FABAD J. Pharm. Sci., 48, 3, 493-500, 2023
Doi: 10.55262/fabadeczacilik.1346677
RESEARCH ARTICLE

Drug Administration via Feeding Tube in Intensive Care Unit: A Cross-Sectional Study

Nursel SÜRMELİOĞLU[*°], Yaren İLERİ[**], Murat GÜNDÜZ[***], Dilek ÖZCENGİZ[****]

Drug Administration via Feeding Tube in Intensive Care Unit: A Cross-Sectional Study

SUMMARY

The aim of this study was to evaluate the appropriateness of the administration of drugs in critically ill patients receiving enteral feeding support. This prospective, observational, and descriptive study was conducted in the reanimation unit of a university hospital. A clinical pharmacist on the intensive care team evaluated the drug administration of enterally fed patients at daily visits. The necessary interventions for incorrect drug administration via the feeding tube detected in the patient's treatment were reported to the responsible physician. Thirty patients who met the relevant criteria between December, 6 and April,1 2022 were included in the study. Fifteen (50%) of the patients were female, and the mean age of all patients was calculated as 49.16±20.23. It was determined that 76% of the patients received nutritional support via feding tube. The appropriateness of 74 drugs, 36 of which were different, administered via the feeding tube of these patients was evaluated. Thirty-three of the 36 medications were in solid dosage form Most of the drugs administrated by tube (94.6%) were in dose form appropriate for tube administration, whereas 17.56% of the administration method was incorrect. Unlike the recommendations, solid dosage forms are primarily applied in drug administrations made via feeding tubes. It is thought that the creation of algorithms that can be used in clinical practice for the correct method of administering the limited number of drugs available for application will contribute to the effectiveness and safety of the treatment.

Key Words: *Enteral nutrition, feeding tube, drug administration, drug-related problems.*

Yoğun Bakım Ünitesinde Beslenme Tüpüyle İlaç Uygulaması: Kesitsel Bir Çalışma

ÖZ

Bu çalışmada, enteral beslenme desteği alan kritik hastalarda ilaç uygulamalarının uygunluğunun değerlendirilmesi amaçlanmıştır. Prospektif, gözlemsel ve tanımlayıcı bu çalışma, bir üniversite hastanesinin reanimasyon ünitesinde gerçekleştirilmiştir. Yoğun bakım ekibine dahil olan bir klinik eczacı, günlük vizitlerle enteral beslenen hastaların ilaç uygulamalarını değerlendirmiştir. Hastanın tedavisinde tespit edilen beslenme tüpünden yanlış ilaç uygulamasına yönelik yapılması gereken müdahaleler sorumlu hekime bildirilmiştir. Çalışmaya 6 Aralık 2021- 1 Nisan 2022 tarihleri arasında ilgili kriterleri sağlayan 30 hasta dahil edilmiştir. Hastaların 15'i (%50) kadın olup, tüm hastaların yaş ortalaması 49,16±20,23 olarak hesaplanmıştır. Hastaların %76'sının beslenme desteğinin beslenme tüpünden sağlandığı tespit edilmiştir. Bu hastalara beslenme tüpünden uygulanan 36'sı farklı olmak üzere 74 adet ilacın uygunluğu değerlendirilmiştir. Bu ilaçların 33'ü katı dozaj, 3'ü sıvı dozaj formundadır. Tüpten uygulanan ilaçların çoğunun (%94,6) tüpten uygulamaya uygun dozaj formunda olduğu ancak, %17,56'sının uygulama tekniğinin uygun olmadığı tespit edilmiştir. Beslenme tüpünden yapılan ilaç uygulamalarında, önerilerin aksine çoğunlukla katı dozaj formları uygulanmaktadır. Kısıtlı sayıdaki uygulamaya elverişli ilacındoğru yöntemle uygulanması için klinik pratikte kullanılabilecek algoritmaların oluşturulmasının tedavinin etkinliği ve güvenliğine katkı sağlayacağı düşünülmektedir.

