ORIGINAL ARTICLE

Mechanical adverse events and gastrointestinal complications associated with the use of nasogastric and nasoenteric catheters during hospitalization

Eventos adversos mecânicos e complicações gastrointestinais associados ao uso de cateteres nasogástricos e nasoenterais durante a internação hospitalar

Eventos adversos mecánicos y complicaciones gastrointestinales asociados al uso de catéteres nasogástricos y nasoenterales durante la hospitalización

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ABSTRACT

Objective: to assess the incidence of mechanical adverse events and gastrointestinal complications related to the use of nasogastric and nasoenteric catheters during hospitalization of adults and elderly. **Methods:** a prospective observational study involving hospitalized adults and elderly, which the data collection was performed using intermittent direct observation, interviews and medical records. The Mann-Whitney test, chi-square test and Spearman's correlation coefficient ($p < 0.05$) were used for inferential analysis. **Results:** a total of 123 patients were followed up, with 201 catheters assessed (55.22% nasoenteric and 44.78% nasogastric). The follow-up time ranged from 1 to 106 days, with a median of 8 days [P25: 4 days; P75: 15 days]. Throughout the time 351 incidents were identified during the use of catheters, of which 135 were mechanical adverse events and 216 were gastrointestinal complications. The median number of incidents per patient was 1 [P25: 0 incidents; P75: 3 incidents]. The predominant mechanical adverse event was inadvertent removal in both catheterizations. Nausea/emesis and diarrhea were the most frequent gastrointestinal complications in nasogastric and nasoenteric catheterization, respectively. **Conclusion:** the incidence of mechanical adverse events and gastrointestinal complications is high in patients using nasogastric and nasoenteric catheters, demanding the urgent need to implement prevention protocols.

Descriptors: Catheters; Nursing; Enteral nutrition; Patient safety; Nutrition therapy.

RESUMO

Objetivo: *avaliar a incidência de eventos adversos mecânicos e complicações gastrointestinais relacionados ao uso de cateteres nasogástricos e nasoenterais durante a internação hospitalar de adultos e idosos.* ***Métodos:*** *estudo observacional prospectivo, envolvendo adultos e idosos hospitalizados. Para coleta de dados, utilizou-se observação direta intermitente, entrevista e consulta ao prontuário, e para análise inferencial utilizou-se Teste de Mann-Whitney, Teste de qui-quadrado e o Coeficiente de Correlação de Spearman (p < 0,05).* ***Resultados:*** *foram acompanhados 123 pacientes, com avaliação de 201 cateteres (55,22% nasoenterais e 44,78% nasogástricos). O tempo de acompanhamento variou de 1 a 106 dias, com mediana de 8 dias [P25: 4 dias; P75:15 dias]. Nesse período, durante o uso de cateteres, identificaram-se 351 incidentes, sendo 135 eventos adversos mecânicos e 216 complicações gastrointestinais. A mediana de incidentes por paciente foi de 1 [P25: 0 incidentes; P75: 3 incidentes]. O evento adverso mecânico predominante foi a retirada inadvertida, em ambos os cateterismos. Náuseas/êmese e diarreia foram as complicações gastrointestinais mais frequentes no cateterismo nasogástrico e nasoenteral, respectivamente.* ***Conclusão:*** *a incidência de eventos adversos mecânicos e complicações gastrointestinais é elevada em pacientes em uso de cateteres nasogástricos e nasoenterais, demandando a urgente necessidade de implantação de protocolos de prevenção.*

Descritores: *Catéteres; Enfermagem; Nutrição enteral; Segurança do paciente; Terapia nutricional.*

