World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

Check for updates

Aspiration pneumonia among enteral fed home care adult patients in Qatar

Muhannad B. Al Lahham [1,*], Zohair Ali Mohd Al Arabi [2], Wlla Abdallah Said Badran [3], Akshaya Kamath [4], Prem Chandra [5], Reem Khalid Al-Saadi [6] and Noora Mohammed Al -Jaffali [7]

[1] *Principal investigator, Senior clinical dietitian, Hamad Medical Corporate, Qatar.*
[2] *Co-investigator, clinical dietitian supervisor, Hamad Medical Corporate, Qatar.*
[3] *Research Assistant, clinical dietitian, Hamad Medical Corporate, Qatar.*
[4] *Research Assistant, Senior clinical dietitian, Hamad Medical Corporate, Qatar.*
[5] *Statistician, Hamad Medical Corporate, Qatar.*
[6] *Research study administrator, Director Dietetics & Nutrition-Corporate, Hamad Medical Corporate, Qatar.*
[7] *Research Study Coordinator, Corporate Head Dietitian, Hamad Medical Corporate, Qatar.*

World Journal of Advanced Research and Reviews, 2025, 28(03), 1031-1041

Publication history: Received on 08 November 2025; revised on 13 December 2025; accepted on 16 December 2025

Article DOI: https://doi.org/10.30574/wjarr.2025.28.3.4169

Abstract

Introduction: Aspiration Pneumonia is common in older people. Aspiration is preceded by symptoms of dysphagia, difficulty of oral intake, and malnutrition. The use of enteral feeding is the last option for providing nutrition and hydration. 40% of patients receiving enteral nutrition develop aspiration pneumonia with mortality rate of 17-62%.

Methods: Retrospective study method was used to collect information regarding aspiration pneumonia events among all enteral-fed home healthcare patients who met the criteria for inclusion. 276 patients were included after excluding patients who did not meet the criteria. Data collected included: age, sex, time under enteral feeding, mode of enteral feeding (bolus, continuous), route of administration (NGT, PEG), infusion rate feed volume, total calorie per day, total water flushing volume, and total water flushing and feed volume, feed strength and aspiration. Data was collected by three dietitians and checked by the principal investigator.

Results: Incidence rate of aspiration pneumonia during the year 2023 among the study population was 36.96% and mean age was 79.61 years. No significant difference was found between the variables (Sex, age, BMI, route of administration, mode of administration and use of pump). There was a noted decrease in aspiration pneumonia among those who are using pump and those using PEG. When we combined these variables against no pump use and NGT, it was not a statistically significant difference.

A statistically significant difference for aspiration pneumonia was found with less time under enteral feed, and less total water flushing per day (P-Value < 0.05). A statistically significant difference was found with higher calorie intake (P-Value < 0.01). When checked standard adult feeds with other concentrated formulas as a reference group, a significant difference was found between standard formula and 1.5 feed concentration formulas (P- Value < 0.05). All other concentrated formulas have higher aspiration percentages but are not statistically significant. The mean volumes from feed and flushing water were almost the same. The main reason for aspiration is the increased calorie intake through feeds which have higher osmolarity or osmolality.

Conclusion: Homecare patients have no active medical issues that require admission; they are considered medically stable. It is important to emphasize the application of safe enteral feeding strategies to individual patient needs.

* Corresponding author: Muhannad Al Lahham

Keywords: Aspiration Pneumonia; Enteral feeding; Naso Gastric Tube; Percutaneous Endoscopic Gastrostomy tube

1. Introduction

Aspiration pneumonia (AP) is a pulmonary infection that commonly occurs in geriatric patients [1]. Advanced age is a risk factor for pneumonia and a major cause of mortality in older adults over 70 years of age [2,3], accounting for 75% of pneumonia cases [4,5], 86.7% of which are attributed to Aspiration Pneumonia.

It is noted that patients with AP, particularly the elderly, will usually present with a history of dysphagia, difficulty with oral intake [6] and malnutrition [7].

Atypical presentations of AP include increased respiratory rate, foul-smelling sputum, hemoptysis, and fever [8]. Additionally, Impaired T cell function in older patients may hinder their ability to mount a febrile response [9]. This may lead to many complications which include chemical pneumonitis due to aspiration of acidic gastric contents, secondary bacterial infections following chemical pneumonitis or a primary infection, in addition to acute obstruction of smaller and possibly larger airways through particle-associated aspiration, which is the inhalation of particulate matters of the gastric content [10].

1.1. Risk factors for aspiration pneumonia

1.1.1. Advanced age

Either associated with multiple comorbidities [11] or related to physiological functions impairment [12]. Elderly patients in the community had the prevalence of dysphagia to be 13.8% [13], while in nursing homes the prevalence was 52.7% [14]. General medical literature suggests a prevalence rate in older adults residing in nursing homes between 40% and 60% [15].