Anahtar Kelimeler: *Enteral beslenme, beslenme tüpü, ilaç uygulama, ilaç ilişkili sorunlar.*

Received: 22.08.2023
Revised: 8.09.2023
Accepted: 11.09.2023

[*] ORCID:0000-0001-7758-7100, Department of Clinical Pharmacy, Faculty of Pharmacy, Çukurova University, Adana, Türkiye, e-mail: nurselisci@gmail.com
[**] ORCID:0009-0008-1014-3474, Department of Clinical Pharmacy, Faculty of Pharmacy, Marmara University, İstanbul, Türkiye, e-mail: yarenileri01@gmail.com
[***] ORCID:0000-0003-0006-8796, Department of Anesthesia and Reanimation, Faculty of Medicine, Çukurova University, Adana, Türkiye, e-mail: hmuratgunduz@gmail.com
[****] ORCID:0000-0002-2598-0127, Department of Anesthesia and Reanimation, Faculty of Medicine, Çukurova University, Adana, Türkiye, e-mail: dilekozcengiz@gmail.com

[°] Corresponding Author; Nursel SÜRMELİOĞLU
Phone: +905330546901, e-mail: nurselisci@gmail.com

INTRODUCTION

Enteral nutrition is applied to prevent malnutrition, reduce mortality and complications, protect muscle mass and functions, regulate gastrointestinal functions, accelerate wound healing, and strengthen the immune system (Gündoğdu, 2008; Bahar, 2022). Enteral nutrition support is provided with a nasogastric or nasojejunal tube if it will be short-term, and gastrostomy tubes that can be placed endoscopically or radiologically if it will be long-term (Dumlu et al., 2013). Concomitant drug therapy is also used in most patients receiving enteral nutrition. Especially in the critically ill group, where multiple drug use is expected, the patient's therapy should be reviewed while planning nutritional support (Çulcu & Çomoğlu, 2010). Although oral administration of drugs seems more manageable and more convenient in terms of patient compliance than parenteral, enteral administration can become much more complicated in the case of critically ill patients. The requirement to administer drugs via a feeding tube in critically ill patients is not suitable for the pharmaceutical structure of every drug (Bayraktar-Ekincioğlu, 2014). In the case of concurrent drug therapy and nutritional therapy, mechanical problems such as tube clogging may occur (Williams, 2008). In addition, the administration of pharmaceutical formulations that should not be administered via the tube, such as controlled release, enteric-coated tablets, and drugs containing cytotoxic substances, may cause loss of efficacy, change in pharmacokinetic properties of the drug, and increase in adverse effects. Intensive care patients carry a higher risk in this respect than other services. While developing a nutritional support plan, it is essential to identify potential problems in the treatment of patients with these risks, and to assess the appropriateness of the pharmaceuticals included in the therapy to be supplied via the feeding tube (Izadpanah et al., 2019). The aim of this study was to evaluate the appropriateness of the administration of drugs in critically ill patients receiving enteral feeding therapy.

MATERIALS AND METHOD

This prospective and descriptive study was conducted at Çukurova University. During the study, a clinical pharmacist, who was included in the multidisciplinary team in Çukurova University Medical Faculty Hospital Anesthesiology and Reanimation Unit, between 6 December 2021 and 1 April 2022, evaluated the drug administration of enteral-fed patients during daily visits;

- 18 years and over,
- Receiving enteral nutrition support,
- Patients whose drug administration was evaluated by the clinical pharmacist were included in the study. Demographic and clinical data of the patients included in the study (comorbidities, body mass index, NRS 2002 and APACHE II scores, enteral nutrition products, and drug therapy) were obtained from patient files and the hospital information management system and recorded by anonymizing. The drugs included in the treatment of the patients were evaluated;
- Suitability of drugs and pharmaceutical forms administered via the feeding tube,
- Suitability of the tube application technique and the suitability of tube application were monitored

To evaluate the administration of drugs from the tube, the 'Handbook of Drug Administration via Enteral Feeding Tubes'' resource and the algorithm (Figure 1) created based on this resource and included in the 'Data Collection Form' were used (White & Bradnam, 2015).