RESUMEN

Objetivo: *evaluar la incidencia de eventos adversos mecánicos y complicaciones gastrointestinales relacionadas con el uso de catéteres nasogástricos y nasoenterales durante la estancia hospitalaria en adultos y ancianos.* ***Métodos:*** *estudio observacional prospectivo, en el que participaron adultos y ancianos hospitalizados. Para la recolección de datos se utilizó observación directa intermitente, entrevistas y consulta de historias clínicas. Para el análisis inferencial se utilizó la prueba de Mann-Whitney, la prueba de Chi cuadrado y el coeficiente de correlación de Spearman (p < 0,05).* ***Resultados:*** *se monitorearon 123 pacientes, con evaluación de 201 catéteres (55,22% nasoenteral y 44,78% nasogástrico). El tiempo de seguimiento osciló entre 1 y 106 días, con una mediana de 8 días [P25: 4 días; P75:15 días]. En este período, durante el uso de catéteres, se identificaron 351 incidentes, incluidos 135 eventos adversos mecánicos y 216 complicaciones gastrointestinales. La mediana del número de incidentes por paciente fue 1 [P25: 0 incidentes; P75: 3 incidentes]. El evento adverso mecánico predominante fue la retirada inadvertida en ambos cateterismos. Las náuseas/emesis y la diarrea fueron las complicaciones gastrointestinales más frecuentes en el cateterismo nasogástrico y nasoenteral, respectivamente.* ***Conclusión:*** *la incidencia de eventos adversos mecánicos y complicaciones gastrointestinales es alta en pacientes que utilizan catéteres nasogástricos y nasoenterales, exigiendo la urgente necesidad de implementar protocolos de prevención.*

Descriptores: *Catéteres; Enfermería; Nutrición enteral; Seguridad del paciente; Terapia nutricional.*

INTRODUCTION

Enteral nutrition therapy (ENT) encompasses a group of procedures aimed at preventing, maintaining or restoring nutritional status, and is indicated in cases of inability to ingest food orally associated with total or partial functionality of the gastrointestinal tract[1,2]. It is widely used because it is more physiological, promoting the mucosal barrier integrity and preventing bacterial translocation[3]. It reduces infectious complications, problems associated with healing, length of hospital stay, hospital costs and mortality[4].

Short-term access routes are guaranteed, preferably by the Levine-type Nasogastric Catheter (NGC) (nasally inserted and pre-pyloric allocation) and the Dobbhoff-type Nasoenteral Catheter (NEC) (nasally inserted and post-pyloric allocation)[5], commonly used in hospital practice for administering diet, medications, and to gastric drainage[6,7].

However, the processes of insertion, maintenance and removal of these catheters involve risks and can result in complications or up to adverse event (AE). This is characterized as an incident that results in harm to patients, which can prolong hospitalization, generate temporary or permanent disability and even death[8,9].

Mechanical AE may result from respiratory, esophageal or pharyngeal aggravations due to catheter malposition; obstruction due to lack of flushing and/or diet-medication interaction; inadvertent removal due to patient-related factors; in addition to events resulting from the presence of the device, such as nasopharyngeal pain and injuries related to nasal fixation of catheters, among others[9-13].

On the other hand, gastrointestinal complications involve problems related to ENT infusion, with manifestations of epigastric pain, abdominal cramps, nausea, emesis, diarrhea and constipation, being pointed out as the main causes of delay or interruption of administration of diets, which can increase the length of permanence of catheters and the risk of incidents[14-16].

In this context, patient safety emphasizes actions aimed at avoiding or mitigating adverse outcomes resulting from care processes[8]. This depends on the process of professionals' continuous monitoring and assessment, requiring specific skills so that nutritional care occurs free from harm[10].

It is essential that these professionals, especially those on the nursing team, understand the potential risks of using ENT and are familiar with the main preventive strategies, such as use of a diet infusion pump, adaptation of pharmacological therapy, daily assessment of patient positioning, standardization of equipment and adequate fixation of catheters[8-10].

Studies on this topic are important in order to seek improvements in existing patient safety protocols[9]. Thus, this study aimed to assess the incidence of mechanical AEs and gastrointestinal complications related to the use of NGC and NEC during hospitalization of adults and older adults.

METHODS

This is an observational prospective study, carried out between August 2020 and March 2021, in a university hospital, a reference in the treatment of infectious and parasitic diseases, located in the city of Belém (PA). The report was organized in accordance with the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) recommendations.

The aforementioned institution has a multidisciplinary nutritional therapy team that follows protocols and Standard Operating Procedures (SOP) established for NEC and NGC insertion and maintenance, but does not control the incidence of AE/complications.

The study population consisted of patients over 18 years of age, regardless of sex or diagnosed pathology, using NGC or NEC during the investigation period. As established by the institutional protocol, all study participants had their catheters inserted by clinic nurses, at the bedside, or by physicians, via endoscopy. As for nutritional therapy, artisanal diet infusion occurred through an open system (gravitational), and industrialized diets were infused through a closed system, with a continuous infusion pump.

Patients were included only once in the study and, in case of readmission, they were considered ineligible. Patients with catheters inserted in another institution were excluded.

