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ORIGINAL ARTICLE

Percutaneous endoscopic gastrostomy: dealing with the issue of dislodgement

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ABSTRACT

Introduction: Percutaneous Endoscopic Gastrostomy (PEG) is accepted as an efficient method to provide long-term enteral nutrition. PEG accidental dislodgement (device exteriorization confirmed by expert evaluation) rate is high and can lead to major morbidity.

Objective: To identify independent risk factors for PEG accidental dislodgement.

Methods: Retrospective, single-center study, including consecutive patients submitted to PEG procedure, for 38 consecutive months. Every patient had 12 months minimum follow-up after PEG placement. Univariate analysis selected variables with at least marginal association ($p < .15$) with the outcome variable, PEG dislodgement, which were included in a logistic regression multivariate model. Discriminative power was assessed using area under curve (AUC) of the receiver operating curve (ROC).

Results: We included 164 patients, 67.7% (111) were female, mean age was 81 years. We report 59 (36%) PEG dislodgements, of which 13 (7.9%) corresponded to early dislodgements. The variables with marginal association were hypoalbuminemia ($p = .095$); living at home ($p = .049$); living in a nursing home ($p = .074$); cerebrovascular disease (CVD) ($p = .028$); weight change of more than 5 kg, either increase or decrease ($p = .001$); psychomotor agitation ($p < .001$); distance inner bumper-abdominal wall ($p = .034$) and irregular appointment follow-up ($p = .149$). At logistic multivariate regression, the significant variables after model adjustment were CVD OR 4.8 (CI 95% 2.0–11.8), weight change OR 4.7 (CI 95%1.6–13.9) and psychomotor agitation OR 18.5 (CI 95% 5.2–65.6), with excellent discriminative power (AUC ROC 0.797 [CI95% 0.719–0.875]).

Conclusion: PEG is a common procedure and accidental dislodgement is a frequent complication. CVD, psychomotor agitation and weight change >5 kg increase the risk of this complication and should be seriously considered when establishing patients' individual care requirements.

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Percutaneous endoscopic gastrostomy; PEG complication; dislodgment

Introduction

Enteral feeding is the safest and most cost-effective method for artificial nutrition, in individuals unable to maintain an adequate oral intake. By obviating bowel rest it is possible to decrease the likelihood of intestinal mucosal atrophy, bacterial translocation and rupture of the intestinal wall as an immunologic barrier [1]. The endoscopic approach for enteral feeding was first described by Ponsky in 1981 [2]. Percutaneous endoscopic gastrostomy (PEG) is nowadays widely accepted as an efficient way to provide long term nutritional support, either solely by the device or as a complement to oral intake, presenting several advantages in comparison to nasogastric tube, in terms of quality of life and patients' satisfaction [3].

PEG is indicated when enteral nutrition is required. A prerequisite is the absence of a major dysfunction in the rest of the gastrointestinal tract [4]. The optimal timing for the procedure is a matter of debate and, ultimately, it should be an individualized decision for each patient. However, it is often required when enteral feedings are still required after 4 weeks of nasogastric tube feedings, and when the life expectancy is at least 4 to 6 weeks [5–7].

PEG indications are wide, including neurological diseases (cerebrovascular disease (CVD), Parkinson disease, amyotrophic lateral sclerosis (ALS), dementia, etc.), some neoplasms (cervical and esophageal) and some miscellaneous conditions [8]. Absolute contraindications are rare, for example total gastrectomy, morbid obesity and bowel obstruction; some circumstances are considered relative contraindications, for instance, short life expectancy, sepsis, ascites or coagulation disorders [5,8,9].

Regarding the endoscopic procedure, there are two main techniques, the pull-PEG and the push-PEG. Concerning the latter, it is usually associated with lower infection rate and lower tumor implantation, which make it applicable for cancer patients with oropharyngeal or esophageal tumors [10].

PEG procedure has a high rate of success, with an adequate insertion reported in about 95-100% of interventions [11]. Although it is considered a safe procedure, complication rates are not negligible and need to be addressed

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[12]. Complications are classified by severity as major (buried bumper syndrome; endoscopic related bleeding; necrotising fasciitis; aspiration pneumonia, etc.) or minor (tube dislodgement; peristomal leakage; wound infection, etc.); and by time of occurrence (procedure related; early or late post-procedure) [4,12,13].

