out routine enteral

nutrition actions with lower than adequate levels of attention. The more the actors involved know about the theme[17], the more they will be capable of recognizing the potential risks associated to the ET, being able to take preventive actions[1] that promote an assistance that is in accordance to the directives of patient safety[5].

This study aims to know the adverse events related to the insertion, maintenance and removal of enteral tube described in the literature.

Method

This is an integrative literature review whose stages comprised the elaboration of the guiding question, a survey of literature, data collection, a critical analysis of the studies found, including an evaluation of their level of evidence, discussion of results, and the presentation of the integrative review[18]. Additionally, this review observed the recommendations of PRISMA (Transparent Reporting of Systematic Reviews and Meta-analyses)[19].

In the first stage, to elaborate the guiding question, the PICO[20] strategy was used. It refers to: P (patient/population) – adult patients using nasally inserted ETs; I (intervention) – an activity of assistance related to the insertion, maintenance or removal of enteral tubes; C (control) – does not apply; O (outcome) – any adverse event related to the maintenance or removal of enteral tubes. Therefore, the guiding question was: What are the complications and adverse events described in literature with regards to the insertion, maintenance and removal of ETs in adult patients?

To define Complications and Adverse Effects (AE), a document from the Brazilian Ministry of Health was used. Complications were thus defined as "Event or circumstance that could have led, or which led, to unnecessary damage to the patient"[5:7], while AEs were defined as any "Complications that lead to damage to the patient"[5:7].

In the research stage, clinical studies were selected. They included Portuguese, English and Spanish case reports involving patients older than 18 years of age, published in the databases U.S. National Library of Medicine (PubMed), Embase and Scopus Info Site (Scopus), from June 2009 to July 2019. The period analyzed, comprising the last ten years, was chosen due to the need to report results that were recent, thus reflecting the current practices and actions regarding the theme.

The research strategy used the following descriptors: Intubation, Nasogastric; Gastrointestinal Intubation; Intubation, Gastrointestinal; Enteral Feeding Tube, combined using the Boolean operator OR. Despite not being described in the Medical Subject Headings (MeSH), the term "Enteral Feeding Tube" was included in the research due to its wide use in clinical practice and in publications in the field.

In addition to the descriptors related to the ET, the Boolean operator AND was used to include the descriptors Adverse Effects, Pneumonia, Pneumothorax, Brain Injuries, Lung Injury and Nursing. The use of these descriptors was motivated by earlier researches, in which only the terms related to ET and Adverse Effects had been employed, leading to a very low number of results. By adding the other terms, the research brought other possible complications and adverse events into its scope, as described in the results.

This study did not include researches regarding gastrostomy or jejunostomy. This was mainly due to the difference in the characteristics of insertion and type of care required in these cases. Studies that were present in more than one database were counted in the first stage of the research, but repeated ones were later eliminated using the first research platform (PubMed) as a reference for the exclusions.

The research in the databases was carried out by two independent researchers who followed the same selection criteria (descriptors), filters (humans, age>18, language, and publication period) and were read in the same order: titles, then abstracts, and finally complete articles. At the end of each stage, the reviewers met to reach a consensus. Disagreements were resolved by a third reviewer. Selected articles were included in a database.