A universe of 1,800 patients hospitalized in six months was considered to calculate the sample size, of which 10% had an indication for catheter-based ENT. By using Epi info™ (version 7.2.5.0., Centers for Disease Control and Prevention - CDC, United States of America), sample size calculation was performed, considering 95% confidence level, 5% significance level and finite population of 180 patients, resulting in a sample of 123 participants.

An instrument was developed for data collection based on the literature[1-3,10,12], containing variables covering five domains:

1. Sociodemographic and clinical-pathological data; among these, data related to education stratified as illiterate, complete elementary school, complete high school and complete higher education or more, due to the educational structure of the country of origin;
2. Catheter insertion data;
3. Catheter use characterization;
4. Related AEs/complications; and
5. Catheter use completion.

This instrument was assessed by 15 experts (remotely) and applied to 10 patients, whose data were not included in the analysis (pre-test).

The outcome variables were mechanical AEs and gastrointestinal complications caused by the use of NGC or NEC. The mechanical AEs investigated were nasopharyngeal pain, malposition (catheter exteriorization beyond the marking made during insertion), nasal ulceration, catheter obstruction (device lumen occlusion, making it impossible to use)[10], inadvertent withdrawal (unplanned catheter removal)[12].

In turn, gastrointestinal complications were epigastric pain/abdominal colic, nausea/emesis (> 1 occasion in 12 hours), diarrhea (three or more liquid bowel movements in 24 hours) and constipation (absence of bowel movements for 3 days)[1-3].

The identification of AEs "malposition" and "nasal ulceration" was performed by visual assessment. The other AEs/complications were identified by patients' self-report. Information regarding the events that occurred in the intervals between field observations was collected from medical records and confirmed with patients or companions/caregivers.

To standardize data collection, training was provided to seven nursing students from the last semester. Training initially took place in a laboratory, using realistic simulation, and later with the institution's patients, for a week, under the supervision of the research team coordinator. The data collected during the training period were not included in the analysis of this study.

Data collection was performed in four inpatient clinics through intermittent direct observation, carried out three times a week (Mondays, Wednesdays and Fridays), to identify and recruit eligible patients, obtain their consent to participate in the study, perform their initial assessment and follow-up until the catheter was removed. Data regarding the intervals between observations were collected based on medical records and interviews with participants about the occurrence of the phenomena of interest.

Data consolidation was performed using Epi info Software (version 7.2.5.0, 2021, CDC, United States of America), with double checking. The data were exported to an Excel® spreadsheet (version 2019, Microsoft Excel, United States of America) and analyzed by the Jupyter Notebook platform (version 6.5.2, The Jupyter Trademark, United States of America).

Descriptive data were presented according to their characteristics and distribution. Continuous variables that did not present normal distribution were represented by median and interquartile range [25th percentile – 75th percentile]. Categorical variables were presented in absolute numbers and percentages. To calculate the cumulative incidence rate, the formula used was: (Number of AE or complication/Total number of catheterizations) x 100[17].

Additionally, the following test were used: Mann-Whitney test to compare the similarity between the medians of incidents between NGC and NEC; Chi-square test to compare the incidence proportion of AEs and complications between the types of catheters; and Spearman's correlation coefficient (r) to analyze the re-

lationship between the number of AEs and the time of patient follow-up. This coefficient ranges from -1 to +1, and can be classified as weak (0 to 0.5), moderate (0.5 to 0.8), and strong (0.8 to 1.0) correlation, with positive or negative values[18,19]. The significance level considered was $p < 0.05$.

This study was developed according to the ethical precepts of the Brazilian National Health Council (In Portuguese, CNS – *Conselho Nacional de Saúde*), respecting Resolution 466 of December 12, 2012, Resolution 510 of April 7, 2016, and Resolution 580 of March 22, 2018. It was approved by the Research Ethics Committee of the Oncology Research Center of the *Universidade Federal do Pará* – Certificate of Presentation of Ethical Consideration (In Portuguese, *Certificado de Apresentação para Apreciação Ética* – CAAE) number 14042519.4.0000.5634.

RESULTS

A total of 123 individuals using one or more consecutive catheters for ENT participated in the study, totaling 201 nutritional catheters (90 NGC and 111 NEC).