PEG tube dislodgement is one of the most common complications, with rates of overall dislodgement reported up to 13% [14]. Regarding PEG's device, there is an inner bumper or balloon, which is supposed to keep the PEG in place, by holding the stomach against the inner anterior wall of the abdomen, in order to provide the adhesion of the stomach and the wall, as the gastrocutaneous tract and stoma matures - usually within the first 14–21 days. If the PEG is pulled out of the stomach by accident or willfully during this time period, it can result in peritonitis and major harm, whereas dislodgement after this time is more likely to result in minor or no harm. After dislodgement the tube may be in the peritoneal cavity, inside the abdominal wall or completely outside the patient. The principal causes for accidental dislodgement are the removal of the device by the patients themselves, accidentally during patients transfer, repositioning or overall care and deflated or ruptured retention balloons (in the case the initial option was a device with inner balloon) [15]. The soft inner bumper allows for an easy external removal, although it contributes to accidental dislodgement as a frequent complication. Therefore, the dislodgement rate is high and can lead to major harm, severe morbidity and substantial burden on healthcare resources [14]. We seek to acknowledge risk factors that commonly contribute to PEG accidental removal, thus allowing for a better selection of patients' individual vigilance and care requirements.

Methods

Retrospective cohort study, including consecutive adult patients (>18 years) undergoing PEG procedure. Participants included met our eligibility criteria and attended from January 2014 to March 2017 in a single Gastroenterology Department of a university-affiliated hospital in the city of Guimarães in Portugal. This department is highly experienced in PEG procedures, performing about 150 procedures/year. Every patient had a 12 months minimum follow-up after the PEG procedure. We excluded all patients that were lost to follow-up for various reasons, mostly mortality.

Data were collected from the electronic medical records of every patient. PEG procedures were performed by expert gastroenterologists using the pull-PEG technique. All PEG tubes had a diameter of 24 Fr (8 mm). Immediately after the procedure, every patient's inner bumper was re-examined endoscopically to ensure an optimal positioning and to exclude concomitant complications. Procedures were mainly performed on an outpatient basis. Every patient was monitored post procedure, in 8-h shift vigilance, including the first feeding, and thorough guidance of PEG handling was given to the respective provider of care, providing basic tools for an initial recognition of complications. PEG was tightened to the abdominal wall and providers instructed to revise daily the device, rotating the tube and adjusting the distance accordingly. A 24-h hospital phone open line was also provided. In particular cases, the expert in charge decided to admit the patient into a 24-h stay in the hospital (difficulties during the procedure, impossibility of explaining PEG handling to the provider, etc.). The first hospital consultation for review of the device was scheduled one month after each procedure.

Variables collected included demographic characteristics (age and gender), residence (proper/family home: living with family providers, nursing home: out-home residency without daily individual health specialized care or specialized continuous healthcare: out-home residency with daily individual health specialized care), PEG indications (dementia, cerebrovascular disease, neoplasm, neuromuscular dystrophy, others), the existence of expert nurse care, the regular attendance to physician (1st month evaluation; 6th month evaluation; 12th month evaluation), the need for 24-h hospital admission after procedure, total number of hospital admissions (during total follow-up time or until the occurrence of dislodgement), weight change of more than 5 kg (either increase or decrease) (defined as the highest variation between the weight before procedure and the weights measured at the 1st, 6th and 12th month appointments), the occurrence of variation in the distance inner bumper-abdominal wall of more than 0.5 cm (defined as the highest variation between the distance measured after procedure and the distances measured in the 1st, 6th and 12th month appointments) and previous history of psychomotor agitation. We also collected data on laboratory findings: total serum albumin levels (hypoalbuminemia was considered for levels lower than 3.5 g/dl of serum albumin). We measured the mortality rate, during one-year follow-up, and the overall mortality rate, assessed since the PEG procedure until 2017. Finally, we assessed if patients had more than one dislodgement event as well as a second PEG procedure.