1.1.2. Oral hygiene (Oral health)

Half of healthy adults aspirate saliva during sleep [16]. With normal immunity, good cough reflex, normal respiratory ciliary movement, and good oral hygiene, there will be no harmful effects of aspirated saliva. However, with reduced to no activity of the oral cavity along with compromised immunity, the colonization of the micro-flora and gram-negative bacteria are guaranteed. Due to low saliva production in elderly, the chances of bacterial transfer to the lung increases leading to aspiration pneumonia [17]. In contrast, good oral hygiene and the use of dentures [18] were associated with a reduced risk of aspiration pneumonia among elderly inpatients in a community-based integrated care unit [19].

1.1.3. Dysphagia and gag reflux

Stroke, advanced dementia, and Parkinson's disease are the most common causes for oropharyngeal dysphagia in older people [8,20]. Some studies report that abnormal gag reflex and cough reflex are associated with aspiration in the lungs [21]. However, other studies fail to confirm this correlation [22].

1.1.4. Medications

Diuretics, anticholinergics, anxiolytics, antipsychotics, and levodopa reduce salivary flow and increase bacterial flora in the oral cavity, whereas antipsychotics and anxiolytics, lead to impaired swallowing function because of the effect on the central nervous system [23]. Histamine H_2 blockers and PPI increase the pH of the stomach, favoring the growth of bacteria [24]. All can increase the risk of aspiration pneumonia.

1.1.5. Poor nutritional status

Low albumin level [25] and low geriatric nutritional risk index (GNRI) [26] are associated with higher risk of aspiration pneumonia among elderly patients admitted to a long-term care unit.

1.1.6. Use of tube feeding

The risk of AP might increase with the use of tube feeding [27], for several reasons, first by weakening the ability of the lower esophageal sphincter to prevent gastro-esophageal reflux after the NGT placement [28]. Second, the use of tube feeding leads to neglect of oral hygiene practices in patients. Lastly, partial pulling of the NG tube by confused elderly while the feeding is running can cause the feed to drip into the trachea, leading to AP.

Despite the higher risk of aspiration pneumonia with the use of tube feeding compared to oral feeding [28,29]. Patients who fail to meet their nutritional needs orally and are diagnosed with oropharyngeal dysphagia require the use of enteral tube feeding.

The commonly used methods of enteral tube feeding are nasogastric tube (NGT) and percutaneous endoscopic gastrostomy (PEG) [30]. For elderly patients with oropharyngeal dysphagia, PEG is a better choice than NGT for long term enteral nutrition applications. It was also noted that the risk of pneumonia requiring hospitalization was lower in patients with oropharyngeal dysphagia with PEG [31].

Though results weren't conclusive whether the risk of AP is lower with PEG than NGT [32, 33]. Conversely, PEG use carries many associated problems such as dumping syndrome, dislodgement, and movement of the tube up to stomach, that will limit its use in older patients.

In comparison feeding via percutaneous endoscopic gastrostomy with jejunal extension (PEGJ) might decrease the chance of aspiration in the selected high-risk group such as those with severe gastroparesis [34].

No difference was found in mortality rates for patients receiving enteral nutrition feeding infusion at continuous rate (CEF) or intermittent rate (IEF) and pneumonia [35,36]. However, IEF could increase the risk of developing gastrointestinal and pulmonary complications compared to CEF [37,38,39].

Similarly, Head-up positions, such as sitting and standing, and continued oral intake of water jelly administered by a speech pathologist [40] and use of a novel semi-solidifying liquid formula via the nasogastric route are considered effective in preventing aspiration pneumonia [41].

Aspiration pneumonia is the fourth-leading cause of death which resulted in 2.6 million deaths in 2019 [42], and the most common cause of death in patients with enteral tube feeding [43, 44], with Only 38% of nursing home patients were alive at 1 year after feeding tube placement [45]. While the chance of weaning off tube feeding is lower than 20% among all indications for tube placement [46], that warrants more research into this age group.

2. Study methodology

A retrospective method was used to collect information about home healthcare patients with Aspiration pneumonia on enteral feeding using data from medical files at computer-based information system (Cerner) used at Hamad Medical Corporate. Aspiration pneumonia considered in calculation was the hospital admission diagnosis. The total number of patients was 371 adult patients followed by home healthcare dietitians during the year 2023, only 276 patients of which were included after excluding patients who did not meet the inclusion criteria. Data collected included age, sex, time under enteral feeding, mode of enteral feed (bolus, continues), route (NGT, PEG), Infusion rate, feed volume, total calorie per day, total water flushing, feed strength, and aspiration. Data collection was conducted by three researchers and checked by the principal investigator.

2.1. Inclusion Criteria

Adults with enteral feeding under home healthcare department.

2.2. Exclusion Criteria

Adult Patients who were not on enteral feeding, patients with neurological dysphagia like (Amyotrophic Lateral Sclerosis, Guillain-Barré syndrome, Traumatic Brain Injury, Anoxic Brain Injury), Multiple Sclerosis, Down syndrome, Cerebral Palsy, patients under oral intake with enteral feeding and dead subjects.

3. Results

276 patients met the criteria for inclusion. Data analysis was done by the HMC statistician at ABHATH (research department) using IBM SPSS Statistics version 29.