Most individuals were male (59.35%), had completed elementary school (58.24%) and had a family income of up to 1 minimum wage (68.29%). The median age was 53 years [P25:39; P75:68]. Concerning clinical characteristics, 40.65% had a medical diagnosis of cancer and the most frequent indication for catheter insertion was the inability to ingest orally (48.78%) (Table 1).

Patient follow-up time ranged from 1 to 106 days, with a median of 8 days [P25:4; P75:15]. The mean time the devices remained in place was 6 days [P25:2; P75:10] for NGC and 7 days [P25:3; P75:10] for NEC. The median number of catheters used per patient was 1 [P25:1; P75:1.5] (Table 1).

In relation to the type of device, NEC predominated 55.22% (111/201) (Table 2). The occurrence of 351 incidents was verified during follow-ups, of which 135 were mechanical AEs and 216 were gastrointestinal complications. Of the total incidents, 152 (43.31%) occurred with NGC and 199 (56.69%) with NEC.

The most incident AE was inadvertent withdrawal, in both types of catheterization, with 26.66% and 28.82%, respectively. Among the gastrointestinal complications, epigastric pain/abdominal cramps and diarrhea ($p = 0.014$) are the most common.

The median number of incidents per patient was 1 [P25: 0; P75: 3], with no differences in relation to the type of catheter ($p = 0.53$, Mann-Whitney test).

A moderate and positive correlation was observed between the emergence of AEs/complications according to patient follow-up time (Graphic 1), with Spearman's correlation coefficient (r) = 0.55 (p value = 0.00).

Table 1 - Sociodemographic and clinical profile of study participants, Belém (PA), Brazil, 2021

Features	n (%)
Age (years)	
Median	53 [39–68]*
Minimum-Maximum	19–94
Sex	
Female	50 (40.65)
Male	73 (59.35)
Education	
Illiterate	15 (12.20)
Completed elementary school	72 (58.54)
Completed high school	32 (26.02)
Completed higher education or higher	4 (3.24)
Income (minimum wages)	
≤1	84 (68.29)
> 1 and ≤ 2	33 (26.83)
> 2 and > 3	6 (4.88)
Main medical diagnosis	
Cancer	50 (40.65)
Bacterial infectious disease	17 (13.82)
HIV disease	35 (28.46)
Other	21 (17.07)
Indication for catheterization	
Oral intake inability	60 (48.78)
Decreased oral intake	36 (29.27)
Gastric drainage	20 (16.26)
Preoperative	7 (5.69)
Follow-up time (days)	
Median	8 [4–15]*
Minimum-maximum	1–106
Time with NGC device (days)	
Median	6 [2–10]*
Minimum-maximum	1–46
Time with NEC device (days)	
Median	7 [3–12]*
Minimum-maximum	1–36
Number of catheters	
Median	1 [1–1.5]*
Minimum-Maximum	1–11

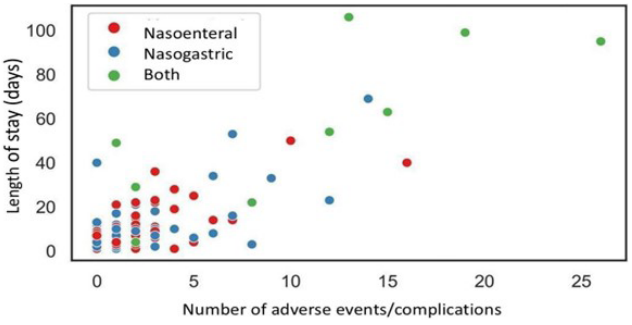
Abbreviation: HIV: Human Immunodeficiency Virus; NGC: Nasogastric Catheter; NEC: Nasoenteral Catheter.
Note: *[25th Percentile – 75th Percentile].

Table 2 - Comparison of incidence rates of mechanical adverse events/complications (n = 351) according to the type of catheterization, Belém (PA), Brazil, 2021