All variables were studied toward the primary outcome, which consisted of the occurrence of PEG dislodgement completely outside the patient, confirmed by direct expert evaluation of device exteriorization in the gastroenterology department. A secondary endpoint was analyzed, early dislodgement, including all episodes occurring less than 3 weeks after the PEG procedure.

Statistical analysis

Categorical variables were described using absolute frequencies and percentages, while continuous variables were described using means and standard-deviations or medians and interquartile ranges (IQR). We compared the frequency of dislodgement events according to the different collected variables. Univariate analysis was performed with chi square and Fisher's exact tests for categorical variables. Continuous patient characteristics were analysed univariately with the Student's *t*-test or Mann–Whitney *U* test.

Independent variables with at least a marginal association with the outcome variable (occurrence of a dislodgement

event) ($p < .150$) were simultaneously tested in a stepwise forward logistic regression multivariable model. A univariate sub-analysis was made testing variables towards the outcome early dislodgement.

Variables with statistically significant association with the dependent variable in the multivariable analysis were included in a model in which performance was assessed, testing it against the outcome variable by means of a receiver operator characteristic (ROC) curve – we determined the area under the curve (AUC-ROC) and the respective 95% confidence intervals (CI).

Statistical significance was defined as $p < .050$. Statistical analysis was performed using SPSS version 24.0 (IBM, Armonk, NY).

Results

One hundred and sixty-four PEG procedures, 111 (67.7%) patients were female with a median age of 81 year. The main PEG indication was dementia ($n = 80$; 50%).

Fifty-nine patients presented an event of PEG dislodgement during follow-up, corresponding to an overall dislodgement rate of 36%. Thirteen patients presented early dislodgement of the feeding tube, corresponding to an early dislodgement rate of 7.9%.

Table 1 lists the descriptive analysis of all variables included.

Table 2 lists the results of the univariable analysis comparing patients who presented PEG dislodgement event *versus* the remaining. Variables at least marginally associated with PEG dislodgement (outcome variable) were introduced in a multivariable logistic regression model. The following variables presented statistically marginal association with PEG dislodgement (Table 2): hypoalbuminemia ($p = .095$); living at home ($p = .049$); living in a nursing home ($p = .074$); cerebrovascular disease ($p = .028$); weight change of more than 5 kg ($p = .001$); psychomotor agitation ($p < .001$); variance in the distance abdominal wall-inner bumper ($p = .034$) and irregular attendance to the 12th month medical appointment ($p = .149$).

Table 3 lists the variables that remained statistically significant after multivariate logistic model: cerebrovascular disease odds ratio (OR) of 4.8 [CI 95% 2.0–11.8]; weight change of more than 5 kg OR 4.7 [CI 95%1.6–13.9] and psychomotor agitation OR 18.5 [CI 95% 5.2–65.6].

The model presented a suitable discriminative power and good accuracy when tested against the outcome variable (AUC ROC 0.797 [CI95% 0.719–0.875]).

As a secondary endpoint, Table 4 lists the results of the univariable analysis comparing patients who present an early PEG dislodgement event *versus* the remaining. For this secondary outcome, we excluded variables such as medical evaluation appointment, weight fluctuance, variance of the distance inner bumper-abdominal wall and number of hospital admissions as they were not suitable to be collected or correctly evaluated in a 3-week' timeline.

The following remaining variables presented statistically significant association with early PEG dislodgement (Table 4): living in a nursing home ($p = .034$); dementia ($p = .036$); cerebrovascular disease ($p = .011$); psychomotor agitation displayed a marginal association towards early dislodgement ($p = .062$). A multivariate analysis was also performed, but none of the variables were statistically significant for independent association with the secondary outcome, the early dislodgement of the feeding tube.

Table 1. Descriptive analysis of all variables included.