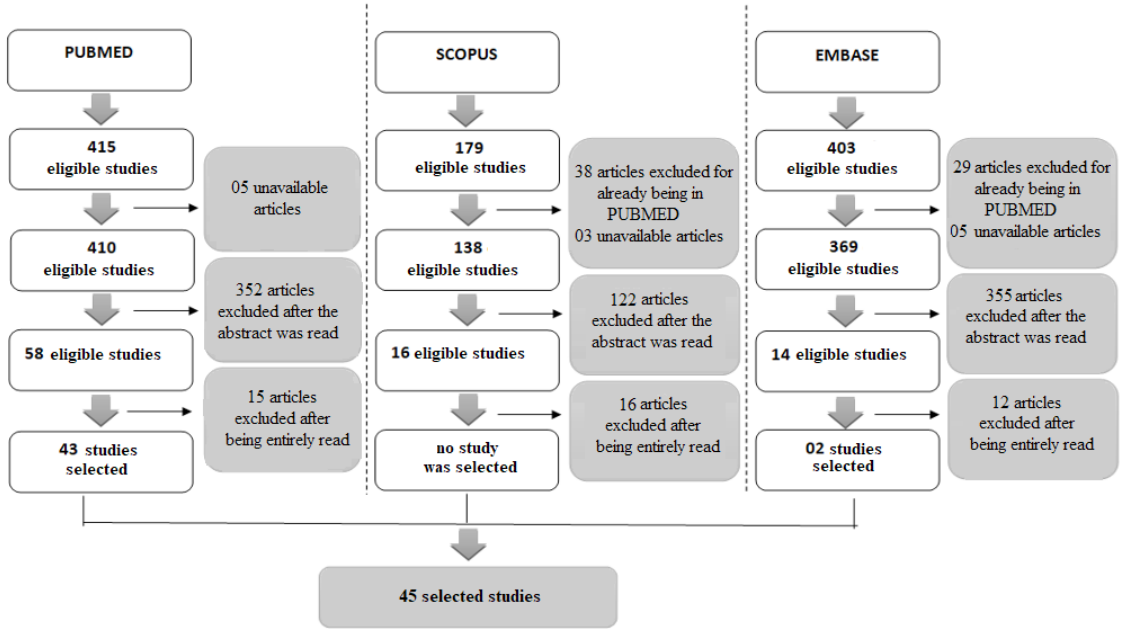
To analyze data, four synoptic tables were elaborated, including the following information: title, authors, year of publication, country of origin of the article, patient profile, design, complication or adverse event reported, possible damage caused to the patient, additional demands for care regarding the AE, in addition to information on the clinical evolution of the patient. The findings were grouped in categories according to the stage of the process of ET usage in which the AE took place: during ET insertion; during ET maintenance and diet administration; or during ET removal. It should be noted that the articles in which the ET was inserted in the lungs and there was secondary damage due to the administration of diet were placed under the category "ET maintenance and diet administration".

This review was carried out in accordance to the Brazilian legislation with regards to authorial rights[21-22] and is linked to a larger project whose ethical and methodological aspects were evaluated by a Research Ethics Committee in the institution in which the study was carried out.

Results

The Figure 1 presents data regarding the path towards the selection of the articles. From the total number of articles, 88 were read in their entirety, from which 45 were selected to be part of this review. The sample mostly comprised case reports (n=44). Exclusions in the first stage of the review were mainly due to repetition of articles found in the first database consulted (PubMed). Most exclusions happened after the abstract was read, and were due to the article addressing: gastrostomy, jejunostomy, ileostomy; methods of ET insertion and positioning; tests for the administration of medications or vitamins via ET; neonatal studies (despite the use of the age filter); gastrointestinal complications.

Figure 1 - Flowchart of the selection of the article.



Source: Created by the authors.

From the articles selected, 22 described adverse events related to the insertion of the enteral tube (Chart 1). Most of them were published in 2011 (n=4), 2012 (n=4) and 2015 (n=4). Spain (n=5) and the United States of America (n=4) were the countries with the most publications. The complications in the insertion of the enteral tube had different types of severity, going from incidents with no ET related harm to the patient, to the insertion of the tube in the brain causing cerebrospinal fluid leakage. It stands out that in 77% of these cases the patient required additional exams or procedures as a result from the insertion of the ET. Five studies had death as their clinical outcome. Four studies did not report the need for additional care and nine did not present the clinical outcome of the patient.