Incidents	Nasogastric catheter		Nasoenteral catheter		Total		p-value‡
	n* (%)	Inc.†	n*(%)	Inc.†	n* (%)	Inc.†	
Nasopharyngeal pain	23 (37.10)	25.55	14 (19.18)	12.61	37 (27.41)	18.40	(0.0881)
Malposition	7 (11.29)	7.77	9 (12.33)	8.10	16 (11.85)	7.96	(0.6214)
Nasal ulceration	2 (3.22)	2.22	1 (1.36)	0.90	3 (2.22)	1.49	(0.4236)
Obstruction	6 (9.68)	6.22	17 (23.29)	15.31	23 (17.04)	11.44	(0.3808)
Inadvertent withdrawal	24 (38.71)	26.66	32 (43.84)	28.82	56 (41.48)	27.86	(0.593)
Total	62 (45.93)	-	73 (54.07)	-	135 (100.00)	-	
Gastrointestinal complications							
Epigastric pain/Abdominal colic	15 (16.67)	16.66	04 (3.17)	3.60	19 (8.80)	9.45	(0.475)
Nausea/emesis	30 (33.33)	33.33	32 (25.40)	28.82	62 (28.70)	30.84	(0.906)
Diarrhea	28 (31.11)	31.11	59 (46.83)	53.15	87 (40.28)	43.28	(0.014)
Constipation	17 (18.89)	18.88	31 (24.60)	27.92	48 (22.22)	23.88	(0.386)
Total	90 (41.67)	-	126 (58.33)	-	216 (100.00)	-	

Note: *n: gross number of events/complications identified; †Inc.: incidence; ‡χ^2test.

Graphic 1 - Dispersion of the number of adverse events/complications and patient follow-up time using nasogastric or nasoenteric catheters or both, Belém (PA), Brazil, 2021



Note: Spearman's correlation coefficient (r)=0.55.

Regarding the reason for ending catheter monitoring (Table 3), AEs/complications were observed as a highlight in 32.2% in NGC and 40.2% in NEC, however without statistical significance.

DISCUSSION

The use of catheters for enteral nutrition is an essential practice for patients with clinical indications[1,2]; however, as it is an invasive procedure, AEs and gastrointestinal complications may occur.

In the present investigation, 351 incidents were identified in 123 patients using 201 devices. Of the total events, 135 (38.46%) were mechanical AEs and 216 (61.54%) were gastrointestinal complications.

Inadvertent removal was the most frequent AE in both types of catheterization, with 38.71% and 43.84%, respectively. This is also a reality present in other healthcare services. A multicenter study that followed 116 patients using NGC/NEC identified 191 incidents, of which 70.1% corresponded to inadvertent catheter removal (mechanical AE)[11]. Another documentary study[12] analyzed the unplanned removal of invasive devices in critically ill patients and identified 1,084 records of invasive devices, of which 414 (40%) were removed in an unplanned manner and the enteric catheter (43.24%) was the device with the highest occurrence of this event.

This AE may result in new catheter insertion, which, combined with the time of therapy, may lead to other mechanical events, such as nasopharyngeal and epigastric pain, as found in the present investigation. Inadvertent removal also carries the possibility of causing nasopharyngeal injuries, prolonging hospital stay and increasing costs for the institution[12].

Thus, the need to implement measures that minimize the occurrence and risk caused by this event is reaffirmed through the adoption of good practices such as: adequate catheter fixation and daily assessment of the need for replacement; assessment of the presence of delirium or dementia and indication of mechanical restraint until periods of psychomotor agitation decrease; and guidance on the need for the device to remain in place for both patients and caregivers[9].

Another AE found in both the present investigation and another study[20] was catheter obstruction. In the latter, which was a retrospective analysis[20] of 1,170 hospitalized patients using a catheter in the gastric or enteral position, an incidence rate of 12% of AE was found.

Table 3 - Comparison between reasons for completion of follow-up according to type of catheterization, Belém (PA), Brazil, 2021

Reason for ending monitoring	NGC n (%)	NEC n (%)	χ^{2*}	p- value
End of indication for catheter use	32 (35.6)	25 (22.5)	7.170*	0.208*
Adverse event/complication	29 (32.2)	45 (40.5)		
End of catheter use upon patient discharge	16 (17.8)	20 (18)		
End of catheter use upon patient death	7 (7.8)	16 (14.4)		
Others	6 (6.7)	5 (4.5)		
Total	90 (100.0)	111 (100.0)		

Abbreviation: NGC: Nasogastric Catheter; NEC: Nasoenteral Catheter.
Note: *Teste de χ^2.

This AE is multifactorial, with fluctuating incidences in the literature[17] and may occur due to inadequate handling (lack of flushing), type of enteral diet, drug interaction, among others. These factors are responsible for reducing catheter lumen, delaying or preventing nutritional or pharmacological administration to patients[9].