36.96% of the study population had aspiration pneumonia during the study period (year 2023) and the mean age was 79.61 years. No significant difference was found between the variables (Sex, age, BMI, route of administration, mode of administration, and use of pump), there was a noted decrease in aspiration among those who were using pump or on

PEG, only one researcher who is working as dietitian at home healthcare collected data about the use of a pump; other dietitians could rarely find this information in dietary progress notes, so it was not collected. Results seen in table (1).

Table 1 Chi Square test of significance of variables with aspiration

Variables	# of aspiration/Total Subjects (102/276) 36.96%	P-Value
Sex Male Female	 50/130 (38.5%) 52/146 (35.6%)	0.625
Age < 80years ≥80 years	 49/135 (36.3%) 53/141 (37.6%)	0.824
BMI <22.5 ≥22.5 - <30 ≥30	 32/77 (41.6%) 52/153 (34.0%) 18/46 (39.1%)	0.504
Route NGT PEG	 81/203 (39.9%) 21/73 (28.8%)	0.091
Mode Bolus Continuous	 65/185 (35.1%) 37/91 (40.7%)	0.371
Use pump No pump	9/48 (18.8%) 11/32 (34.4%)	0.114
Use Pump and PEG No Pump and NGT	3/16 (18.8%) 10/23 (43.5%)	0.107

-Decreased percentage for PEG and patients using pump but not significantly.

We calculated the difference between patients who were using a pump and on PEG with aspiration pneumonia against those who were not using pump and on NGT and found Decreased percentage but not statistically significant difference (P-value 0.107).

Table 2 T-test for significance on variables with aspiration (n=276)

Variables	Number of patients	Mean ± SD	P-value
Age (years) No Aspiration Aspiration	 (174 Patient) (102 Patient)	 78.82 ± (12.171) 80.97 ± (11.339)	0.147
Weight (Kg) No Aspiration Aspiration	 (174 Patient) (102 Patient)	 68.037 ± (14.449) 65.71 ± (14.530)	0.198
Height (cm) No Aspiration Aspiration	 (174 Patient) (102 Patient)	 161.69 ± 8.122 161.82 ± 7.645	0.893
BMI			

No Aspiration Aspiration	(174 Patient) (102 Patient)	25.978 ± 4.94 25.017 ± 4.96	0.120
Time under enteral feed (month) No Aspiration Aspiration	 (171 Patient) (102 Patient)	 41.26 ± 30.3 32.75 ± 12.517	 0.020*
Infusion rate for (continuous feed) (ml) No Aspiration Aspiration	 (55 Patient) (36 Patient)	 51.02 ± 11.259 50.06 ± 12.517	 0.704
Total Calorie No Aspiration Aspiration	 (174 Patient) (102 Patient)	 1320.98 ± 242.96 1409.36 ± 242.61	 0.004**
Feed volume (ml) Q 4 hours No Aspiration Aspiration	 (174 Patient) (102 Patient)	 218.74 ± 71.81 219.56 ± 39.26	 0.915
Total volume from feed /day (ml) No Aspiration Aspiration	 (174 Patient) (102 Patient)	 1073.45 ± 207.435 1105.05 ± 197.437	 0.208
Total water flushing/day(ml) No Aspiration Aspiration	 (174 Patient) (102 Patient)	 990.832 ± 311.76 914.069 ± 308.42	 0.048*
Feed and water flushing volume Q4 hours (ml) No Aspiration Aspiration	 (174 Patient) (102 Patient)	 412.74 ± 74.73 403.14 ± 72.20	 0.298

* (P-Value 0.05). ** (P-Value 0.01).

Results from t-test for equality of means showed more aspiration with higher age, decreased weight, decreased BMI, and higher volume from feed, but were not statistically significant.

Height, infusion rate for continuous feed, feed volume, and feed volume together with water flushing volume showed no difference.

A statistically significant difference for aspiration was found with less time under enteral feed, and less total water flushing per day (P-Value 0.05). A statistically significant difference was found with higher calorie intake (P-Value 0.01).

We also checked if there is a difference in calorie intake between different routes of entry (NGT vs. PEG) or mode (bolus vs. continuous) with P-values: (0.462 and 0.786) respectively, which were not statistically significant.

Association between type of feed and aspiration was checked and great variation from standard feeding with higher feed concentration was found as seen in graph (1).