	Total ($n = 164$)
Age – median (IQR)	81 (14)
Gender – *n* (%)	
Male	53 (32.3)
Female	111 (67.7)
Residence – *n* (%)	
Home	64 (39.0)
Nursing home	55 (33.5)
Specialized continuous healthcare	45 (27.4)
PEG indication – *n* (%)	
Dementia	82 (50.0)
Cerebrovascular disease	56 (34.1)
Neoplasm	10 (6.1)
Neuromuscular dystrophy	6 (3.7)
Other	10 (6.1)
Total albumin serum levels – mean (SD)	2.7 (0.6)
Hypoalbuminemia – *n* (%)	145 (88.4)
Expert nurse care – *n* (%)	122 (74.4)
Attendance to physician – *n* (%)	
1st month	139 (84.8)
6th month	112 (68.3)
12th month	81 (49.4)
Hospital admission of 24 hour – *n* (%)	157 (95.7)
Total hospital admissions – *n* (%)	75 (45.7)
Weight change > 5 kg – *n* (%)	28 (18.4)
Psychomotor agitation – *n* (%)	29 (17.8)
Variance distance inner bumper-abdominal wall[a] – *n* (%)	29 (19.0)
Overall PEG dislodgment – *n* (%)	59 (36.0)
Early PEG dislodgment	13 (7.9)
More than one dislodgment[b]	9 (5.5)
Second PEG procedure	24 (14.6)
Mortality[c] – *n* (%)	43 (26.2)
Mortality in the first year	26 (15.9)

[a]Only three variations with amplitude over 0.5 cm; [b]five cases with two dislodgments and four cases with three; [c]only one death related with PEG.

Discussion

PEG is a widely accepted procedure and the most common method to provide long-term nutritional enteral support. Despite being an overall safe intervention, with high success rates, we must strive to prevent any PEG related complications. In this study, we address specifically tube dislodgement, attempting to recognize risk factors independently associated with this condition. Thus, we report cerebrovascular disease as PEG indication, weight change of more than 5 kg and psychomotor agitation as risk factors specifically associated with PEG dislodgement.

Tube dislodgement is defined as the accidental external removal of a PEG tube [8,12]. It is a common complication with substantial morbidity and mortality impact, imposing a high burden on healthcare resources [14].

Rosenberg *et al.* raised the question about the low dislodgement rates reported in several cohorts [14]. Most reports attest dislodgement rates of 4–8% [4,8,14,16]. However, the complication was assessed one or two weeks after the procedure. If on one side it is reasonable to assess the complication in early stages, when it can be more

Table 2. Univariate analysis result towards *outcome* a variable (Overall PEG dislodgement).

	Without PEG dislodgment ($n = 86$)[a]	With PEG dislodgment ($n = 58$)	*p* Value
Age – median (IQR)	82 (15)	80 (10)	.344†
Gender – *n* (%)			.680*
Male	28 (32.6)	17 (29.3)	
Female	58 (67.4)	41 (70.7)	
Residence – *n* (%)			
Home	36 (41.9)	15 (25.9)	.049*
Nursing home	26 (30.2)	26 (44.8)	.074*
Specialized continuous healthcare	24 (27.9)	17 (29.3)	.855*
PEG indication – *n* (%)			
Dementia	47 (54.7)	25 (43.1)	.174*
Cerebrovascular disease	26 (30.2)	28 (48.3)	.028*
Neoplasm	3 (3.5)	1 (1.7)	.648**
Neuromuscular dystrophy	4 (4.7)	1 (1.7)	.648**
Other	6 (7.0)	3 (5.2)	.740**
Total albumin serum levels – mean (SD)	2.7 (0.6)	2.8 (0.5)	.858††
Hypoalbuminemia – *n* (%)	72 (83.7)	54 (93.1)	.095*
Expert nurse care – *n* (%)	69 (80.2)	42 (72.4)	.274*
Attendance to physician – *n* (%)			
1st month	74 (86.0)	49 (84.5)	.794*
6th month	64 (74.4)	39 (67.2)	.349*
12th month	52 (60.5)	28 (48.3)	.149*
Hospital admission of 24h – *n* (%)	82 (95.3)	55 (94.8)	1.000**
Total hospital admissions – *n* (%)	39 (45.3)	23 (39.7)	.499*
Weight change > 5 kg[b] – *n* (%)	8 (10.3)	18 (32.7)	.001*
Psychomotor agitation – *n* (%)	4 (4.7)	23 (39.7)	<.001*
Variance distance inner bumper-abdominal wall[b] – *n* (%)	11 (14.1)	16 (29.1)	.034*

*Chi-square test; **Fisher's exact test; †Mann-Whitney U test; ††*t*-test for independent samples.
[a]Exclusion of patients who died during follow up ($n = 18$) similar results if all patients were included; [b]Data collected from only 78 individuals without PEG dislodgment and 55 with PEG dislodgement.

