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REPORT

POORLY POSITIONED NASOENTERAL CATHETERS: CASE REPORTS

CATETERES NASOENTERAIS MAL POSICIONADOS: RELATO DE CASOS

CATÉTERES NASOENTERALES MAL POSICIONADOS: INFORMES DE CASOS

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ABSTRACT

Objective: to report cases of poorly positioned nasoenteral catheters after blind insertion at the bedside. **Method:** three cases are presented, which occurred in a hospital located in the state of São Paulo. The catheters were inserted by the nurse according to institutional protocol, for placement at the enteric level. Epigastric auscultation and pH measurement were the methods used to confirm the positioning of the catheters and subsequently the X-Ray exam was performed, considered a reference exam to confirm the positioning of nasoenteral catheters. **Results:** of the three poorly positioned catheters, two were with the distal end projected to the esophagogastric junction and one was not visualized, despite the auscultation being positive and the pH values being higher than six. **Conclusion:** the results revealed important limitations of both methods in verifying the positioning of nasoenteral catheters that were recently inserted blindly at the bedside.

Keywords: Catheters; Intubation, Gastrointestinal; Enteral Nutrition; X-Rays; Hydrogen-Ion Concentration; Nursing.

RESUMO

Objetivo: *relatar casos de cateteres nasoenterais mal posicionados, após inserção às cegas à beira leito.* ***Método:*** *são apresentados três casos, os quais ocorreram em uma instituição hospitalar localizada no estado de São Paulo. Os cateteres foram inseridos pelo enfermeiro conforme protocolo institucional, para posicionamento em nível entérico. Ausculta epigástrica e mensuração do pH foram os métodos empregados na confirmação do posicionamento dos cateteres e posteriormente foi realizado o exame de Raios-X, considerado exame de referência para confirmar o posicionamento de cateteres nasoenterais.* ***Resultados:*** *dos três cateteres mal posicionados, dois estavam com a extremidade distal projetada para a junção esofagogástrica e uma não foi visibilizada, apesar de a ausculta ter sido positiva e os valores de pH terem sido superiores a seis.* ***Conclusão:*** *os resultados revelaram importantes limitações de ambos os métodos na verificação do posicionamento de cateteres nasoenterais que foram inseridos recentemente às cegas à beira leito.*

Palavras-chave: *Cateteres; Intubação Gastrointestinal; Nutrição Enteral; Raios-X; Concentração de Íons de Hidrogênio; Enfermagem.*

RESUMEN

Objetivo: *reportar casos de catéteres nasoenterales mal posicionados tras inserción ciega a pie de cama.* ***Método:*** *se presentan tres casos, ocurridos en un hospital ubicado en el estado de São Paulo. Los catéteres fueron insertados por el enfermero según protocolo institucional, para su colocación a nivel entérico. La auscultación epigástrica y la medición del pH fueron los métodos utilizados para confirmar la posición de los catéteres y posteriormente se realizó el examen de rayos X, considerado un examen de referencia para confirmar la posición de los catéteres nasoenterales.* ***Resultados:*** *de los tres catéteres mal posicionados, dos tenían el extremo distal proyectado a la unión esofagogástrica y uno no se visualizaba, a pesar de que la auscultación era positiva y los valores de pH superiores a seis.* ***Conclusión:*** *los resultados revelaron importantes limitaciones de ambos métodos para verificar la posición de los catéteres nasoenterales recientemente insertados a ciegas a la cabecera de la cama.*

Palabras clave: *Catéteres; Intubación Gastrointestinal; Nutrición Enteral; Concentración de Iones de Hidrógeno; Rayos X; Enfermería.*

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INTRODUCTION

Considered the main artificial route of choice for the administration of drugs, fluids, and enteral nutrition (EN), the nasoenteral catheter has different lengths and can be placed in the stomach (nasogastric catheter and orogastric catheter) or intestine (nasoenteric catheter and oroenteric catheter). Its ideal location should be determined considering the particularities of each patient, such as anatomy and motility of the gastrointestinal system (GIT), duration of nutritional therapy and disease severity.[1,2] Despite being common in clinical practice, nasoenteral catheters are frequently associated with serious and fatal adverse events.