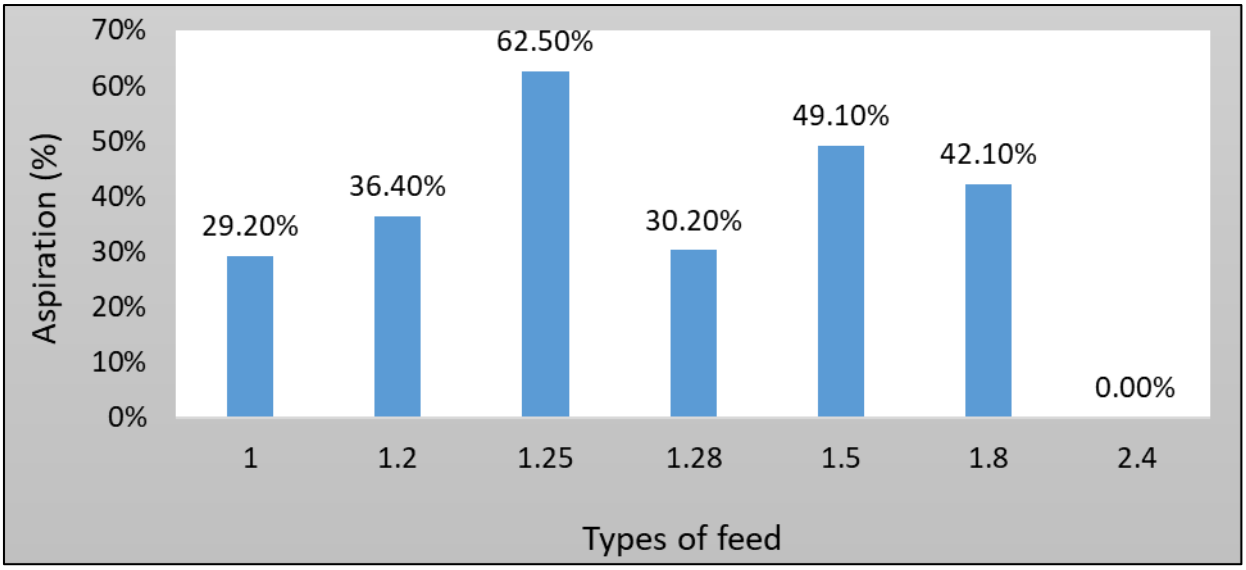

Figure 1 Association between types of feed and Aspiration

Statistical difference was checked between standard adult formula as a reference with other feed strength using 2*2 contingency tables, and the only significant difference was found in those who were receiving formula with 1.5 (strength), (P-value < 0.05). Results seen in table (3).

Table 3 Feed strength and aspiration

Feed strength	# and % of patients Under the feed	# and % of patients who had aspiration	P- Value between standard 1.0 and other formulas
1.0	72 (26.1%)	21 (29.2%)	reference
1.2	66 (23.9%)	24 (36.4%)	0.368
1.25	8 (2.9%)	5 (62.5%)	0.06
1.28	53 (19.2%)	16 (30.2%)	0.88
1.5	57 (20.7%)	(49.1%)	0.020*
1.8	19 (6.9%)	8 (42.1%)	0.28
2.4	1 (0.4%)	0 (0.0%)	-

Overall P-value (Linear by Linear Chi-Square) is 0.094. * Significant difference, P-value < 0.05. Each feed strength was compared using (2*2 contingency table) feed strength 1.0 (standard feed) as a reference group.

Total volumes from feed and water flushing for different formula concentrations were also checked and were nearly the same as seen in graph (2)