Table 3. Results from the multivariate logistic regression model (*stepwise forward method*) including variables that displayed marginal statistical association ($p < 0.15$) towards outcome variable (Overall PEG dislodgment).

	OR (95% CI)	*p* Value
Cerebrovascular disease	4.8 (2.0-11.8)	.001
Weight change > 5 kg	4.7 (1.6-13.9)	.005
Psychomotor agitation	18.5 (5.2-65.6)	<.001

Table 4. Univariate analysis results towards *outcome* variable (early PEG dislodgement).

	Without early PEG dislodgment ($n = 149$)[a]	With early PEG dislodgment ($n = 13$)	*p* Value
Age – median (IQR)	81 (14)	81 (8)	.637†
Gender – *n* (%)			1.000**
Male	49 (33.1)	4 (30.8)	
Female	99 (66.9)	9 (69.2)	
Residence – *n* (%)			
Home	59 (39.9)	3 (23.1)	.233*
Nursing home	46 (31.1)	8 (61.5)	.034**
Specialized continuous healthcare	43 (29.1)	2 (15.4)	.519**
PEG indication – *n* (%)			
Dementia	79 (53.4)	3 (23.1)	.036*
Cerebrovascular disease	46 (31.1)	9 (69.2)	.011**
Other[b]	23 (15.5)	1 (7.7)	.694**
Total serum albumin levels – mean (SD)	2.8 (0.6)	2.7 (0.7)	.647††
Hypoalbuminemia – *n* (%)	131 (88.5)	11 (84.6)	.653**
Expert nurse care – *n* (%)	113 (76.4)	8 (61.5)	.313**
Hospital admission of 24h – *n* (%)	141 (95.3)	13 (100)	1.000**
Psychomotor agitation – *n* (%)	24 (16.3)	5 (38.5)	.062**

*Chi square teste; **Fisher's exact test; †Mann–Whitney *U* test; ††*t*-test for independent samples.
[a]Exclusion of patients who died in the first 3 weeks ($n = 3$); [b]Including neoplasm, neuromuscular dystrophy and others.

hazardous, then it can also lead to an underestimation of the overall dislodgement rate. Late dislodgements do not require emergency attention, since they do not imply high mortality risk, however, they do impose allocation of substantial healthcare resources [14]. We report an overall PEG dislodgement rate of 36% (59 patients), including all dislodgement events over a one-year follow-up. Rosenberg *et al* reported a rate of overall dislodgement up to 13% [14]. This discrepancy may be due to different cohort features or outcome definitions. The fact that we follow our patients intensively with regular appointments and PEG evaluations, as well as providing a 24-h phone line for doubts and complications

assessment, could also contribute to increase the rate of reported complications, while setting the opportunity for timely management.

Secondly and most important, 50% of our PEG indications were dementia, summing up a subpopulation of older patients, malnourished, bedridden, with need of 24-h full life care support. PEG daily care requires involvement of a multidisciplinary health team. Nurses have a critical role in monitoring PEG device and providing daily maintenance. Most of our patients lived at home or in a nursing home, where daily PEG maintenance could not be optimally provided, neither the possibility of being timely evaluated by an expert health professional, likely contributing to the relatively high complication rate in our series [17]. Sampson EL, in a Cochrane review, addressed the issue of PEG in advanced dementia patients, the evidence was not robust, however, insufficient to support full benefit of enteral tube feeding in this subpopulation [18]. In our extensive clinical reality, we deal with an aged population, and most cases include dementia patients with prolonged nasogastric tube feeding. We must address this cohort bias, since we do not include every dementia patient for PEG, but they are the vast majority of the cases we deal with.