Among the serious adverse events are pneumothorax, aspiration pneumonia and pulmonary hemorrhage, which can result in death. Professionals must be aware to recognize the risks and respond appropriately, before EN starts and results in disastrous consequences.[3]

The administration of NE into the lungs as a result of catheter misplacement was designated a Never Event in England by the National Patient Safety Agency (NPSA) in 2009. Such an event is serious and preventable through the implementation of prevention measures based on scientific evidence. Misplacement of nasoenteral catheters was first recognized as a patient safety issue by the NPSA in 2005. And subsequently the National Health Service of the UK (National Health Service England, NHS) issued three safety alerts between 2011 and 2013.[3]

Between September 2011 and March 2016, another 95 catheter incidents were reported to the National Reporting and Learning System (NRLS) in the United Kingdom. These incidents involved the administration of fluids or medications into the respiratory tract or pleura through a misplaced nasoenteral catheter.[3]

Between April 1, 2020 and August 31 of the same year, 115 serious incidents were reported in the Strategic Executive Information System (StEIS), also in the United Kingdom. Of these, 11 were related to the administration of enteral diet through a nasogatric or orogastric catheter positioned in the respiratory system.[4]

In a previous research carried out with the objective of describing clinical and autopsy findings in three Intensive Care Unit (ICU) patients, it was revealed that the cause of death was the administration of EN in the lungs, after blind insertion of a nasogastric catheter.[5]

Although adverse events related to nasoenteral catheters are common in hospitals, and with significant mortality, the issue has not been widely studied, especially in low- and middle-income countries. Studies that aimed to identify the types and adverse events related to the most frequent nasoenteral catheters can reduce this gap and the risk of harm caused to patients, as well as reduce the overall cost of care.[6]

In Brazil, it is the nurse's responsibility to insert nasoenteral catheters, in addition to the responsibility for the safe maintenance of the device, which includes the correct administration of medication and nutrition and the prescription of Nursing care with the catheter.7,8 To the technical professional of Nursing competes to follow the Nursing prescription to promote specific care to patients under the supervision of the nurse.[8]

A study published in 2015 showed that non-evidence-based practices, such as cup testing, gastric aspiration, and epigastric auscultation, are used by 88% of nurses to confirm the placement of nasoenteral catheters. Researchers describe these methods as unsafe and may increase the risk of serious adverse events. For this reason, they defend the non-use of these methods in clinical practice, as the difficulty in confirming the position of the catheter through these methods can come from even more experienced professionals.[9]

Considering that nasoenteral catheters, when misplaced, can cause serious and potentially fatal adverse events and that such events are considered preventable, this study aimed to report cases of misplaced nasoenteral catheters after blind insertion at the bedside.

DESCRIPTION OF CASES

This study describes the report of three cases of misplaced nasoenteral catheters, after blind insertion at the bedside, which occurred in a hospital located in the state of São Paulo, from April to September 2019.

The inserted catheters were 12 French (Fr), made of transparent silicone, had a tungsten distal tip and a lubricated stainless-steel guidewire.

Catheters were inserted into adult patients by the nurse, according to institutional protocol. The measurement of the length of the catheter was: tip from the nose to the earlobe and from the earlobe to the xiphoid appendix,[6] added 20 cm, all inserted in an enteric or post-pyloric position.[10]

The clinical methods used to confirm the position of the nasoenteral catheter were performed as follows: epigastric auscultation and pH measurement. The auscultation method consisted of placing the stethoscope in the epigastric region, injecting 10 to 20 mL of air through the catheter, and simultaneously auscultating the emitted sound.