Chart 1 – Characterization of studies in which adverse events took place in the stage of enteral tube insertion

(continued)

Country/ Year	Adverse Event/Patient profile	Demand for additional care/ clinical evolution of the patient
United Kingdom 2012[11]	Gastric perforation after insertion. Male, 32 y/o, admitted with aneurysm of a ruptured left hepatic artery. Differential diagnostic of Fibromuscular Dysplasia	Abdominal tomography, X-rays and urgent laparotomy. The study does not report the clinical evolution.
Greece 2012[12]	Insertion into the brain. Male, 52 y/o, admitted with head trauma after an auto accident.	Prophylactic antibiotics and tomography. The study does not report the clinical evolution.
India 2010[13]	Insertion into the brain. Male, 52 y/o, admitted with severe cranio-facial trauma after an auto accident.	Critical care and mechanical ventilation. Death.
Italy 2011[14]	Brain insertion through the front sinus. Male, 80 y/o, admitted with brain hemorrhage.	Tomography. The study does not report the clinical evolution.
India 2010[23]	Insertion in the first part of the left bronchus. Male, 60 y/o, admitted into the Intensive Care Unit with dysphagia.	Mechanic ventilation. Death.
Nepal 2010[24]	Insertion into the left hemisphere of the brain. Male, 55 y/o, admitted with head trauma caused by a corn harvester.	Mechanic ventilation. Death after six days of hospitalization.
China 2011[25]	Perforation of the small intestine by the tube. Male, 78 y/o, admitted with abdominal pain after tube replacement. History of gastrectomy due to cancer.	Urgency tomography and laparotomy. Enteral tube replaced by jejunostomy. Death 19 days after surgery.
Spain 2011[26]	Esophageal perforation Distal end of the tube inserted into the right pleural cavity. Unknown sex, 88 y/o, admitted due to impacts of the bolus in the esophagus.	Thorax tomography, urgency thoracotomy, antibiotics therapy. Discharged 20 days after admission.
United Kingdom 2011[27]	Insertion of the tube in the main right bronchus leading to pneumothorax. Female, 44 y/o, admitted with Ischemic Cerebrovascular Accident.	Thorax drainage. The study does not report the clinical evolution.
Spain 2012[28]	Perforation of the retropharyngeal space, accessing the venous network through the facial venous trunk (internal jugular and superior vena cava), distal end lodged in the right-side atrium and stuck to pacemaker wiring. Male, 76 y/o, admitted with sub-aracnoid hemorrhage. History of vocal fold carcinoma.	Thorax x-ray, tomography and angiography for the removal of the tube. The study does not report the clinical evolution.

Chart 1 – Characterization of studies in which adverse events took place in the stage of enteral tube insertion

(conclusion)

Country/ Year	Adverse Event/Patient profile	Demand for additional care/ clinical evolution of the patient
United States of America 2012[29]	Insertion in the cerebral trunk and marrow with cerebrospinal fluid leakage. Male, 57 y/o, admitted in the post-operative after chordoma clivus resection surgery.	Tomography and surgery to remove the tube. Death.
India 2013[30]	Insertion in the trachea causing laryngospasm. Male, 45 y/o, admitted with brain cholecystectomy.	The study does not report any additional care. Hospital discharge.
France 2013[31]	Insertion in the trachea during stomach reduction surgery. Female, 44 y/o, admitted for a gastric bypass.	The study does not report any additional care. The study does not report the clinical evolution.
United States of America 2013[32]	Insertion led to the leakage of a pseudoaneurysm in the pharyngeal branch, leading to severe epistaxis. Female, 53 y/o, admitted with respiratory infection, abdominal pain and vomit.	Pseudoaneurysm embolization and critical care. Antibiotics therapy. Hospital discharge.
Spain 2015[33]	Insertion of the tube in the right lung, leading to pneumothorax. Female, 82 y/o, admitted with dysphagia;	Thorax drainage. The study does not report the clinical evolution.
United States of America 2015[34]	Insertion during face fracture corrective surgery, distal end of the tube in the inferior left lobe of the lung. Male, 64 y/o, admitted after face fracture.	The study does not report any additional care. Hospital discharge.
Portugal 2015[35]	Insertion of the tube in the right lung, leading pleural effusion and hydropneumothorax. Female, 62 y/o, admitted in the psychiatric ward with severe malnutrition.	Patient required a thoracic x-ray, tomography and thorax drainage. Atypical lung resection. The study reports there was clinical improvement.
Spain 2015[36]	Insertion of the tube in the right lung, leading to hydropneumothorax. Female, 46 y/o, admitted in the Intensive Care Unit with subarachnoid hemorrhage.	The study does not report any additional care. The study does not report the clinical evolution.
Saudi Arabia 2015[37]	Insertion of the tube in the main right bronchus with the distal end in the pleural space, leading to pneumothorax. Male, 60 y/o, admitted with diarrhea.	Thorax drainage. Study reports positive clinical evolution.
Spain 2016[38]	Insertion in the right lung during surgical procedure. Male, 64 y/o, admitted due to a cervical abscess.	Multiple attempts to reinsert the tube. The study does not report the clinical evolution.
United States of America 2018[39]	Multiple attempts to reinsert the tube, causing bilateral pneumothorax. Male, 74 y/o, admitted with polytrauma due to being run over by a car.	Daily x-ray and bilateral thorax drainage. Hospital discharge.
Singapore 2019[40]	Insertion of the tube in the main right bronchus leading to pneumothorax. Male, 72 y/o, admitted with Ischemic Cerebrovascular Accident.	Thorax drainage, tomography, thoracoscopy, and lower right lobe resection. Hospital discharge.