Preventing tube dislodgement is key for diminishing complication rates. We were able to identify risk factors that need to be addressed in the post-PEG surveillance. Concerning the technique, the pull method is associated with a lower rate of PEG dislodgement compared to push-PEG, probably due to a better gastric inlet fixation [13,19]. In our cohort, all PEG interventions employed the pull technique. Furthermore, T-fasteners/anchor systems, in selected cases, are reported to ensure a better stomach fixation, decreasing dislodgement and intra-abdominal contamination through an open gastrostomy into the peritoneal cavity with subsequent peritonitis [14,20]. Nevertheless, there is data acknowledging that T-fasteners do not protect entirely against accidental PEG removal [14], and major complications have been reported due to retained T-fasteners, including pneumoperitoneum [21]. Our department does not have experience regarding this specific device, so no data is reported, but we do intend to include T-fasteners in our daily practice, ensuring the best care for our patients.

Body mass index (BMI) has been extensively evaluated regarding PEG complications. A high BMI ($>30\,kg/m^2$) is a relative PEG contraindication, concerning a long subcutaneous gastrostomy route, and difficulties during procedure transillumination [8]. It is also associated with PEG dislodgement, wound infection and other complications [13]. On the other hand, a low BMI is associated with malnourished patients, and a higher rate of mortality after PEG insertion [4,22]. We decided to study weight change, and we report a significant statistical association with overall PEG dislodgement. Data regarding this association has not been previously reported. This concept expands the knowledge about PEG dislodgement prevention and raises the acknowledgment for specific individual care. The rationale behind relies in the substantial modification in body weight that may be associated with alteration in body morphology, and, ultimately, a deficit in the PEG inner bumper gastric fixation. It is important to notice that we report weight change, both increase or decrease in body weight, however most of the patients tended to weight gain. As stated above, weight change influences the PEG device management. On one hand, weight gain may cause the tube to become too tight, possibly leading to abdominal discomfort and, ultimately to buried bumper syndrome (BBS); on the other hand, weight loss and subsequently a loose tube may lead to abdominal leakage and infection. Despite not having the data to properly address this problem, since it is beyond the scope of our study, we have experience in these situations. Firstly, we try to avoid them, by providing the caregivers with the tools to be able to acknowledge an adequate state of the device or to recognize a complication. For this matter, the 24-h hospital phone open line is very important. Secondly, we regularly check the PEG and adjust it to a correct distance. Still, we must manage some buried bumper syndromes and some device infections, mainly arising from patients that do not attend regularly for evaluation.

Psychomotor agitation was already established as an impactful factor regarding tube dislodgement. It is reasonable to acknowledge that patients with a medical history of disorientation and agitation episodes and previous history of removal of their own urinary catheters, nasogastric tubes and other devices, have an increased risk for PEG dislodgement [17]. Identifying this subpopulation is very important, increasing the full awareness of care around the device, as well as providing measures to prevent the dislodgement complication, namely, soft wrist restraints, mittens or abdominal binders [17]. In this setting, it is imperative to address the indication for PEG. Primarily, patients need to be properly engaged by a psychiatric specialist, for an initial medical and supportive optimization of the problem. Afterwards, a discussion with the providers should address the ratio risk/benefit associated with the PEG procedure in the context of each specific patient. The point of care is very important, and the individual vigilance of the outpatient needs to be fully understood.

Cerebrovascular disease has already been described as an intrinsic risk factor for major and minor PEG complications. This correlation may be associated with underlying comorbidities such as diabetes, cardiovascular diseases and age, which are closely associated with stroke events [13,23]. In our series, 34.1% of our PEG procedures were indicated for cerebrovascular disease. This underlying condition was further associated with overall PEG dislodgement in our cohort. Therefore, cerebrovascular disease patients are more prone to PEG dislodgement post-procedure, consolidating the requirement for regular follow-up and expert health care.