The measurement of pH was performed according to the recommendation proposed by the NPSA[11], which follows the following steps: aspirate the gastric residue with a 20 mL syringe; test the aspirated residue on a reagent strip with a pH indicator; certify the test result (the pH should indicate between 1 and 5.5). In the absence of aspirate, auxiliary techniques were used, respectively: placing the patient in the right lateral decubitus position; inject 10-20 mL of air through the catheter and wait 15-30 minutes before aspirating again.[6]

Values pH above six were considered indicators that the nasoenteral catheters were in the enteric or post-pyloric position. After measuring the pH, the patients underwent an abdominal X-ray examination, and the reading of the tests was performed by a physician from the emergency unit (EU) or by the assistant physician responsible for the patient's hospitalization. The physician determined the delivery of nutrition verbally, regardless of whether the catheter was gastric or enteric. Subsequently, the examination reports were issued by a physician with a specialty in Radiology, specifically chest and abdomen.[10]

The study was approved by the Research Ethics Committee of *Escola de Enfermagem* of the *Universidade de São Paulo* at *Ribeirão Preto*.

First Case

The first case involved an 82-year-old female patient with a history of Alzheimer's disease and breast cancer. She was bedridden, skinny, conscious, but confused (Glasgow coma scale-ECG = 14), using a nasoenteral catheter in an enteric position, due to lack of appetite. The patient belonged to the Home Care Program and was referred to the emergency unit (EU) for a new catheter insertion, after accidental removal by the patient herself. The new catheter was inserted blindly, at the bedside, by the nurse and there was difficulty in carrying out the procedure, as the patient did not cooperate. Auscultation was positive and the pH revealed a result of seven. Afterwards, the patient underwent an X-ray examination, which revealed positioning at the esophagogastric junction (EGJ) (Figure 1). The exam was evaluated by an EU physician and the patient was discharged, without a report from a specialist in Radiology.

Second Case

The second case involved a female patient, 80-year-old, bedridden for 11 years, tracheostomized, with

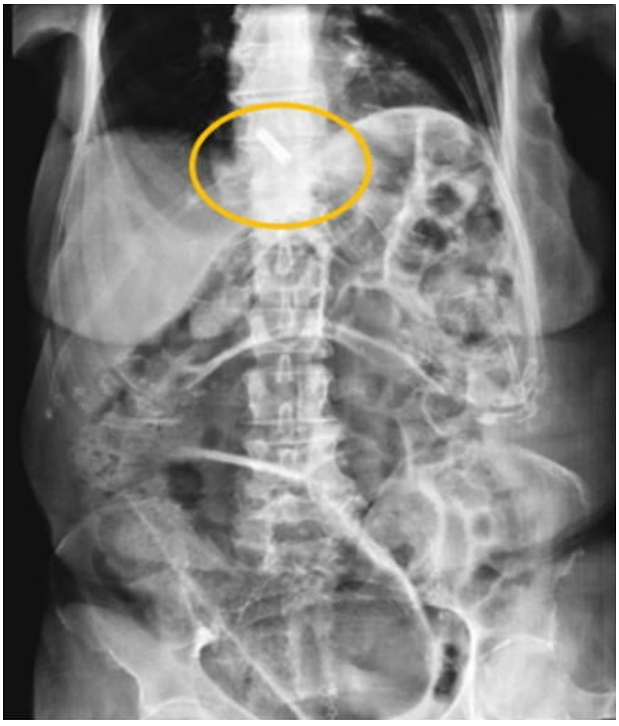

Figure 1 - Nasoenteral catheter with the distal proximity designed for the esophagogastric junction - Franca-SP, Brazil, 2020
Source: the authors.

brain neoplasm and tumor resection, ECG = 13, using a nasoenteral catheter in an enteric position due to dysphagia. The patient belonged to the Home Care Program and was referred to the ER to change the catheter, which was obstructed.

The new catheter was inserted blindly, at the bedside, by the nurse and uneventfully. Auscultation was positive and the pH revealed a result of eight. Afterwards, the patient underwent an X-ray examination, which revealed placement of the catheter in the lower third of the esophagus (Figure 2). The exam was evaluated by an EU physician and the patient was discharged without the report of the specialist in Radiology.

Third Case

The third case involved a 56-year-old female with a diagnosis of disseminated femur osteosarcoma, osteoblastic lesions of the spine and pelvis, mediastinal lymphadenomegaly due to probable carcinomatous lymphangitis, multiple pulmonary nodules, and pericardial effusion. She was conscious (ECG = 15) and collaborative. The catheter was inserted blindly by the hospital nurse at the bedside, and there was resistance during the procedure, even with the patient's cooperation. Auscultation was

positive and the pH value was equal to eight. Afterwards, the patient underwent an X-ray examination, however, it was not possible to visualize the path and also the distal end of the catheter (Figure 3). The catheter was removed after examination by the assistant physician.