Source: Created by the authors.

14 publications resulting from many countries and mostly published in 2012 (n=4) and 2018 (n=3) identified AEs related to the maintenance of the tube or the administration of diet (Table 2). The most common AE was the administration of diet into the respiratory tract (n=6), followed by nasogastric tube syndrome (n=3), and the formation of bezoars (n=3), among other events. It stands out that only one study did not report additional exams or procedures. The others described the need of thorax drainage, antibiotic therapy, mechanic ventilation, and the use of enzymatic agents in the cases of benzoar formation. One patient needed Extracorporeal Membrane Oxygenation (ECMO). Despite more than half the studies describing, as their clinical evolution, improvements, discharges, or transferences, the outcome of two cases was the death of the patient. Two studies do not report their outcome.

Chart 2 – Characterization of studies in which the adverse event happened in the stage of tube maintenance and/or diet administration

(continued)

Country/ Year	Adverse Event/Patient profile	Demand for additional care/ clinical evolution of the patient
Brazil 2018[7]	Distal end pointed at the esophagus. Diet aspiration. The tube was removed and reinserted, and the diet was administered in a position of risk yet again. The study did not report patient data.	No additional demands were described. Death.
Japan 2016[8]	Nasogastric tube syndrome Larynx lesion caused by the tube, causing vocal fold paresis and larynx edema. Male, 76 y/o, admitted to treat colon cancer.	Bronchoscopy, mechanical ventilation and tracheostomy. Hospital discharge.
Spain 2010[9]	Nasogastric tube syndrome. Larynx lesion caused by the tube, causing vocal fold paresis and larynx edema. Female ,70 y/o, admitted with Ischemic Cerebrovascular Accident.	Tracheostomy. The study reports there was clinical improvement.
Japan 2009[41]	Insertion of the tube in the left lung with the distal end in the pleural space. Pleuritis from diet infusion. Female, 87 y/o, admitted with pneumonia and lack of appetite.	Thorax drainage and antibiotic therapy. Death 12 days after the fact. Necropsy showed an association between the pleuritis and the death.
China 2011[42]	Insertion of the tube in the right lung and infusion of the diet in the lung. Male, 49 y/o, admitted for head and neck tumor surgery.	X-ray, thorax tomography, bronchoscopy and antibiotic therapy for two weeks. Hospital discharge.
China 2012[43]	Insertion of the tube in the right lung and infusion of the diet there. Pulmonary inflammation and pleural effusion. Male, 67 y/o, admitted with ulcerative colitis.	Critical care, mechanical ventilation and fibrobronchoscopy. Patient submitted to Extracorporeal Membrane Oxygenation (ECMO). Hospital discharge.
United Kingdom 2012[44]	Insertion in the right lung, with diet infusion into the lung. Male, 54 y/o, admitted with head and neck tumor.	X-ray, antibiotic therapy and oxygen therapy. Transferred to a palliative care unit.
Ireland 2012[45]	Complete esophageal obstruction due to bezoar formation and aspiration pneumonia. Male, 20 y/o, admitted in the Intensive Care Unit with meningoencephalitis.	Mechanical ventilation and antibiotic therapy. Endoscopy to remove a bezoar. Transference to the nursing ward.