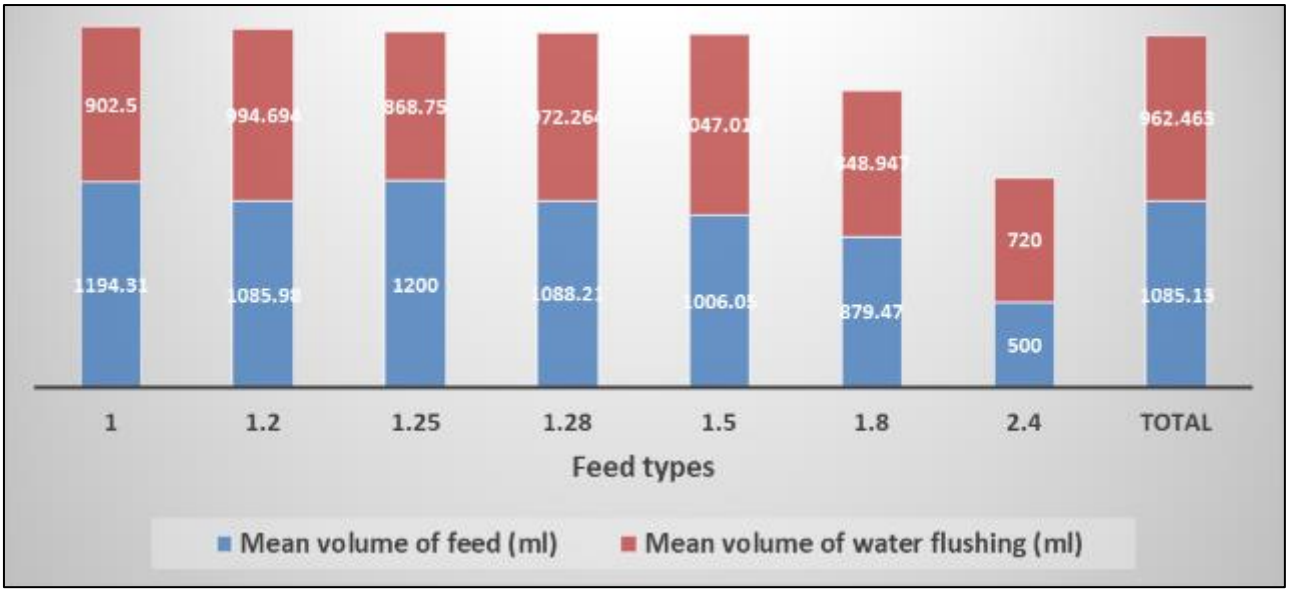

Figure 2 Mean volume of feed and water flushing across feed types among Elderly

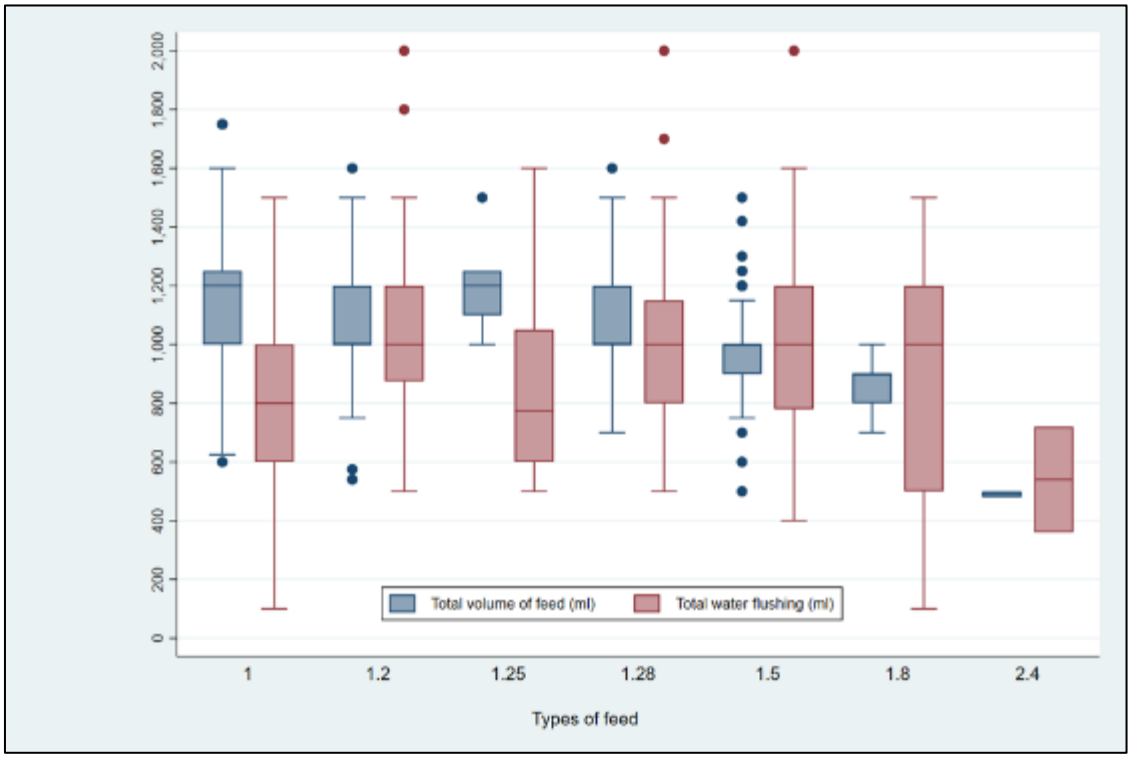

Figure 3 Box Plot Chart shows total volume of feed and water flushing with mean, median, upper limit, lower limit, range, and extreme values

Abbreviations and Acronyms

AP (Aspiration Pneumonia), NGT (Naso Gastric Tube), PEG (Percutaneous Endoscopic Gastrostomy tube), GNRI (Geriatric Nutritional Risk Index), PEGJ (Percutaneous Endoscopic Gastrostomy with Jejunal extension), CEF (Continuous Enteral Feeding), IEF (Intermittent Enteral Feeding).

4. Conclusion

Homecare patients have no active medical issues that require admission; they are considered medically stable. In relation to aspiration pneumonia, there was no significant difference in incidence between patients on NGT or PEG despite it being lower in PEG, and no significant difference between bolus from continuous mode of feed even though it was less in bolus. In addition, the incidence of aspiration pneumonia was less with those who were using pump but not statistically significant. Even when gathering more than one variable together to observe a cumulative effect, there was no significant difference (PEG with bolus Vs. NGT with continuous feed), (Use pump with PEG Vs. no pump with NGT). Decreased volume of flushing water and less time under enteral feeding plays a role in increasing aspiration pneumonia (P-value <0.05), but the total calorie intake had the highest effect (P-value <0.01). aspiration pneumonia was found to be unrelated to route of entry (NGT Vs. PEG), nor to Mode (bolus Vs. continuous). The total amount of fluids taken (feed and flushing water) had no effect on aspiration when gathered. Thus, the major effect was something different and when checking the feed type there was a large discrepancy between different feed strength and percentages of aspiration. After conducting statistical analysis to compare standard adult feed (lowest in aspiration percentage) with other feeds, there was a statistically significant difference with 1.5 feed strength formulas as seen in table 3. Highest percentage of aspiration pneumonia in 1.25 strength formula (62.5%).

Higher feed concentration will result in higher (Osmolality, mOsm/kg H2O, osmolarity mOsmol/l), thus decreased gastric emptying [47]. We can attribute the increase in aspiration to this basic piece of knowledge.

Finally, it is important to emphasize the application of safe enteral feeding strategies to meet individual patient needs [48].