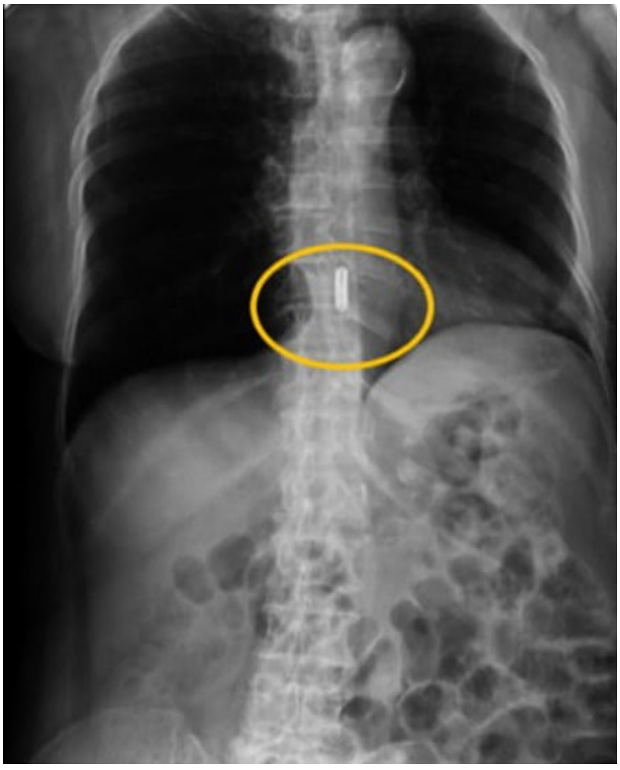

Figure 2 - Nasoenteral catheter with distal proximity projected to the lower third of the esophagus - Franca-SP, Brazil, 2020
Source: the authors.

DISCUSSION

The catheters inserted in the patients were measured for enteric or post-pyloric positioning and it is desired that, after insertion of the catheter, it remains in a gastric position and, according to peristaltic movements, spontaneously migrates to the intestine. This process depends on the patient's gastrointestinal peristalsis, which can be slow, but can be facilitated by walking, administering prokinetic medications and placing the patient in the right lateral decubitus position.[6]

The American Society for Parenteral and Enteral Nutrition (ASPEN) clarifies that the nasoenteric catheter is not indicated for all patients, but for those with severe gastroparesis, reflux, aspiration suggestive of gastric

Figure 3 - Non-visible nasoenteric catheter - Franca-SP, Brazil, 2020
Source: the authors.

secretion and pylorus obstruction.[1,2] The patients in this study did not have gastrointestinal tract dysfunction that would justify the use of a nasoenteric catheter. These patients could benefit from a long-term enteral catheter, such as gastrostomy, as they lived at home.[2]

By analyzing the images of the X-ray examination, researchers identified in an experience report that catheters measured for enteric positioning, therefore longer, had a lower chance of migrating to the desired location when compared to short catheters, in addition to a higher risk for positioning in the esophagus and lung and to curl more easily.[12]

Therefore, enteral catheters measured for enteric or post-pyloric placement and inserted blindly at the bedside have a greater chance of gastric positioning, bending, and directing upwards, close to the EGJ region or in the esophagus, which helps to increase the risk of the patient bronchospiring.[2]

It is noteworthy that in both cases the X-ray examination was interpreted by the assistant physician of the EU and that, despite the catheter not being correctly positioned, it allowed the administration of the diet via catheter. It is noteworthy that this practice can put the patient

at risk for pulmonary aspiration followed by aspiration pneumonia. According to specialists, the interpretation of the X-ray examination must be performed by a professional specialized in Radiology to minimize adverse respiratory events caused by failures in the interpretation of the examination by the medical professional, as reported in the literature.[13] Furthermore, the entire examination must be shown in the examination. trajectory of the catheter at the main anatomical points of the GIT and not just the distal end of the catheter in the stomach or intestine.[6]