Preventing this AE requires nursing staff to adopt safe practices when handling catheters, which include: checking the compatibility of medication grinding and administration via the enteral route; grinding solid pharmaceutical forms until they are transformed into a fine, homogeneous powder; scheduling medications to avoid possible drug interactions[9], as well as interrupting the enteral diet, followed by flushing (washing the catheter with 20 ml of drinking water) before and after administering diet or medications[13].

As for gastrointestinal complications, the most common in this study were nausea/emesis, with no difference between the types of catheters (p = 0.90) and diarrhea, with a higher occurrence during the use of NEC (p = 0.01). Similar results were found in a study[15] carried out with 67 patients, in which diarrhea (38.8%) and emesis (40.3%) were the most frequent complications.

In another study[16], with 25 patients on ENT, in the city of Bagé/RS, the occurrence of diarrhea (23.10%), emesis (53.80%), and nausea (23.10%) was also observed, reinforcing the need to adopt good practices, surveillance and promptness in care.

Most studies[11,12,15,16] disregard the feeding catheter positioning as an important factor for the occurrence of AEs/complications. However, a comparative study[14] of 70 patients found much lower rates of diarrhea and emesis in patients using NEC than in those using NGC. These results are partially consistent with the findings of this study, since the complications "nausea/emesis" were more prevalent in patients using NGC (33.33%) than in those using NEC (28.70%), whereas diarrhea was more frequent in patients using NEC (40.28%).

It is important to know the reasons that led to the occurrence of AEs/complications, in order to implement protocols that minimize recurrence as well as, more broadly, to implement a culture of institutional safety[21].

Factors such as controlling catheter composition, diet infusion speed, maintaining the head of the bed elevated and strict observation regarding tolerance of enteral nutrition as well as adequate nutritional monitoring are important practices that can reduce the occurrence of gastrointestinal complications when implemented[9,14,22].

Furthermore, it is important to note that, during the period a catheter is in place, it is necessary to assess both the physical and functional aspects and the evolution of patients' clinical condition, because the risks of AE/associated complications are directly proportional to length of stay[13].

In this study, the median device retention time, in days, was 6 [P25: 2; P75: 10] days for NGC and 7 [P25: 3; P75: 10] for NEC. The initial periods for both types of catheters are those with the highest incidence of AEs and gastrointestinal complications. This finding constitutes an unprecedented contribution to knowledge in this area, since no studies were found that performed this type of analysis.

In this study, AEs/complications were the second leading cause of ENT termination, with 32.2% for NGC and 40.5% for NEC, supporting previous studies[10,23].

There are currently recommendations for good practices regarding NGC and NEC management and maintenance, but periodic updates[10] and continuing health education are necessary for the team of professionals who handle the catheter[9,13,24].

Although this study has enabled the generation of relevant knowledge, it is necessary to consider that among its limitations it is worth noting that data collection occurred intermittently, which may have led to underestimation of the incidence of AEs/complications, due to underreporting of these phenomena and participant memory bias when reporting AEs/complications.

There is a need for better therapeutic planning and assessment of indicators that measure both the occurrence of AEs and complications and the preventive measures implemented to reduce risk. Furthermore, there is a need to implement an institutional safety culture in order to mitigate the occurrence of AEs and gastrointestinal complications due to the use of nasoenteric catheters.

Among the measures, the use of specific forms/instruments to monitor catheter insertion, maintenance and removal is necessary to enhance patient safety, in addition to adopting a continuing education program for professionals who work in direct care for these patients.

It is expected that this analysis will encourage new scientific productions to support the adoption of preventive measures that have a positive impact on good practices for NGC and NEC indication, insertion, maintenance and removal.

CONCLUSION

The incidence of mechanical AEs and gastrointestinal complications during the use of NGC and NEC is high. Among the most common mechanical adverse events, inadvertent catheter removal stands out, and among the gastrointestinal complications, nausea/emesis and diarrhea stand out. In addition, the highest incidence of AEs and complications is during the initial periods of use for both types of catheters.

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Conflict of interest

None.

Authors' contributions - CRediT

TPS: conceptualization; data curation; formal analysis; methodology; writing – original draft and writing – review & editing.
CMC: data curation and writing – original draft.
ACAR: data curation; formal analysis; and writing – original draft.
WSAJ: data curation and writing – original draft.
JVSF: data curation and writing – original draft.
ASFD: data curation and writing – original draft.
GLSB: data curation and writing – original draft.
AMPCR: conceptualization; methodology; project administration; supervision and writing – review & editing.

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