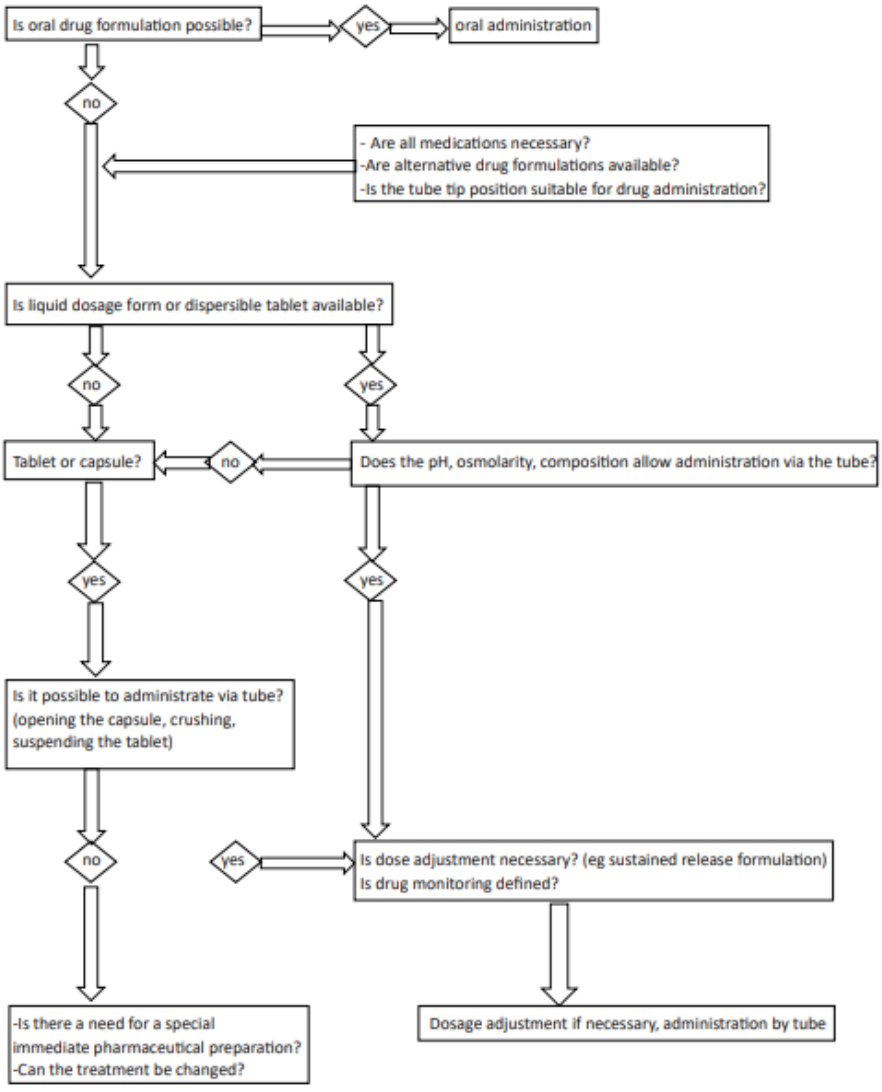

Figure 1. Drug administration in patients with enteral feeding tube algorithm

The necessary interventions for incorrect drug administration via the feeding tube detected in the patient's treatment were reported to the physician. The detected drug administration errors and the recommendations for these errors were recorded with the 'Data Collection Form'. No intervention was made on the patient's treatment without the physician's knowledge. Necessary approval was obtained from the Non-Invasive Clinical Research Ethics Committee of Çukurova University Faculty of Medicine for the study (Decision No: 117/53).

RESULTS AND DISCUSSION

Thirty patients who satisfied the necessary criteria and were treated at Cukurova University Medical Faculty Hospital Anesthesiology and Reanimation Unit between 6 December 2021 and 1 April 2022 were included in the study. Fifteen (50%) of the patients were female, and the mean age of all patients was 49.16±20.23; NRS 2002 mean was 2.93±0.18; the mean body mass index was 26.47±3.85. It was determined that 24 (80%) of the 30 patients included

in the study were provided with nutritional support via the nasogastric tube. The administration of 74 drugs, 36 of which were different, in threating of these patients via the feeding tube was evaluated. Thirty-three of the 36 medications were in solid dosage form, while three were in liquid dose form. The distribution of pharmaceutical forms of 74 drugs administered via the feeding tube is given in Table 1.