In the third case presented in this report, it was not possible to visualize the trajectory and the distal end of the catheter through the X-ray examination. The PH value was equal to eight and auscultation was positive. It is noteworthy that, due to the complications of the preexisting disease, the patient was in palliative care. In this patient profile, some characteristics are common, such as lethargy, decreased cough reflexes and signs of respiratory distress, increased residual gastric volume, nausea, and vomiting, which can contribute to catheter displacement.[14]

Epigastric auscultation is a widely used method to confirm the placement of newly inserted nasoenteral catheters blindly at the bedside. This method, however, is considered to have little agreement with the X-ray image, and should be associated with other more sensitive and accurate methods, such as measuring the pH, and never in isolation.1 In the three cases presented in this report, epigastric auscultation was positive for gastric positioning, although the distal end is projected towards the EGJ (case 1) or the lower third of the esophagus (case 2) or is not visible on the X-ray examination (case 3).

In a review of 14 international guidelines aimed at differentiating the gastric and pulmonary positioning of a nasogastric catheter recently inserted at the bedside, the authors demonstrated that the auscultatory method is the least desirable because it is frequently associated with false-positive results. Furthermore, the air injected through the catheter can be auscultated in a variety of places in the body. They highlighted that, among the non-radiological methods, the measurement of pH is considered safer. However, applying a cutoff of 5.5 for the pH is questionable.[13]

The pH has different reference values in the lung, stomach and intestine, and the gastric is acidic, with reference values between 1 and 5.5.13 Values equal to or above six are suggestive of intestinal or respiratory aspiration, the latter being more alkaline .15 However, values below six suggest gastric position of the catheter and exclude possible displacement of the catheter to the pulmonary area.[14] However, it does not eliminate the chance that the catheter is located in the esophagus or in the EGJ. For this reason, the NPSA suggests that the pH measurement be performed by another professional if the pH value is between five and six.[6]

In a survey conducted in the United Kingdom, with the objective of determining the safety of the pH measurement cutoff points through an analytical decision approach, it was found that results equal to or less than 5.0 were safer for confirming the position of nasogastric catheter and that a pH of 5.5 had low sensitivity (81%) in detecting the positioning of the catheter in the EGJ.[16]

The pH measurement has limitations, and the administration of liquids or solutions through the catheter before measuring the pH can change the result.[3] Gastric pH can also be affected by medications, particularly by proton pump inhibitors (e.g., omeprazole, lansoprazole, and pantoprazole) and H_2 receptor antagonists (e.g., cimetidine, ranitidine and nizatidine). Therefore, healthcare professionals should consider that correct pH readings can be altered if they are taken soon after administration of these medications. The most likely reason for a high pH is the dilution of gastric acid by food. Stopping the enteral diet for up to an hour will allow the stomach to partially empty and the pH to decrease. When in doubt about the position of the catheter and/or the result of the pH measurement, EN should not be initiated, and a systematic risk assessment should be carried out.[3]

Despite the limitations, scholars assert, based on evidence, that other methods do not have similarity (or surpass) the accuracy of pH measurement or X-ray examination in confirming the gastric positioning of the nasoenteral catheter, newly inserted blindly at the bedside.[8] In the case of nasoenteric or post-pyloric catheter, endoscopy or X-ray examination should be performed to confirm the positioning of the catheter, because, in both cases, the success rate of visualization of the path and the position of the distal end of the catheter is high.[14]

It is noteworthy that, in this report, the pH result ranged from seven to eight, despite the catheter being positioned in the EGJ, at the lower end of the esophagus or not being visible. This result may be associated with the size of the catheter used for post-pyloric insertion (NEX measure + 20 cm).