Chart 2 – Characterization of studies in which the adverse event happened in the stage of tube maintenance and/or diet administration (conclusion)

Country/ Year	Adverse Event/Patient profile	Demand for additional care/ clinical evolution of the patient
Spain 2012[46]	Insertion in the right lung, with diet infusion into the lung, leading to hydropneumothorax. Male, 77 y/o, admitted wit aspiration pneumonia History of Parkinson's disease.	Thorax drainage and antibiotic therapy. Study reports positive clinical evolution.
Ireland 2012[47]	Case 1: Insertion of the tube into the main right-side bronchus, with diet infusion into the lung, leading to pneumothorax and pneumonia. Female, 88 y/o, admitted with Ischemic Cerebrovascular Accident. Case 2: Insertion of the tube in the main left-side bronchus, with diet infusion into the lung. Patient developed pulmonary abscess and pleural effusion. Male, 73 y/o, admitted with an Ischemic Cerebrovascular Accident.	Case 1: Thorax drainage. The study does not report the clinical evolution. Case 2: thorax tomography, thorax drainage, and antibiotic therapy. The study does not report the clinical evolution.
Italy 2013[48]	Looping formation in the stomach with the distal end pointing towards the esophagus. Patient presented with vomits immediately after the diet started. Female, 68 y/o, admitted with malnutrition and dysphagia. History of Alzheimer.	Repositioning of the enteral tube through an endoscopy. Discharge from the hospital into a long-permanence institution.
Spain 2016[49]	Case 1: Complete esophageal obstruction due to bezoar formation in the distal third of the esophagus. Male, 66 y/o, admitted due to a coma and hypotension. Case 2: esophageal obstruction due to the formation of a bezoar in the proximal third of the esophagus. Male, 67 y/o, admitted with a septic shock and respiratory failure.	Case 1: gastroscopy and enzymatic agent to remove bezoar. The study does not report the clinical evolution. Case 2: gastroscopy and enzymatic agent to remove bezoar. The study does not report the clinical evolution.
Austria 2018[50]	Esophageal obstruction by bezoar. Female, elder, admitted due to a myocardial infarction.	Gastroscopy and enzymatic agent to remove the bezoar. The study does not report the clinical evolution.
Sri Lanka. 2018[51]	Nasogastric tube syndrome. Larynx lesion caused by the tube, causing vocal fold paresis and larynx edema. Female, 76 y/o, admitted with an Ischemic Cerebrovascular Accident.	Bronchoscopy, mechanical ventilation and tracheostomy. The enteral tube was replaced through a gastrostomy. Hospital discharge.

Source: Created by the authors.

Nine articles described complications and AEs related to the removal of ETs (Table 3). The most common complication was difficulties in removing the ET due to knots or entanglements of the tube in itself (n=5). One study presented a case in which the ET was sutured to the anastomosis from a gastrectomy surgery, making it impossible to remove. Two studies reported mixed AEs, related to the mistaken insertion of the tube into the respiratory tract and damage being caused to the patient during a subsequent removal to replace the tube. In six studies,

patients presented with clinical improvement and/or discharge. One study did not report the clinical outcome, and one death was ascribed to hypertensive pneumothorax secondary to the removal of the tube (which was mistakenly inserted into the lung). A case from one of the studies did not require extra care or exams.

Chart 3 – Characterization of studies in which the adverse event took place during the removal of the enteral tube.

(continued)