Table 1. Distribution of the drugs administered via the feeding tube according to the pharmaceutical forms of the patients

Dosage form	n (%)
Conventional tablet	30 (40.54)
Film-coated tablet	17 (22.97)
Suspension	9 (12.16)
Effervescent tablet	8 (10.8)
Controlled release tablet	4 (5.4)
Hard gelatin capsule	3 (4.05)
Soft gelatin capsule	1 (1.35)
Dragee	1 (1.35)
Disintegrating tablet	1 (1.35)
Total	74

The 'Handbook of Drug Administration through Enteral Feeding Tubes®' resource and the algorithm developed from it were used to assess the suitability of drug administration via the feeding tube of the patients (Table 2). Accordingly, it was determined that were 18 drugs administered by the incorrect method (crushed or dissolved) via the enteral feeding tube. In addition, it has been determined that there is not enough data for 25 drugs in the "Handbook of Drug Administration via Enteral Feeding Tubes" (White & Bradnam, 2015), which is used to evaluate of drugs.

Table 2. Evaluation of the compatibility of the drugs administered via the tube with the algorithm

	Yes, n (%)	No, n (%)
Has the tube been washed before administration?	74 (100)	0
Is the drug formulation suitable for tube administration?	70 (94.6)	4 (5.4)
Is the drug administered by its pharmaceutical form, and active substance?	36 (48.64)	13 (17.56)
Is the tube washed after the administration?	74 (100)	0

Recommendations were provided for alternative drug or pharmaceutical forms for some drugs that are inappropriate for administration via a feeding tube or are being delivered using an incorrect method in the treatment of patients (Table 3).

Table 3. Drugs that are not suitable for administration via the feeding tube and recommendations for them

Drug name	Pharmaceutical Form	Recommendations
Beloc zok®	Controlled release tablet	Conventional tablet
Delix®	Conventional tablet	It can be administered by crushing, but because it is a tablet that dissolves quickly in water, it is preferable to dissolve it.
Ator®	Film-coated tablet	It can be administered by crushing, but because it is a tablet that dissolves quickly in water, it is preferable to dissolve it.
Tegretol®	Conventional tablet	It can be administered by crushing, but because it is a tablet that dissolves quickly in water, it is preferable to dissolve it.
Rivotril®	Conventional tablet	It can be administered by crushing, but because it is a tablet that dissolves quickly in water, it is preferable to dissolve it.
Cetryn®	Film-coated tablet	Film-coated tablets can be crushed, but parenteral chlorpheniramine is recommended.
Minirin®	Disintegrating tablet	Intranasal administration
Cipralex®	Film-coated tablet	The film-coated tablets can be crushed, but the oral drop form is recommended.

Concomitant administration of drugs with enteral nutrition support can be done orally or via feeding tube. In these situations, application errors may occur in drug therapy due to insufficient evidence, the unsuitability of most drugs to be administered via the feeding tube, and pharmacokinetic and pharmacodynamic changes in critically ill patients (Izadpanah et al., 2019). It is advised not to add drugs to the enteral formulas and to carry out the applications effectively to get the optimum benefit from the therapy (Demirkan, Bayraktar-Ekincioglu, Gulhan-Halil & Abbasoglu., 2017; Ayık & Nuray, 2019). In this study, it was determined that the drugs of the patients were not administered with enteral formulas.