Although the NEX measure is the most used for catheter insertion in the gastric position, scientific evidence has shown that this measure is not the safest.[17]

In a randomized trial, 20.2% of nasogastric catheters were placed in the esophageal danger zone, or either in the lower esophageal sphincter or in the distal portion of the esophagus, when the NEX measurement was used, increasing the risk of regurgitation and pulmonary aspiration.[18] In another prospective observational study, researchers aimed to test the accuracy of the corrected NEX formula to determine the length required for nasogastric catheter insertion in adults admitted to an ICU. They concluded that the formula (NEX × 0.38696) + 30.37 + 6 cm was the safest option to determine the length of the nasogastric catheter. Furthermore, all nasogastric catheters, measured according to the corrected formula, were correctly positioned in the stomach.[19]

With regard to nasoenteral catheter in post-pyloric position, there is still no consensus on the safest measure for correct positioning.[20] The insertion procedure is often performed blindly at the bedside, with a low success rate because the procedure is influenced by several factors related to the patient and the professional who performs it.[20]

A study carried out with critically ill patients in an ICU in Japan evaluated, through a prospective study, an experimental method to advance the catheter tip beyond the pylorus, without the aid of equipment or medication. Using 120-cm 12 French-gauge catheters, the method consisted of inserting 70 cm of catheter through the nostril; confirm the location of the distal end of the catheter to the right of the epigastric area towards the right hypochondriac region, by injecting 5 mL of air; detect the bubbling movement of the injected air by touch; and advancing the catheter to a length of 100 cm, during which the bubbling force appears to decrease on palpation. According to the researchers, the method demonstrated success in post-pyloric positioning in 95% of catheters introduced blindly, at the bedside.[20]

Serious and fatal adverse events can occur if there is a failure to confirm the placement of the distal end of the catheter. Nurses are responsible for knowing the profile of the patient under their care and their attributions in planning safe and harm-free care in the exercise of their profession.[21] Radiologists are responsible for ensuring that the catheter is viewed throughout its course and that the interpretation of the exam is correct. And it is up to health institutions to offer the necessary resources to ensure quality and safety in confirming the positioning of nasoenteral catheters inserted at the bedside.[3]

Given this scenario, with the purpose of developing educational tools for insertion and verification of catheter placement, the New Opportunities for Enteral Tube Location Verification (NOVEL) project, formed by interorganizational and international leaders, suggested methods to standardize care in location verification of enteral catheters. More recently, the NOVEL project has developed a document aimed at practices based on best evidence, to ensure safety in the procedure for inserting enteral catheters.[9]

The Patient Safety Movement Foundation, a non-profit organization that works in partnership with global health leaders to create free resources aimed at improving the quality of health care and patient safety, also developed collaborative work with the National Health Service of the United Kingdom and with the authors of the NOVEL project. They prepared the document entitled "Feeding via nasogastric catheter and verification of insertion and placement of catheters for drainage", which included recommendations on equipment safety, training and professional competence, institutional policies, insertion safety and confirmation of the positioning of newly inserted catheters, monitoring the positioning of catheters, in addition to contraindicated practices.[9]

In order to improve the safety of patients using enteral catheters, institutional support for the development and updating of care protocols based on the best scientific evidence and investments in the culture of safety is important. Furthermore, patients and family members should be encouraged to engage in decision-making and safe care planning at all levels of health care.

STUDY LIMITATIONS

Nasoenteral catheters were measured to be placed in the bowel or post-pylorus; therefore, the long length of the catheter may have contributed to esophageal or gastric positioning. The pH of the lung and intestine is alkaline (equal to six), which can make it difficult to distinguish between the two anatomical regions. Such limitation can expose patients to risks, in addition to causing serious and fatal events. Furthermore, the clinical conditions of the patients included in this case report may have interfered with the migration of the catheter from the stomach to the intestine. Future studies are recommended to better elucidate this relationship.

CONCLUSION

The report of cases of poorly positioned nasoenteral catheters has important limitations in the application of non-radiographic methods (epigastric auscultation and pH measurement) in confirming the position of nasoenteral catheters in the enteric or post-pyloric position, which contraindicates the application of these methods. Therefore, X-ray examination remains the method with the best level of evidence to verify the placement of newly inserted nasoenteral catheters blindly at the bedside.

It is expected that the data obtained provide support for Nursing professionals to search for good practices in the face of multiple care demands and promote safe methods to verify the placement of enteral catheters inserted blindly at the bedside.

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