Limitations

- We have seven types of standard formulas including diabetic, two formulas with strength 1.2, one formula with 1.25 strength, two formulas with 1.28 strength, three formulas with 1.5 strength including two diabetics, and two 1.8 feed strength and one 2.4 dietary supplement used as feed for one patient.
- No statistical analysis was done to compare different formulas used with the same strength or concentration.
- Only one researcher collected data about pump use from the three researchers. Completed data about pump use may bring into attention the importance of pump use in decreasing aspiration pneumonia, even if other clinical studies cannot find any differences in Aspiration Pneumonia between patients receiving continuous pump feeding and those receiving intermittent feeding [35].
- Less time under enteral feeding increases aspiration pneumonia; this may be attributed to the fact that care givers had better training in oral hygiene care and self-feeding practices over time and this reduce the incidence of aspiration pneumonia [49,50].
- NGT is recommended for temporary enteral nutrition lasting less than 4 weeks, whereas PEG is recommended for cases longer than 4 weeks [51,52,53,54]. Even with long standing enteral fed patients, only 73 patients inserted PEG from 276 patients (26.45%).
- Data available at computer-based system (Cerner) are available only after the year 2016. Some patients started enteral feeding before 2016 but were only registered from that date. So, the average time under enteral feeding (38.08 months) could be higher.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no conflict of interests.

Statement of ethical approval

The study design and operationalization adhered to the principles of respect, justice and confidentiality stipulated in the 2013 Declaration of Helsinki Good Clinical Practice. Also, in line with the laws and regulations of the Ministry of Public Health in Qatar, the study protocol was approved by HMC's Medical Research Center (MRC).

Statement of informed consent

Data collected from medical files at computer-based information system (Cerner) used at Hamad Medical Corporate, so no informed consent was collected.

References

[1] Teramoto S, Yoshida K, Hizawa N. Update on the pathogenesis and management of pneumonia in the elderly-roles of aspiration pneumonia. Respir Investig. 2015; 53:178–84.

[2] CM Sarabia-Cobo. The incidence and prognostic implications of dysphagia in elderly patients institutionalized: A multicenter study in Spain. Appl Nurs Res (2016)

[3] G. Kojima. Prevalence of frailty in nursing homes: a systematic review and meta-analysis, J Am Med Directors Assoc (2015)

[4] Teramoto S., Fukuchi Y., Sasaki H., Sato K., Sekizawa K., Matsuse T. High incidence of aspiration pneumonia in community-and hospital-acquired pneumonia in hospitalized patients: A multicenter, prospective study in Japan. J. Am. Geriatr. Soc. 2008; 56:577–579. doi: 10.1111/j.1532-5415.2008.01597.

[5] Y-H Park. Prevalence and associated factors of dysphagia in nursing home residents. Geriatric Nursing (2013)

[6] Manabe T, Teramoto S, Tamiya N, Okochi J, Hizawa N. Risk factors for aspiration pneumonia in older adults. PLoS One. 2015;10: e0140060.

[7] Sura L, Madhavan A, Carnaby G, Crary MA. Dysphagia in the elderly: management and nutritional considerations. Clin Interv Aging. 2012; 7:287–98.

[8] Marik PE. Aspiration pneumonitis and aspiration pneumonia. N Engl J Med 2001;344:665-71.

[9] Fein AM. Pneumonia in the elderly. Special diagnostic and therapeutic considerations. Med Clin North Am 1994; 78:1015-33.

[10] Janda M, Scheeren TW, Nöldge-Schomburg GF. Management of pulmonary aspiration. Best Pract Res Clin Anaesthesiol 2006;20:409-27.

[11] Othman HA, Gamil NM, Elgazzar AEM, Fouad TA. Ventilator associated pneumonia, incidence and risk factors in emergency intensive care unit Zagazig university hospitals. Egypt J Chest Dis Tuberc. 2017;66(4):703-8. https://doi.org/10.1016/j.ejcdt.2017.08.004

[12] Miki Y, Makuuchi R, Honda S, Tokunaga M, Tanizawa Y, Bando E et al. Prospective phase II study evaluating the efficacy of swallow ability screening tests and pneumonia prevention using a team approach for elderly patients with gastric cancer. Gastric Cancer. 2018;21(2):353-9.

[13] Kawashima K, Motohashi Y, Fujishima I. Prevalence of dysphagia among community-dwelling elderly individuals as estimated using a questionnaire for dysphagia screening. Dysphagia. 2004;19(4):266-271.

[14] Park YH, Han HR, Oh BM, et al. Prevalence and associated factors of dysphagia in nursing home residents. Geriatr Nurs. 2013;34(3):212-217.

[15] Shanley C, O'Loughlin G. Dysphagia among nursing home residents: an assessment and management protocol. J Gerontol Nurs. 2000;26(8):35-48.

[16] Gleeson K, Eggli DF, Maxwell SL. Quantitative aspiration during sleep in normal subjects. Chest 1997;111:1266-72.

[17] Seedat J, Penn C. Implementing oral care to reduce aspiration pneumonia amongst patients with dysphagia in a South African setting. S Afr J Commun Disord. 2016 Feb 16;63(1):102. doi: 10.4102/sajcd.v63i1.102. PMID: 26974243; PMCID: PMC8631170.