While administering drugs via the enteral feeding tube, the suitability of both drugs, and pharmaceutical forms should be considered. In addition, potential problems that may occur in line with the possibility of tube blockage, correct application technique, and compliance with pharmacokinetic and pharmacodynamic properties should be determined, and a decision should be made about its applicability from an enteral feeding tube. Within the scope of the study, the suitability of 74 drugs, 36 of which were different, for administration via feeding tube was evaluated. It was determined that only 3 of the 36 drugs were in liquid dosage form, while the others were in solid dosage form. It is recommended that drugs administered via feeding tube should be preferred primarily in liquid dosage form (White & Bradnam, 2015). However, liquid dosage forms of most of these drugs are not available in our country. For those that are not in liquid dosage form, those in conventional forms should be preferred, and it is recommended to apply them in a suitable technique. In this study, it was determined that the pharmaceutical forms administered via the feeding tube were mainly conventional form (30; 40.54%), and followed by the film-coated tablets (17; 22.97%). Some tablets are coated with a polymer film or sugar to protect the active substance against light, air, and moisture, to increase its durability during production, packaging, and transportation, to provide ease of swallowing to the patient, to prevent gastric irritation, to protect the active substance from gastric secretions or to change the release properties of the drugs (Çekmen & Dikmen, 2014). Caution is required when administering coated dosage forms via an enteral feeding tube. Tablets, which are coated only to improve the tablet's appearance, and mask the unpleasant taste, can be crushed when administered via an enteral feeding tube. When the tablets, which are coated to protect from moisture, light, and air, are crushed, the stability of the drugs may be impaired.

In the case of crushing the coated tablets to ensure controlled release, and protect the drug from gastric irritation, the release properties of the drug may change, if there is a relatively large particle remaining during crushing, it may cause blockage in the tube (Demirkan & Ekincioğlu, 2016).

In this study, 8 of the drugs administered via the feeding tube were effervescent tablets. Effervescent tablets disperse rapidly in water with the carbon dioxide output due to the reaction of the acid and base in the formula and release the active substance into the solution. The volume of water required for dissolution is usually about half a glass of water. Still, it is generally dissolved with a smaller volume of water when administered via an enteral feeding tube. Requires a relatively high volume to disperse in the liquid fully, can cause gas formation in the enteral feeding tube if it is not fully dispersed in the syringe (therefore, it must be fully dispersed before administration), and may adversely affect hypertensive patients due to its high sodium content are the limiting factors for its administration via the feeding tube (Demirkan & Ekincioğlu, 2016).

Four of the drugs administered via the feeding tube by crushing the patients included in the study are tablets with controlled release. Controlled-release tablet forms are designed to provide more minor fluctuations in the plasma concentration-time graph and to achieve slow and sustained absorption compared to rapid-release (conventional) preparations. With the ideal and desired plasma concentration obtained, beneficial and non-toxic effects of the drugs are provided. As a result of crushing the drug, modified-release dosage forms are unsuitable for administration via the enteral feeding tube, as the characteristics of the dosage form, the release, and the pharmacokinetics of the drug change. When the drug, which is designed for an extended dose interval (such as 12, or 24 hours), is administered as a whole dose at once, the treatment may fail, as toxicity and side effects can be observed as a result of excessive increase in plasma concentration (Demirkan & Ekincioğlu, 2016).

The suitability of drugs administered via the feeding tube; is evaluated according to the created algorithm. According to this, in all patients, it was determined that the tube was washed before and after feeding. Tube blocakge is one of the essential problems encountered in drug administration. Care should be taken to avoid large particles from crushing the drug; this risk should be minimized by washing the tube after each application. It has been determined that most of the drugs administered via the tube (94.6%) are in dosage form suitable for administration via the tube. Still, the application technique (such as crushing or dissolving) of some of the drugs (17.56%) is not suitable. This situation can change the stability of drugs and, thus their effectiveness. "Handbook of Drug Administration via Enteral Feeding Tubes" was used for the convenience, and application techniques of drugs from the feeding tube (White & Bradnam, 2015). However, there is no appropriate and, or sufficient data for some drugs or the preparations in our country. There is a requirement for data about the administration via feeding tube systems of drugs commonly utilized in clinical.