Country/ Year	Adverse Event/Patient profile	Demand for additional care/ clinical evolution of the patient
China 2010[10]	3x4 cm tube entanglement, leading to obstruction. Its removal led to lacerations to the esophagus. Male, 53 y/o, admitted with pneumonia. Parkinson's disease, history of head and neck cancer.	Endoscopy to evaluate esophageal lesions. Study did not report clinical evolution, but states that there were improvements in the esophageal lesions in five weeks.
Denmark 2016[15]	Insertion in the lower lobe of the right-side lung. After removal, the patient developed hypertensive pneumothorax. Female, 87 y/o, admitted with atrial fibrillation and Ischemic Vascular Accident during hospitalization.	Thorax x-ray. No report of additional care. Death.
United Kingdom 2009[52]	Distal end entangled in surgical suture. Female, 59 y/o, admitted for laparoscopic hiatal herniorrhaphy	Endoscopy to remove the tube. Hospital discharge.
United States of America 2011[53]	Difficulties in inserting the tube. As there was an attempt to remove the tube and reinsert it, it resisted. Its distal end had become entangled with itself and the patient had an epistaxis. Male, 78 y/o, admitted with an intestinal obstruction.	Cranial x-ray to identify the position of the tube. Consultations with an otolaryngologist to define future conduct, and fibroscopy to remove the tube. The study does not report the clinical evolution.
United States of America 2013[54]	Insertion in the right bronchus, distal end in the costophrenic angle, adjacent to the pleura. During removal, there was a pneumothorax. Female, 85 y/o, admitted due to dehydration.	Thorax x-ray before and after tube removal. Supplementary oxygen. The study reports there was clinical improvement.
United Arab Emirates 2016[55]	The tube was obstructed as it was entangled in itself in the nasopharynx. An attempt to remove it was unsuccessful. Male, 74 y/o, admitted with a Transitory Ischemic Accident, incapable of swallowing.	Cranial x-ray to identify the location of the tube. Fibroscopy to remove it. The study reports clinical improvement and transference to the nursing ward.
United Kingdom 2017[56]	A knot in the distal end of the tube led it to resist being removed. Patient did not suffer any damage during removal. Female, 75 y/o, admitted with intestinal obstruction.	No additional demands. Clinical and hospital improvement.
Greece 2017[57]	Looping formation, making it impossible to remove the tube. Female, 90 y/o, admitted in the endoscopy sector due to the impossibility of removing the tube. History of hiatal hernia.	Endoscopy to remove the tube. The study does not report the clinical evolution.

Chart 3 – Characterization of studies in which the adverse event took place during the removal of the enteral tube.

(conclusion)

Country/ Year	Adverse Event/Patient profile	Demand for additional care/ clinical evolution of the patient
Saudi Arabia 2018[58]	Total pre-gastrectomy insertion. Tube presented resistance to removal. An endoscopy found that the tube had been sutured in the anastomosis. Male, 41 y/o, admitted for gastrectomy due to stomach cancer.	Endoscopy to remove the tube. Hospital discharge.

Source: Created by the authors.

Discussion

This study identified incidents and adverse events related to the insertion, maintenance, and removal of ETs, as described through case reports originating from many different countries. There were several reasons for the AEs and the damage caused was of varying severity. While some patients had positive evolutions despite requiring additional treatment, a considerable number passed away. Nearly one third of the studies did not present the clinical outcome of the patient.

It should be noted that Enteral Nutrition is described as an adjunct therapy for the recovery of patients, diminishing the length of hospitalizations and the frequency of septic complications and mortality, in addition to preventing extra costs to the health system[1-2]. However, inserting and maintaining feeding devices such as nasogastric ETs is a procedure that has the risk of complications or AE[1-2], as shown by the results in this study. The ETs are mostly inserted by nurses, at bedside and with no visualization of the path the tube is traversing, which makes it impossible to guarantee that the tube is following all insertions of the gastrointestinal tract[1-4].

Data on bad ET positioning varies from 0.3 to 15%[40]. Among the most common reports in this study, are the insertion of the ET in the bronchial tree and lung[34-38] and in the brain[12,14,24,29], while esophagus[26], gastric[11], and intestine[25] perforations, as well as the insertion of the tube in an atrium[27], were reported less frequently. In some cases, previous conditions of the patient contributed for these complications[11-13,25,27,29,34,52], reiterating the need for care and clinical history evaluation, and for the nursing team to know indications and counterindications for the insertion of ETs[1-4]. Examples of this are the strict recommendation[1] not to insert tubes nasally in patients with cranial trauma, and the study[59] that showed a higher risk of bleeding in thrombocytopenic patients who undergo tube insertions.