[18] Takeuchi K., Izumi M., Furuta M., Takeshita T., Shibata Y., Kageyama S., Okabe Y., Akifusa S., Ganaha S., Yamashita Y. Denture Wearing Moderates the Association between Aspiration Risk and Incident Pneumonia in Older Nursing Home Residents: A Prospective Cohort Study. Int. J. Environ. Res. Public Health. 2019; 16:554. doi: 10.3390/ijerph16040554.

[19] Isao Uno, Takaaki Kubo. Risk Factors for Aspiration Pneumonia among Elderly Patients in a Community-Based Integrated Care Unit: A Retrospective Cohort Study. Geriatrics (Basel). 2021 Dec; 6(4): 113.Published online 2021 Nov 30.

[20] Ertekin C, Aydogdu I. Neurophysiology of swallowing. Clin Neurophysiol 2003;114:2226-44.

[21] Horner J, Brazer SR, Massey EW. Aspiration in bilateral stroke patients: a validation study. Neurology 1993;43:430- 3.

[22] Terré R, Mearin F. Oropharyngeal dysphagia after the acute phase of stroke: predictors of aspiration. Neurogastroenterol Motil 2006;18:200-5.

[23] Aparasu RR, Chatterjee S, Chen H. Risk of pneumonia in elderly nursing home residents using typical versus atypical antipsychotics. Ann Pharmacother 2013;47:464-74.

[24] Eom CS, Jeon CY, Lim JW, Cho EG, Park SM, Lee KS. Use of acid-suppressive drugs and risk of pneumonia: a systematic review and meta-analysis. CMAJ 2011;183:310- 9.

[25] Matsusaka K., Kawakami G., Kamekawa H., Momma H., Nagatomi R., Itoh J., Yamaya M. Pneumonia risks in bedridden patients receiving oral care and their screening tool: Malnutrition and urinary tract infection-induced inflammation. Geriatr. Gerontol. Int. 2018; 18:714–722. doi: 10.1111/ggi.13236.

[26] Mitani Y., Oki Y., Fujimoto Y., Yamaguchi T., Iwata K., Watanabe Y., Takahashi K., Yamada K., Ishikawa A. Relationship between functional independence measure and geriatric nutritional risk index in pneumonia patients in long-term nursing care facilities. Geriatr. Gerontol. Int. October 2017; 17:1617–1622. doi: 10.1111/ggi.12942.

[27] Vergis EN, Brennen C, Wagener M, Muder RR. Pneumonia in long-term care: a prospective case-control study of risk factors and impact on survival. Arch Intern Med 2001;161:2378-81.

[28] Gomes GF, Pisani JC, Macedo ED, Campos AC. The nasogastric feeding tube as a risk factor for aspiration and aspiration pneumonia. Curr Opin Clin Nutr Metab Care 2003;6:327-33. CrossRef

[29] Sakashita R, Takami M, Ono H, Nishihira T, Sato T, Hamada M. Preventing Aspiration Pneumonia Among the Elderly: A Review Focused on the Impact of the Consistency of Food Substances. In: Sasaki K, Suzuki O, Takahashi N, editors. Interface Oral Health Science 2014. Tokyo: Springer Japan (2015).

[30] Rowat A. Enteral Tube Feeding for Dysphagic Stroke Patients. Br J Nurs (2015) 24(3):138, 140, 142–5. doi: 10.12968/bjon.2015.24.3.138

[31] Tai-Han Lin1, Chih-Wei Yang, Wei-Kuo Chang. Front. Evaluation of Oropharyngeal Dysphagia in Older Patients for Risk Stratification of Pneumonia. Immunol., 02 February 2022 Sec. Nutritional Immunology, Volume 12 – 2021.

[32] Jaafar MH, Mahadeva S, Morgan K, Tan MP. Percutaneous Endoscopic Gastrostomy Versus Nasogastric Feeding in Older Individuals with Non-Stroke Dysphagia: A Systematic Review. J Nutr Health Aging (2015) 19(2):190–7. doi: 10.1007/s12603-014-0527-z

[33] Gomes CA Jr, Andriolo RB, Bennett C, Lustosa SA, Matos D, Waisberg DR, et al. Percutaneous Endoscopic Gastrostomy Versus Nasogastric Tube Feeding for Adults with Swallowing Disturbances. Cochrane Database Syst Rev (2015).

[34] Lin F, Luk JK, Ng MM, Chan FH. Jejunal feeding for an elderly man with advanced Parkinson's disease. Asian J Gerontol Geriatr 2013; 8:50-3.

[35] MacLeod JB, Lefton J, Houghton D, et al. Prospective randomized control trial of intermittent versus continuous gastric feeds for critically ill trauma patients. J Trauma 2007; 63:57-61

[36] Lee JS, Kwok T, Chui PY, et al. Can continuous pump feeding reduce the incidence of pneumonia in nasogastric tube-fed patients? A randomized controlled trial. Clin Nutr 2010; 29:453-8.