CONCLUSION

In the study, drug administrations with enteral nutrition support were evaluated. Contrary to the recommendations, solid dosage forms are mainly used for drug administrations via feeding tube, and it is thought that this is due to the limited availability liquid dosage forms. It has been determined that some of the dosage forms suitable for administration from the feeding tube, are not applied with the correct method. It is envisaged that 'drug administration protocols via feeding tube' to be created by

pharmacists to administere drugs with the correct method will contribute to the effectiveness and safety of treatment in intensive care units. The evaluation of the suitability of administering drugs via a feeding tube has shown a lack of data for certain drugs in the widely utilized 'Handbook of Drug Administration via Enteral Feeding Tubes' reference, commonly relied upon by clinical pharmacists. It is thought that providing information about the applicability of the drugs via the feeding tube in the package insert of the preparations by the manufacturers will provide ease of administration to the clinicians.

ACKNOWLEDGEMENT

The authors declared that they did not received any financial support for the research, writing, or publication of this article.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTION STATEMENT

NS: Developing hypothesis, statistics analysis, interpretation of the data, literature research, preparing the study text. Yİ: Interpretation of the data, preparing the study text, literature research. MG: Reviewing the text, experimenting, technical supports. DÖ: Reviewing the text, experimenting, technical supports.

REFERENCES

Ayık, D.B., & ENÇ, N. (2019). Yoğun Bakım Hastalarında Enteral Beslenme, *Yoğun Bakım Hemşireliği Dergisi*, *23*(2), 114- 122.

Bahar, M. (2022). Yoğun Bakımda Kritik Hastada Nütrisyon, *5.Ulusal İç Hastalıkları Kongresi*, Antalya.

Bayraktar-Ekincioğlu, A., & Demirkan, K. (2014). Besin ve Besin Ögesi ile İlaç Etkileşimleri, *Beslenme ve Diyet Dergisi*, *42*(2), 154– 159.

Çekmen, N., & Dikmen, E. (2014). Yoğun Bakım Hastalarında Enteral ve Parenteral Nütrisyon, *Bulletin of Thoracic Surgery/Toraks Cerrahisi Bülteni, 5*(3), 187- 197.

Çulcu, T., & Çomoğlu T. (2010). Ağızda Hızla Dağılan/ Çözünen Tabletler*, Ankara Eczacılık Fakültesi Dergisi, 39*(1), 69- 90.

Demirkan, K., & Bayraktar-Ekincioglu, A.B. (2016). Enteral Beslenme Tüpünden İlaç Uygulanmasında İlaç Dozaj Şekillerinin Önemi. *Journal of the Turkish Society of Intensive Care, 14*(1), 1- 8.

Demirkan, K., Bayraktar-Ekincioglu, A., Gulhan-Halil, M., & Abbasoglu, O. (2017). Assessment of drug administration via feeding tube and the knowledge of health-care professionals in a university hospital, *European Journal of Clinical Nutrition, 71*(2), 164- 168.

Dumlu, E., Bozkurt, B., Tokaç, M., Kıyak, G., Özkardeş, A., Yalçın, S. & Kılıç, M. (2013). Cerrahi Hastalarda Malnütrisyon ve Beslenme Desteği, *Ankara Medical Journal*, *13*(1), 33-39.

Gündoğdu, H. (2008). Yoğun Bakım Hastasında Nütrisyon Destek Tedavisinin İlkeleri, *Yoğun Bakım Dergisi, 8*(1), 5-21.

Izadpanah, M., Amraie, N., Soltani, F., Kouti, L., Sayyadi, S., Aghakouchakzadeh, M., & Hariri, M. (2019). Medication administration through enteral feeding tubes in mechanically ventilated critically ill patients: Evaluation of the potential medication errors, *Journal of Pharmaceutical Care, 7*(3),52-56.

Thomson, F.C., Naysmith, M.R., & Lindsay, A. (2000). Managing drug therapy in patients receiving enteral and parenteral nutrition*, Hospital Pharmacist*, *7*(6),155– 164.

White, R., & Bradnam, V. (2015). *Handbook of drug administration via enteral feeding tubes*, 3rd ed. Pharmaceutical Press.

Williams, N.T. (2008). Medication administration through enteral feeding tubes. *American Journal of Health-System Pharmacy*, *65*(24), 2347– 2357.