As a secondary endpoint, we addressed early PEG dislodgement. Gastrostomy tract formation requires at least 3 weeks for full maturation [8,12]. Accidental PEG tube removal before this timing may imply the greatest impact on morbidity and mortality, with increased risk of peritonitis, sepsis and a rapid decline in patient health status [17,24]. As mentioned above, several cohorts analyzed early PEG dislodgement events one or two weeks after PEG insertion [13,14]. We considered early

dislodgement as on occurring before 3 weeks after PEG intervention, aiming for the 3 weeks of gastrostomy maturation. We report a rate of 7.9%, 13 events of early dislodgement, a rate similar to the literature, bearing in mind the disparity of definition of 'early PEG dislodgement'. Living in a nursing home, dementia and cerebrovascular disease were associated with early PEG dislodgement. We also report a statistical marginal association regarding psychomotor agitation (Table 4). It is important to notice that, in our practice, all patients that underwent early dislodgment were hospitalized and thoroughly monitored until the full closure of the gastro-cutaneous fistula (not fully matured, as stated above). They were discharged with a nasogastric feeding, and further plan management was decided at follow-up appointments. We do not report major complications developed by early dislodgments, namely, peritonitis or death.

In our study we report a one year mortality rate of 43%. This finding was similar to previous reports, with rates up to 42% [22,25,26]. It is important to highlight that mortality rates are far more correlated with intrinsic comorbidities and underlying disease than PEG related death. In most studies, PEG related death accounts for merely 1% overall mortality [4]. In our cohort, only one death was PEG related, a buried bumper syndrome that progressively induced sepsis and death.

We acknowledge that featuring a retrospective cohort implies the need for further data validation. Furthermore, being a single center study, the selection bias of a centers standard practice may be underestimated. However, our strict policy of regular PEG following, in comparison with similar centers, allows us to analyze our data with higher confidence.

Conclusion

Our study reflects a progress in the overall knowledge surrounding PEG complications. PEG dislodgement is an impactful and common condition in post-PEG intervention. By properly following our patients and accurately identifying our complications we were able to identify three major risk factors for overall PEG dislodgement.

Cerebrovascular disease, psychomotor agitation and weight change were specifically associated with PEG dislodgement. These factors currently influence patients' individual care requirements in our unit. A 3-variable model, with good accuracy and suitable discriminative power, that allow us, by intensifying the vigilance and the awareness in this subpopulation, to ultimately aim to decrease incidental PEG dislodgement.

Authors' contributions

Rui de Sousa Magalhães was involved in all stages of the manuscript construction: from the conduct, reporting, conception and design, to the acquisition of data or analysis, literature review and writing the final paper; Tiago Cúrdia Gonçalves was involved in the conception, design and discussion of the final paper to be published; Bernardo Sousa Pinto was involved in the statistical analysis and in the discussion of the final paper to be published; Bruno Rosa was involved in the conception, design and discussion of the final paper to be published; Carla Marinho was involved in the discussion of the final paper to be published; José Cotter was involved in the conception, design and discussion of the final paper to be published.

Disclosure statement

The authors report no conflict of interest.

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References

[1] A. Mesejo Arizmendi NCMyOCG. Conceptos básicos de la nutrición enteral y parenteral. Otros abordajes terapéuticos de la malnutrición. Medicine. 2002.

[2] Ponsky JL, Gauderer MW. Percutaneous endoscopic gastrostomy: a nonoperative technique for feeding gastrostomy. Gastrointest Endosc. 1981;27(1):9–11.

[3] Gomes CA Jr, Andriolo RB, Bennett C, et al. Percutaneous endoscopic gastrostomy versus nasogastric tube feeding for adults with swallowing disturbances. Cochrane Database Syst Rev. 2015;(5):CD008096.

[4] Vujasinovic M, Ingre C, Baldaque Silva F, et al. Complications and outcome of percutaneous endoscopic gastrostomy in a high-volume centre. Scand J Gastroenterol. 2019;54(4):513–518.

[5] Lucendo AJ, Friginal-Ruiz AB. Percutaneous endoscopic gastrostomy: An update on its indications, management, complications, and care. Rev Esp Enferm Dig. 2014;106(8):529–539.

[6] Farrag K, Shastri YM, Beilenhoff U, et al. Percutaneous endoscopic gastrostomy (PEG): a practical approach for long term management. BMJ. 2019;364:k5311.

[7] Bankhead R, Boullata J, Brantley S, et al.; the A.S.P.E.N. Board of Directors. Enteral nutrition practice recommendations. JPEN J Parenter Enteral Nutr. 2009;33(2):122–167.