These findings are a way to alert teams of assistance, students and caretakers with regards to the complications in this procedure. With regards to this, other insertion techniques have been studied, such as positioning the tube through a laryngoscopy[60] guided by video or electromagnetic devices[61]. A study which evaluated the insertion of the ETs using the latter method[61] found a sensitivity of 98% (CI95%: 93.9% – 99.7%) and a specificity of 100% (CI95%: 48% – 100%) when compared to a conventional x-ray. This technique makes it possible to immediately locate the tube, preventing it from staying in inadequate places until the image exam is carried out. However, these technologies still require training and, especially, have costs attached to their implementation.

Administering the diet of the patient into the respiratory tract is a frequent AE in the assistance of patients who use ETs. Despite preoccupations in determining the adequate positioning of the tube in the moment of insertion, and despite national[3-4] and international[1-2] recommendations to perform image exams, the

results of this study showed that different centers still adopted only clinical tests – listening and pH evaluation – to predict the location of the tube[40-45]. In the healthcare routine of inserting and maintaining the ETs, bedside tests were shown to be of little accuracy in this regard[62-63], and technologies such as the ultrasound have shown promise, but are still unable to eschew the use of the x-rays[64-65].

Recommendations such as that of the American Society of Parenteral and Enteral Nutrition[1] and Brazilian regulations (RDC n. 63/2000)[3] have established responsibilities and Good Practices for all stages of the process, from the insertion to the maintenance of ETs, but there are still challenges for the safe performance of these stages. Resistance and lack of knowledge are hindrances in this setting. A study[65] carried out with a nursing team showed a lack of theoretical knowledge about healthcare to ET users. In addition, during their practices, few professionals carry out any type of test to confirm the adequate positioning of the distal end of the tube.

Fewer but no less relevant studies were found regarding complications and AEs during the removal of the ET. Currently, both international[1-2] and national[3-4] regulations are lacking with regards to directives for the adequate removal of the tube. These documents, guides to healthcare practices elaborated by specialists, should involve all stages (insertion, maintenance, removal), but do not address the aspects of the latter.

Therefore, it seems important for the nurse to carry out a minute evaluation[4] not only of risk factors for bad positioning, but also to pay close attention to the moment of ET removal. The evaluation of recent image exams with regards to the moment of ET removal, the attention to the situations in which they feel resistance as they try to remove it, and attention to the complaints of the patients can be alternatives to prevent complications or AEs in this stage.

Finally, it stands out that this study described the needs for exams and additional procedures related to complications or AEs in the insertion, maintenance, and removal of ETs. Getting to know the impact of the complications for patients, professionals, and institutions[66] may collaborate for the elaboration of protocols that can make assistance safer. Another important data is the fact that 13 studies[9,11-12,14,27-28,31,33,36,38,47,49-50] did not describe the clinical outcome of their patients, which prevented this study from finding the development of these cases and accurately measure the severity of the AEs.

This study contributed to raise the awareness of nursing professionals with regards to complications and adverse events resulting from assistance to patients using enteral tubes. Only by getting to know the potential complications of the assistance process one can establish measures capable of minimizing them, avoiding AEs not only in the hospital environment, but in any level of the healthcare network.

A possible limitation of this study is that it only included articles that were fully available in the databases researched, including case reports with low evidence levels and lacking any in-depth epidemiological study. This suggests that a higher number of publications, possibly with different designs, may be available in literature, reporting other complications and AEs.

Conclusion

This study concluded that different adverse events described in literature can take place during the insertion, maintenance, diet administration, and removal of the enteral tube. Getting to know them may guarantee that nursing assistance is safe, qualified, and based on the best scientific evidence available.

Evaluations of physical conditions and of the clinical history of the patient at the time of tube insertion seem to be important strategies to minimize the risk of complications, as do the careful confirmation of the positioning shown in the x-rays and the performance of attentive removal procedures. New researches with a more robust design could be carried out as a way to synthesize the information in this field.

Collaborations:

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2 – writing of the article and relevant critical review of the intellectual content: Franciele Anziliero, Bárbara Elis Dal Soler, Bárbara Amaral da Silva, Ana Paula Almeida Corrêa and Mariur Gomes Beghetto;

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