[37] Ciocon J. O., Galindo-Ciocon D. J., Tiessen C., Galindo D. Continuous compared with intermittent tube feeding in the elderly. Journal of Parenteral and Enteral Nutrition. 1992;16(6):525–528. doi: 10.1177/0148607192016006525.

[38] Steevens E. C., Lipscomb A. F., Poole G. V., Sacks G. S. Comparison of continuous vs intermittent nasogastric enteral feeding in trauma patients: perceptions and practice. Nutrition in Clinical Practice. 2002;17(2):118–122. doi: 10.1177/0115426502017002118.

[39] Guang Yang, Bojun Zheng, and Yi Yu. Risk Assessment of Intermittent and Continuous Nasogastric Enteral Feeding Methods in Adult Inpatients: A Meta-Analysis Evid Based Complement Alternat Med. 2021; 2021: 8875002.

[40] Morita A., Horiuchi A., Horiuchi I., Takada H. Effectiveness of Water Jelly Ingestion for Both Rehabilitation and Prevention of Aspiration Pneumonia in Elderly Patients with Moderate to Severe Dysphagia. J. Clin. Gastroenterol. 2021; 19:1–5.

[41] DiBardino D.M., Wunderink R. Aspiration pneumonia: A review of modern trends. J. Crit. Care. 2015; 30:40–48. doi: 10.1016/j.jcrc.2014.07.011

[42] World Health Organization (WHO) Media Centre Fact Sheet. The Top Ten Causes of Death. WHO; Geneva, Switzerland: 2017.

[43] Tokunaga T, Kubo T, Ryan S, Tomizawa M, Yoshida S, Takagi K, et al. Long-Term Outcome After Placement of a Percutaneous Endoscopic Gastrostomy Tube. Geriatr Gerontol Int (2008) 8(1):19–23. doi: 10.1111/j.1447-0594.2008.00442.x

[44] Nordin N, Kamaruzzaman SB, Chin AV, Poi PJ, Tan MP. A Descriptive Study of Nasogastric Tube Feeding Among Geriatric Inpatients in Malaysia: Utilization, Complications, and Caregiver Opinions. J Nutr Gerontol Geriatr (2015) 34(1):34–49. doi: 10.1080/21551197.2014.998326

[45] Mitchell SL, Tetroe JM. Survival after percutaneous endoscopic gastrostomy placement in older persons. J Gerontol A Biol Sci Med Sci 2000;55:M735-9.

[46] Wolfsen HC, Kozarek RA, Ball TJ, Patterson DJ, Botoman VA, Ryan JA. Long-term survival in patients undergoing percutaneous endoscopic gastrostomy and jejunostomy. Am J Gastroenterol 1990;85:1120-2.

[47] Okabe T, Terashima H, Sakamoto A. What is a determinant of liquid gastric emptying? Comparisons between milk and isocalorically adjusted clear fluids. British Journal of Anesthesia 2015; 114: 77–82.

[48] Ahmed M Abdelbaky 1,✉, Wael G Elmasry 1, Ahmed H Awad 1 Bolus Versus Continuous Enteral Feeding for Critically Ill Patients: A Systematic Review and Meta-Analysis, Cureus. 2024 Feb 13;16(2): e54136. doi: 10.7759/cureus.54136

[49] Szu-Yu Hsiao 1 2, Ching-Teng Yao 3, Yi-Ting Lin 1 2, Shun-Te Huang 2 4, Chi-Chen Chiou 4 5, Ching-Yu Huang 2, Shan-Shan Huang 2, Cheng-Wei Yen 2, Hsiu-Yueh Liu 4 6. Relationship between Aspiration Pneumonia and Feeding Care among Home Care Patients with an In-Dwelling Nasogastric Tube in Taiwan: A Preliminary Study. Int J Environ Res Public Health. 2022 Apr 29;19(9):5419.doi: 10.3390/ijerph19095419.

[50] John R Ashford 1. Impaired oral health: a required companion of bacterial aspiration pneumonia. Front Rehabil Sci. 2024 Jun 4:5:1337920. doi: 10.3389/fresc.2024.1337920. eCollection 2024.

[51] Volkert D, Beck AM, Cederholm T, Cruz-Jentoft A, Goisser S, Hooper L, et al. ESPEN Guideline on Clinical Nutrition and Hydration in Geriatrics. Clin Nutr (2019) 38(1):10–47. doi: 10.1016/j.clnu.2018.05.024.

[52] Stroud M., Duncan H., Nightingale J. Guidelines for enteral feeding in adult hospital patients. Gut. 2003;52:vii1–vii12. doi: 10.1136/gut.52.suppl_7.vii1.

[53] Loser C., Aschl G., Hebuterne X., Mathus-Vliegen E.M., Muscaritoli M., Niv Y., Rollins H., Singer P., Skelly R.H. ESPEN guidelines on artificial enteral nutrition--percutaneous endoscopic gastrostomy (PEG) Clin. Nutr. 2005;24:848–861. doi: 10.1016/j.clnu.2005.06.013. [DOI] [PubMed] [Google Scholar]

[54] Pash E. Enteral Nutrition: Options for Short-Term Access. Nutr. Clin. Pract. 2018;33:170–176. doi: 10.1002/ncp.10007. [DOI] [PubMed] [Google Scholar]