[8] Molina Villalba C, Vázquez Rodríguez JA, Gallardo Sánchez F. Percutaneous endoscopic gastrostomy. Indications, care and complications. Med Clin (Barc). 2019;152(6):229–236.

[9] Rahnemai-Azar AA, Rahnemaiazar AA, Naghshizadian R, et al. Percutaneous endoscopic gastrostomy: indications, technique, complications and management. WJG. 2014;20(24):7739–7751.

[10] Hiki N, Maetani I, Suzuki Y, et al. Reduced risk of peristomal infection of direct percutaneous endoscopic gastrostomy in cancer patients: comparison with the pull percutaneous endoscopic gastrostomy procedure. J Am Coll Surg. 2008;207(5):737–744.

[11] Itkin MDM, Fang JC, McClave SA, et al. Multidisciplinary Practical Guidelines for Gastrointestinal Access for Enteral Nutrition and Decompression From the Society of Interventional Radiology and American Gastroenterological Association (AGA) Institute, With Endorsement by Canadian Interventional Radiological Association (CIRA) and Cardiovascular and Interventional Radiological Society of Europe (CIRSE). Gastroenterology. 2011;141(2):742–765.

[12] Hucl T, Spicak J. Complications of percutaneous endoscopic gastrostomy. Best Pract Res Clin Gastroenterol. 2016;30(5):769–781.

[13] Peveling-Oberhag J, Osman I, Walter D, et al. Risk factors for early and late procedure-related adverse events in percutaneous endoscopic gastrostomy: A single center, retrospective study. J Gastroenterol Hepatol. 2019;34(2):404–409.

[14] Rosenberger LH, Newhook T, Schirmer B, et al. Late accidental dislodgement of a percutaneous endoscopic gastrostomy tube:

an underestimated burden on patients and the health care system. Surg Endosc. 2011;25(10):3307–3311.
[15] Feil M. Dislodged gastrostomy tubes: preventing a potentially fatal complication. Reviews Analyses. 2017;14(1):9–16.
[16] Santos PM, McDONALD J. Percutaneous endoscopic gastrostomy: avoiding complications. Otolaryngol Head Neck Surg. 1999;120(2): 195–199.
[17] Mincheff TV. Early dislodgement of percutaneous and endoscopic gastrostomy tube. J S C Med Assoc. 2007;103(1):13–15.
[18] Sampson EC, Jones L. Enteral tube feeding for older people with advanced dementia. Cochrane Database Syst Rev. 2009;(2):CD007209.
[19] Kohler GK, Koch OO, Luketina RR, et al. Comparison of 231 patients receiving either "pull-through" or "push" percutaneous endoscopic gastrostomy. Surg Endosc. 2015;29(1):170–175.
[20] Timratana P, El-Hayek K, Shimizu H, et al. Percutaneous endoscopic gastrostomy (PEG) with T-fasteners obviates the need for emergent replacement after early tube dislodgement. Surg Endosc. 2012;26(12):3541–3547.
[21] Ho T, Margulies D. Pneumoperitoneum from an eroded T-fastener. Surg Endosc. 1999;13(3):285–286.
[22] Kurien ML, Delegge MH, Robson HE, et al. Mortality among patients who receive or defer gastrostomies. Clin Gastroenterol Hepatol. 2013;11(11):1445–1450.
[23] Lee SP, Lee KN, Lee OY, et al. Risk factors for complications of percutaneous endoscopic gastrostomy. Dig Dis Sci. 2014;59(1): 117–125.
[24] Jamie Marie O'Rear J. Early Percutaneous Endoscopic Gastrostomy Tube Dislodgment. Am J Nurs. 2015;115(6):26–31.
[25] Arora GR, Gupta S. High in-hospital mortality after percutaneous endoscopic gastrostomy: results of a nationwide populationbased study. Clin Gastroenterol Hepatol. 2013;11(11):1437–1444.e3.
[26] Udd ML, Mustonen H, Back L, et al. Assessment of indications for percutaneous endoscopic gastrostomy-development of a predictive model. Scandinavian Journal of Gastroenterology. 2015;50(2): 245–252.